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LOT INSPECTION FOR THE INVERSE GAUSSIAN DISTRIBUTION BASED ON RUN LENGTHS OF CONFORMING ITEMS

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ABSTRACT

In acceptance sampling plans, it is still a challenging problem to make a decision on either accepting or rejecting a specific lot of items. This paper deals the designing of acceptance sampling plan when life testing of items is done sequentially and the incoming lot is rejected or accepted depending on the upper and lower threshold values. Hence the basic objective is to determine these optimal threshold values and number of inspected items using a Markovian model approach by assuming that run length of conforming item follows the inverse Gaussian distribution. The plan parameters are obtained by satisfying producer's risk and consumer's risk. The efficiency of the proposed plan is discussed over the existing sampling plans. The tables are explained with the help of two real examples.

KEYWORDS

Acceptance sampling plan; Markov model; inverse Gaussian distribution, Weibull distribution.

INTRODUCTION

Acceptance sampling is considered a technique which is used to test the sample of incoming batches for determining the defect. Sampling plan basically involves a sample size and a rule for making a decision that sets an acceptance threshold. The decision making rule also takes into account the sample information which is used as a basis in either accepting or rejecting the submitted lot of product. The sampling plans also play an important role for implementing quality control applications FallahNezhad [1]. The sampling plans make available set of rules which enable the producer and the consumer to formulate decisions on the lot sentencing while satisfying their predetermined requirements on product quality. In industry, the decision regarding acceptance or rejection of a received batch of items is made by sampling plans. So the basic objective of the acceptance sampling is to provide appropriate balance between consumer

protection and producer interests. According to FallahNezhad and Niaki [2] that the count of the number of defective items forms the basis for the decision to accept/reject in attribute sampling plan. McWilliams et al. [3] pointed out that one should make use of those plans that provide error probabilities of committing type-I (the chance of rejecting a good lot) and type-II (the probability of accepting a bad lot) errors close to the specified producer's and consumer's risk.

An important issue that arises in acceptance sampling is inspection error. William et al. [4] addresses this issue by developing a variety of mathematical models that can be put into use to design both 100% inspection and single sampling plan. William et al. [4] induced inspection error in the model in order to lessen the consequences by spending resources. A continuous loss function is also designed which calculate the cost that arises whenever the actual value of product quality characteristic deviates from its target. Klassen [5] introduced the concept of credit in acceptance sampling. The credit is defined as the total sum of all the lots that are accepted till the last one that is rejected. The sample size in the model is considered simply a function of the lot size, credit and a limit on the outgoing quality. Aminzadeh [6] derived economic acceptance sampling plans centred on Bayesian approach using the inverse Gaussian model and step-loss function. It is important to note that normal distribution needs not to be an applicable underlying distribution in many processes that run in the industry. Since Aminzadeh [6] employed economic acceptance sampling by variable which consists of the mean of the lots that are derived from these processes. Aminzadeh [6] suggested using inverse Gaussian (IG) distribution as a lifetime model in order to achieve optimum sample size and decision limit based on step-loss function. Niaki and FallahNezhad [7] proposed an acceptance-sampling plan based on Bayesian inferences and stochastic dynamic programming. Niaki and FallahNezhad [7] objective function considered the ratio of the total discounted system cost to the discounted system correct choice probability.

The concept of taking run lengths of consecutive conforming items as a performance measure for processes has been discussed in the literature. Run length is defined as the computation of the number of non-defective items between successive defective items and so a decrease in the run lengths means that the fraction defective increases while an enlargement in this number means a reduction in the fraction defective. Calvin [8] used the idea of employing run-lengths of successive conforming items which form the tools for the process of a control chart. Goh [9] proposed a charting method to maintain control on the productions of low-nonconformity items. Bourke [10] also utilized this concept in his model of continuous sampling plan in which major decision is involved whether to shift the process to sampling or 100% inspection. Bourke [10] sampling plan constitutes the sum of run-lengths of conforming items.

The application of Markovian models is done extensively in the machine repair policy to derive the optimal process control. Bowling et al. [11] make use of Markovian approach in a multi stage serial production system to derive the optimum process-target levels. Moreover, Fallahnezhad and Niaki [2] proposed a single sampling plan which employs an optimization model that utilizes Markov approach to minimize the expected total cost on inspection of the items. The feasible values of control threshold are also determined by taking run-lengths of successive conforming items which serve as an indicator of process performance. Recently, FallahNezhad and Niaki [12] extended this

approach to the sum of run-lengths of successive conforming items. Aslam et al. [13] further strengthens the idea that run length proved to be a strong tool in evaluating quality performance by inducing this concept in his sampling plan via Markov models when the lifetime of the product follows a Weibull distribution with unknown shape parameters. After exploring the literature we intended to advance the work done by Aslam et al. [13] on the acceptance sampling plan by using the run lengths of the conforming items when the life time of products follows inverse Gaussian distribution.

In this paper, we will focus on the designing of run length sampling plan using repetitive sampling and resubmitted sampling. The earlier was designed by Sherman [14]. The operational procedure of repetitive sampling is similar to sequential sampling. It is more convenient to apply as compared to double sampling and sequential sampling. Balamurali and Jun [15] showed that repetitive sampling is more efficient than single and double sampling plans. The later was proposed by Govindaraju and Ganesalingam [16] and Damija and Hammer [17]. The resubmitted sampling is widely used where the producer or consumer has doubt or cannot agree with first inspection results. The details and applications of resubmitted plan can be seen in Wu et al. [18], Aslam et al. [19, 20].

1. NOTATIONS

p=fraction nonconforming
p_{ij}=probability of going from state (i) to state (j) in a single step
m_{ij}=expected number of transitions from a non-absorbing state(i) to another non-absorbing state (j) before absorption occurs
P=transition probability matrix
U=upper control threshold
L=lower control threshold
I=number of items to be inspected until the decision is made
t_0=experiment time (total testing time for the item)
μ_0=mean life of time to failure for a nonconforming item
μ_1=mean life of time to failure for a conforming item
p_1=acceptable quality level (AQL) in terms of fraction nonconforming
p_2=limiting quality level (LQL) in terms of fraction nonconforming
a=termination ratio

2. THE PROPOSED PLAN

Let us consider the plan proposed by FallahNezhad et al. [2] based on a time-truncated life test. Consider an incoming lot of items with fraction nonconforming p. For the incoming lot one item is randomly chosen at a time and is put on a test until the termination time t_0. The item will be conforming if it does not fail until the termination time but will be nonconforming if it fails before the termination time. This sampling continues sequentially until the decision of accepting or rejecting the lot will be made. Suppose Y_i is the number of conforming items between the successive (i-1)th and ith nonconforming items, with U and L as the upper and lower control thresholds. The decision on the lot will be made as follows:

Step 0: Start with i = 1.
Step 1: Accept the lot if $Y_i \geq U$ and reject the lot if $Y_i \leq L$.
Step 2: If $L < Y_i < U$, then increase i by 1 and repeat the procedure.

Note that the random variables $Y_i's$ are independent and identically distributed. In fact, Y_i follows a geometric distributionwith the parameter p:

$$P\{Y_i = r\} = (1-p)^r\, p \text{ , r = 1, 2,…} \tag{1}$$

In order to model the above system as a Markov chain, let us define the following three states:

State 1: Repeating the experiment ($L < Y_i < U$)
State 2: Accepting the lot ($Y_i \geq U$)
State 3: Rejecting the lot ($Y_i \leq L$)

Then, the transition probability matrix is expressed as follows [2]:

$$\text{P}=\begin{bmatrix} p_{11} & p_{12} & p_{13} \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \tag{2}$$

In the above,

$$p_{11} = P\{L < Y_i < U\} = \sum_{Y_i=L+1}^{U-1} (1-p)^{Yi}.p \tag{3}$$

$$p_{12} = P\{Y_i \geq U\} = \sum_{Y_i=U}^{\infty} (1-p)^{Yi}.p \tag{4}$$

$$p_{13} = P\{Y_i \leq L\} = \sum_{Y_i=0}^{L} (1-p)^{Yi}.p \tag{5}$$

The matrix P is an absorbing Markov model, with states 2 and 3 being absorbing and state 1 being transient.

Let m_{11} be the expected long-run number of times the transient state 1 is occupied before absorption occurs (i.e., accepted or rejected), given that the initial state is 1. Then, it is obtained by

$$m_{11} = \frac{1}{1-p_{11}} \tag{6}$$

The matrix F provides the long run absorption probabilities by [2]:

$$F = \left[\frac{p_{12}}{1-p_{11}} \frac{p_{13}}{1-p_{11}}\right] \tag{7}$$

The components of the F matrix denoted by f_{12} and f_{13} give the probability of the lot being accepted or rejected.

According to Aslam et al. [13], the expected number of items to be inspected until the decision is made is calculated by

$$E[I] = m_{11}E[Y_i] = \frac{1}{p(1-p_{11})} \quad (8)$$

In the proposed test procedure, the inspection of products is sequentially performed. By the lifetime testing of respective products, the individual product is judged to be a conforming items or nonconforming item. Y_i indicates the number of conforming items between successive (i-1)th and ith nonconforming items. When $Y_i \leq L$, the lot is rejected. Then, when $L < Y_i < U$, the decision on the lot is pending and then the next inspection cycle will be started. On one hand, the lot is accepted at the moment when successive U conforming items are observed. Therefore, the expected number of items to be inspected until the decision is made is given as follows. Let

$$q_1 = E[Y_i|L < Y_i < U] = \frac{1}{p_{11}}\sum_{Y_i=L+1}^{U-1}(Y_i+1)(1-p)^{Y_i}p \quad (9)$$

$$q_2 = E[Y_i|Y_i \geq U] = \frac{1}{p_{12}}\sum_{Y_i=U}^{\infty}U(1-p)^{Y_i}p = U \quad (10)$$

$$q_3 = E[Y_i|Y_i \leq L] = \frac{1}{p_{13}}\sum_{Y_i=0}^{L}(Y_i+1)(1-p)^{Y_i}p \quad (11)$$

$$E[I] = (q_2p_{12} + q_3p_{13}) + p_{11}(q_1 + q_2p_{12} + q_3p_{13}) + p_{11}^2(2q_1 + q_2p_{12} + q_3p_{13}) + \cdots \quad (12)$$

$$E[I] = \frac{1}{1-p_{11}}(q_2p_{12} + q_3p_{13}) + \sum_{k=1}^{\infty}kp_{11}^2q_1 \quad (13)$$

$$= \frac{1}{1-p_{11}}(q_2p_{12} + q_3p_{13}) + p_{11}q_1\left\{\frac{1}{1-p_{11}} + \frac{p_{11}}{(1-p_{11})^2}\right\} \quad (14)$$

$$E[I] = \frac{1}{1-p_{11}}(q_1p_{11} + Up_{12} + q_3p_{13}) + \left(\frac{p_{11}}{1-p_{11}}\right)^2 q_1 \quad (15)$$

3. DESIGNING OF REPETITIVE GROUP PLAN

Robert Brown was the famous English botanist who was basically focused on the study of random motion of particles (the mathematical model of such random movement is referred to as Brownian motion) from where the Inverse Gaussian distribution is originated. Schrodinger [21] showed that this distribution can be served as the time to first passage of the Brownian motion, the distribution is later identified as IG distribution and Tweedie [22] discussed its application with reference to a Brownian motion. The Brownian motion can be widely used in the field of natural and physical sciences to explain the intrinsic process of many phenomena. Since the first passage time of a Brownian motion is distributed as IG, it is reasonable to apply IG in modelling a lifetime data. Wald [23] showed that IG can be designed as a limiting form of the sample size distribution in sequential probability ratio tests. Tweedie [24] thoroughly investigated IG with its statistical properties that it can be suitably implemented in relating the distributions going from almost normal to extremely skewed ones. Chhikara and Folks [25] discovered that IG is employed extensively in different areas which may include life testing and product reliability studies, cardiology, agriculture, demography, linguistics, employment service, labour dispute resolution, and finance. Jain and Jain [26] emphasized on the properties of the IG distribution and its usage in designing the model in reliability. Smith and Lansky [27] based their work on the application of the mixture of

IG distributions in the context of reliability. Tsai and Wu [28] applied this distribution in the reliability sampling plans for truncated life tests and claimed that his proposed sampling scheme can consume less test time in several real-world applications.

Assume the lifetime of an item follows an IG distribution with shape parameter *b* and scale parameter θ, having the following cumulative density function (c.d.f.):

$$F(t) = \phi\left\{\sqrt{\frac{b\theta}{t}}\left(\frac{t}{\theta}-1\right)\right\} + \exp\{2b\}\,\phi\left\{\sqrt{\frac{b\theta}{t}}\left(\frac{t}{\theta}+1\right)\right\} \tag{16}$$

where $\phi(.)$ is the cdf of the standard normal distribution.

It can be shown that the mean of the distribution, denoted by μ, is given by θ, the scale parameter. It is vital to observe that the cdf in Eq. (16) is dependent upon θ only through t/θ. If the shape parameter is unknown, it can be estimated from the failure data.

The fraction nonconforming is the probability that an item fails until time t_0. For IG distribution, it is given by

$$\mathrm{p} = \mathrm{F}(t_0) \tag{17}$$

Let μ_0 be the specified mean life of interest. It would be suitable to write $t_0 = a\mu_0$ for a constant *a*. So, the probability of an item's failure before experiment time t_0 is given as

$$p = \phi\left\{\sqrt{\frac{b}{a(\mu/\mu_0)}}\left(\frac{a}{(\mu/\mu_0)}-1\right)\right\} + \exp\{2b\}\,\phi\left\{\sqrt{\frac{b}{a(\mu/\mu_0)}}\left(\frac{a}{(\mu/\mu_0)}+1\right)\right\} \tag{18}$$

Each feasible sampling design should satisfy two constraints of type-I and type-II errors. Then, the relevant conditions imposed here are: if $p = p_1$ (AQL), the probability of accepting a good lot should be greater than $1-\alpha$ (α being the producer's risk) and in case where $p = p_2$ (LQL), the probability of accepting the bad batch should be less than β (β being the consumer's risk). We should determine the feasible values of *L* and *U* so as to satisfy these two inequalities while minimizing the expected number of items to be inspected. Thus the following optimization model for determining the optimal parameters is utilized:

Minimize $E[I]$ (18a)

Subject to

$$L(p_1) = \frac{P\{Y_i \geq U\}}{1 - P\{L < Y_i < U\}} \geq 1-\alpha \tag{18b}$$

$$L(p_2) = \frac{P\{Y_i \geq U\}}{1 - P\{L < Y_i < U\}} \leq \beta \tag{18c}$$

Note that in life test experiments, the ratio μ/μ_0 acts as a quality parameter. Often, the LQL (p_2) is chosen for $\mu = \mu_0 (\text{or } \mu/\mu_0 = 1)$ and the AQL (p_1) is chosen so that $\mu/\mu_0 > 1$.

The values of p_1 and p_2 can be obtained from equation (11) as follows:

$$p_1 = \phi\left\{\sqrt{\frac{b}{a(\mu/\mu_0)}}\left(\frac{a}{(\mu/\mu_0)}-1\right)\right\} + \exp\{2b\}\,\phi\left\{\sqrt{\frac{b}{a(\mu/\mu_0)}}\left(\frac{a}{(\mu/\mu_0)}+1\right)\right\} \quad (19)$$

and

$$p_2 = \phi\left\{\sqrt{\frac{b}{a}}(a-1)\right\} + \exp\{2b\}\,\phi\left\{\sqrt{\frac{b}{a}}(a+1)\right\} \quad (20)$$

The plan parameters of the proposed plan are determined for mean ratio μ/μ_0, the termination constant a and the shape parameter b of IG distribution.

Table 1 is constructed for the shape parameters b = 1 and 2 of the IG distribution for termination ratio (a=0.5), producer's risk (α=0.05) and five values of mean ratio ($\mu/\mu_0 = 2, 2.5, 3, 3.5, 4$) while Table 2 is constructed for the shape parameter b = *3* of the IG distribution for a = 0.5 and 1.0,

Table 1: Plan parameters of the repetitive sampling plan when a = 0.50

β	μ/μ_0	*b=1.0*					*b=2.0*				
		L	U	$E(I)$	$L(p_1)$	$L(p_2)$	L	U	$E(I)$	$L(p_1)$	$L(p_2)$
0.25	2	-	-	-	-	-	0	10	36.29	0.9640	0.2342
	2.5	-	-	-	-	-	4	6	3.68	0.9518	0.2181
	3	-	-	-	-	-	4	6	3.68	0.9831	0.2181
	3.5	1	5	4.19	0.9561	0.1475	4	6	3.68	0.9941	0.2181
	4	3	5	2.63	0.9520	0.1098	4	6	3.68	0.9979	0.2181
0.10	2	-	-	-	-	-	0	14	57.04	0.9599	0.0960
	2.5	-	-	-	-	-	3	11	6.95	0.9590	0.0771
	3	-	-	-	-	-	8	10	4.09	0.9697	0.0726
	3.5	1	7	5.45	0.9542	0.0652	7	9	4.03	0.9905	0.0952
	4	3	8	3.24	0.9504	0.0306	7	9	4.03	0.9967	0.0952
0.05	2	-	-	-	-	-	0	17	66.38	0.9565	0.0458
	2.5	-	-	-	-	-	3	16	8.29	0.9570	0.0218
	3	-	-	-	-	-	10	12	4.18	0.9631	0.0424
	3.5	1	8	5.86	0.9533	0.0424	10	12	4.18	0.9870	0.0424
	4	2	8	3.92	0.9621	0.0343	10	12	4.18	0.9954	0.0424
0.01	2	-	-	-	-	-	-	-	-	-	-
	2.5	-	-	-	-	-	3	20	8.69	0.9554	0.0077
	3	-	-	-	-	-	13	19	4.36	0.9527	0.0067
	3.5	0	13	18.34	0.9732	0.0074	16	18	4.28	0.9799	0.0086
	4	2	12	4.28	0.9603	0.0057	16	18	4.28	0.9929	0.0086

Note: cells with no data denote that plan parameters did not satisfy the conditions.

Table 2: Plan parameters of the repetitive sampling plan when b = 3.0

β	μ/μ_0	*a=0.50*					*a=1.0*				
		L	U	$E(I)$	$L(p_1)$	$L(p_2)$	L	U	$E(I)$	$L(p_1)$	$L(p_2)$
0.25	2	5	9	6.03	0.9537	0.2471	-	-	-	-	-
	2.5	6	9	5.53	0.9885	0.2319	-	-	-	-	-
	3	7	9	5.20	0.9972	0.2205	0	2	2.02	0.9632	0.2025
	3.5	7	9	5.20	0.9994	0.2205	2	4	1.67	0.9503	0.0247
	4	7	9	5.20	0.9999	0.2205	5	7	1.65	0.9544	0.0014
0.10	2	5	16	10.07	0.9513	0.0894	-	-	-	-	-
	2.5	12	14	5.85	0.9787	0.0909	-	-	-	-	-
	3	12	14	5.85	0.9954	0.0909	0	3	2.88	0.9619	0.0907
	3.5	14	16	5.99	0.9989	0.0640	2	4	1.67	0.9503	0.0247
	4	13	15	5.92	0.9998	0.0763	5	7	1.65	0.9544	0.0014
0.05	2	4	21	14.53	0.9574	0.0442	-	-	-	-	-
	2.5	16	18	6.08	0.9723	0.0452	-	-	-	-	-
	3	17	19	6.12	0.9937	0.0380	0	7	3.79	0.9562	0.0024
	3.5	17	19	6.12	0.9986	0.0380	1	4	1.92	0.9661	0.0273
	4	15	18	6.15	0.9997	0.0457	4	6	1.65	0.9618	0.0037
0.01	2	4	30	16.34	0.9544	0.0097	-	-	-	-	-
	2.5	26	28	6.27	0.9563	0.0080	-	-	-	-	-
	3	25	27	6.26	0.9908	0.0095	0	9	3.81	0.9531	0.0004
	3.5	24	27	6.28	0.9981	0.0095	1	6	2.04	0.9650	0.0043
	4	24	27	6.28	0.9996	0.0095	5	7	1.65	0.9544	0.0014

Note: cells with no data denote that plan parameters did not satisfy the conditions.

From the tables we observe the following trends

(i) As the mean ratio μ/μ_0 increases for the other parameters the expected value of inspecting the items i.e. *E (I)* decreases. There is a bigger change in the values of upper and lower control thresholds as the mean ratio increases from 2 to 4. For ratio, larger than 2, *L* (p_2) becomes approximately 0. This is due to a big jump in $L(p_2)$ values. This trend makes the results interesting as smaller values of ratio are preferable in practice.

(ii) Also value of *E(I)* decreases when the termination time multiplier increases from 0.5 to 1 at the same level of the mean ratios.

4. DESIGNING OF RESUBMITTED PLAN

We propose following resubmitted plan

Step 0: Start with i=1.

Step 1: Accept the lot if $Y_i \geq U$ and reject the lot if $Y_i \leq L$.

Step 2: if lot is not accepted, apply step-1 m times and reject the lot of the product at the m-th resubmission if the lot is not accepted on $(\mathrm{m}-1)^{\mathrm{st}}$ resubmission

The OC function of resubmitted plan is given as follows Wu et al. [18], Aslam et al. [19] and Aslam et al. [20] is given as follows

$$P_a(p) = 1 - \left(1 - L(p)\right)^m \quad (21)$$

where $L(p) = P\{Y_i \geq U\}$ and m shows resubmission.

We will use the same optimization models [Eq. (18a) to Eq. (18c)] by considering Eq. (21) to find the plan parameters of the proposed resubmitted plan. The plan parameters for b = 1, 2 of the IG distribution, $m = 2$, termination ratio for a = 0.5, while plan parameters for b = *3* (two values of termination ratio for a = 0.5 and 1) producer's risk α = 0.05 and five values of mean ratio $(\mu/\mu_0 = 2, 2.5, 3, 3.5, 4)$ are placed in Tables 3-4.

Table 3: Plan parameters of the resubmitted plan when a = 0.50

β	μ/μ_0	b = 1.0					b = 2.0				
		L	*U*	*E(I)*	$L(p_1)$	$L(p_2)$	*L*	*U*	*E(I)*	$L(p_1)$	$L(p_2)$
0.25	2	-	-	-	-	-	6	8	3.94	0.9585	0.22662
	2.5	-	-	-	-	-	6	8	3.94	0.9943	0.22662
	3	3	5	2.63	0.9714	0.19587	6	8	3.94	0.9993	0.22662
	3.5	3	5	2.63	0.9900	0.19587	6	8	3.94	0.9999	0.22662
	4	3	5	2.63	0.9965	0.19587	6	8	3.94	1.0000	0.22662
0.10	2	-	-	-	-	-	-	-	-	-	-
	2.5	-	-	-	-	-	10	12	4.18	0.9877	0.08199
	3	-	-	-	-	-	10	12	4.18	0.9984	0.08199
	3.5	5	7	2.69	0.9811	0.08155	10	12	4.18	0.9998	0.08199
	4	5	7	2.69	0.9934	0.08155	10	12	4.18	1.0000	0.08199
0.05	2	-	-	-	-	-	-	-	-	-	-
	2.5	-	-	-	-	-	12	14	4.23	0.9836	0.04874
	3	-	-	-	-	-	12	14	4.23	0.9978	0.04874
	3.5	7	9	2.72	0.9700	0.03330	12	14	4.23	0.9997	0.04874
	4	7	9	2.72	0.9893	0.03330	12	14	4.23	1.0000	0.04874
0.01	2	-	-	-	-	-	-	-	-	-	-
	2.5	-	-	-	-	-	19	21	4.29	0.9655	0.00774
	3	-	-	-	-	-	19	21	4.29	0.9952	0.00774
	3.5	-	-	-	-	-	19	21	4.29	0.9994	0.00774
	4	10	12	2.73	0.9816	0.00858	19	21	4.29	0.9999	0.00774

Note: cells with no data denote that plan parameters did not satisfy the conditions.

Table 4: Plan parameters of the resubmitted plan when b = 3.0

β	μ/μ_0	a=0.50					a=1.0				
		L	U	$E(I)$	$L(p_1)$	$L(p_2)$	L	U	$E(I)$	$L(p_1)$	$L(p_2)$
0.25	2	10	12	5.66	0.9922	0.23640	-	-	-	-	-
	2.5	10	12	5.66	0.9996	0.23640	1	3	1.74	0.9559	0.11744
	3	10	12	5.66	1.0000	0.23640	4	6	1.65	0.9619	0.00732
	3.5	10	12	5.66	1.0000	0.23640	13	15	1.65	0.9509	0.00000
	4	10	12	5.66	1.0000	0.23640	30	32	1.65	0.9521	0.00000
0.10	2	16	18	6.08	0.9832	0.08761	-	-	-	-	-
	2.5	16	18	6.08	0.9991	0.08761	-	-	-	-	-
	3	16	18	6.08	1.0000	0.08761	4	6	1.65	0.9619	0.00732
	3.5	16	18	6.08	1.0000	0.08761	13	15	1.65	0.9509	0.00000
	4	16	18	6.08	1.0000	0.08761	30	32	1.65	0.9521	0.00000
0.05	2	20	22	6.20	0.9756	0.04444	-	-	-	-	-
	2.5	20	22	6.20	0.9987	0.04444	-	-	-	-	-
	3	20	22	6.20	0.9999	0.04444	4	6	1.65	0.9619	0.00732
	3.5	20	22	6.20	1.0000	0.04444	13	15	1.65	0.9509	0.00000
	4	20	22	6.20	1.0000	0.04444	30	32	1.65	0.9521	0.00000
0.01	2	29	31	6.29	0.9547	0.00949	-	-	-	-	-
	2.5	29	31	6.29	0.9975	0.00949	-	-	-	-	-
	3	29	31	6.29	0.9999	0.00949	4	6	1.65	0.9619	0.00732
	3.5	29	31	6.29	1.0000	0.00949	13	15	1.65	0.9509	0.00000
	4	29	31	6.29	1.0000	0.00949	30	32	1.65	0.9521	0.00000

Note: cells with no data denote that plan parameters did not satisfy the conditions.

We note similar behaviour in Tables 3-4 as in Tables 1-2.

5. COMPARISONS OF PLANS

In this section, we will compare the proposed repetitive plan using existing E(I) and new E(I). So, we will use Eq. (8) for existing E(I) and Eq. (15) for proposed E(I). A plan with smaller values of E(I) is considered as efficient plan. To save the space, we will consider only the case of b = 3. We determined the values of E(I) and placed in Table 5.

Table 5: Comparison of $E(I)$ when b = 3.0 and a = 0.5

β	μ/μ_0	*New* E(I)	*Existing* E(I)
0.25	2	7.37	6.03
	2.5	6.32	5.53
	3	6.31	5.20
	3.5	6.31	5.20
	4	6.31	5.20
0.10	2	8.91	10.07
	2.5	6.32	5.85
	3	6.31	5.85
	3.5	6.31	5.99
	4	6.31	5.92
0.05	2	10.44	14.53
	2.5	6.32	6.08
	3	6.31	6.12
	3.5	6.31	6.12
	4	6.31	6.15
0.01	2	10.81	16.34
	2.5	6.32	6.27
	3	6.31	6.26
	3.5	6.31	6.28
	4	6.31	6.28

From Table 5, we note that the new E(I) is smaller than the existing E(I). For example, when $\beta = 0.25$ and $\mu/\mu_0 = 2$, the new E(I) $= 6.03$ and existing E(I) $= 7.37$. So, the proposed plan with new E(I) is more efficient than plan with existing E(I).

We will compare the efficiency of proposed repetitive plan with the proposed resubmitted plan in terms of E(I). A plan is said to be more efficient than the other if E(I) is smaller. We will select the same values of all the specified parameters for this purpose. Table 6 gives the different values of E(I) for the two proposed plan for b = 3 and a = 0.5.

Table 6: Comparison of $E(I)$ when b = 3.0 and a = 0.5

β	μ/μ_0	*Resubmitted plan E(I)*	*Repetitive plan E(I)*
0.25	2	5.66	6.03
0.10	2	6.08	10.07
0.05	2	6.20	14.53
0.01	2	6.29	16.34

We note from Table 6 that the resubmitted plan provides the smaller values of E(I) as compared to repetitive sampling plan when $\mu/\mu_0 \geq 2$. For $\mu/\mu_0 > 2$, we noted that repetitive sampling performs better than resubmitted plan. For example, $\beta = 0.25$ and $\mu/\mu_0 = 2$, the E(I) $= 5.66$ from the resubmitted plan and it 6.03 from repetitive sampling plan. So, resubmitted plan with $m = 2$ performs better than repetitive sampling plan.

6. APPLICATION OF PROPOSED PLAN IN INDUSTRY

Example 1:

The inspection of failure time of a big lot of deep-groove ball bearings was done in an experiment. Twenty-three ball bearings were used in a life test study and produced the results given in Table 8, in millions of revolutions to failure.

Table 8: Failure times of 23 deep-groove ball bearings

17.88	28.92	33.00	41.52	42.12
45.60	48.48	51.84	51.96	54.12
55.56	67.80	68.64	68.64	68.88
84-12	93.12	98.64	105.12	105.84
127.92	123.04	173.40		

Pavur et al. [29] identified that the data set follows an IG distribution. This data set is regarded as a pre-sample and the above sampling scheme needs to be conducted to test how many items are inspected. Since the shape parameter is unknown here, it needs to be estimated from the pre-sample.

For m integer m > 0, the m-th moment of a random variable T following IG distribution is given as,

$$E(T^m) = \theta^m \sum_{i=0}^{m-1} \frac{(m-1+i)!}{i!(m-1-i)!}\left(\frac{1}{2b}\right)^i \tag{15}$$

In particular the first moment of IG is given by $\mu = \theta$.

Based on the Eq. (15), the shape parameter can be given as Tzong and Cheng [30].

$$b = \frac{\theta^2}{Var(T)}$$

The estimator of b can be obtained by

$$\hat{b} = \frac{\bar{X}^2}{S^2}$$

where $\overline{X}$ and S^2 are the sample mean and the sample variance of the lifetime data, respectively. In this example, $\overline{X}$ =72.224 and S^2=1405.402 which gives $\hat{b}$ =3.71. The plan parameters for this value are placed in Table 7.

Table 7: Plan parameters of the proposed plan when b = 3.7

β	μ/μ_0	*a=0.50*					*a=1.0*				
		L	U	E(I)	$L(p_1)$	$L(p_2)$	L	U	E(I)	$L(p_1)$	$L(p_2)$
0.25	2	15	17	8.24	0.9505	0.1085	_	_	_	_	_
	4	98	100	8.11	0.9998	0.0000	15	17	1.67	0.9505	0.0000
	6	98	100	8.11	1.0000	0.0000	87	100	1.67	0.9936	0.0000
	8	98	100	8.11	1.0000	0.0000	59	91	1.67	0.9999	0.0000
	10	97	99	8.11	1.0000	0.0000	46	56	1.67	1.0000	0.0000
0.10	2	15	18	8.35	0.9504	0.0965	_	_	_	_	_
	4	96	98	8.11	0.9998	0.0000	15	17	1.67	0.9505	0.0000
	6	97	99	8.11	1.0000	0.0000	41	94	1.67	0.9969	0.0000
	8	98	100	8.11	1.0000	0.0000	56	89	1.67	0.9999	0.0000
	10	98	100	8.11	1.0000	0.0000	60	90	1.67	1.0000	0.0000
0.05	2	14	27	9.12	0.9520	0.0323	_	_	_	_	_
	4	98	100	8.11	0.9998	0.0000	15	17	1.67	0.9505	0.0000
	6	98	100	8.11	1.0000	0.0000	52	55	1.67	0.9961	0.0000
	8	98	100	8.11	1.0000	0.0000	44	98	1.67	0.9999	0.0000
	10	98	100	8.11	1.0000	0.0000	41	93	1.67	1.0000	0.0000
0.01	2	14	37	9.34	0.9505	0.0089	_	_	_	_	_
	4	98	100	8.11	0.9998	0.0000	15	17	1.67	0.9505	0.0000
	6	98	100	8.11	1.0000	0.0000	87	89	1.67	0.9936	0.0000
	8	98	100	8.11	1.0000	0.0000	57	77	1.67	0.9999	0.0000
	10	98	100	8.11	1.0000	0.0000	44	95	1.67	1.0000	0.0000

Note: cells with no data denote that plan parameters did not satisfy the conditions

Suppose the manufacture wants to use the proposed plan for the inspection of the deep groove ball bearing. Now since the dataset on the ball bearing used by Pavur et al. [29] showed that the lifetime of these items follow IG distribution with shape parameter =3.7 then for this experiment, let $\mu/\mu_0 = 2$, a = 0.5, $\alpha = 0.95$ and $\beta = 0.05$. The optimal values for the plan parameters from Table 7 are L = 14, U = 27 and E(I) = 9.12.

Let Yi be the number of conforming items between the successive fourth and fifth non-conforming items.

The decision on the lot will be made in the following steps:

Step 0: Start with i=1.

Step 1: Accept the lot if no of conforming items is greater than or equal to 27 and reject the lot if Yi $\leq$14.

Step 2: The testing of ball bearing continues if Yi lies between threshold values 14 and 27, then increase i by 1 and repeat the procedure.

The experiment yields on average 9.12 ball bearings will be inspected.

Example 2:

The Inverse Gaussian distribution is found as a useful lifetime model in the application of early occurrences of events like the failure or repair of items in industries.

In the same context, Chhikara and Folks [31] presented data for maintenance of active repair time of an airborne communication transceiver in hours that follow IG distribution. They calculated the unbiased estimator for shape parameter as $\hat{b}\simeq 2$. The data is given in Table 9.

Table 9: Repair time of 45 transceivers (in hours)

0.2	0.3	0.5	0.5	0.5	0.5	0.6	5	8.8
0.6	0.7	0.7	0.7	0.8	0.8	1	5.4	9
1	1	1	1.1	1.3	1.5	1.5	5.4	10.3
1.5	1.5	2	2	2.2	2.5	2.7	7	22
3	3	3.3	4	4	4.5	4.7	7.5	24.5

The proposed plan can be used for the testing of this product. Let $\mu/\mu_0 = 2$, a = 0.5, $\alpha = 0.95$ and $\beta = 0.05$. The optimal values for the plan parameters from Table 1 are L = 0, U = 10 and E(I) = 36.29.

The plan parameters for resubmitted sampling plan when $\mu/\mu_0 = 2$, a = 0.5, $\alpha = 0.95$, m=2 and $\beta = 0.05$ from Table 3 are L = 6, U =8 and E(I) = 3.94. The plan is implemented as follows

Step 0: Start with i=1.
Step 1: Accept the lot if $Y_i \geq 8$ and reject the lot if $Y_i \leq 6$.
Step 2: if lot is not accepted, apply step-1 2 times and reject the lot of the product at the 2nd resubmission if the lot is not accepted on 1st resubmission.

7. CONCLUDING REMARKS

In this paper, two plans are proposed when run lengths of conforming items follow IG distribution. The number of conforming items between successive defective items is taken as the measure for decision making criteria. The extensive tables are presented for both sampling plans. Two real world examples are provided for the industrial application of the proposed plans. Further, we compared the efficiency of the proposed plan with the two existing sampling plans in terms of *E (I).* From the comparisons, we found that the proposed plan performs better than the existing sampling plans. Hence employing the proposed plan can remarkably reduce the cost, effort and time of lifetime experiments that are conducted for the inspection of products whose lifetime follow IG distribution. For future research the proposed model can be extended to group acceptance sampling scheme or the plan can be modified for some other lifetime distributions for instance Gamma distribution, Generalized Rayleigh, and half normal distribution etc.

REFERENCES

1. FallahNezhad, M.S. (2012). *New Models of Acceptance Sampling Plans*. Chapter 3.
2. FallahNezhad, M.S. and Niaki, S.T.A. (2013). A New Acceptance Sampling Policy Based on Number of Successive Conforming Items. *Communications in Statistics - Theory and Methods*, 42(8), 1542-1552.

3. McWilliams, T.P., Saniga, E.M. and Davis, D.J. (2001). On the design of single sample acceptance sampling plans. *Economic Quality Control*, 16, 193-198.
4. William. G., Ferrell J.R. and Chhoker, A. (2002). Design of economically optimal acceptance sampling plan with Inspection error. *Computer and Operation Research*, 29, 1283-1300.
5. Klassen C.A.J. (2001). Credit in acceptance sampling on attributes. *Technometrics*, 43, 212-222.
6. Aminzadeh, M.S. (2003). Bayesian Economic Variable Acceptance-Sampling Plan Using Inverse Gaussian Model and Step-Loss Function. *Communications in Statistics-Theory and Methods*, 32(5), 961-982.
7. Niaki S.T.A., FallahNezhad M.S. (2009). Designing an optimum acceptance plan using Bayesian inference and stochastic dynamic programming. *Scientia Iranica*, 16(1), 19-25.
8. Calvin, T.W. (1983). Quality control techniques for "zero-defect. *IEEE Transactions on Components, Hybrids, and Manufacturing Technology*, 6, 323-328.
9. Goh, T.N. (1987). A charting technique for control of low-nonconformity production. *International Journal of Quality and Reliability Management*, 5, 53-62.
10. Bourke, P.D. (2003). A continuous sampling plan using sums of conforming run-lengths. *Quality and Reliability Engineering International*, 19, 53-66.
11. Bowling, S.R. Khasawneh, M.T., Kaewkuekool, S. and Cho, B.R. (2004). A Markovian approach to determining optimum process target levels for a multi-stage serial production system. *European Journal of Operational Research*, 159, 636-650.
12. FallahNezhad, M.S. and Niaki, S.T.A. and Abooie, M.H. (2011). A New Acceptance Sampling Plan Based on Cumulative Sums of Conforming Run-Lengths. *Journal of Industrial and Systems Engineering*, 4, 256-264.
13. Aslam, M., FallahNezhad, M.S. and Azam, M. (2013). Decision Procedure for the Weibull Distribution Based on Run Lengths of Conforming Items. *Journal of Testing and Evaluation*, 41(5), 826-832.
14. Sherman, R.E. (1965). Design and evaluation of repetitive group sampling plan, *Technometrics*, 7, 11-21.
15. Balamurali, S. and Jun, C.-H. (2006). Repetitive group sampling procedure for variables Inspection. *Journal of Applied Statistics*, 33, 327-338.
16. Govindaraju, K. and Ganesalingam, S. (1997). Sampling inspection for resubmitted lots. *Communications in Statistics - Simulation and Computation*, 26, 1163-1176.
17. Damija, O.P. and Hammer, W.C.K. (1990). Manual of Food Quality Control. Vol. 6. Food for Export, FAO Food and Nutrition Paper 14/6. Rev. 1, Food and Agriculture Organization of the United Nations, Rome.
18. Wu, C.W., Aslam, M. and Jun, C.-H. (2012). Variable sampling inspection scheme for resubmitted lots based the process capability index Cpk. *European Journal of Operational Research*, 217(3), 560-566.
19. Aslam, M., Wu, C.W., Azam, M. and Jun, C.-H. (2013). Variable Sampling Inspection for Resubmitted Lots Based on Process Capability Index C_{pk} for Normally Distributed Items. *Applied Mathematical Modelling*, 37, 667-675.
20. Aslam, M., Khan, N., Ahmad, N. and Jun, C.-H. (2014). Resubmitted Sampling Inspection Plan using Exponentiated Weibull Distribution. *Journal of Testing and Evaluation*, In Press.

21. Schrödinger, E. (1915). Zur Theorie der Fall-und Steigversuchean Teilchennmit Brownsche Bewegung. *Physikalische Zeitschrift*, 16, 289-295.
22. Tweedie, M.C.K. (1945). Inverse Statistical Variates. *Nature*, 155, 453-453.
23. Wald, A. (1947), Sequential Analysis. New York: John Wiley & Sons.
24. Tweedie, M.C.K. (1957). Statistical Properties of Inverse Gaussian Distributions. *Annals of Mathematical Statistics*, 28(2), 281-545.
25. Chhikara, R.S. and Folks, J.L. (1989). the Inverse Gaussian Distribution-theory, methodology, and applications. New York and Basel: Marcel Dekker.
26. Jain, R.K. and Jain, S. (1996). Inverse Gaussian distribution and its Application to Reliability. *Microelectronics and Reliability*, 36(10), 1323-1335.
27. Smith, C.E. and Lansky (1994). Reliability Application of a Mixture of Inverse Gaussian Distributions. *Applied Stochastic Models and Data Analysis*, 10(1), 61-69.
28. Tsai, T.-R. and Wu, C.-J. (2008). Reliability Sampling Plans for Truncated Life Tests with Inverse Gaussian Lifetime Data. *Biomedical Soft Computing and Human Sciences* 13, 13-24.
29. Pavur, R.J., Edgeman, R.L. and Scott, R.C. (1992). Quadratic Statistics for the Goodness-of-fit Test of the Inverse Gaussian Distribution. *IEEE Transactions on Reliability*, 41(1), 118-123.
30. Tzong-Ru Tsai1 and Cheng-Ju Wu. (2008). Reliability Sampling Plans under Truncated Life Tests with Inverse Gaussian Data. *Biomedical Soft Computing and Human Sciences*, 13(1), 13-24.
31. Chhikara, R.S. and Folks, J.L. (1977). The Inverse Gaussian Distribution as a Lifetime Model. *Technometrics*, 19(4), 461-468.

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IMPACT OF PERSONALITY TRAITS OF MANAGER ON THE PERFORMANCE OF PROJECT

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ABSTRACT

Several factors contribute to the success of a project. Among these, personality traits of the project manager have a special role and contribution to the success of the project. This study aims at describing the extent of variation in the performance of the project explained by the personality traits of the project manager which include his authority, extroversion, introversion, and vision. The study also explores the mediatory role of team building between the personality traits of the manager and the performance of the project. The study is based on a representative sample of 100 plus individuals involved in various aspects of projects executed in Pakistan. Path and multivariate analysis have been used in the study to draw conclusions. The results reveal that all the above mentioned personality traits are directly related in desired directions with the performance and success of the project and explain significant amount of variability in the dependent variable. However, full mediatory role of team building is established for extroversion only whereas partial mediatory role of team building is established for authority, introversion and the vision of the project manager. Areas of further research have been suggested in the paper.

KEYWORDS

Project performance, project success, personality traits, team building.

INTRODUCTION

Project management has changed drastically over a period of time. Big changes are visible in the areas of planning, organization, coordination and monitoring of project activities. The focus presently is on effective management and balancing of project staff, project schedule, and budget and project targets. These areas are becoming more complex and critical with the passage of time which ultimately affects the project performance. In order to execute them properly and to achieve set targets, projects essentially need effective project teams comprising of people of various expertise and capabilities and belonging to different cultures and backgrounds. One of the most important functions of a project manager is to build a team which directly affects the project performance. The professional competence of a project manager casts heavy shadows on the team building and project performance is affected by the team performance. Not only the technical skills and professional competence but also the managerial capacity and knowhow of a project manager play an important role for the team performance and project success. Several factors contribute towards the success of a project. The well-known factors are: a

focused project approach, properly designed project objectives, top management support, dedicated and committed project team, effective resources management and well prepared project execution machinery. Besides it, personality traits of the project manager have their own role and contribution to the success of the project. The study aims at describing the extent of variance in the performance of the project explained by the personality traits of the project manager, which include authority, extroversion, introversion, and vision. The study also explores the impact of authority, extraversion, introversion and visionary role of the project manager on team building and also checks the direct effect of the team building on project performance.

Admittedly, a project manager should be an authoritative personality and must have leadership skills to perform the roles and responsibilities assigned to him / her effectively and efficiently in the relevant project and get best output from the project team. Without the authoritative roles and skill it's very tough and difficult to lead the project team that consists of individuals with varying working capacities and technical knowhow and having different cultural and professional backgrounds. Project manager should be a person who has the ability to create such an environment for his team members in whom they feel easy to understand each other, coordinate with each other, help each other and feel comfortable, confident, relaxed and happy while executing or implementing their responsibilities, irrespective of their roles in the team.

Extrovert personality of a project manager is also important to be social and leadership oriented and to pay due attention to the staff and team members. An extrovert project manager is energetic, enthusiastic, action oriented, cooperative, and interactive and prefers to reach at the best solutions as a result of open and frank discussions with the team members.

On the other hand, an introvert manager is ill-communicative and unable to adopt a scientific and logical approach to a project with an element of innovation and creativity. An effective team building skill is also essential for a successful project and this ability is generally non-existent in an introvert project manager.

Likewise, a visionary project manager is creative and innovative. He knows the skill to align the team with the objectives of the project. He provides the required structure and motivates the workers to achieve the best of the team performance, resulting in the landmark success of the project. A visionary project manager has ability to motivate the team to work together to deliver results more effectively and efficiently and in a better way. A competent and visionary project manager has the ability to encourage project team, monitor its progress regularly, assist individuals to set the goals and provide vision on how to achieve them.

OBJECTIVES OF THE STUDY

This study explores the evidence of the effect of personality traits of the project manager on project performance. The study measures the direct and indirect effect of the personality traits of the project manager on the project performance. The study also finds out the most prominent personality traits amongst authority, extroversion, introversion and vision that affect the project performance most significantly and bifurcates personality traits having direct and indirect impact on the project performance. The study

also examines whether or not the team building mediates between the project performance and the personality traits of the project manager.

RESEARCH QUESTIONS

- Is there any evidence of the effect of personality traits of the project manager on project performance?
- Do personality traits of project manager affect directly as well as indirectly the project performance?
- Does team building mediate between the personality traits of the project manager and the project performance?

SIGNIFICANCE OF THE STUDY

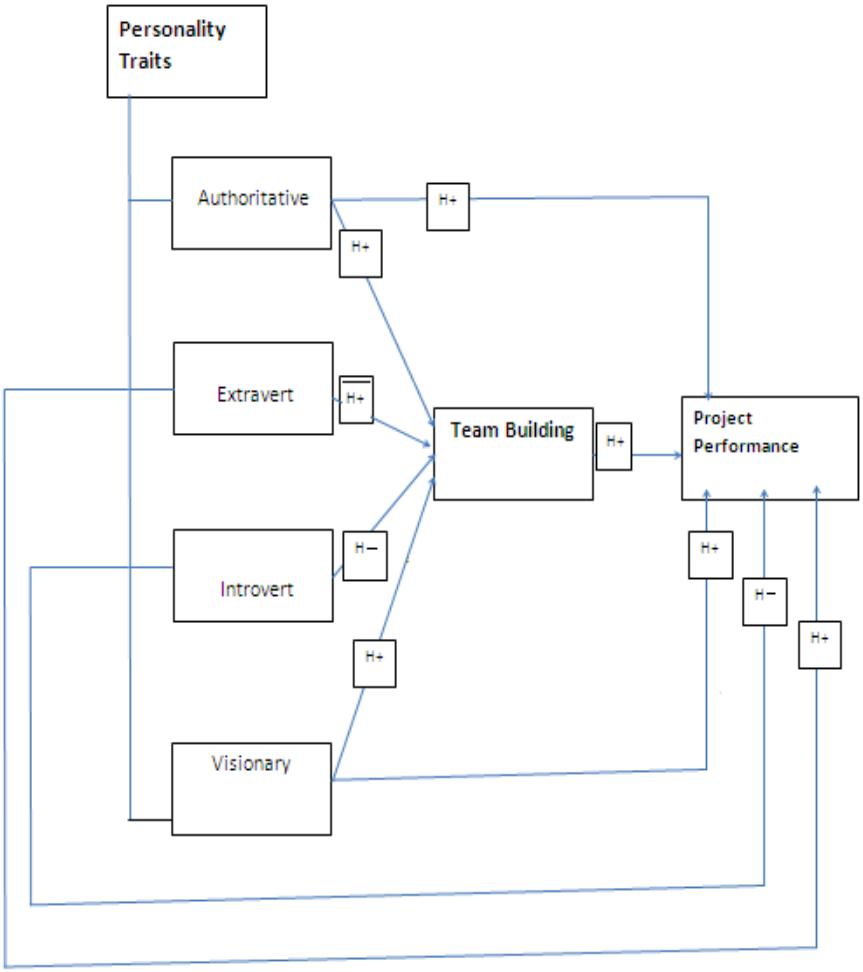
While doing this research, we found that there is a variety of factors which affect the project performance. These factors include a focused project approach, effective project communication, properly designed project objectives, stakeholders' endorsement of project objectives, top management commitment and support, dedicated and hardworking project team, effective resources management and well prepared project execution machinery. Despite these, personality traits of the project manager also play their own role and contribute in a unique manner to the success of the project. The study thus aims at describing the extent of variance in the performance of the project explained by the personality traits of the project manager alone, which include extroversion, introversion, authority and vision of the project manager. The study also explores the mediatory role of team building theorized to be existing between the personality traits of the manager and the performance of the project. Competing hypotheses regarding personality traits of the project manager, having direct and indirect impact on project performance have been tested and discussed in this research.

THEORETICAL & CONCEPTUAL FRAMEWORK

We theorize that:

- Project performance is a function of several factors including the personality traits of the project manager.
- Team building intervenes between personality traits of the project manager and project performance.
- Some of the personality traits of the project managers have direct effect on the project performance over and above their effects through team building after controlling for other traits.

The following theoretical and conceptual framework summarizes the theory outlined above.



HYPOTHESES

Based on the stated theory and the conceptual framework, following hypotheses are developed and tested in the research paper:

H1: Authority has a positive and significant impact on project performance.
H2: Extroversion has a positive and significant impact on project performance.
H3: Introversion has a negative and significant impact on project performance.
H4: Vision has a positive and significant impact on project performance.
H5: Authority has a positive and significant impact on team building.
H6: Extroversion has a positive and significant impact on team building.
H7: Introversion has a negative and significant impact on team building.
H8: Vision has a positive and significant impact on team building.
H9: Team Building mediates between authority and project performance.

H10: Team Building mediates between extraversion and project performance.
H11: Team Building mediates between introversion and project performance.
H12: Team Building mediates between vision and project performance.
H13: Team Building has a positive and significant impact on project performance.

METHODOLOGY

This is a quantitative and cross sectional research and the purpose of this study is to check the impact of project manager's personality traits on the project performance with the mediating effect of team building. The target population consists of organizations from where the data was collected and these include petroleum companies, software houses and telecommunication companies having projects located in Rawalpindi and Islamabad, The units of analysis are senior employees of the projects in the afore mentioned areas in Pakistan. Due to the lack of a comprehensive and reliable sample frame of the target companies, the researchers couldn't collect the data through random sampling. That's why the convenient sampling technique was used to collect the data for the study. Data was collected through a structured questionnaire which was floated through electronic media followed by personal visits. Two hundred questionnaires were distributed among the above mentioned organizations and 101 filled in and useable documents were received back which gives a response rate of more than 50%. Four personality traits of the project manager, namely 'authority', 'extroversion', 'introversion' and 'vision' were measured on an interval scale from 0 to 5. Mediating variable, 'team building' and the dependent variable 'project performance' were also measured on the same interval scale. Correlation and multiple regression techniques were used to examine relationships between the variables under study and path and multivariate analyses were applied for analysis of data and drawing of results.

A pilot testing was conducted to check the reliability of the questionnaire. The content and face validity of the questionnaire were checked by the experts of the relevant areas. The researchers used the Cronbach's alpha for checking the internal consistency of the instrument. The Cronbach's alpha for all variables under examination remained between 0.7 and 0.9.

DATA ANALYSIS AND RESULTS

Correlation Analysis

Table-1 shows that there is a positive correlation between authority of the project manager and project performance and authority plays a significant role in the project performance. Extroversion and vision of the project manager also have a positive relationship with the project performance and these variables have a significant impact on the project performance. Introversion of the project manager has a negative impact on project performance and this impact is also statistically significant. The correlation matrix also shows that authority, extroversion and vision of the project manager positively affect the team building and this effect is statistically significant at 1% level of significance. Introversion of the project manager negatively and significantly impacts the team building in projects of the organizations under study. Team Building has a positive impact on the project performance and this impact is also highly significant at 1% level of significance.

Table 1: Correlations

		Authority	Extrovert	Introvert	Vision	TB	PP
Authority	Pearson Correlation	1					
Extroversion	Pearson Correlation	.529**	1				
Introversion	Pearson Correlation	-.160	-.351**	1			
Vision	Pearson Correlation	.407**	.587**	-.276**	1		
TB	Pearson Correlation	.408**	.763**	-.413**	.639**	1	
PP	Pearson Correlation	.515**	.623**	-.409**	.632**	.708**	1

****. Correlation is significant at the 0.01 level (2-tailed).**

REGRESSION ANALYSIS

Step 1

The regression analysis reveals that variation in project performance is explained to the extent of 56% (R square=0.560, Table-2) through variation in authority, extroversion, introversion and vision of the project manager. This shows the strength of these personality traits as predictors of the project performance.

Impact of Personality Traits of Manager on the Performance of Project

Table 2: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.748[a]	.560	.541	.67389

a. Predictors: (Constant), Authority, Extrovert, Introvert, Vision

Table 3: ANOVA[a]

Model	Sum of Squares	Df	Mean Square	F	Sig.
1 Regression	54.374	4	13.594	29.933	.000[b]
Residual	42.688	94	.454		
Total	97.062	98			

a. Dependent Variable: PP

b. Predictors: (Constant), Authority, Extroversion, Introversion, Vision

ANOVA shows the model fitness. The value of F=29.933 is significant which establishes the validity of the regression model and the predictive power of independent variables in the model.

Table-4 indicates the partial impact of each independent variable on dependent variable after controlling for the other independent variables. All the independent variables (authority, extroversion, introversion, and vision) have a significant impact on project performance in the desired direction. Authority, extroversion and vision have a positive impact whereas introversion has a negative impact on project performance. The significant role of authority, introversion and vision on project performance can be

checked both at 5% and 1% level of significance (Sig = .009, Sig = .009, Sig = .000 respectively) whereas extroversion is significant at 5% level of significance (Sig = .016).

Table 4: Coefficients

Model	Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	.610	.396		1.542	.126
Authority	.240	.090	.217	2.666	.009
Extroversion	.232	.095	.231	2.443	.016
Introversion	-.158	.059	-.196	-2.665	.009
Vision	.452	.109	.354	4.132	.000

a. Dependent Variable: PP

Step 2

In Table-5, the value of R square is 0.656 which indicates that the variation in Team Building is explained to the extent of 66% through variation in personality traits of the project manager, namely authority, extroversion, introversion and vision. This indicates the strength of personality traits of project manager as predictors of team building.

Table 5: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.810a	.656	.642	.60576

a. Predictors: (Constant), authority, extroversion, introversion, vision

Table-6, ANOVA, shows the model fitness. The value of F=44.881 is significant which shows the validity and predictive position of the independent variables in the model.

Table 6: ANOVA[a]

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	65.874	4	16.469	44.881	.000[b]
Residual	34.492	94	.367		
Total	100.367	98			

a. Dependent Variable: TB
b. Predictors: (Constant), authority, extroversion, introversion, vision

Table-6 indicates the significant impact of independent variables on mediating variable i.e. team building, individually after controlling for other independent variables as predictors. As indicated in the table, the independent variables (extroversion, vision) have a significant and positive impact on team building and introversion, as expected, has a negative and significant impact on team building. The significant role of introversion, vision and extroversion on team building can be checked at both 5% and 1% level of

significance (Sig = .030, Sig = .000, Sig = .000 respectively) whereas authority is not significant neither at the level of 5% nor at 1% level of significance.

Table 7: Coefficients

Model 1	Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	.738	.356		2.074	.041
Authority	-.029	.081	-.025	-0.353	.725
Extroversion	.573	.085	.563	6.722	.000
Introversion	-.117	.053	-.143	-2.201	.030
Vision	.362	.098	.279	3.683	.000

a. Dependent Variable: TB

Step 3

In Table-8, the value of R square is 0.501 depicting that the variation in project performance is explained to the extent of 50% through variation in team building which shows the strength of team building as a predictor of project performance. The value of R Square also shows that numerous other factors also exist that affect the project performance in Pakistan. The future research should uncover these factors along with their statistical and practical significance.

Table 8: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.708[a]	.501	.496	.70687

a. Predictors: (Constant), TB

Table-9, ANOVA, shows the model fitness. The value of F=97.253 is significant which shows the validity and predictive position of the relevant variable in the model.

Table 9: ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	48.594	1	48.594	97.253	.000[b]
	Residual	48.468	97	.500		
	Total	97.062	98			

a. Dependent Variable: PP

b. Predictors: (Constant), TB

Table-10 shows the impact of team building (mediating variable) on dependent variable, project performance. As indicated in the table, the team building (mediating variable) has a significant and positive impact on project performance. The significant role of team building on project performance can be checked both at 5% and 1% level of significance (Sig = .000).

Table 10: Coefficients

Model	Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
1(Constant)	.985	.255		3.859	.000
Team Building	.696	.071	.708	9.862	.000

a. Dependent Variable: PP

Step 4

In Table-11, the value of R square is 0.613 which indicates that the variation in project to project performance is explained to the extent of 61% through variation in personality traits, namely authority, extroversion, introversion & vision and team building which shows the strength of personality traits of project manager and team building as predictors of project performance.

Table 11: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.783[a]	.613	.593	.63528

a. Predictors: (Constant), authority, extroversion, introversion, vision, team building

ANOVA in Table-12 shows the model fitness. The value of F=29.501 is significant which shows the validity and predictive power of the independent variables in the model.

Table 12: ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	48.594	1	48.594	97.253	.000[b]
	Residual	48.468	97	.500		
	Total	97.062	98			

a. Dependent Variable: PP

b. Predictors: (Constant), Authority, Extroversion, Introversion, Vision, Team Building

Table-13 gives the partial impact of each independent variable and the mediating variable on dependent variable controlling for other variables at the same time. The impact is determined by the slopes of regression lines and significant values of regression coefficients. As indicated in the table, the independent variables "authority' and 'vision' have a significant and positive impact on project performance controlling for team building and other independent variables as predictors whereas introversion impacts the project performance negatively and significantly (at 10% level). The mediating variable 'team building' also has a significant and positive impact on project performance. The significant role of authority and vision on project performance can be checked both at 5% and 1% level of significance whereas introversion is significant at 10% level of significance. The role of independent variable 'extroversion' is not statistically significant on project performance when it is included in the regression model along with

the mediating variable 'team building'. As already mentioned, 'extroversion' has a positive and significant impact on project performance directly but there is no evidence of its impact on project performance after controlling for 'team building'.

Table 13: Coefficients

Model	Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
1 (Constant)	.325	.382		.852	.396
Authority	.252	.085	.227	2.956	.004
Extroversion	.010	.109	.010	.094	.926
Introversion	-.113	.057	-.140	-1.965	.052
Vision	.312	.110	.245	2.828	.006
TB	.387	.108	.393	3.574	.001

a. Dependent Variable: PP

MAJOR FINDINGS AND DISCUSSION

The statistical analysis performed as part of this research reveals that significant evidence exists of the various effects of personality traits of the project manager on project performance. As per theory mentioned above, authority, extroversion, introversion, and vision of the project manager affect the project performance in different directions directly as well as indirectly through their effect on team building. Analysis of the study reveals that the direct effect of each of the personality traits is significant for project performance, controlling for other variables in the model. The strongest direct partial effect is that of the vision followed by extroversion and authority of the project manager. The direct effect of independent variables on project performance changes when we include the team building in the list of direct predictors of the dependent variable i.e. project performance.

The findings of the study also show that the variables that are directly contributing to the project performance are authority, vision, and team building. The strongest partial effect is that of the team building followed by the vision and authority of the project manager respectively.

As theorized, extroversion as personality trait of the project manager is contributing to project performance in the desired direction but its contribution is statistically insignificant. And introversion, another personality trait of the project manager, is significant for project performance at 10% level of significance (Sig=0.052) with the desired negative direction. Both these results are valid only when the intervening variable 'team building' is controlled in the analysis.

When we don't control for the team building (Step-1 of Baron and Kenny procedure), all personality traits of the project manager i.e. authority, extroversion, introversion and vision establish their contribution in the hypothesized directions to the project performance. The partial regression coefficient of each of these personality traits is statistically significant. Thus, the hypotheses regarding their direct effect on project performance are established.

Regarding factors contributing to the team building, largest role is that of extroversion and vision of the project manager controlling for his authority and introversion. The next

partial role, although negative, is that of introvert trait of the project manager and this role is statistically significant controlling for other traits of the project manager.

As per our analysis, authority plays a negative role in team building but its partial effect on team building is statistically insignificant. The negative role of authority in team building appears to be counter-intuitive and it needs further research. The focus of the further research should be to find out why in Pakistan workers are victims of authoritative behavior of project manager and this aspect plays a negative role in team building in a project. Interestingly, although authority does not contribute to team building but when we control for the team building and other variables, the role of the authority becomes significant in project performance. Thus, the hypotheses regarding the roles of extroversion, introversion and vision for team building are established. As for authority, the hypothesis that authority of the project manager has a positive and significant impact on team building is not established.

As is reflected from the results of this research, the extroversion directly contributes to the project performance but its role with team building present in the model as a predictor of project performance is insignificant. Thus, full mediation of team building with respect to the extroversion is evident. Authority, introversion and vision are contributing directly as well as indirectly through their influence via team building to the project performance. The role of these three variables is significant for the project performance both ways. This means that the direct contribution of authority, introversion and vision to project performance is over and above their indirect contribution via team building and thus partial mediation of team building for authority, introversion and vision is established in this research.

Importantly, the partial roles of ‘extroversion’ and ‘introversion’ are significant in their own way for team building but their role for project performance via team building is not established. This implies that ‘extroversion’ and ‘introversion’ as two personality traits of the project manager with their statistically significant roles do affect the project performance directly and these two traits also contribute significantly for the team building but no significant relation for the mediator to the project performance with regard to these two traits is established.

CONCLUSION

This research study has established that personality traits of a project manager play an effective and crucial role in the performance of a project. Some of these personality traits of the project manager highly affect the project performance directly while others affect indirectly via team building. All personality traits, that is, authority, extroversion, introversion and vision affect the project performance directly in the desired direction with a high statistical significance. However, on team building, only extroversion, introversion and vision are impacting in the desired direction with a high statistical significance. Although authority has no significant effect on team building but its role is significant as a direct predictor of project performance. Interestingly, when ‘authority’ is included in the regression model as a predictor along with team building and other personality traits as predictors, its role is statistically significant. Notably, team building affects the project performance significantly both as a single predictor as well as in

combination with other predictors of the project performance. Authority, introversion and vision have both a direct and significant effect on project performance over and above their effects via team building after controlling for other personality traits of the manager. Thus, full mediation of team building is established for extroversion of the project manager whereas mediatory role of team building is partial for authority, vision and introversion of the project manager. The most interesting aspect of the study is that authority of the project manager has been found to be a factor negatively affecting the team building in projects in Pakistan. A possible explanation of this phenomenon is that sometimes the team members feel irritated and uncomfortable because of the authoritative behavior and attitude of the project manager.

MANAGERIAL IMPLICATIONS

Project management is a wide area and technological innovation in Pakistan is on healthy growth. The organizations may focus, among other things, on project manager's personality traits that must be fully aligned with the temperament of the team members. This research will be an alert at the senior managerial level to select a project manager having desired personality traits that an effective project manager should have for the successful performance of the project.

REFERENCES

1. Andersen, E.S. (2006). Toward a project management theory for renewal projects. *Project Management Journal.*
2. Baiden, B.K., Price, A.D.F. and Dainty, A.R.J. (2006). The extent of team integration within construction projects. *International Journal of Project Management.*
3. Bell, A. (2006). *Great Leadership: What it is and what it Takes in a Complex World*. Davies-Black Publishing.
4. Benator, B. (2003). *Project management and leadership skills for engineering and construction projects*.
5. Brewer, J.L. (2005). Project managers: can we make them or just make them better? In *Proceedings of the 6th conference on Information technology education.*
6. Cleland, D.I. (1995). Leadership and the project-management body of knowledge. *International Journal of Project Management*.
7. Costa, P.T. and McCrae, R.R. (1987). Neuroticism, somatic complaints, and disease: Is the bark worse than the bite? *Journal of personality*.
8. Crawford, L. (2005). Senior management perceptions of project management competence. *International Journal of Project Management*,
9. Sadeh & Malach (2006). Projects and project managers: the relationship between project managers' personality, project types, and project success. *Project Management Quarterly*.
10. Gaddis, B., Connelly, S. and Mumford, M.D. (2004). Failure feedback as an affective event: Influences of leader effect on subordinate attitudes and performance. *The Leadership Quarterly*.
11. Gehrig, D.R. (2007). Applying traits theory of leadership to project management. *Engineering Management Review.*

12. Goldberg, L.R. (1990). An alternative "description of personality": the big-five factor structure. *Journal of personality and social psychology*.
13. Hautala, T.M. (2006). The relationship between personality and transformational leadership. *Journal of Management Development*,
14. Keegan, A.E. and Den Hartog, D.N. (2004). Transformational leadership in a project-based environment: a comparative study of the leadership styles of project managers and line managers. *International Journal of Project Management*,
15. LeBlanc, D.C. (2008). *The Relationship between Information Technology Project Manager Personality Type And Project Success*.

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IMPACT OF STRESS ON EMPLOYEE PERFORMANCE OF IT PROJECTS IN PAKISTAN

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ABSTRACT

The purpose of this study is to find out the impact of stress on the employees' performance of information technology projects in Pakistan. The sample consists of relevant individuals involved in the information technology projects located in Pakistan. The data was collected through convenience sampling method. Regression and correlation analysis was undertaken to find out the relationship between independent and dependent variables and to find out the impact of stress factors (work load, work environment and work family conflict) on employees' performance of IT projects. The results show that there is a positive and significant impact of work environment on the employees' performance in IT projects of Pakistan. A positive but statistically insignificant impact of work load and an insignificant and a negative impact of work family conflict on employees' performance have also been found in this study. The results reveal that in information technology sector in Pakistan, the concern of employees is just for a good working environment and not the work load or work family conflict. This is because of less job opportunities available in the country. This research is expected to help organizations to adopt strategies to minimize stress on IT employees for their better performance.

KEYWORDS

Stress, Work load, Work environment, Work family conflict, Employee performance, Information technology projects

INTRODUCTION

The biggest challenge faced today by an organization is to keep the performance of its workers high and up to the mark. Smart organizations fully appreciate that unstressed employees are their real asset whose work results in an improved and better performance. So they are concerned about the factors which affect their employee's performance. Stress on Job has been defined in different ways. Essentially, stress occurs when people try to deal with assigned tasks, projects, and obligations but experience difficulty, stress, anxiety and worry in getting desired results. Stress at work is becoming an issue of high importance and priority at organizations both in the developed and developing world. Addressing stress related situations and reducing stress-related concerns at an appropriate time and with an appropriate attention is advantageous to an organization and is the only way to remain competitive at global level.

Modern research indicates that stress impacts workers' performance very badly. Although, a certain level of stress may be desirable to compel a worker to perform well, stress beyond that level may lead to low productivity, in addition to impacting adversely the physical and mental health of the employees. The success and failure of an organization thus entirely depends on its ability and capacity to deal effectively with the stress-related issues of their employees.

The central focus of this research is to carefully highlight the major stress factors (work load, work environment and work family conflict) of employees, especially those working in IT sector of Pakistan, and to explore the implications of these stress factors with regard to the performance and efficiency of employees in terms of higher level of absenteeism, reduced productivity, defective decision making and a high staff turnover. The particular stress is on the identification of stress factors which are most relevant and crucial for employees of information technology projects in current Pakistani conditions. The IT sector of Pakistan has been selected for this study because of its growing importance in national economy and a wide research gap existing in this field in Pakistan.

PURPOSE AND OBJECTIVES

This study examines correlation between stress and employee performance. As indicated, job stress is present at high level in today's challenging work environment and it causes low productivity, loss of physical and emotional health, high rate of absenteeism, low concentration on work, increased work load, and performance degradation. The employee's stress not only affects his/her own work but also damages the temperament, mood, productivity, motivation, social interaction, and quality of life of the co-employees as well. The study measures the effect of three selected stress factors namely 'work load', 'work environment' and 'work family conflict' on employee performance in the IT projects of Pakistan.

THEORETICAL FRAMEWORK

In the light of detailed literature review and the research gap existing in the area, the following theoretical frame work is used for the study.

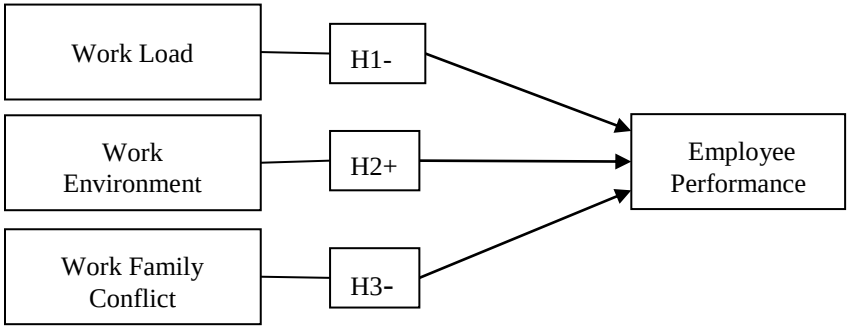

Figure 1: **Theoretical Framework – Impact of stress factors on the employee performance of information technology projects of Pakistan.**

HYPOTHESES

As per the conceptual and theoretical framework, the following hypotheses are tested in the study:

H1: Work load negatively affects the employee performance of the information technology employees in Pakistan.

H2: Work environment positively affects the employee performance of the Information technology employees in Pakistan

H3: Work family conflicts negatively affect the employee performance of the Information technology employees in Pakistan

METHODOLOGY

This study is quantitative and aims to describe the amount of variance in the average level of employee performance as a result of stress factors like work load, work environment and work family conflict in the information technology sector of Pakistan. The study is limited to the information technology projects located in Rawalpindi and Islamabad. As the purpose of this research is to check the critical stress factors with regard to their effect on employee performance, the units of analysis are employees involved in various aspects of information technology projects in Pakistan. Due to unavailability of an authentic sample frame, convenience sampling technique is used for collection of data for the study. Data was collected through questionnaires, floated through electronic media and followed up by personal visits. Two hundred structured questionnaires were distributed among the respondents. Out of these, 101 filled in and useable questionnaires were received back (a response rate of about 50%) which were considered enough for the current study. Data was collected on a five point Likert scale for all variables.

Content and face validity of the instrument were checked by a group of people consisting of IT experts and administrators. Each of experts in the group was asked to ensure validity and reliability of data through thorough examination of the instrument with regard to proper wording, reasonable content, suitable format, clarity in understanding and its overall appearance. Cronbach's alpha was used to assess instrument's internal consistency.

DATA ANALYSIS AND RESULTS:

Appropriate descriptive statistics were calculated for data analysis. Correlation coefficients were calculated and investigated thoroughly with regard to correlation between all variables under study. As for demographic data, out of the total sample, 78% of the respondents were male and 22%female. Most of the respondents, 81% were in the age bracket of below 30, 17% were in the age group of 30-40 and only 2% were in 40-50 age of group. Only 26 % of respondents were married whereas rest of the 74% were singles.

Pearson correlation coefficient was used to measure the strength and statistical significance of the relationship between the variables under study. A correlation matrix (table below) was prepared and examined to investigate multicollinearity. Inter-relations

among the three distinct stress factors revealed that collinearity was not a problem in the case when the stress factors were entered in the regression model. The multiple regression indicated that these three stress factors could explain the variability in the response variable quite well. Suitability of data for multiple regression was assessed by investigating the relationship between the stress factors and the overall employee performance and through study of residuals.

Correlation Coefficients

	Work Load	Work Environment	Work Family Conflict	Employee Performance
Work load	1			
Work Environment	.166	1		
Work family conflict	.518**	.205*	1	
Employee performance	.191	.605**	.110	1

**. *Correlation is significant at the 0.01 level.*

Regression Analysis

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.616[a]	.380	.360	.5463878

a. Predictors: (Constant), work load, work environment, work family conflict.

ANOVA

	Sum of Squares	Df	Mean Square	F	Sig.
Regression	17.717	3	5.906	19.781	.000[b]
Residual	28.958	97	.299		
Total	46.675	100			

a. Dependent Variable: Employee performance

b. Predictors: (Constant), work load, work environment, work family conflict

ANOVA test established the validity and fitness of the regression model which provided a strong reason to the researchers to believe that at least one of the three distinct stress factors, examined simultaneously, was contributing significant predictability for the overall performance of an employee in the IT projects of Pakistan. Results ($F = 19.781$, $p = .000$) show that this model fits very well for the prediction of the response variable.

Regression model summary provided the value of R square as 0.38. R Square = .38 indicates that the fitted regression model with the above said predictors explains 38% of the project to project variation in an employee's average performance in the IT sector of Pakistan.

Coefficients

Variable	Unstandardized Coefficients		Standardized Coefficients		
	B	**Std. Error**	**Beta**	**t**	**Sig.**
(Constant)	-.229	.354		-.646	.520
WL	.163	.115	.134	1.425	.157
WE	.794	.108	.600	7.323	.000
WFC	-.071	.081	-.082	-.870	.386

a. Dependent Variable: Employee performance

b. Predictors: (Constant), work load, work environment, work family conflict

Studying stress factors individually, the work load did not show any significant impact on the employee' performance in IT projects in Pakistan. Although it was hypothesized that this variable has a negative impact on work performance of employees in information technology sector of Pakistan, this turned out to be a positive factor though statistically insignificant. It means that in Pakistani conditions where job opportunities are infrequent, work load is not considered a negative factor or at least it has no relevance for the employees of IT projects at the existing point of time.

A strong and significant relationship, however, exists between work environment and employee performance as shown by the t-statistic and b coefficient of the relevant predictor (Table above). This was as expected as in the prevailing situation, a good working environment, especially for female staff, is crucial for the success of any project and for that matter, for good performance of the workers. This variable is statistically significant at all alpha levels. The relationship between the work family conflict and employee performance is negative as hypothesized but this relationship is not statistically significant. These results show that in information technology sector in Pakistan, the concern of employees is not the work load or work family conflict but their main concern appears to be provision of an appropriate, comfortable and work friendly environment for their work performance and career building. If they get working environment of their choice, they are not going to give any importance to any other factor, including work load and work family conflict.

Consequently, as per the results of the study, the position of the hypotheses tested is as follows:

H_1: Work load negatively affects the overall performance of an employee in the information technology sector of Pakistan...Rejected.

H_2: Work environment positively affects the overall performance of an employee in the information technology sector of Pakistan…Accepted.

H_3: Work family conflict negatively affects the overall performance of an employee in the information technology sector of Pakistan…Rejected.

Regarding first hypothesis, the existing research indicates that work load negatively impacts on the performance of an employee. According to our research, this variable has a positive effect on the performance of an employee in the IT projects of Pakistan although it is statistically insignificant. According to a recent survey in Pakistan, employees both in the public and private sector, have to take work load invariably and in

many organizations, they are considered a liability if they are not able to cope with the given work load, resulting in termination of their services. So, although work load and deadline pressures do increase the stress level of the employees, but they take it positively, at least in the execution of IT related projects of Pakistan.

As far as the second hypothesis is concerned, our study has confirmed that the work environment does have a positive and significant impact on the performance of employees working in the information technology projects of Pakistan. It shows that when workers in a project help each other and exchange positive complements with the colleagues on completion of the given tasks, this leads to the enhancement of work quality. Simultaneously, when the projects offer flexible working hours and take care of their employees appropriately by offering attractive salaries and doling out generously other monetary and non-monetary benefits including professional training and health and safety benefits, the employees tend to work more efficiently and effectively We believe that the performance of employees can be further enhanced by focusing on the factors related to the working conditions in the information technology related projects of Pakistan.

Regarding third hypothesis, a general belief is that work family conflict impacts on an employee's performance negatively and significantly. Interestingly, this study found no significant impact of the work family conflict on employees' performance in the IT sector under study. Although our research has shown a negative effect of work family conflict on the employees' performance, this negative effect has no statistical significance. This means that strong family bindings in Pakistan and adverse employment conditions, don't allow people to bring their family conflicts on their work place and the vice versa. They have learned to separate their professional and personal lives.

CONCLUSION

The stress factor 'work environment' has been established as the most crucial and motivating factor for the performance of an IT employee in Pakistan in the current study. According to our findings, work environment is a deciding factor for the best performance of the employees, and thereby, for the success of any project in IT sector of Pakistan. This is specially the case where the employee is a female. If the work environment is conducive and friendly, the other factors like work load and work family conflicts tend to be lesser stressors, and lose their relevance for the employees. Importantly, when workers of a project support their co-workers and behave friendly, it leads to increased cooperation and coordination, culminating in the enhanced quality of work and output. Likewise, by offering flexible working hours to the employees and taking care of them effectively in terms of provision of good salaries, monetary and non-monetary benefits and taking impressive health and safety measures in all projects, especially in IT related projects, the employees tend to deliver more efficiently and dedicatedly. We can thus conclude that the performance of IT projects of Pakistan can be enhanced by focusing on the factors related to the working conditions of the employees. With regard to work load, it has been found to be a positive factor, though statistically insignificant, in the current study, in contrast to a common belief that this stress factor has a negative impact on the overall performance of an employee. The researchers of this study find this result compatible with existing conditions in the country where the

workers have to save their jobs by confronting work load of any nature and volume. Families do play an important role in individuals work performance but interestingly in Pakistani situation this factor has a non-significant impact. Employees are always concerned about their job and career no matter how little time they have for their families. They are fully aware that their continuity on the projects is conditional to good performance at all costs.

IMPLICATIONS

Project management is a vast field and information technology in Pakistan is on healthy growth.. Project managers need to focus on the key points which can affect the performances of their employees and enhance productivity. This research will show a clear cut extent and nature of relationship of stress factors like work load, work environment and work family conflict with the employee performance. The only limitation of this study is that it is based on convenient sampling and does not cover the entire county. Further, the sample size is comparatively small keeping in view the nature of the study and the variables involved in it.

REFERENCES

1. Leblebici, D. (2012). Impact of workplace quality on employee's productivity: Case study of bank in Turkey. *Journal of Business, Economic & Finance*, 4(1).
2. Tahir, S. and Kaleem, S. (2010). The effect of work-overload on the employee's performance in relation to customer satisfaction: A case of Water & Power Development Authority (WAPDA), Attock, Pakistan.
3. Mehmood, B., Hussain, S., Hannan, A. and Muhammad, N. (2012). The relationship between stress and work performance in an industrial environment of Faisalabad District' *Pakistan Journal of Life & Social Sciences.*
4. Karthik R. (2013). A study on Stress Management in Coromendal Engineering Company Limited, Chennai: Case study. Advances in Management, 6(2).
5. Ali, F., Farooqi, A., Amin, K., Yahya,.K, Idrees, N., Amjad, M., Ikhlaq, M., Noreen, S and Irfan, A. (2006). Effects of Stress on Job Performance. *International Journal of Business and Management Tomorrow*, 1(2).
6. Dar, L., Akmal, A., Naseem, A. and Khan, K. (2011). Impact of Stress on Employees Job Performance in Business Sector of Pakistan. *Global Journal of Management and Business Research*, 11(6) Version 1.0
7. Bashir, U. and Ramay, M. (2010). Impact of Stress on Employees Job Performance: A Study on Banking Sector of Pakistan. *International Journal of Marketing Studies*. 2(1).
8. Jungwee, P. (2007). Work stress and job performance. Statistics Canada — Vol. 7.
9. Sedstrom, O. (2007). Stress and conflict in project management: A mixed research study of a Swedish energy company. *International Project Management.*
10. Vischer, J. (2007). The effects of the physical Environment on job Performance: towards A theoretical model of workspace stress. *International Project Management*, 4(3).

11. Akihito, S. Bakker, A. Demerouti, E. and Petters, M. (2010). Work-family Conflict in Japan: How Job and Home Demands Affect Psychological Distress. *Industrial Health* 48(6), 766-774.
12. Gary, A. Lynda, A. and Daniel, W. (1996). Relationships of Job and Family Involvement, Family Social Support, and Work-Family Conflict with Job and Life Satisfaction. *Journal of Applied Psychology*, 81(4), 411-420.
13. Ali, F. Noreen, H., Karamat, M., Chaudhry, A. Khurram, M., Nadeem, M., Jamshaid, H. and Farman, S. (2011). The Effect of Job Stress and Job Performance on Employee's Commitment. *European Journal of Scientific Research*, 60(2), 285-294.

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COMPARATIVE STUDY FOR CHOOSING RIDGE PARAMETER

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ABSTRACT

Multicollinearity occurs when two or more predictors are linearly related to each other. In this case either OLS estimators do not exist or if exist the associated variances of estimated regression co-efficients are very large, making inferences invalid. Ridge regression is used to counter the effects of multicollinearity. This is done by introducing biasing constant 'k', prime importance in ridge regression analysis.

Ayan Ullah and Maryam Ilyas (2014) proposed some modifications of existing ridge estimatorsk_1–k_{16} by called ridge parameter in the least square objective function. Ridge parameter shrinks the estimates and their variances. Selection and choice of the unknown ridge parameter 'k' is of multiplying them with the factors that make use of Geometric mean and Arithmetic mean of eigen values associated with $(\boldsymbol{X^tX})$ matrix and name resulting estimators as K1G–K16G and K1A–K16A. This study make comparison of existing ridge estimators k_1–k_{16} by multiplying them with the factors that make use of Geometric mean and Arithmetic mean of eigen values associated with $(\boldsymbol{X^tX})$ matrix. The comparative performance of Geometric mean and Arithmetic mean of eigen values was evaluated by Mean Square Error (MSE) using simulated data sets. Data sets considering different levels of collinearity (r), sample size (n), number of predictor (p) and error term variances were generated. It was observed that proposed estimators K1G–K16G outperform K1A–K16A when error terms following normal distribution (σ^2= 0.1, 1) collinearity levels (r) are (i.e. 0.80, 0.90, 0.95) and number of predictors are (i.e. 2, 4).

INTRODUCTION

In regression analysis, usually we consider that the predictors are not linearly related to each other. In practice, there may be some type of relationships among the predictors. In this case the assumption of independence of predictors is no longer valid; violation of this assumption causes the problem of multicollinearity. Regression analysis is most powerful statistical tool that helps in investigating the relationships between response variable and explanatories. Prediction and description mainly depend on the estimated regression coefficients. Least squares method is the mostly used method for estimating the unknown regression coefficients. It gave good estimates only if the assumption of independence of explanatories is valid. The assumptions are that the explanatory variables are independent from each other and this is very difficult to hold in reality. When the purpose is to get more information about the outcome variable, there is need to add more predictors to regression model. By doing so, relationships between these variables occur and the magnitude of these relationships often increases. This type of

linear relationships between the predictors is called the problem of multicollinearity. Chatterjee and Hadi (2006) and Gujarati (2003) highlighted that with the existence of multicollinearity in a data set, two or more explanatories give same or approximately same information. The existence of multicollinearity among explanatories causes many problems. It affects the model's ability to estimate unknown regression coefficients, t-test, computational accuracy, variance of LS estimated regression coefficients, and LS estimated regression coefficients, fitted values and predictions.

In order to overcome the problem of multicollinearity in multiple linear regression model among explanatories, Hoerl and Kennard (1970) suggested ridge regression method instead of OLS method in regression analysis. When explanatories are correlated, then for estimation of regression coefficients ridge regression is a technique that was initially recommended by Hoerl and Kennard.

Multiple linear regression model can be written in matrix form as,

$$\boldsymbol{y} = \boldsymbol{X\beta} + \boldsymbol{\epsilon}, \tag{1.1}$$

y is a vector of dependent variables with order n×1, **X** is matrix of explanatory of order n×p, $\boldsymbol{\beta}$ is a vector of unknown regression coefficients of order p×1 and $\boldsymbol{\epsilon}$ is vector of random errors of order n×1 that are distributed normally whose mean vector is zero while it's covariance matrix is $\sigma^2\mathbf{I}_n$ ($\mathbf{I}_n$is identity matrix of n×n order). The OLS of the regression coefficients $\boldsymbol{\beta}$ is $\widehat{\boldsymbol{\beta}}_{OLS} = (\boldsymbol{X}^t\boldsymbol{X})^{-1}\boldsymbol{X}^t\boldsymbol{y}$, and variance-covariance matrix of $\boldsymbol{\beta}$ is Var $(\widehat{\boldsymbol{\beta}}_{OLS})= \sigma^2(\boldsymbol{X}^t\boldsymbol{X})^{-1}$, both $\widehat{\boldsymbol{\beta}}$ and Var $(\widehat{\boldsymbol{\beta}})$ depend on characteristics of $\boldsymbol{X}^t\boldsymbol{X}$ matrix. If matrix $\boldsymbol{X}^t\boldsymbol{X}$ is near to singular then the variances of ordinary least square (OLS) estimates becomes large. To overcome this difficulty Hoerl and Kennard (1970) discovered RR(Ridge Regression) method and proposed that a small k positive number (≥0) to be added to diagonal of $\boldsymbol{X}^t\boldsymbol{X}$ matrix to counter the effects of multicollinearity.

The most popular method is Ridge regression which was developed by Hoerl and Kennard (1970). Draper and Smith (1981) stated that as a result of multicollinearity, the $\boldsymbol{X}^t\boldsymbol{X}$ matrix is near ill conditioned (singular) that leads to large standard errors for ordinary least squares (OLS) estimates. To solve this problem Hoerl and Kennard (1970) added a positive number (k) to the main diagonal of the matrix $\boldsymbol{X}^t\boldsymbol{X}$ such that the new estimates are,

$$\widehat{\boldsymbol{\beta}}_{\boldsymbol{RR}} = (\boldsymbol{X}^t\boldsymbol{X} + k\mathbf{I}_p)^{-1}\boldsymbol{X}^t\boldsymbol{y},\ k \geq 0 \tag{1.2}$$

This is called an RR estimator. For any positive value of 'k', this gave minimum mean square error (MMSE) as compared to LSE. The 'k' is known as "Ridge" or "biasing" parameter (constant) and will be finding out from data. When k=0, $\widehat{\boldsymbol{\beta}}_{\boldsymbol{RR}}$ becomes the ordinary least square estimates (OLSE) and as 'k' increases more bias is introduced but variance of the regression estimator stabilizes.

Now the MSE of ridge regression that is introduced by Hoerl and Kennard (1970) is defined as:

$$MSE\left(\hat{\beta}(K)\right) = \sigma^2\sum_{i=1}^{p}\frac{\lambda_i}{(\lambda_i+k_i)^2} + \sum_{i=1}^{p}\frac{k^2{}_i\alpha^2{}_i}{(\lambda_i+k_i)^2} \tag{1.3}$$

The 1st term on right hand side of (1.3) is a variance and the second term is an amount of bias, where

$$k_i = \frac{\sigma^2}{\alpha_j^2} \tag{1.4}$$

σ^2 is the variance of the model (1.3) and α_i is i[th] element of α. The unbiased estimator of k_i is,

$$\hat{k}_i = \frac{\hat{\sigma}^2}{\hat{\alpha}^2{}_i} \tag{1.5}$$

where $\hat{\sigma}^2 = \frac{(y-\hat{y})^t (y-\hat{y})}{(n-p-1)}$ is the residual sums of square obtained from the OLS and is an unbiased estimator of σ^2 and $\hat{\alpha}^2{}_i$ is the i[th] elements of $\hat{\alpha}^2$ where $\widehat{\boldsymbol{\alpha}} = \boldsymbol{V}^t\widehat{\boldsymbol{\beta}}$, **V** is orthogonal matrix of order (p×p); the columns of **V** are the normalized eigenvectors of correlation matrix. The MSE of OLS is defined as:

$$MSE(\widehat{\boldsymbol{\beta}}) = variance\ (\widehat{\boldsymbol{\beta}}) + (bias(\widehat{\boldsymbol{\beta}}))^{\mathbf{2}} \tag{1.6}$$

OLS estimators are generally unbiased so the 2[nd] term of right hand side of above equation (1.6) is zero and becomes,

$$MSE(\widehat{\boldsymbol{\beta}}) = variance\ (\widehat{\boldsymbol{\beta}}) \tag{1.7}$$

Many methods for estimation of ridge parameter 'k' have been described by many researchers. In which some well-known existing estimators are following. These estimators make use of the canonical form of regression model.

The canonical form of model (1.3) is (1.8). Consider orthogonal matrix **D** where $\boldsymbol{D}^T\boldsymbol{C}\boldsymbol{D} = \boldsymbol{\Lambda}$, where $\boldsymbol{C} = \boldsymbol{X}^T\boldsymbol{X}$ and $\boldsymbol{\Lambda} = diag(\lambda_1, \lambda_2, \dots, \lambda_p)$ containing eigenvalues 'λ_i' of matrix **C**. Model (1.3) in canonical form is,

$$\boldsymbol{y} = \boldsymbol{X}^*\boldsymbol{\alpha} + \boldsymbol{\epsilon} \tag{1.8}$$

$\boldsymbol{X}^* = \boldsymbol{X}\boldsymbol{D}$ and $= \boldsymbol{D}^T\boldsymbol{\beta}$.

The least square estimators of the canonical form is,

$$\widehat{\boldsymbol{\alpha}} = \boldsymbol{\Delta}^{-1}\boldsymbol{X}^{*T}\boldsymbol{y} \tag{1.9}$$

Ridge estimators in canonical form is

$$\widehat{\boldsymbol{\alpha}}(k) = (\boldsymbol{X}^{*T}\boldsymbol{X}^* + K\boldsymbol{I})^{-1}\boldsymbol{X}^{*T}\boldsymbol{y} \tag{1.10}$$

K = $diag(\lambda_1, \lambda_2, \dots, \lambda_p)$ that is introduce by Hoerl and Kennard (1970). MSE of the above estimators which Hoerl and Kennard defined as:

$$MSE(\hat{\alpha}(k)) = \sigma^2 \sum_{i=1}^{p} \frac{\lambda_i}{(\lambda_i + k_i)^2} + \sum_{i=1}^{p} \frac{k_i{}^2 \alpha_i{}^2}{(\lambda_i + k_i)^2} \tag{1.11}$$

First term on RHS (1.11) is variance and second term is amount of bias.

2. METHODOLOGY

It is evident from the study that multicollinearity is an important phenomenon in regression analysis that cannot be ignored while analysing data. Many researchers made different studies on this topic and it can be further explored. Different researchers have recommended different methods and estimators to overcome the problem of

multicollinearity. In this study, some successful extensions of the existing work have been proposed to deal with multicollinearity problem.

Hoerl and Kennard Estimator

Hoerl and Kennard (1970) explored value of 'k' which minimizing the mean square error (MSE) is the following**:**

$K_1 = \hat{k}_{HK} = \frac{\hat{\sigma}^2}{\hat{\alpha}^2{}_{max}}$ where$\hat{\alpha}^2{}_{max}$ is the square of the maximum value of $\hat{\boldsymbol{\alpha}}$.

Kibria Estimator

Kibria (2003) proposed the following estimators,

$K_2 = \hat{k}_{GM} = \frac{\hat{\sigma}^2}{(\prod_{j=1}^{p} \hat{\alpha}^2{}_j)^{\frac{1}{p}}}$. And $K_3 = \hat{k}_{MED} = Median\{m^2{}_j\}$ Where$m_j = \sqrt{\frac{\hat{\sigma}^2}{\hat{\alpha}^2{}_j}}$

Khalaf and Shukur Estimator

Khalaf and Shukur (2005) proposed a new estimator as a modification of k_{HK}

$K_4 = \hat{k}_{KS} = \frac{t_{max}\hat{\sigma}^2}{(n-p)\hat{\sigma}^2 + t_{max}\hat{\alpha}^2{}_{max}}$

where t_{max} is maximum eigen value of matrix X^tX.

Alkhamisi, Khalaf and Shukur Estimator

Alkhamisi et al. (2006) suggested that,

$K_5 = k_{S3} = \hat{k}^{KS}{}_{max} = \max(s_j)$; $K_6 = \hat{k}^{KS}{}_{md} = \text{med}(s_j)$,

where $s_j = \frac{t_j\hat{\sigma}^2}{(n-p)\hat{\sigma}^2 + t_j\hat{\alpha}^2{}_j}$

Alkhamisi and Shukur Estimator

Alkhamisi and Shukur (2008) suggested the estimators for 'k'as,

$K_7 = k_{KM1} = \hat{k}^{KS}{}_{gm} = (\prod_{j=1}^{p} s_j)^{\frac{1}{p}}$,$K_8 = k_{KM2} = \max\left(\frac{1}{m_j}\right)$,

$K_9 = k_{KM4} = (\prod_{j=1}^{p} \frac{1}{m_j})^{\frac{1}{p}}$, $K_{10} = k_{KM5} = (\prod_{j=1}^{p} m_j)^{\frac{1}{p}}$,

$K_{11} = k_{KM6} = \text{median}\left(\frac{1}{m_j}\right)$, $K_{12} = k_{KM8} = \max\left(\frac{1}{q_j}\right)$,

$K_{13} = k_{KM9} = \max\left(\sqrt{q_j}\right)$, $K_{14} = k_{KM10} = (\prod_{i=1}^{p} \frac{1}{\sqrt{q_j}})^{\frac{1}{p}}$;

$K_{15} = k_{KM11} = (\prod_{i=1}^{p} \sqrt{q_j})^{\frac{1}{p}}$, $K_{16} = k_{KM12} = median\left(\frac{1}{\sqrt{q_j}}\right)$.

where $q_j = \sqrt{\frac{t_{max}\hat{\sigma}^2}{(n-p)\hat{\sigma}^2 + t_{max}\hat{\alpha}^2{}_j}}$

Khalaf, Mansson and Shukur Estimators

Khalaf et al. (2013) proposed modifications of all of the above estimators by multiplying them by a factor,

$w_j = \frac{t_{max}}{\sum_{j=1}^{p} |\hat{\alpha}|_j}$

t_{max} is the maximum eigen value of $\boldsymbol{X}^t\boldsymbol{X}$ matrix. This modification was proposed on the basis that as degree of correlation increases initial eigenvalues are larger than others. Thus, factor w_j will also become larger as it is based on the maximum eigenvalue of $\boldsymbol{X}^t\boldsymbol{X}$ matrix. This will lead to an increase of the estimated value of the ridge parameters 'k'. Hence, this modification leads to larger values of the ridge parameter especially when the degree of correlation is high. The performance of these estimators was good for high collinearity level.

Ayan Ullah and Maryam Ilyas Estimators

Khalaf et al. (2013) proposed modifications by multiplying K_1–K_{16} estimators by a factor w_j which is based on maximum eigen value.

Ayan Ullah and Maryam Ilyas (2014) proposed two new sets of ridge estimators. Which are geometric mean and arithmetic mean of the eigen values associated with $\boldsymbol{X}^t\boldsymbol{X}$ was considered for defining,

$$v_{1j} = \frac{T_{GM}}{\sum_{j=1}^{p}|\hat{\alpha}|_j}$$

$$v_{2j} = \frac{T_{AM}}{\sum_{j=1}^{p}|\hat{\alpha}|_j}$$

Finally, the new set of estimators was defined by multiplying K_1–K_{16} by v_{1j} and v_{2j} and the resulting estimators were denoted by K1G –K16G and K1A –K16A.

The trend of eigen values associated with $\boldsymbol{X}^t\boldsymbol{X}$ matrix was explored and it was identified that for very high multicollinearity (0.95, 0.99) the maximum eigen values is larger than the others, however, as the level of multicollinearity decreases from the said level (0.95, 0.99), the difference between the maximum eigen value and remaining eigen values decreases. Hence, it was expected that some other ridge estimators have potential to be explored in view of this phenomenon.

Thus, instead of using maximum eigen value of $\boldsymbol{X}^t\boldsymbol{X}$ in the numerator of w_j, Geometric mean and Arithmetic mean of eigen values of the $\boldsymbol{X}^t\boldsymbol{X}$ matrix was used. When degree of correlation among repressors were not very high (0.95, 0.99) then there will not be see difference between maximum eigen value and the remaining eigen values so in this situation geometric mean and arithmetic mean was give good results.

This study make comparison between Geometric mean and Arithmetic mean of eigen values associated with $\boldsymbol{X}^t\boldsymbol{X}$ matrix. This study try to make sure that our which estimators are outer perform.

2.2 Mean Square Error (MSE)

The performances of Ridge regression estimators have long being compared making use of MSE. Thus, to explore the competitive performance of the new suggested estimators and existing estimators, MSE was used. MSE is defined as,

$$MSE = \sum_{i=}^{N} \frac{(\hat{\boldsymbol{\beta}}-\boldsymbol{\beta})_i{}^t(\hat{\boldsymbol{\beta}}-\boldsymbol{\beta})_i}{N}$$

$\hat{\beta}$ is the estimator of β obtained from RR orOLS and 'N' is number of replications used in Monte Carlo study.

3. THE MONTE CARLO SIMULATION

Theoretically the proposed and the existing estimators cannot be compared, so simulation studies were designed to explore the performance of the developed and already existing ridge estimators.

Kibria (2003), Gibbons (1981), Wichern and Churchill (1978), McDonald and Galarneau (1975), and many other researchers used the following method to simulate or generate the predictor variables that is;

$$x_{ij} = (1 - r^2)^{\frac{1}{2}} z_{ij} + r z_{ip}; \text{ i = 1, 2, 3...n; j =1, 2, 3...p} \quad (1.12)$$

z_{ij} Are standard normal random variables,'r^2' is level of collinearity between any two explanatories and 'n' is the number of observations. In this study the model that is used is,

$$Y_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \cdots + \beta_p X_{ip} + \varepsilon_i; \text{ i=1, 2, 3 . . . n} \quad (1.13)$$

β_0 is taken to be zero and $\beta_1, \beta_2, \ldots\ldots, \beta_p$ regression coefficients, are considered so that $\sum_j^p \beta_j^2 = 1$. Simulations studies are carried out using programming language R.

4. FACTORS AFFECTING RIDGE ESTIMATORS

Various factors can potentially affect the performance of ridge estimators. These include severity of multicollinearity, sample size, number of explanatory variables, error term variance (normal distribution case) and distributions of error terms. Four levels of multicollinearity between any two repressors were considered as high ($r = 0.80, 0.90$) and very high ($r = 0.95, 0.99$). The variation of sample size and number of explanatories considered as n = 30, 70, 100, 150, 200, 300 and p= 2, 4 respectively. In case of normal error term distribution, the variation of error term variance was considered as σ^2= 0.1, 1.

5. SIMULATION STUDIES

In this study a simulation study have been designed to explore the competitive performance of K1G–K16G andK1A–K16A. The comparisons of these two sets of estimators have been gauged considering different levels of sample size (n=30, 70, 100, 150, 200, 300), number of predictors (p=2, 4), correlation levels (r=0.80, 0.90, 0.95, 0.99) and error terms distributions (N(0,σ^2) with σ^2=1, 0.1.The performances of these estimators have been evaluated making use of Mean Square Error (MSE). Our study compares K1G–K16G and K1A–K16A. The study addresses case is pertaining to the combination of the levels of sample size, number of predictors and correlation levels with normal error terms distribution (σ^2=1, 0.1). The results of the simulation studies are summarized by graphs to make comparative performance of all estimators visible in a particular scenario. The results in terms of the tables and graphs of (r=0.90, 0.99) are maintained as well but are not included in this document to save space. The results of MSE is presented in figures 4.1 (1−4).

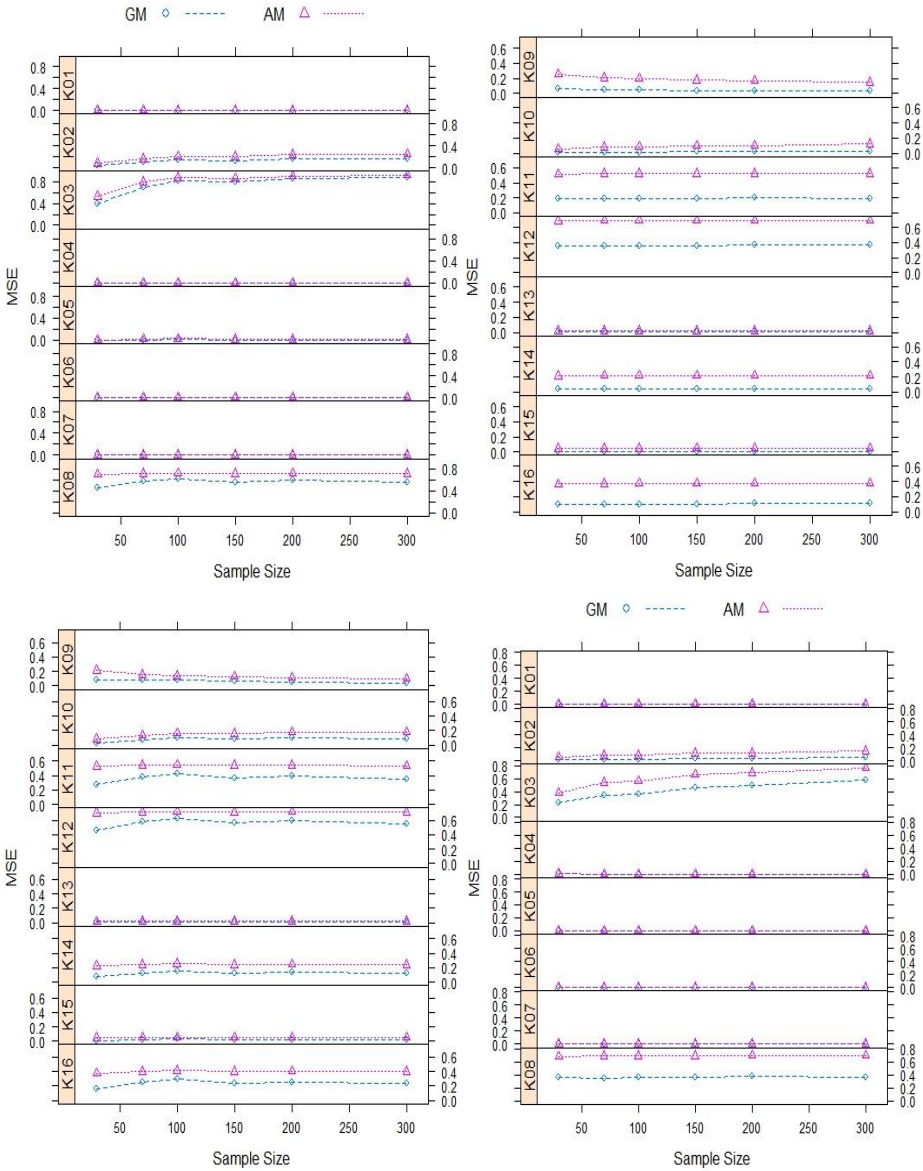

***Figure 4.1 (1).*MSE at p=2 and ε_i~N (0, 0.1). 1st column is the case of r=0.80 and 2nd column is the case of r=0.95.**

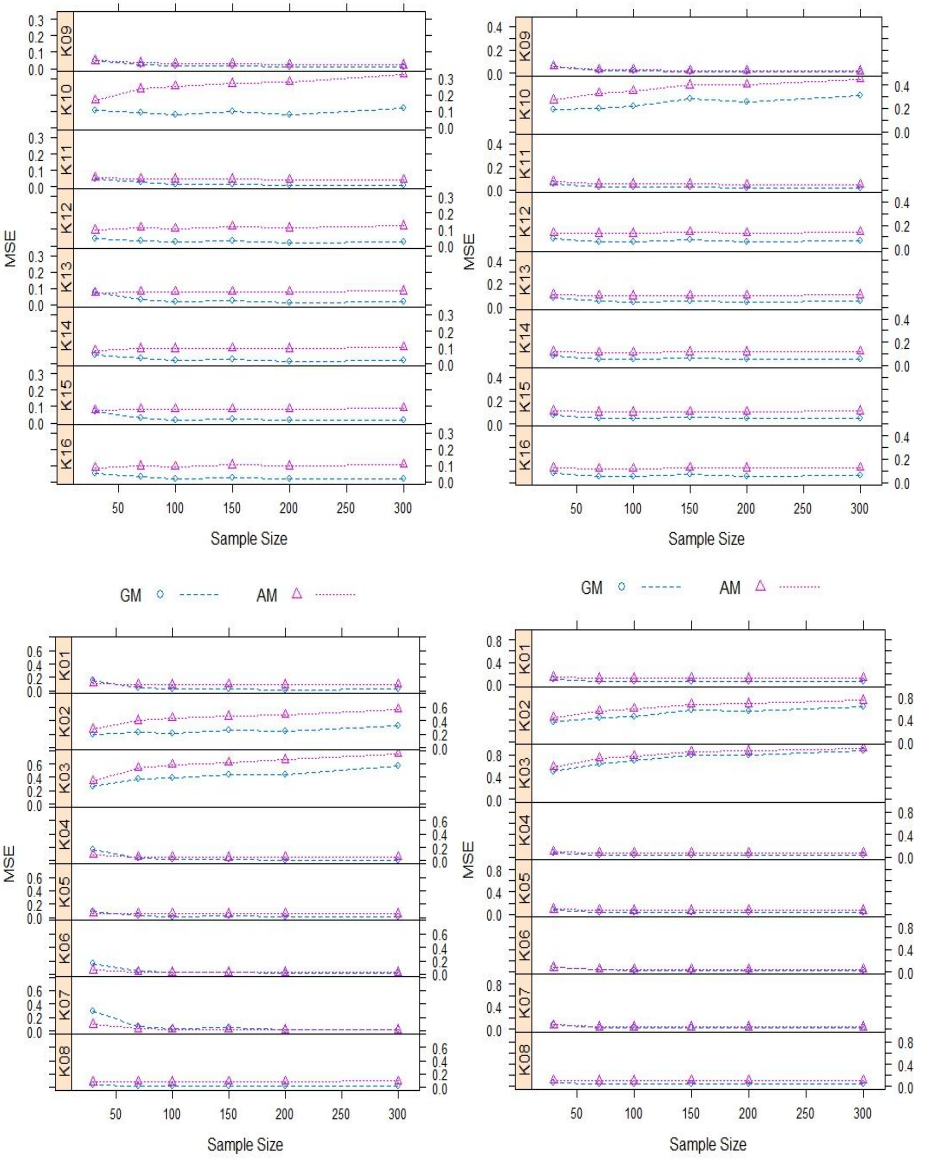

***Figure 4.1 (2).*MSE at p=2 and ε_i~N (0, 1). 1st column is the case of r=0.80 and 2nd column is the case of r=0.95.**

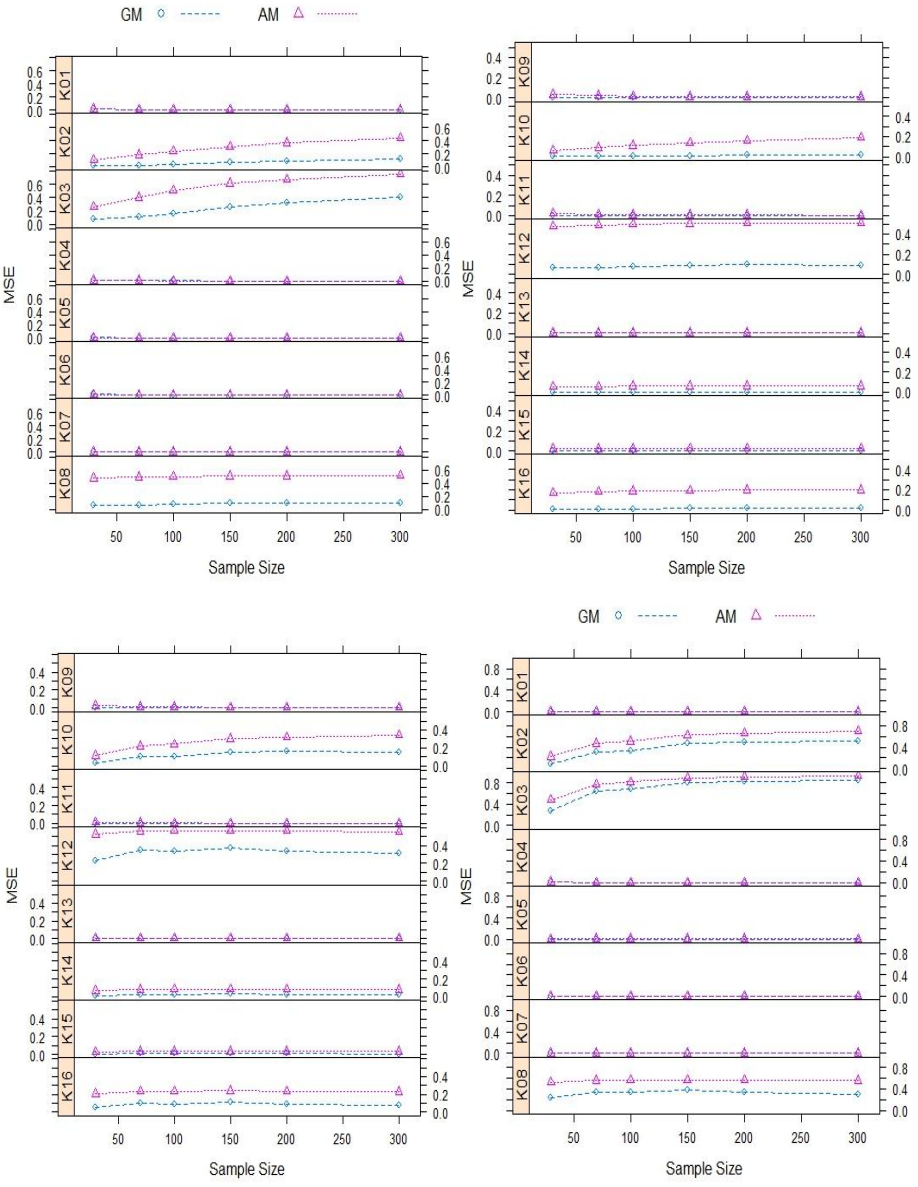

***Figure 4.1 (3).*MSE at p=4 and ε_i~N (0, 0.1). 1st column is the case of r=0.80 and 2nd column is the case of r=0.95.**

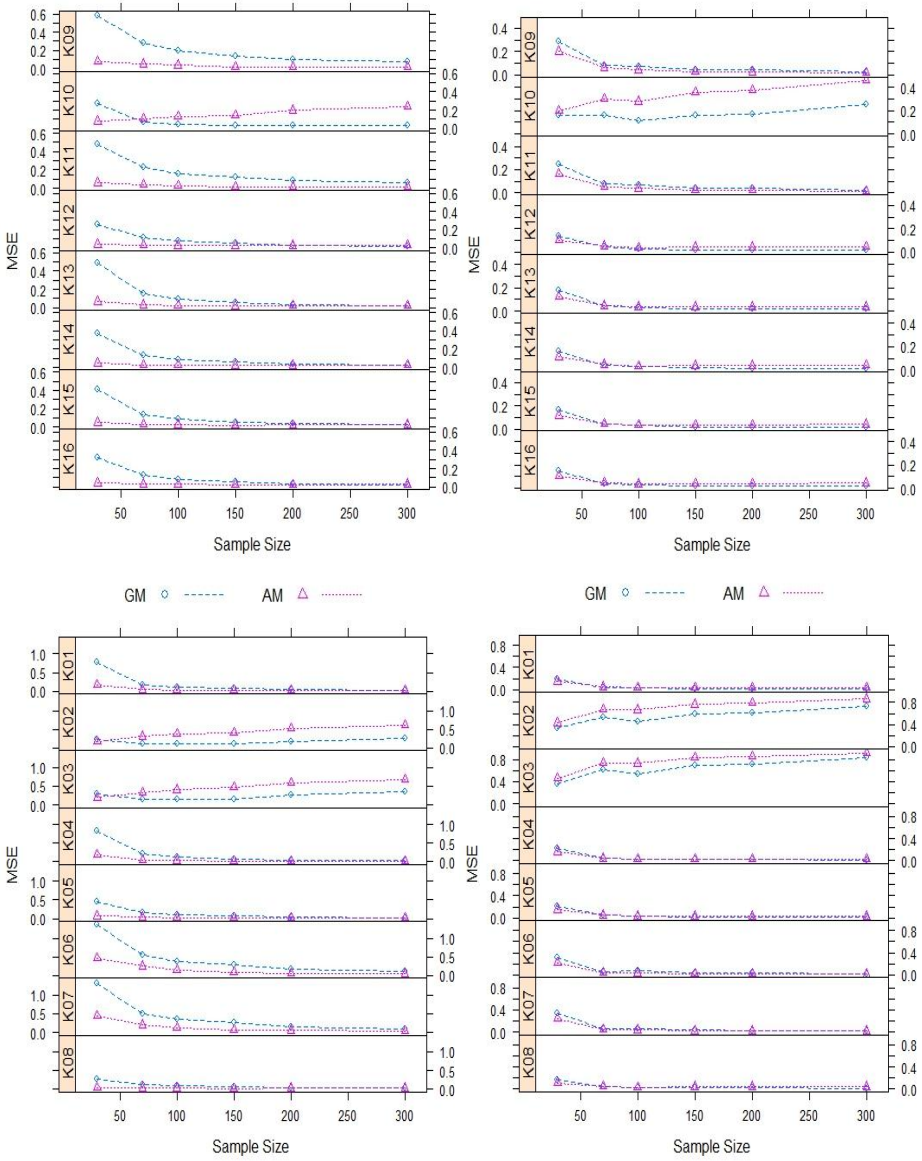

***Figure 4.1 (4).*MSE at p=4 and ε_i~N (0, 1). 1st column is the case of r=0.80 and 2nd column is the case of r=0.95.**

SUMMARY AND CONCLUSIONS

The results of the comparative analysis of set of proposed estimators (K1G–K16G) and (K1A–K16A) indicated that distribution play vital rule. MSEs of all estimator are minimum when error term follow normal distribution (figures (4.1 (1–4))). In case of normal distribution (σ^2=0.1, 1, and p=2, 4) and at all levels of r proposed estimators K1G–K16 Goutperform K1A–K16A. MSE of estimators K2A, K3A, K10A, K11A and K12A are maximum. When p=4 and σ^2=0.1MSE estimators of K2A, K3A, K10A and K12A are maximum. When p=4 and σ^2=1 MSE estimators of K2A, K3A and K10A are maximum.

Thus, it is concluded that our proposed estimators (K1G–K16G) outperform K1A–K16A for collinearity levels (r =0.80, 0.90, 0.95, 0.99), moderate number of predictors (p=2, 4) and error terms following normal distribution (σ^2=1, 0.1). Therefore, it is recommended to use K1G-K16G to deal the cases of high collinearity levels (r=0.80, 0.90, 0.95, 0.99) and moderate number of predictors (p=2, 4) when error terms follow normal distribution with (σ^2=1, 0.1).

REFERENCES

1. Hoerl, A.E. and Kennard, R.W. (1970). Ridge regression: biased estimation for nonorthogonal problems. *Technometrics*, 12, 55-67.
2. Al-Hassan, Y.M. (2008). A Monte Carlo evaluation of some ridge estimators. *Jordan Journal of Applied Science*, 10(2), 101-110.
3. Alkhamisi, M., Khalaf, G. and Shukur, G. (2006). Some modifications for choosing ridge parameters. *Communications in Statistics-Theory and Methods*, 35(11), 2005-2020.
4. Alkhamisi, M.A. and Shukur, G. (2007). A Monte Carlo study of recent ridge parameters. *Communications in Statistics-Simulation and Computation*, 36(3), 535-547.
5. Alkhamisi, M.A. and Shukur, G. (2008). Developing ridge parameters for SUR model. *Communications in Statistics-Theory and Methods*, 37(4), 544-564.
6. Chatterjee, S. and Hadi, A.S. (2006). *Analysis of collinear data: Regression analysis by example* (4th ed.). New Jersey: John Wiley.
7. Chatterjee, S. and Hadi, A.S. (2013). *Regression analysis by example*. New Jersey: John Wiley.
8. Clark, A. and Troskie, C. (2006). Ridge Regression–A Simulation Study. *Communications in Statistics-Simulation and Computation*, 35(3), 605-619.
9. Dempster, A.P., Schatzoff, M. and Wermuth, N. (1977). A simulation study of alternatives to ordinary least squares. *Journal of the American Statistical Association*, 72(357), 77-91.
10. Dorugade, A. and Kashid, D. (2010). Alternative method for choosing ridge parameter for regression. *Applied Mathematical Sciences*, 4(9), 447-456.
11. Epanechnikov, V.A. (1969). Non-parametric estimation of a multivariate probability density. *Theory of Probability & Its Applications*, 14(1), 153-158.
12. Greene, W.H. (2000). *Econometric analysis* (4th ed.). New Jersey: Macmillan.
13. Gujarati, D.N. (1978). *Basic Econometrics* (2nd ed.). New York: McGraw Hill.
14. Gujarati, D.N. (1995). *Basic econometrics* (3rd ed.). New York: McGraw Hill.

15. Gujarati, D.N. and Sangeetha. (2007). *Basic Econometrics*. New Delhi*: Tata McGraw Hill Publishing Company Limited*.
16. Hamed, R., Hefnawy, A.E. and Farag, A. (2013). Selection of the ridge parameter using mathematical programming. *Communications in Statistics-Simulation and Computation* 42(6), 1409-1432.
17. Hefnawy, A.E. and Farag, A. (2014). A Combined nonlinear programming model and Kibria method for choosing ridge parameter regression. *Communications in Statistics-Simulation and Computation* 43(6), 1442-1470.
18. Hoerl, A.E. (1975). Ridge regression: Some simulations. *Communications in Statistics-Theory and Methods*, 4(2), 105-123.
19. Hoerl, A.E. and Kennard, R.W. (1976). Ridge regression iterative estimation of the biasing parameter. *Communications in Statistics-Theory and Methods*, 5(1), 77-88.
20. Hosmer, D.W. and Lemeshow, S. (2004). *Applied logistic regression*. New Jersey: John Wiley.
21. Khalaf, G., Mansoon, K. and Shukur, G. (2013). Modified ridge regression estimators. *Communications in Statistics-Theory and Methods*, 42(8), 1476-1487.
22. Khalaf, G. and Shukur, G. (2005). Choosing ridge parameter for regression problems. *Communications in Statistics-Theory and Methods*, 34, 1177-1182.
23. Kibria, B.G. (2003). Performance of some new ridge regression estimators. *Communications in Statistics-Simulation and Computation*, 32(2), 419-435.
24. Kibria, B.G. (2012). Performance of some logistic ridge regression estimators. *Computational Economics*, 40(4), 401-414.
25. Lawless, J.F. and Wang, P. (1976). A simulation study of ridge and other regression estimators. *Communications in Statistics-Theory and Methods*, 5(4), 122-143.
26. Locking, H, Mansson, G. and Shukur, G. (2013). Ridge estimators for probit regression with an application to labour market data. *Bulletin of Economic Research*, 30(5), 501-513.
27. Månsson, K. and Shukur, G. (2011). On ridge parameters in logistic regression. *Communications in Statistics-Theory and Methods*, 40(18), 3366-3381.
28. Mansson, K. (2010). On some ridge regression estimators: A Monte Carlo simulation study under different error variances. *Journal of Statistics*, 17(1), 1-22.
29. McDonald, G.C. and Galarneau, D.I. (1975). A Monte Carlo evaluation of some ridge-type estimators. *Journal of the American Statistical Association*, 70(350), 407-416.
30. Muniz, G. and Kibria, B.G. (2009). On some ridge regression estimators: An empirical comparisons. *Communications in Statistics-Simulation and Computation*, 38(3), 621-630.
31. Pasha, G. and Shah, M. (2004). Application of ridge regression to multicollinear data. *Journal of research (Science)*, 15(1), 97-106.

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ENERGY MANAGEMENT FOR OPTIMUM PRODUCTIVITY OF ELECTRICITY- A CASE OF PAKISTANI ENERGY SECTOR WITH REFERENCE TO GLOBAL TRENDS

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ABSTRACT

This research addresses call in literature for managing energy resources to enhance productivity in electricity management. The unit of analysis is Pakistan, which is in deficit of electricity production for the last one decade. Pakistan faces the problem of seasonal blackouts for hours in domestic and commercial sectors. Various sources of energy has been explored to overcome the deficiency in the country e.g. thermal, hydro power, nuclear power and renewable energy. This concept paper presents a model for optimum utilization of these sources for the generation of electricity by focusing on SWOT analysis of energy industry in the country. Secondary data from various national and internal sources e.g. World Bank, National Statistical Bureau, United Nations etc. For data analysis various statistical techniques e.g. correlation, frequencies etc. have been applied on the secondary data to dig out the trends. Further research may be done to test the recommended model empirically with advanced statistical techniques.

KEY WORDS

Energy management, electricity production, Pakistan, SWOT Analysis, Model for electricity management

1. INTRODUCTION

Energy is defined as capacity or force available for performing; capacity of matter or radiation to do work activities (Patterson, 1996; Harijan, Uqaili, and Memon 2009). Origin of the word “energy” is “ergon” from Greek language. History of improvement of human lifestyle revolves around the increase in the capacity of energy management. Human beings have developed from Stone Age to industrial era due to its exploitation of energy resources. Human mind has explored the resources to increase the capacity of work done by human beings. Developed countries have efficiently used their resources to produce energy (Dincer, 2000; Harijan, Uqaili, and Memon 2009). In old ages people used man and horse power. But gradually they started using efficient ways of performing activities. For example with the invention of a wheel, people could make a pulley and horse carriages, which are more efficient than just hand power and horseback rides respectively.

In old age there was no concept of electricity. Day light was used efficiently to perform the daily activities. Oil lamps, candles and born fire were used at night time. But with the invention of electricity, it became easier for people to have light bulbs at night time. Further development in the electricity sector provided a lot more innovative electrical devices. The invention of electrical devices such as washing machines, refrigerators, Air conditioners, Televisions etc. improved the living standards at domestic level. In commercial and industrial sectors heavy machineries were invented, which were more efficient. They could produce more products in less time. But with such inventions, consumption of electricity was also increased.

World at large is facing the issues of energy production (Boyle, 2004; Patterson 1996; Dincer 2000). There is a huge demand for the resources such as oil, electricity, gas, coal and other forms of energies (solar energy, wind power and bio mass etc.). It is the current challenge that the world is facing at the moment. Oil, gas and coal are perishable resources. They are gradually depleting (Boyle 2004). Resources' specialists are doing research to find the alternatives of the resources. Environmental scientists around the world are figuring out the solution to the energy resources issues. Some solutions include solar energy, wind power plants, and hydro-electric power plants.

As the demand for electricity increased, demand had to be forecasted and electricity production had to be increased accordingly. Oil, Gas, coal and hydroelectric power stations were used for the production of electricity. It is forecasted that depletion of oil, gas and coal is depleting gradually. Scientists have explored advanced methods of producing electricity which are more efficient. Solar power, nuclear energy, and wind energy are some advanced methods of producing electricity. But these new and advanced methods of production of electricity are more expensive. Developed countries have already adopted these methods of producing electricity. For example Germany is well-known for productions of solar panel (Boyle 2004); Hydro-electric power cars (Harijan, Uqaili, and Memon 2009) etc.

Developing countries cannot afford these expensive methods of producing electricity. Comparative cost studies have shown that hydroelectric power stations are cost effective and efficient method of producing electricity. For this paper, Pakistan is the unit of analysis. Pakistan is considered as a developing country which cannot afford expensive methods of electricity production to meet the demand of the country; therefore hydroelectric power station is the best solution available for it which is one of the cheapest solutions available in energy management (Jeswani, Wehrmeyer and Mulugetta 2008). Building more hydro-electric power stations will produce more electricity to meet the demand of the country. Currently Pakistan is producing electricity, using oil, which is an expensive form of producing electricity. It increases the cost of production and ultimately increases the electricity bills. Hydroelectric power stations will decrease the cost of production, and as a result it will decrease the electricity bills as well.

2. RESEARCH PROBLEM

Blackouts in Pakistan are a prominent problem in Pakistan. Pakistan heavily depends on generators for the power outage, which means that oil is used as an alternative. Oil is a very expensive item. It increases the cost of electricity. According to the article

“Electricity sector in Pakistan", it stated that "Rolling blackouts began nation-wide in Pakistan in early 2008 and continue presently in to 2014. It intensifies in the long summers, with many places around the country having no electricity for 20 hours per day. According to Pakistan Electric Power Company (PEPCO), Pakistan's electricity shortfall is normally 2,500 Megawatts (MW) but reaches around 6,000 MW or more during the summer season. The country's electricity problems are so severe that demonstrations against energy crises takes place occasionally in some regions, including Punjab the country's most populous province.

2.1 Access to Electricity (% of Population)

Access to electricity is the percentage of population with access to electricity. Electrification data are collected from industry, national surveys and international sources. International Energy Agency, World Energy Outlook. (IEA 2014). Catalog Sources World Development Indicators

67% of population has access to electricity, 33% of population does not have a minimum amount of access to electricity. Pakistan needs to need to electricity production about 33% more. If this production is projected for next 10 years then it all accumulates to about at least 50% more production. Because currently Pakistan faces electricity shortage as well. Meeting the current demand, foreseeing the future’s population growth and increasing access of remaining population of the country would accumulated the total demand to increase at least 50 % more for the next 10 years.

2.2 Power theft

Pakistan faces the problem of power theft as well. People use electricity from electric poles. They hang a wire with a hook to electricity power poles. Government is working on this problem, but this is one of the problems Pakistan is facing at the moment.

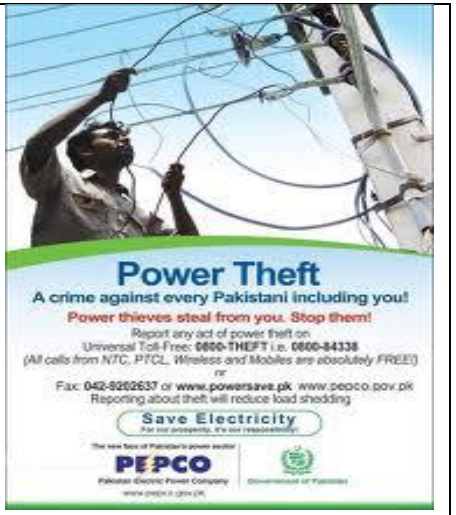

Figure 1: Power theft image

Source: https://encrypted-tbn1.gstatic.com/images?q=tbn:ANd9GcTDj5bvFJNnmvPXh-AD1HF_fKxbawI32wGqwArotb4eYYkSl...

Pakistan is the country being analyzed; currently it is in deficit of electricity production. Pakistan faces the problem of blackouts for hours. The duration of the blackouts increases during summer since, Air conditions consumes a lot of electricity.

2.3 Demand and Supply of electricity in Pakistan

The following figure 1 depicts that demand exceeds the firm supply of electricity in Pakistan. Pakistan is facing deficit in electricity production. Pakistan has a long road to travel in order to meet the demands of the country. Therefore it is recommended that four to five other sources of production of electricity may be utilized. Since Pakistan

is in dire need of electricity production therefore a lot of work need to be done in all the forms of production to meet the demand of our country.

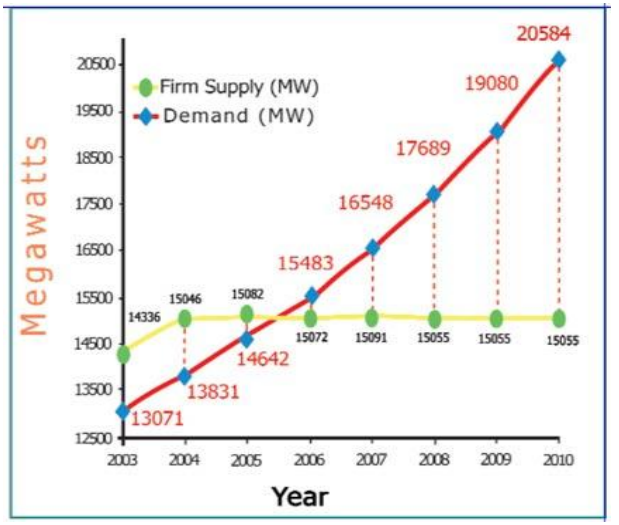

Figure 2: Demand and Supply of Electricity in Pakistan
Source: http://www.ptj.com.pk/2008/04-08/Hafsa-final.htm

Pakistan may focus on producing electricity from other renewable sources and increase its production from existing sources:

i. Hydroelectric power stations
ii. Wind power
iii. nuclear energy
iv. Solar energy

In this paper focus is on hydroelectric power plants. Since, they are very efficient, and comparatively cheaper in cost. They are environment friendly; they do not emit any harmful gases. They convert 90% or energy into electricity. Pakistan is the country of flowing rivers. Therefore there is availability of suitable sites to build hydro electrical power station.

3. SOLUTIONS AND RECOMMENDATIONS

The following comparative figure # 1 depicts that Pakistan heavily depends on oil and gas for the production of electricity. They are very costly means of production. Instead Pakistan may focus on cheaper means of production such as coal, wind energy, nuclear and other renewable sources.

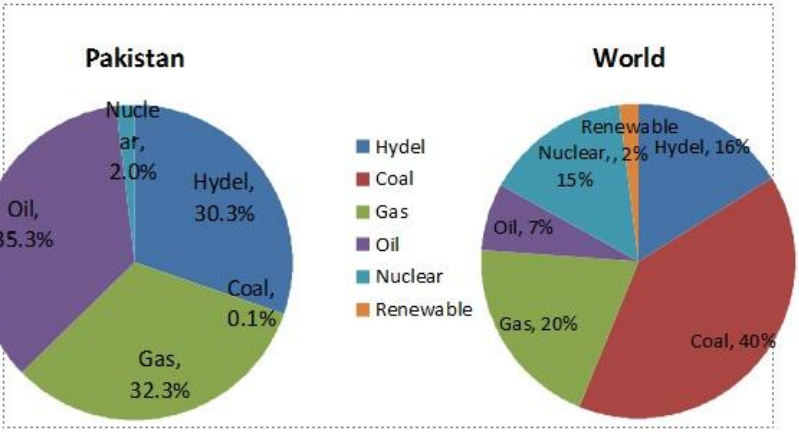

Figure 3: Sources of Production (Pakistan vs the World)
Source: http://ww3.comsats.edu.pk/ciitblogs/BlogsDetailsOuter.aspx?ArticleId=368

3.1 Electricity production from renewable sources (kWh) in Pakistan

Electricity production from renewable sources includes hydropower, geothermal, solar, tides, wind, biomass, and biofuels. Pakistan produced 28,517,000,000 MWh in 2011 from renewable sources. Currently Pakistan needs to produces more electricity from renewable sources. Those sources include:

- Hydroelectric power: Hydropower is an efficient method of generating electricity. Modern hydro turbines can convert as 90% of the available energy into electricity. The best fossil fuel plants are only about 50% efficient. In the U.S., hydropower is produced for an average of 0.85 cents per kilowatt-hour (kwh).This is about 50% the cost of nuclear, 40% the cost of fossil fuel, and 25% the cost of using natural gas. (Wisconsin Valley Improvement Company 2014)
- Wind power: We can easily install wind power plants, but we need proper planning, education and finance to work on this project.
- Solar panels: Solar panels are expensive but if we plan ahead of time and save from efficient use of energy, we can have solar panels as well.
- Biomass: Research is requires for this type of fuel in Pakistan. More awareness is required that this type of electricity production is more efficient and cheaper than the electricity production from oil and gas.
- Bio fuels: Pakistan is producing from Biofuels but it needs to increase its production from this source of production.

3.2 Timeframe for Completion of the demand of electricity production capacity

Pakistan had a total installed power generation capacity of 22,000 MW in 2013. World average per capita electricity Consumption is 2730 kWh compared to Pakistan's per capita electricity consumption of 451 kWh. International Energy Agency has forecast that total electricity demand of the country will be 49,078 MW in 2025. (Source: Wikipedia, the free encyclopedia).Pakistan needs to produce 50,000 MW till 2025. It needs to increase its production capacity to meet the demand of the country. It means that Pakistan may build more power stations in next 10 years to be able to meet the demand of the country.

In addition, following figure 4 shows that Pakistan is increasingly going into electricity deficit. In the five years(2007 to 2011), it has reached from 1000 MW to 5000 MW deficit which means that in next 15 years the deficit will reach to about 20,000MW deficit by the year 2025. Pakistan has to produce about 20,000 MW more by 2025, which is only possible if we have a mixture of sources used for production because such a heavy demand cannot be filled by just one source of production.

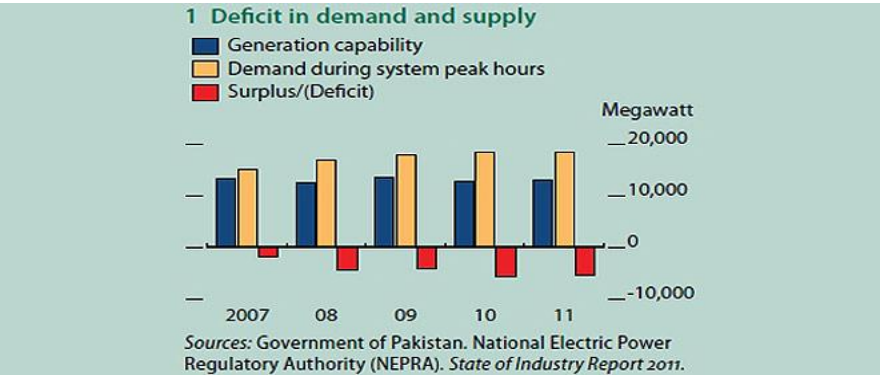

Figure 4: Deficit in Demand and Supply of Pakistan

Pakistan may build Wind power plants, hydroelectric plants (powered by water dams), Nuclear plants, and Geothermal plants in the short term and solar panels plants in the long term. These projects will take about 10 to 15 years.

3.3 Consumption of Electricity by Sectors, Pakistan (1990-91 to 2000-01 Average)

The following figure # 5 shows that the household and industrial sector consumes most of the electricity. Therefore there may be awareness about efficient use of electricity in these sectors. If electricity is used efficiently in household and Industrial sectors, Pakistan can easily save a lot of energy.

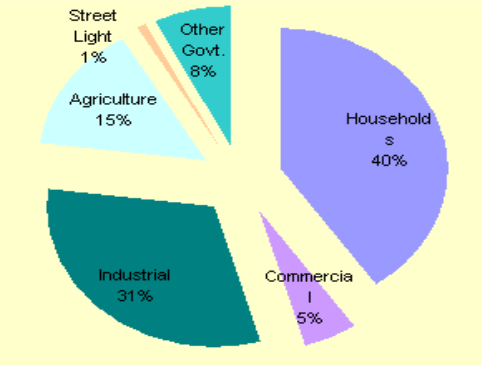

Figure 5: Consumption of electricity by sectors in Pakistan
Source: Population Association of Pakistan accessed at http://www.pap.org.pk/statistics/Resources.htm

Suggested suggestions for doing that are:

a) Using energy efficient lights
b) Switch off lights and fans when not needed.
c) Using day light
d) using sensor lighting system
e) Buildings may have natural ventilation system
f) Windows may be double panned if needed
g) Doors, windows, and roofs may be air sealed
h) Using energy efficient appliances at home and in industrial sectors.

If home appliances are shut down while not in use then up to 6% of energy used in phantom load can be saved.

Energy efficient appliances are expensive but their cost of usage is less, which saves a lot of money.

Following figure 5 shows that Pakistan is highly depending on oil and gas, which is not very efficient. These are costly forms of production. Therefore Pakistan may produce electricity from other sources as well.

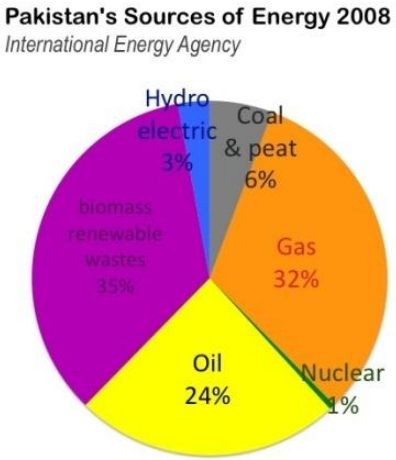

Figure 6: Pakistan's Sources of Energy
Source: http://burnanenergyjournal.com/wp-content/uploads/2011/06/PakistanSourcesEnergy_pie.jpg

4. CONCLUSION

As a summary, it could be concluded that Pakistan's current production does not meet the consumption in Pakistan. There is a need to increase the production by 28,000MW more until 2025. Further, cheaper renewable sources of production may be used to produce for future needs. Our country heavily depends on oil and gas, they are expensive commodity and their prices will increase more in future. We need to produce electricity from other sources as well.

Electricity produced from oil is more expensive. Therefore the electricity produced from oil is less efficient. Comparatively electricity produced from the hydro power, which are water dams. It is less expensive. Therefore it is more efficient as well. Since Pakistan is a developing country therefore Hydro power stations is the best solution available for Pakistan. Since Pakistan is an agricultural country, it has major five rivers along with other rivers and flowing water streams. It has suitable areas for the construction of water dams.

REFERENCES

1. Aqeel, A. and Butt, M.S. (2001). The relationship between energy consumption and economic growth in Pakistan. *Asia-Pacific Development Journal*, 8(2), 101-110.
2. Azam Amjad Chaudhry (2010). A Panel data Analysis of electricity Demand in Pakistan. *The Lahore Journal of Economics*, 15, 75-106.
3. Boyle, G. (2004). *Renewable energy*. Oxford University Press.
4. Byrne, J., Shen, B. and Wallace, W. (1998). The economics of sustainable energy for rural development: a study of renewable energy in rural China. *Energy policy*, 26(1), 45-54.
5. Dincer, I. (2000). Renewable energy and sustainable development: a crucial review. *Renewable and Sustainable Energy Reviews*, 4(2), 157-175.
6. Hafsa Riaz (2008). Energy savings and conservation measures, National Textile University, Faisalabad, Pakistan. <http://www.ptj.com.pk/2008/04-08/Hafsa-final.htm> web. 1st November, 2014.
7. Harijan, K., Uqaili, M.A. and Memon, M. (2009). Renewable energy for managing energy crisis in Pakistan. In *Wireless Networks, Information Processing and Systems* (pp. 449-455). Springer Berlin Heidelberg.
8. Image of "Power theft, A crime against every Pakistani, including you",
9. International Energy Agency (2014). Statistics by Country, IEA Statistics © OECD/IEA, http://www.iea.org/stats/index.asp, 1st November, 2014.
10. Jeswani, H.K., Wehrmeyer, W. and Mulugetta, Y. (2008). How warm is the corporate response to climate change? Evidence from Pakistan and the UK. *Business Strategy and the Environment*, 17(1), 46-60.
11. Patterson, M.G. (1996). What is energy efficiency? Concepts, indicators and methodological issues. *Energy Policy*, 24(5), 377-390.
12. Population Association Pakistan, % Consumption of Electricity by Sector, Pakistan (1990-91 to 2000-01 Average), Economic survey of Pakistan 2001-2002, Economic Advisors Wing, Finance Division, Government of Pakistan, Islamabad. Accessed at <http://www.pap.org.pk/statistics/Resources.htm>, Web. 1st November, 2014.
13. Tribune (2014). Tajikistan plans to boost production to increase exports, Newspaper TRIBUNE International. Online newspaper. 27th March, 2014, accessed on <http://tribune.com.pk/story/687691/power-generation-tajikistan-plans-production-boost-to-increase-exports>
14. Wisconsin Valley Improvements Company (2014). Facts about hydropower, Website by Big Fat Designs LLC. <http://www.wvic.com/Content/Facts_About_Hydropower.cfm>. Web. 1st November, 2014.

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A NEW LIFETIME DISTRIBUTION WITH BATHTUB HAZARD RATE FUNCTION

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ABSTRACT

A new lifetime distribution is being introduced in this paper. The new distribution is quite flexible for analyzing positive data and has a bathtub-shaped hazard rate function. Some basic statistical functions associated with the proposed distribution are obtained. The parameters of the proposed distribution can be estimated by making use of the maximum likelihood approach. This distribution is fitted to model two lifetime data sets. The proposed distribution is shown to provide a better fit than related distributions as measured by two well-known goodness–of–fit statistics. The proposed distribution may serve as a viable alternative to other distributions available in the literature for modeling positive data arising in various fields of scientific investigation such as the physical and biological sciences, reliability theory, hydrology, medicine, meteorology, survival analysis and engineering.

KEYWORDS

Weibull distribution; Transmuted distribution; Exponential–Weibull distribution; Goodness–of–fit statistics; Lifetime data.

1. INTRODUCTION

The Weibull distribution is a popular life time distribution model in reliability engineering. However, this distribution does not have a bathtub or upside–down bathtub–shaped hazard rate function that is why it cannot be utilized to model the life time of certain systems. To overcome this shortcoming, several generalizations of the classical Weibull distribution have been discussed by different authors in recent years. Many authors introduced flexible distributions for modeling complex data and obtaining a better fit. Extensions of the Weibull distribution arisein different areas of research as discussed for instance in Ghitany*et al.* (2005), Nichol and Padgett (2006),Carrasco *et al.* (2007),Zografos and Balakrishnan (2009),Barreto *et al.* (2010), Cordeiro *et al.* (2010), Silva*et al.* (2010), Aryal and Tsokos (2011), Provost*et al.* (2011), Pinho *et al.* (2012), Singla *et al.* (2012), Badmus *et al.* (2013), Cordeiro *et al.* (2013a), Cordeiro *et al.* (2013b), Cordeiro *et al.* (2013c), Cordeiro *et al.* (2013d), Cordeiro and Lemonte (2013), Cordeiro *et al.* (2014a), Cordeiro *et al.* (2014b), Peng and Yan (2014),Saboor *et al.*

(2014a),Saboor *et al.* (2014b),Saboor and Pogány(2014) and Tojeiro *et al.* (2014). Many extended Weibull models have an upside--down bathtub shaped hazard rate, which is the case of the extensions discussed by Jiang and Murthy (1998), Carrasco *et al.* (2008),Nadarajah *et al.* (2011) and Singla *et al.* (2012), among others.

Adding new shape parameters to expand a model into a larger family of distributions to provide significantly skewed and heavy-tails plays a fundamental role in distribution theory. More recently, there has been an increased interest in defining new univariate continuous distributions by introducing additional shape parameters to the baseline model. There has been an increased interest in defining new generators for univariate continuous families of distributions by introducing one or more additional shape parameter(s) to the baseline distribution. This induction of parameter(s) has been proved useful in exploring tail properties and also for improving the goodness-of-fit of the proposed generator family.

In this article, we defined a new family of transmuted exponential Weibull distribution. The main feature of this model is that a transmuted parameter is introduced in the subject distribution which provides greater flexibility in the form of new distributions. Using the quadratic rank transmutation map studied by Shaw*et al.* (2007), we develop the four parameter transmuted exponential Weibull. We provide a comprehensive description of mathematical properties of the subject distribution with the hope that it will attract wider applications in reliability, engineering and in other areas of research. If the baseline distribution has the cumulative density function (cdf) $G(x)$ and pdf $g(x)$, the *transmuted extended* distribution is defined by the cdf and probability density function (pdf) (for $|\alpha| \le 1$).

$$F(x) = (\alpha+1)G(x) - \alpha G(x)^2, \qquad |\alpha| \le 1. \tag{1}$$

Cordeiro *et al.* (2013a) introduced an exponential-Weibull distribution. The cdf and pdf of their distribution are defined as follow:

$$G(x) = 1 - e^{-\lambda x - \beta x^k}\, 1_{\mathbb{R}_+}(x),\ \lambda > 0, \beta > 0\,, 0 < k > \infty\,, \tag{2}$$

and

$$g(x) = \left(\lambda + \beta k\, x^{k-1}\right) \mathrm{e}^{-\lambda x - \beta x^k}\, 1_{\mathbb{R}_+}(x)\,, \tag{3}$$

here and in what follows $1_A(x)$ denotes the indicator function of the set *A*, that is $1_A(x) = 1$ when $x \epsilon A$ and equals 0 else.

We further generalize their model by applying the transmuted technique to equations (2) and (3), which defines the so-called transmuted exponential-Weibull (TEW) distribution.

The cdf and pdf of the transmuted exponential–Weibull distribution, for which $G(x)$ is the baseline cdf, are given by

$$F(x) = (\alpha+1)\left(1-e^{-\lambda x-\beta x^k}\right) - \alpha\left(1-e^{-\lambda x-\beta x^k}\right)^2 1_{\mathbb{R}_+}(x), \tag{4}$$

and

$$f(x) = \frac{\left(\lambda x+\beta k x^k\right)e^{\lambda x+\beta x^k}\left(1-\alpha\right)+2\alpha\right)e^{-2\left(\lambda x+\beta x^k\right)}}{x} 1_{\mathbb{R}_+}(x), \tag{5}$$

here $\lambda > 0, \beta > 0, k > 0, |\alpha| \leq 1$. Accordingly, the four–parameter distribution of the random Variable (rv) X having cdf in the form (4) will signify this correspondence as $X \sim TEW_{\alpha}(\lambda, \beta, k)$. In short, we use TEW as a Transmuted variant of the exponential–Weibull distribution. We note that

$$\lim_{x\to 0} f(x) = \infty \text{ and } \lim_{x\to\infty} f(x) = 0$$

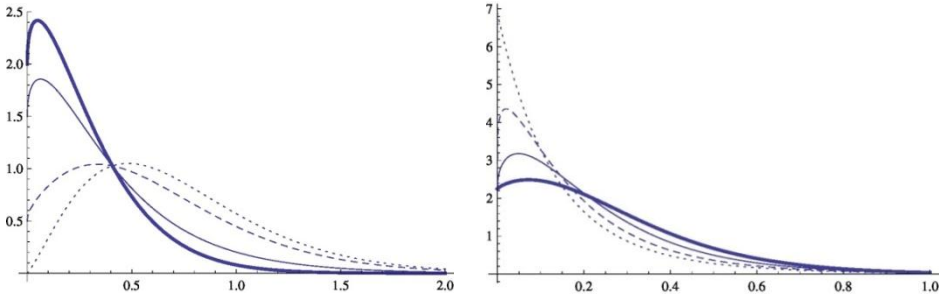

Fig. 1: The TEW pdf.

Left panel: $\lambda = 1,\ \beta = 1.1,\ k = 1.5$ and $\alpha = -1$ (dotted line)
$\alpha = -0.5$ (dashed line), $\alpha = 0.5$ (Solid line), $\alpha = 1$ (thick line).
Right panel: $\lambda = 1.5,\ \beta = 3.1,\ \alpha = 0.5,\ k = 1$ (dotted line),
$k = 1.2$ (dashed line), $k = 1.5$ (Solid line), $k = 1.9$ (thick line).

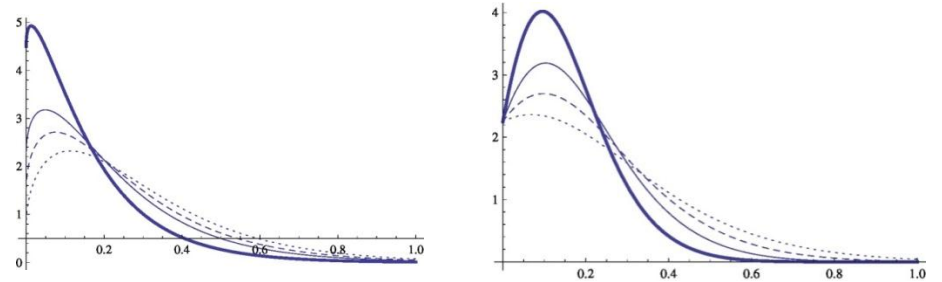

Fig. 2: The TEW pdf.

Left panel: $\alpha = 0.5,\ \beta = 3.1,\ k = 1.5$ and $\lambda = 0.5$ (dotted line),
$\lambda = 1$ (dashed line), $\lambda = 1.5$ (Solid line), $\lambda = 3$ (thick line).
Right panel: $\lambda = 1.5, k = 2,\ \alpha = 0.5,\ \beta = 3$ (dotted line),
$\beta = 5$ (dashed line), $\beta = 8$ (Solid line), $\beta = 14$ (thick line).

The left and right panels of Figure 1 and 2 illustrate that the parameters α, k, λ and β effect the TEW distribution. As seen from left panel of Figure 1, left and right panel of Figure 2, if the pdf increases α, λ and β increase respectively. As seen from right panel of Figure 1, the pdf decreases when k increase.

The structure of the density function (5) can be motivated as it provides more flexible distribution than the standard two parameter Weibull and many other generalized Weibull distributions. Representations of certain statistical functions are provided in Section 2. The parameter estimation technique described in Section 3 is utilized in connection with the modeling of two actual data sets originating from the engineering and biological sciences in Section 4, where the new model is compared with several related distributions.

2. STATISTICAL FUNCTIONS OF TEW DISTRIBUTION

In this section, we derive computable representations of some statistical functions associated with the TEW distribution whose probability density function is specified by (5). The resulting expressions can be evaluated exactly or numerically with symbolic computational packages such as *Mathematica*, *MATLAB* or *Maple*. In numerical applications, infinite sum can be truncated whenever convergence is observed. We now derive closed form representations of the positive, negative and factorial moments of a TEW random variable. Let us begin with the following *Lemma* (Provost *et al*., 2011, Saboor *et al*., 2012).

Lemma1.

For all $\Re(\eta), \Re(\theta), \Re(s) > 0$ *and k is rational number such that* $k = p/q$, *where* p *and* $q \neq 0$ *are integers, we have the following computational representation*

$$\int_0^\infty x^{\eta-1} e^{-\theta x^k} e^{-sx} dx = \frac{(2\pi)^{1-(q+p)/2} q^{1/2} p^{r+1/2}}{(s)^{\eta}} G_{p,q}^{q,p}\left(\left(\frac{p}{s}\right)^p \left(\frac{\theta}{q}\right)^q \middle| \begin{matrix} 1-\frac{i+\eta}{p},\ i=0,1,...,\mathrm{p}-1 \\ j/p \quad j=0,1,...,p-1 \end{matrix} \right) \tag{6}$$

where the symbol $G_{p,q}^{m,n}(.|.)$ *denotes Meijer's G-function (Meijer, 1946). For the definition of the Meijer's G-function, see Appendix A.*

Proof:

Now consider the integral on L.H.S of equation (6)

$$\int_0^\infty x^{\eta-1} e^{-\theta x^k} e^{-sx} dx. \tag{7}$$

First, we shall show that (7) is proportional to $h_1\left(\theta^{1/k}\right)$ where $h_1(.)$ denotes the pdf of the ratio of the random variables X_1 and X_2 whose pdf's are

$$g_1(x_1) = c_1 e^{-x_1^k}, x_1 > 0$$

and

$$g_2(x_2) = c_2 e^{sx_2} x_2^{\eta-2}, x_2 > 0,$$

respectively, c_1 and c_2 being normalizing constants. Let $u = x_1 / x_2$ and $v = x_2$ so that $x_1 = uv$ and $x_2 = v$, the absolute value of the Jacobian of the inverse transformation being v. Thus, the joint pdf of the random variables U and V is $v\, g_1(u\, v)\, g_2(v)$ and the marginal pdf of $U = X_1 / X_2$ is

$$h_1(u) = \int_0^\infty v\, g_1(uv)\, g_2(v)\, dv,$$

that is

$$h_1(u) = c_1 c_2 \int_0^\infty e^{-(uv)^k} v\, v^{\eta-2} e^{-sv} dv,$$

which on letting $u = \theta^{1/k}$ and $v = x$, becomes

$$h_1\left(\theta^{1/k}\right) = c_1 c_2 \int_0^\infty e^{-sx} x^{\eta-1} e^{-\theta x^k} dx. \tag{8}$$

Alternatively, the pdf of X_1 / X_2 can be obtained by means of the inverse Mellin transform technique. The required moments of X_1 and X_2 are given below

$$E\left(X_1^{t-1}\right) = c_1 \int_0^\infty x_1^{t-1} e^{-x_1^k} dx_1 = \frac{c_1}{k} \Gamma(t/k)$$

and

$$E\left(X_2^{1-t}\right) = c_2 \int_0^\infty x_2^{\eta-t-1} e^{-sx_2} dx_2 = c_2 \left(\frac{1}{s}\right)^{\eta-t} \Gamma(\eta - t),$$

provided $\Re(s) > 0$ and $\Re(\eta) > 0$. The inverse Mellin transform of $U = X_1 / X_2$ is then

$$h_1(u) = \frac{c_1 c_2}{k(s)^\eta} \frac{1}{2\pi i} \int_c (u/s)^{-t} \Gamma(t/k) \Gamma(\eta - t)\, dt, \tag{9}$$

where C denotes an appropriate Bromwich path (Meijer, 1946). Thus, (9) can be expressed as follows in terms of an H–function (Mathai and Sexena, 1978):

$$h_1(u) = \frac{c_1 c_2}{k(s)^\eta} H_{1,1}^{1,1}\left(\frac{u}{s}\middle|\begin{matrix}(1-\eta,1)\\(0,1/k)\end{matrix}\right). \tag{10}$$

Since, (8) is equal to (10) when $u = \theta^{1/k}$, then one has

$$\int_0^\infty x^{\eta-1} e^{-\theta x^k} e^{-sx} dx = \frac{1}{k(s)^\eta} H_{1,1}^{1,1}\left(\frac{\theta^{1/k}}{s}\middle|\begin{matrix}(1-\eta,1)\\(0,1/k)\end{matrix}\right). \tag{11}$$

When $k = p/q$, the ratio of two positive integers, the integral on the right–hand side of (9) cane expressed as a Meijer's G-function. Considering $z = t/p$ and making use of the Guass-Legender multiplication formula,

$$\Gamma(r+qz) = (2\pi)^{\frac{1-q}{2}} q^{r+qz-\frac{1}{2}} \prod_{k=0}^{q-1} \Gamma\left(\frac{k+r}{q}+z\right), \tag{12}$$

one has

$$\begin{aligned} h_1(u) &= \frac{c_1 c_2 q}{(s)^{\eta}} \frac{1}{2\pi i} \int_c (u/s)^{-pz} \Gamma(qz)\Gamma(\eta - pz)dz \\ &= \frac{c_1 c_2 q}{(s)^{\eta}} \frac{i}{2\pi i} \int_c (u/s)^{-pz} (2\pi)^{\frac{1-q}{2}+\frac{1-p}{2}} \\ &\quad \times q^{qz-1/2} p^{\eta-pz-1/2} \left\{\prod_{j=0}^{q-1} \Gamma\left(\frac{j}{q}+z\right)\right\}\left\{\prod_{i=0}^{p-1} \Gamma\left(\frac{i+\eta}{p}+z\right)\right\}, \end{aligned}$$

that is

$$\begin{aligned} h_1(u) &= \frac{c_1 c_2 (2\pi)^{1-(p+q)/2} q^{1/2} p^{\eta-1/2}}{(s)^{\eta}} \\ &\quad \times G_{p,q}^{q,p}\left(\left(\frac{up}{s}\right)^p q^{-q} \middle| \begin{matrix} 1-\frac{i+\eta}{p}, i=0,1,...,p-1 \\ j/q, \quad j=0,1,...,q-1 \end{matrix}\right). \end{aligned} \tag{13}$$

which on considering $u = \theta^{p/q} \left(= \theta^{1/k}\right)$, yields

$$h_1\left(\theta^{1/k}\right) = \frac{c_1 c_2 (2\pi)^{1-(p+q)/2} q^{1/2} p^{\eta-1/2}}{(s)^{\eta}} G_{p,q}^{q,p}\left(\left(\frac{p}{s}\right)^p \left(\frac{\theta}{q}\right)^q \middle| \begin{matrix} 1-\frac{i+\eta}{p}, i=0,1,...,p-1 \\ j/q, \quad j=0,1,...,q-1 \end{matrix}\right). \tag{14}$$

Since the expressions in (14) and (8) are equal when $k = p/q$ which gives us (6).

Theorem 1.

Let $X \sim TEW_{\alpha}(\lambda,\beta,k)$. *For all* $\lambda,\beta,k,|\alpha|<1$ *we have the computational representation real* r^{th} *order moment of the TEW distribution whose density function is specified by (5) is*

$$\begin{aligned} E(X^r) &= 2\alpha\lambda \frac{(2\pi)^{1-(p+q)/2} q^{1/2} p^{r+1/2}}{(2\lambda)^{r+1}} \\ &\quad \times G_{p,q}^{q,p}\left(\left(\frac{p}{2\lambda}\right)^p \left(\frac{2\beta}{q}\right)^q \middle| \begin{matrix} 1-\frac{i+r+1}{p}, i=0,1,...,p-1 \\ j/q, \quad j=0,1,...,q-1 \end{matrix}\right) \end{aligned}$$

$$+\lambda(1-\alpha)\frac{(2\pi)^{1-(p+q)/2}\,q^{1/2}\,p^{r+1/2}}{(\lambda)^{r+1}}$$
$$\times G_{p,q}^{q,p}\left(\left(\frac{p}{\lambda}\right)^{p}\left(\frac{\beta}{q}\right)^{q}\middle|\begin{matrix}1-\frac{i+r+1}{p}, i=0,1,...,p-1\\ j/q,\quad j=0,1,...,q-1\end{matrix}\right)$$
$$+k\beta(1-\alpha)\frac{(2\pi)^{1-(p+q)/2}\,q^{1/2}\,p^{r+k-1/2}}{(\lambda)^{r+k}}$$
$$\times G_{p,q}^{q,p}\left(\left(\frac{p}{\lambda}\right)^{p}\left(\frac{\beta}{q}\right)^{q}\middle|\begin{matrix}1-\frac{i+r+k}{p}, i=0,1,...,p-1\\ j/q,\quad j=0,1,...,q-1\end{matrix}\right)$$
$$+2k\alpha\beta\frac{(2\pi)^{1-(p+q)/2}\,q^{1/2}\,p^{r+k-1/2}}{(\lambda)^{r+k}}$$
$$\times G_{p,q}^{q,p}\left(\left(\frac{p}{2\lambda}\right)^{p}\left(\frac{2\beta}{q}\right)^{q}\middle|\begin{matrix}1-\frac{i+r+k}{p}, i=0,1,...,p-1\\ j/q,\quad j=0,1,...,q-1\end{matrix}\right). \tag{15}$$

Proof:

Applying standard formula of real r[th] order moment on (5), we have

$$E\left(\mathrm{X}^{r}\right)=\int_{0}^{\infty}x^{r-1}\left(\lambda x+\beta k x^{k}\right)\left(e^{\lambda x+\beta x^{k}}(1-\alpha)+2\alpha\right)e^{-2\left(\lambda x+\beta x^{k}\right)}dx$$
$$=2\alpha\lambda\int_{0}^{\infty}x^{r}e^{-2\beta x^{k}}e^{-2\lambda x}dx+(1-\alpha)\lambda\int_{0}^{\infty}x^{r}e^{-\beta x^{k}}e^{-\lambda x}dx$$
$$+k\beta(1-\alpha)\int_{0}^{\infty}x^{k+r+1}e^{-\beta x^{k}}e^{-\lambda x}dx+2k\beta\alpha\int_{0}^{\infty}x^{k+r+1}e^{-2\beta x^{k}}e^{-2\lambda x}dx. \tag{16}$$

Using *Lemma* 1 and replacing η with $r+1$, s with 2λ and θ with 2β in the first integrand of first integral, η with $r+1$, s with λ and θ with β in the second integrand, η with $r+k$, s with λ and θ with β in the third integrand and η with $r+k$, s with 2λ and θ with 2β in the fourth integrand of fourth integral on the R.H.S of Equation (16), one obtains (15), which finishes the proof.

Consequently by (15), being $|\alpha|<1$, we conclude

$$EX^{0}\;\big|_{r=0}=1.$$

So the TEW distribution is well defined.

Remark 1:

The h^{th} order negative moment of arv X can readily be determined by replacing r with $-h$ in (15).

Remark 2:

The factorial moments of arv X of the positive integer order $\boldsymbol{N} \in \mathrm{N}$ is

$$EX(X-1)(X-2)...(X-N+1) = \sum_{m=0}^{N-1} \phi_m (-1)^j E\left(X^{N-m}\right).$$

Theorem 2:

Let $X \sim TEW_{\alpha}(\lambda,\beta,k)$. For all $\lambda,\beta,|\alpha|<1$ and k is rational number such $k = p/q$, p and $q \neq 0$ are integers, we have the computational representation the moment generating function of the TEW distribution whose density function is specified by (5) is

$$\begin{aligned}
M(t) = {} & 2\alpha\lambda \frac{(2\pi)^{1-(p+q)/2} q^{1/2} p^{1/2}}{2\lambda - t} \\
& \times G_{p,q}^{q,p}\left(\left(\frac{p}{2\lambda - t}\right)^p \left(\frac{2\beta}{q}\right)^q \middle| \begin{matrix} 1-\frac{i+2}{p}, i = 0,1,...,p-1 \\ j/q, \quad j = 0,1,...,q-1 \end{matrix} \right) \\
& + \lambda(1-\alpha) \frac{(2\pi)^{1-(p+q)/2} q^{1/2} p^{1/2}}{\lambda - t} \\
& \times G_{p,q}^{q,p}\left(\left(\frac{p}{\lambda - t}\right)^p \left(\frac{\beta}{q}\right)^q \middle| \begin{matrix} 1-\frac{i+2}{p}, i = 0,1,...,p-1 \\ j/q, \quad j = 0,1,...,q-1 \end{matrix} \right) \\
& + 2\lambda\beta k \frac{(2\pi)^{1-(p+q)/2} q^{1/2} p^{k-1/2}}{(2\lambda - t)^k} \\
& \times G_{p,q}^{q,p}\left(\left(\frac{p}{2\lambda - t}\right)^p \left(\frac{2\beta}{q}\right)^q \middle| \begin{matrix} 1-\frac{i+k}{p}, i = 0,1,...,p-1 \\ j/q, \quad j = 0,1,...,q-1 \end{matrix} \right) \\
& + k\beta(1-\alpha) \frac{(2\pi)^{1-(p+q)/2} q^{1/2} p^{k-1/2}}{(\lambda - t)^k} \\
& \times G_{p,q}^{q,p}\left(\left(\frac{p}{\lambda - t}\right)^p \left(\frac{\beta}{q}\right)^q \middle| \begin{matrix} 1-\frac{i+k}{p}, i = 0,1,...,p-1 \\ j/q, \quad j = 0,1,...,q-1 \end{matrix} \right).
\end{aligned} \tag{17}$$

Proof:

Bearing in mind the formula of *the moment generating function*, one has

$$M(t)=\int_0^{\infty} e^{tx}x^{-1}\left(\lambda x+\beta k x^{k}\right)\left(e^{\lambda x+\beta x^{k}}(1-\alpha)+2\alpha\right)e^{-2\left(\lambda x+\beta x^{k}\right)}dx$$

$$=\int_0^{\infty} e^{tx}\left(2\lambda\alpha e^{-2(\beta x^{k}+\lambda x)}+(1-\alpha)\lambda\right)e^{-\beta x^{k}-\lambda x}$$

$$+2\alpha\beta k\,x^{k-1}e^{-2(\beta x^{k}+\lambda x)}+\beta k(1-\alpha)x^{k-1}e^{-\beta x^{k}-\lambda x}dx$$

$$=2\alpha\lambda\int_0^{\infty} e^{-2\beta x^{k}}e^{-(2\lambda-t)x}dx+(1-\alpha)\lambda\int_0^{\infty} e^{-\beta x^{k}}e^{-(\lambda-t)x}dx$$

$$+2k\beta\alpha\int_0^{\infty} x^{k-1}e^{-2\beta x^{k}}e^{-(2\lambda-t)x}dx+k\beta(1-\alpha)\int_0^{\infty} x^{k-1}e^{-\beta x^{k}}e^{-(\lambda-t)x}dx. \qquad (18)$$

On replacing η with 1, s with $2\lambda-t$ and θ with 2β in the integrand of first integral, η with 1, s with λ-t and θ with β in the integrand of second integral, η with k, s with $2\lambda-t$ and θ with 2β in the integrand of third integral and η with k, s with λ and θ with β in the integrand of fourth integral and making use of (15), when $k=p/q$, which gives (17).

Here, we will discuss some other significant statistical properties corresponding to (5) i.e. *the mean residue life function, survival function, hazard rate function, mean deviation* and *quantile function.*

Central role is playing in the reliability theory by the quotient of the probability density function and the survival function. The survival function of the TEW distribution whose density function is specified by (5) is

$$S(x)=1-(\alpha+1)\left(1-e^{-\lambda x-\beta x^{k}}\right)-\alpha\left(1-e^{-\lambda x-\beta x^{k}}\right)^{2}1_{\mathbb{R}_+}(x). \qquad (19)$$

The *hazard function* (or also frequently called failure rate function) of the TEW distribution whose density function is specified by (5) is

$$h(x)=\frac{f(x)}{1-F(x)}=\frac{\left(\lambda+\beta k x^{k-1}\right)\left(e^{\lambda x+\beta x^{k}}(1-\alpha)+2\alpha\right)e^{-2\left(\lambda x+\beta x^{k}\right)}}{x\left(\lambda+e^{\lambda x+\beta x^{k}}\left(-1-3\alpha+2e^{\lambda x+\beta x^{k}}(1+\alpha)\right)\right)}1_{\mathbb{R}_+}(x). \qquad (20)$$

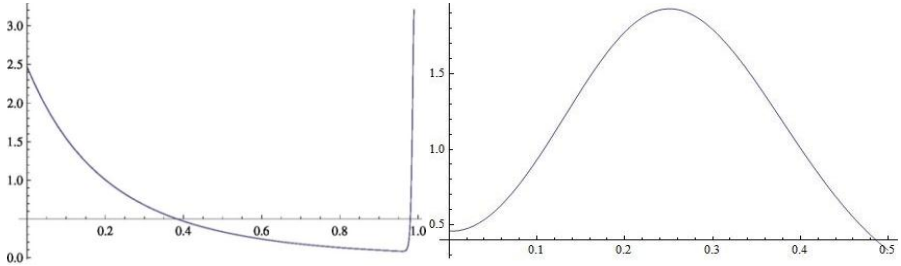

Fig 3: The TEW hazard rate function. Left Panel: λ= 1:3; β= 10; k = 300 and α= 0:9. Right Panel: $\lambda=0.23;\beta=10;k=3;\alpha=1$.

Figure 3 represent the bathtub-shaped and upside-down bathtub-shaped hazard rate functions.

The *mean residue life function* is defined as

$$K(x)=\frac{1}{S(x)}\int_x^{\infty}(y-x)f(y)dy=\frac{1}{S(x)}\int_x^{\infty}yf(y)dy-x$$
$$=\frac{1}{S(x)}\left[E(Y)-\int_0^x yf(y)dy\right]-x,$$

where $S(x)$, $f(y)$ and $E(Y)$ are given in (19), (5) and (15), respectively and

$$\int_0^x yf(y)dy=\int_0^x y\frac{\left(\lambda y+\beta k y^{k-1}\right)\left(e^{\lambda y+\beta y^k}(1-\alpha)+2\alpha\right)e^{-2\left(\lambda y+\beta y^k\right)}}{y}dy$$
$$=\int_0^x y\left(\lambda+\beta k y^{k-1}\right)\left(e^{\lambda y+\beta y^k}(1-\alpha)+2\alpha\right)e^{-2\left(\lambda y+\beta y^k\right)}dy$$
$$=\int_0^x y\left[\left(\lambda+\beta k y^{k-1}\right)e^{\lambda y+\beta y^k}(1-\alpha)\right]dy+\int_0^x y\left[\left(\lambda+\beta k y^{k-1}\right)2\alpha e^{-2\left(\lambda y+\beta y^k\right)}\right]dy.$$

By expending exponential in the last expression, one has the following expression

$$\int_0^x yf(y)dy=(1-\alpha)\sum_{j=0}^{\infty}\frac{(-1)^j\lambda^j}{j!}\int_0^x y\left(\lambda+\beta k y^{k-1}\right)e^{-\beta y^k}dy$$
$$+2\alpha\sum_{j=0}^{\infty}\frac{(-1)^j(2\lambda)^j}{j!}\int_0^x y\left(\lambda+\beta k y^{k-1}\right)e^{-2\beta y^k}dy$$

$$=(1-\alpha)\sum_{j=0}^{\infty}\frac{(-1)^j\lambda^j}{j!}\lambda\int_0^x yG_{0,1}^{1,0}\left(\beta y^{p/q}\Big|_0^-\right)dy$$
$$+\beta\frac{p}{q}\int_0^x y^{p/q}G_{0,1}^{1,0}\left(\beta y^{p/q}\Big|_0^-\right)dy$$
$$+2\alpha\sum_{j=0}^{\infty}\frac{(-1)^j(2\lambda)^j}{j!}\lambda\int_0^x G_{0,1}^{1,0}\left(2\beta y^{p/q}\Big|_0^-\right)dy$$
$$+\beta\frac{p}{q}\int_0^x y^{p/q}G_{0,1}^{1,0}\left(2\beta y^{p/q}\Big|_0^-\right)dy, \qquad (21)$$

where $e^{-g(x)}=G_{0,1}^{1,0}\left(g(x)\Big|_0^-\right)$, $k=p/q$, $p\geq 0$, $q\geq 0$ are natural co-prime numbers and

$$\int_0^x y^t G_{0,1}^{1,0}\left((n+1)\beta y^{p/q}\Big|_0^-\right)dy$$

$$= \frac{q x^{p(t+1)}}{p(2\pi)^{(q-1)/2}} G_{p,p+q}^{q,p}\left(\left(\frac{((n+1)\beta)^q x^p}{q^q}\right)\Bigg|_{0,\frac{-t-1}{p},\frac{t}{p},\ldots\frac{p-t-2}{p}}^{\frac{-t}{p},\frac{1-t}{p},\ldots\frac{p-t-1}{p}} -\right). \quad (22)$$

Equation (21) is obtained by making use of Equation (13) of Cordeiro *et al.* (2013b).

The *mean deviation* about the mean is defined by

$$\delta(x) = \int_0^{\infty} |x - E(X)| f(x)dx = \int_0^{E(X)} (E(X) - x) f(x)dx = \int_{E(X)}^{\infty} (x - E(X)) f(x)dx. \quad (23)$$

where $E(X)$ can be evaluated by letting $r = 1$ in (15). The mean deviation can easily be evaluated by numerical integration.

The *quantile function* is very useful to obtain various mathematical properties of distributions and it is in widespread use in general statistics. For some cases, it is possible to invert the cdf as that one given by (4). However, for some other distributions, the solution is not possible. Power series methods are at the heart of many aspects of applied mathematics and statistics. To obtain the quantile function of X

$$Q_X(p) = \inf\{x \in \mathbb{R} : p \le F(x)\},\ p \in (0,1),$$

we have to invert the equation $F(x) = p$ for some $p \in (0,1)$ with respect to x setting

$$A = 1 - e^{-\lambda x - \beta x^k},$$

the problem reduces to the quadratic equation $\alpha A^2 - (1+\alpha)A + p = 0$. Thus,

$$A_{1,2} = \frac{1+\alpha \pm \sqrt{(1+\alpha)^2 - 4p\alpha}}{2\alpha},$$

that is, we look for an explicit solution $x = Q_X(p)$ from the nonlinear equation

$$1 - e^{-\lambda x - \beta x^k} = A_{1,2}.$$

However, since the left-hand side of this equation is less than one, not both solutions $A_{1,2}$ are satisfactory in this model. Actually, we have the restriction $A < 1$ on the whole range of parameters $\min(\lambda; \beta; k) > 0$ in conjunction with $p \in (0,1)$. Since

$$A_1 - 1 = \frac{1-\eta+\sqrt{(1+\alpha)^2 - 4p\alpha}}{2\alpha} < \frac{1-\alpha+1+\alpha}{2\alpha} = \frac{1}{\alpha},\ \alpha > 0,$$

and

$$A_2 - 1 = \frac{1-\alpha+\sqrt{(1+\alpha)^2 - 4p\alpha}}{2\alpha} < \frac{1-\alpha-(1-\alpha)}{2\alpha} = 0,\ \alpha > 0,$$

we obtain

$$1-e^{-\lambda x-\beta x^k}=A=\frac{1-\alpha-\sqrt{(1+\alpha)^2-4p\alpha}}{2\alpha},$$

where x is the solution of $\lambda x+\beta x^k+\ln(1-A)=0$. Let $\mu=$ of $\lambda x+\beta x^k$. By using Taylor series expansion, one gets $\sum_{j=0}^{\infty}(k)_j(x-1)^j/j!=\sum_{h=0}^{\infty}a_h x^h$ where $a_h=\sum_{h=0}^{\infty}(-1)^{j-h}j!(k)_j/[h!(j-h)!j!]$ and $(k)_j=k(k-1)(k-2)...(k-j+1)$ is the descending factorial. Hence,

$$\mu=\sum_{h=0}^{\infty}b_h x^h,$$

where $b_0=\beta a_0$, $b_1=\beta a_1-+\lambda$ and $b_h=a_h$ for $h\geq 2$. If $b_1\neq 0$, we can invert the last power series and obtain [7, Equation 25.2.60] after elementary, but tedious rearrangements,

$$x=Q(p)=\sum_{h=1}^{\infty}c_h z^h$$

where $c_1=b_1^{-1}$, $c_2=-b_2 b_1^{-3}$, $c_3=\left(2b_2^{\,2}-b_1 b_3\right)b_1^{-5}$, $c_4=\left(5b_1 b_2 b_3-b_1^{\,2}b_2-5b_2^{\,3}\right)b_1^{-7}$ and so on.

3. PARAMETER ESTIMATION

In this section, we will make use of the two parameter gamma (Gamma), two parameter Weibull (Weibull), the gamma exponentiated exponential (GEE) (2012), exponential-Weibull (EW) (2013),extended Weibull (ExtW) (2014), Kumaraswamy modified Weibull (KwMW) (2014) and the TEW distributions to model two well–known real data sets, namely the Carbon fibres (2006) and the Cancer patients(2003) data sets. The parameters of the TEW distribution can be estimated from the maximum log likelihood estimation method of the sample in conjunction with the *N Maximize* command in the symbolic computational package *Mathematica*. Additionally, two goodness-of-fit measures are proposed to compare the density estimates.

3.1 Maximum Likelihood Estimation

In order to estimate the parameters of the proposed TEW distribution as specified by the density function appearing in Equation (5), the log likelihood of the sample is maximized with respect to the parameters by making use of the *N Maximize* command in the symbolic computational package *Mathematica*. Given the data $x_i, i=1,2,...,n$ the log likelihood function is given by

$$\ell(\lambda,\beta,k,\alpha)=\sum_{i=1}^{n}\log\left(2\alpha+(1-\alpha)\,e^{\lambda x_i+\beta x_i^{\,k}}\right)+\sum_{i=1}^{n}\log e^{-2\left(\lambda x_i+\beta x_i^{\,k}\right)}$$
$$+\sum_{i=1}^{n}\log\left(\lambda x_i+\beta k x_i^{\,k}\right)+\sum_{i=1}^{n}\log\left(x_i^{-1}\right). \qquad (23)$$

where $f(x)$ is given in (5). The associated nonlinear likelihood function $\frac{\partial\ell(\theta)}{\partial\theta}=0$ for MLE estimator derivation reads as follow:

$$\frac{\partial\ell(\theta)}{\partial\lambda}=\sum_{i=1}^{n}-2x_i+\sum_{i=1}^{n}\frac{e^{\lambda x_i+\beta x_i^{k}}(\alpha-1)x_i}{e^{\lambda x_i+\beta x_i^{k}}(\alpha-1)+2\alpha}+\sum_{i=1}^{n}\frac{x_i}{\lambda x_i+k\beta x_i^{k}}=0$$

$$\frac{\partial\ell(\theta)}{\partial\beta}=\sum_{i=1}^{n}-2x_i^{\,k}+\sum_{i=1}^{n}\frac{e^{\lambda x_i+\beta x_i^{k}}(\alpha-1)x_i^{\,k}}{e^{\lambda x_i+\beta x_i^{k}}(\alpha-1)+2\alpha}+\sum_{i=1}^{n}\frac{kx_i^{\,k}}{\lambda x_i+k\beta x_i^{k}}=0$$

$$\frac{\partial\ell(\theta)}{\partial k}=\sum_{i=1}^{n}-2\beta x_i^{k}\log(x_i)+\sum_{i=1}^{n}-\frac{(\alpha-1)\beta x_i^{k}\log(x_i)e^{\beta x_i^{k}+\lambda x_i}}{2\alpha-(\alpha-1)e^{\beta x_i^{k}+\lambda x_i}}+\sum_{i=1}^{n}\frac{\beta x_i^{k}+k\beta x_i^{k}\log(x_i)}{k\beta x_i^{k}+\lambda x_i}=0$$

$$\frac{\partial\ell(\theta)}{\partial\alpha}=\sum_{i=1}^{n}\frac{\left(2-e^{\lambda x_i+\beta x_i^{k}}\right)}{\left(e^{\lambda x_i+\beta x_i^{k}}(\alpha-1)+2\alpha\right)}=0. \qquad (24)$$

Solving the above equations simultaneously produce the maximum likelihood estimates of the four parameters. For estimating the parameters, one can use the numerical iterative techniques. The global maxima of the log-likelihood can be investigated by setting different starting values for the parameters. The information matrix will be required for interval estimation. The 4×4 total observed information matrix along with elements $J(\theta)=Jrs(\theta)$ for $r;s=\lambda,\beta,k,\alpha$ are given in Appendix B. Under conditions that are fulfilled for parameters in the interior of the parameter space but not on the boundary, the asymptotic distribution of $\sqrt{n}\left(\hat{\theta}-\theta\right)_{\mathrm{X}}$ is $N_4\left(O,K(\theta)^{-1}\right)$,where $K(\theta)=E\{J(\theta)\}$ is the expected information matrix. The approximate multivariate normal $N_4\left(O,K(\theta)^{-1}\right)$ distribution, where $J(\theta)^{-1}$ is the observed information matrix evaluated at $\theta=\hat{\theta}$, can be used to construct approximate confidence intervals and confidence regions for the individual parameters and for the hazard and survival functions. An asymptotic confidence interval (ACI) with significance level γ for each parameter θ_r is given by

$$ACI\left(\theta_r,100(1-\gamma)\%\right)=\left(\hat{\theta}_r-z_{\gamma/2}\sqrt{\hat{\kappa}^{\theta_r,\theta_r}},\hat{\theta}_r+z_{\gamma/2}\sqrt{\hat{\kappa}^{\theta_r,\theta_r}}\right),$$

where $\hat{\kappa}^{\theta_r,\theta_r}$ is the rth diagonal element of $J(\theta)^{-1}$ estimated at $\hat{\theta}$ and $z_{\gamma/2}$ is the quantile $1-\gamma/2$ of the standard normal distribution.

3.2 Goodness-of-Fit Statistics

The Anderson-Darling test statistics (Anderson and Darling, 1952) and Cramér-von-Mises test statistics (Cramér, 1928 and Von-Mises, 1928) are widely utilized to determine how closely a specific distribution whose associated cumulative distribution function denoted by cdf $(\cdot)$ fits the empirical distribution associated with a given data set. The smaller these statistics are, the better the fit. Upper tail percentiles of the asymptotic distributions of these goodness–of–fit statistics were tabulated in Stephens (1976).

4. APPLICATION

In this section, we present two applications where the TEW model is compared with other related models, namely two parameter gamma (Gamma), the two parameter Weibull (Weibull), the gamma exponentiated exponential (GEE) (2012), exponential-Weibull (EW) (2013), extended Weibull(ExtW) (2014) and Kumaraswamy modified Weibull (KwMW) (2014) distributions. We make use of two data sets: first, the Carbon fibres data set (2006) and, secondly, the Cancer patients data set (2003).

- The classical gamma (Gamma) distribution with density function

$$f(x)=\frac{x^{\xi-1}e^{-x/\phi}}{\phi^{\xi}\Gamma(\xi)},\ x>0,\xi>0,\phi>0$$

- The classical Weibull (Weibull) distribution with density function

$$f(x)=\frac{k}{\lambda}\left(\frac{x}{\lambda}\right)^{k-1}e^{-(x/\lambda)^{k}},\ x>0,k>0,\lambda>0.$$

- The gamma exponentiated exponential (GEE, 2012) distribution with density function

$$f(x)=\frac{\lambda\alpha^{\delta}\left(1-\mathrm{e}^{-\lambda x}\right)^{\alpha-1}\left(-\log\left(1-\mathrm{e}^{-\lambda x}\right)\right)^{\delta-1}}{\Gamma(\delta)},\ x,\lambda,\alpha,\delta>0.$$

- The exponential-Weibull (EW, 2013) distribution with density function

$$f(x)=\left(\lambda+\beta k x^{k-1}\right)\mathrm{e}^{-\lambda x-\beta x^{k}},\ x,\lambda,\beta,k>0.$$

- The extended Weibull (EW, 2014) distribution with density function

$$f(x)=a\left(\mathrm{c}+\mathrm{b}\,x\right)x^{b-2}e^{-c/x-ax^{b}e^{-c/x}},\ x,a,b>0,c\geq 0.$$

- The Kumarswamy modified Weibull (KwMW, 2014) distribution with density function

$$f(x)=ab\alpha x^{\gamma-1}\left(\gamma+\lambda x\right)\exp\left(\lambda x-\alpha x^{\gamma}\,\mathrm{e}^{\lambda x}\right)\left(1-\exp\left(-\alpha x^{\gamma}\,\mathrm{e}^{\lambda x}\right)\right)^{\alpha-1}$$
$$\times\left(1-\left(1-\exp\left(-\alpha x^{\gamma}\,\mathrm{e}^{\lambda x}\right)\right)^{\alpha}\right)^{b-1},\ x,a,b,\gamma,\alpha>0,\lambda\geq 0.$$

4.1. The Carbon Fibres Data Set

We shall consider the uncensored real data set on the breaking stress of carbon fibres (in Gba) as reported in [6]. The data are (n = 66): 3.70, 2.74, 2.73, 2.50, 3.60, 3.11, 3.27, 2.87, 1.47, 3.11, 3.56, 4.42, 2.41, 3.19, 3.22, 1.69, 3.28, 3.09, 1.87, 3.15, 4.90, 1.57, 2.67, 2.93, 3.22, 3.39, 2.81, 4.20, 3.33, 2.55, 3.31, 3.31, 2.85, 1.25, 4.38, 1.84, 0.39, 3.68, 2.48, 0.85, 1.61, 2.79, 4.70, 2.03, 1.89, 2.88, 2.82, 2.05, 3.65, 3.75, 2.43, 2.95, 2.97, 3.39, 2.96, 2.35, 2.55, 2.59, 2.03, 1.61, 2.12, 3.15, 1.08, 2.56, 1.80, 2.53.

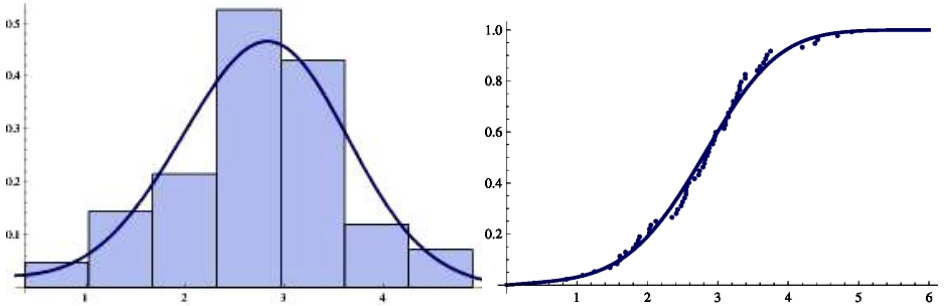

Fig. 4: Left Panel: The TEW Density Estimates Superimposed on the Histogram for Carbon Fibres Data.

Right Panel: The TEW cdf Estimates and Empirical cdf.

Table 1
Estimates of Parameters (Standard Errors in Parenthesis) and Goodness-of-Fit Statistics for Carbon Fibres Data

Distributions	Estimates					A_0^2	W_0^2
Gamma (ξ, ϕ)	7.48803 (1.27552)	0.368528 (0.0649272)	--	--	--	1.32674	0.248153
Weibull (k, λ)	3.4412 (0.330936)	47.0505 (20.1189)	--	--	--	0.49167	0.084301
GEE $(\lambda, \alpha, \delta)$	0.26555 (0.216206)	10.0365 (2.59504)	7.23658 (7.05288)	--	--	1.43415	0.266823
EW (k, λ, β)	3.73666 (0.445755)	0.0170948 (0.0213386)	0.0140172 (0.00845419)	--	--	0.40364	0.06479
ExtW (a, b, c)	16.1979 (25.7118)	1×10^{-7} (0.938764)	8.05671 (1.65309)	--	--	2.26745	0.416152
KwMW $(\alpha, \gamma, \lambda, a, b)$	0.14981 (0.326517)	1.7994 (2.40813)	0.49987 (0.616749)	0.64975 (1.13328)	0.17111 (0.529126)	1.29338	0.213215
TEW $(\lambda, \beta, k, \alpha)$	0.012974 (0.0137694)	0.005819 (0.00397957)	4.111803 (0.506705)	0.672444 (0.371294)	--	**0.33372**	**0.05325**

4.2. The Cancer Patients Data Set

The second data set represents the remission times (in months) of a random sample of 128bladder cancer patients as reported in [15]. The data are 0.08, 2.09, 3.48, 4.87, 6.94, 8.66, 13.11,23.63, 0.20, 2.23, 3.52, 4.98, 6.97, 9.02, 13.29, 0.40, 2.26, 3.57, 5.06, 7.09, 9.22, 13.80, 25.74,0.50, 2.46, 3.64, 5.09, 7.26, 9.47, 14.24, 25.82, 0.51, 2.54, 3.70, 5.17, 7.28, 9.74, 14.76, 26.31,0.81, 2.62, 3.82, 5.32, 7.32, 10.06, 14.77, 32.15, 2.64, 3.88, 5.32, 7.39, 10.34, 14.83, 34.26, 0.90, 2.69, 4.18, 5.34, 7.59, 10.66, 15.96, 36.66, 1.05, 2.69, 4.23, 5.41, 7.62, 10.75, 16.62, 43.01,1.19, 2.75, 4.26, 5.41, 7.63, 17.12, 46.12, 1.26, 2.83, 4.33, 5.49, 7.66, 11.25, 17.14, 79.05, 1.35,2.87, 5.62, 7.87, 11.64, 17.36, 1.40, 3.02, 4.34, 5.71, 7.93, 11.79, 18.10, 1.46, 4.40, 5.85, 8.26,11.98, 19.13, 1.76, 3.25, 4.50, 6.25, 8.37, 12.02, 2.02, 3.31, 4.51, 6.54, 8.53, 12.03, 20.28, 2.02,3.36, 6.76, 12.07, 21.73, 2.07, 3.36, 6.93, 8.65, 12.63, 22.69.

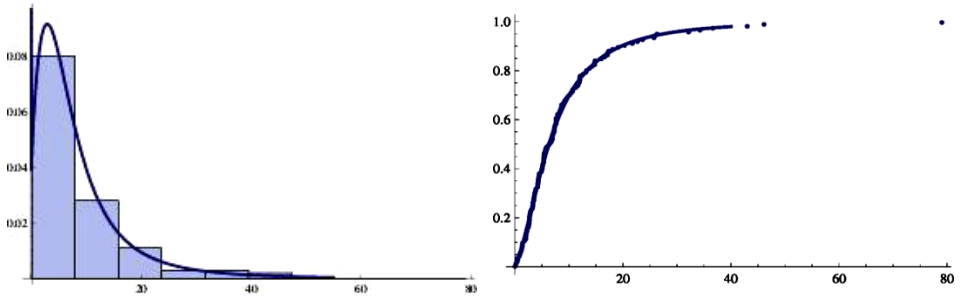

Fig. 5: Left Panel: The TEW Density Estimates Superimposed on the Histogram for Cancer Patients data.
Right panel: The TEW cdf Estimates and Empirical cdf.

Table 2
Estimates of Parameters (Standard Errors in Parenthesis) and Goodness-of-Fit Statistics for Bladder Cancer Patients Data

Distributions	Estimates					A_0^2	W_0^2
Gamma (ξ, ϕ)	1.17251 (0.245079)	7.98766 (0.895546)	--	--	--	0.77625	0.136063
Weibull (k, λ)	1.04783 (0.0675775)	10.651 (2.16445)	--	--	--	0.96345	0.154303
GEE $(\lambda, \alpha, \delta)$	0.121167 (0.106783)	1.21795 (0.187678)	1.00156 (0.865881)	--	--	0.71819	0.128403
EW (k, λ, β)	1.04783 (0.314243)	1×10^{-7} (0.301314)	0.0938877 (0.117931)	--	--	0.96345	0.154303
ExtW (a,b,c)	1.9621 (0.708999)	1×10^{-21} (0.138443)	3.74383 (0.389542)	--	--	13.3317	2.49818
KwMW $(\alpha, \gamma, \lambda, a, b)$	0.639622 (0.116828)	0.381865 (0.064379)	0.029602 (0.00458728)	0.322842 (0.0763509)	0.37499 (0.0594068)	18.8864	3.68568
TEW $(\lambda, \beta, k, \alpha)$	1.087×10^{-10} (0.0784429)	0.047836 (0.0721666)	1.133310 (0.144136)	0.744922 (0.202475)	--	**0.56339**	**0.08825**

5. DISCUSSION

There has been a growing interest among statisticians and applied researchers in constructing flexible lifetime models in order to improve the modeling of survival data. As a result, significant progress has been made towards the generalization of some well–known lifetime models, which have been successfully applied to problems arising in several areas of research. In particular, several authors proposed new distributions that are based on the traditional Weibull model. In this paper, we introduce a four–parameter distribution which is obtained by applying the transmuted technique to the exponential–Weibull model. Interestingly, our proposed model has bathtub-shaped hazard rate function. We studied some of its mathematical and statistical properties. We also provided a computable representation of the positive and negative moments, the factorial moments, the moment generating function, the mean residue life function and the mean deviation. The proposed distribution was applied to two data sets and shown to provide a better fit than other related models. The distributional results developed in this article should find numerous applications in the physical and biological sciences, reliability theory, hydrology, medicine, meteorology and engineering and survival analysis.

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REFERENCES

1. Anderson, T.W. and Darling, D.A. (1952). Asymptotic theory of certain "goodness-of-fit" criteria based on stochastic processes. *Annals of Mathematical Statistics*, 23, 193-212.
2. Aryal, G.R. and Tsokos, C.P. (2011). Transmuted Weibull distribution: a generalization of the Weibull probability distribution. *Euro. J. Pure Appl. Math.*, 4, 89-102.
3. Badmus, N.I., Ikegwu and Emmanuel, M. (2013). The beta-weighted Weibull distribution: some properties and application to bladder cancer data, *J. Appl. Computat. Math.*, 2(145) [cited 2013 Nov 25]. Available from: DOI: 10.4172/2168-9679.1000145.
4. Barreto-Souza, W., Morais, A.L. and Cordeiro, G.M. (2010). The Weibull-Geometric distribution. *J. Statist.Comput. Simul.*, 60, 35-42.
5. Carrasco, J.M.F., Edwin, M.M. Ortega and Cordeiro, G.M. (2008). A generalized modified Weibull distribution for lifetime modeling. *Comput. Stat. Data Anal.*, 53, 450-462.
6. Cordeiro, G.M., Edwin, M.M. Ortega and Cunha, D.C.C. (2013). The exponentiated generalized class of distributions. *J. Data Sci.*, 11, 1-27.
7. Cordeiro, G.M., Edwin, M.M. Ortega, and Lemonte, A.J. (2013). The exponential-Weibull lifetime distribution. *J. Statist. Comput. Simulation.* [cited 2013 May 14]. Available from: DOI: 10.1080/00949655.2013.797982.

8. Cordeiro, G.M., Hashimoto, E.M., Edwin and M.M. Ortega. (2014) .The McDonald Weibull model. *Statistics: A Journal of Theoretical and Applied Statistics*, 48, 256-278.
9. Cordeiro, G.M. and Lemonte, A.J. (2013). On the Marshall-Olkin extended Weibull distribution. *Stat. Papers*, 54, 333-353.
10. Cordeiro, G.M., Edwin, M.M. Ortega and Nadarajah, S. (2010). The Kumaraswamy Weibull distribution with application to failure data. *J. Franklin Inst.*, 347, 1399-1429.
11. Cordeiro, G.M., Edwin, M.M. Ortega and Silva, G.O. (2014). The Kumaraswamy modified Weibull distribution: theory and applications. *J. Statist.Comput. Simulation*, 84, 1387-1411.
12. Cordeiro, G.M., Gomes, A.E., da-Silva, C.Q. and Edwin, M.M. Ortega (2013). The beta exponentiated Weibull distribution. *J. Statist.Comput. Simulation*, 83(1), 114-138.
13. Cordeiro, G.M., Silva, G.O. and Edwin, M.M. Ortega (2013). The beta–Weibull geometric distribution. *Statistics: A Journal of Theoretical and Applied Statistics*, 47, 817-834.
14. Cramér, H. (1928). On the Composition of Elementary Errors. *Scandinavian Actuarial Journal*, 11, 141-180.
15. Ghitany, M.E., Al-Hussaini, E.K. and Al-Jarallah, R.A. (2005). Marshall-Olkin extended Weibull distribution and itsapplication to censored data. *J. Appl. Statist.*, 32, 1025-1034.
16. Jiang, R. and Murthy, D.N.P. (1998). Mixture of Weibull distributions–parametric characterization of failure rate function. *Appl. Stoch. Models and Data Anal.*, 14, 47-65.
17. Lee, E. and Wang, J. (2003). *Statistical Methods for Survival Data Analysis*. Wiley & Sons, New York.
18. Luke, Y.L. (1969). *The Special Functions and Their Approximation*, Vol. I, Academic Press, New York & London.
19. Mathai, A.M. and Saxena, R.K. (1978). *The H–function with Applications in Statistics and Other Disciplines*, Wiley–Halsted Press, New York.
20. Meijer, C.S. (1946). On the *G*-function I–VIII, Proc. Kon. Ned. Akad. Wet., 49, 227-237, 344-356, 457-469,632-641, 765-772, 936-943, 1063-1072, 1165-1175.
21. Nadarajah, S., Cordeiro, G.M., Edwin, M.M. Ortega (2011). General results for the beta–modified Weibull distribution. *J. Statist. Comput. Simulation.*, 81, 121-132.
22. Nichols, M.D. and Padgett, W.J. (2006). A bootstrap control chart for Weibull percentiles. *Qual. Reliab. Eng. Int.*, 22, 141-151.
23. Peng, X. and Yan, Z. (2014). Estimation and application for a new extended Weibull distribution. *Reliable. Eng. Syst. Safe.*, 121, 34-42.
24. Pinho, L.G.B., Cordeioro, G.M. and Nobre, J.S. (2012). The gamma–exponentiated Weibull distribution. *Journal of Statistical Theory and Applications*, 11, 379-395.
25. Provost, S.B., Saboor, A. and Ahmad, M. (2011). The gamma–Weibull distribution. *Pak. J. Statist.*, 27, 111-113.
26. Saboor, A., Khan, A. and Mubeen, S. (2014). A ψ_2 hypergeometric generalized inverse Gaussian distribution. *Bothalia*, 44(8) *to Appear*.

27. Saboor, A., Khan, M.N., Kamal., M. and Mubeen, S. (2014). The Modified Beta Exponential–Weibull Distribution. *Bothalia*, 44(8), 36-50.
28. Saboor, A., and Pogány, T.K. (2014). Marshall–Olkin Gamma–Weibull Distribution with Application. *Commun. in Statist.: Theo. and Meth.*, to Appear.
29. Ristić, M.M. and Balakrishnan, N. (2012). The gamma–exponentiated exponential distribution. *J. Statist. Comput., Simul.*, 82(8), 1191-1206.
30. Saboor, A. Provost, S.B. and Ahmad, M. (2012). The moment generating function of a bivariate gamma-type distribution. *Appl. Math. Comput.*, 218(24), 11911-11921.
31. Silva, G.O., Edwin, M.M. Ortega and Cordeiro, G.M. (2010). The beta modified Weibull distribution. *Lifetime Data Anal*., 16, 409-430.
32. Singla, N. Jain, K.S. and Sharma, K. (2012). The beta generalized Weibull distribution: properties and applications. *Reliable. Eng. Syst. Safe.*, 102, 5-15.
33. Tojeiro, C., Louzada, F., Roman, M. and Borges, P. (2014). The complementary Weibull geometric distribution. *J. Statist. Comput. Simul.*, 84, 1345-1362.
34. Von-Mises, R.E. (1928). *Wahrscheinlichkeit, Statistik und Wahrheit.* Julius Springer, Vienna, Austria.
35. Zografos, K. and Balakrishnan, N. (2009). On families of beta- and generalized gamma–generated distributions and associated inference. *Statistical Methodology*, 6, 344-362.

APPENDIX A

Meijer G-Function

The symbol $G_{p,q}^{m,n}(.|.)$ denotes Meijer's *G*-function (1946) defined in terms of the Mellin–Barnesintegral as

$$G_{\mathrm{p,q}}^{\mathrm{m,n}}\left(z\left|\begin{matrix}a_1,\ldots,\mathrm{a_p}\\ b_1,\ldots,\mathrm{b_p}\end{matrix}\right.\right)=\frac{1}{2\pi i}\int_c \frac{\prod_{j=1}^{m}\Gamma\left(\mathrm{b_j}-\mathrm{s}\right)\prod_{j=1}^{n}\Gamma\left(1-\mathrm{a_j}+\mathrm{s}\right)}{\prod_{j=m+1}^{q}\Gamma\left(1-\mathrm{b_j}-\mathrm{s}\right)\prod_{j=n+1}^{p}\Gamma\left(\mathrm{a_j}-\mathrm{s}\right)}z^s ds,$$

where $0<\mathrm{m}<\mathrm{q},0<\mathrm{n}<\mathrm{p}$ and the poles a_j,b_j are such poles $\Gamma\left(b_j-s\right).j=\overline{1.m}$ coincide with the $\Gamma\left(1-a_j-s\right).j=\overline{1.n}$ i.e. $a_k-b_j\notin\mathbb{Z}$ while $z\neq 0$. c is a suitable integration contour which start at $-\mathrm{i}\infty$ and goes to $i\infty$ and separate the poles $\Gamma\left(b_j-s\right).j=\overline{1.m}$ which lie to the right of the contour, from all poles of $\Gamma\left(1-a_j-s\right).j=\overline{1.n}$ which lie to the left of c. The integral converges if $\delta=m+n-\frac{1}{2}(\mathrm{p}+\mathrm{q})>0$ and $\left|\arg(z)\right|<\delta\pi$, see (Luke, 1969 p. 143) and Meijer (1946).

The G function's Mathematica code reads.

$$MeijerG\left[\left\{\left\{a_1,\ldots,a_n\right\}\left\{a_{n+1},\ldots,a_p\right\}\right\}\left\{\left\{b_1,\ldots,b_m\right\}\left\{b_{m+1},\ldots,b_q\right\}\right\},z\right].$$

APPENDIX B

The 4×4 total observed information matrix along with the elements are given below

$$J(\theta)=\begin{bmatrix} J_{\lambda\lambda}(\theta) & J_{\lambda\beta}(\theta) & J_{\lambda k}(\theta) & J_{\lambda\alpha}(\theta) \\ J_{\beta\lambda}(\theta) & J_{\beta\beta}(\theta) & J_{\beta k}(\theta) & J_{\beta\alpha}(\theta) \\ J_{k\lambda}(\theta) & J_{k\beta}(\theta) & J_{kk}(\theta) & J_{k\alpha}(\theta) \\ J_{\alpha\lambda}(\theta) & J_{\alpha\beta}(\theta) & J_{\alpha k}(\theta) & J_{\alpha\alpha}(\theta) \end{bmatrix}$$

$$J_{\lambda\lambda}(\theta)=\sum_{i=1}^{n}\left(-\frac{e^{2\lambda x_i+2\beta x_i^k}\left(-1+\alpha\right)^2 x_i^2}{\left(-e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)+2\alpha\right)^2}+\frac{e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)x_i^2}{-e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)+2\alpha}\right)$$

$$+\sum_{i=1}^{n}-\frac{x_i^2}{\left(\lambda x_i+k\beta x_i^k\right)^2},$$

$$J_{\lambda\beta}(\theta)=\sum_{i=1}^{n}-\frac{k x_i^{1+k}}{\left(\lambda x_i+k\beta x_i^k\right)^2}$$

$$+\sum_{i=1}^{n}\left(-\frac{e^{2\lambda x_i+2\beta x_i^k}\left(-1+\alpha\right)^2 x_i^{1+k}}{\left(-e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)+2\alpha\right)^2}-\frac{e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)x_i^{1+k}}{-e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)+2\alpha}\right),$$

$$J_{\lambda k}(\theta)=\sum_{i=1}^{n}\left(-\frac{e^{2\lambda x_i+2\beta x_i^k}\left(-1+\alpha\right)^2\beta\log(x_i)x_i^{1+k}}{\left(-e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)+2\alpha\right)^2}-\frac{e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)\beta\log(x_i)x_i^{1+k}}{-e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)+2\alpha}\right)$$

$$\times\sum_{i=1}^{n}-\frac{x_i\left(\beta x_i^k+k\beta\log\left[x_i\right]x_i^k\right)}{\left(\lambda x_i+k\beta x_i^k\right)^2},$$

$$J_{\alpha\alpha}(\theta)=\sum_{i=1}^{n}-\frac{\left(2-e^{\lambda x_i+\beta x_i^k}\right)^2}{\left(-e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)+2\alpha\right)^2},$$

$$J_{\lambda\alpha}(\theta)=\sum_{i=1}^{n}\left(\frac{e^{\lambda x_i+\beta x_i^k}\left(2-e^{\lambda x_i+\beta x_i^k}\right)\left(-1+\alpha\right)x_i}{\left(-e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)+2\alpha\right)^2}-\frac{e^{\lambda x_i+\beta x_i^k}x_i}{-e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)+2\alpha}\right),$$

$$J_{\beta\beta}(\theta)=\sum_{i=1}^{n}-\frac{k^2x_i^{2k}}{\left(\lambda x_i+k\beta x_i^k\right)^2}+\sum_{i=1}^{n}\left(-\frac{e^{2\lambda x_i+2\beta x_i^k}\left(-1+\alpha\right)^2x_i^{2k}}{\left(-e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)+2\alpha\right)^2}-\frac{e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)x_i^{2k}}{-e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)+2\alpha}\right),$$

$$J_{\beta k}(\theta)=\sum_{i=1}^{n}\left(-\frac{e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)\log\left[x_i\right]x_i^k}{-e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)+2\alpha}-\frac{e^{2\lambda x_i+2\beta x_i^k}\left(-1+\alpha\right)^2\beta\log\left[x_i\right]x_i^{2k}}{\left(-e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)+2\alpha\right)^2}\right)$$

$$+\sum_{i=1}^{n}\left(\frac{x_i^k}{\lambda x_i+k\beta x_i^k}+\frac{k\log\left[x_i\right]x_i^k}{\lambda x_i+k\beta x_i^k}-\frac{kx_i^k\left(\beta x_i^k+k\beta\log(v)x_i\right)}{\left(\lambda x_i+k\beta x_i^k\right)^2}\right)$$

$$+\sum_{i=1}^{n}-2\log(x_i)x_i^k+\sum_{i=1}^{n}\left(-\frac{e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)\beta\log\left[x_i\right]x_i^{2k}}{-e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)+2\alpha}\right),$$

$$J_{kk}(\theta)=\sum_{i=1}^{n}\left(-\frac{e^{\lambda x_i+\beta x_i^k}\log\left(-1+\alpha\right)\beta\log\left[x_i\right]x_i^{1+k}}{-e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)+2\alpha}-\frac{e^{2\lambda x_i+2\beta x_i^k}\log\left(-1+\alpha\right)^2\beta^2\log\left[x_i\right]x_i^{1+2k}}{\left(-e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)+2\alpha\right)^2}\right)$$

$$+\sum_{i=1}^{n}\left(-\frac{e^{\lambda x_i+\beta x_i^k}\log\left(-1+\alpha\right)\beta^2\log\left[x_i\right]x_i^{1+2k}}{-e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)+2\alpha}\right)+\sum_{i=1}^{n}-2\log\beta\log(x_i)x_i^{1+k}$$

$$J_{k\alpha}(\theta)=\sum_{i=1}^{n}\left(\frac{e^{\lambda x_i+\beta x_i^k}\left(2-e^{\lambda x_i+\beta x_i^k}\right)\log\left(-1+\alpha\right)\beta x_i^{1+k}}{\left(-e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)+2\alpha\right)^2}-\frac{e^{\lambda x_i+\beta x_i^k}\log\beta x_i^{1+k}}{-e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)+2\alpha}\right),$$

$$J_{\alpha\alpha}(\theta)=\sum_{i=1}^{n}-\frac{\left(2-e^{\lambda x_i+\beta x_i^k}\right)^2}{\left(-e^{\lambda x_i+\beta x_i^k}\left(-1+\alpha\right)+2\alpha\right)^2}.$$

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A GENERALIZED EXPONENTIAL TYPE ESTIMATOR OF POPULATION MEAN IN THE PRESENCE OF NON-RESPONSE

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ABSTRACT

In this paper a generalized exponential type estimator of the population mean including two auxiliary variables has been proposed. New estimator under non-response in different situations has been studied also mean square error of the new estimator is calculated and has been found that the new estimator performs better than the previous estimators in terms of efficiency. Usual exponential ratio estimator, exponential product estimator and many more estimators are identified from new proposed estimator. An empirical study has been performed in support of our findings.

1. INTRODUCTION

The auxiliary information in sample surveys has long been used by researchers for improving the efficiency of estimates. Many estimators are available in literature based on the use of auxiliary information. According to Cochran (1940, 1942), "if the correlation co-efficient between study and auxiliary information is positive, then the ratio type estimators are used". Robson (1957) and Murthy (1964) stated that "if the correlation co-efficient between study and auxiliary information is negative then the product type estimators are used to estimate the population parameters".

To increase the accuracy of the estimates of population parameter, researchers use auxiliary information in sample survey. Graunt (1662) is supposed to consider the first researcher who used auxiliary information.

More than one auxiliary variable are used by many researchers in different situations. Sahoo and Sahoo (1993) proposed estimators with two auxiliary variables in double phase sampling. Factor type estimator with one parameter family was discussed by Singh and Shukla (1987). In order to get a better result, Shukla et al. (1991) transformed factor type estimator.

Singh et al. (1994) proposed chain ratio estimator under two phase sampling with two auxiliary variables. Factor type estimator in double phase sampling was proposed by Shukla (2002). Perri (2007) proposed ratio-cum-product type estimators by analyzing the work of Singh (1965, 1965b).

Many researchers like Khare and Srivastava (1981), Shukhatme et al. (1984), Srivastava and Jhajj (1983), Naik and Gupta (1991), Mukhopadhyay (2000), etc. have used more than one auxiliary variable in estimation of population parameters.

When we fail to collect information from one or more than one respondents on one or more than one variables in sample surveys, then non-response is said to occur. Non-

response occurs due to many reasons which include lack of information provided by respondents; also some of the respondents refuse to answer the questionnaire, sometimes difficult to trace the respondents etc.

Hansen and Hurwitz (1946) studied the difficulty of non-response that one faces in estimation of population mean. Later on, many researchers followed the technique proposed by Hansen and Hurwitz (1946) in the ratio estimation method like El-Badry (1956), Singh et al. (2010) Srinath (1971), Khare and Srivastava (1993, 1995, 1997, 2010), Ismail et al. (2011) etc.

2. NOTATIONS

Notations used in this study are:

$\bar{Y}$, $\bar{X}$, and $\bar{Z}$: Population means

$\bar{y}$, $\bar{x}$, and $\bar{z}$: Sample means

n : sample size

f : Sampling fraction $\left(f = \frac{n}{N} \right)$

N : Size of Population

$\rho_{xy}, \rho_{yz}, \rho_{xz}$: Correlation between X and Y, Y and Z, X and Z

$C_y = \frac{S_y}{\bar{Y}}$, $C_x = \frac{S_x}{\bar{X}}$, $C_z = \frac{S_z}{\bar{Z}}$: Coefficient of variation for variable Y, X and Z

$\theta = W_2 \left(\frac{h-1}{n} \right)$ And $\lambda = \frac{N-n}{nN}$.

3. SOME WELL-KNOWN ESTIMATORS

Many researchers work to estimate population mean in presence of non-response. Some well-known estimators in the presence of non-response in estimation of population mean are listed along with their mean square errors.

1. Hansen and Hurwitz (1946) Estimator

Hansen and Hurwitz (1946) proposed estimator is

$$\bar{y}^* = \left(\frac{r_1}{n} \right) \bar{y}_{r1} + \left(\frac{r_2}{n} \right) \bar{y}_k ,$$

where

$$\bar{y}_{r1} = \frac{1}{r_1} \sum_{i=1}^{r_1} y_i ,$$

and $$\bar{y}_k = \frac{1}{k} \sum_{i=1}^{k} y_i .$$

Its variance is given as:

$$Var\left(\bar{y}^*\right) = \lambda S_Y^2 + \theta S_{Y(2)}^2 .$$

2. Cochran's Estimators (1977)

a. Ratio estimator

$$t = \frac{\bar{y}^*}{\bar{x}^*}\bar{X}$$

And its Mean square error is

$$MSE(t) \approx \lambda \bar{Y}^2 \left(C_Y^2 + C_X^2 - 2\rho_{YX} C_Y C_X\right) + \theta \bar{Y}^2 \left(C_{Y(2)}^2 + C_{X(2)}^2 - 2\rho_{YX(2)} C_{Y(2)} C_{X(2)}\right)$$

b. Product estimator

$$t = \bar{y}^* \frac{\bar{x}^*}{\bar{X}} .$$

Mean square error is

$$MSE(t) \approx \lambda \bar{Y}^2 \left(C_Y^2 + C_X^2 + 2\rho_{YX} C_Y C_X\right) + \theta \bar{Y}^2 \left(C_{Y(2)}^2 + C_{X(2)}^2 + 2\rho_{YX(2)} C_{Y(2)} C_{X(2)}\right)$$

3. Kumar and Bhougal (2011) Estimator

$$t = \bar{y}^* \left\{ \alpha \exp\left(\frac{\bar{X} - \bar{x}^*}{\bar{X} + \bar{x}^*}\right) + (1-\alpha)\exp\left(\frac{\bar{x}^* - \bar{X}}{\bar{x}^* + \bar{X}}\right)\right\},$$

where α is constant and can be calculated such that the mean square error of t is least.

$$MSE^*(t) \approx \lambda \bar{Y}^2 \left[C_Y^2 + \tau^2 C_X^2 - 2\tau\rho_{YX} C_Y C_X\right] + \theta \bar{Y}^2 \left[C_{Y(2)}^2 + \tau^2 C_{X(2)}^2 - 2\tau\rho_{YX(2)} C_{Y(2)} C_{X(2)}\right],$$

where, $\tau = \frac{1}{2}(2\alpha - 1)$.

4. Estimator of Singh et al. (2010)

Improved ratio estimator for estimating population mean $\bar{Y}$ was suggested by Singh et al. (2010)

$$t = \bar{y}^* \exp\left(\frac{\bar{X}_1 - \bar{x}^*}{\bar{X}_1 + \bar{x}^*}\right).$$

With mean square error

$$\text{MSE}(t) \approx \lambda_3\left(S_y^2+(1-4C)\left(\frac{R^2S_x^2}{4}\right)\right)+\lambda_1 S_y^2+\theta\left(S_{y_2}^2+(1-4C_{(2)})\left(\frac{R^2S_{x_2}^2}{4}\right)\right),$$

where

$$C=\frac{\beta}{R} \qquad C_{(2)}=\frac{\beta_{(2)}}{R}.$$

5. Singh and Kumar (2008a) Estimators

Chain-ratio-type estimator was proposed by Singh and Kumar (2008a)

$$t=\bar{y}^*\left(\frac{\bar{X}}{\bar{x}^*}\right)\left(\frac{\bar{X}}{\bar{x}}\right).$$

With mean square error:

$$MSE(t)\approx\lambda\bar{Y}^2\left[C_Y^2+4C_X^2-4\rho_{YX}C_YC_X\right]+\theta\bar{Y}^2\left[C_{Y(2)}^2+C_{X(2)}^2-2\rho_{YX(2)}C_{Y(2)}C_{X(2)}\right].$$

Ratio cum product type estimator was also suggested by Singh and Kumar (2008a) which is:

$$t=\bar{y}^*\left(\frac{\bar{x}^*}{\bar{X}}\right)\left(\frac{\bar{x}}{\bar{X}}\right).$$

Its mean square error is:

$$MSE(t)\approx\lambda\bar{Y}^2\left[C_Y^2+4C_X^2+4\rho_{YX}C_YC_X\right]+\theta\bar{Y}^2\left[C_{Y(2)}^2+C_{X(2)}^2+2\rho_{YX(2)}C_{Y(2)}C_{X(2)}\right].$$

6. Rao's (1986) Estimators

Ratio-type estimator of population mean which was proposed by Rao (1986)

$$t=\frac{\bar{y}^*}{\bar{x}}\bar{X}.$$

With the mean square error:

$$MSE(t)\approx\lambda\bar{Y}^2\left(C_Y^2+C_X^2-2\rho_{YX}C_YC_X\right)+\theta S_{Y(2)}^2.$$

Product-type estimator was also suggested by Rao (1986)

$$t=\bar{y}^*\frac{\bar{x}}{\bar{X}}.$$

Its mean square error which is:

$$MSE(t)\approx\lambda\bar{Y}^2\left(C_Y^2+C_X^2+2\rho_{YX}C_YC_X\right)+\theta S_{Y(2)}^2.$$

4. PROPOSED ESTIMATOR

Motivated by Singh and Shukla (1993) and Shukla et al. (2013) we proposed the following estimator. In case ofnon-response on study variable as well as on two auxiliary variables

$$t_p = \bar{y}^{*} \exp\left(\frac{N_1 - D_1}{N_1 + D_1}\right)\exp\left(\frac{N_2 - D_2}{N_2 + D_2}\right)$$

where, $N_1 = (A_1 + C_1)\bar{X} + fB_1\bar{x}^{*}$, $D_1 = (A_1 + fB_1)\bar{X} + C_1\bar{x}^{*}$

$N_2 = (A_2 + C_2)\bar{Z} + fB_2\bar{z}^{*}$, $D_2 = (A_2 + fB_2)\bar{Z} + C_2\bar{z}^{*}$

$A_i = (K_i - 1)(K_i - 2)$; $B_i = (K_i - 1)(K_i - 4)$; $C_i = (K_i - 2)(K_i - 3)(K_i - 4)$, $i = 1,2$

We can derive new estimators from our proposed estimator for different values of k_1 and k_2 i-e 1,2,3,4. By putting different values for k_1 and k_2 we get new estimators. Some of the estimators match with previous estimators and this is one of the properties of our proposed estimator.

Case 1: when k_1=1 and k_2=1 $t_1 = \bar{y}^{*} \exp\left(\frac{\bar{x}^{*} - \bar{X}}{\bar{x}^{*} + \bar{X}}\right)\exp\left(\frac{\bar{z}^{*} - \bar{Z}}{\bar{z}^{*} + \bar{Z}}\right)$	**Case 2: When k_1=1 and k_2=2** $t_2 = \bar{y}^{*} \exp\left(\frac{\bar{X} - \bar{x}^{*}}{\bar{X} + \bar{x}^{*}}\right)\exp\left(\frac{\bar{z}^{*} - \bar{Z}}{\bar{z}^{*} + \bar{Z}}\right)$
Case 3: When k_1=1 and k_2=3 $t_3 = \bar{y}^{*} \exp\left(\frac{\bar{X} - \bar{x}^{*}}{\bar{X} + \bar{x}^{*}}\right)\exp\left(\frac{n(\bar{Z} - \bar{z}^{*})}{2N\bar{Z} - n(\bar{z}^{*} + \bar{Z})}\right)$	**Case 4: When k_1=1 and k_2=4** $t_4 = \bar{y}^{*} \exp\left(\frac{\bar{X} - \bar{x}^{*}}{\bar{X} + \bar{x}^{*}}\right)$
Case 5: When k_1=2 and k_2=1 $t_5 = \bar{y}^{*} \exp\left(\frac{\bar{x}^{*} - \bar{X}}{\bar{x}^{*} + \bar{X}}\right)\exp\left(\frac{\bar{Z} - \bar{z}^{*}}{\bar{Z} + \bar{z}^{*}}\right)$	**Case 6: When k_1=2 and k_2=2** $t_6 = \bar{y}^{*} \exp\left(\frac{\bar{x}^{*} - \bar{X}}{\bar{x}^{*} + \bar{X}}\right)\exp\left(\frac{\bar{z}^{*} - \bar{Z}}{\bar{z}^{*} + \bar{Z}}\right)$
Case 7: When k_1=2 and k_2=3 $t_7 = \bar{y}^{*} \exp\left(\frac{\bar{x}^{*} - \bar{X}}{\bar{x}^{*} + \bar{X}}\right)\exp\left(\frac{n(\bar{Z} - \bar{z}^{*})}{2N\bar{Z} - n(\bar{z}^{*} + \bar{Z})}\right)$	**Case 8: When k_1=2 and k_2=4** $t_8 = \bar{y}^{*} \exp\left(\frac{\bar{x}^{*} - \bar{X}}{\bar{x}^{*} + \bar{X}}\right)$
Case 9: When K_1=3 and k_2=1 $t_9 = \bar{y}^{*} \exp\left(\frac{n(\bar{X} - \bar{x}^{*})}{2N\bar{X} - n(\bar{x}^{*} + \bar{X})}\right)\exp\left(\frac{\bar{Z} - \bar{z}^{*}}{\bar{Z} + \bar{z}^{*}}\right)$	**Case 10: When k_1=3 and k_2=2** $t_{10} = \bar{y}^{*} \exp\left(\frac{n(\bar{X} - \bar{x}^{*})}{2N\bar{X} - n(\bar{x}^{*} + \bar{X})}\right)\exp\left(\frac{\bar{z}^{*} - \bar{Z}}{\bar{z}^{*} + \bar{Z}}\right)$

Case 11: When k_1=3 and k_2=3 $t_{11} = \bar{y}^{*} \exp\left(\frac{n(\bar{X}-\bar{x}^{*})}{2N\bar{X}-n(\bar{x}^{*}+\bar{X})}\right) \exp\left(\frac{n(\bar{Z}-\bar{z}^{*})}{2N\bar{Z}-n(\bar{z}^{*}+\bar{Z})}\right)$	**Case 12: When k_1=3 and k_2=4** $t_{12} = \bar{y}^{*} \exp\left(\frac{n(\bar{X}-\bar{x}^{*})}{2N\bar{X}-n(\bar{x}^{*}+\bar{X})}\right)$
Case 13: When k_1=4 and k_2=1 $t_{13} = \bar{y}^{*} \exp\left(\frac{\bar{Z}-\bar{z}^{*}}{\bar{Z}+\bar{z}^{*}}\right)$	**Case 14: When k_1=4 and k_2=2** $t_{14} = \bar{y}^{*} \exp\left(\frac{\bar{z}^{*}-\bar{Z}}{\bar{z}^{*}+\bar{Z}}\right)$
Case 15: When k_1=4 and k_2=3 $t_{15} = \bar{y}^{*} \exp\left(\frac{n(\bar{Z}-\bar{z}^{*})}{2N\bar{Z}-n(\bar{z}^{*}+\bar{Z})}\right)$	**Case 16: When k_1=4 and k_2=4** $t_{16} = \bar{y}^{*}$

5. ASSUMPTIONS FOR OUR PROPOSED ESTIMATOR

$$\bar{y}^{*} = \bar{Y} + \bar{e}_y^{*};\ \bar{x}^{*} = \bar{X} + \bar{e}_x^{*};\ \bar{z}^{*} = \bar{Z} + \bar{e}_z^{*};\ \alpha_i = \frac{fB_i}{A_i + fB_i + C_i};\ \beta_i = \frac{C_i}{A_i + fB_i + C_i};$$

$$\delta_{1i} = \alpha_i - \beta_i,\ i = 1,2$$

$$E(\bar{e}_y^{*}) = E(\bar{e}_x^{*}) = E(\bar{e}_z^{*}) = 0;\ E(\bar{e}_y^{*2}) = \lambda C_y^2 + \theta C_{y(2)}^2;\ E(\bar{e}_x^{*2}) = \lambda C_x^2 + \theta C_{x(2)}^2;$$

$$E(\bar{e}_z^{*2}) = \lambda C_z^2 + \theta C_{z(2)}^2;$$

$$E(\bar{e}_y^{*}\bar{e}_x^{*}) = \lambda\rho_{xy}C_xC_y + \theta\rho_{xy(2)}C_{x(2)}C_{y(2)};\ E(\bar{e}_y^{*}\bar{e}_z^{*}) = \lambda\rho_{yz}C_yC_z + \theta\rho_{yz(2)}C_{y(2)}C_{z(2)};$$

$$E(\bar{e}_x^{*}\bar{e}_z^{*}) = \lambda\rho_{xz}C_xC_z + \theta\rho_{xz(2)}C_{x(2)}C_{z(2)};\ \lambda = \left(\frac{N-n}{Nn}\right);\ \theta = \frac{W_2(h-1)}{n}.$$

5.1 Theorem:

The estimator "t" up to first order approximation in terms of

$\bar{e}_y^{*}, \bar{e}_x^{*}, \bar{e}_z^{*}$ **is** $(t-\bar{y}) \approx \bar{e}_y^{*} + \frac{\bar{Y}}{2\bar{X}}(\bar{e}_x^{*})\delta_1^2 + \frac{\bar{Y}}{2\bar{Z}}(\bar{e}_z^{*})\delta_2^2$ **having Mean square error**

$$MSE(t) \approx \bar{Y}^2[\lambda\{C_y^2 + \frac{C_x^2}{4}\delta_1^2 + \frac{C_z^2}{4}\delta_2^2 + C_yC_x\rho_{xy}\delta_1 + C_yC_z\rho_{yz}\delta_2 + \frac{C_xC_y}{2}\rho_{xz}\delta_1\delta_2\}$$

$$+\theta\{C_{y(2)}^2 + \frac{C_{x(2)}^2}{4}\delta_1^2 + \frac{C_{z(2)}^2}{4}\delta_2^2 + C_{y(2)}C_{x(2)}\rho_{xy(2)}\delta_1$$

$$+C_{y(2)}C_{z(2)}\rho_{yz(2)}\delta_2 + \frac{C_{x(2)}C_{z(2)}}{2}\rho_{xz(2)}\delta_1\delta_2\}]$$

Proof:

Putting values in our proposed estimator we will get:

$$t = (\bar{Y} + \bar{e}_y^*)\exp\left(\frac{(A_1 + C_1)\bar{X} + fB_1(\bar{X} + \bar{e}_x^*) - (A_1 + fB_1)\bar{X} - C_1(\bar{X} + \bar{e}_x^*)}{(A_1 + C_1)\bar{X} + fB_1(\bar{X} + \bar{e}_x^*) + (A_1 + fB_1)\bar{X} + C_1(\bar{X} + \bar{e}_x^*)}\right)$$

$$\exp\left(\frac{(A_2 + C_2)\bar{Z} + fB_2(\bar{Z} + \bar{e}_z^*) - (A_2 + fB_2)\bar{Z} - C_2(\bar{Z} + \bar{e}_z^*)}{(A_2 + C_2)\bar{Z} + fB_2(\bar{Z} + \bar{e}_z^*) + (A_2 + fB_2)\bar{Z} + C_2(\bar{Z} + \bar{e}_z^*)}\right)$$

After solving we will get

$$t = (\bar{Y} + \bar{e}_y^*)\exp\left(\frac{(fB_1 - C_1)\dfrac{\bar{e}_x^*}{\bar{X}}}{2A_1 + 2C_1 + 2fB_1 + (fB_1 + C_1)\dfrac{\bar{e}_x^*}{\bar{X}}}\right)$$

$$\exp\left(\frac{(fB_2 - C_2)\dfrac{\bar{e}_z^*}{\bar{Z}}}{2A_2 + 2fB_2 + 2C_2 + (fB_2 + C_2)\dfrac{\bar{e}_z^*}{\bar{Z}}}\right)$$

$$t = (\bar{Y} + \bar{e}_y^*)\exp\left(\frac{\alpha_1 - \beta_1}{\dfrac{2}{r} + \alpha_1 + \beta_1}\right)\exp\left(\frac{\alpha_2 - \beta_2}{\dfrac{2}{r'} + \alpha_2 + \beta_2}\right), \text{ where } r = \frac{\bar{e}_x^*}{\bar{X}} \text{ and } r' = \frac{\bar{e}_z^*}{\bar{Z}}$$

$$t \approx (\bar{Y} + \bar{e}_y^*)\left(1 + \frac{r}{2}(\alpha_1 - \beta_1)\right)\left(1 + \frac{r'}{2}(\alpha_2 - \beta_2)\right)$$

$$t - \bar{Y} \approx \bar{e}_y^* + \bar{Y}\frac{r}{2}(\alpha_1 - \beta_1) + \bar{Y}\frac{r'}{2}(\alpha_2 - \beta_2)$$

Squaring both sides of equation and putting values of r,r', $\alpha_1 - \beta_1$ and $\alpha_2 - \beta_2$ we will get

$$(t - \bar{Y})^2 \approx \bar{e}_y^* + \frac{\bar{Y}^2}{4}\left(\frac{\bar{e}_x^*}{\bar{X}}\right)^2\delta_1^2 + \frac{\bar{Y}^2}{4}\left(\frac{\bar{e}_z^2}{\bar{Z}}\right)^2\delta_2^2 + \bar{e}_y^*\bar{e}_x^*\frac{\bar{Y}}{\bar{X}}\delta_1 + \bar{e}_y^*\bar{e}_z^*\frac{\bar{Y}}{\bar{Z}}\delta_2 + \bar{e}_x^*\bar{e}_z^*\frac{\bar{Y}}{2\bar{X}}^2\frac{1}{\bar{Z}}\delta_1\delta_2$$

Taking expectation on both sides

$$E(t-\bar{y})^2 \approx \lambda S_y^2 + \theta S_{y(2)}^2 + \frac{\bar{Y}^2}{4\bar{X}}(\lambda S_x^2 + \theta S_{x(2)}^2)\delta_1^2 + \frac{\bar{Y}^2}{4\bar{Z}}(\lambda S_z^2 + \theta S_{z(2)}^2)\delta_2^2$$
$$+\frac{\bar{Y}}{\bar{X}}\delta_1(\lambda S_y S_x \rho_{xy} + \theta S_{y(2)} S_{x(2)} \rho_{xy(2)}) + \frac{\bar{Y}}{\bar{Z}}\delta_2(\lambda S_y S_z \rho_{yz} + \theta S_{y(2)} S_{z(2)} \rho_{yz(2)})$$
$$+\frac{\bar{Y}^2}{2\bar{X}}\frac{1}{\bar{Z}}\delta_1\delta_2(\lambda S_x S_z \rho_{xz} + \theta S_{x(2)} S_{z(2)} \rho_{xz(2)})$$

Mean square error is

$$MSE(t) \approx \bar{Y}^2[\lambda\{C_y^2 + \frac{C_x^2}{4}\delta_1^2 + \frac{C_z^2}{4}\delta_2^2 + C_y C_x \rho_{xy}\delta_1 + C_y C_z \rho_{yz}\delta_2 + \frac{C_x C_y}{2}\rho_{xz}\delta_1\delta_2\}$$
$$+\theta\{C_{y(2)}^2 + \frac{C_{x(2)}^2}{4}\delta_1^2 + \frac{C_{z(2)}^2}{4}\delta_2^2 + C_{y(2)} C_{x(2)} \rho_{xy(2)}\delta_1$$
$$+C_{y(2)} C_{z(2)} \rho_{yz(2)}\delta_2 + \frac{C_{x(2)} C_{z(2)}}{2}\rho_{xz(2)}\delta_1\delta_2\}] \qquad (5.1.1)$$

6. MINIMUM MEAN SQUARED ERROR

By differentiating equation (5.1.1) with respect to δ_1 and δ_2, and equating equation (6.1) and (6.2)to zero we will get values for δ_1 and δ_2

$$\lambda(C_x^2\delta_1 + 2C_x C_y \rho_{xy} + C_x C_z \rho_{xz}\delta_2) + \theta(C_{x(2)}^2\delta_1$$
$$+2C_{x(2)} C_{y(2)} \rho_{xy(2)} + C_{x(2)} C_{z(2)} \rho_{xz(2)}\delta_2) = 0 \qquad (6.1)$$

$$\lambda(C_z^2\delta_2 + 2C_y C_z \rho_{yz} + C_x C_z \rho_{xz}\delta_1) + \theta(C_{z(2)}^2\delta_2$$
$$+2C_{y(2)} C_{z(2)} \rho_{yz(2)} + C_{x(2)} C_{z(2)} \rho_{xz(2)}\delta_1) = 0 \qquad (6.2)$$

By solving these simultaneous equations i-e equation (6.1) and (6.2) we will get the values for δ_1 and δ_2

$$\delta_1 = \frac{G+H+I}{O+P+Q} \text{ And } \delta_2 = \frac{J+K+L}{O+P+Q}$$

where,

$$G = 2\lambda^2 C_z^2 C_x C_y(\rho_{xz}\rho_{yz} - \rho_{xy})$$

$$H = 2\lambda\theta C_x C_{z(2)}(C_z C_{y(2)}\rho_{xz}\rho_{yz(2)} - C_y C_{z(2)}\rho_{xy})$$
$$+2\lambda\theta C_{x(2)} C_z(C_y C_{z(2)}\rho_{yz}\rho_{xz(2)} - C_z C_{y(2)}\rho_{xy(2)})$$

$$I = 2\theta^2 C_{x(2)} C_{y(2)} C_{z(2)}^2(\rho_{yz(2)}\rho_{xz(2)} - \rho_{xy(2)})$$

$$J = 2\lambda^2 C_x^2 C_y C_z(\rho_{xy}\rho_{xz} - \rho_{yz})$$

$$K = 2\lambda\theta C_z C_{x(2)} (C_x C_{y(2)} \rho_{xz} \rho_{xy(2)} - C_y C_{x(2)} \rho_{yz})$$
$$+2\lambda\theta C_{z(2)} C_x (C_y C_{x(2)} \rho_{xy} \rho_{xz(2)} - C_x C_{y(2)} \rho_{yz(2)})$$

$$L = 2\theta^2 C_{y(2)} C_{z(2)} C_{x(2)}^2 (\rho_{xy(2)} \rho_{xz(2)} - \rho_{yz(2)})$$

$$O = \lambda^2 C_x^2 C_z^2 (1 - \rho_{xz}^2)$$

$$P = \lambda\theta (C_x^2 C_{z(2)}^2 + C_{x(2)}^2 C_{z(2)}^2 - 2C_x C_z \rho_{xz} C_{x(2)} C_{z(2)} \rho_{xz(2)})$$

$$Q = \theta^2 C_{x(2)}^2 C_{z(2)}^2 (1 - \rho_{xz(2)}^2)$$

7. EMPIRICAL STUDY

To check the efficiencies for our proposed estimator with respect to their mean square error, we are taking population data which are already used by earlier researchers. In order to check efficiencies for our proposed estimator we are taking different values for h i-e 2, 4, 6, 8 and 16.

Population data (Khare and Sinha (2007)).

y = Weights (in kg) of children
x = Skull circumference (in cm) of the children and
z = Chest circumference (in cm) of the children.

We have

$N = 95$, $n = 35$, $w_2 = 0.25$, $\bar{Y} = 19.4968$, $\bar{X} = 51.1726$, $\bar{Z} = 55.8611$
$C_y = 0.15613$, $C_{y(2)} = 0.12075$, $C_x = 0.03006$, $C_{x(2)} = 0.02478$
$C_z = 0.0586$, $C_{z(2)} = 0.05402$, $\rho_{xy} = 0.328$, $\rho_{xy(2)} = 0.477$,
$\rho_{yz} = 0.846$, $\rho_{yz(2)} = 0.729$, $\rho_{xz} = 0.297$, $\rho_{xz(2)} = 0.57$

8. CONCLUSION

We proposed a generalized exponential type estimator using two auxiliary variables under non-response in single-phase sampling. From table 1 and table 2 we calculated percent relative efficiencies and found that the estimator which we proposed performs much better not only from new estimators but also from previous estimators. Therefore estimator which we proposed is preferable in different situations i-e when no auxiliary variable is used, single auxiliary variable is used and two auxiliary variables are used.

Table 1
Estimators' percent relative efficiencies (PREs)
with respect to $\bar{y}^{*}$ for various values of h.

Percent Relative efficiencies

Estimators	**h=2**	**h=4**	**h=6**	**h=8**	**h=16**
$\bar{y}^{*}$	100	100	100	100	100
t_1	217.8441	218.2845	218.7266	219.1705	220.9644
t_2	60.82773	60.81152	60.79532	60.77912	60.71443
t_3	131.9339	131.7801	131.6267	131.4736	130.865
t_4	182.5707	182.3249	182.0797	181.8353	180.8639
t_5	159.5699	159.3542	159.139	158.9244	158.0718
t_6	50.43346	50.40329	50.37316	50.34306	50.22304
t_7	101.3924	101.4049	101.4175	101.43	101.4801
t_8	85.90042	85.78678	85.67345	85.56041	85.11123
t_9	206.043	206.2328	206.4229	206.6133	207.3787
t_{10}	57.72225	57.68542	57.64863	57.61189	57.46539
t_{11}	122.767	122.7805	122.7939	122.8074	122.8613
t_{12}	103.2924	103.2335	103.1747	103.116	102.8816
t_{13}	197.5674	197.3014	197.036	196.7714	195.7201
t_{14}	56.27216	56.19918	56.12639	56.0538	55.76527
t_{15}	96.85582	70.04355	54.85752	45.08313	26.32266
t_{new}	**349.5796**	**328.6039**	**317.3124**	**310.6492**	**298.7455**

Table 2
Previous estimators present relative efficiencies (PREs)
with respect to $\bar{y}^*$ for various values of h.
Percent Relative Efficiencies

Estimators	h =2	h =4	h =6	h =8	h =16
$\bar{y}^*$	100	100	100	100	100
t_1	12.96657	12.32605	11.74583	11.21777	9.507988
t_2	12.41088	11.56923	10.83448	10.18749	8.22324
t_3	80.85635	58.46973	45.79149	37.63165	21.97107
t_4	91.23656	66.80858	52.69882	43.50971	25.63192
t_5	59.03326	43.85708	34.8881	28.96469	17.24979
t_6	87.14377	61.68825	47.74228	38.93922	22.41044
t_7	87.14377	61.68825	42.6043	38.93922	22.41044
t_8	43.4269	72.17506	54.54907	42.48046	22.25255
t_{new}	**349.5796**	**328.6039**	**317.3124**	**310.6492**	**298.7455**

REFERENCES

1. Abu-Dayyeh, W.A., Ahmed, R.A. and Muttlak, H.A. (2003). Some estimators of finite population mean using auxiliary information. *Applied Mathematics and Computation*, 139, 287-298.
2. Cochran, W.G. (1940). The estimation of the yields of cereal experiments by sampling for the ratio gain to total produce. *Journal of Agricultural Society*, 30, 262-275.
3. Cochran, W.G. (1942). Sampling theory when the sampling units are of unequal sizes, *Journal of American Statistical Association*, 37, 119-132.
4. El-Badry, M.A. (1956). A sampling procedure for mailed questionnaires. *J. Amer. Statist. Assoc.*, 51, 209-227.
5. Graunt, J. (1662). *The Economic Writings of Sir William Petty*, 1899, Cambridge University Press, Vol. 2, 314-431.
6. Hansen, M.H. and Hurwitz, W.N. (1946). The problem of non-response in sampling surveys. *J. Amer. Statist. Assoc.*, 41, 517-529.
7. Ismail, M., Shahbaz, M.Q. and Hanif, M. (2011). A general class of estimator of population mean in presence of non-response. *Pak. J. Statist.*, 27(4), 467-476.
8. Khare, B.B. and Srivastava, S.R. (1981). A generalized regression ratio estimator for the population mean using two auxiliary variables. *The Aligarh Journal of Statistics*, 1(1), 43-51.
9. Khare, B.B. and Srivastava, S. (1993). Estimation of population mean using auxiliary character in presence of non-response. *Nat. Acad. Sci. Lett. India*, 16, 111-114.

10. Khare, B.B. and Srivastava, S. (1995). Study of conventional and alternative two-phase sampling ratio, product and regression estimators in presence of non-response. *Proc. Indian. Nat. Sci. Acad.*, 65, 195-203.
11. Khare, B.B. and Srivastava, S. (1997). Transformed ratio type estimators for the population mean in presence of non-response. *Comm. Statist. Theory Methods*, 26, 1779-1791.
12. Khare, B.B. and Srivastava, S. (2010). Generalized two phase estimators for the population mean in the presence of non-response. *Aligarh J. Statist.*, 30, 39-54.
13. Mukhopadhyay, P. (2000). *Theory and methods of survey sampling*, Prentice Hall of India Pvt. Ltd., New Delhi.
14. Murthy, M.N. (1964). Product method of estimation. *Sankhya*, 26, A, 294- 307.
15. Naik, V.D. and Gupta, P.C. (1991). A general class of estimators for estimating population mean using auxiliary information. *Metrika*, 38, 11-17.
16. Perri, P.F. (2007). Improved Ratio-cum-product type estimator. *Statistics in Transition*, 8, 1, 51-69.
17. Rao, P.S.R.S. (1986). Ratio estimation with sub sampling the non-respondents. *Survey Methodology*, 12(2), 217-230.
18. Sahoo, J. and Sahoo, L.N. (1993). A class of estimators in two-phase sampling using two auxiliary variables. *Jour. Ind. Soc. Ag. Stat*., 31, 107-114.
19. Shukla, D., Singh, V.K. and Singh, G.N. (1991). On the use of transformation in factor type estimator. *Metron*, 49, 1-4, 359-361.
20. Shukla, D. (2002). F-T estimator under two-phase sampling. *Metron*, 59, 1-2, 253-263.
21. Shukla, D., Pathak, S. and Thakur, N.S. (2013). Estimation of population mean using two auxiliary sources in sample surveys. *Statistics in Transition*, 13(1), 21-36.
22. Singh, M.P. (1965). On the estimation of ratio and product of the population parameters. *Sankhya* B, 27, 321-328.
23. Singh, M.P. (1965). Ratio cum product method of estimation. *Metrika*, 12, 34-42.
24. Singh, V.K. and shukla, D. (1987). One parameter family of factor-type ratio estimator. Metron, 45, 1-2, 273-283.
25. Singh, V.K., Singh, G.N. and shukla, D. (1994). A class of chain ratio estimator with two auxiliary variables under double sampling scheme. *Sankhya*, Ser. B., 46(2), 209-221.
26. Singh, H.P. and Kumar, S. (2008). A regression approach to the estimation of the finite population mean in the presence of non-response. *Aust. N.Z.J. Statist.*, 50(4), 395-408.
27. Singh, H.P., Kumar, S. and Kozak, M. (2010). Improved Estimation of Finite-Population Mean Using Sub-Sampling to Deal with Non Response in Two-Phase Sampling Scheme. *Commun. Statist. Theor. Meth.*, 39(5), 791-802.
28. Srinath, K.P. (1971). Multiphase sampling in non-response problems. *J. Amer. Statist. Assoc.*, 66, 583-586.
29. Srivastava, S.K. and Jhajj, H.S. (1983). A class of estimators of the population mean using multi-auxiliary information. *Calcutta Statistical Association Bulletin*, 32, 47-56.
30. Sukhatme, P.V., Sukhatme, B.V., Sukhatme, S. and Ashok, C. (1984). *Sampling Theory of Surveys with Applications*, Iowa State University.

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FACTORS AFFECTING THE ACADEMIC PERFORMANCE OF PRIMARY SCHOOLS (COMPARISON OF PUBLIC AND PRIVATE SCHOOLS AT DISTRICT PESHAWAR)

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ABSTRACT

The study was conducted to find out the causes affecting the primary school performance both in public and private sectors. The study was conducted in district Peshawar. There are 647 public primary (boys) schools and 247 are private primary schools in the district of Peshawar. Since it was very difficult to collect data from all primary schools in district Peshawar, so a sample of 20 private and 20 public primary schools were selected for the data collection. Closed ended questionnaire with 3 scale (Yes, Don't know and No) was designed and distributed to 320 teachers in public and private schools. 297 questionnaires were received back and then used for the data analysis. The response rate was 88.3 percent. The data comprise of categorical variables. Logistic regression (multinomial) was used in SPSS v 20 for the data analysis. According to the logistic regression of private sector schools, 1) teachers interest has significant relationship with performance; 2) administration interest has insignificant relationship with performance; 3) sports facilitation has significant relationship with performance; 4) curriculum has significant relationship with performance; 5) lab facilitation has significant relationship with performance; 6) infrastructure has insignificant relationship with performance. According to the public school results; 1) teachers interest has significant relationship with performance; 2) administration interest has significant relationship with performance; 3) curriculum has insignificant relationship with performance; 4) utilities has significant relationship with performance; 5) lab facilitation has insignificant relationship with performance; 6) infrastructure has insignificant relationship with performance.

KEYWORDS

Primary school, Public, Private, Peshawar, Performance, Logistic regression etc.

INTRODUCTION

In this time of globalization and scientific revolution, education is measured as the initial step for every human movement. It plays a significant role in the growth of human capital and is linked with an individual's well-being and opportunities for better living (Battleand Lewis, 2002).Education is need of every society and for the socialization of

society, citizens should get good education. "Education is the most powerful weapon which you can use to change the world." (Mandela, 2003).

Primary education is the stand for any education in future. But it is very unfortunate that in our country it is very much ignored, no attention is paid to this level, Govt is interested mostly in higher education and this important pillar is going towards downside day by day but on the same channel private sector is growing and providing a lot of facilities to the students to polish them to give them a clear picture of their future.

The feature of students 'performance remains main concern for educationalists. It is considered for making a difference locally, provincially, country widely and internationally. Educationalists, guides, and investigators have long been making efforts in discovering factors significantly effecting the quality of performance of students. These variables are within and out of school that have an effect on students' quality of educational success. These variables maybe considered as student, family, school and peer (Crosnoe, JohnsonandElder,2004). The proper analysis about the job of these ethnic segmentation variables originated in 17th century (Mann,1985).in general these variables consist of age, sex, territorialbe longingness, traditions, marital status, socioeconomic status (SES), guardians' qualification level, parental profession, language, income and religious affiliations. In a wide scenario demography is considered as a way to discover the nature and influence of demographic variables in the biological and social scenario. Unluckily, to define and measure the quality of education is not that easy and the complication of this progression rises due to changing values of quality characteristics related with the different investors' view point (Blevins, 2009; Parri, 2006)."A good head and good heart are always a formidable combination. But when you add to that a literate tongue or pen, then you have something very special." (Nelson Mandela).

According to District EMIS (2011-12),

Total Number of schools in KPK 27808

Working	Non-working
27456	352

Out of working 27456 Schools

Primary	Secondary
22760	4696

Out of 22760 Primary Schools

Govt Schools	Mosque/Maktab	Community Primary Schools	JICA Primary Schools
19805	2668	257	30

Serviceable Primary Schools by Location

Urban	Rural
1305	21455

Total number of sanctioned teachers in Govt Schools is 130450

Govt. Primary Schools	Middle Schools	High Schools	Higher Secondary Schools
76748	17757	26712	9233

Total number of working teachers in Govt Schools is 116949

Govt. Primary Schools	Middle Schools	High Schools	Higher Secondary Schools
71992	14622	22384	7951

According to District EMIS (2012-13), there are 1981 Non-Govt primary schools, enrolled students in primary level schools are 161707 (96137 boys + 65570 girls Total number of teachers working in primary level schools are 9928 (3500 male+ 6428 female). Number of students in the Non-Govt/ Private schools is 1510646, out of which 1042260 are Boys and 468386 are Girls students. Share of enrolment in Non-Govt Schools is 27%, in Deeni Madaris is 4% while that of in Govt Schools is 69%.

A number of public schools are used for personal use of forceful people. The guiding principle of one teacher for 40 students to the most terrible policy of student – teacher ratio. There are many schools in district Peshawar managed by only one or two teachers only. (Rasool, 2000).

LITERATURE REVIEW

Farooq et al. (2011) conducted a study to check various causes affecting the educational performance of secondary schools' students in the urban areas of Pakistan. The respondents for this study were 10th grade students (300 males and 300 females). A study was designed by using opinion poll in order to gather information about various causes related to educational performance of students. The educational performance was determined by the result of their 9th grade yearly examination. Standard t-test and ANOVA were used to examine the effect of various causes on students' accomplishment. The outcome of the study exposed that socio-economic standing (SES) and guardian education has an important upshot on students 'overall educational achievement. The high and average socio-economicst age has an effect on the performance more than the lower level. It is very appealing that guardian education has more effect than their profession in relation to their children's educational performance at school.

Ali (2013) conducted a study to investigate the factors causing some effect on performance of Govt Primary School in Constituency Mardan. Due to lack of resource is was limited to Rustam District Mardan. Only 20 Schools were selected to from district Mardan using simple random sample. It was a descriptive research and a close ended questionnaire was constructed, the questionnaire included 21 questions and all questions had two possible answer. After collection the data was analyzed and interpreted in percentage method. On the basis of the analysis it was concluded that there is not sufficient facilities and strong political interference in the Schools. The results also showed that in majority of schools the faculty was not sufficient. Educational policies were not that much efficient to bring positive change in the performance of students. The

researcher recommended that there should be a system for motivation and training of the teacher and eradicate political interference and corruption.

Studies conducted earlier shows that performance of student is explained on factors like learning facilities, sex and difference in age. Performance (Hansen and Joe B., 2000) Performance of students is significantly associated with learning environment, library, computer lab etc. (Karemera, 2003). Qualification of member of enlightening board has a significant impact on performance of students. (Robert and Sampson, 2011). Students performance is connected the use of library and their parent's education. Using library significantly affects students' performance. (Young, 1999).The educational environment has an effect on students' performance. (Kirmani and Siddiquah, 2008).Students' academic achievements their family income, parents education, parental involvement in guidance all of them are related to the performance of students. (Noble, 2006).

Guidance by parents is factor which can improve student's attitude towards his studies and is directly related to academic achievement. Those students performed well in the examinations who were guided well b parents. (Zajacova, Lynch and Espenshade, 2005). Raychadhuri, et.al. (2010), conducted a study and found that students' academic performance also depends on class attendance, parent's education, teacher- student ratio, gender, distance of home from school. Hijaz and Naqvi (2006) in there study found that there is negative relationship between students achievement and family income.

OBJECTIVE OF THE STUDY

1. To identify the significant factors affecting the educational performance of public and private primary schools.
2. To provide solutions to overcome the problems those are affecting the performance of primary school students.

METHODOLOGY

There are 647 Govt schools for boys in district Peshawar and 3525 teachers are working there, on the other hand 247 private schools in which 79 for boys 38 for girls and the remaining are co-education. Due to lack of resources, 20 Govt and 20 private schools were randomly selected number of faculty members in Govt and Private schools were 245 and 200 respectively. 320 questionnaires were distributed among 320 teachers (160 Govt, 160 Private). Out of 320 questionnaire 297 (150 private, 147 Govt) was returned so the response rate was 92% (93% private, 91% Govt). The questionnaire was designed on 3 scale (Yes, Don't know and No). The data was analyzed using SPSS v20 (statistical package for social sciences). Since our response variable (performance of students) was categorical in nature so multinomial logistic regression model was designed to identify the significant factors associated with it.

Multinomial logistic model:

$$\text{Log (odds perf)} = \beta 0 + \beta 1\text{Inf} + \beta 2\text{Lab} + \beta 3\text{Uti} + \beta 4\text{Cur} + \beta 5\text{Spo} + \beta 6\text{Adm} + \beta 7\text{teach}$$

where,

Perf = Performance of students

$\beta 0$ = Intercept term

Inf = Infrastructure
Lab = Lab facilities
Uti = Utilities
Cur = Curriculum
Spo = Sport facilities
Adm = Interest of administration
Tech = Teachers interest

So the above model was applied for Govt and Private schools separately and conclusion was made.

Analysis:

The following fitted model for Private primary schools

Table 1: Model Summary

Model	Likelihood Ratio Tests		
	Chi-Square	df	Sig.
Intercept Only Final	201.352	22	.000

$$\text{Log (odds perf)} = \beta 0 + \beta 1\text{Inf} + \beta 2\text{Lab} + \beta 3\text{Uti} + \beta 4\text{Cur} + \beta 5\text{Spo} + \beta 6\text{Adm} + \beta 7\text{teach}$$

The above table 1 shows that the model was significant at 5% level of significance.

The pseudo R-Square of Cox and Snell is 73.9%, Negelkerke 83.55 and McFadden 62.2%, indicates that the model explains at least 62% of variation in response variable (perf) due to explanatory variables.

All the explanatory variables are highly significant at 5% level of significance except infrastructure and administrations having p-value of 0.870 and 0.678 respectively.

The following fitted model for Govt primary schools

$$\text{Log (odds perf)} = \beta 0 + \beta 1\text{Inf} + \beta 2\text{Lab} + \beta 3\text{Uti} + \beta 4\text{Cur} + \beta 5\text{Spo} + \beta 6\text{Adm} + \beta 7\text{teach}$$

Table 2: Model Summary

Model	Likelihood Ratio Tests		
	Chi-Square	df	Sig.
Intercept Only Final	123.447	20	.000

The above table.2 shows that the model was significant at 5% level of significance.

The pseudo R-Square of Cox and Snell is 56.1%, Negelkerke81.6% and McFadden 62.2%, indicates that the model explains at least 70.8% of variation in response variable (perf) due to explanatory variables.

All the explanatory variables are highly significant at 5% level of significance except infrastructure, lab facilities and curriculum having p-value of 0.293, 0.469 and 0.868 respectively.

Table# 3: Pseudo R-Square

	Private	Public
Cox and Snell	.739	.588
Nagelkerke	.835	.818
McFadden	.622	.712

The purpose of the above (R-square) is to find out the variance in the school performance explained by the independent variables (causes). Three R-square values has been calculated. According to the table, as per the Cox and Snell, the causes explained 73.9 percent variance, Nagelkerke's square shows 83.5 percent variance and McFadden's R-square shows 62.2 percent variance in the school performance of private sector. As per the Cox and Snell, the causes explained 58.8 percent variance, Nagelkerke's square shows 81.8 percent variance and McFadden's R-square shows 71.2 percent variance in the school performance of private sector.

Private:

Table 4: Likelihood Ratio Tests

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	32.980a	.000	0	.
Teacher interest	61.392	28.412	4	.000
Admn interest	35.298b	2.318	4	.678
Sports facilities	45.426	12.446	4	.014
curriculum	87.265	54.285	4	.000
Utilities	32.980a	.000	0	.
Lab facilitation	52.511	19.531	2	.000
Infrastructure new	34.231b	1.251	4	.870

The above table shows the significance of the causes included in the model according to likelihood ratio tests. The table shows that teacher's interest has strong significant relationship with private school performance.

If the teachers are being motivated in the school, the ultimate effect will be on the students' performance which is the school performance. The private's schools teachers in our sample area are taking interest to enhance school performance. Administration interest has insignificant relationship with performance. Indicating that administration has no direct effect on students' academic achievements. Utilities have also insignificant relationship with performance. Utilities include the electricity facility, clean water drinking facility etc. These facilities have no effects on performance as these are very common on the private school perspective. Curriculum and lab facilitation has strong

significant relationship with school performance. The parents and teachers both are very interested in updating the curriculum according to the new improvements in the market. They suggested the lab facilitation due to the practical exposure of the students. Sports facilitation has significant relationship with private school performance. The majority of the respondents were agree to provide healthy sports facility for the students, as it is also necessary for the good performance of students. The infrastructure has insignificant relationship with private school performance. As all the private schools in Peshawar district has the infrastructure. It is very common from private school's perspective.

Public:

Table 5: Likelihood Ratio Tests

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	6.552a	.000	0	.
Teacher	17.506b	10.954	4	.027
Admn	29.608b	23.056	4	.000
Sports	6.552a	.000	0	.
Curriculum	7.805b	1.252	4	.869
Utilities	36.339	29.786	2	.000
Lab	9.963b	3.411	4	.492
Infrastructure	8.996b	2.444	2	.295

The above table shows the significance of the causes included in the model according to likelihood ratio tests. The table shows that teacher's and administration interest have significant relationship with public school performance. In public schools both the teachers and administration are actively involved in the enhancement of student's performance. Sports facilitation has insignificant relationship with public school performance. Most of the schools has no facility of sports grounds. The above results indicates that performance has nothing to do with sports facilities they are independent of each other. Utilities have also significant relationship with performance. Utilities include the electricity facility, clean water drinking facility etc. These facilities have strong effects on public school performance as these are very rare common on the public school perspective. Curriculum, lab facilitation and infrastructure have insignificant relationship with school performance. Which is indicating that the factors has no direct effect on the student's performance.

CONCLUSION

Teachers interest always plays an important role in the motivation the students towards good performances. In current study the teacher's interest, sports facilities, curriculum and lab facilities have a significant relationship with the academic performances of private schools. It was analyzed during the data collection that these variables are dealt with great care by the administration of the schools as the parents of the students are giving much more emphasis on these variables. The administration

interest and the infrastructure have an insignificant relationship with the private school academic performance.

In the public schools, teacher's interest, administration interest and the availability of utilities (clean water, electricity etc) have significant relationship with academic performance of the public sector schools. Curriculum, lab facilitation and infrastructure has insignificant relationship with school academic performance.

REFERENCES

1. Ali, N. (2013). Causes Affecting the Academic Performance of Primary Schools in District Mardan KPK Pakistan. VFAST Transactions on Education and Social Sciences, 2, 01-09.
2. Department, E.S.E. and Pakhtunkhwa, G.o.K. (2013). Annual Statistical Report on Non-Govt Schools, KPK.
3. Hijazi, Syed Tahir and Naqvi, S.M.M. Raza (2006). Factors Affecting Students' Performance: A Case of Private Colleges. *Bangladesh e-Journal of Sociology*: 3(1).
4. Hassan, Z. (2014). Impact of education on Pakistan economy. *Journal of Managerial Sciences*, 98(1), 78-90.
5. Irfan Mushtaq, S.N.K. (2012). Factors Affecting Students' Academic Performance. *Global Journal of Management and Business Research*, 12(9).
6. Kirmani, Neghat Sana and Siddiquah, Aishah (2008). Identification and Analysis of Factors Affecting Students Achievement in Higher Education. 2nd International Conference on assessing quality in higher education.
7. KPK, E.S.E.D.G.o. (2011). Annual Statistical Report of Govt: Schools.
8. Noble, Julie P., Roberts, William L. and Sawyer Richard L. (2006). Student Achievement, Behavior, Perceptions, and Other Factors Affecting ACT Scores. ACT Research Report Series 2006-1.
9. Roberts, Kerry L. and Sampson, Paulinen M. (2011). School board member professional development and effect on student achievement. *International Journal of Educational Management*, 25(7), 701-713.
10. Raychaudhuri, Amitava, Debnath, Manojit, Sen, Seswata and Majundra, Braja Gopal. (2010). Factors affecting Student's academic performance: A case study in agartala municipal concial area. *Bangladesh e-journal of Sociology*, 7(2).
11. Raychaudhury, Amitawa., Debnath, Manojit., Sen, Saswata and Majumder, Braja Gopal. (2010). Factors Affecting Students' Academic Performance: A Case Study in Agartala Municipal Council Area. *Bangladesh e-journal of Sociology*, 7(2).
12. Saenz, Terry, Marcoulides, George A., Jum, Ellen and Young, Ray. (1999). The relationship between college experience and academic performance among minority student. *The International Journal of Educational Management*, 199-207.
13. Sultana Habibullah, J.A. (2103). Factors Affecting Academic Performance of Primary School Children. *Pakistan Journal of Medical Research*, 52(2), 47-52.
14. Zajacova, Anna, Lynch, Scott M. and Espenshed Thomes J. (2005). Self-Efficacy and academic success in college, *Research in Higher Education*, 40(6), 677-706.

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HUMAN DEVELOPMENT IN KHYBER PAKHTUNKHWA

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ABSTRACT

The current study calculates the Human Development Index for KPK, by using secondary data for the period 1979-2012. Human development index is the summary measure of three indices, educational attainment index, health status index and income index. The results of this study show the consistent improvement in all three indicators of HDI, during the whole period of study. Educational attainment index shows that education system has achieved the significant improvements. Health status index also shows the consistent improvement in life expectancy, due to enhance of funding in health sector by Govt. as well as private sector. Similarly income index shows the expansion in income component of HDI due to better education, training and health facilities.

I. INTRODUCTION

Model of human development is recognized as one of the few greatest ideas of the 20th century, after the failure of trickle-down theory. This idea was expressed, conceived and promoted all over the world by Pakistani Dr. Mahbub-ul Haq. Human development is not taking into account only improved human abilities but it pays attention on using those capabilities completely by a qualifying structure for progress and employment. The model of Human development firstly concerns with growth of economic variables and then gives attention to its distribution and quality. The major difference between human development model and economic growth model is that economic growth is only concerned with expansion of income while development model grips the expansion of all human choices, financial, political and social etc.

People are considered to be the real asset of a nation. The main purpose of development is to develop a qualifying environment for societies to enjoy long, healthy and creative lives. According to human development report 2013 "The Human Development Index (HDI) is a summary measure of key dimensions of human development. It measures the average achievements in a country in three basic dimensions of human development: a long and healthy life, access to knowledge and decent standard of living" (*Human Development Report 2013*, p.2). Both long life and literacy are obviously valuable features of a good life, and also valuable components of the ability to do other tasks. But the third important element of human development is "command over resources" required for a "decent livening standard". Command over resources is considered a tool for other ends; the only income is considered the best proxy variable for this command. The objective of incorporating this in the HDI was to note the point that there are several skills which are depending upon the income level.

The HDI was generated to re-emphasize that individuals and their skills should be the ultimate criteria for evaluating the process of country's development not only growth of economic variables. Thus the HDI pulled the attention of NGOs, media and Economist's away from the economic variables to emphasis on human abilities. It opens the discussion on the topic that how two economies having similar per capita can be diverse in HDI values? For example Pakistan and Nicaragua have parallel per capita income, but Nicaragua has greater value of HDI as compare to Pakistan because of better life expectancy and literacy rate. These striking contrasts directly open debate on government planning about health and literacy, asking why what has been achieved in one country is far from the reach of the other. This summary measure also highlights differences within countries, among the capitals or states, across gender, ethnicity, as well as other socio-economic federations. Highlighting internal or regional inequalities along these lines have raised the national debate in many countries.

According to human development report 2014, from the last few years many countries have improved their progress regarding to human development and remaining countries are now going towards the better achievements. According to Human Development Report (HDR) 2013, greater than 40 developing economies, that is major part of word's population had achieved better outcomes in HDI components, while their predicted HDI value was very low in 1990s. Literacy rate has increased due to big investment in education sector and due to low infant mortality, better food security and improved nutrition, life expectancy has risen.

According to the UNDP human development report (2014) Pakistan has ranked at 146th out of 187 countries with 0.54 HDI value. Report shows the steady improvement in HDI value from 0.50 in 2012 and 0.515 in 2013. Though Pakistan's rank has improved during 2012 but little improvement has been made in attaining improvement in HD results. Though Government of Pakistan has achieved substantial success in sustainable economic growth level and dropping poverty in monitory form during the past decade, but the human development gap "i.e. what one might imagine for the country's income level and what is really observed" is large and going. A tremendous amount of research has been done both nationally and internationally regarding HD. However the literature does not provide latest evidences of HD research in KPK. Therefore, thirst to work on this study area till remains same. The entire situation led the author to carry a research on HD in KPK. The present study will encompass an era from 1979-2012.

II. LITERATURE REVIEW

Abbas (2000) checked the impact of human capital on economic growth, a relative analysis of two developing economies i.e. India and Pakistan. For empirical analysis he used the standard growth accounting methodology with human capital specifies an aggregate production function. In which (GDP) is dependent and employment, physical capital & human capital were used as independent variable. He used time series data from 1970 to 1994 and find that when human capital is represented by primary schooling enrollment rates then it has positively related to economic growth only for India. When secondary school enrollment rate was used as proxy for human capital then it has significant impact on growth for both Pakistan & India. He suggests that first of all Government of Pakistan allocate the significant amount of annual budget in technical

education & training programs to improve the labor as well as great attention should be given to increase the investment in primary, secondary & higher secondary education. India raises the budget spending at primary & secondary level of education & also allocates the budget in technical education to make the HC more productive factor of production, especially in rural areas.

Ranis (2004) determined the interrelation between human development (HD) & economic growth, he finds that human development does not directly affect the economic growth, but human development cause to improve the human capital and then HC effects the economic growth of a nation. He analyzed that different components of HD have distinct impact on EG, like education strongly effect on labor productivity, innovation & technology enhancement. Health also demonstrated positive impact on economic growth. Strauss & Thomas (1998) review a large literature, which provide evidence that how improved health & nutrition increases productivity & income. Schultz (2000) find the correlation between height & income, in his study that was conducted in Ghana, cote d-Ivories, Brazil & Vietnam, a range of labor productivity gains have been observed that were associated with increased calories in take in developing economies. Finally he concludes that the old view of "growth first & worry about HD later" is not supported by evidence.

Abbas and foreman-peck (2007) conducted the study for Pakistan to check the relationship between human capital and economic growth for long time period. Time series data was collected from 1960 to 2003. In order to measure the human capital they used the stock of human capital (at secondary level), literacy rate and health expenditures as percentage of GDP as proxy variables. He used Augmented Dickey Fuller (ADF) and Phillips-Perron test statistics to test the degree of integration and co-integration. Regression technique was used to find the long run relationship. To find the year to year changes in output per worker they used error correction equation. The results indicated that about 47% growth of output is explained by employed labor force, 12% from human capital and contribution of physical capital was only 7% over the whole period from 1961 to 2000. It means that output elasticity of raw labor is higher than elasticity of human capital; it may be due to inefficient measures or proxies for human capital because there is ineffective education system in Pakistan.

Leeuwen and Foldvari (2008) seek the evidence about two major historical views regarding the human capital and economic growth by Lucas (1998) and Romer (1990). They conduct the study for three countries i.e. Japan, Indonesia and India. Time series data was used from 1890 to 2000. Unit root test was used to validate or falsify the theoretical importance of hypothesis, while Johenson co-integration technique was used to test the long run relationship between the variable. Long run relationship between human capital and economic growth is considered as an initial hypothesis and after empirical analysis this hypothesis was accepted only for developing countries like India and Indonesia according to Lucas. But in case of Japanese economy Lucas theory was only applied first half of the 20^{th} century, while after 1950 technology was improved and large amount of human capital was employed to extend the technology, so after second half of 20^{th} century Romer's theory was applied.

Ahmed, Abdullah & Sharif (2010) conduct the study to verifying the contribution of human resource development efforts in growth process of Bangladesh. They used data from 1991–2010. They used the couple of econometric test, i.e. Augmented Dickey Fuller (ADF), unit root test & Engle Granger co-integration to check the co-relation between human recourse development and economic growth process in Bangladesh. This research also used error-correction mechanisms to take care of short run dynamic. Finally they conclude that human capital & knowledge are main causal factors that affect the economic growth.

Farooq, Chaudhry and Ali (2012), examined the role of human capital formation in economic growth in Pakistan. They used secondary data from 1972–1973 to 2010–2011. By using OLS method where GDP is independent variable while education enrollment index, gross fixed capital formation, gini co-efficient, head count ratio infant mortality rate, investment growth rate & CPI inflation rate are serve as independent variable. Regression error in equation of this model will be tested for autocorrelation with the help of Durbin Watson test stats. Study finds that there is long run relationship between dependent & independent variable of the model. According to results there is negative impact of head count ratio & investment growth rate on economic growth while gross fixed capital formation, education enrollment index and genii co-efficient are positively related with economic growth. Finally study suggests that Gov. should give more attention in advancement of technology, training and skills to improve HC for EG. Gov. should improve the productivity of labor & quality of life through investment in HC.

Rehman & Khan's (2012) analyzed the human capital in different provinces of the country by using descriptive analysis in Pakistan. They recognized that condition in urban areas is better than rural areas. Reason is better educational status in urban areas, which spread awareness in the inhabitants of those areas about health & learning. Study recommends that abilities of work force can be raised by investing in human capital that can increase marginal productivity for physical capital. Work force of Pakistan might be raised to the world standard after a big investment in human capital. But a lot of time is required to improve in quality of health & education.

Ilegbinosa (2013) stated that as Nigerian economy is rich blessed with human resource as well as natural resource but still country operates on slowing growth rate. So this study finds the impact of investment in human capital on growth and development of the economy. Study also checks the relationship between investment in human capital and growth. They used the primary data that was collected through questionnaire which were distributed among higher institutes. For the purpose of analysis they used chi-square technique. They find that investment in human capital has statistically significant impact on development but problem is that Govt. allocates very small amount in education sector. Study recommends to the federal Govt. to increase their spending in human capital formation in the form of investment in education sector and also improve the quality of education. In order to improve the skills of labor force, companies and industries should arrange the seminar, trainings and workshops etc. Rather than Govt. the private sector also participate about investment in human capital.

Hanushek (2013) observed that investment in human capital especially in education is the main key factor of economic growth in developing economies. He analyzed that poor

economies have made attention in covering the gap with developed economies in terms of quantity of schooling, not quality of education. Without improving the quality of education developing countries cannot achieve long run economic growth. Finally he concludes that much of appreciation for human capital policies in developing economies is the possibility of providing economic growth & in the result of economic growth, level of income will improve.

III.HUMAN DEVELOPMENT INDEX

There are several measures and proxies to measure the human development, but usually health, education and living standard are considered to be substantial components of HD, so this research also adopt the same measures . The HDI consist of three equally weighted components, a long and healthy life which is measured by life expectancy, knowledge or education is measured by average year of schooling and expected year of schooling while decent standard of living is measured by per capita.

By following the technique that used in UNDP (2013), we build educational attainment index, health status index and income index, by cumulating these three indices we will obtain human development index for KPK. Required data is collected from HIES, PSLM, and PDHS.

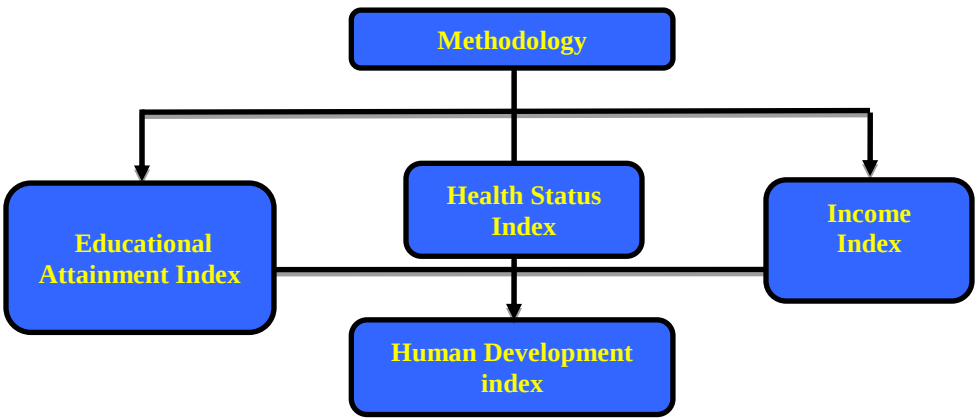

Fig 3.1: Methodology

Educational Attainment Index

The education component of HDI has depend upon two measures, mean year of schooling and expected year of schooling, but due to non-availability of data we use the net enrollment rate (at primary level 4-9) and percentage of literates in labor force as proxies for education. Two third weights is assign to literates in labor force and one third is assign to combined enrollment rate. In Pakistan, primary net enrollment rate is defined as "the number of children aged 5 to 9 year attending primary level divided by the total number of children aged 5 to 9 year" (*Pakistan Economic Survey* 2012-13).

$$EAI = \frac{(2/3)(L) + (1/3)(E)}{(100 - 0)}$$

where 0 is lower limit and 100% is upper limit of education. Data has been collected from PSLM and HIES (various issues)

Health Status Index

According to UNDP, health is second components of HDI. The situation of an individual's body is a significant component of overall wellbeing of that person. Employment opportunities are also governed by physical welfare. Thus, labor market contribution and earning prospects may be affected by poor health condition. Fitness seems to be one of the vital measurements of human development. However, it is the most difficult part to measure the health status of human body in numeric form. But there are some proxies to measure the health status.

In this context life expectancy at birth is considered the best proxy. Due to data constraint at provincial level, we adopt an indirect route. In ordered to measure the life expectancy at birth, crude birth rate and infant mortality rate are considered to be the best proxies. Infant mortality rate is considered a significant component to evaluate the welfare of infants. It is defined as "infant mortality rate is the probability of dying before the first birth day". (*Pakistan Demographic Health Survey*). This rate is expressed as 1,000 live births. Crude birth rate is defined as "annual number of live births per one thousand persons". Crude birth rate is called crude because it does not consider age or gender differences among the population. Less than 18% live births are considered low crude birth rate and greater than 30% live births are considered to be the high rate. (*Issues in Pakistan Economy* by S. Akbar Zaidi).

In order to obtain the life expectancy for KPK, we collected the data on three indicators, life expectancy, crude birth rate and infant mortality rate from 1960 to 2013(WDI) for south Asian regions (Afghanistan, Bhutan, Bangladesh, India, Nepal, Maldives, Pakistan and Sri Lanka) and fitted the following regression,

$$Life\exp ec\tan cy = 78.574 - 0.2069(CBR) - 0.144(IMR)$$

By substituting the values of crude birth rate and infant mortality rate in above equation we get life expectancy for KPK. To get the value of health status index, we use standard procedure that is given in UNDP; human development report (2013) is followed.

$$HSI = \frac{(Life\exp ec\tan cy - 20)}{(83.6 - 20)}$$

Lower limit of life expectancy is 20 years, while its upper limit is around 83.6 year. The data on CBR and IMR has been collected from Demographic Health Survey published by national institute of population studies (various issues) and Pakistan Bureau of Statistics SHMI section.

Income Index

Per capita income is necessary to calculate the income index that is third key component of HDI. Data on per capita income is not available at provincial level; there for household average monthly income is used to calculate the income index at provincial level. It is defined as, "income in cash includes all money receipts such as wages,

salaries, rent from land, property, income from self-employed, gifts and assistance" (*Household Integrated Economic Survey*). In the income index 100$ is set as minimum level while $87478 is set as maximum level of income. Data has been collected from (*Household Integrated Economic Survey*, various issues).

$$II = \frac{(HouseholdIncome) - \ln(100)}{\ln(87478) - \ln(100)}$$

Human Development Index

HDI is summary measure of key dimensions of HD. It measures the average achievements in a country in three basic dimensions of HD; long and healthy life, access to knowledge and a decent standard of living. In numeric form HDI is the geometric mean of normalized indices from each of these three dimensions, UNDP report (2013)

$$\sqrt[3]{II * EAI * HSI}$$

By adopting the above formula, we calculate different values for HDI from 1979–2012.

IV. HUMAN DEVELOPMENT ANALYSIS

In this section we present the analysis in empirical form by using the education, health and standard of living as proxies for human development. Numeric data was taken from 1979-2012 and calculate human development index for KPK. The trend of human development index is going upward especially in past decade and remaining is persistent during the whole study because Pakistani nation has achieved substantial improvement in sustainable economic growth and dropping income poverty. The reason is improved education system, better health facilities and better standard of life.

HDI Values for KPK

Table 5.1: Human Development Index (KPK)

Years	Geo Mean	Average
1979	0.47	0.49
1984-86	0.49	0.51
1990-92	0.53	0.53
1993-97	0.58	0.58
1998-99	0.60	0.60
2002-03	0.62	0.62
2004-05	0.61	0.61
2005-06	0.62	0.63
2006-07	0.62	0.63
2007-08	0.62	0.63
2010-11	0.64	0.64
2011-12	0.65	0.65

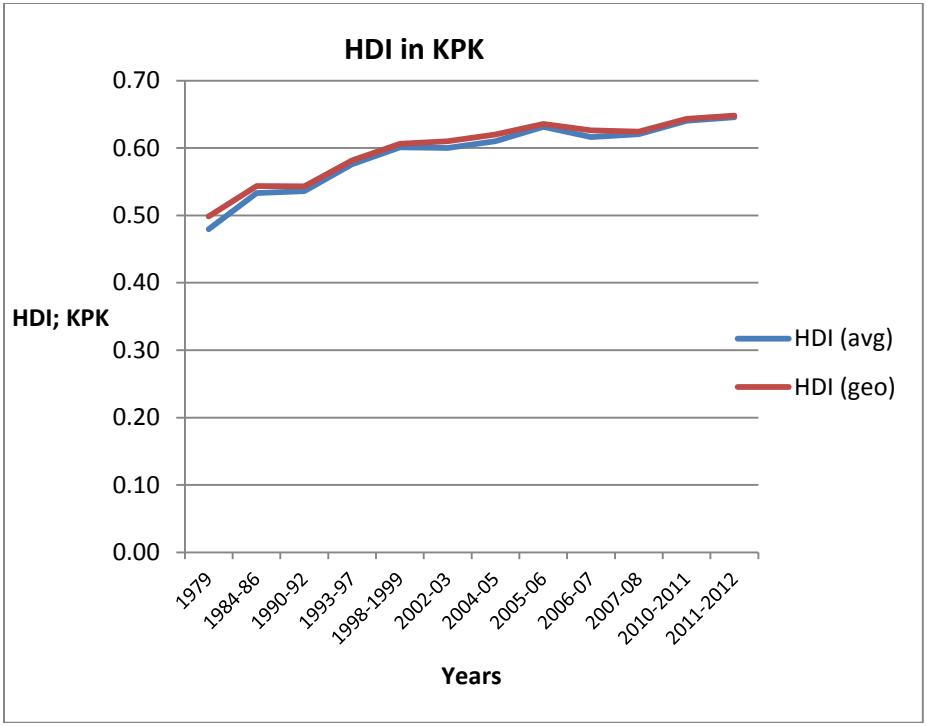

Fig. 5.1: Human Development Index (for KPK)

Current study made an effort to provide the descriptive analysis of the human development in KPK, the province of Pakistan, from 1979-2012. The results of this study show the consistent improvement in all three indicators of HDI, (as shown in figure) during the whole period of study. Educational attainment index shows that education system has achieved the significant improvements in each province of the country due to enhance of funding by government as well as private sector. Under the national education policy (2009), the government was committed to spend 7% of GDP on literacy and spread the free universal primary education. Under the 18th Constitutional Amendment, the education sector has been decentralized to the provinces, now provinces are responsible to implement the national education policy as effective as possible.

Health status index also shows the significant improvement in life expectancy, due to enhance of funding in health sector by Gov. as well as private sector. The number of registered doctors, dentists, nurses, lady health visitors has been increased, additional hospital beds, rural health centers and basic health units were established. Government also launched a series of programs and projects to develop the health status of the people and to reduce the burden of diseases; including TB, malaria, cancer and AIDS etc.

Similarly income index shows the expansion in income component of HDI due to better education, training and health facilities. Government allocates the minimum of 4.5% of GDP to public and poverty reduction strategies. Pakistan poverty alleviation fund (PPAF), Benazir income support program (BISP), peoples works program, workers

welfare funds, Pakistan Bait-ul-mal and Zakat fund were also launched to raise the living standard of the society and to reduce poverty.

Human Development Index for Pakistan

Table 5.2: Human Development Index (for Pakistan)

Years	HDI Pakistan	Years	HDI Pakistan
1991	0.31	2003	0.50
1992	0.30	2004	0.50
1993	0.31	2005	0.52
1994	0.39	2006	0.54
1995	0.48	2007	0.55
1996	0.44	2008	0.55
1997	0.45	2009	0.53
1998	0.45	2010	0.49
1999	0.51	2011	0.50
2000	0.52	2012	0.50
2001	0.49	2013	0.53
2002	0.50	2014	0.54

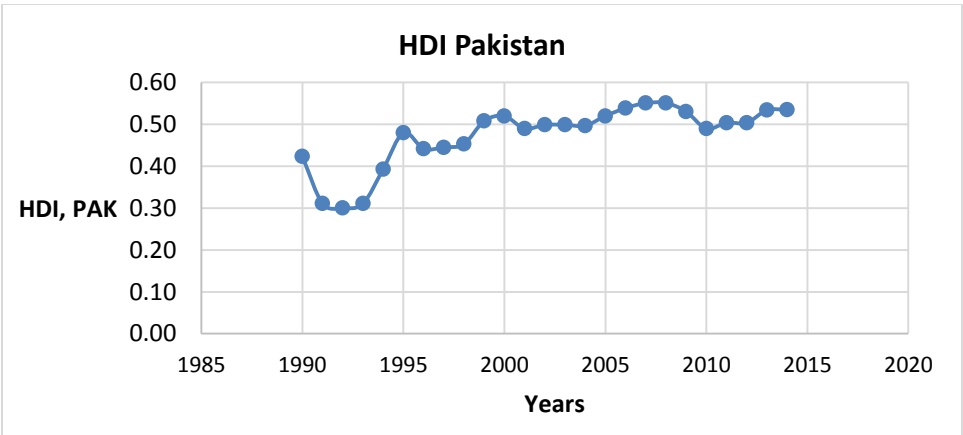

Fig 5.2: Human Development Index (for Pakistan)

Trend in the values of HDI that was calculated for Pakistan is generally positive and going upward, but lees than KPK. According to human development report 2014, Pakistan lies among the low human development category which is ranging from 0.34 to 0.54. And KPK lies in the category of medium human development, ranging from 0.55 to 0.69. The HDI value for KPK was 0.65 in 2012. This is so because in Pakistan there are some regions, other than KPK, whose performance in HDI is quite poor

Comparison between KPK and Pakistan

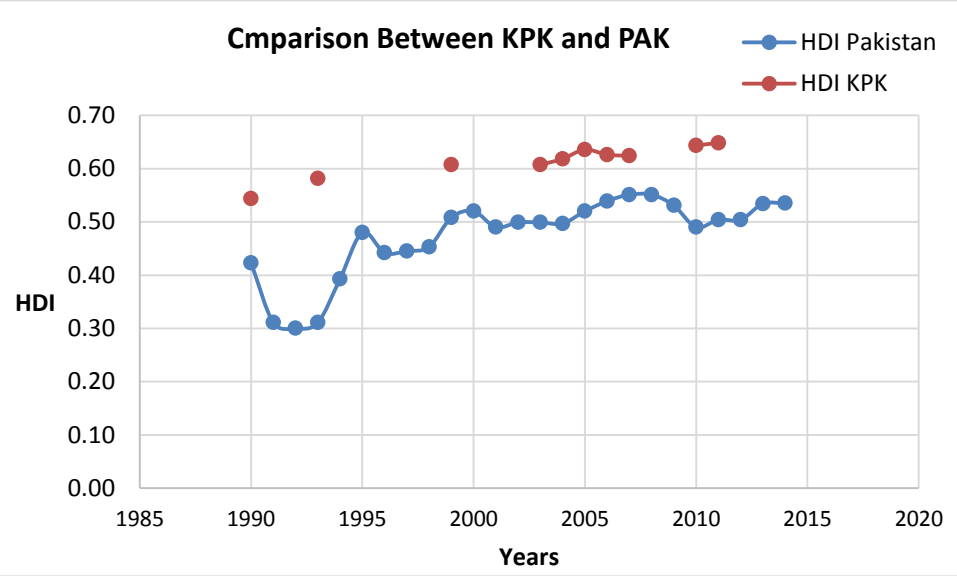

Fig 5.3: Comparison between KPK and PAK

The values of HDI that is calculated for KPK is throughout high as compare to Pakistan from 1990 to 2012. According to Social Policy and Development Centre(SPDC) Research report NO. 73,(TRENDS IN REGIONAL HUMAN DEVELOPMENT INDICES)Reason is high annual growth rate in HDIs as compare to other provinces of the country. It was more than 3% in 14 districts of the provinces out of 24 districts. This rate was less than 1% in most districts of Balochistan and over all annual growth rates for the country is only about 3%.

Another reason is that two districts of KPK (Haripur and Abbottabad) lie in top ten districts of the country according to their estimated values of HDI (0.7339, 0.7304) respectively, while only one from Balochistan. According to UNDP categorization of HDI, seven districts of Balochistan were lying in low HDI, while only three from KPK.

According to human development report 2014, Pakistan lies among the low human development category while KPK lies in the category of medium human development because 5districts of KPK show the extra ordinary annual growth rate (more than 4%) in HDIs, while 2 from Sindh, 2 from Balochistan and only one from Punjab. There are 4 districts from Punjab, 2 from Balochistan and 6 from KPK which moved at least 10^{th} position upward in HDIs ranking because of education and income index from 1998 to 2005. There are some districts who have lose their position in HDI ranking due to insufficient or negative growth in HDI components especially in income component, including 6 districts from Punjab, 7 from Balochistan and only 4 from KPK.

V. CONCLUSION AND SUGGESTIONS

Taking an advantage of the UNDP National Human Development Report, this research has applied the concept of HDI at provincial level from 1979 to 2012.The results of this study show the consistent improvement in all three indicators of HDI.Spending on education and health improved the MDG's indicators in these areas: net primary enrollment, completion rate to grade five and adult literacy rate.

Health conditions of the population are better now, but health indicators still remains poor as compared to other Asian countries due to low rate of progress. The speed of improvement is not satisfactory due to some reasons including low budget spending, low literacy level, poverty,lack of civic facilities, food insecurity, poor dietary habits and shortage of safe drinking water as compare to other Asian regions. One major reason of low life expectancy is higher population growth rate at 2.00% in 2013. Pakistan can achieve better health outcomes by creating awareness among masses through seminars, conferences and education by increasing budget spending on health and education sector.

The government of Pakistan is making every effort to raise the income level, reduce poverty, improve living standard and make the lives easiest. Government decided to increase the expenditures on pro-poor sector, which was RS.977228 million in 2008-09, this ratio has been increased up to RS.1980819 million in 2011-12 which was 9.9% of GDP. These expenditures were made on roads, highways, water supply & sanitation, literacy, population planning, social safety & welfare, unusual climates, agriculture, rural development, subsidies, food support programme, people's programme-1, people's programme-2, low cost housing, justice administration and law & order. According to this research, some policy recommendations are stated as follows:

- Government can increase the enrollment rate, especially in those areas where the facilities of education, (primary education) are inadequate. In this way Education contributes to raise the economic activities through the production of knowledge and skills. It also raises labor productivity and quality of life.
- The govt. as well as private sector can play their active role by opening up of health centers and health units in rural areas. They will be helpful in reducing the infant mortality rate and improve the health status, which may increase life expectancy.
- To get improved results of HDI and standard of living, it is suggested that Government can increase the job opportunities for people in rural areas as well as urban areas.

REFERENCES

1. Abdullah, S., Ahmed, J. and Sharif, T. (2010). Human Resource Development and Economic Growth in Bangladesh: An Econometric Analysis. *European Journal of Business and Management*, 5(7).
2. Abbas, Q. (2000). The Role of Human Capital in Economic Growth: A Comparative Study of Pakistan and India. *The Pakistan Development Review*, 39, 451-473.
3. Abbas, Q. and Foreman-Peck, J. (2007). *Human Capital and Economic Growth: Pakistan*. JEL Classification: C13, C22, C51, O15, O53.

4. Ali, S., Chaudhry, I.S. and Farooq, F. (2012). Human Capital Formation and Economic Growth in Pakistan. *Pakistan Journal of Social Sciences*, 32, 229-240.
5. Foldvari, P. and Leeuwen, B.V. (2008). Human capital and economic growth in Asia. *Asian Economic Journal*, 22(3), 225-240.
6. Hanushek, E. (2013). Economic Growth in Developing Countries: The Role of Human Capital. *JEL Classification*: I2, O4, H4.
7. Ilegbinosa, A.I. (2013). Human Capital Investment as an Effective Tool for Economic Development in Nigeria. *International Journal of Management & Business Studies*, 3, ISSN: 2230-9519.
8. Jamal, H. and Khan, A.J. (2007). Trends in Regional Human Development Indices. *Social Policy and Development Centre (SPDC)*, Research report No. 73.
9. Khan, M.A. and Rehman, H. (2012). Regional Disparities in Human Capital the Case of Pakistan. *Pakistan Economic and Social Review*, 50, 57-69.
10. Planning Commission of Pakistan (2013). Economic Survey of Pakistan, Government of Pakistan. Printing Corporation of Pakistan, Islamabad.
11. Ranis, G. (2004). Human Development and Economic Growth. *Economic Growth Center Yale University*, No. 887.
12. United Nations Development Programme (2013). *Human Development Report 2013*. New York: Oxford University Press.

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ANALYSIS OF ISSUES IN OFFSHORE SOFTWARE OUTSOURCING

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ABSTRACT

Software outsourcing is meant to engagement of an external developer or a team of developers in a foreign country to implement some local business tasks. This common definition of outsourcing can be distinguished from off shoring, where the tasks are performed in an overseas country by a distant subsidiary. Most of the researchers point out that such practice of sending an effort outside the country with high remuneration reduces their own domestic employment and investment. The purpose of this paper is to find out different issues in offshore software outsourcing and an endeavour has been made to propose their possible solutions.

1. INTRODUCTION

Outsourcing is a business approach which is adopted by many application and system development groups in different environments. In the business terminology it is a contract or agreement of providing some services or products of a business process with some other organization. Sometime it is also possible in outsourcing to relocate employees, assets and services from one business organization to some third organization but not permanently. Software Outsourcing is further divided in to three sub types such as: Inshore software outsourcing, near shore outsourcing and offshore outsourcing [1]. "Inshore" outsourcing is done when the vendor and customer organizations are in the same locality or district. When vendor and client organizations are in different countries but these countries are not so far away but in neighbourhood of each other, it is called "near shore" outsourcing. While outsourcing to a vendor which is in a country of a different continent than that of the client organization, it is called "far shore" or "offshore" software outsourcing.

Offshore software outsourcing is a form of global software development or distributed software development which can be established on an agreement-based association between vendor and customer organizations. Offshore software outsourcing is mostly used by customer organizations when the main purpose is to reduce software development cost [2]. Problems like language barriers, cultural and communication, management, country instability are the main limitations of offshore software development which can have an immense effect on both vendor and client organizations. As a consequence these limitations become big problems and issues in Offshore software out sourcing business strategy [3].

This research aims to analyse these issues in offshore software outsourcing and its implications. It also aims to discuss possible solutions in the context of Pakistan's software business.

2. ISSUES IN OFFSHORE SOFTWARE OUTSOURCING

In today's era of software boom, participation in software outsourcing business can bring a lot of revenue to a country. To have a grasp over the business it is vital to understand the issues as to be able to tackle them when confronted with them. The following sections present a discussion and analysis of some mostly talked about issues in offshore software outsourcing.

2.1 Requirements Misconception

The deviations from client expectations is major barrier in outsourcing as requirements can be ambiguous. A clear understanding of the customer expectations and collection of organization's requirements are challenging tasks to realize in general and practically in an offshore development environment [4]. The reasons include lack of communication between client and vendor, unclear definition of client requirements, and unclear business objectives [5].

2.2 Communication Barriers

Due to geographically scattered team in offshore software development face-to-face contact and discussion is not possible at all times which is needed to clarify any misunderstandings. Instead in outsourcing processes telecommunication tools such as fax, phone, electronic-mail, and Voice Over IP (VOIP) are commonly used [6] which work to a large extent but still cannot fully replace face to face communication. Proper communication and collaboration among distributed team members is key to the success of the project as shared understanding of the system being designed is vital and urgent. These communication barriers can be removed by proper initial planning, and a planned setup of team meetings and client-vendor contact using any of the above mentioned methods [7].

2.3 Cultural Differences

Researchers and practitioners have highlighted that culture is also a critical success factor in software outsourcing development relationship. Difference of cultures among offshore team members have an adverse impact on team performance and may cause misunderstandings [8]. There is always a difference of everyday routines and culture of people across global teams, which is unavoidable in case of outsourced projects [9].This social problem can also become drastic and can cause failure of an offshore project. To make project success we should concentrate more carefully on general understanding of the social structures of vendor and client organization.

2.4 Project Management

Project management plays a vital role in the success of large scale development ventures and in outsourcing projects it adds another level of complexity. In budding software development industries, such as in Pakistan, approximately half of project managers working on outsourced projects do not have a prior experience of managing

such type projects having where multiple critical issues are to be handled at the same time. Another reason may be to use an appropriate development methodology to have the flexibility to incorporate time-delayed plans into normal development cycles. Lack of technical know-how about the use of available CASE tools certainly help in distributed knowledge management and sharing is also a factor affecting project management of outsource software development projects [4, 10].

2.5 Software Maintenance Outsourcing

The maintenance of a system built from outsourced modules is a very complicated task. Reliable maintenance and preservation is only possible if satisfactory measures are taken prior to project's starting and maintenance stage, and accepted in the maintenance deal. It is suggested that the vendor's organization will be informed in advance about the overall maintenance that may occur in future, specifically for remedial and adaptive maintenance. Also these activities should be well documented [11].

3. PROPOSED SOLUTION TO OUTSOURCING ISSUES

The following sections propose solutions to the problems in offshore outsourcing mentioned in the previous section.

3.1 Solution to Requirements Misconception

Different authors have presented different solutions about the requirements misconception problem which is a critical challenge in offshore software outsourcing. Study shows that this issue can be solved to a greater extent by formally employing Win-Win Spiral Model [17] as software development process. In this model vendor and customer move into a process of negotiation, in which the customer may be requested to balance performance, functionality, and other product features against human resources and cost(time and budget) to market. Among customer and vendor organizations the best dialogue and conversation derives a "win-win" end result. That is to say, the customer or client wins by receiving the product that fulfills the majority of the customer organization desires and the developer organization wins by convincing customer over feasible budget and cutoff date [12]. Win-win spiral model defines a set of activities which are based on negotiation at the beginning of each process around the spiral model [13, 14]. Figure 1 shows that major activities of the Win-Win model, which clearly shows multiple communication stages throughout the development process, rather than the normal customer-developer communication in the beginning of a project.

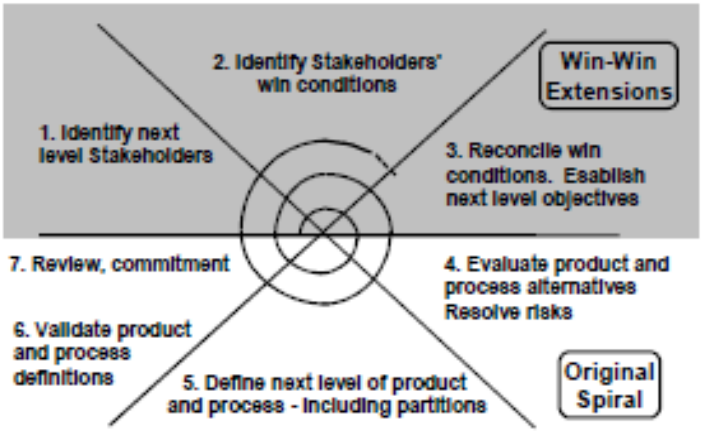

Figure 1: Win-Win Spiral Model [17]

3.2 Proposed Solution to Communication Barriers

Foreign language is the main problem in maintaining proper communication and collaboration link among development teams. English is most widely used language in the internationalized software development industry. As it may be the case that it is a foreign language for the customer and/or developer organization(s), therefore, there may be some communication gap due to language, multifold due to geographical distance among them. This language barrier and communication problems can be solved by hiring a special IT experts/managers to handle communication and collaboration requirements for status and planning meetings, etc.

Considering the offshore software outsourcing business development in Pakistan, it is a general observation that English language is not a critical barrier here. As in Pakistan's universities medium of instruction is English language and graduates can speak, read and write English with an appropriate competence. Therefore, Pakistan is easily join the international business of IT, especially in the flourishing business of establishing call centers in different countries.

3.3 Proposed Solution to Cultural Differences Problem

For companies in outsourcing business it is possible to hire IT managers who have specific culture and social behavior related information about clients from different regions of the world. For example there may be a project manager who has a notable experience of working with clients from European countries may be assigned European projects and likewise a project manager with prior experience of working with Arab companies is assigned projects of Arab clients. The managers will then be able to deal properly with clients, will be able to guide their team, and also can act as a mediator during technical meetings among client and vendor organization.

As Pakistan is situated in a central location in Asia, has different close neighboring countries of different cultures. Hence it is possible for IT professional to easily get used to the cultures of India, Central Asian and South East Asian countries, as well as of Arab nations. With an increased number of foreign graduates in It and Computer Science, and

academic level cooperation of Pakistan's Higher Education Commission (HEC) it is possible to find managers and developers who have experience of working with people from Europe and America. This will greatly help Pakistani software development companied to tackle with problems related to cultural difference when working with clients from these areas [15].

3.4 Proposed Solution to Project Management Problem

For outsourcing projects it is suggested to employ two responsible members as project managers. These managers will work as project managers and as developers alternately. So each project manager will also be involved in technical tasks and each one will be able to put more time in critical tasks of project management. This insight into technical and project management issues will help the managers to clearly understand and related technical issues with project management. Also, information sharing among both managers will further improve the situation.

3.5 Proposed Solution to Software Maintenance Problem

The maintenance of project is depend on client and vendor's organization contract, that what they have decide in the contract and for how many time and what kind of maintenance is expected in future. It is recommended that steadfast maintenance is only possible if satisfactory analysis is done prior to the project's beginning and of maintenance phase. Also it should be acknowledged in the maintenance agreement.

In offshore outsourcing projects vendor and client organizations are in different countries which makes the maintenance work much more difficult. Use of up-to-date and state of the art CASE tools and designing comprehensive documentation of product may greatly help the client organization as well as to other vendors hired for maintenance tasks in future.

4. OBSERVATIONS AND ANALYSIS

As different researchers have notified different issues in offshore software outsourcing, which are more critical for some countries and for some, not. Different countries have different rules and regulations, culture, languages and social behavior etc., It is observed that requirement misconception will not be a critical issue if Win-Win Spiral model is followed, because in this model requirements are obtaining through negotiations with clients and are updated regularly. As explained above, communication is not so critical issue for Pakistani software vendor organizations. Pakistan's IT directorate gives major incentives to the international software development organizations which include hundred percent equity tenure, hundred precent deportation of investment and bonuses, and has exempted IT industries from tax till 2016 [16]. So foreign IT business organizations are invited to join the Pakistan IT industry for investment, through this motivation the cultural problem can solve through international and cross functional, and cross cultural teams. There is a large talent-pool of cost-competitive, and professional skilled workforce, along with a large number of internationally-certified companies and availability of reliable telecom infrastructure, etc. which are the requirements for a software development industry.

5. CONCLUSION

Software outsourcing is a favorable business model for many obvious reasons yet it carries a number of socio-technical complications. These complications broadly include requirements misconception, communication gap and difficulties, cultural differences, project management and software maintenance in general. This research shows that many of these above mentioned problems outsourcing are not as much critical for those clients who are outsourcing to South Asian countries - especially to Pakistan. In South-Asia India grasps lot of outsourcing business. Pakistan in the neighborhood of India can enjoys the same benefits and can participate in this business at least at the same level. As the cultural and social behaviors of both countries are related, the foreign clients will not face an entirely different social and technical setup. The research suggests that the problems of requirements misconception and client expectations can be solved by employing the win-win spiral model. Whereas, communication and problems in information sharing can be solved by employing IT experts who also have a hold on foreign languages. For large scale outsourcing it is also suggested to employ two mangers, both working in general project management and on the technical side, specifically to tackle with technical issues arise due to the specific technical in offshore software outsourcing. In the context of promotion of software offshore outsourcing business, by all means Pakistan is a favorable country and its IT industry is ready to take a leap in this direction.

REFERENCES

1. Gonzalez, R., Gasco, J. and Llopis, J. (2006). Information systems offshore outsourcing: a descriptive analysis. *Industrial management & data systems*, 106, 1233-1248.
2. Kirkegaard, J.F. (2004). Offshore outsourcing-much ado about what, in *Cesifo Forum*, 22-29.
3. Nakatsu R.T. and Iacovou, C.L. (2009). A comparative study of important risk factors involved in offshore and domestic outsourcing of software development projects: a two-panel delphi study. *Information & Management*, 46, 57-68.
4. Jalil, Z. and Hanif, A. (2009). Improving management of outsourced software projects in Pakistan, in *Computer Science and Information Technology, ICCSIT 2009. 2nd IEEE International Conference*, 524-528.
5. Islam, S. Joarder, M.M.A. and Houmb, S.H. (2009). Goal and risk factors in offshore outsourced software development from vendor's viewpoint, in *Global Software Engineering, ICGSE 2009. Fourth IEEE International Conference*, 347-352.
6. Holtbrügge, D. and Schillo, K. (2008). Managing from a distance: virtual delegation to India, in *Rightshore!*, Ed: Springer, 121-144.
7. Sangwan, R.S. and Ros, J. (2008). Architecture leadership and management in globally distributed software development, in *Proceedings of the First International Workshop on Leadership and Management in Software Architecture*, 17-22.
8. Herbsleb, J.D., Mockus, A. Finholt, T.A. and Grinter, R.E. (2000). Distance, dependencies, and delay in a global collaboration, in *Proceedings of the 2000 ACM Conference on Computer Supported Cooperative Work*, 319-328.

9. Winkler, J.K., Dibbern, J. and Heinzl, A. (2008). The impact of cultural differences in offshore outsourcing—case study results from german–indian application development projects, *Information Systems Frontiers*, 10, 243-258.
10. Sutherland, J. Viktorov, A., Blount, J. and Puntikov, N. (2007). Distributed scrum: agile project management with outsourced development teams, in *System Sciences, HICSS 2007. 40th Annual Hawaii International Conference*, 274a-274a.
11. Ahmed, R.E. (2006). Software maintenance outsourcing: issues and strategies, *Computers & Electrical Engineering*, 32, 449-453.
12. Munassar, N.M.A. and Govardhan, A. (2010). A comparison between five models of software engineering, *IJCSI*, 93.
13. Boehm, B. and Hansen, W. (2001). The spiral model as a tool for evolutionary acquisition," *Crosstalk*, 14, 4-11.
14. Singh, B., Sharma, K.D. and Chandra, S. (2012). A new model for software risk management, *International Journal of Computer Technology and Applications*, 3.
15. Nauman, A.B., Aziz, R., Ishaq, A. and Mohsin, M. (2004). An analysis of capabilities of Pakistan as an offshore it services outsourcing destination," in *Multitopic Conference, Proceedings of INMIC 2004. 8th International*, 403-408.
16. Mujahid, Y.H. (2002). Digital opportunity initiative for Pakistan, *the Electronic Journal of Information Systems in Developing Countries*, Vol. 8.
17. Boehm, B. and Hansen, W.J. (2000). *Spiral development: experience, principles, and refinements* (no. Cmu/sei-2000-sr-008). Carnegie-mellon univ pittsburgh pa software engineering inst.

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THE EFFECT OF AGGRESSIVE WORKING CAPITAL MANAGEMENT POLICIES ON FIRM'S VALUE (NON FINANCIAL FIRMS)

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ABSTRACT

The study was conducted to find out the effect of aggressive working capital management investment and financing policies and its effects on firm market value. The study was conducted on non financial firms listed at Karachi Stock Exchange. On convenient sampling technique 100 non financial firms were taken as a sample of the study. The data was collected from 2007 to 2012. Panel data regression was applied on the data. As per the results of working capital investment policy; 1) working capital investment policy has negative (-6.5669) but significant (t-value: -3.1093; p-value: 0.00198) effect on firm value. 2) Size has positive (1.11745) but insignificant (t-value: 0.7800; p-value: 0.43576) effect on firm value. 3) Leverage has positive (1.62667) but significant (t-value: 14.8091; p-value: 0.00001) effect on firm value. The results of working capital financing policy are; 1) working capital financing policy has positive (1.08106) but insignificant (t-value: 1.8399; p-value: 0.06638) effect on firm value. 2) Size has positive (1.21151) but insignificant (t-value: 0.8245; p-value: 0.41006) effect on firm value. 3) Leverage has positive (1.00423) but significant (t-value: 2.6826; p-value: 0.00755) effect on firm value. The results of multicollinearity test shows that there is no problem of multicollinearity in the data. White's test for heteroskedasticity shows no problem of heteroskedasticity.

KEYWORDS

Working capital management, Investment policies, Financing policies, size, leverage.

INTRODUCTION

This study shed light on the analysis of working capital management and its relationship with firm's profitability and risk of the firm, whether aggressive or conservative form of decision making creates value of the firm. Traditionally in literature corporate finance has focused on long term decision making like capital structure, investment, company valuation or dividend decisions, nevertheless short term liabilities and assets are also major component of total assets and it call for deliberate analysis. The management of these short term liabilities and assets justified their self, since the

management of working capital contributes in the risk and profitability and value of the firm (Smith, 1980).

Working capital is the capital invested in the marketable securities, account receivables and inventories (short term assets) of the firms, is also named as gross working capital (Brigham Houston). Working capital management is basically managerial accounting strategy center upon preserving both elements of working capital, short term assets and liabilities at optimal level. This management of working capital assures that the firm should have enough cash flow to meet operating expenses and obligation of current liabilities. The firms should ensure an optimal level of working capital for the maximization of their values (Deloof 2003, Howorth and Westhead 2003, Nazir and Afza 2007). While on the other hand liberal policy of trade credit and prominent inventory of the firm may cause of increase in the sales, because this can reduce the risk in case of stock out of the firm. Liberal trade credit policy may induce sales of the firm because it appropriates the customers to evaluate the quality of the product before paying (Deloof and Jegers, 1996; Long, Malitz and Ravid, 1993). The reason why companies provide credit to their customer is that suppliers have substantial cost advantages than credit provided by financial institution to their customers, and this is also cheap source of financing for their customers (Rajan and Petersen, 1997). The other aspect of having liberal credit policy and maintain high inventory may cause of locked up the money in the working capital of the firm.

The efficiency of the working capital management has significance for manufacturing organizations since short term asset is a major component of total assets (Horne and Wachowitz, 2000). Working capital management has directly effect on the liquidity and profitability of the firms (Rehman and Nasr, 2007). Due to liquidity/profitability trade off If the firm's management does not pay consideration on working capital management may leads towards bankruptcy (Kargar and Bluementhal, 1994). The efficiency of working capital management significance is irrefutable (Filbeck and Krueger, 2005).

In practice, to manage the working capital of the organization is the most crucial subject for the management, where the financial executives struggle to identify the key factors of indication and optimal level of working capital (Lamberson 1995). Accordingly firm can manage their risk appreciate their performance by realizing the indicators and their roles in the working capital. Firms can assume aggressive (a policy where minimum investment in current assets while extensive exercise of current liabilities) or conservative (extensive investment in short term assets while minimum utilization of short term debts) working capital policy. By employing an inordinate level of short term (aggressive working capital policy) have negative impact on the profitability of the firm, while maintaining minimum level of current assets may leads the firm into liquidity problem and stock out may disturb the operation of the firm (Wachowicz and Van Horne 2004).

Globally many researchers focused on to find out the relationship between valuation of working capital management and its relationship firm's profitability such as such as Samiloglu and Demirgunes, 2008; Uyar, 2009. While there are few researches conducted on working capital management policies (aggressive and conservative policy) and profitability in the context of Pakistan such as Shah and Sana 2006; Afza and Nazir 2007 and 2008 and Rahman and Nasr 2007.

LITERATURE REVIEW

Working capital management always remains an important research area in finance literature and still researches are conducted to explore its different aspects to increase the profitability and liquidity of the businesses. Anand and Gupta (2001) analyzed the relationship between working capital profitability and risk and reached at conclusion that effective working capital management increase firm profitability and decrease insolvency risk. Working capital management is one of the most important functions of corporate finance because it's directly linked with risk and return.

Most of the previous studies identified the relationship of working capital with profitability by using financial ratios but very few link this concept with working capital policies. According to Hassani and Arezoo (2014) Working capital include all current assets that can be converted in cash within the time period of one year and net working capital is deference between current liabilities and current assets. The different policies can be designed by changing the level of current assets and current liabilities i.e. aggressive, moderate and conservative. Aggressive policy refers minimum investment in current assets and relies on short term liabilities and conservative policy is just opposite of this.

Most of traditional studied foster the aggressive working capital policies because empirical result shows that less investment in current assets increase the profitability of the firm. Jose, et al. (1996) concluded in industry wise analysis that aggressive working capital policy leads to higher profitability. Wang (2002) used the sample of Japanese and Taiwanese firms and Deloof (2003) took the data from Belgian firm both concluded that maintaining sorter cash conversion cycle (aggressive policy) by making less investment in inventory and account receivable increase the firm profitability. Hassan Pour (2007) analyzed the listed companies of Tehran stock exchange and found that working capital policy have impact on return on investment(ROI) and concluded that with aggressive working capital policy higher return on investment(ROI) can be achieved.

Vural et al. (2012) found that less investment in accounts payables and shorter cash conversion cycle leads to higher profitability. Conversely higher investment in current asset (conservative policy) and less rely on current liabilities in order to avoid insolvency risk leads to decrease overall profitability of the firm Bardia (1988).

But on the other hand some researches change the traditional view of working capital policies and empirically proved that value creation is also possible with conservative working capital policy. Nazir and Afza (2009) studied impact of different working capital policies by taking the Panel data set which was obtained from 204 non financial firms of KSE from 1998-2005 and conclude that aggressive working capital policy reduce the return on assets and value creation is possible through conservative policy. But on the other hand aggressive current liability policy can increase the current market value of the firm because investors like the firms which not issue additional debt and equity securities for short term financing.

Sharma and Kumar (2011) conducted study by undertaking the data from 2002 to 2008 of 263 non-financial firms of Bombay stock exchange. Multiple regression analysis

were used for data analysis and found that (ROA) is positively correlated with (CCC). The study concluded that more investment in current assets leads to higher profitability.

METHODOLOGY

The idea of current was taken from the study conducted by Nazir and Afza (2009) to find out the effect of working capital investment and financing policy on firm's value, they studied 204 non financial firms from 1998 to 2005; and Weinruab and Visscher (1998), they studied 126 firms in the US market. The data was collected from the annual reports and the publication of State Bank of Pakistan.

Variables and their Measurement Working Capital Investment Policy

The aggressive investment policy shows the minimum level investment in the current assets as compared to fixed assets. The following ratio was calculated by:-

$$\text{WCIP} = \frac{Total\ Current\ assets}{Total\ Assets}$$

Working Capital Financing Policy

The aggressive financing policy utilizes high level of current liabilities and less long term debts. The following ratio was calculated by:-

$$\text{WCFP} = \frac{Total\ Current\ liabilities}{Total\ Assets}$$

Tobin's q (Firm Value):

This ratio compare the market value of the company with book value of the company's assets. Low q-ratio means that the cost to replace firms is higher as compared to their stock. High q-ratio means that stocks are expensive as compared to the replacement cost of their assets (Nazir and Afza, 2009). The following ratio was calculated by:-

$$\text{Tobin's q} = \frac{Market\ value\ of\ the\ firm}{Book\ value\ of\ assets}$$

Control Variables

In the previous works on the working capital policies (Lamberson 1995; Smith and Begemann 1997; Deelof 2003; Eljelly 2004; Teruel and Solano 2005; Lazaridis and Tryfonidis 2006; Nazir and Afza 2009), they use different control variables to get opposite results. In the current study size and leverage has been taken as a control variable of the study. The SIZE of the firm has been calculated by taking the log of the total assets of the firm in the current year. LEVERAGE has been measured by taking the ratio to total debts to total assets.

Model

$$\text{Tobin } q_{it} = \alpha o + \beta_1 (\text{WCIP})_{it} + \beta_2 (\text{SIZE})_{it} + \beta_3 (\text{LEV})_{it} + \varepsilon \ldots (a)$$

$$\text{Tobin } q_{it} = \alpha o + \beta_1 (\text{WCFP})_{it} + \beta_2 (\text{SIZE})_{it} + \beta_3 (\text{LEV})_{it} + \varepsilon \ldots (b)$$

FV = Firm value (Q ratio) of company (i) at time (t)
WCIP = Working capital investment policy of company (i) at time (t)
WCFP = Working capital financing policy of company (i) at time (t)
Size = Size of the firm of company (i) at time (t)
LEV = Leverage of company (i) at time (t)

ANALYSIS

Chow Test

The chow test was used to select among the pooled OLS and fixed effect model. In this regard H_0: Pooled OLS is appropriate and fixed effect model is not appropriate, H_1: Pooled OLS is not appropriate and fixed effect model is appropriate.

Chow test for structural break at observation 50:7
F(4, 591) = 6.81919 with p-value 0.0000

The p-value of chow test shows that there is not enough evidence to support null hypothesis so fixed effect model is appropriate for the data analysis.

Table 1: Fixed effect-Working capital Investment Policies and firm value

Variable	Coefficient	t-value	P-value
WCIP	-6.5669	-3.1093	0.00198***
Size	1.11745	0.7800	0.43576
Lev	1.62667	14.8091	0.00001***
F-value	13.57		
DW	1.25		
P-value	0.000		

Table 1 shows the results of fixed effect model of working capital investment policies and firm value. The f-value of the model is 13.57 which show that the model is statistically significant. The value of Durbin Watson is 1.25 which means that there is positive auto correlation. The p-value of the model shows that the model is overall significant. The negative value of coefficient of working capital investment policies shows that there is a negative relationship between WCIP and firm value. The positive coefficient value of size and leverage shows that they have positive relationship with firm value.

Chow Test

The chow test was used to select among the pooled OLS and fixed effect model. In this regard H_0: Pooled OLS is appropriate and fixed effect model is not appropriate, H_1: Pooled OLS is not appropriate and fixed effect model is appropriate.

Chow test for structural break at observation 50:7
F(4, 591) = 4.28254 with p-value 0.0020

The p-value of chow test shows that there is not enough evidence to support null hypothesis so fixed effect model is appropriate for the data analysis.

Table 2: Fixed effect, Working capital Financing Policies and firm value

Variable	Coefficient	t-value	P-value
WCFP	1.08106	1.8399	0.06638*
Size	1.21151	0.8245	0.41006
Lev	1.00423	2.6826	0.00755***
F-value	13.25		
DW	1.26		
P-value	0.000		

Table 1 shows the results of fixed effect model of working capital financing policies and firm value. The f-value of the model is 13.25 which show that the model is statistically significant. The value of Durbin Watson is 1.26 which means that there is positive auto correlation. The p-value of the model shows that the model is overall significant. The positive value of coefficient of working capital financing policies shows that there is a positive relationship between WCFP and firm value. The positive coefficient value of size and leverage shows that they have positive relationship with firm value.

CONCLUSION

The current study was conducted to find out the effect of aggressive working capital investment and financing policy on firm's value. The data was collected from 100 non financial firms from 2007 to 2012. The impact of aggressive working investment policy on firm value was studied under panel data regression and found that working capital investment policy has significant effect firm value and the relationship among working capital investment policy and firm value was negative. The study also discusses the impact of working capital financing policy on firm value and found insignificant effects on firm value. The relationship between working capital financing policy and firm value was positive. The study will also be helpful for the investors and also policy makers in the Pakistani market. However the study can be more explored by increasing sample size and also the time period of data collection.

REFERENCES

1. Anand, M. and Gupta, C. (2001). Working Capital Performance of Corporate India. *Management and Accounting Research*, 4(4), 35-65.
2. Brigham, E.F. and Ehrhardt, M.C. (2004). *Financial Management: Theory and Practice* (11th Edition). New York: South-Western College Publishers.
3. Bardia, S.E. (1988). *Working Capital Management*. Point Publisher, P56 and 84-98.
4. Deloof, M. (2003). Does Working Capital Management Affect Profitability of Belgian Firms? *Journal of Business, Finance and Accounting* 30(3&4), 573-587.
5. Deloof, M. and Jeger, M. (1996). Irade Oedit. Product Quality and Intragroup Irade: Some European Evidence. *Financial Management*, 25(3), 945-(i8.
6. Deloof, M. (2003). Does Working Capital Management Affects profitability of Belgian Firms? *Journal of Business Finance and Accounting*, 30(3&4), 0306-686X.

7. Eljelly, A.M.A. (2004). Liquidity-Profitability Tradeoff: An Empirical Investigation in an Emerging Market. *International Journal of Commerce and Management* 14(2), 48-61.
8. Filbeck, G. and Krueger, T.M. (2005). An Analysis of Working Capital Management results across Industries. *American Journal of Business*, 20(2), 11-18.
9. Howorth, C. and Westhead, P. (2003). The Focus of Working Capital Management in UK Small Firms. *Management Accounting Research*, 14(2), 94-111.
10. Hassani, M. and Arezoo, R. (2014). To Survey the Effect of Working Capital Policies (Investing and Financing) on Profitability Risk (Evidence from Tehran Stock Exchange). *Journal of Investment and Management*; 3(1), 30-36.
11. Hassanpour, S. (2007). Effects of Working Capital Strategies on Stock Return. *Journal of Financial Accounting*, 1, 1-19.
12. Jose, M.L. Lancaster, C. Stevens, J.L. (1996). Corporate Return and Cash Conversion Cycle. *Journal of Economics and Finance*, 20, 33-46.
13. Kargar, J. and Blumenthal, R.A. (1994). Leverage Impact of Working Capital in Small Businesses. *TMA Journal*, 14(6), 46-53.
14. Lamberson, M. (1995). Changes in Working Capital of Small Firms in Relation to Changes in Economic Activity. *Mid-American Journal of Business*, 10(2), 45-50.
15. Lazaridis, I. and Tryfonidis, D. (2006). Relationship between Working Capital Management and Profitability of Listed Companies in the Athens Stock Exchange. *Journal of Financial Management and Analysis*, 19(1), 26-35.
16. Long, M.S., Malitz, L.B. and Ravid, S.A. (1993). Trade Credit, Quality Guarantees, and Product Marketability. *Financial Management*, 22(4), 117-27.
17. Nazir, S. and Afza, T. (2007). A Panel Data Analysis of Working Capital Management Policies, *Business Review*, 4(1).
18. Raheman, A. and Nasr, M. (2007). Working capital management and profitability-case of Pakistani firms. *Intl. Rev. Business Research Papers*, 3(1), 279-28.
19. Smith, K. (1980). *Profitability versus Liquidity Tradeoffs in Working Capital Management, in Readings on the Management of Working Capital*. New York: St. Paul, West Publishing Company.
20. Samiloglu, F. and Demirgunes, K. (2008). The Effects of Working Capital Management on Firm Profitability: Evidence from Turkey. *The International Journal of Applied Economics and Finance*, 2(1), 44-50.
21. Shah, A. and Sana, A. (2006). Impact of Working Capital Management on the Profitability of Oil and Gas Sector of Pakistan. *European Journal of Scientific Research*, 15(3), 301-307.
22. Sharma, A.K. and Kumar, S. (2011). Effect of Working Capital Management on Firm Profitability: Empirical Evidence from India. *Global Business Review*, 12(1), 159-173.
23. Smith, M.B. and Begemann, E. (1997). Measuring Association between Working Capital and Return on Investment. *South Africa Journal of Business Management*, 28(1), 1-5.
24. Teruel, P.J.G. and Solano, P.M. (2005). *Effects of Working Capital Management on SME Profitability*. Working Papers Series. Dept. Organización de Empresas y Finanzas, Facultad de Economía y Empresa, Universidad de Murcia, Campus Espinardo, Spain.

25. Uyar, A. (2009). The Relationship of Cash Conversion Cycle with Firm Size and Profitability: An Empirical Investigation in Turkey. *International Research Journal of Finance and Economics*, 24.
26. Vural, G., Sokmen, A.G. and Cetenak, E.H. (2012). Affects of Working Capital Management on Firm Performance: Evidence from Turkey. *International Journal of Economics and Financial Issues*, 2(4), 488-495.
27. Van Horne, J.C. and Wachowicz, J.M. (2000). Fundamentals of Financial Management, Prentice Hall Inc., 11th Ed.
28. Wang, Y.J. (2002). Liquidity Management, Operating Performance, and Corporate Value: Evidence from Japan and Taiwan. *Journal of Multinational Financial Management*, 12, 159-169.
29. Weinraub, H.J. and Visscher, S. (1998). Industry Practice Relating to Aggressive Conservative Working Capital Policies. *Journal of Financial and Strategic Decision*, 11(2), 11-18.

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DEVELOPING VARIABLE REPETITIVE GROUP SAMPLING CONTROL CHART USING REGRESSION ESTIMATOR

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ABSTRACT

In this article, we propose a control chart based on repetitive group sampling scheme for the location parameter. This charting scheme is based on the regression estimator; an estimator that capitalize the relationship between the variables of interest to provide more sensitive control than the commonly used individual variables. The control limit coefficients have been estimated for different sample sizes for less and highly correlated variables. The monitoring of the production process is constructed by adopting the procedure of the Shewhart's x-bar control chart. Its performance is verified by the average run length calculations when the shift occurs in the average value of the estimator. It has been observed that the less correlated variables have rapid false alarm rate.

KEYWORDS

Average run length, control charts, process shift, regression estimators, repetitive group sampling.

INTRODUCTION

Control chart is an important tool of the statistical process control techniques used to monitor the excess variability in any business activity. Shewhart (1926) introduced the concept of control chart to produce the goods and services with minimum known variability. Variable control charts ($\bar{X}$ chart, R chart, S chart etc.) have been developed to monitor the measurable quality characteristic of the production process whereas the attribute control charts (p chart, np chart, c chart etc.) are used to monitor the countable items of the production process. Several graphical tools have been developed for the monitoring of the average ($\bar{X}$) value of a small sample group (usually not more than 5) of the quality characteristic.

Production processes require continuous monitoring for any major variability in the product because the instruments as well as the raw material and the operators are going to be changed. The continuous monitoring of the production process is neither feasible nor economical. So, we have to rely on samples on some specific periodic time scale for searching assignable causes when it falls out of the control limits. An increased number

of items falling in out of control limits may be the result of high variation in the process and the production of less number of defective items due to the small variation in the process Acosta Mejia et al. (1999).Several innovations have been developed for the early detection of the out of control process. For a long period the Shewhart control chart had been investigated using the single sampling scheme until Croasdale (1974) proposed the double sampling scheme for the Shewhart control chart. Double sampling scheme have been studied by many authors as Daudin, 1992; Irianto and Shinozaki, 1998; Carot et al., 2002; He et al., 2002; He and Grigoryan, 2002, 2006; Costa et al., 2005); Machado and Costa (2008).

Sherman (1965) developed the idea of repetitive group sampling for the acceptance sampling plan for the attribute quality characteristics. According to him the repetitive sampling scheme is more efficient as compared to the single sampling scheme and less efficient as compared to the sequential probability ratio sampling scheme. Balamurali and Jun (2006) reported that the repetitive group sampling is more efficient than the single and double sampling scheme. For more details about the repetitive group sampling scheme, reader may refer to Sherman (1965) and Balamurali and Jun (2006). Aslam et al. (2011) examined the acceptance sampling plan using the loss function for the repetitive group sampling scheme. Aslam et al. (2013) proposed the acceptance sampling plan for the process capability index Cpk using the repetitive group sampling scheme. Ahmad et al. (2013) developed the repetitive group sampling control chart for the process capability index C_p.

Regression estimator for the mean level of the particular quality characteristic has a superior performance over the traditional cause-selecting and regression-adjusted control charts Riaz (2008). The information about some auxiliary variables (Xs) and the variable of the interested quality characteristic (Y) can be used to increase the precision of estimated parameter. Assuming bivariate normality of the defined variables Y and X, a Shewhart-type process mean control chart has been developed based on the regression estimator of process mean level. The regression estimator for the mean of Y, using a single auxiliary variable can be defined as a bivariate random sample (y_1, x_1), (y_2, x_2), … (y_n, x_n) of size n as,

$$M_t = \bar{y} + b(\mu_x - \bar{x}),$$

where $\bar{y}$ is the mean of variable Y, μ_x is the population mean, $\bar{x}$ is the sample mean and b is the regression coefficient defined as,

$$b = r_{xy}\ (s_y/s_x),$$

where r_{xy} is the sample correlation coefficient between x and y, s_y is the sample standard deviation of X and s_x is the sample standard deviation of the variable Y.

Various control chart procedures for monitoring the process average and variability are available in the literature (see for example Montgomery (2009)). However, no control chart procedure is available for repetitive group sampling using the regression estimators of the mean level of the interested quality characteristic which cause the motivation to the researchers. Therefore, this research article is an attempt to develop a repetitive group sampling control chart for mean of the regression estimator for normally distributed

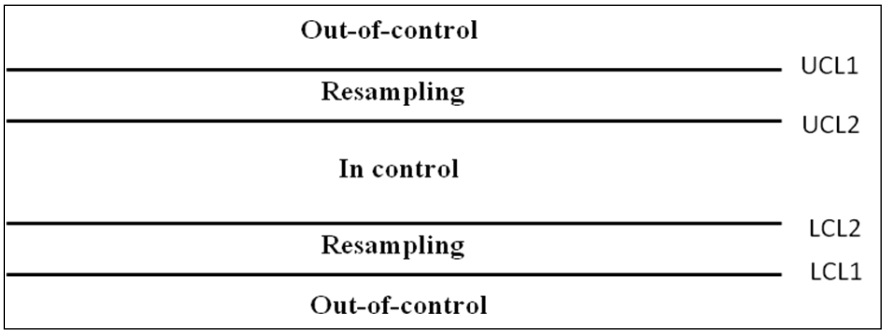
quality characteristic using the Monte Carlo simulation (explained in section 3) procedure.

The rest of the paper is organized as, the scheme of the repetitive group sampling control chart is given in Section 2. Monte Carlo simulation procedure has been described in Section 3. In Section 4 the criteria for the evaluation of the performance of proposed control chart is discussed. In the last Section 5 the conclusion is described.

2. REPETITIVE GROUP SAMPLING SCHEME CONTROL CHART

Sherman (1965) developed a new idea of sampling inspection for the attribute quality characteristics for the acceptance sampling plan with the name of repetitive group sampling plan. The operation of the scheme is similar to the sequential sampling scheme but simple. According to Sherman, the repetitive group sampling scheme/plan is better than the single sampling plan but less efficient as compared to the sequential sampling scheme. In short, we can say that the repetitive group sampling scheme is intermediate in efficiency between single sampling and repetitive sampling scheme.

The operation of the repetitive group sampling can be best described in the following diagram.



Following the above diagram the steps of the repetitive sampling scheme will be:

Step-1: Select a bivariate random sample Y and $X$of size n from the multivariate normal distribution and calculate sample means $\bar{Y} = {\sum_{i=1}^{n} y_i}/{n}$, $\bar{X} = {\sum_{i=1}^{n} x_i}/{n}$ and sample variances $S_y^2 = [\sum_{i=1}^{n}(Y_i - \bar{Y})^2/n - 1]$, $S_x^2 = [\sum_{i=1}^{n}(X_i - \bar{X})^2/n - 1]$ and $b = r_{xy}\,(s_y/s_x)$, where r_{xy} is some pre-defined value of correlation coefficient between two variables x and y,s_x and s_y are the standard deviation of the two variables X and Yrrespectively.

Step-2: Calculate $M_t = \bar{Y} + b(\mu_x - \bar{X})$,

Step-3: We shall declare out-of-control if $M_t \geq UCL_1$ or $M_t \leq LCL_1$ (UCL_1 and LCL_1 are called outer control limits) and in-control if $LCL_2 \leq M_t \leq UCL_2$ (UCL_2 and LCL_2 are called inner control limits). Otherwise, go to step 1 and repeat the process.

3. MONTE CARLO SIMULATION PROCEDURE

Simulation models are considered as a very good predictors of the performance of a newly designed production process (Montgomery, 2009). In recent years the Mont Carlo simulation has become a most popular an inevitable statistical process control tool. This method provides approximate solutions to a number of mathematical expressions by using statistical sampling on the computers. By the widespread use of computers many theoretical situations can be evaluated by the statistical experimental techniques with less time and expense (Schaffer, & Kim, 2007). There is no hard and fast rule for the choice of the number of replications of the statistical experiment to reach the desired level of the average run length but it depends upon the phenomenon under study. Less number of replicates may cause the inaccurate estimates. However, using simulation to find control limits is a reasonable approach (Montgomery, 2009). Under the Monte Carlo simulation technique, we have generated 10,000 samples of size n=5, 10 and 15 for specified values of correlation coefficient, $\rho = 0.10$ and 0.50. The value for each posted random variable M_t is drawn using simulation corresponding to specific set of values. Table 1 shows the average length values at different levels of shift for specified in-control run length (r_0=200and r_0=300) for the repetitive sampling scheme (RSS)

Table 1
Average Run Length Values of Repetitive Group Sampling Scheme for $\rho = 0.10$

Shift (f)	n=5		n=10		n=15	
	k_1=2.4137, k_2=0.7259	k_1=3.0019, k_2=1.001	k_1=2.961, k_2=0.8212	k_1=3.0649, k_2=1.0156	k_1=2.7962, k_2=0.82512	k_1=3.1551, k_2=0.8284
	r_0=200	r_0=300	r_0=200	r_0=300	r_0=200	r_0=300
0.00	200.08	300.14	200.47	299.99	200.80	300.01
0.10	165.12	288.54	140.10	253.67	112.82	284.009
0.20	110.05	239.89	75.29	149.19	51.775	140.85
0.30	73.17	166.91	36.72	72.70	22.653	53.818
0.40	42.12	95.17	20.01	38.03	11.823	26.06
0.50	22.14	58.61	10.05	20.15	6.804	12.182
0.60	12.00	35.09	5.80	11.96	3.846	6.987
0.70	10.30	21.80	3.00	6.91	2.578	4.05
0.80	7.13	13.60	1.92	4.70	1.963	2.683
0.90	4.14	9.24	1.41	3.28	1.569	1.994
1.00	3.47	6.08	1.04	2.39	1.348	1.639
1.50	1.27	2.01	1.00	1.11	1.005	1.02
2.00	1.03	1.06	1.00	1.00	1.001	1.00
2.50	1.00	1.00	1.00	1.00	1.000	1.00
3.00	1.00	1.00	1.00	1.00	1.000	1.00

Under the same setting the single sampling scheme(SSS) was run with the Monte Carlo simulation procedure and the values of average run length are given in table 2 for n=5, 10 and 15.

Table 2
Average Run Length Values of Single Sampling Scheme for $\rho = 0.10$

Shift (f)	n=5		n=10		n=15	
	k=2.8277	k=3.1775	k=2.8271	k=3.1013	k=2.8269	k=3.1649
	r_0=200	r_0=300	r_0=200	r_0=300	r_0=200	r_0=300
0.00	201.16	299.28	202.12	297.01	202.34	299.38
0.10	179.34	296.74	149.46	270.87	134.85	277.77
0.20	127.54	261.85	81.42	172.26	61.19	146.14
0.30	76.99	191.18	41.61	79.07	27.29	57.30
0.40	48.38	117.34	21.44	39.12	13.61	24.91
0.50	30.31	68.09	12.76	21.72	7.18	12.74
0.60	19.56	41.70	7.61	12.47	4.21	6.80
0.70	13.39	26.82	4.84	7.50	2.82	4.20
0.80	9.29	16.91	3.52	4.90	2.08	2.81
0.90	6.73	12.02	2.45	3.49	1.63	2.01
1.00	4.94	8.87	2.01	2.46	1.34	1.59
1.50	1.81	2.36	1.07	1.15	1.01	1.02
2.00	1.16	1.29	1.00	1.01	1.00	1.00
2.50	1.04	1.06	1.00	1.00	1.00	1.00
3.00	1.01	1.01	1.00	1.00	1.00	1.00

Table 3
Average Run Length Values of Repetitive Group Sampling Scheme for $\rho = 0.50$

Shift (f)	n=5		n=10		n=15	
	k_1=2.9057, k_2=0.8101	k_1=3.167175, k_2=1.45847	k_1=2.8418, k_2=1.0322	k_1=3.2192, k_2=1.2285	k_1=2.8293, k_2=0.9587	k_1=3.1777, k_2=0.87304
	r_0=200	r_0=300	r_0=200	r_0=300	r_0=200	r_0=300
0.00	202.47	303.78	204.77	299.08	201.39	299.981
0.10	182.69	256.3505	156.14	281.86	162.32	236.824
0.20	166.14	239.264	126.15	270.21	102.09	155.632
0.30	141.00	208.185	73.95	219.40	60.96	82.276
0.40	101.76	171.4925	45.61	142.93	30.13	46.538
0.50	81.19	135.0875	25.67	74.16	20.07	25.902
0.60	60.37	101.676	13.38	47.15	10.02	16.722
0.70	40.21	73.962	10.96	24.36	8.50	11.275
0.80	31.52	50.4445	5.58	13.53	5.56	7.82
0.90	19.21	39.252	3.03	10.16	3.83	5.179
1.00	12.97	29.686	2.12	8.13	2.62	1.806
1.50	5.08	8.2075	1.40	2.12	1.06	1.252
2.00	2.01	3.487	1.07	1.23	1.00	1.112
2.50	1.02	2.252	1.00	1.14	1.00	1.05
3.00	1.00	1.6875	1.00	1.01	1.00	1.00

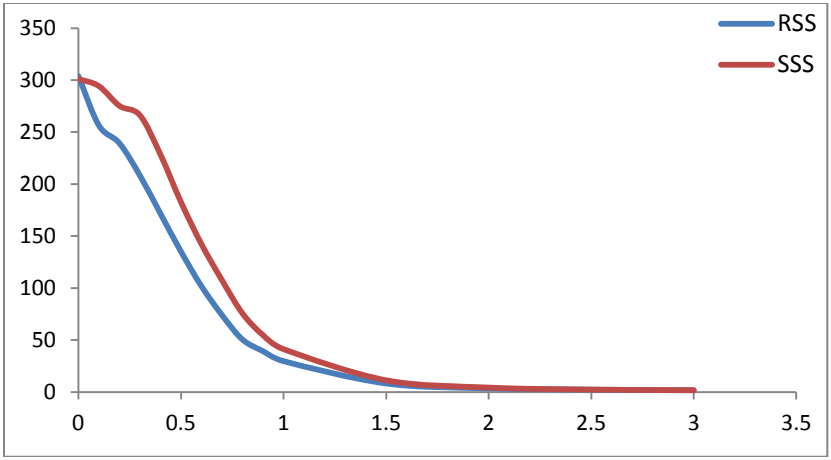


Figure 1: Comparison of Proposed (RSS) and Existing (SSS) for $\rho = 0.50$, n=5 and r_0=300

Table 4
Average Run Length Values of Single Sampling Scheme for $\rho = 0.50$

Shift (f)	n=5		n=10		n=15	
	k= 2.9793	k=3.3630	k=2.8347	k=3.1842	k=2.8253	k=3.3404
	r_0=200	r_0=300	r_0=200	r_0=300	r_0=200	r_0=300
0.00	202.77	301.12	202.93	302.60	197.01	297.87
0.10	196.05	294.19	166.87	292.16	165.39	287.76
0.20	173.29	275.21	131.54	282.47	105.63	282.62
0.30	149.23	266.14	81.96	213.24	62.04	261.30
0.40	114.24	228.37	53.04	134.18	35.48	215.71
0.50	89.26	182.65	34.81	83.02	21.26	173.81
0.60	65.26	142.16	23.93	50.72	14.77	139.70
0.70	46.28	107.49	15.79	32.94	9.19	102.15
0.80	35.25	75.52	11.22	20.64	6.62	70.58
0.90	26.44	54.65	7.87	14.28	4.79	55.42
1.00	20.32	41.23	6.29	10.62	3.57	39.32
1.50	6.44	11.28	2.26	2.99	1.57	10.52
2.00	3.08	4.29	1.48	1.65	1.19	4.18
2.50	2.00	2.33	1.23	1.32	1.08	2.35
3.00	1.58	1.77	1.13	1.18	1.05	1.79

4. AVERAGE RUN LENGTH

Average run lengths have been used extensively in studying the performance of the control charts and also known as the traditional measure to evaluate the process. It is constructed for the proposed as well as the existing chart. The average run length for the in-control process may be defined as the number of sample points falling in the in-control limits until it is out of control, on the average. The average run length for the for the out

of control process may be defined as the number of sample points falling in the in-control limits until it falls in the out of control region, on the average when the process has been shifted. The performance of the proposed control chart is compared with the single sampling control chart, used for the same purpose following the Monte Carlo simulation procedures.

5. CONCLUSION

We developed the repetitive group sampling control chart for regression estimators when the interested quality characteristic depends upon the independent variable (auxiliary variable). The parameters are estimated for the repetitive and single sampling chart procedures. It has been observed that the control charts based on proposed repetitive group sampling scheme show better performance in the quick detection of the out of control process as compared to the single sampling control charts.

REFERENCES

1. Acosta-Mejia, C.A., Pignatiello Jr., J.J. and Rao, B.V. (1999). A comparison of control charting procedures for monitoring process dispersion, *IIE Transactions* 31, 569-579.
2. Ahmad, L., Aslam, M. and Jun, C. H. (2014). Designing of X-bar control charts based on process capability index using repetitive sampling. *Transactions of the Institute of Measurement and Control*, 36(3), 367-374.
3. Aslam, M., Wu, C.W., Jun, C.H., Azam, M. and Negrin, I. (2013). Developing a variables repetitive group sampling plan based on process capability index C_{pk} with unknown mean and variance. *Journal of Statistical Computation and Simulation*, 83(8), 1507-1517.
4. Aslam, M., Yen, C.H., and Jun, C.H. (2011). Variable repetitive group sampling plans with process loss consideration. *Journal of Statistical Computation and Simulation*, 81(11), 1417-1432.
5. Balamurali, S. and Jun, C.H. (2006).Repetitive Group Sampling Procedure for Variables Inspection. *Journal of Applied Statistics*, 33(3), 327-338.
6. Carot, V., Jabaloyes, J.M. and Carot, T. (2002). Combined double sampling and variable sampling interval $\bar{X}$ chart. *International Journal of Production Research*, 40, 2175-2186.
7. Costa, A.F.B., De Magalhaes, M.S. and Epprecht, E.K. (2005).The non-central chi-square chart with double sampling. *Brazilian Journal of Operation and Production Management*, 2, 57-80.
8. Croasdale, R. (1974). Control charts for a double sampling scheme based on average production run length. *International Journal of Production Research*, 12, 585-592.
9. Daudin, J.J. (1992). Double sampling $\bar{X}$ charts. *Journal of Quality Technology*, 24, 78-87.
10. He, D. and Grigoryan, A. (2002). Construction of double sampling S control charts for agile manufacturing. *Quality and Reliability Engineering International*, 18, 343-355.
11. He, D. and Grigoryan, A. (2006). Joint statistical design of double sampling $\bar{X}$ and S charts. *European Journal of Operational Research*, 168, 122-142.

12. He, D., Grigoryan, A. and Sigh, M. (2002). Design of double and triple sampling $\bar{X}$ control charts using genetic algorithms. *International Journal of Production Research*, 40, 1387-1404.
13. Irianto, D. and Shinozaki, N. (1998). An optimal double sampling $\bar{X}$ control chart. International *Journal of Industrial Engineering–Applications and Practice*, 5, 226-234.
14. Machado, M.A.G. and Costa, A.F.B. (2008). The double sampling and the EWMA charts based on the sample variances. *International Journal of Production Economics*, 114, 134-148.
15. Montgomery, D.C. (2009).*Statistical Quality Control: A Modern Introduction* (6th ed.). New York: John Wiley & Sons, Inc.
16. Riaz, M. (2008). Monitoring process mean level using auxiliary information. *Statistica Neerlandica*, 62(4), 458-481.
17. Schaffer, J.R. and Kim, M.J. (2007). Number of Replications Required in Control Chart Monte Carlo Simulation Studies. *Communications in Statistics - Simulation and Computation*, 36(5), 1075-1087.
18. Sherman, R.E. (1965). Design and evaluation of a repetitive group sampling plan. *Technometrics*, 7(1), 11-21.
19. Shewhart, W.A. (1926). Quality Control Charts. *Bell System Technical Journal*, 5(4), 593-603.

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CLOUD COMPUTING IN LIBRARY INFORMATION SYSTEM

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ABSTRACT

Cloud computing is an Internet-based computing, whereby shared resource, software, and information are provided to computers and other devices on demand, like the electricity grid. Cloud computing service is everywhere now, it is time for librarian to concentrate on providing pro-active services and move from general service to personalize information services to the users for the benefit of academic community rather than hunting for technology to deliver the services. It is more efficient and speedy distribution of library services with lower cost.

Cloud computing in library information system will be used for Data such as Bibliographic, Digital, Administrative, License, Access and Preservation, for Content such as: Collections, Subscriptions, Print, and Publishing, for Services such as: Library as Place, Content Access, Content Creation, Instruction, Research and, Preservation. Experience such as: Research, Study Support, Peer based Collaboration, and IT Exploration.

The paper presents an overview of cloud computing and its possible applications that can be clubbed with library services on the web based environment. This study may be helpful in identifying and generating cloud based services for libraries. This paper described Cloud Computing and analyzed the current status of user service models in university libraries. Then it proposed to improve current user service model with Cloud Computing. The real value of cloud computing is that it makes your library related software and data available transparently and everywhere including in latest available smart phone devices.

KEYWORDS

Cloud Computing; Models of Cloud Computing; library services; Unified Computing.

1. INTRODUCTION

Information technology play very vital role in library science. It helps in collecting, Storage, compilation, processing, and analysis of information. Presently, Library field is facing many challenges due to applications of information technology. New concepts are being added to ease the practices in the libraries. Due to innovation of information technology, libraries have become automated which is the basic need towards

advancement followed by networks and more effort are being made towards virtual technology.

According to (Stroh et al., 2009) "Cloud Computing is nothing more than the collection of computing software and services that can be accessed via the Internet rather than residing on a desktop or internal server". The "means of communication between client and cloud have been termed middleware and depend very much on formation of images of virtual machines".

The "Cloud" element of Cloud Computing can be seen as an acronym that stands for C- Computing resources, L- that is Location independent, O- can be accessed via Online means, U- used as an Utility & D- is available on Demand. There are three service models of Cloud Computing: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), & Software as a Service (SaaS). IaaS offers necessary computing resources like (processing, storage, networks, and operating resources) over the Internet. PaaS offers platform (Google App Engine) to run the user created or acquired applications on the Internet. SaaS provides applications and software (Google Docs) on cloud which can be accessed through any device having web browser. Usually, "cloud services are based on the Internet which are accessed, transported & used over the Internet in user`s web browsers" (Wang & Huang, 2011).

A lot of researchers have analyzed the use of mobile and smart phones to access cloud based services accessed via web browsers. Giurgiu et al. (2009) has used the cloud as the container for mobile applications. Luo (2009) first of all tried to the use cloud computing to enhance mobile devices capabilities. (Liu & Cai, 2013) asserts that "driven by this new technology trend and the benefits of cloud computing, an increasing number of libraries are shifting their key applications and services to the cloud". Cloud Computing for Libraries aims to equip libraries with the information and practical advice needed to evaluate the many opportunities to take advantages of cloud computing for the benefit of their organizations. The use of cloud computing in libraries and how cloud computing actually works is illustrated in this paper. It overviews the basic concept of newly develop area known as cloud computing.

2. WORKING OF CLOUD COMPUTING

To understand exactly how cloud computing works, let's consider that the cloud consists of layers -mainly the back end layers and the front end layers. They connect to each other through a network, usually the Internet. The front layers are the parts you see and interact with. When you access your profile on your Facebook account for example, you are using software running on the front end of the cloud. The back end is the "cloud" section of the system. On the back end there are various computers, servers and data storage systems that create the "cloud" of computing services. A central server administers the system, monitoring traffic and client demands to ensure everything runs smoothly. It follows a set of rules called protocols Servers and remote computers do most of the work and store the data. In other words, the back end consists of the hardware and the software architecture that delivers the data you see on the front end. The Clouds use a network layer to connect users' end point devices, like computers or smart phones, to resources that are centralized in a data centre. Users can access the data centre via a

company network or the internet or both. Clouds can also be accessed from any location, allowing mobile workers to access their business systems on demand.

Applications running on the cloud take advantage of the flexibility of the computing power available. The computers are set up to work together so that it appears as if the applications were running on one particular machine. This flexibility is a major advantage of cloud computing, allowing the user to use as much or as little of the cloud resources as they want at short notice, without any assigning any specific hardware for the job in advance. **One of the benefits of clouds is their relative ease of use.** Clouds often employ a technique called 'virtualization' to give users more control when using the cloud. Virtualization allows users to create their own 'virtual computer', with specified applications, software and operating machines. For example we could set up a Windows-based virtual machine but run it inside a Mac.

3. USE OF CLOUD COMPUTING IN LIBRARY

Cloud computing offers many interesting possibilities for libraries that may help to reduce technology cost and increase capacity reliability, and performance for some type of automation activities. Cloud computing has made strong in roads into other commercial sectors and is now beginning to find more application in library science. The cloud computing pushes hardware to more abstract levels. Cloud computing is an enhancement of distributed computing, parallel computing, grid computing and distributed databases. Among these, grid and utility computing are known as predecessors of cloud computing.

Cloud computing has large potential for libraries. Libraries may put more and more content into the cloud. Using cloud computing user would be able to browse a physical shelf of books, CDs or DVDs or choose to take out an item or scan a bar code into his mobile device. All historical and rare documents would be scanned into a comprehensive, easily searchable database and would be accessible to any researcher. Many libraries already have online catalogues and share bibliographic data with Online Computer Library Center (OCLC). More frequent online catalogues are linked to consortium that share resources.

Data storage cloud be a main function of libraries, particularly those with digital collections storing large digital files can stress local server infrastructures. The files need to be backed up, maintained, and reproduced for patrons. This can strain the data integrity as well as hog bandwidth. Moving data to the cloud may be a leap of faith for some library professionals. A new technology and on the surface it is believed that library would have some control over this data or collections. However, with faster retrieval times for requests and local server space it could improve storage solutions for libraries. Cloud computing or IT infrastructure that exists remotely , often gives users increased capacity and less need for updates and maintenance , and has gained wider acceptance among librarians .

Apart from above mentioned services cloud computing has rich potentials for cloud based learning and training. According to Ratten (2012) "In implementation Smart Phones Mobile Phones. Level of cloud computing in libraries and can be accessed on any media having stranded on individual machines; it al., 2009) "libraries need to deliver services and& researchers or they risk alienating users". Tablets, Mobile devices, tablets, & iPod in libraries to wirelessly connected to the Internet will speed 'device-centric' to

an ‘information-centric’ world and cheaper, more and more different kinds of objects will connect the term cloud computing describes the software and are available to multiple users via the Internet, rather computer”. Cloud computing has created opportunities for IT& support are necessary for cloud deployment “applications by the library professionals. Cloud learning occurs on the basis of cloud technology as it supports the use of software in the cloud to learn by providing data, storage & software that can be accessed in an online environment.

4. ANALYSIS OF CURRENT USER SERVICE MODEL

The University Library is a most important academic and scientific research base, It is providing information services for its users. In the past, most libraries insisted that their service is based on their own library resources. So librarians scarcely considered users ‘demands. But today, modern libraries have changed this viewpoint. And librarians usually need to collect as more information as they can do it according to users' requirements. Then they will analyze the information and sort out them. Finally, they will provide them for users in some certain technical methods. However, services in modern libraries will increasingly focus on users' demanding in future. And the ultimate goal of modern library is to offer appropriate, comprehensive and multilevel services for its users. At current user service models are mainly World Wide Web service models, File Transfer Protocol service model, Bulletin Board Services and E-mail service model, etc.

4.1 World Wide Web Service Model

World Wide Web (WWW) is based on client-Server model. It presents all kinds of information browsing systems with the bases of Hypertext Markup Language (HTML) and Hypertext Transfer Protocol (HTTP). The specific division is: WWW Servers are in charge of linking web pages by hypertext links and WWW clients are responsible for displaying information and sending requests to servers. And the most significant feature of WWW service is its high degree of integration. In other words, it can connect all kinds of information and services seamlessly and provide users with vivid graphical user interface finally. In general, WWW provides new means of searching and sharing information for people around the world. Meanwhile, it gradually becomes the best means of dynamic multimedia interactive for people.

4.2 File Transfer Protocol Service Model

File Transfer Protocol (FTP) is a widely used communication protocol. And it is comprised of various rules that support file transfer on the Internet. As such rules can permit online users copy files from one host to another, it brings great convenience and benefits to users. Just as other Internet services, FTP are also based on client-Server model. Meanwhile, it's easy to learn to use FTP service. First, you only need to start the FTP client program to connect with remote host, then you should issue file transfer command to remote host and after remote host received the command, it will give respond and implement the correct operation. Launching FTP service in university library network system is a good type which brings great convenience for users and library as well. By using FTP service in university library, users can make their own password, such as using their Email address, and this can let librarians obtain users visiting records

easily. Furthermore, according to users' visiting records, librarians can offer corresponding services for them and improved users' satisfaction.

4.3 Bulletin Board Service and E-mail Service Model

Bulletin Board Service (BBS) is a kind of electronic information service system on the Internet. It is just like a public blank board on the Internet; all users can write their thoughts or release information on this board. And E-mail is just another kind of information service on the Internet. In a word, E-mail provides a very quick, simple and economical way of communication for the Internet users in the whole world. Through BBS system, library users can ask and consult librarians at any time. Usually they can get their response in a very short period of time.

Meanwhile, librarians can communicate with more users at a time through BBS. What's more, university libraries can open lectures, release announcements and provide online help for users by BBS system. And through Email system, users can obtain their needed information and knowledge resources more quickly and economically as they don't need to visit libraries personally. BBS were generally text-based, rather than GUI-based and early BBS conversed using the simple ASCII character set. However, some home computer manufacturers extended the ASCII character set to take advantage of the advanced color and graphics capabilities of their systems.

5. IMPROVEMENT OF USER SERVICE MODEL

In University Libraries with the rapid development of various IT technologies, users' information requirements are increasingly personalized. And now more and more libraries advocated user-centered services. So librarians should mine and study users' information requirements frequently. And only in this way, they can provide the basic demands of their users. And furthermore, library can develop itself according to such information and improve users' satisfaction. University library, as we all know, is famous for its academic and teaching influences. And IT technology has been the driving force of library development. What's more, librarians can keep using new technology to develop library and optimize library service. With the expansion of Cloud Computing application, this paper proposed to apply Cloud Computing in libraries. By establishing a pubic cloud among many university libraries, it not only can conserve library resources but also can improve its user satisfaction.

5.1 Unified Search Service Model

Although there are Online Public Access Catalog (OPAC) and Inter-library loan (ILL) services available, Library users still cannot access to the shared resources through a uniform access platform. However, with the adoption of cloud computing in university library, the integrated library resources support distributed uniform access interface. At the same time, the uniform access platform can promote library resources, guide and answer users’ questions by using high-quality navigation. As a result, users can grip more information retrieval methods and make better use of library resources.

5.2 Integrated Consulting Services Model

Today almost every university library can provide its users with network reference by BBS or E-mail. But with the constant improvement of users demanding, integrated digital

reference service came into being. And driven by Cloud Computing, Cooperative digital reference service (CDRS) can realize the sharing of technology, resources, experts and services of university libraries.

5.3 Real-time Access Services Model

In the era of digital libraries, library users paid more attention to electronic journals, electronic databases and so on. This is really a big challenge for university libraries. But by introducing Cloud Computing, university libraries can establish a shared public cloud jointly. As shared cloud can have infinite storage capacity and computing power theoretically. It can bring obvious benefits to libraries. On one hand, allied libraries no longer consider the hardware cost; on the other hand, it can help reduce the purchase of electronic database resources repeatedly among allied libraries. Meanwhile, users can visit the shared resources by any terminal equipment, such as PC, mobile phone or PDA only if you can access to the internet.

5.4 Knowledge Service Model

In the context of the knowledge economy, knowledge resource has become the main resource affecting productivity development. And university libraries are the main departments of storing, processing and spreading knowledge. So how to provide users with efficient transmission of information and knowledge services became urgent task for librarians today. However, the emergence of Cloud Computing accelerated libraries development. And the establishment of shared public cloud can save manpower and material resources greatly among university libraries. Therefore, with the aid of Cloud Computing, librarians won't have to maintain their own equipment’s or deal with consultations personally. And librarians will have more time and energy to offer users with their needed knowledge-based services but not only information.

5.5 All- Oriented Service Model

Comparing with foreign university libraries, we can find that foreign libraries are intended to provide services for all the people. Besides the professors, teachers or students, all the people of that country can access to the library resources. In addition, they also permit users access to many libraries' resources by handling related certificate of that library. And fortunately, domestic libraries can also do this in the cloud environment. Anybody who can through the legal network identity authentication has the right to visit the joint resources of university libraries on the Internet. In other words, university libraries will offer services for all the people with the help of Cloud Computing.

6. ADVANTAGES OF CLOUD COMPUTING IN LIBRARIES

- **Reduction of costs** – unlike on-site hosting the price of deploying applications in the cloud can be less due to lower hardware costs from more effective use of physical resources.
- **Universal access** – cloud computing can allow remotely located employees to access applications and work via the internet.
- **Up to date software** – a cloud provider will also be able to upgrade software keeping in mind feedback from previous software releases.

- **Choice of applications**. This allows flexibility for cloud users to experiment and choose the best option for their needs. Cloud computing also allows a business to use, access and pay only for what they use, with a fast implementation time
- **Potential to be greener and more economical** – the average amount of energy needed for a computational action carried out in the cloud is far less than the average amount for an on-site deployment. This is because different organizations can share the same physical resources securely, leading to more efficient use of the shared resources.
- **Flexibility –** cloud computing allows users to switch applications easily and rapidly, using the one that suits their needs best. However, migrating data between applications can be an issue.

7. LIST OF CLOUD LIBRARIES

7.1 Online Computer Library Center, Inc. (OCLC):

It is a nonprofit, membership, computer library service and research organization dedicated to the public purposes of furthering access to the world's information and reducing information costs.

7.2 Library of Congress (LC):

The Library of Congress is the research library that officially serves the United States Congress, but which is the de facto national library of the United States. It is the oldest federal cultural institution in the United States.

7.3 Exlibris:

It is a leading provider of library automation solutions, offering the only comprehensive product suite for the discovery, management, and distribution of all materials—print, electronic, and digital. Dedicated to developing the market's most inventive and creative solutions, ExLibris leads the way in defining and designing efficient, user-friendly products that serve the needs of academic, research, and national libraries today, enabling them to transition into the future.

7.4 Polaris:

Serve your communities now and into the future Community matters. Your library inspires, influences, and benefits the lives of individuals in your communities, and the Polaris Integrated Library System provides the foundation for your success. The Polaris ILS is designed from the ground up to provide a robust and scalable software solution with powerful staff tools and an intuitive experience for patrons. Built on a Microsoft SQL server database platform with documented APIs, the Polaris ILS is open to connections: with your patrons and their social media, with third-party vendors, and with resources beyond your walls.

7.5 Scribd:

It is a digital library, featuring an eBook, audio book and comic book subscription service that includes New York Times Best-Sellers and classics. Scribe's subscription service is available on Android, IOS, and Window phone, smart phones and tablets, as well as the Kindle Fire, and personal computers for a fee which lets readers have unlimited access to more than 500,000 books from over 900 publishers. Scribd is a

personal library you can carry in your pocket. Read instantly on your mobile devices anywhere! Log into Scribd from our apps on your iPhone, iPod, Android, or Kindle Fire or access Scribd.com on other mobile device to access millions of titles where ever you want. We mean personal pocket library. You can save your favorites, create collections, bookmark titles, and create the library you've been dreaming of. Scribd is also your own personal publishing company. If you're an author looking to publish your work on Scribd, you'll be putting your work on a site with 80 million readers around the globe.

7.6 Discovery Service

Web services provide access to software systems over the Internet using standard protocols. In the most basic scenario there is a Web Service Provider that publishes a service and a Web Service Consumer that uses this service. Web Service Discovery is the process of finding a suitable Web Service for a given task. Publishing a Web service involves creating a software artifact and making it accessible to potential consumers. Web Service Providers augment a Web service endpoint with an interface description using the Web Services Description Language (WSDL) so that a consumer can use the service.

Optionally, a provider can explicitly register a service with a Web Services Registry such as Universal Description Discovery and Integration (UDDI) or publish additional documents intended to facilitate discovery such as Web Services Inspection Language (WSIL) documents. The service users or consumers can search Web Services manually or automatically. The implementation of UDDI servers and WSIL engines should provide simple search APIs or web-based GUI to help find Web services. Web services may also be discovered using multicast mechanisms like WS-Discovery, thus reducing the need for centralized registries in smaller networks.

7.7 Google Scholar

Create and edit text documents right in your browser—no dedicated software required. Multiple people can work at the same time, and every change is saved automatically. **Google Scholar will tell you not only how many times an article was cited, but will also generate a list of those publications.** Many people are familiar with looking at Google Scholar search results and noting the number of times a particular publication has been cited.

Google Scholar will tell you if your library has access to the article you want. Many people have complained to me that they love searching in Google Scholar over doing traditional library database searches, but hate the hassle of then logging into their University library site to see if they have access. Google Scholar allows you to add a Library Preference and will then highlight which articles your designated library has access to. This feature can be added

7.8 Google Docs

Google Docs **now integrates a "Research Feature."** The day this rolled out was better than puppies and rainbows for a dedicated Google Docs user like myself. With this feature, Google Docs allows a you to choose the Research Tool and search for a term or author on the open web**.**

7.8 Worldcat

Connect your users to the information they need. Connect your library to the world. Search WorldCat, the world's most comprehensive library database to identify resources at your library and in the collections of the world's libraries. Library users and staff use WorldCat Discovery to search the WorldCat database of electronic, digital and physical resources; to identify materials they need and to find out where they are available.

7.9 Encore

The Encore Discovery Solution brings the complete library experience into the light. With Encore, you'll deliver fantastic search that brings anything you want to light – scholarly articles, books, local digital collections, and more. It's simple enough for new library users, and deep enough to satisfy exacting researchers. Innovative has forged partnerships with content providers so Encore libraries can integrate a full range of resources. For example Library users can initiate eBook checkouts and place holds for eBooks directly in the Encore environment with 3M™ Cloud Library or OverDrive®. ChiliFresh™ integration with Encore empowers social interaction with the library with a rich database of trusted ratings and reviews written by library users.

7.10 National Digital Library Pakistan

The Higher Education Commission of Pakistan has introduced a digital library Information System, to provide researchers within public and private universities in Pakistan and non-profit research and development organizations with access to international scholarly literature based on electronic (online) delivery, providing access to high quality, peer-reviewed journals, databases and articles across a wide range of disciplines. There are over 30 databases providing access to around 75,000 number of electronic content from the world's leading publishers. Digital Library is accessible to 400 institutes (Public Universities, Private Universities, R&D Organizations). It is observed that nearly 6 million articles are downloaded in 2009 and the number is continuously rising day by day. Access to collection of over 150 million items available through British Library Document Delivery Service. Collection of over 50,000 e-books available for researchers

8 . CONCLUSION

It is a know fact that library is a knowledge house; its main objective is to provide best services to its users. In the age of information technology, libraries should improve itself constantly by adopting new IT technologies. In this paper, we have tried to improve current user service model in university library by using Cloud Computing. Application of Cloud Computing is still in the initial stage in Pakistan. By introducing Cloud Computing to university libraries, services of libraries will be improved in the near future. In future, services to be provided by libraries will become more user-oriented, more professional and more effective. It is believed that libraries will create more knowledge base in Pakistan by applying Technology. In this connection, Higher Education Commission of Pakistan has taken an initiative and introduced digital library Information system for Public and Private Universities.

Cloud environment is a highly developed network environment; it appears to the users of high-quality service and high security. The Cloud computing techniques and methods applied to digital libraries, will improve the optimal use of resources and will enhance the confidence of the Provincial Universities. Mostly Librarians are using various tools provided by Online Computer Library Center, ExLibris, and Duraspace which are dedicated to library services.

Librarians support the idea of introducing cloud computing into the library and are desirous of various services that can be implemented on the cloud platform. Although, cloud computing is more economic and cost-saving than the traditional computing methods. However, the study has identifies the problems that cripple its implementation. The question of trust over the cloud service provider, data protection and broadband accessibility hinders its implementation on a larger scale. Further research with a broader scope, or using cluster and/or stratified sampling would provide additional information on the useage of digital libraries in Public and Private Universities of Pakistan.

REFERENCES

1. Abidi, F. and Abidi, H.J. (2012). Cloud Libraries: A novel application for Cloud computing. *International Journal of Cloud Computing*.
2. Fan Bingsi (2009). Cloud Computing and Libraries: Defense for Research on the Cloud Computing, Library and Information Service.
3. Hu Guangxia (2007). *Research on Information Service Model of University Library in Digital era*, Tianjin Polytechnic University.
4. Huang Fuyan (2008). *Research on the Development of Library Information Service Models in the Information Culture Environment*, OJ Xiangtan University.
5. Kishore, K. and Murthy, Y. (2012). Application of Cloud Technology in Digital Library, *IJCSI International Journal of Computer Science Issues*, 9(3), No 1, ISSN (Online): 1694-0814.
6. Kaushik, A. and Kumar, A. (2013). Application of cloud computing in libraries. *International Journal of Information Dissemination and Technology*, 3(4), 270-273.
7. Li Xia (2011). Research on the CRM - Based Mode of Individualized Information Service in the University.
8. Mayank Yuvaraj (2012). Cloud Computing Applications in Indian Central University libraries. *International Journal of Digital Library Services*, Issue-33.
9. QianYang, Dai Jun and Liao Xiaoyan (2009). Analysis on performance of Cloud Computing Oriented to Information Resource Management, Library and Information.
10. Yang, M. and Yuan, X. (2009). Digital Libraries under the Cloud Computing Environment, Library Development.

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IMAGE LOCAL-GLOBAL STATISTICS BASED MULTIPHASE SEGMENTATION MODEL

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ABSTRACT

Many techniques have been developed for image segmentation tasks. The Milestone multiphase image segmentation model is the Chan-Vese (CV) model [22] which shows its productivity when segmentation is in homogeneous and constant intensities. However, the CV model uses only global image statistics which causes weak detection when segmenting images with inhomogeneous intensities. Therefore, we introduce a new multiphase image segmentation model equipped with both local and global statistics which works more efficiently in both homogeneous and inhomogeneous multiphase image segmentation. Local image statistics helps in capturing local minute details and helps in handling varying intensities of objects whereas global image statistics helps in robust, fast detection of global image structure and handling noise. The experimental tests validate that the proposed model is far better than the standard multiphase image segmentation model.

KEYWORDS

Image segmentation, Active contour model, Chan-Vese two phase and multiphase (CV) models, Local Binary Fitting (LBF) model. Intensity Homogeneity, Intensity In-homogeneity, Real life and MRI images.

1. INTRODUCTION

Image segmentation is always a challenging but classical and basic problem in computer version. Image segmentation is the division of an image into categories or regions, which correspond to different objects or parts of the objects. Every pixel in an image is assigned to one of a number of these categories. Image segmentation helps us to detect different regions and objects forming images. Extracting and analyzing of these objects or regions is called image segmentation using widely in computer. The contribution adds up to this paper is extended from the 2-phase LBF model [13] and 2-phase active contour without edges model [5] to multiphase image segmentation equipped with both local and global statistics. The C V [5] which is a particular case of the Mumford and Shah [17] of image segmentation. CV and Mumford Shah models are segmenting globally features in the image, although it is useful in certain segmentation where to find a particular object in image. Osher and Sethian [18] introduced level set methods techniques, which is worked efficiently. First, they are dealing with changes in the topology of the active contour implicitly through the evolution of the curve. This is the main characteristic and advantage of the level set methods as the topological changes

should not be explicitly taken into account. Secondly, for numerical approximations, a fixed discrete grid in the spatial domain and finite difference approximations for spatial and temporal derivatives can be used and the third advantage of the level set methods can be extended to any dimension which classical snakes models lack. It can detect the object boundaries accurately smooth and then we have the most trendy CV model constitute the image into two regions the one is called foreground which representing the objects requires to be detect and the second is called the background of the image. Chan and Vese extended its earlier work to multiphase [22] image segmentation in which multiple regions can be detect and discovers multiple objects by using multiple level set formulation. These models are shown poor performance where an image has intensity in-homogeneities objects division, also called piecewise constant models [PC]. This poor performance is due to wrong globally information given to evolving curves. In image segmentation there are two main categories which have proven their effectiveness accordingly. The first is called the Edged-based Method while the second is called the Region-based Method. Edged-based Method depends upon the gradient of a given image [2, 7, 8]. The phenomena behind this category are to bend these curves in the direction of the desired and interested boundaries of an object by applying the partial differential equations (PDEs). The second category Region-Based Method including active contour models works with minimal length criteria [11] and on region-growing and emerging [1], watershed algorithm [23] and Mumford and Shah functional minimization are common examples of this method. Recently BC model [2], based efficient statistic coefficient of variation (CoV), is a mix-up of these both edged and Region-based categories models which is robust for noisy images. This model [BC] is able to detect overlapping objects with regions of homogeneous intensity, and can also detect the object with non-homogeneous intensities; however this model does not produce clear identification of an object into image. In image segmentation another model, Local Binary Fitting [LBF] [13] introduced by Li et al. This model is not only capable of coping with In-homogeneity, but also giving definite results, but this model is limited to two-phase not applicable to multiphase segmentation directly. In our present work we develop a multiphase image segmentation model with addition of both locally and globally information is known previously. Local information are getting by the model Local Binary Fitting [LBF] [13] and globally by Vese and Chan [22] with the mix-up of these two information our model does not only work more efficiently in homogeneous and inhomogeneous, but also in smooth and intensity of texture image.

Sections of our paper are as follows; Sections 2 describes briefly reviews and related works of image segmentation, Section 3 describes our model in details, examples and results are labeled to section 4, Conclusion is presenting in section 5.

2. RELATED WORK BACKGROUND

2.1 Vese and Chan Multiphase Model

Chan and Vese extended their work from two phases (one level set) to multiphase (4-phases or two levels set). Multiphase level set formulation [15, 22] has been proposed to detect multi-regions by Chan-Vese. This model has a major drawback with the poor segmentation results for images with intensity in homogeneities. The model as follow

$$F_u(c,\Phi) = \int_\Omega (u_0 - c_{11})^2 H(\phi_1)H(\phi_2)dxdy + \int_\Omega (u_0 - c_{10})^2 H(\phi_1)\big(1 - H(\phi_2)\big)dxdy + \int_\Omega (u_0 - c_{01})^2 \big(1 - H(\phi_1)\big)H(\phi_2)dxd + \int_\Omega (u_0 - c_{00})^2 (1 - H(\phi_1))\big(1 - H(\phi_2)\big)dxd + v\int_\Omega |\nabla H(\phi_1)|dxdy + v\int_\Omega |\nabla H(\phi_2)|\,dxdy$$

where

$$c = (c_{00}, c_{01}, c_{10}, c_{11}) \text{ is constant vector and } \Phi = (\phi_1, \phi_2)$$

$$c_{11} = \frac{\int_\Omega u_0(x,y)\,H(\phi_1)\,H(\phi_2)\,dxdy}{\int_\Omega H(\phi_1)\,H(\phi_1)dxdy},\ c_{10} = \frac{\int_\Omega u_0(x,y)\,H(\phi_1)\,(1 - H(\phi_2))\,dxdy}{\int_\Omega H(\phi_1)\,(1 - H(\phi_2))\,dxdy}$$

$$c_{01} = \frac{\int_\Omega u_0(x,y)\,(1 - H(\phi_1))\,H(\phi_2)\,dxdy}{\int_\Omega (1 - H(\phi_1))\,H(\phi_2)\,dxdy},\ c_{00} = \frac{\int_\Omega u_0(x,y)\,(1 - H(\phi_1))\,(1 - H(\phi_2))\,dxdy}{\int_\Omega (1 - H(\phi_1))(1 - H(\phi_2))dxdy}$$

where the image function is expressing in the following notation.

$$u = c_{11}H(\phi_1)\,H(\phi_2) + c_{10}H(\phi_1)\big(1 - H(\phi_2)\big) + c_{01}\big(1 - H(\phi_1)\,H(\phi_2)\big) + c_{00}(1 - H(\phi_1))\big(1 - H(\phi_2)\big).$$

minimizing with respect to c and Φ and to get the Euler-Lagrange equations with the following PDEs

$$\frac{\partial(\phi_1)}{\partial t} = \delta_\varepsilon(\phi_1)\{v\,div\left(\frac{\nabla(\phi_2)}{|\nabla(\phi_2)|}\right) - [((u_0 - c_{11})^2) - ((u_0 - c_{01})^2)\,H(\phi_1)] + [((u_0 - c_{10})^2) - ((u_0 - c_{00})^2)\,H(\phi_1)]\}.$$

$$\frac{\partial(\phi_2)}{\partial t} = \delta_\varepsilon(\phi_2)\{v\,div\left(\frac{\nabla(\phi_1)}{|\nabla(\phi_1)|}\right) - [((u_0 - c_{11})^2) - ((u_0 - c_{01})^2)\,H(\phi_2)] + [((u_0 - c_{10})^2) - ((u_0 - c_{00})^2)\,H(\phi_2)]\}$$

It noticed that across the boundary the equation is completely managed by the mean curvature and jump of the data energy term possessing.

2.2 The Local Binary Fitting Model (LBF)

PS Model is avoiding because of expensive one therefore [12, 13] introduced a model called LBF model by targeting small structure type segmentation. The LBF model cope with the problem, poor results with intensity in homogeneities, in PS model more accurately and more efficient than the PS model by embedding local based information in the given image. Taking a vector value function such as,

$$u_0 : \Omega \to \mathcal{R}^d,$$

where $\Omega \subset \mathcal{R}^n$ represents image domain and d ≥ 1 which is the dimension of vector function u_0. It is taking to be as d = 1 and d = 3, for gray level image and color image respectively. The kernel function has been introduced to the LBF model as follow,

$$E(c, f_1, f_2) = \lambda_1 \int [\int_{inside(C)} \kappa_\sigma (x - y) |u_0(y) - f_1(x)|^2 \, dy] \, dx + \lambda_2 \int [\int_{outside(C)} \kappa_\sigma (x - y) |u_0(y) - f_2(x)|^2 \, dy] \, dx.$$

where λ_1 *and* λ_2 are positive constants and κ is a kernel function with a localization property that κ (u) decreases and approaches zero as $|u|$, and $f_1(x)$ *and* $f_2(x)$ are two numbers that fit image intensities near the point x. We call the point x the center point of the above integral and the above energy the Local Binary Fitting (LBF) energy around the center point x. Where kernel function $\kappa_\sigma(x)$ is a Guassian Kernel,

$$\kappa_\sigma(x) = \frac{1}{(2\pi)^{\frac{n}{2}} \sigma^2} \cdot \frac{e^{-|x|^2}}{2\sigma^2}$$

with a scale parameter σ > 0. It should be emphasized that the numbers $f_1 and\, f_2$ that minimize the energy vary with the center point x. The introduction of the spatially vary fitting functions $f_1 and\, f_2$ makes our methods essentially different from PC model. With the level set representation, the energy functional $\varepsilon_x^{LBF}(c, f_1(x), f_2(x))$ in above can be written as,

$$\varepsilon_x^{LBF}(c, f_1(x), f_2(x)) = \lambda_1 \int \kappa_\sigma (x - y) |u_0(y) - f_1(x)|^2 H(\phi(y)) dy + \lambda_2 \int \kappa_\sigma (x - y) |u_0(y) - f_1(x)|^2 (1 - H(\phi(y))) \, dy$$

where H is a Heaviside function, thus the fitting energy ε can be written as,

$$\varepsilon_x^{LBF}(\phi, f_1(x), f_2(x)) = \int_\Omega \varepsilon_x^{LBF}(\phi, f_1(x), f_2(x)) + \lambda_1 \int_\Omega \kappa_\sigma (x - y) |u_0(y) - f_1(x)|^2 H(\phi(y)) \, dy + \lambda_2 \int_\Omega \kappa_\sigma (x - y) |u_0(y) - f_2(x)|^2 (1 - H(\phi(y))) \, dy$$

where

$$f_1(x) = \frac{\kappa_\sigma(x) * H_\varepsilon(\phi(x)) \, u_0(x)}{\kappa_\sigma(x) * H_\varepsilon(\phi(x))}, \; f_2(x) = \frac{\kappa_\sigma(x) * (1 - H_\varepsilon(\phi(x))) \, u_0(x)}{\kappa_\sigma(x) * (1 - H_\varepsilon(\phi(x)))}.$$

$H_\varepsilon(\phi) > 0, (1 - H_\varepsilon) > 0,$ *keeping* $f_1 \, and \, f_2 \, fixed$ and minimizing the energy function $F_\varepsilon(\phi, f_1, f_2)$ $w.r.t\, \phi$,we get the gradient descent function.

$$\frac{\partial \phi}{\partial t} = -\sigma_\varepsilon(\phi)(\lambda_1 - c_1 - \lambda_2 c_2) + v\sigma_\varepsilon(\phi) \, div\left(\frac{\nabla(\phi)}{|\nabla(\phi)|}\right) + \mu(\nabla^2\phi - \left(div\left(\frac{\nabla(\phi)}{|\nabla(\phi)|}\right)\right).$$

where σ_ε is the smooth Dirac function given by above equation and e_1 and e_2 are the function as follows,

$$e_1(x) = \int_\Omega \kappa_\sigma (x - y) |u_0(x) - f_1|^2 dy,$$
$$e_2(x) = \int_\Omega \kappa_\sigma (x - y) |u_0(x) - f_2|^2 dy.$$

3. THE PROPOSED MODEL

We proposed the following model with a mix-up of local and globally features in image segmentation such as,

$$F(\Phi, c, f) = \mu \int |\nabla H(\phi_1)| + \mu \int |\nabla H(\phi_2)| + \int (u_0 - (\lambda f_{11} + (1-\lambda))\, c_{11})^2 H(\phi_1)\, H(\phi_2)$$
$$+ \int (u_0 - (\lambda f_{01} + (1-\lambda))\, c_{01})^2\, H(\phi_1)\, H(\phi_2)$$
$$+ \int (u_0 - (\lambda f_{10} + (1-\lambda))\, c_{10})^2\, H(\phi_1)\, H(\phi_2)$$
$$+ \int (u_0 - (\lambda f_{00} + (1-\lambda))\, c_{00})^2\, H(\phi_1)\, H(\phi_2)$$

We calculate $(c_{11}, c_{10}, c_{01}, c_{00})$ and $(f_{11}, f_{10}, f_{01}, f_{00})$ by using the following formulae and the Euler - Lagrange equation obtained by minimizing the above equation with respect to Φ.

$$c_{11} = \frac{\int_\Omega u_0(x,y)\, H(\phi_1) H(\phi_2)\, dxdy}{\int_\Omega H(\phi_1)\, H(\phi_2)\, dxdy}, \qquad c_{10} = \frac{\int_\Omega u_0(x,y)\, H(\phi_1)(1 - H(\phi_2))\, dxdy}{\int_\Omega H(\phi_1)\,(1 - H(\phi_2))\, dxdy}$$

$$c_{01} = \frac{\int_\Omega u_0(x,y)\,(1 - H(\phi_1))\, H(\phi_2)\, dxdy}{\int_\Omega (1 - H(\phi_1))\, H(\phi_2)\, dxdy}, \qquad c_{00} = \frac{\int_\Omega u_0(x,y)\,(1 - H(\phi_1))\,(1 - H(\phi_2))\, dxdy}{\int_\Omega (1 - H(\phi_1))\,(1 - H(\phi_2))\, dxdy}$$

$$f_{11}(x) = \frac{\kappa_\sigma(x) * H_\varepsilon(\phi_1(x)) * H_\varepsilon(\phi_2(x))\, u_0(x)}{\kappa_\sigma(x) * H_\varepsilon(\phi_1(x)) * H_\varepsilon(\phi_2(x))}, \qquad f_{10}(x) = \frac{\kappa_\sigma(x) * H_\varepsilon(\phi_1(x)) * (1 - H_\varepsilon(\phi_2(x)))\, u_0(x)}{\kappa_\sigma(x) * H_\varepsilon(\phi_1(x)) * H_\varepsilon(\phi_2(x))}$$

$$f_{01}(x) = \frac{\kappa_\sigma(x) * (1 - H_\varepsilon(\phi_1(x))) * H_\varepsilon(\phi_2(x))\, u_0(x)}{\kappa_\sigma(x) * (1 - H_\varepsilon(\phi_1(x))) * H_\varepsilon(\phi_2(x))}, \qquad f_{11}(x) = \frac{\kappa_\sigma(x) * (1 - H_\varepsilon(\phi_1(x))) * (1 - H_\varepsilon(\phi_2(x)))\, u_0(x)}{\kappa_\sigma(x) * (1 - H_\varepsilon(\phi_1(x))) * (1 - H_\varepsilon(\phi_2(x)))}$$

where

$c = (c_{00}, c_{01}, c_{10}, c_{11}), f = (f_{11}, f_{10}, f_{01}, f_{00})$ is constant vector and $\Phi = (\phi_1, \phi_2)$

$$\frac{\partial \phi_1}{\partial t} = -\sigma_\varepsilon \{ v\, div\left(\frac{\nabla(\phi_1)}{|\nabla(\phi_1)|}\right) - [((u_0 - (\lambda f_{11} + (1-\lambda)\, c_{11})^2$$
$$- (u_0 - (\lambda f_{01} + (1-\lambda) c_{01})^2) \mathrm{H}(\phi_2)$$
$$+ [((u_0 - (\lambda f_{10} + (1-\lambda)\, c_{10})^2 - (u_0 - (\lambda f_{00} + (1-\lambda) c_{00})^2) \mathrm{H}(\phi_2)$$

$$\frac{\partial \phi_2}{\partial t} = -\sigma_\varepsilon \{ v\, div\left(\frac{\nabla(\phi_2)}{|\nabla(\phi_2)|}\right) - [((u_0 - (\lambda f_{11} + (1-\lambda)\, c_{11})^2$$
$$- (u_0 - (\lambda f_{01} + (1-\lambda) c_{01})^2) \mathrm{H}(\phi_1)$$
$$+ [((u_0 - (\lambda f_{10} + (1-\lambda)\, c_{10})^2 - (u_0 - (\lambda f_{00} + (1-\lambda) c_{00})^2) \mathrm{H}(\phi_1),$$

where $(c_{11}, c_{10}, c_{01}, c_{00})$ and $(f_{11}, f_{10}, f_{01}, f)$ are usual meaning and calculations by previously discussed models CV1 and FBL in details

4. EXPERIMENTAL RESULTS

This section is demonstrated the results and evaluation of our proposed model M-2 and the CV M-1 model. All the results shown and compare to their corresponding figures to each other. Next we display four types of images for each model such as the Initial contour, the final contour, the segmented result and at the last by mesh 3D plot. We match the results by constructing two rows and four columns. The top row shows results for CV M-1 model and the bottom row display our proposed model M-2 results. Observations make obvious that the performance of our proposed model M-2 is better when we apply the contour on in-homogenous, overlapping and texture regions than to compare with the CV M-1 model. Below discussion clarify the comparison.

For clarity, we shall denote by

M-1 — the CV Model, M-2 — the GWS Model

In this section we will give a brief discussion and analysis of both our proposed model and the CV model. Our proposed model can also apply to the real images, some

MRI images and synthetic images. Moreover, we compare the experimental results and outcomes with CV model taking start with a real medical brain MRI image which has distinct regions and intensities in-homogeneity as displayed in figure (1). It can be clearly observed from test figures 1(b) and 1(f) that our proposed model performed better than the CV model because the CV model relies on the homogeneity of the intensities at each region. Our model is clarify the objects and giving some meaningful information near the boundaries and at the bottom of the segmented image as compare to CV model which is traditionally does not capable of accurate results if there is no homogeneity. Secondly, we use λ for all experiments with different values for better results. Next experimental image is another MRI with in-homogeneity intensities and variability regions displayed in figure (2). It is clear from the figure 2(b) and 2(f) that our model is more better result than the CV model. Figure (3) which is a synthetic one illustrate the non-uniform intensities .The CV model shows a week detection while our model demonstrate the non-uniform intensities and variability accurately. This difference is shown in 3(b) and 3(f). Figure 4 is a real life image which shows that CV model fails to detect the regions properly while our proposed model is capable to capture the desire regions. Comparison is displayed in 12(b) and 12(d).

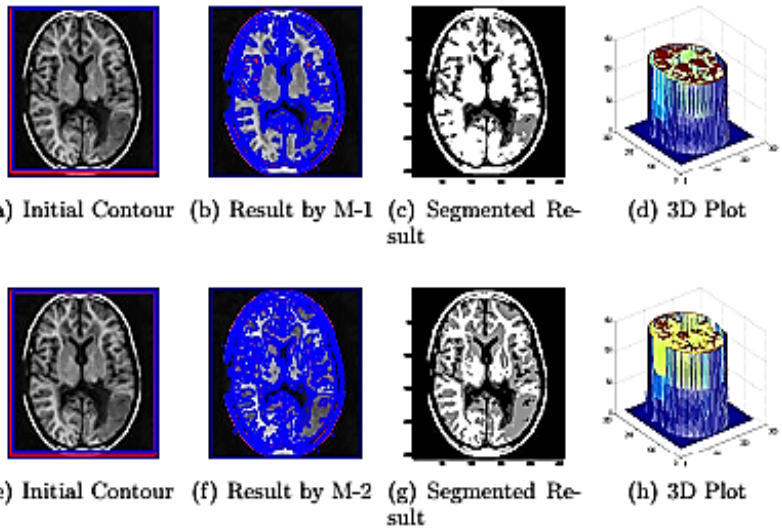
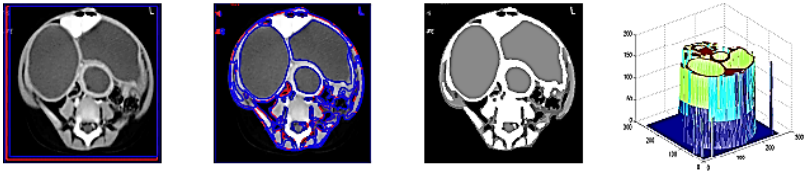
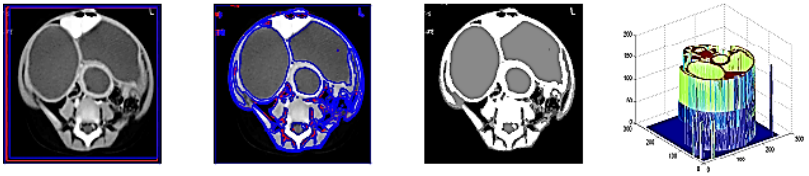


Fig. 1: The comparison of the M-1 and the proposed model M-2 on segmenting real MRI image.Segmented results shows our better accuracy and detection,while M-1 is lacking information and detection in the image. The evidence is given in figure 1(b) and figure 1(f). For M-1 and our Proposed model M-2 parameters used are: $\lambda = 0.4$, $\mu = 0.032768$, Iteration $= 500$ and $\sigma = 3$.



) Initial Contour (b) Result by M-1 (c) Segmented Result (d) 3D Plot



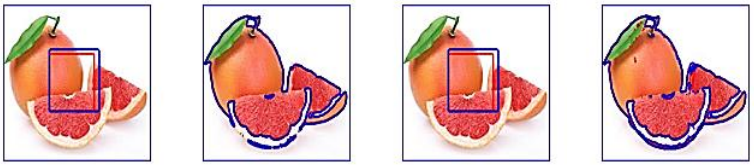
) Initial Contour (f) Result by M-2 (g) Segmented Result (h) 3D Plot

Fig. 2: The comparison between M-1 and the proposed model M-2 is shown on segmenting another real MRI image. Results clarify in figure 2(b) and figure 2(f) that our proposed model is better than the CV M-1 model with the following parameters
$\lambda = 0.43$, $\mu = 0.016384$, Iteration $= 500$ and $\sigma = 2$.

(a) Initial Contour (b) Result by M-1 (c) Segmented Result (d) 3D Plot

(e) Initial Contour (f) Result by M-2 (g) Segmented Result (h) 3D Plot

Fig. 3: The comparison of the M-1 and proposed model M-2 on segmenting a synthetic image. Our Model M-2 is successfully detected the variabilities on this segmenting while M-1 model has a weak detection of the region. figure 3(b) and figure 3(f) tell the story. For this comparison we used the parameters, $\lambda = 0.7$, $\mu = 385.5$, Iteration $= 2000$ and $\sigma = 2$.



a) Initial Contour (b) Result by M-1 (c) Initial Contour (d) Result by M-2

Fig. 4: M-1 and M-2 creating figure 4(b) and figure 4(d) respectively. Evaluation in this segmenting image observed that our proposed model is better than the CV M-1 model on segmenting a real life orange image. Our model shows better accuracy as we compare our results to CV M-1 model. For this experiment supported parameters are, $\lambda = 0.65$, $\mu = 0.0000819$, Iteration $= 200$ and $\sigma = 2$.

5. CONCLUSION

In this paper we set up a new multiphase image segmentation model equipped with both local and global statistics which works more efficiently in both homogeneous and inhomogeneous multiphase image segmentation. This proposed model shows its productivity and efficiency where we talk about vacuum or overlapping, previous work by multiphase model [22] handles these problems, but when we face problem with intensity in-homogeneities then the CV [22] model often fails and leads a poor and weak segmentation. This is why the results for image with intensity in-homogeneities due to wrong moment and direction of the evolving curves guided by global image information. Our proposed model embraces these problems accurately and efficiently both in intensity homogeneity and in-homogeneity. Another advantage of our model is to handle with intensity in-homogeneity by utilizing the local based minute information in the image; even this work has been introduced by LBF model [13], but restricted to two phase and cannot work when we have a problem of multiphase image segmentation, another thing has been noticed in previous results section that our proposed much better results with intensities in-homogeneities as compare

to the LBF model [13]. Local image statistics helps in capturing local minute details and helps in handling varying intensities of objects whereas global image statistic helps in robust, fast detection of global image structure and handling noise .the experimental tests validate that the proposed model is far better than the standard multiphase image segmentation model and finally our model prove its utility to other problems, such as texture segmentation and discrimination.

REFERENCES

1. Adams, R. and Bischof, L. (1994). *Seeded region growing. IEEE Trans*. Pattern Analysis and Machine .Intelligence, 16(6), 641-647.
2. Badshah, N. and Chen, K. (2010). *Image Selective Segmentation under Geometrical Constraints Using .an Active Contour Approach*. Math. Comp., 7, 759-778.
3. Caselles, V., Francine, Catte, Cell, T. and Dibos, F. (1993). *A geometric model for active contours. Numer. Math*., 66(1), 131.
4. Caselles, V., Kimmel, R. and Sapiro, G. (1997). On Geodesic active contours. *International Journal of Computer Vision*, 22(1), 61-79.

5. Chan, T.F. and Vese, L.A. (2001). *Active contours without edges*. IEEE Transactions on Image. *Processing*, 10(2), 266-277.
6. Cosellel, V., Kimmel., R and Sapiro., G. (1995) .*Geodesic Active Contours, Proc. IEEE Intl Conf. Computer Vision*, 694-699.
7. Gout, C., Guyader, C.L. and Vese, L.A. (2005). Segmentation under geometrical conditions with geodesic active contour and interpolation using level set method. *Numerical Algorithms*, 39, 155-173.
8. Guyader, C.L. and Gout, C. (2008). Geodesic active contour under geometrical conditions theory and 3D applications. *Numerical Algorithms*, 48, 105-133.
9. Kass, M., Witkin, A. and Terzopoulos, D. (1988). Snakes: active Contours Models. *International Journal of Computer Vision*, 1, 321-331.
10. Kichenassamy, S., Kumar, A., Olever, P., Tannenbanum, A. and Yezzi, A. (1996). Conformal curvatures flows: From phase transitions to active vision. *Arch. Rational Mech. Anal.*, 134(3), 275-301.
11. Leclerc, Y. (1990). Region *growing using the MDL principle, In*: DAPPRA Image Understanding Workshop.
12. Li, C., Kao, C.Y., Gore, J. and Ding, Z. (2008). Minimization of region-scalable fitting energy for image segmentation. *IEEE Transactions on Image Processing*, 17, 1940-1949.
13. Li, C., Kao, C.Y., John C., Gore. and Ding, Z. (2007). Implicit Active Contours Driven by Local. Binary Fitting Energy. *IEEE Conference on Computer Vision and Pattern Recognition* (CVPR), 1-7.
14. Li, C., Xu, C., Gui, C. and Fox, M.D. (2005). Level set evolution without re-initialization: a new variational formulation. *IEEE Conference on Computer Vision and Pattern Recognition*, San Diego, 430-436.
15. Li, Y.B. and Kim, J.S. (2011). Multiphase image segmentation using a phase-field model. *Computers and Mathematics with Applications*, 62, 737-745.
16. Malladi, R., Sethian, J.A. and Vemuri, B.C. (1995). Shape Modeling with Front Propagation: A Level Set Approach. *IEEE Trans. Pattern Anal. Machine Intell.*, 17, 158-175.
17. Mumford, D. and Shah, J. (1989). Optimal approximation by piecewise smooth functions and associated variational problems. *Communications on Pure Applied Mathematics*, 42, 577-685.
18. Osher, S. and Sethian, J.A. (1988). Fronts propagating with curvature-dependent speed: algorithms based on Hamilton-Jacobi formulations. *J. Comput. Phys.*, 79(1), 12-49.
19. Siddiqiy, K., Lauzierez, Y.B., Tannenbaum, A. and Zuckery, S.W. (1998). Area and length minimizing flows for shape segmentation. *IEEE Trans. Image Processing*, 7, 433-443.
20. Siddiqi, K., Tannenbaum, A. and Zucker, S.W. (1998). Hyperbolic smoothing of shapes. *Proc. 6th Int. Conf. Comput. Vision (ICCV)*, 1, 215-221.
21. Tsai, A., Yezzi, A., Alan, S. and Willsky. (2001). Curve evolution implementation of the Mumford-Shah functional for image segmentation, denoising, *IEEE Transaction on Image Processing*, 10(8).

22. Vese, L.A. and Chan, T.F. (2002). *A multiphase level set framework for image segmentation using the Mumford and Shah model*. *Int. J. Computer Vision*, 50(3), 271-293.
23. Vincent, L. and Soille (1994). *Watersheds in Digital Spaces - an efficient algorithm based on immersion*. *IEEE Trans. Pattern Analysis and Machine Learning*, 6, 583-598.
24. Xu., C. and Jerry, L. and Prince., J.L. (1998). Snakes, Shapes, and Gradient Vector Flow. *IEEE Transaction on Image Processing*, 7(3).

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IMPACT OF RADIATION HAZARDOF HIROSHIMA AND NAGASAKI, CHERNOBYL EPISODE ON ENVIRONMENT AND ITS SAFETY MEASUREMENTS

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ABSTRACT

This is a review article. It briefly discusses the understanding and the consequences of radiation energy deposition in DNA. From a mechanistic point of view, physical, chemical and biochemical changes in DNA will be linked to biological consequences and impact on human health. More information like biological effects of Radiation, Deterministic and Stochastic effects of Radiation, Acute Radiation Syndrome (ARS), Cancer deaths attributable to Radiation, the Risk & Exposure impact of Hiroshima and Nagasaki, and Chernobyl on Environment have also been explained and discussed. The data for radiation protection & shielding is being analyzed & presented in this article.

1. INTRODUCTION

Radiation is an energy which is emitted from any source and which travels through some material or space in the form of waves and particles. It is a natural phenomenon which is existing since time immemorial. Light, Heat, Sound are some of the basic examples of radiation. To understand the basic concept of radiation one must know about the nature's building block called "atom".

1.1 Classification of Radiation

The classification of radiation can be considered as "Electromagnetic Spectrum". The electromagnetic (EM) Spectrum is nothing but a bunch of different types of radiations such as: Alpha particles **(α),** Beta particles (β), X-rays, Gamma rays. Radiation that ranges from extremely low frequency (ELF) radiation to ultraviolet light renamed as: Radio waves, Micro waves, Infrared light, visible light, ultra violet radiation. The sources of radiation can be classified as follows: Cosmic radiations, Terrestrial radiations, manmade radiations

1.2 Applications of Radiations

Radiation is applied in many fields such as: Medical field, Industrial field, Agricultural field, and in scientific research. For the purpose of this we will describe its application in only scientific research.

1.2.1 Medical field

The use of radiation has become an integral part in field of medical science. From the X-ray image of a broken limb to the treatment of cancer, radiation is widely used. Throughout the year, many patients are diagnosed and treated with the help of this

technology. X-rays (a type of radiation) is largely used to get information on bone's fracture and other medical problems. Radio isotopes are used in the field of nuclear medicine. With the help of these many diseases are diagnosed.

a. Treatment of cancer has been possible because of the use of radiation. Radiation is allowed to fall on the cancer affected cells. It breaks cells and stops its growth.
b. Sterilization of blood and other items like sutures, syringes, catheters and hospital clothing used particularly in operation is done through and also through other means.

1.2.2 Industrial field

No doubt, in many industrial fields, the use of radiations has improved the degree of performance. Its importance and use in the described referenced field are as follows:

a. Density gauging is one of the very important and useful aspects of radiation. With the help of radiation density of the ground is measured to make roads.
b. Well-logging is made easier with the application of radiation.
c. Through radiation defects and leakages are easily found in the pipes which are buried in the ground, etc.

1.2.3 Agricultural field:

Another important field where radiation is applied is agricultural. With the help of radiation tremendous progress can be achieved in this field. For example,

a. Radiation is being used to preserve different varieties of food. The process exposes food to high doses of radiation from cobalt-60. This process kills bacteria, insects and parasites, while the food itself remains safe without becoming radioactive.
b. In agriculture, radiation has been used to breed new seed varieties with higher yields, such as the "miracle" rice that has greatly expanded rice production in Asia.
c. Radiation has also been used to improve the nutritional value of some crops, as well as to improve their baking or melting qualities or reduce their cooking time.

1.2.4 Scientific Research

Without any doubt discovery and production of radiation has opened a new horizon for more and more scientific research. From the study of basic building block of nature i.e. atom to the huge discoveries, all has been made possible because of usage of radiation. Some of the current usages of radiation in scientific research are:

a. The effectiveness and safety of almost all new drugs is tested with the help of radioactive materials.
b. Radioactive materials are also essential to biomedical research that seeks causes and cures for diseases like AIDS (acquired immune deficiency syndrome) and cancer.
c. Radio nuclides are used extensively in genetic engineering and environmental protection studies, etc.

2. X-RADIATION AND BIOLOGICAL EFFECTS

X-rays which are one of the members of ionizing radiations can cause damage to living cells. When X-rays (or ionizing radiations) interacts with a cell, they either ionize or produce excitation in the cell. The cell contains biologically significant molecules like DNA, RNA, Protein, enzymes etc. “Deoxyribo-Nucleic-Acid” means DNA which acts as a brain of a cell can be affected by the direct interaction of the X-rays. And can become of abnormal structure which initiates the events that leads to biological changes. Basically, the biological changes occur when DNA damage is not repaired or is poorly repaired. Extensive damage to DNA can lead to the cell death. Large numbers of cells dying can lead to organ failure. Damaged or poorly repaired DNA may develop into Lymphoma and Cancers in somatic cells.

2.1 Structure of DNA

The structure is shown in the figure 1.

3. BASIC CONCEPT OF RADIATION PROTECTION

Radiation protection helps us a lot (x-rays etc) but they can be hazardous as well. Radiation is present in the environment but we should avoid undue exposure to radiation. There are three basic concepts of radiation protection. They are (a) Time (b) distance (c) shielding.

3.1 Deterministic effects

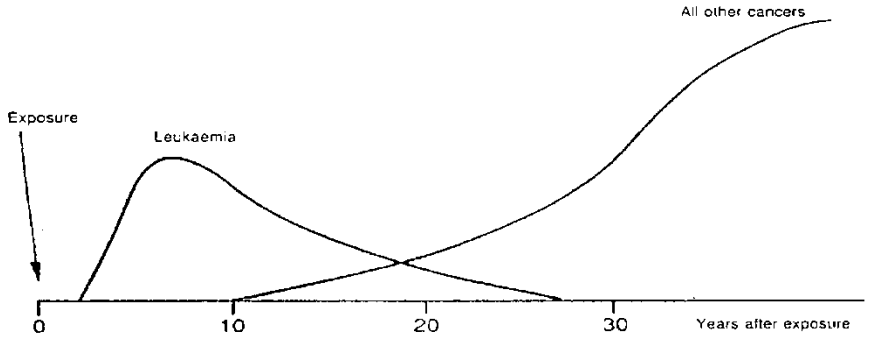
There exists a certain level, that is, the "threshold", below which the effect will be absent. These kinds of effects are known as "deterministic effects". It is based on a large number of experiments involving animals and other researches. Further supplemented by theoretical studies, it was discovered that severity of certain effects on human beings will increase with increasing doses. Examples are: cataract, erythema, infertility etc. Severity of deterministic effects depends on dose. However, thresholds exist, only above which the effects will occur. The International Commission on Radiological Protection (ICRP) considers that if the annual radiation doses to the lens of the eyes of radiation workers are restricted to 150 mSv (equivalent to 150 mGy for X-ray), cataract is unlikely to occur during his/her life assuming a working period of 50 years.

For other major organs, the annual dose limits for preventing deterministic effects is as follows. According to the time for the effects to occur, the biological effects of radiation can be divided into two categories: acute effects and latent effects.

3.1.1 Acute Effects

There are three types of acute effects of radiation: Hematopoietic syndrome, gastrointestinal syndrome, Central Nervous syndrome.

Latent effects of radiation refer to those which occur 6 months after the exposure. It consists of two categories: Somatic effects and Genetic effects. The Somatic effect occur on the exposed individuals (e.g. cataracts, radiation sickness, cancers, etc.) while the Genetic effect occurs in their future generations because of mutations of the genetic cells. Figure 2 Latency periods for radiation-induced cancer.



3.1.2 Somatic Effects

This is the biological effect that occurs on the exposed individuals.

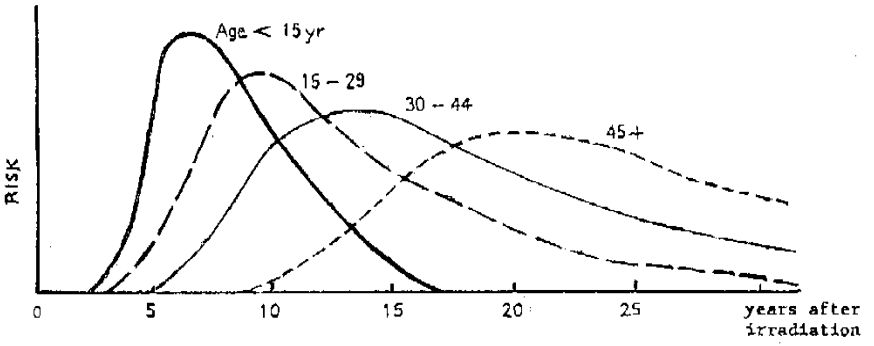
Genetic effects: Genetic effects refer to biological changes on the descendants of the exposed individuals due to mutation of their genetic cells. When genetic cells are irradiated, the chromosomes or DNA of the cells may be affected which may lead to genetic mutations, chromosome aberrations or changes in the number of chromosomes in the cells. As a result, the probability of genetic changes will increase, bringing detrimental effects to the descendants of the exposed persons.

4. SENSITIVITY OF BODY ORGANS TO RADIATION

Following are the sensitive parts of body which can be affected by the radiation:

Gonad: The probability of cancer induction in this organ is comparatively low. The main concern is the genetic effects due to irradiation of this organ and the probability is proportional to the absorbed dose.

Red bone marrow (Blood Cancer): The effect on bone marrow plays an important role in the induction of leukemia. Based on statistical data from radiotherapy patients and atomic bomb survivors in Japan, the induction of leukemia is at maximum for several years after the irradiation, and will return to the normal incident level after about 25 years.Figure3shows the Risk of leukaemia depending on age at exposure to Atomic bomb.



Bone: The radiosensitive cells in bone are endosteal cells and epithelial cells on the bone surfaces. The sensitivity of bone is less than that of the breast, lung and thyroid.

Lung: Cancer of the lung has been observed in minors exposed to high concentration of radon and its decay products. External irradiation can also induce lung cancer and the risk is about the same as that for the development of leukemia.

Thyroid: Radiation can induce thyroid cancer. However, the mortality of this type of cancer is much lower than that of leukemia, primarily because of the success in the treatment of thyroid cancer.

Breast: During reproductive life, the female breast may be one of the more radiosensitive tissues of the human body. The risk for breast cancer is about one half of that of leukemia.

Skin: The effects on skin depend on absorbed dosage and the area of irradiation. Major effects are erythema and ulceration of the skin. The probability of induction of skin cancer is less than the above organs.

Lens: The effects of radiation on the eyes are causing cataract, which is the opacity of the lens. The lens is 5 to 10 times more sensitive to neutrons than to x-ray. Thresholds exist with lower values for children than those for the adults.

Fetus: Effects depend on the stage of pregnancy at the time of exposure. At the early stage of pregnancy when the cells are still not differentiated, it usually causes death of the embryo. It is generally believed that exposure of fetus during the first 3 weeks of pregnancy should not cause any deterministic and stochastic effect to the embryo. Later stage irradiation of the fetus may lead to malformation of body organs and increase in cancer risk of the child.

4.1 Stochastic effects

The severity of stochastic effects is independent of the absorbed dose. Under certain exposure conditions, the effects may or may not occur. There is no threshold and the probability of having the effects is proportional to the dose absorbed.

Characteristics of stochastic effects:

- Severity is independent of absorbed dose
- Threshold does not exist
- Probability of occurrence depends on absorbed dose
- Example: radiation induced cancer, genetic effect

As stochastic effects of radiation have no thresholds and can cause cancers or genetic modifications, of which the curing rates are rather low to date, they become a major subject of research in radiation protection.

Biological effects of radiation in time perspective

Sources of data on human effects of radiation overexposure

The severity of stochastic effects is independent of the absorbed dose. Under certain exposure conditions, the effects may or may not occur. There is no threshold and the probability of having the effects is proportional to the dose absorbed.

Characteristics of stochastic effects, Severity is independent of absorbed dose, Threshold does not exist, Probability of occurrence depends on absorbed dose, Example: radiation induced cancer, genetic effect, stochastic effects

5. CANCER DEATHS ATTRIBUTABLE TO ATOMIC BOMB

In 86572 survivors of Hiroshima and Nagasaki, 7827 persons died of cancer in the year during 1950-90 as shown in the Table 1.

Table 1
Cancer deaths attributable to Atomic bomb

	Observed	Expected	Excess	Percentage (%)
All tumours	7578	7244	334	4.4
Leukaemia	249	162	87	35.0
All cancers	7827	7406	421	5.4

Ref. Pierce et al, Rad. Res. 146: 1-27, 1996

5.1 Childhood leukaemia around UK nuclear facilities

46,000 children (till the age of 25 yrs) born to parents working in nuclear industry, 111 cases of acute leukaemia observed, i.e. fewer than expected in a group of this size and age study found 3 cases of leukaemia in children of male workers who had received a pre-conception exposure of 100 mSv or more. Two of these three cases had already been identified in the 1990 Gardner report (proposed theory that paternal pre-conception radiation leads to increased risk of leukaemia in offspring).

Table 2
Cancer Mortality of Nuclear Industry Workers

Observed/Expected deaths Dose range, mSv							**Total number of deaths**	**Trend test (p-value)**
<10	10-	20-	50-	100-	200-	400-		
Observed/Expected number of deaths from cancers other than leukaemia								
2234/ 2228.3	462/ 465.4	445/ 479.6	276/ 254.3	196/ 190.5	161/ 147.6	56/ 67.3	3830	-0.28
Observed/Expected number of deaths from leukaemia other than CLL (chronic lymphocytic leukaemia								
60/ 62.0	19/ 17.2	14/ 17.2	8/ 9.0	8/ 6.4	4/ 4.7	6/ 2.3	119	1.85 (0.046)

Ref: Cardis, E. et al: Combined Analyses of Cancer Mortality among nuclear industry workers in Canada, the UK and USA. IARC Technical Report No. 25, Lyon, 1995

6. EFFECTS OF CHERNOBYL

6.1 Chernobyl disaster effects, National and international spread of radioactive substances

Four hundred times more radioactive material was released from Chernobyl than by the atomic bombing of Hiroshima. The disaster released 1/100 to 1/1000 of the total amount of radioactivity released by nuclear weapons testing during the 1950s and 1960s. Approximately 100,000 km² of land was significantly contaminated with fallout, with the worst hit regions being in Belarus, Ukraine and Russia. Slighter levels of contamination were detected over all of Europe except for the Iberian Peninsula.

The initial evidence that a major release of radioactive material was affecting other countries came not from Soviet sources, but from Sweden. On the morning of 28 April 1986 workers at the Forsmark Nuclear Power Plant (approximately 1,100 km (680 mi) from the Chernobyl site) were found to have radioactive particles on their clothes.It was Sweden's search for the source of radioactivity, after they had determined there was no leak at the Swedish plant that at noon on 28 April 1986 led to the first hint of a serious nuclear problem in the western Soviet Union. Hence the evacuation of Pripyat on 27 April 36 hours after the initial explosions was silently completed before the disaster became known outside the Soviet Union. The rise in radiation levels had at that time already been measured in Finland, but a civil service strike delayed the response and publication.

Ref. Ikäheimonen, T.K. (ed.) YmparistonRadioaktiivisuusSuomessa–20 Vuotta Tshernobylista [Environmental Radioactivity in Finland], Säteilyturvakeskus Stralsäkerhetscentralen (STUK, Radiation and Nuclear Safety Authority).

Table 3
Areas of Europe contaminated with ^{137}Cs

Country	37–185 k Bq/m^2		185–555 kBq/m^2		555–1480 kBq/m^2		>1480 kBq/m^2	
	km^2	% of country	km^2	% of country	km^2	% of country	km^2	% of country
Belarus	29,900	14.4	10,200	4.9	4,200	2.0	2,200	1.1
Ukraine	37,200	6.2	3,200	0.53	900	0.15	600	0.1
Russia	49,800	0.29	5,700	0.03	2,100	0.01	300	0.002
Sweden	12,000	2.7	—	—	—	—	—	—
Finland	11,500	3.4	—	—	—	—	—	—
Austria	8,600	10.3	—	—	—	—	—	—
Norway	5,200	1.3	—	—	—	—	—	—
Bulgaria	4,800	4.3	—	—	—	—	—	—
Switzerland	1,300	3.1	—	—	—	—	—	—
Greece	1,200	0.91	—	—	—	—	—	—
Slovenia	300	1.5	—	—	—	—	—	—
Italy	300	0.1	—	—	—	—	—	—
Moldova	60	0.2	—	—	—	—	—	—
Totals	**162,160 km^2**		**19,100 km^2**		**7,200 km^2**		**3,100 km^2**	

Ref. “3.1.5 Deposition of radionuclide’s on solid surfaces” (PDF). Environmental Consequences of the Chernobyl Accident and their Remediation: Twenty years of Experience, Report of the Chernobyl Forum Expert Group ‘Environment’. Vienna: International Atomic Energy Agency (IAEA). 2006. pp. 23–25. ISBN 92-0-114705-8. Retrieved 2013-09-12.

7. CONCLUSIONS

We have briefly discussed the understanding and the consequences of radiation energy deposition in DNA. From a mechanistic point of view, physical, chemical and biochemical changes in DNA will be linked to biological consequences and impact on human health. The information like biological effects of Radiation, Deterministic and Stochastic effects of Radiation, Acute Radiation Syndrome (ARS), Cancer deaths attributable to Radiation, the Risk & Exposure impact of Hiroshima and Nagasaki on Environment have also been explained and discussed. The data for radiation protection & shielding is being analyzed & presented. More work can be carried out.

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REFERENCES

1. Pierce, D.A., Shimizu, Y., Preston D.L. et al. (1996). Studies of the mortality of atomic bomb survivors, Report 12, Part 1, Cancer: 1950-1990. *Rad. Res.* 146, 1-27.
2. ICRF, LSHTM&LRF: Nuclear Industry Family Study (NIFS). BMJ, 28-05-1999.
3. Cardis, E. et al. (1995). Combined Analyses of Cancer Mortality among nuclear industry workers in Canada, the UK and USA. *IARC Technical Report* No. 25, Lyon.
4. ICRP, Publ. 60, 1991.
5. IAEA report from internet 2007.
6. Torch: The Other Report on Chernobyl—executive summary. European Greens and UK scientists Ian Fairlie Ph.D. and David Sumner – Chernobylreport.org. April 2006. Retrieved 20 August 2011.
7. Facts: The accident was by far the most devastating in the history of nuclear power. *Ten years after Chernobyl: What do we really know?* International Atomic Energy Agency (IAEA). 21 September 1997. Retrieved 20 August 2011.
8. Marples, David R. (1996). The Decade of Despair. *The Bulletin of the Atomic Scientists,* 52(3), 20-31.
9. Chernobyl, 20 ans après, (in French). RFI. 24 April 2006. Retrieved 24 April 2006.
10. L'accident et sesconséquences: Le panache radioactif, [The accident and its consequences: The plume] (in French). Institut de Radioprotection et de SûretéNucléaire (IRSN). Retrieved 16 December 2006.
11. Jensen, Mikael; Lindhé, John-Christer (Autumn 1986). International Reports – Sweden: Monitoring the Fallout. *IAEA Bulletin* (International Atomic Energy Agency (IAEA)).
12. Mould, Richard Francis (2000). *Chernobyl Record: The Definitive History of the Chernobyl Catastrophe*. CRC Press. p. 48. ISBN 0-7503-0670-X.
13. Ikäheimonen, T.K. (Ed.). *Ympäristön Radioaktiivisuus Suomessa – 20 Vuotta Tshernobylista* [*Environmental Radioactivity in Finland - 20 Years from Chernobyl*]. Säteilyturvakeskus Stralsäkerhetscentralen (STUK, Radiation and Nuclear Safety Authority).
14. 3.1.5. Deposition of radionuclide's on soil surfaces (PDF). *Environmental Consequences of the Chernobyl Accident and their Remediation: Twenty Years of Experience, Report of the Chernobyl Forum Expert Group 'Environment'*. Vienna: International Atomic Energy Agency (IAEA). 2006. pp. 23–25. ISBN 92-0-114705-8. Retrieved 2013-09-12.

Sources:

The source documents relating to the emergency, published in unofficial sources:

Technological Regulations on operation of 3 and 4 power units of Chernobyl NPP (in force at the moment of emergency).

Tables and graphs of some parameters variation of the unit before the emergency.

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REPETITIVE GROUP ACCEPTANCE SAMPLING PLAN FOR EXPONENTIATED WEIBULL DISTRIBUTION

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ABSTRACT

In this paper, the repetitive group acceptance sampling plan is proposed by assuming that the lifetime of the product follows the exponentiated Weibull distribution. The repetitive sampling plan is a good alternative to single and double acceptance sampling plans. The plan parameters have been determined through simulation satisfying both the producer's risk and client (consumer) risk. It has been observed that the proposed plan is better for the acceptance sampling plan. A comparison of the proposed study with the single sampling scheme has been provided. A discussion with the help of an example for industrial application has also been elaborated.

KEYWORDS

Repetitive group sampling, producer's risk, and consumer's risk.

1. INTRODUCTION

Acceptance sampling plans are practical tool to ensure quality in industries. Companies are under increasing demand to enhance the quality and reliability of their products. So reliability verification by companies is very important before products are sent to the customer. An acceptance sampling plans have been widely used in industries for inspection of the finished product. A lot of the product is rejected if the number of failed items is larger than the specified number of failures, otherwise the lot will be accepted. This decision is taken on the basis of a few items selected from the lot therefore there is a chance of rejecting a good lot and accepting a bad lot. If a good lot is rejected on the basis of sample information, this probability is called the producer's risk and if a bad lot is accepted on the basis of sample information, this chance is called the consumer's risk. Therefore, the producer and the consumer want that the operating characteristic (OC) curve must passes through the two points by satisfying the both risks. The lot acceptance probability is considerably higher for a lot of good quality. The acceptance sampling plan minimizes the chance of rejection of a good lot and acceptance of a bad lot. An acceptance sampling plans have been widely used in industry for inspection of products. The details about the acceptance sampling schemes can be seen in Schilling (1982), Montgomery (2001), Das and Mitra (1964), Kao (1971), Guenther

(1969), Jennett and Welch (1939), Balamurali and Jun (2006), Lio et al. (2010), Balakrishnan et al. (2007), Rao and Kantam (2010), Rao et al. (2010), Rao (2013), Aslam et al. (2010), Aslam et al. (2011), Odeh and Owen (1983).

Among the other acceptance sampling schemes, the repetitive acceptance sampling originally defined by Sherman (1965) attracted researchers due to its application in industry. Balamurali and Jun (2006) showed that the repetitive sampling plan is more efficient than the single and double sampling plan in terms of sample size. Therefore, the repetitive sampling plan is a good alternative to single and double acceptance sampling plans. Aslam et al. (2011) designed the repetitive acceptance sampling plan using the process loss function. Recently, Ahmad et al. (2014) proposed the control charts based on process capability index under the repetitive group sampling scheme. More details about the applications of this sampling scheme can be read in Lee (2012), Aslam et al. (2012), Aslam et al. (2013) and Ahmad et al. (2014a).

In life testing experiments, the lifetime of products can be modeled by a variety of distributions. Researchers are trying to introduce new distributions in the area of acceptance sampling so that an efficient acceptance sampling plan can be designed to reduce the testing and inspection cost. See, for example, Aslam et al. (2013).

The exponentiated Weibull distribution was derived by Mudholkar and Srivastava (1993). The application of this distribution to bath tub failure data is given by Mudholkar et al. (1995, 1996) and Pal et al. (2006). This distribution is an extension of exponential, Weibull and generalized exponential distributions. By exploring the literature, we could not find a repetitive sampling plan using this distribution. In this paper, we will design the repetitive sampling plan using the exponentiated Weibull distribution. We will compare the efficiency of the proposed plan with the existing sampling plan. We will discuss the application of the proposed plan with the help of a real example.

2. DESIGNING OF PROPOSED PLAN

In this section, we present the repetitive sampling plan following Balamurali and Jun (2006) and Aslam et al. (2013). The operational steps of this test are given as follows

Step-1: Take a random sample of size n from a large lot and put it on life test for time t_0.

Step-2: Accept the lot if the number of inadequacies, D, is smaller than or equal to the acceptance number c_1. Truncate the test and reject the lot when D surpasses c_2, where $c_2 \geq c_1$.

Step-3: If $c_1 < D \leq c_2$, then repeat Step 1.

The proposed exponentiated Weibull distribution has three parameters λ, γ and κ. According to Balamurali and Jun (2006), the operating characteristic (OC) function in the case of variable repetitive sampling is given by:

$$L(p) = \frac{P_a}{P_a + P_r} \tag{1}$$

where P_a is the probability of accepting a lot and P_r is the probability of rejecting a lot. The OC function of the single acceptance plan is given as

$$P_a(\mathrm{p}) = Pr(D \leq c_1 |\ \mathrm{p}) = \sum_{i=0}^{c_1} \binom{n}{i} (\mathrm{p})^i (1-\mathrm{p})^{n-i} \tag{2}$$

The Eq. (2) under the exponentiated Weibull distribution is given as follows

$$P_a(p) = Pr(D \leq c_1 | \mathrm{p}) = \sum_{i=0}^{c_1} \binom{n}{i} \left(\left[1 - exp\left(\left(\delta_q^0/\left(t_q/t_q^0\right)\right)\right)^{\gamma}\right] \times log\left(1 - q^{1/\kappa}\right)^{\kappa}\right)^i \left(1 - \left[1 - exp\left(\left(\delta_q^0/\left(t_q/t_q^0\right)\right)\right)^{\gamma}\right] \times log\left(1 - q^{1/\kappa}\right)^{\kappa}\right)^{n-i} \tag{3}$$

The probability of rejection for the single acceptance sampling plan is given as follows

$$P_r(p) = 1 - \sum_{i=0}^{c_2} \binom{n}{i} \left(\left[1 - exp\left(\left(\delta_q^0/\left(t_q/t_q^0\right)\right)\right)^{\gamma}\right] \times log\left(1 - q^{1/\kappa}\right)^{\kappa}\right)^i \left(1 - \left[1 - exp\left(\left(\delta_q^0/\left(t_q/t_q^0\right)\right)\right)^{\gamma}\right] \times log\left(1 - q^{1/\kappa}\right)^{\kappa}\right)^{n-i} \tag{4}$$

Let α and β are producer's risk and consumer's risk, respectively. We want to determine the plan parameters of the proposed plan so that good lot has probability of acceptance larger than producer's confidence level, $1-\alpha$ at acceptable quality level (AQL=p_1) and the bad lot has this chance smaller than β at limiting quality level (LQL=p_2). The desired plan parameters of the proposed plan will be determined by using following non-linear optimization solution.

Minimize average sample number at ratio 1

$$ASN = \frac{n}{P_a + P_r}$$

Subject to

$$L(p_1) \geq 1 - \alpha \tag{5}$$

$$L(p_1) \leq \beta \tag{6}$$

Table 1
Plan parameters when $q = 0.25$; $\kappa = 0.6843264$; γ =1.6465868

		$\delta = 0.5$				$\delta = 1.0$			
β	Ratio	n	$c1s$	$c2s$	ASN	n	$c1s$	$c2s$	ASN
0.25	2	58	4	6	82.1043	27	4	6	39.2736
	3	18	0	2	38.8103	9	0	2	18.971
	4	25	1	2	32.5557	12	1	2	15.631
	5	15	0	1	21.5699	7	0	1	10.1665
	6	15	0	1	21.5699	7	0	1	10.1665
0.1	2	52	2	6	111.881	39	5	8	54.1704
	3	29	0	3	60.4336	16	1	3	24.298
	4	23	0	2	39.8192	12	0	2	18.7207
	5	34	1	2	39.5267	15	1	2	17.7706
	6	34	1	2	39.5267	9	0	1	11.6167
0.05	2	93	5	9	132.332	37	4	8	58.8489
	3	48	1	4	68.3112	14	0	3	28.1986
	4	41	1	3	53.4093	12	0	2	18.7207
	5	28	0	2	40.6499	12	0	2	18.7207
	6	28	0	2	40.6499	12	0	2	18.7207
0.01	2	113	5	11	160.775	46	4	10	73.2281
	3	61	1	5	81.6947	19	0	4	35.2633
	4	40	0	3	55.6716	19	0	3	25.6364
	5	40	0	3	55.6716	19	0	3	25.6364
	6	39	0	2	45.1945	17	0	2	20.1466

Table 2
Plan parameters when $q = 0.5;\ \kappa = 0.5596468; \gamma = 2.2949663$

		$\delta = 0.5$				$\delta = 1.0$			
β	Ratio	n	$c1s$	$c2s$	ASN	n	$c1s$	$c2s$	ASN
0.25	2	20	2	4	32.7287	6	1	3	13.2414
	3	13	1	2	17.202	6	1	2	7.83673
	4	8	0	1	11.558	3	0	1	4.8
	5	8	0	1	11.558	3	0	1	4.8
	6	8	0	1	11.558	3	0	1	4.8
0.1	2	26	2	5	44.7903	15	4	6	19.8514
	3	12	0	2	21.2539	5	0	2	9.41176
	4	17	1	2	20.1632	7	1	2	8.37383
	5	11	0	1	13.7522	4	0	1	5.33333
	6	11	0	1	13.7522	4	0	1	5.33333
0.05	2	41	4	7	54.8082	14	3	6	22.1021
	3	21	1	3	27.9813	9	1	3	11.7551
	4	14	0	2	21.2909	6	0	2	8.93023
	5	14	0	2	21.2909	6	0	2	8.93023
	6	13	0	1	15.1788	5	0	1	5.92593
0.01	2	45	3	8	64.8092	17	3	7	24.5724
	3	29	1	4	35.948	8	0	3	12.4878
	4	22	0	3	29.2052	9	0	3	12.0313
	5	22	0	2	23.3122	8	0	2	9.30909
	6	22	0	2	23.3122	8	0	2	9.30909

Table 3
Plan parameters when $q = 0.75$; $\kappa = 0.6843264$; $\gamma = 1.6465868$

		$\delta = 0.5$				$\delta = 1.0$			
β	Ratio	n	$c1s$	$c2s$	ASN	n	$c1s$	$c2s$	ASN
0.25	2	20	6	7	23.3405	9	5	6	11.7432
	3	5	0	2	11.6803	5	2	3	6.79045
	4	7	1	2	9.15707	4	1	2	5.06931
	5	4	0	1	5.8859	2	0	1	3.2
	6	4	0	1	5.8859	2	0	1	3.2
0.1	2	19	4	7	29.0837	12	6	8	17.0653
	3	9	1	3	14.1244	5	1	3	7.71084
	4	8	1	2	9.75205	4	1	2	5.06931
	5	8	1	2	9.75205	2	0	1	3.2
	6	5	0	1	6.48591	2	0	1	3.2
0.05	2	18	3	7	32.5583	14	7	9	17.9532
	3	8	0	3	16.567	5	1	3	7.71084
	4	7	0	2	10.6142	3	0	2	6.85714
	5	7	0	2	10.6142	4	0	2	5.38947
	6	7	0	2	10.6142	4	0	2	5.38947
0.01	2	28	5	10	39.0547	16	7	10	19.5643
	3	17	2	5	20.897	9	2	5	10.7705
	4	10	0	3	14.5145	6	1	3	7.18386
	5	11	0	3	14.3222	4	0	2	5.38947
	6	9	0	2	10.926	4	0	2	5.38947

Table 1 shows the results for the exponentiated Weibull distribution, when $\delta = 0.5$, $\kappa = 0.6843264$ and $\gamma = 1.646586$. Table 2 show plan parameters when the q=0.5, $\beta = 0.25\delta = 0.5$, $\kappa = 0.5596468$ and $\gamma = 2.2949663$ .Table 3 shows the plan parameters when q=0.75, $\delta = 1$, $\kappa = 0.6843264$ and $\gamma = 1.6465868, \beta = 0.25$

3. COMPARATIVE STUDY

In this section, we will compare the performance of the proposed plan with the single acceptance sampling plan based on exponentiated Weibull distribution by fixing the same levels of all specified plan parameters. We present two tables for the comparison purpose.

Table 4 shows plan parameters of both acceptance sampling plans when $q = 0.25;\ \kappa = 0.68432264; \gamma$ =1.6465868.

Table 4
Comparison of proposed plan with existing plan parameters when $q = 0.25;\ \kappa = 0.6843264;\ \gamma$ =1.6465868

		$\delta = 0.5$		$\delta = 1.0$	
		Single Plan	Proposed Plan	Single Plan	Proposed Plan
β	Ratio	n	ASN	n	ASN
0.25	2	100	82.1043	47	39.2736
	3	52	38.8103	24	18.971
	4	33	32.5557	15	15.631
	5	33	21.5699	15	10.1665
	6	22	21.5699	10	10.1665
0.1	2	168	111.881	73	54.1704
	3	87	60.4336	35	24.298
	4	55	39.8192	25	18.7207
	5	55	39.5267	25	17.7706
	6	44	39.5267	20	11.6167
0.05	2	212	132.332	93	58.8489
	3	109	68.3112	50	28.1986
	4	75	53.4093	34	18.7207
	5	64	40.6499	29	18.7207
	6	64	40.6499	23	18.7207
0.01	2		160.775		73.2281
	3	154	81.6947	70	35.2633
	4	119	55.6716	54	25.6364
	5	95	55.6716	43	25.6364
	6	82	45.1945	37	20.1466

From Table 4, we note that the proposed plan provides the smaller values of ASN as compared to the existing one. For example, when β=0.25, δ=0.5 and ratio is 2. The ASN

from the proposed plan is 82 and from existing sampling plan 100. Similarly, Table 5 is constructed for both plans when $q = 0.5; \kappa = 0.5596468; \gamma = 2.2949663$. Table 6 shows plan parameters when $q = 0.75;\ \kappa = 0.68432264; \gamma = 1.6465868$. The proposed plan performs better in all cases than the single acceptance sampling plan in term of sample size.

Table 5
Comparison of proposed plan with existing plan parameters when $q = 0.5;\ \kappa = 0.5596468; \gamma = 2.2949663$

		$\delta = 0.5$		$\delta = 1.0$	
		Single Plan	Proposed Plan	Single Plan	Proposed Plan
β	Ratio	n	ASN	n	ASN
0.25	2	43	32.7287	16	13.2414
	3	23	17.202	10	7.83673
	4	17	11.558	7	4.8
	5	12	11.558	5	4.8
	6	12	11.558	5	4.8
0.1	2	67	44.7903	26	19.8514
	3	35	21.2539	14	9.41176
	4	29	20.1632	9	8.37383
	5	23	13.7522	9	5.33333
	6	23	13.7522	9	5.33333
0.05	2	85	54.8082	30	22.1021
	3	45	27.9813	18	11.7551
	4	33	21.2909	13	8.93023
	5	27	21.2909	11	8.93023
	6	27	15.1788	11	5.92593
0.01	2	127	64.8092	47	24.5724
	3	68	35.948	25	12.4878
	4	49	29.2052	19	12.0313
	5	42	23.3122	17	9.30909
	6	35	23.3122	14	9.30909

Table 6
Comparison of proposed plan with existing plan when $q = 0.75;\ \kappa = 0.6843264; \gamma = 1.6465868$

		$\delta = 0.5$		$\delta = 1.0$	
		Single Plan	Proposed Plan	Single Plan	Proposed Plan
β	Ratio	n	ASN	n	ASN
0.25	2	27	23.3405	16	11.7432
	3	14	11.6803	7	6.79045
	4	11	9.15707	6	5.06931
	5	9	5.8859	5	3.2
	6	9	5.8859	5	3.2
0.1	2	41	29.0837	22	17.0653
	3	20	14.1244	10	7.71084
	4	14	9.75205	7	5.06931
	5	11	9.75205	7	3.2
	6	11	6.48591	6	3.2
0.05	2	50	32.5583	26	17.9532
	3	25	16.567	13	7.71084
	4	19	10.6142	9	6.85714
	5	16	10.6142	8	5.38947
	6	13	10.6142	6	5.38947
0.01	2		39.0547	36	19.5643
	3	36	20.897	18	10.7705
	4	27	14.5145	13	7.18386
	5	23	14.3222	9	5.38947
	6	20	10.926	9	5.38947

4. EXAMPLE

Suppose an electronic company would like to know if the mean life of their product is greater than the specified life of 1000 hour. The lifetime of the product follows Exponentiated Weibull distribution with plan parameters $q = 0.5, \alpha = 0.5596468, \gamma = 2.2949663$ and $\delta = 0.5$. So from Table 4 the minimum random sample number is n =8 and the acceptance numbers are c_1=0 and c_2=1. We check a random sample of size $n = 8$ from the lot. If the number of failures is equal to 0 $(c_1 = 0)$ we accept the lot. If the number of failures is 1 or more then we reject the lot.

Suppose a light producer would like to know if the mean life of their product is greater than the specified life is 1000 hour. The lifetime of product follows Exponentiated Weibull distribution using $q = 0.75;\ \kappa = 1.5; \gamma = 1.5 \text{and}\ \delta = 1$. It consumer's and producer's risks are 5 percent. Table 8 shows that the smallest random sample number is n =5 and the acceptance numbers are c_1=2 and c_2=3. We check a random sample of 5 from the lot, we will accept the lot if number of failures is smaller than c_1=2

5. CONCLUSION

The repetitive sampling plan using the exponentiated Weibull distribution is given in this paper. The extensive tables of plan parameters are also presented. The comparison of the proposed plan with single plan is presented and concluded that the proposed plan performs better than the existing acceptance sampling plan. The proposed plan can be applied in the industries for the inspection of the product at low cost. The proposed plan can be used for testing of carbon fibres data given by Pal et al. (2006). The use of the exponentiated distribution for other sampling schemes can be considered as future research.

REFERENCES

1. Ahmad, L., Aslam, M. and Jun, C.H. (2014). Designing of X-bar control charts based on process capability index using repetitive sampling. *Transactions of the Institute of Measurement and Control,* 36(3), 367-374.
2. Ahmad, L., Aslam, M. and Jun, C.H. (2014a). Coal Quality Monitoring With Improved Control Charts. *European Journal of Scientific Research,* 125(2), 427-434.
3. Aslam M., Razzaque, A, Ahmad, M. and Zafer, Y. (2010). Group Acceptance Sampling Plans for Pareto Distribution of the Second Kind. *Journal of Testing and Evaluation*, 38(2), 143-150.
4. Aslam M., Yen, C.-H and Jun, C.-H. (2011). Variable Repetitive Group Sampling Plans with Process Loss Consideration *Journal of Statistical Simulation and Computation*, 81(11), 1417-1432.
5. Aslam, M., Kundu, D. Jun, C.-H and Ahmad, M. (2011). Time Truncated Improved Group Acceptance Sampling Plans for Generalized Exponential Distribution, *Journal of Testing and Evaluation,* 39(4), 671-677.
6. Aslam, M., Lio, Y.L. and Jun, C.-H. (2013). Repetitive acceptance sampling plans for burr type XII percentiles. *International journal of Advanced Manufacturing Technology,* 68, 495-507.
7. Aslam, M., Niaki, S.T.A., Rasool, M. and Fallahnezhad, M.S. (2012). Decision rule of repetitive acceptance sampling plans assuring percentile life (ordinary sampling, GED and the Weibull), *Scientia Iranica*, 19(3), 879-884.
8. Aslam, M., Wu, Chien-Wei., Jun, C.-H., Azam, M., and Itay, N. (2013). Developing a variables repetitive group sampling plan based on process capability index C_{pk} with unknown mean and variance. *Journal of Statistical Simulation and Computations,* 83(8), 1507-1517.
9. Balakrishnan, N., Leiva, V. and Lopez, J. (2007). Acceptance sampling plans from truncated life tests based on the generalized Birnbaum-Saunders distribution. *Communication in Statistics-Simulation and Computation*, 36, 643-656.

10. Balamurali, S. and Jun, C.-H. (2006). Repetitive group sampling procedure for variables inspection, *J. Appl. Stat*. 33(3), 327-338.
11. Das, N.G. and Mitra, S.K. (1964). The effect of non-normality on sampling inspection. *Sankhya* 26A, 169-176.
12. Guenther, W.C. (1969). Use of the binomial, hypergeometric and Poisson tables to obtain sampling plans. *Journal of Quality Technology* 1(2), 105-109.
13. Kao, J.H.K. (1971). MIL-STD-414: Sampling procedures and tables for inspection by variables for percent defective, *Journal of Quality Technology* 3, 28-37.
14. Lee, S., Aslam, M. and Jun, C.-H. (2012). Repetitive Group Sampling Plans with Two Specification Limits. *Pak. J. Statist.*, 28(1), 41-57.
15. Lio, Y.L., Tsai, T-R. and Wu, S-J. (2010b). Acceptance sampling plans from truncated life tests based on the Burr type XII percentiles, *Journal of the Chinese Institute of Industrial Engineers*, 27(4), 270-280.
16. Montgomery, D.C. (2001). *Introduction to Statistical Quality Control*, fourth ed. Wiley, New York.
17. Mudholkar, G.S. and Hutson, A.D. (1996). The exponentiated Weibull family: some properties and a flood data application, *Communications Statistics- Theory and Methods*, 25(12), 3059-3083.
18. Mudholkar, G.S. and Srivastava, D.K. (1993). Exponentiated Weibull family for analyzing bathtub failure-real data, *IEEE Transaction Reliability*, 42, 299-302.
19. Mudholkar, G.S., Srivastava, D.K. and Freimes, M. (1995). The exponentiated Weibull family: a reanalysis of the Bus-Motor-failure data. *Technometrics*, 37, 436-445.
20. Nichols, M.D. and Padgett, W.J. (2006). A bootstrap control chart for Weibull percentiles. *Quality and Reliability Engineering International*, 22, 141-151.
21. Odeh, R.E. and Owen, D.B. (1983). *Attribute Sampling Plans, Tables of Tests and Confidence Limits for Proportions*, Marcel Dekker, New York.
22. Pal, M., Ali, M.M. and Woo, J. (2006). Exponentiated Weibull distribution, *Statistica, LXVI, n. 2*, 139-147.
23. Rao, G.S. (2013). Acceptance sampling plans for percentiles based on the Marshall-Olkin extended Lomax distribution. *International Journal of Statistics and Economics*, 11(2), 83-96.
24. Rao, G.S. and Kantam, R.R.L. (2010). Acceptance sampling plans from truncated life tests based on the log-logistic distribution for percentiles. *Economic Quality Control*, 25(2), 153-167.
25. Rao, G.S., Kantam, R.R.L., Rosaiah, K. and Reddy, J.P. (2012). Acceptance sampling plans for percentiles based on the Inverse Rayleigh Distribution. *Electronic Journal of Applied Statistical Analysis*, 5(2), 164-177.
26. Schilling, E.G. (1982). *Acceptance Sampling in Quality Control*, Marcel Decker, New York.
27. Sherman, R.E. (1965). Design and Evaluation of Repetitive Group Sampling Plan, *Technometrics*, 7, 11-21.

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TIME SERIES MONITORING OF OLR AND TIR ANOMALIES IN RELATION TO THE EARTHQUAKE ACTIVITY IN PAKISTAN

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ABSTRACT

The study presents the monitoring and analysis of two short term earthquake precursors: Outgoing Longwave Radiation (OLR) and the Thermal Infrared (TIR) which are being monitored over the time span of six months form July 1st to 31st December, 2014. The data was acquired from the websites of National Oceanic and Atmospheric Administration (NOAA) and MODIS Satellite of NASA. For OLR the moving average values for weekly, monthly and six monthly are: (10.00-58.57), (14.67-46.00) and 30 W/m^2 respectively. Weekly, monthly and six monthly Moving average values of TIR are: (6.45-10.11), (6.92-9.66) and 8.533 $W \cdot sr^{-1}/m^2$ respectively. Two anomalies were detected in the OLR data one from 7th-22nd July, 2014 and second from 2nd-10th December, 2014. No earthquake could be correlated for the first anomaly while the second anomaly is under observation. In the TIR data two anomalies were detected; first one is from 8th-26th August, 2014 and the second one is from 15th September to 2nd October, 2014 but there is no impending earthquake which could be correlated to this anomalous behavior of TIR. In addition to these anomalies the concentration of TIR energy has shifted from east to the south-central part of the region of interest. Since no major earthquake occurred in Pakistan during the last six months of 2014 so the anomalous behavior in the OLR and TIR data cannot be correlated with earthquake activity but these anomalies may be a result of some other geological and environmental processes.

KEY WORDS

Earthquake precursor; OLR; Radiance of MODIS Satellite (TIR); ArcGIS; Moving Average.

1. INTRODUCTION

Major earthquakes that have caused casualties, massive damage to economy and disappearance of societies in a flash from the face of the earth have been documented throughout history. The destruction caused by earthquakes accelerated the need to understand them in depth regarding their mechanism, method or model that might leads us to predict such devastating events. Earthquake forecasting holds great potential for

saving lives, reducing property damage, enhancing the safety of critical facilities and help to make possible rapid restoration of normal lives after destruction.

Anomalous behavior has been observed by many researchers in earth atmosphere and ionosphere prior and during the major earthquakes e.g. anomalous emination of radon gas (Chyi et al. 2005, Walia et al. 2005, Singh et al. 2009) thermal infrared (TIR) (Ouzounov et al., 2006, Jianxi et al. 2007, Saraf et al., 2011), Total Electron Content (TEC) (Norsuzila, Pulinet & Boyarchuk, 2004), Outgoing longwave radiation (OLR) (Ouzounov et al., 2007, Xiong et al. 2010, Tronin et al. 2004) etc. The Lithoshpere-Atmosphere-Ionosphere-Coupling (LIAC) model (Ouzounov et al., 2006 & 2007) explains the possible generation of these phenomenon and allow us to study in more detail the spatial temporal changes that occurred before and during significant earthquakes.

The Earth's absorption of solar radiation, followed by its outgoing thermal radiation is the two most important processes that determine the temperature and climate of the Earth. Thermal radiations emitted by earth are of lower intensity and different spectral distribution (infrared rather than visible) because it is cooler and consists of a wide range of frequencies. OLR is the radiant energy or the radiative flux leaving the Earth–atmosphere system in the infrared (IR) region of the electromagnetic spectrum in a very broad wavelength ranging from 4 to 100 microns. Similarly TIR is the radiant energy which earth radiates into the atmosphere in a frequency range having time period more than I micron. In the history of earthquake precursory research the OLR and TIR are undeniable earthquake precursors.

The concept of building effective preparation zone especially prior to large earthquakes due to stress development within rocks inside earth which raise the internal temperature and cause increase in OLR and TIR intensities. In this research, we monitored and analyzed the spatio-temporal variations occurred in the OLR and TIR during the study period.

1.2 Tectonic Settings of Pakistan and Surrounding Region with Earthquake Activity

Pakistan extends Southwest to Northeast from Latitude 24°N to 37°N and West to East from Longitude 60°E to 78°E. Tectonically it is located in the region of intersection of three plates, Indian, Eurasian and Arabian-Sea plate. In the north there is convergent plate boundary between Eurasian and Indian plate, resulting into great Himalaya. The Main Boundary Thrust (MBT), the Main Mantle Thrust (MMT) and Main Korakaram Thrust (MKT), the Hindu Kush region and the Himalayan region are the active tectonic features of northern region (Monalisa and Khwaja 2005). In the west the intersection between these two plates became transform in nature and in the south lies Makran subduction Zone (MSZ) where the Arabian-Sea plate subducts under Eurasian plate. The southern region of Pakistan and southeastern region of Iran lie in this active subduction zone. The internal consistency of inferred motions at the three boundaries between Arabian, Eurasian and Indian plates is considered as their common triple junction (Kazmi and Jan, 1997, Shafiq-ur-Rehman et al. 2012). Figure 1 shows the tectonics settings of Pakistan and surrounding regions with earthquake activity for magnitude 5.0 and above from January 01, 1964 to December 31, 2014.

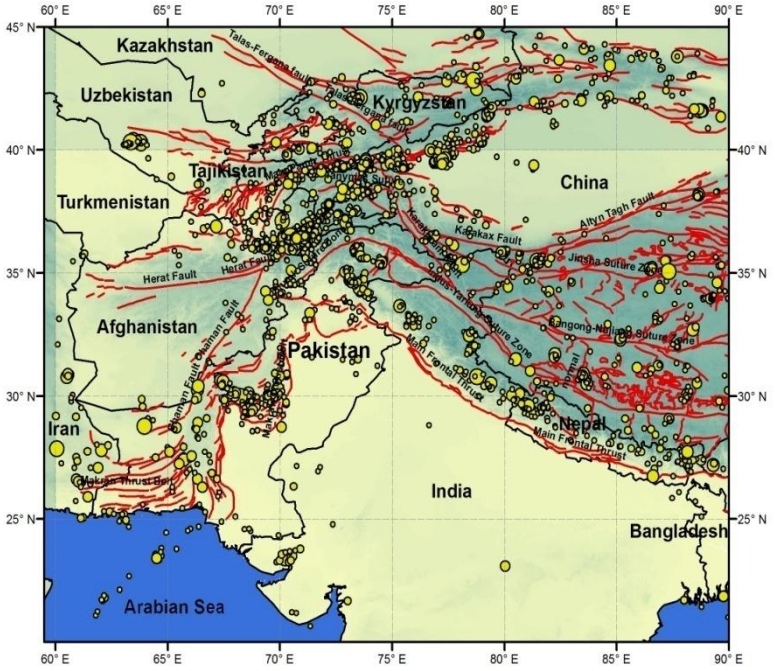

Figure 1: Tectonic map of Pakistan and surrounding regions with earthquake magnitude 5.0 and above (01 January, 1964 – 31 December, 2014).

2. METHODOLOGY

The OLR satellite images were analyzed for possible Spatial Temporal Variation in the outgoing longwave radiation values, which are downloaded from 1st July to 31st December, 2014 through US based NOAA agency on daily basis. The OLR image from NOAA data base depicts the average OLR values for the globe, therefore ArcGIS software was used to extract information for the study area after modifying images by doing proper digitization, gridding and adding names of important cities. The value of OLR is measured in W/m2 and different classes are defined for high and low variation in the OLR. In this study we use the highest reported value of OLR as the daily value.

If the OLR image shows some continuous increase from the base value for 1 to 2 weeks then it is considered as an anomaly. In order to reconfirm this anomaly the daily data of OLR is plotted against the OLR base value and daily trend of increasing and decreasing is represented in this graph. Also the moving average is calculated on weekly and monthly basis to further reconfirm any possible trend. The alarm is declared for those areas which show the high OLR value and the impending earthquake may occur within 2 to 90 days.

For TIR the satellite imagery data is taken from the AQUA-MODIS satellite of NASA at the resolution of 1 km and for radiance we select the band 31 which covers our study area.. Similar to OLR this data is also analyzed and monitored on daily basis with the same time span as for the OLR. After selecting the required image, we use ENVI software which provides us important information in quantitative form. Minimum, maximum and average values for the region of interest (ROI) are achieved of which average value of TIR is used for monitoring purposes. Modification in the images obtained from ENVI is carried out by using ArcGIS for better representation and analysis of results. In this research the moving average on weekly and monthly basis is also obtained from average value of ROI. The following image shows the changes present in the values of radiance (TIR) from low to high (see below legend).

2.2 Data Set

The OLR data is taken from the web site: http://esrl.noaa.gov/psd/map/ from 1st July to 31st December, 2014. At the NOAA data always lags two days from the current day. It means 1st July data was available on 3rd July but this limitation of the availability of data does not affect the monitoring process. The data set contains information about OLR values for the whole globe from which required OLR values of the study area of Pakistan were extracted.

Satellite data of MODIS for the calibrated radiance with resolution of 1 km and cloud free day time was downloaded from the web site: http://laadsweb.nascom.nasa.gov/. The grid of ($6^o \times 8^o$) i.e. (31^o-38^o)N and (68^o-76^o)E was selected for analysis which covers central to northern Pakistan. The radiance data of each day is carefully viewed to ensure the cloud free data otherwise it would represent the radiance of clouds not the earth's surface.

3. RESULTS AND DISCUSSIONS

3.1 OLR Data

OLR data was monitored and analyzed on daily basis so we have about 165 OLR images for six months period and we detected two anomalies in it. Although we have 165 images but due to scarcity of space we only show those images from which the anomaly was detected. Details for these anomalies are given below.

First Anomaly:

This anomaly was detected from July 07-22, 2014. It is clear from the figure 2 that the OLR variations are very low on July 03, 2014 which continues to increase until it reaches maximum value with highest spread on July 21, 2014. This high trend is also visible in the graph of daily OLR which showed that on July 02 the value was 30 W/m2 which increased and lifted up to 50 W/m2 on July 05. This increasing trend continues from July 07 to 22, 2014 and reaches up to the highest level i.e. 70 W/m2. This value is the highest ever reported since the analysis started. After this anomalous behavior the OLR values return to the normal range during summer season i.e. 30-50 W/m2.

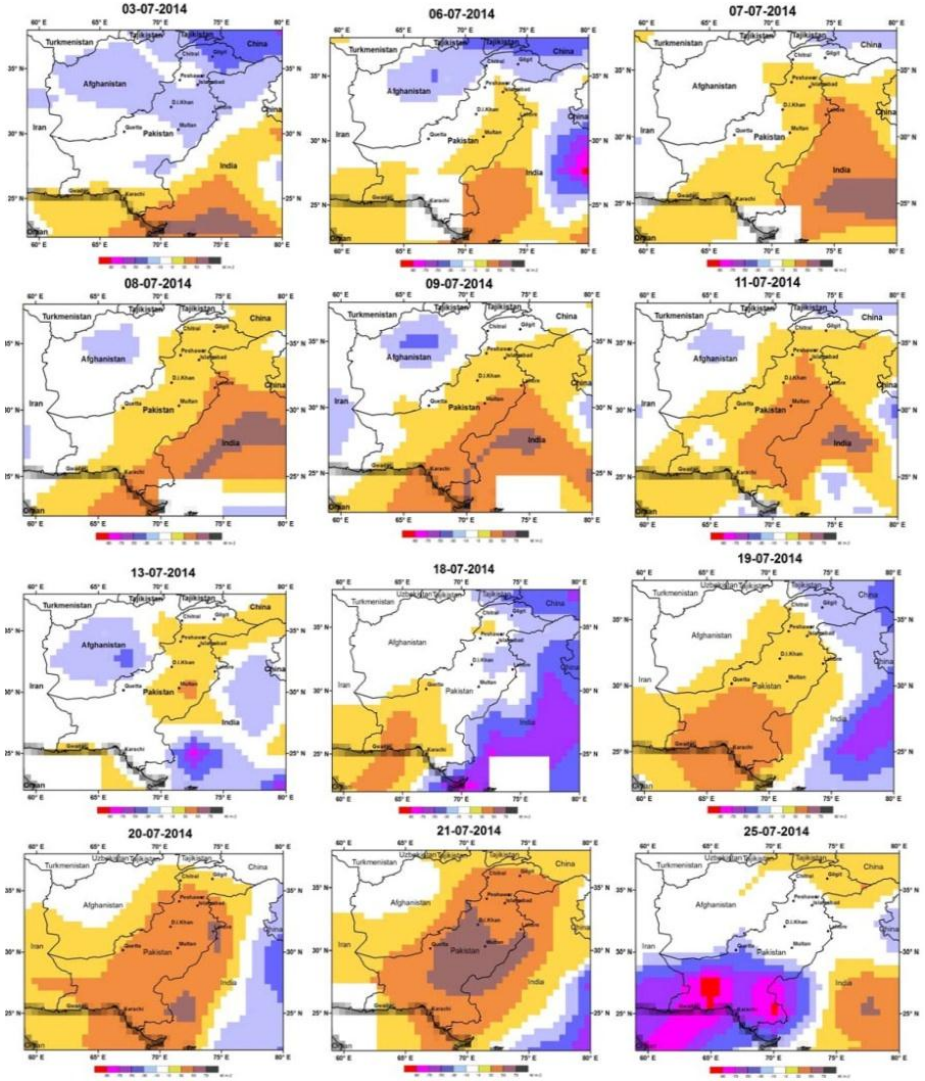

Figure 2: Spatial temporal variation of OLR during the month of July, 2014

Second Anomaly:

The second anomaly was detected from 2nd December to 10th December 2014 (see figure 4). As during the month of December the temperature in Pakistan always remain low as compared to the other months of the year; hence the OLR is also affected with these temperature variations. During this period the OLR should range between 10-30 w/m2 but from figure 4 it is quite clear that it has raised up to 50 W/m2, which shows increasing trend and after December 10th it converges back towards the normal range. On November 25, 2014 the OLR value ranges between -10-20 w/m2 which shows significantly low level. From 31st November it showed increasing trend and reached at

the top value on 6th December. This higher trend continues for the next 4 days and then decreases significantly from 11th December 2014 onwards to lie within normal range.

The graphs of OLR for weekly and monthly moving averages also confirm both anomalies by showing the peaks during the above mentioned dates (see figure 4, 5 & 6). Anomaly detected in the OLR data generates alarm for the next 2 to 90 days. For the first anomaly, no significant earthquake occurred which can be correlated to it and the second anomaly has started from 2nd December 2014, so alarm will be active up to first week of March, 2015.

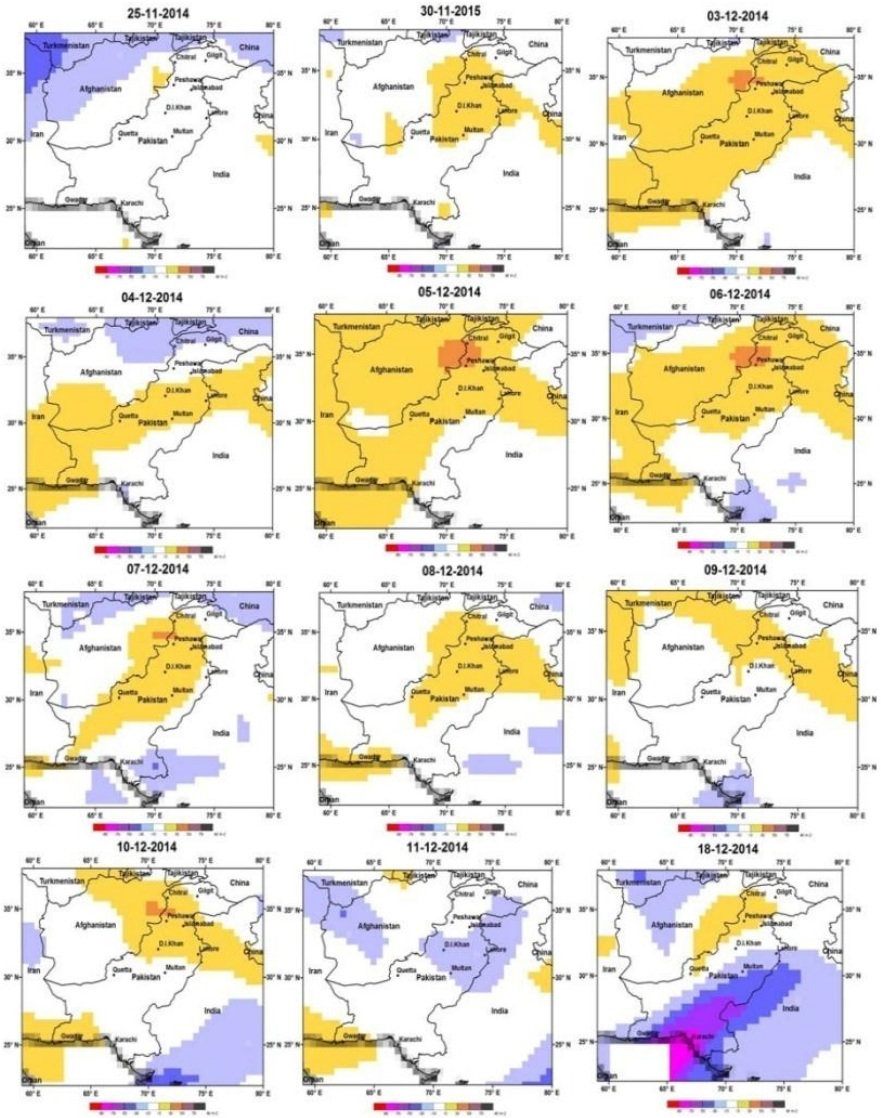

Figure 3: Spatial temporal variation of OLR during the month of Nov –Dec, 2014

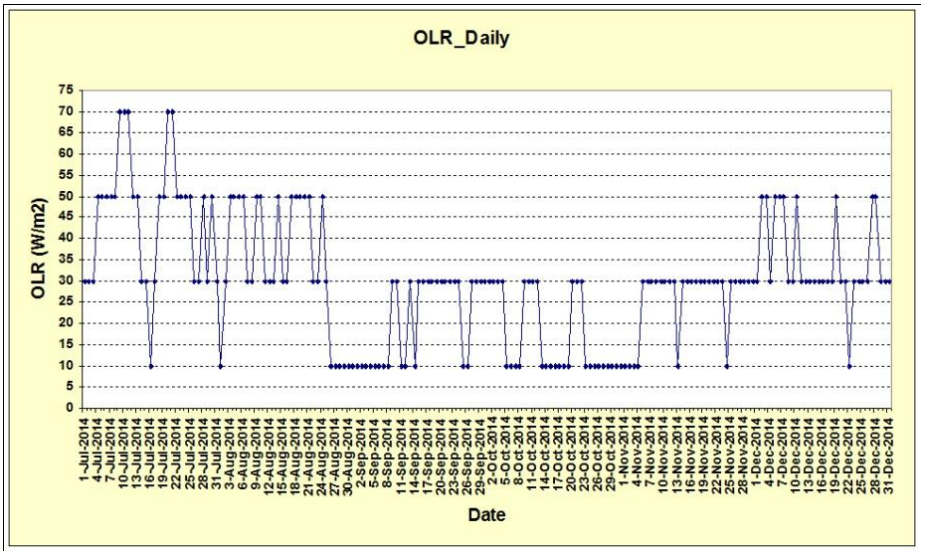

Figure 4: Daily OLR value (July 01 to December 31, 2014)

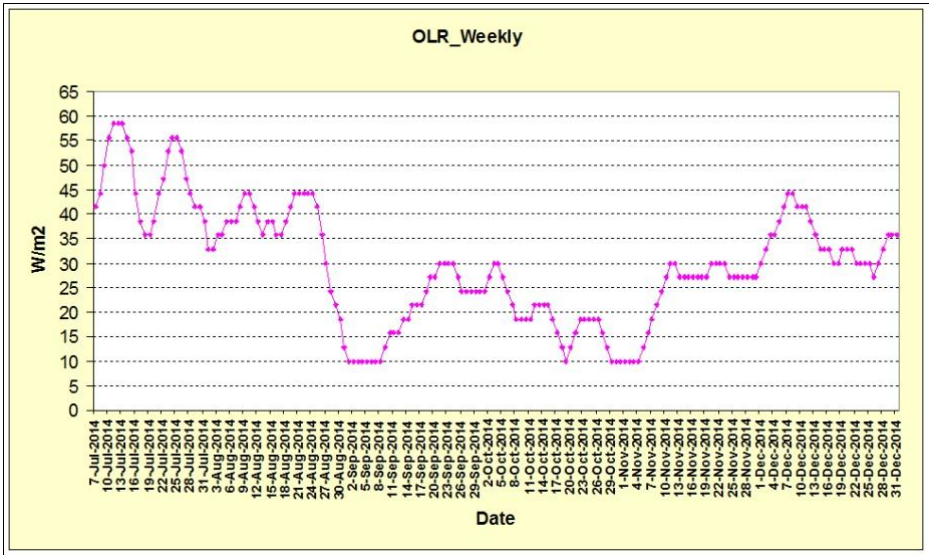

Figure 5: Weekly moving average of OLR value (July 01 to December 31, 2014)

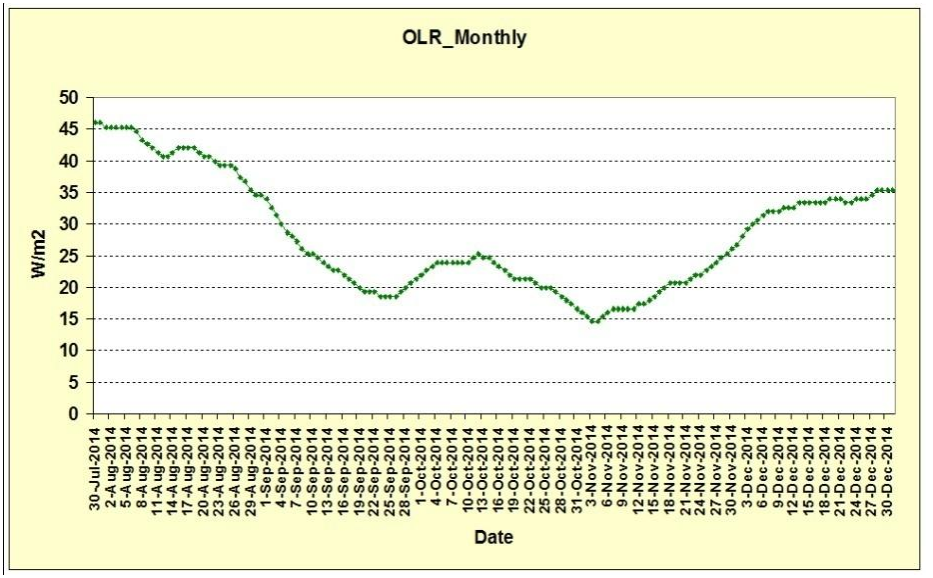

Figure 6: Monthly moving average of OLR value (July 01 to December 31, 2014)

3.2 TIR Data

In this data set there are two main limitations: one it should be cloud free data and the second is the satellite data image must contain the Region of Interest (ROI) which is defined in the below table. Also due to these constrains we have less number of satellite data images available as compare to the OLR.

Region of Interest (ROI)

Grid Dimension ($1^o \approx 111$ km)	Latitude Range	Longitude Range
$6^o \times 8^o$	**$(31^o\text{-}38^o)$N**	**$(68^o\text{-}76^o)$E**

Similar to the OLR we have also detected the two anomalies in the TIR data and details are in the following section.

First Anomaly:

It is detected from 8th-26th August, 2014 and the figure 7 showed the spatio-temporal changes in the TIR. In the region of interest at 6th August the area covered by the high values of TIR is relatively lower than the coming days i.e. 8-26th August. On 17th and 19th August it showed the highest coverage with red color and on 28th August it started to decrease. After analyzing, it is clear from all the images of TIR that the trend of high energy concentration is revealed in western part of ROI.

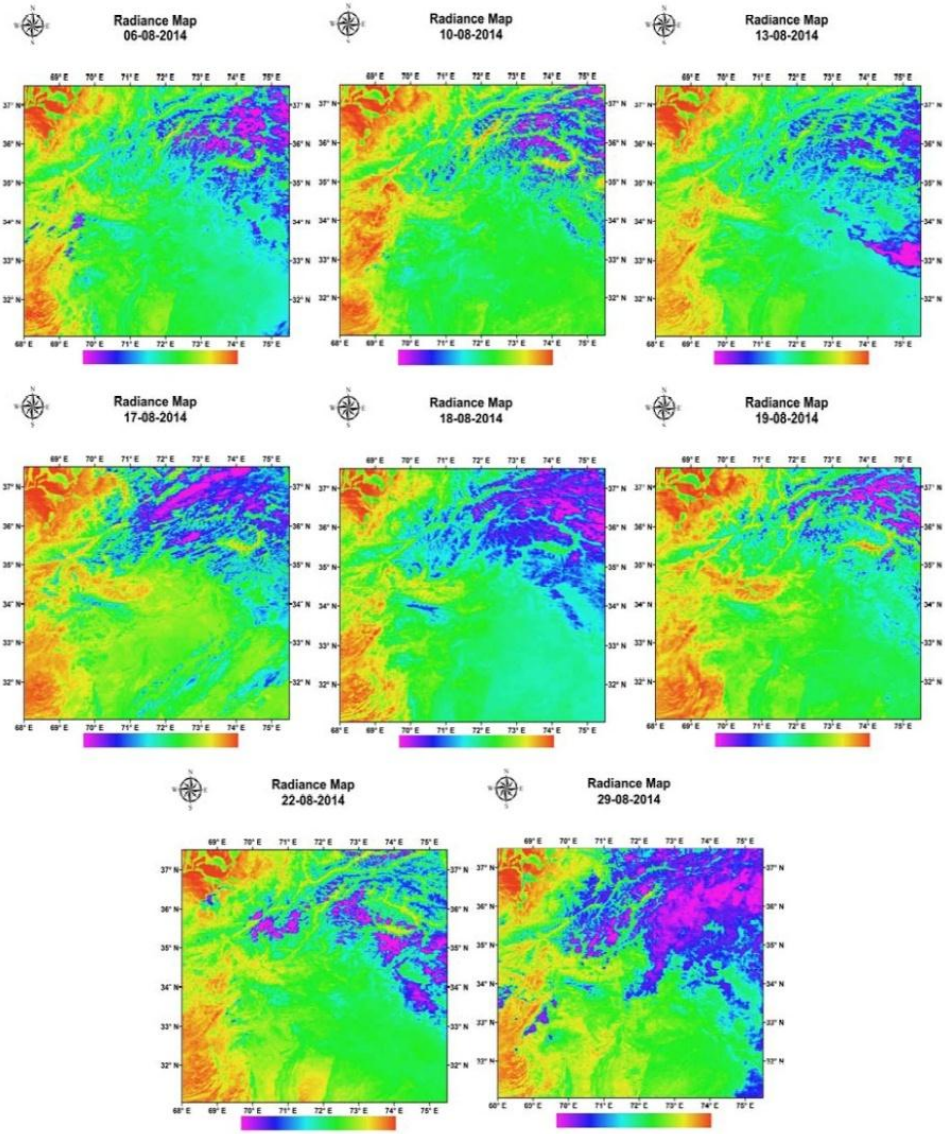

Figure 7: Spatial temporal variation of TIR during the month of August, 2014

Second Anomaly:

This anomalous behavior started from 15th September and end on 2nd October, 2014. It started building on September 11 and high energy concentration increased gradually from 15 to onward and reached at highest level spread on 23rd September (figure 8). This anomaly has spread from western part to the central part of the ROI as compared to the first one. In the graph of daily TIR value both anomalies are clearly visible but due to

lack of data the increasing trend in not very clear in the graph of weekly and monthly moving averages (see figure 9, 10 & 11).

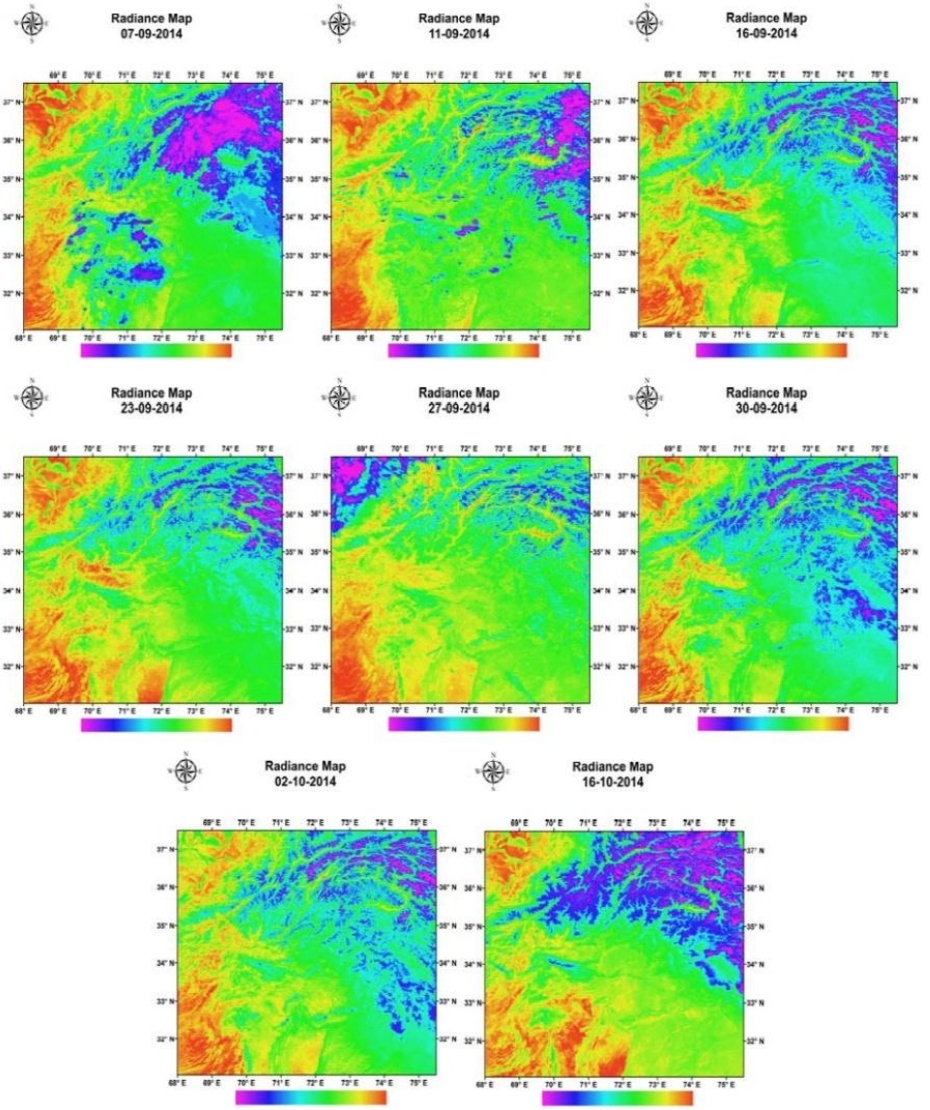

Figure 8: Spatial temporal variation of TIR during the month of September, 2014

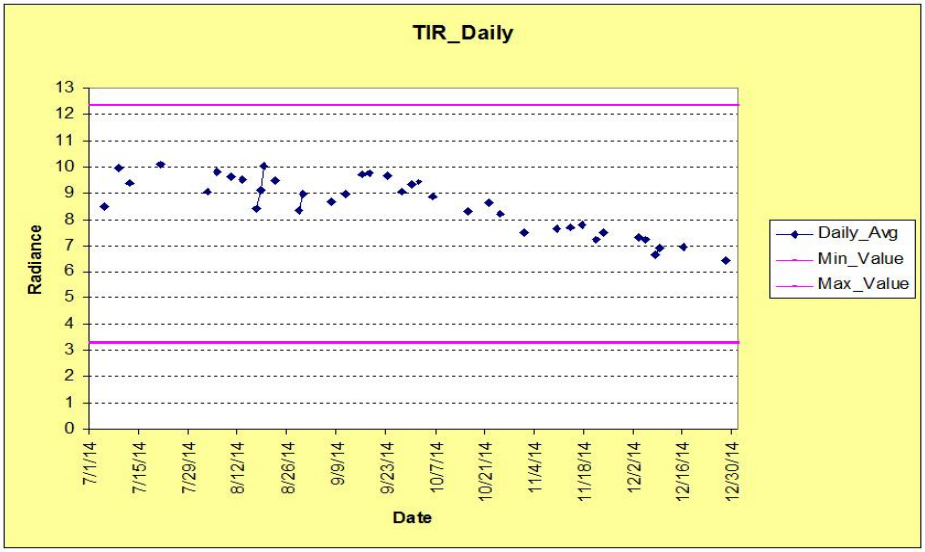

Figure 9: Daily TIR (Radiance) value (July 01 to December 31, 2014)

Figure 10: Weekly moving average of TIR (Radiance) value (July 01 to Dec. 31, 2014)

Figure 11: Monthly moving average of TIR (Radiance) value (July 01 to Dec. 31, 2014)

4. CONCLUSION

OLR and TIR data was studied as earthquake precursors and two anomalies were detected for each type of data. In case of OLR data one has expired and the other is in process which is under consideration for any significant earthquake with magnitude ≥ 5.5. For TIR data both anomalies are expired and cannot be related to any significant earthquake. From December 2014 to onward the high energy concentration has moved towards the North central part of Pakistan. Since for first anomaly of OLR data and both anomalies of TIR there is no significant earthquake occurred hence it may be concluded that these anomalous behaviors are because of some other environmental and geological changes and not due to the earthquakes.

REFERENCES

1. Chyi, L.L., Quick, T.J., Yang, T.F. and Chen, C.H. (2005). Soil gas radon spectra and earthquakes. *Terr. Atmos. Ocean. Sci.*, 16, 763-774.
2. Jianxi, H., Mao, F., Zhou W. and Zhu X. (2008). Satellite Thermal IR Associated with Wenchuan Earthquake in China Using MODIS Data. The *14th World Conference on Earthquake Engineering* October 12-17, Beijing, China.
3. Kazmi A.H. and Jan, M.Q. (1997). *Geology and Tectonics of Pakistan*, Graphic Publishers, Nazimabad Karachi.
4. Lillesand, T.M. and Kiefer, R.W. (2004). *Remote Sensing and Image Interpretation*, 5th Edition. John Wiley and sons USA pp-8.
5. Monalisa and Khwaja A.A. (2005). Seismic Activity along the Main Boundary Thrust (MBT), Pakistan. *Geological Bulletin of Peshawar*, 38, 23-30.

6. Norsuzila, Y., Abdullah, M. and Ismail, M. "*GPS Total Electron Content (TEC) Prediction at Ionosphere Layer over the Equatorial Region*". http://www.intechopen.com
7. Pulinets, S. and Boyarchuk, K. (2004). *Ionospheric Precursors of Earthquakes*. Copyright Springer-Verlag Berlin Heidelberg.
8. Ouzounov, D., Bryant, N., Logan, T., Pulinets, S. and Taylor, P. (2006). Satellite thermal IR phenomena associated with some of the major earthquakes in 1999-2003. *Physics and Chemistry of the Earth*, 31, 154-163.
9. Ouzounov, D., Liu, D., Chunli, K., Cervone. G, Kafatos, M. and Taylor, P. (2007). Outgoing Longwave Radiation Variability from IR Satellite Data Prior to Major Earthquakes. *Tectonophysics Elsevier B.V.* 431 211-220.
10. Saraf, A.K., Rawat, V., Banerjee, P., Choudhury, S., Panda, S.K., Dasgupta, S. and Das, J.D. (2008). Satellite detection of earthquake thermal infrared precursors in Iran. *Natural Hazards*, 47(1), 119-135.
11. Saraf, A.K., Rawat V., Das J.D., Zia M. and Sharma K. (2011). Satellite detection of thermal precursors of Yamnotri, Ravar and Dalbandin earthquakes. *Nat Hazards*, DOI 10.1007/s11069-011-9922-5.
12. Shafiq-ur-Rehman, Najeeb, A.A., Conrad, L. and Zahid, R. (2012). Probabilistic Seismic Hazard Analysis for Quetta City, Pakistan prepared by Pakistan Materology Department and NORSAR Norway. *Technical Report No. PMD-16/2012*.
13. Singh, S., Kumar, A., Bajwa, B.S., Mahajan, S., Kumar, V. and Dhar, S. (2010). Radon Monitoring in Soil Gas and Ground Water for Earthquake Prediction Studies in North West Himalayas, India. *Terr. Atoms. Ocean. Sci*., 21(4), 685-695.
14. Tronin, A.A., Biagi, P.F., Molchanov, O.A., Khatkevich, Y.M. and Gordeeev, E.I. (2004). Temperature Variations Related to Earthquakes from Simultaneous Observation at the Ground Stations and by Satellites in Kamchatka Area. *Phys. Chem. Earth*, 29, 501-506.
15. Walia, V., Su, T.C., Fu, C.C. and Yang, T.F. (2005). "Spatial Variations of Radon and Helium Concentrations in Soil-Gas Across Shan-Chiao Fault, Northern Taiwan. *Radiat. Meas.*, 40, 513-516, doi: 10.1016/j.radmeas.2005.04.011.
16. Websites for data: http://www.earthquakes.usgs.gov; http://laadsweb.nascom.nasa.gov/ and http://esrl.noaa.gov/psd/map/
17. Xiong, P., Yaxin, B. and Shen, X. (2009). *Study of OLR Anomalies Associated with Two Earthquakes in China using Wavelet-Maxima*. In E. Corchado et al. (Eds): HAIS, LNAI 5572 pp 77-87, Springer-Verlag Berlin Heidelberg.

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EXPLICIT EXPRESSIONS FOR THREE ENTROPIES OF DAGUM DISTRIBUTION

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ABSTRACT

Entropy has wide application in science, engineering and probability theory, and has been used in various situations as a measure of variation of the uncertainty. Simply, an entropy of a random variable X is a measure of uncertain amount of information in a distribution. The idea of entropy was applied by Claude Shannon (1948) in the field of information theory. The idea of entropy came into existence in the nineteenth century in the field of Statistical Mechanics and Thermodynamics. Numerous measures of entropy have been studied and compared in the literature. We have applied same idea on one of the income size distributions named Dagum distribution.

Dagum distribution has vital role to model the size distribution of income. We derive explicit expressions for three most important entropies of X$\sim Da(\beta,\lambda,\delta)$. Shannon entropy, Renyi entropy, q-entropy and Generalized Entropy (GE).

First, we consider the Shannon entropy which plays a similar role as the kurtosis in comparing the shapes of various densities and measuring heaviness of tails. Secondly Renyi entropy is one of the main extensions of the Shannon entropy was introduced by Renyi (1961).Thirdly q-entropy is a one –parameter generalization of the Shannon entropy which can lead to models or statistical results that are different from those obtained by using the Shannon entropy.

Shannon Entropy

Shannon entropy which plays a similar role as the kurtosis measure in comparing the shapes of various densities and measuring heaviness of tails.

Derivation of Shannon Entropy

Let x be a random variable with distribution of the form (1), then Shannon entropy is defined by

$$H(x) = \mathrm{E}[-logf(x)] = -\int f(x)logf(x) \tag{2}$$

For the Dagum pdf given by (8)

$$logf(x) = log\left\{\beta\lambda\delta\int_0^\infty x^{-\delta-1}\left(1+\lambda x^{-\delta}\right)^{-\beta-1}\right\} \tag{3}$$

$$H(x) = -log\beta - log\lambda - log\delta + (\delta + 1)\mathrm{E}(logx) + (\beta + 1)\mathrm{E}\left(log\left(1 + \lambda x^{-\delta}\right)\right) \tag{4}$$

$$\mathrm{E}(logx) = \frac{1}{\delta}[\psi(\beta) - 1] \tag{5}$$

$$\mathrm{E}\log\left(1 + \lambda x^{-\delta}\right) = \frac{-1}{\beta} \tag{6}$$

where $\psi(z) = \frac{\Gamma`(z)}{\Gamma(z)}$ is the digamma function.Substituting the result of (eq) and (eq), the Shannon entropy for Dagum distribution will be

$$z(x) = -log\beta - log\lambda - log\delta + \frac{1}{\delta}(\delta + 1)[\psi(\beta) - 1] - \frac{(\beta+1)}{\beta} \tag{7}$$

Renyi Entropy

Renyi entropy is one the main extensions of the Shannon entropy was introduced by Renyi (1961).

Renyi entropy is defined by

$$I_R(\gamma) = \frac{1}{1-\gamma} log\{\int f^{\gamma}(x)dx\} \tag{8}$$

where $\gamma > 0\ and\ \gamma \neq 1$.This additional parameter γ is used to describe complex behavior in probability models and the associated process under study. Renyi entropy is monotonically decreasing in γ.

For $Da(\beta, \lambda, \delta)\ pdf\ given\ in(4)$

$$f^{\gamma}(x) = \frac{1}{1-\gamma} log\left\{\beta\lambda\delta \int_0^{\infty} x^{-\delta-1}\left(1 + \lambda x^{-\delta}\right)^{-\beta-1}\right\}^{\gamma} \tag{9}$$

$$\int f^{\gamma}(x) = [\beta\lambda\delta]^{\gamma} \int_0^{\infty} x^{-\gamma\delta-\gamma}\left(1 + \lambda x^{-\delta}\right)^{-\gamma\beta-\gamma} \tag{10}$$

After simplification, we get final expression

$$I_q(\gamma) = \frac{1}{1-\gamma} log\left\{\beta^{\gamma}\delta^{\gamma}\lambda^{\gamma}\mathrm{B}\left(\frac{\gamma}{\delta}(1 + \delta)\right) - \frac{1}{\delta}, \gamma(1 + \beta) - \frac{\gamma}{\delta}(1 + \delta) + \frac{1}{\delta}\right\} \tag{11}$$

q-entropy

The $q - entropy$ was originally introdeuced by Havrda and Charvat and later applied to physical problems by Tsallis (1967).

Tsallis exploited its non-extensive features and placed in a physical setting (hence it is also known as Tsallis entropy).Moreover ,q-entropy is a one-parameter generalization of the Shannon entropy which can lead to models or statistical results that are different from those obtained by using the Shannon entropy. It is to be noted here that $\beta - entropy$ is a monotonic function of the Renyi entropy (Ullah, 1996).

For a continuous random variable X having pdf f(x), the $q - entropy$ is defined by

$$I_q(\gamma) = \frac{1}{q-1}[\int f^q f(x)dx] \tag{12}$$

$where\ q > 0\ and\ q \neq 1$

$For\ the\ Dagum\ pdf\ given\ by$ (12)

$$f^q(x) = \left\{\int_0^\infty x^{-\delta-1}\left(1+\lambda x^{-\delta}\right)^{-\beta-1}\right\}^q \tag{12}$$

The Final expression for q-entropy will be

$$I_q(\gamma) = \frac{1}{q-1} \left[1 - \left\{\beta^q \delta^q \lambda^{q-\frac{q}{\delta}(1+\delta)-\frac{1}{\delta}} \mathrm{B}\left(\frac{q}{s}(1+\delta)-\frac{1}{\delta}\right), q(1+\beta)-\frac{q}{\delta}(1+\delta)-\frac{1}{\delta}\right\}\right]. \tag{13}$$

REFERENCES

1. Dagum (1977). A new model of personal income distribution: specification and estimation. *Economie Appliquee*, 30, 413-437.
2. Dagum (1980). The generation and distribution of income, the Lorenz curve and the Gini ratio. *Economie Appliquee*, 33, 327-367.
3. Havrda, J. and Harvat, F. (1967). Quantification methods in classification processes: concept of structural $\alpha - entropy$. *Kybernetika*, 3, 30-35.
4. Renyi, A. (1961). *On measures of entropy and information*. University of California Press Berkeley, California, pp.547-561.
5. Tsallis, C. (1988). Possible generalization of Boltzmann-Gibbs statistics. *Journal of Statistical Physics*, 52, 479-487.
6. Ullah, (1996). Entropy, divergence and distance measures with econometric application. *Journal of Statistical Planning and Inference*, 49,137-162.

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ON BAYESIAN PREDICTION OF FUTURE QUARTILES IN MIXTURE GEOMETRIC DISTRIBUTION UNDER VARIOUS CENSORING TECHNIQUES

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ABSTRACT

In statistical inference, prediction has been being considered extensively in many fields of life including reliability engineering for the last a few years. This article establishes the study of Bayes prediction for various order statistics in future sample from the contagious distribution of two geometric densities. In particular, approximate lower and upper prediction limits have been derived for quartiles associated with the prospective sample from the model. A variety of censoring plans, namely type-I right, type-II right and left censoring, priors, and predictive densities were exercised in the analysis. The study also takes in the numerical results produced on real observations in order to corroborate the mathematical outcome.

KEYWORDS

Prediction Interval; Ordered Observation; Geometric Distribution; Mixture Model; Censoring Schemes.

1. INTRODUCTION

Prediction is being used in majority of the real-world phenomena such as commerce, medication, manufacturing and reliability engineering. As in classical statistics, prediction for dependent variable is made using the specified regression model and the sample data, so as in Bayesian statistics, prediction for the future sample observations is carried out using the predictive distribution. Bayesian prediction has been considered commonly in the literature. Some of the recent publications include Al-Hussaini (2003), Jong-Wuu Wu et al. (2007), Rahman et al. (2013) and Rahman and Aslam (2014a).

Mixture models of finite components have been taken frequently under consideration in recent years. The literature regarding such work on continuous distributions consists of many notes; for instance, Kazmi et al. (2013), Ali et al. (2013), and Rahman and Aslam (2014b) but a little attention was paid on mixture of discrete distributions.

The geometric distribution, one of the most significant discrete probability distributions, has been chosen for analysis in this article. Kaminsky et al. (1992) expressed a few practical applications of geometric distribution. The distribution was also studied by other authors like Chan et al. (1997) and Majeed et al. (2012).

Taking into account the importance of prediction, mixture model, and geometric distribution; an attempt has been made, in this paper, to construct Bayesian prediction intervals for various order statistics in the upcoming sample related to contagious distribution of two geometric density components.

The probability density function and the corresponding cumulative distribution function of the two-component mixture geometric distribution for random variable z with unknown parameters λ_1 , λ_2 (probabilities of success) and θ (mixing proportion), are given respectively as:

$$f(z) = \theta f_1(z) + \phi f_2(z)$$
$$F(z) = \theta F_1(z) + \phi F_2(z)$$

where:

$f_t(z) = \lambda_t(1-\lambda_t)^z$,
$F_t(z) = 1-(1-\lambda_t)^{z+1}$, $z = 0,1,2,\dots,\infty$,
$\phi = 1-\theta$, $0 < \lambda_t, \theta < 1$, $t = 1,2$

2. PREDICTIVE MODEL UNDER RIGHT TYPE-I CENSORED SAMPLES

Suppose that $X_1, X_2, X_3, \dots, X_n$ be a random sample of size n drawn from the population, for testing the reliability of items. Suppose also that $z_1, z_2, z_3, \dots, z_w$ be the w items in the sample having the lifetime in the space $[0, R]$, where R is a fixed termination time of the experiment. While, the left over $n-w$ items of the sample are still working even the prefixed time R has past. Considering this sampling scheme for each of the two sub-groups of the population, suppose finally that $z_{i1}, z_{i2}, z_{i3}, \dots, z_{iw_i}$ be w_i items corresponding to i^{th} sample from i^{th} sub-group, $i = 1,2$. such that $w = w_1 + w_2$ where z_{1j}, $j = 1,2,3,\dots,w_1$ and z_{2j}, $j = 1,2,3,\dots,w_2$; $z_{1j}, z_{2j} \in [0, R]$ characterize the failure times of the j^{th} item associated with subgroup-I and subgroup-II, respectively.

The above definitions lead to form the following likelihood function:

$$L(\lambda_1, \lambda_2, \theta|\mathrm{z}) \propto \{\prod_{j=1}^{w_1} \theta\, f_1(z_{1j})\}\{\prod_{j=1}^{w_2} \phi\, f_2(z_{2j})\}\{(1-F(R))^{n-w}\} \quad (1)$$

where:

$\mathrm{z} = [z_{1j}, z_{2j}]$, $z_{1j} = [z_{11}, z_{12}, \dots, z_{1w_1}]$, $z_{2j} = [z_{21}, z_{22}, \dots, z_{2w_2}]$,
$F(R) = \theta(1-\lambda_1)^{R+1} + \phi(1-\lambda_2)^{R+1}$, $\phi = 1-\theta$

Evaluating (1), it gives

$$L(\lambda_1, \lambda_2, \theta|\mathrm{z}) \propto \sum_{r_1=0}^{n-w} \binom{n-w}{r_1} \theta^{k_1}(1-\theta)^{k_2}\lambda_1^{w_1}(1-\lambda_1)^{s_1}\lambda_2^{w_2}(1-\lambda_2)^{s_2} \quad (2)$$

where:

$s_1 = (n-w-r_1)(1+R) + \sum_{j=1}^{w_1} z_{1j}$,
$s_2 = r_1(1+R) + \sum_{j=1}^{w_2} z_{2j}$, $k_1 = n - w_2 - r_1$,
$k_2 = w_2 + r_1$

Let $\lambda_1 \sim Beta(a_1, b_1)$, $\lambda_2 \sim Beta(a_2, b_2)$ and $\theta \sim Beta(c, d)$, so the prior (joint) distribution of $\Omega = (\lambda_1, \lambda_2, \theta)'$ is:

$$g(\Omega) \propto {\lambda_1}^{a_1-1}(1-\lambda_1)^{b_1-1}{\lambda_2}^{a_2-1}(1-\lambda_2)^{b_2-1}\theta^{c-1}(1-\theta)^{d-1},\ 0<\Omega<1 \quad (3)$$

The posterior (joint) distribution of $\Omega = (\lambda_1, \lambda_2, \theta)'$ given data using (2) and (3) is:

$$g(\Omega|\mathrm{z}) = \frac{1}{D}\sum_{r_1=0}^{n-w}\binom{n-w}{r_1}\theta^{c+k_1-1}(1-\theta)^{d+k_2-1}{\lambda_1}^{a_1+w_1-1}$$
$$(1-\lambda_1)^{b_1+s_1-1}{\lambda_2}^{a_2+w_2-1}(1-\lambda_2)^{b_2+s_2-1},\ 0<\Omega<1 \quad (4)$$

where:

$$D = \sum_{r_1=0}^{n-w}\binom{n-w}{r_1}\mathrm{B}(c+k_1, d+k_2)\mathrm{B}(a_1+w_1, b_1+s_1)\mathrm{B}(a_2+w_2, b_2+s_2)$$

Suppose now that Y_m represents the lifetime of the ordered m^{th} unit ($1 \le m \le g$), which is to be failed in the future sample. Then the probability density function of Y_m is given as:

$$p(y_m|\Omega) = \frac{1}{\mathrm{B}(m, g-m+1)}[F(y_m)]^{m-1}[1-F(y_m)]^{g-m}f(y_m) \quad (5)$$

where:

$f(y_m) = \theta f_1(y_m) + (1-\theta)f_2(y_m)$,
$F(y_m) = \theta F_1(y_m) + (1-\theta)F_2(y_m)$
$f_t(y_m) = \lambda_t(1-\lambda_t)^{y_m}$,
$F_t(y_m) = 1-(1-\lambda_t)^{y_m+1}$, $y_m = 0,1,2,\ldots,\infty$, $0<\lambda_t<1$, $t = 1,2.$

The powers of $F(y_m)$ and $1-F(y_m)$ in (5) are expanded as:

$$[F(y_m)]^{m-1} = \sum_{r_2=0}^{m-1}\binom{m-1}{r_2}(-1)^{r_2}\{\theta(1-\lambda_1)^{y_m+1} + (1-\theta)(1-\lambda_2)^{y_m+1}\}^{r_2}$$
$$= \sum_{r_2=0}^{m-1}\sum_{r_3=0}^{r_2}\binom{m-1}{r_2}\binom{r_2}{r_3}(-1)^{r_2}$$
$$\{(1-\theta)(1-\lambda_2)^{y_m+1}\}^{r_3}\{\theta(1-\lambda_1)^{y_m+1}\}^{r_2-r_3} \quad (6)$$

$$[1-F(y_m)]^{g-m} = \sum_{r_4=0}^{g-m}\binom{g-m}{r_4}$$
$$\{(1-\theta)(1-\lambda_2)^{y_m+1}\}^{r_4}\{\theta(1-\lambda_1)^{y_m+1}\}^{g-m-r_4} \quad (7)$$

Placing the results (6) and (7) in (5), the density function of Y_m becomes:

$$(y_m|\Omega) = A\sum_{r_2,r_3,r_4} K\,\theta^{\gamma}(1-\lambda_1)^{\gamma(y_m+1)}(1-\theta)^{\delta}(1-\lambda_2)^{\delta(y_m+1)}$$
$$\{\theta\lambda_1(1-\lambda_1)^{y_m} + (1-\theta)\lambda_2(1-\lambda_2)^{y_m}\} \quad (8)$$

where:

$K = \binom{m-1}{r_2}\binom{r_2}{r_3}\binom{g-m}{r_4}(-1)^{r_2}$,
$\sum_{r_2,r_3,r_4} = \sum_{r_2=0}^{m-1}\sum_{r_3=0}^{r_2}\sum_{r_4=0}^{g-m}$,
$A = \frac{1}{\mathrm{B}(m,g-m+1)}$, $\gamma = g-m+r_2-r_3-r_4$, $\delta = r_3+r_4$

The posterior predictive density function is obtained as:

$$p(y_m|\mathrm{z}) = \int_{\Omega} p(y_m|\Omega)\, g(\Omega|\mathrm{z})\, \mathrm{d}\Omega \quad (9)$$

Using (4) and (8) in (9), we have

$$p(y_m|\mathrm{z}) = A^* \int_\Omega \sum_{r_1,r_2,r_3,r_4} K^* [\theta^{\gamma^*}(1-\theta)^{\delta^*-1}\lambda_1^{\mu_1}(1-\lambda_1)^{\psi_1(y_m)+y_m-1}\lambda_2^{\mu_2-1}(1-\lambda_2)^{\psi_2(y_m)-1} + \theta^{\gamma^*-1}(1-\theta)^{\delta^*}\lambda_1^{\mu_1-1}(1-\lambda_1)^{\psi_1(y_m)-1}\lambda_2^{\mu_2}(1-\lambda_2)^{\psi_2(y_m)+y_m-1}]\mathrm{d}\Omega \quad (10)$$

where:

$$A^* = \frac{A}{D},\ K^* = K\binom{n-w}{r_1},$$
$$\sum_{r_1,r_2,r_3,r_4} = \sum_{r_1=0}^{n-w}\sum_{r_2=0}^{m-1}\sum_{r_3=0}^{r_2}\sum_{r_4=0}^{g-m}$$
$$\gamma^* = c + k_1 + \gamma,\ \delta^* = d + k_2 + \delta,$$
$$\mu_1 = a_1 + w_1,\ \mu_2 = a_2 + w_2,$$
$$\psi_1(y_m) = b_1 + s_1 + \gamma(y_m+1),$$
$$\psi_2(y_m) = b_2 + s_2 + \delta(y_m+1)$$

Solving integrals with respect to $\Omega = (\lambda_1, \lambda_2, \theta)'$ in (10), we get

$$p(y_m|\mathrm{z}) = A^* \sum_{r_1,r_2,r_3,r_4} K^* [\mathrm{B}(\gamma^*+1, \delta^*)\mathrm{B}(\mu_1+1, \psi_1(y_m)+y_m)\mathrm{B}(\mu_2, \psi_2(y_m)) + \mathrm{B}(\gamma^*, \delta^*+1)\mathrm{B}(\mu_1, \psi_1(y_m))\mathrm{B}(\mu_2+1, \psi_2(y_m)+y_m)] \quad (11)$$

$$y_m = 0,1,2,\ldots,\infty$$

3. PREDICTIVE MODEL UNDER RIGHT TYPE-II CENSORED SAMPLES

For testing reliability of units, a random sample $X_1, X_2, X_3, \ldots, X_n$ of size n units is drawn from the population. Let $z_1, z_2, z_3, \ldots, z_w$ be the first w units in the sample ($z_1 < z_2 < z_3 < \cdots < z_w$) that have been failed and the remaining $n-w$ units of the sample are still working. Now consider this sampling scheme for each of the two sub-groups of the population, and again suppose that $z_{i1}, z_{i2}, z_{i3}, \ldots, z_{iw_i}$ be w_i items corresponding to i^{th} sample from i^{th} sub-group, $i = 1,2$. such that $w = w_1 + w_2$, where z_{1j}, $j = 1,2,3,\ldots,w_1$ and z_{2j}, $j = 1,2,3,\ldots,w_2$ are the failure times of the j^{th} item associated with subgroup-I and subgroup-II, respectively.

The likelihood function on the above definitions is given by:

$$L(\lambda_1, \lambda_2, \theta|\mathrm{z}) \propto \{\prod_{j=1}^{w_1} \theta\, f_1(z_{1j})\}\{\prod_{j=1}^{w_2} \phi\, f_2(z_{2j})\}\{(1-F(z_w))^{n-w}\} \quad (12)$$

where

$$\mathrm{z} = [z_{1j}, z_{2j}],\ z_{1j} = [z_{11}, z_{12}, \ldots, z_{1w_1}],$$
$$z_{2j} = [z_{21}, z_{22}, \ldots, z_{2w_2}],$$
$$F(z_w) = \theta(1-\lambda_1)^{z_w+1} + \phi(1-\lambda_2)^{z_w+1},$$
$$\phi = 1-\theta$$

Simply replacing R by z_w in the predictive density in (11), we can have the predictive density of Y_m under type-II censoring scheme given as follows:

$$p(y_m|\mathrm{z}) = A' \sum_{r_1,r_2,r_3,r_4} K^* [\mathrm{B}(\gamma^* + 1, \delta^*) \mathrm{B}(\mu_1 + 1, \psi_1{}^*(y_m) + y_m)\mathrm{B}\big(\mu_2, \psi_2{}^*(y_m)\big) + \mathrm{B}(\gamma^*, \delta^* + 1)\mathrm{B}\big(\mu_1, \psi_1{}^*(y_m)\big)\mathrm{B}(\mu_2 + 1, \psi_2{}^*(y_m) + y_m)] \quad (13)$$

$$y_m = 0,1,2, \dots, \infty$$

where:

$$D' = \sum_{r_1=0}^{n-w} \binom{n-w}{r_1} \mathrm{B}(c + k_1, d + k_2)\mathrm{B}(a_1 + w_1, b_1 + s_1{}^*)\mathrm{B}(a_2 + w_2, b_2 + s_2{}^*)$$

$$K^* = \binom{n-w}{r_1}\binom{m-1}{r_2}\binom{r_2}{r_3}\binom{g-m}{r_4}(-1)^{r_2},$$

$$\gamma = g - m + r_2 - r_3 - r_4 \,,\ \delta = r_3 + r_4 \,,$$

$$k_1 = n - w_2 - r_1 \,,\ k_2 = w_2 + r_1 \,,\ A = \frac{1}{\mathrm{B}(m, g-m+1)}$$

$$A' = \frac{A}{D'} \,,\ \sum_{r_1,r_2,r_3,r_4} = \sum_{r_1=0}^{n-w} \sum_{r_2=0}^{m-1} \sum_{r_3=0}^{r_2} \sum_{r_4=0}^{g-m}$$

$$\gamma^* = c + k_1 + \gamma \,,\ \delta^* = d + k_2 + \delta \,,\ \mu_1 = a_1 + w_1 \,,\ \mu_2 = a_2 + w_2 \,,$$

$$\psi_1{}^*(y_m) = b_1 + s_1{}^* + \gamma(y_m + 1) \,,\ \psi_2{}^*(y_m) = b_2 + s_2{}^* + \delta(y_m + 1),$$

$$s_1{}^* = (n - w - r_1)(1 + z_w) + \sum_{j=1}^{w_1} z_{1j} \,,\ s_2{}^* = r_1(1 + z_w) + \sum_{j=1}^{w_2} z_{2j}.$$

4. PREDICTIVE MODEL UNDER LEFT CENSORED SAMPLES

For testing reliability of units, a random sample $X_1, X_2, X_3, \dots, X_n$ of size n units is drawn from the population. Let $z_{w+1}, z_{w+2}, z_{w+3}, \dots, z_n$ be the last $n - w$ units in the sample ($z_{w+1} < z_{w+2} < z_{w+3} < \cdots < z_n$) that have been failed. Consider the same situation for sampling from each of the two sub-populations of the model, suppose $z_{i,w+1}, z_{i,w+2}, z_{i,w+3}, \dots, z_{in_i}$ be $n_i - w_i$ units corresponding to i^{th} sample from i^{th} sub-population, $i = 1,2.$ such that $w = w_1 + w_2$ and $n = n_1 + n_2$ while, z_{1j}, $j = w + 1, w + 2, w + 3, \dots, n_1$ and z_{2j}, $j = w + 1, w + 2, w + 3, \dots, n_2$ represent the failure times of the j^{th} unit associated with subpopulation-1 and subpopulation-2, respectively.

Considering the above definitions, the likelihood function becomes:

$$L(\lambda_1, \lambda_2, \theta|\mathrm{z}) \propto \left\{\prod_{j=w_1+1}^{n_1} \theta\, f_1(z_{1j})\right\}\left\{\prod_{j=w_2+1}^{n_2} \phi\, f_2(z_{2j})\right\}\left\{\big(F(z_{w+1})\big)^w\right\} \quad (14)$$

where:

$$\mathrm{z} = [z_{1j}, z_{2j}] \,,$$

$$F(z_{w+1}) = \theta(1 - \lambda_1)^{z_{w+1}+1} + \phi(1 - \lambda_2)^{z_{w+1}+1} \,,$$

$$\phi = 1 - \theta \,,\ 0 < \theta < 1.$$

Evaluating (14), we have

$$L(\lambda_1, \lambda_2, \theta|\mathrm{z}) \propto \sum_{t_1=0}^{w} \sum_{t_2=0}^{t_1} \binom{w}{t_1}\binom{t_1}{t_2}(-1)^{t_1}\theta^{\varepsilon_1}(1 - \theta)^{\varepsilon_2}\lambda_1{}^{n_1 - w_1} (1 - \lambda_1)^{\xi_1}\lambda_2{}^{n_2 - w_2}(1 - \lambda_2)^{\xi_2} \quad (15)$$

where:

$$\xi_1 = t_2(1 + z_{w+1}) + \sum_{j=w_1+1}^{n_1} z_{1j} \,,$$

$$\xi_2 = (t_1 - t_2)(1 + z_{w+1}) + \sum_{j=w_2+1}^{n_2} z_{2j} \,,$$

$$\varepsilon_1 = t_2 + n_1 - w_1 \,,\ \varepsilon_2 = t_1 - t_2 + n_2 - w_2$$

Using the joint prior (3) and the likelihood function (15), the posterior (joint) distribution of $\Omega = (\lambda_1, \lambda_2, \theta)'$ given data is:

$$g(\Omega|\mathrm{z}) = \frac{1}{D''}\sum_{t_1=0}^{w}\sum_{t_2=0}^{t_1}\binom{w}{t_1}\binom{t_1}{t_2}(-1)^{t_1}\theta^{c+\varepsilon_1-1}(1-\theta)^{d+\varepsilon_2-1}{\lambda_1}^{a_1+n_1-w_1-1}$$
$$(1-\lambda_1)^{b_1+\xi_1-1}{\lambda_2}^{a_2+n_2-w_2-1}(1-\lambda_2)^{b_2+\xi_2-1} \quad (16)$$
$$0 < \Omega < 1$$

where:

$$D'' = \sum_{t_1=0}^{w}\sum_{t_2=0}^{t_1}\binom{w}{t_1}\binom{t_1}{t_2}(-1)^{t_1}\mathrm{B}(c+\varepsilon_1, d+\varepsilon_2)$$
$$\mathrm{B}(a_1+n_1-w_1, b_1+\xi_1)\mathrm{B}(a_2+n_2-w_2, b_2+\xi_2)$$

Using the posterior density (16) and the density function of Y_m (8) in (9) and evaluating the multiple integrals w.r.t $\Omega = (\lambda_1, \lambda_2, \theta)'$, the posterior predictive density function is given by:

$$p(y_m|\mathrm{z}) = A''\sum_{t_1,t_2,r_2,r_3,r_4}K'\,[\mathrm{B}(\gamma'+1, \delta')$$
$$\mathrm{B}({\mu_1}'+1, {\psi_1}'(y_m)+y_m)\mathrm{B}\big({\mu_2}', {\psi_2}'(y_m)\big)$$
$$+\mathrm{B}(\gamma', \delta'+1)\mathrm{B}\big({\mu_1}', {\psi_1}'(y_m)\big)\mathrm{B}({\mu_2}'+1, {\psi_2}'(y_m)+y_m)] \quad (17)$$
$$y_m = 0,1,2,\ldots,\infty$$

where:

$A'' = \frac{A}{D''}$, $K' = K\binom{w}{t_1}\binom{t_1}{t_2}(-1)^{t_1}$,

$\sum_{t_1,t_2,r_2,r_3,r_4} = \sum_{t_1=0}^{w}\sum_{t_2=0}^{t_1}\sum_{r_2=0}^{m-1}\sum_{r_3=0}^{r_2}\sum_{r_4=0}^{g-m}$,

$\gamma' = c+\varepsilon_1+\gamma$, $\delta' = d+\varepsilon_2+\delta$,

${\mu_1}' = a_1+n_1-w_1$, ${\mu_2}' = a_2+n_2-w_2$,

${\psi_1}'(y_m) = b_1+\xi_1+\gamma(y_m+1)$,

${\psi_2}'(y_m) = b_2+\xi_2+\delta(y_m+1)$

$100(1-\alpha)\%$ Bayesian prediction interval (L_0, U_0) for m^{th} ordered future observation can be obtained by solving the following two implicit equations using statistical package Mathematica.

$$\sum_{y_m=0}^{L_0}p(y_m|\mathrm{z}) = \frac{\alpha}{2} = \sum_{y_m=U_0}^{\infty}p(y_m|\mathrm{z}). \quad (18)$$

Here, α is the level of significance and $p(y_m|\mathrm{z})$ is posterior predictive distribution of m^{th} ordered future random variable Y_m (as given in eq. (11,13,17)). Prediction intervals for various order statistics can be attained for specified values of m and α in (18).

5. NUMERICAL RESULTS

Xie and Goh (1997) treated the data set of number of orders per truck for shipments in a distribution centre, having 30 observations as geometrically distributed. Consider these data for two-component geometric mixture model. Assuming mixing proportion to be $= 0.7$, the division of observed data into two sub-samples of sizes $n_1 = 21$ and $n_2 = 9$ respectively is as follows:

z_1	22	11	14	11	11	40	18
	22	9	19	26	27	37	18
	20	12	12	33	15	16	20
z_2	39	19	23	12	8	25	27
	15	30					

Suppose $g = 15$ be the future sample size. Let Y_4, Y_8 and Y_{12} denote lower quartile, median, and upper quartile future number of orders, respectively. Using the above data and $\alpha = 0.05$ in eq. (18), 95% prediction intervals for various ordered number of orders are calculated and given in table 1.

Table 1
95% Prediction Intervals for Future Number of Orders

Future Observation	Censoring Scheme		
	Type-I Right	Type-II Right	Left
Y_4	(0,16)	(0,16)	(0,13)
Y_8	(5,34)	(5,36)	(4,28)
Y_{12}	(13,72)	(14,79)	(11,56)

6. CONCLUDING NOTES

1. Contagious model of two geometric distributions is studied comprehensively for predictions in this article. In section 2-4, three contagious densities under type-I (right), type-II (right) and left censoring techniques are obtained, respectively. Afterward, the posterior predictive densities for mth ordered future observation have been derived from the contagious densities in conjunction with the use of conjugate Beta priors for three parameters.

2. Real application for the validation of derived expressions has been performed in section 5. A data set of 30 observations from a real-life phenomenon is obtained on number of orders per truck for shipments in a distribution centre. Assuming 70% proportion of first density module and 30% proportion of second density module of mixture model, the sample is further bifurcated into subsamples with sizes 21 and 9 respectively. It is further assumed that a prospective sample of number of orders includes 15 figures which are to be predicted via Bayesian methodologies conferred in section 2-4. The observations at 4^{th}, 8^{th}, and 12^{th} positions in array future data can be regarded as the lower quartile, median, and upper quartile point of data, respectively, collectively known as quartiles.

3. The numerical results of prediction limits at 5% significance level for quartiles number of orders in the future 15 observations are demonstrated in table 1. The prediction figures reveal that up to 16 orders per truck for shipments are expected for the lower quartile observation in the future type-I as well as type-II censored sample and up to 13 orders per truck for shipments in the future left censored sample. The median observation in the future type-I censored sample would have approximately 5 to 34 orders per truck for shipments in a distribution centre. The corresponding statistics from type-II and left censored samples are approximately 5 to 36 and 4 to 28

orders per truck, respectively. Similarly, the upper quartile observation in the future sample is predicted to have the number of orders per truck for shipments in the approximate intervals of (13,72), (14,79) and (11,56) using type-I, type-II and left censoring schemes, respectively.

4. The prediction intervals under left censored samples are observed to be shorter than that of right (type-I & type-II) censored samples. This indicates that the left censoring technique is more reliable than the right one and is more feasible to be used in the analogous circumstances.

5. The application of derived prediction bounds enables one predict the future events in the situations where the geometric mixture model is suitably fitted along with the specific censoring plan.

REFERENCES

1. Al-Hussaini, E. K. (2003). Bayesian predictive density of order statistics based on finite mixture models. *Journal of Statistical Planning and Inference*, 113, 15-24.
2. Ali, S., Aslam, M. and Kazmi, S.M.A. (2013). Choice of Suitable Informative Prior for the Scale Parameter of the Mixture of Laplace Distribution. *Electronic Journal of Applied Statistical Analysis*, 6(1), 32-56.
3. Chan, L.Y., Xie, M. and Goh, T.N. (1997). Two-stage control charts for high yield processes. *International Journal of Reliability Quality Saf. Eng.*, 4, 149-165.
4. Jong-Wuu Wu, Shu-Fei Wu and Chin-Mei Yu (2007). One-Sample Bayesian Predictive Interval of Future Ordered Observations for the Pareto Distribution. *Quality and Quantity*, 41, 251-263.
5. Kaminsky, F.C., Benneyan, J.C. and Davis, R.D. (1992). Statistical Control Charts Based on a Geometric Distribution. *Journal of Quality Technology*, 24(2), 63-69.
6. Kazmi, S.M.A., Aslam, M., Ali, S. and Abbas, N. (2013). Selection of suitable prior for the Bayesian mixture of a class of lifetime distributions under type-I censored datasets. *Journal of Applied Statistics*, 40(8), 1639-1658.
7. Majeed, M.Y., Aslam, M. and Riaz, M. (2012). Mixture cumulative count control chart for mixture geometric process characteristics. *Quality and Quantity*, DOI 10.1007/s11135-011-9656-1.
8. Rahman, J., Aslam, M. and Ali, S. (2013). Estimation and Prediction of Inverse Lomax Model via Bayesian Approach. *Caspian Journal of Applied Sciences Research*, 2(3), 43-56.
9. Rahman, J. and Aslam, M. (2014a). Interval Prediction of Future Order Statistics in Two-component Mixture Inverse Lomax Model: A Bayesian Approach. *American Journal of Mathematical and Management Sciences*, 33(3), 216-227.
10. Rahman, J. and Aslam, M. (2014b). On Estimation of Two-component Mixture Inverse Lomax Model via Bayesian Approach. *International Journal of Systems Assurance Engineering and Management*, DOI 10.1007/s13198-014-0296-4.
11. Xie, M. and Goh, T.N. (1997). The use of probability limits for process control based on geometric distribution. *International Journal of Quality & Reliability Management*, 14(1), 64-73.

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ANALYZING FACTORS INFLUENCING PRIVATE SECTOR SCHOOL CHILDREN PARENTS' CHOICE IN SELECTING SCHOOL FOR THEIR CHILDREN

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ABSTRACT

The present study aimed at to find out the factors that influence private sector school children parents' choice for selecting a school for their children. The sample of the study comprised of 30 primary private sector schools situated in urban area of District Peshawar. A self-administered questionnaire was used to collect data from 300 randomly selected parents of the 30 conveniently selected schools; 10 parents were randomly selected from each of 30 schools. Appropriate statistical tools including descriptive statistics, Pearson correlation and frequency analysis were used for data analysis of results and its interpretation.

According to results, family size, family income, total number of children in a family, parents' profession and fact that the male-parents attended private school for their own education have turned out to be the major factors that influence parents' decision in selecting a private school for their children. It was further found that parents preferred private schools over the public ones because they understand the former type of schools have good facilities, good teachers, higher qualification/characteristics, better and supportive caring environment, modern style education, good examination results, and greater fee concession and scholarships. On the of avoidance of government schools, parents gave their main reasons as poor examination results, low/inferior educational facilities, unsuitable educational environment, overcrowded classes, poor discipline, poor teaching, corporal punishment, No-diary writing, homework not checked.

KEYWORDS

Private schools, parents' choice, private versus public schools, Pakistan.

1. INTRODUCTION

1.1 Introduction

Situation of public versus private schooling education differ from country to country. In Cambodia, 60 percent of the resources for public primary education are provided directly by households rather than indirectly via the State, while in Indonesia, 69 percent of the resources of private primary schools are provided by the Government. In Singapore, students meet 20 percent of the recurrent costs of public university-level education through fees, but at the secondary level, the government meets over 90 percent of the costs of the institutions in the Independent Schools Scheme. Education in Netherlands is free for the compulsory years of schooling. The Dutch government spends

at the OECD (Organization for Economic Co-operation and Development) average, at all levels of education. Spending on education as a part of GDP is 4.8 percent, which is below the OECD average of 5.0 percent. Thus, attainment levels are high, while comparative costs are low.

School choice in the Netherlands manifests itself in the existence of a large number of private schooling options for parents and their children. This rivalry between public and private may be leading to many good things, like schools becoming more functional having executive control on work force, teaching students, fostering school orderliness, managing budgets, and incorporating parents.

The private sector played a vital role in the development of education system in Pakistan before formulation of National Education Policy 1972. However, under the National Education Policy 1972, private schools were nationalized, which caused a major setback for the private sector, generated barriers in further enlargement of private sector in the country. Nevertheless, the subsequent National Education Policies 1979, 1992 and 1998-2010 made required arrangements for the involvement of private sector in the process of educational development in the country. As a result, private sector is up to a significant extent contributing in quantitative expansion and qualitative improvement of education system. A plenty of educational institutions are privately managed and tough competition is found among these institutions for producing quality education.

The basic decision relating to school choice was in the hands of the parents. Parents want to provide their children with the best possible educational environment. Their decision to invest in children education depends on social, economic or cultural factors. In Pakistan education is offered by both private and public sectors. In public schools it is almost free of cost, whereas the parents have to pay fees in private sector.

The private sector in this country play an important role in imparting education at all levels. The private schools have enhanced their quality in late years, appealing parents of brilliant students through fee concession, ranging from half to full fee favor.

Private schools provide an opportunity for the investors, interested in investment. Many aspects regarding education system of Pakistan have already been discussed in various studies as yet, in spite of the determinants which prompt the parents to choose private schools for their children are yet to be examined.

When the parents are disappointed with the falling standards of public schools, they usually decide to send their children to private schools. Some of the reasons for effectiveness of private schools are favorable educational environment (Dronkers and Peter 2003), teacher student ratio, and class size. However the parents decide about their children schools on the basis of various factors such as household income, family size, parent's education, area, and social set up.

1.2 Research Theme and Research Questions and Objectives

The discussion made in the preceding section brings up the value and worth of private sector schooling and especially the importance of its recent growth, relative to the public sector schooling in Pakistan. This discussion motivates this researcher to carry out an

analysis of those factors which motivate the parents to enroll their children in private schools and avoid public sector schools.

This study will specifically test the following hypothesis and pursue the research questions and objectives, narrated in the following sub-sections.

Hypothesis

The parents of private sector school children prefer private schools over the public ones because of their understanding that the former schools provide relatively better education.

Research Questions

1. Whether parents prefer private schools over public schools?
2. If yes, what are the major factors that influence the parents' decision in selection of private schools for their children?

Research Objectives

1. To study whether parents in fact prefer private schools over public ones.
2. To find out the factors affecting parents' decision in selecting of private schools for their children schooling.
3. To bring problems if any to the light and recommend policy prescriptions for both private and public sector education.

Significance of the Study

This piece of research has analyzed as to whether parents prefer private schools over public ones for their children and what have been the major factors that influence the parents' decision in selection of private schools for their children.

The information and data this research has brought on to the surface may reveal several insights for policy makers in education in particular and other sectors in general. Policy makers may base their policy and future actions on the facts and figures revealed in this study, and make suitable changes wherever found suitable and necessary.

Private investors, interested in investment in education sector, may use the findings for better outcomes.

Delimitation of the Study

Due to lack of resources and limited time, about 10% schools i.e. 30 private Primary schools were conveniently selected. Similarly the study is delimited to the urban areas of the district Peshawar.

METHODOLOGY

Population, Sampling Procedure and Sample Size

Since the topic of this research required that we investigate as to what factors have influenced parents' choice who selected private schools, instead of public, for their children education, the population for this research therefore consists of all parents of children who are admitted in private schools all over Pakistan. However, due to certain

limitations on part of this researcher, district of Peshawar (KP) is chosen as research cite for this research.

District Peshawar has 328 private primary schools in all. About 10% of this district Peshawar private primary school population or 30 schools in number, situated in urban part of the district have been included in the sample for this research.

The sampled area of district Peshawar includes Peshawar city area, Cantonment area and Hayatabad Township area, with school number breakup, as follows.

Area	Number of Schools
Cantonment	9
Peshawar City	12
Hayatabad Town	9
Total	30

Because of time and financial limitations, the above 30 private sector primary schools were conveniently selected. However, 10 parents from each of the 30 schools were then randomly selected from the lists of parents obtained from the school administration. A total of 300 parents were thus included in the sample.

Research Instrument

A self-administered questionnaire, annexed at Annexure – II, has been used to collect needed information from the 300 randomly selected parents of the 30 selected private primary schools' children. Questionnaires were delivered through school teachers, and for this purpose, this researcher herself visited each of the selected schools, and delivered questionnaires along with a letter, appended herewith as Appendix – A, from Mr. Amjad Ali, Registrar, City University of Science and Information Technology Peshawar wherein purpose of the research was mentioned and request to cooperate with the research was made. This researcher made several personal visits of each of the schools to persuade and expedite the filling in of the questionnaire.

Questionnaire has several parts. In the first part, general questions on size of family, number of children and number of children going to schools, family income, parents' education and number of children going to private schools. In the second part, questions regarding factors behind parents' decision for selecting private school for their children. In the third, questions onthe reasons as to why parents avoid public sector schools.

Statistical Tools and Analysis

Three major statistical tools have been used for analyzing data collected from the respondents. These tools included:

Descriptive Statistics:

This statistical tool provided us to measure average or mean value of various variables, along with its standard deviations and minimum-maximum ranges.

Descriptive statistics have been developed in the fourth chapter for the variables namely family size, number of children and number of children going to schools, family income, parents' education and parents' profession and children going to private schools.

Pearson Correlation:

Pearson Correlation has been estimated in the fourth chapter to analyze the strength of the degree of association between variables namely total school going children, number of children in private school, family income, father education and mother education.

Frequency Analysis:

Frequency analysis has been carried out in the fourth chapter for the frequency analysis or counting of the variables namely father attending private school, mother attending private school, parents' profession (government vs. business and business vs. others), good facilities, good teachers, supportive caring environment, modern style education, good examination results, fee concession/scholarship, transport facility available, child receive individual attention, good principal leadership, school follows national curriculum, extra-curricular activities, well qualified staff, parents teachers meeting, provides computer facilities, activity based learning, near to home, child's friends siblings going school, only option local area, poor examination result, teachers less qualified, educational facilities, Avoid public unsuitable educational environment, Avoid public over-crowded classes, Avoid public poor disciple, Avoid public unsuitable teaching, Avoid public corporal punishment, Avoid public no Diary writing, Avoid public homework not checked.

RESULTS AND DISCUSSION

Relationship between Family Size and Number of Children Going to Schools

Table 1 provides descriptive statistics of size of the family (FS), total number of children (NOC) and number of children admitted in the public and private schools.

Table 1
Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Family size	300	3.00	9.00	5.3467	1.49910
Number of Children	300	1.00	6.00	3.0000	1.34388
Total School going Children	300	1.00	6.00	2.7600	1.22505
Number of children in public school	300	.00	3.00	.4233	.77855
Number of children in private school	300	1.00	5.00	2.3367	1.09575
Valid N (list wise)	300				

The mean value of family size is 5.35, with a minimum-maximum range of 3 – 9. The mean value of the number of children estimates at 3.00 and ranges between 1 – 6. As far

as number of school-going-children are concerned, their average number is 2.76, out of which 0.42 (15.22%) are going to public and 2.34 (84.78%) are going to private schools.

The above results indicate that the respondent families preferred to send their children to private schools.

Analysis in preceding section indicates that around 85% of families' children go to private schools. To reinforce these results, we compute Pearson Correlation between total number of school going children (TSGC) and children admitted in private schools (NOCPR). Results are provided in Table 2.

Table 2
Correlations

		Total School Going Children	**Number of Children in Private School**
Total School going Children	Pearson Correlation	1	.780**
	Sig. (2-tailed)		.000
	N	300	300
Number of children in private school	Pearson Correlation	.780**	1
	Sig. (2-tailed)	.000	
	N	300	300

**. Correlation is significant at the 0.01 level (2-tailed).

From the above table 2, it is cleared that correlation between total numbers of school going children (TSGC) and number of children deputed to the private school works out to be $r = 0.780$ which is statistically significant at $\alpha < 0.01$ (2- tailed).

Relationship between family income, parents' education and profession and children going to private schools

Table 3 works out descriptive statistics of family income, parent's education and children going to private schools.

Table 3
Descriptive Statistics

	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Family income	300	10000.00	41000.00	32740.0000	9670.09665
Father Education	300	.00	21.00	12.9300	4.57693
Mother Education	300	.00	21.00	7.3633	7.04201
Number of children in private school	300	1.00	5.00	2.3367	1.09575
Valid N (list wise)	300				

The mean value of family income is Pak Rs. 32,740.00, which ranges in between 10000.00 – 41000.00. The mean value of the father education is 12.93 years, which ranges between nil and 21.00 years. As far as mothers' education is concerned, the mean value is 7.36 which ranges between nil and 21.00 years.

The correlation between families income and number of children going to school estimates at r = 0.348, which is statistically significant at $\alpha < 0.00$ (Table 4).

Table 4
Correlations

		Parents Income	Number of Children in Private School
Family Income	Pearson Correlation	1	.348**
	Sig. (2-tailed)		.000
	N	300	300
Number of Children in Private School	Pearson Correlation	.348**	1
	Sig. (2-tailed)	.000	
	N	300	300

**. Correlation is significant at the 0.01 level (2-tailed).

The correlation between father's education and number of children going to school estimates at r = 0.235, which is statistically significant at $\alpha < 0.00$ (Table 4.5).

Table 5
Correlations

		Father Education	Number of Children in Private School
Father Education	Pearson Correlation	1	.235**
	Sig. (2-tailed)		.000
	N	300	300
Number of Children in Private School	Pearson Correlation	.235**	1
	Sig. (2-tailed)	.000	
	N	300	300

**. Correlation is significant at the 0.01 level (2-tailed).

The correlation between mothers' education and number of children going to school estimates at r = 0.078, which is statistically insignificant at $\alpha > 0.10$ (Table 6).

Table 6
Correlations

		Mother Education	Number of children in private school
Mother Education	Pearson Correlation	1	.078
	Sig. (2-tailed)		.177
	N	300	300
Number of children in private school	Pearson Correlation	.078	1
	Sig. (2-tailed)	.177	
	N	300	300

It is note-worthy that the magnitude of correlation between fathers' education and children going to private schools is substantial and statistically significant while correlation between mothers' education and children going to private schools is meagre and statistically insignificant. These results indicate that fathers' education, as compared to mothers, contribute more effectively.

We have carried out frequency analysis of both the parents, who attended private school for their own education; results are provided in the following table.

Table 7
Father Attending Private School (FAPS)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	58	19.3	19.3	19.3
	1.00	242	80.7	80.7	100.0
	Total	300	100.0	100.0	

Table 8
Mother Attending Private School (MAPS)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	136	45.3	45.3	45.3
	1.00	164	54.7	54.7	100.0
	Total	300	100.0	100.0	

It appears that about 81% of male – parents attended private school, compared to 55% mothers, who attended private schools. This data further substantiate our earlier conclusion that level of fathers' education and their previous affiliation with private school as a student have positively affected their decision of their children sending to the private school.

Parents' profession (whether belong to government sector or doing private job) seems does not create much difference as 51 percent parents serve in government sector and 49 percent in private sector (Table 9).

Table 9
Government vs. Business

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	146	48.7	48.7	48.7
	1.00	154	51.3	51.3	100.0
	Total	300	100.0	100.0	

As far as parents' doing own business are concerned; only 27.30 per cent parents were found running their own businesses (10).

Table 10
Business vs. Others

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	218	72.7	72.7	72.7
	1.00	82	27.3	27.3	100.0
	Total	300	100.0	100.0	

CONCLUSION AND RECOMMENDATIONS

Conclusions

The aforementioned research-findings help draw at least three major conclusions, namely:

First, that family size, family income, number of children in a family, parents profession and male-parent attendance of private school for their own education are the most important factors that influence parents decision in selecting a private or public schools for their children.

Second, that parents select private schools for their children because they believe that these private schools have certain better characteristics than public schools; these characteristics include better facilities, good teachers, better qualification/characteristics of school teachers and staff, supportive and caring environment, modern style of education, good examination results, fee concession and scholarships, availability of better transport facility, children receiving individual attention, good principal leadership, schools following national curriculum, extra-curricular activities, well qualified staff, parents teachers meetings, provides of computer facilities and activity based learning, etc. Even two third of the respondent didn't considered relatively high fees of private schools and schools being too strict in discipline as weaknesses of private schooling system.

Third, that regarding the of avoidance of government schools, parents mentioned main reasons as poor examination results, teachers being less qualified, low educational facilities, unsuitable educational environment, overcrowded classes, poor class and school discipline, corporal punishment, no diary writing, homework not checked; however, parents did not agreed with low academic qualifications of public school teachers.

Recommendations

1. Since majority of parents have been found expressing relatively more satisfied with private schools, it is thus natural to recommended that public policy makers working in national and provincial educational systems consider this fact and study, and make appropriate measures to improve public schools to bring those as par in the aspects where private schools are considered better.
2. Public school policy makers and administrators are recommended that they consider steps to improve the image of public school through steps like making improvements in physical facilities at public schools, teachers' qualifications and training, discipline in classes and school system, attendance of teachers and students, etc.
3. It is recommended that public sector administrators give more attention to making available to number of required teachers and their appropriate qualification. Introduction and extensive use of parents-teacher conferences in public schools are highly recommended.
4. It is recommended that overcrowding be managed through provision of additional schools, through additional rooms wherever possible, double shifting and through both new public sector schools and encouraging private sector.
5. It is recommended that corporal punishment be prohibited and teachers be trained to adopt motivational ways of encouraging students to behave and learn.
6. Public policy makers and administrators at both national and provincial levels should have a vigilant monitoring check on the overall educational environment and make sure that a healthy environment is created and maintained between the two pillars of public and private schooling system.

REFERENCES

1. Andrabi, T. Das, J. and Khwaja, A.I. (2002). *The rise of private schooling in Pakistan: Catering to the urban elite or educating the rural poor? (Mimeo).* Washington, DC: World Bank.
2. Andrabi, T. Das, J., and Khwaja, A.I., Vishwanath, T. and Zajonc, T. (2007).*Learning and education achievements in Punjab schools (LEAPS): Insights to inform the education policy debate*. Washington, DC: World Bank.
3. Andrabi, T. Das, J., and Khwaja, A.I. (2006). *Private Schooling in Pakistan: Possibilities and Limits.* Working Paper.
4. Alderman, H., Orazem, P.F., and Peterno, E.M. (2001).School Quality, School Cost, and the Public/Private School Choices of Low Income Households in Pakistan. Retrieved July 8, 2011, from http://www2.econ.iastate.edu/faculty/orazem/lahore.pdf
5. Annual Status of Education Report (ASER) Pakistan. (2010). Lahore, South Asian Forum for Education Development (SAFED).

6. Anon (2004) Private Sector in Education-Ministry of Education [online].Available from :>http://www.pakistan.gov.pk/education-ministry/highlights/NEP-private sector. jsp-23k-cached-similarpages [Accessed 1 June 2004].
7. Anemone, Alex. (2008). A Descriptive Study of the Factors Influencing Middle School Choice in a Diverse Magnet School District in Northern New Jersey (2008). *Seton Hall University Dissertations and Theses (ETDs)*. Paper 78.
8. AEPAM (2004). A study on National sample survey of private schools in Pakistan. Islamabad Ministry of Education.
9. Abid, N.M. Ishfaque, M. and Gondal, M. (1993). *Private School on our Government. Schoolon kay Usatizah mein Vadeed Tadreesi Muawnaat kay Istimal ka Moazna.* Unpublished Master's Thesis. Lahore: IER, University of the Punjab.
10. Accra, Ghana (2009). *Public Private Partnerships in Education*. PPPs for Social Services and Infrastructure.
11. Birdsall, N. and James, E. (1992). *Efficiency and equity in social spending: How and why governments misbehave.* In J. van der Gaag (Ed.), Including the Poor. Washington, D.C.: World Bank.
12. Brown, J.D. (2001). *Using Surveys in Language Programs.* Cambridge: Cambridge University Press,
13. Bano, M. (2008). *Public Private Partnerships (PPPs) as 'anchor' of educational reforms: lessons from Pakistan*. ''Paper commissioned for the EFA Global Monitoring Report 2009, *Overcoming Inequality why governance matters*. http://www.efareport@unesco.org.
14. Beegle, C. and Newhouse, D. (2005). *The effect of school type on academic achievement:* evidence from Indonesia, Policy Research Working Papers, World Bank.
15. Baeber, M. (2011).*Education Reform In Pakistan: This Time It's Going To Be Different.* Retrieved July 8, 2011, from www.pakistan educationtaskforce.com/erp.pdf
16. Bibby, J. and Peil, M. (1974). Secondary Education in Ghana: Private Enterprise and Social Selection *Sociology of Education*, Vol. 47, No. 3 (Summer, 1974).
17. Beavis, Adrian (2004). *Why parents choose public or private schools*: Research Developments, Vol. 12, Art. 3.
18. Bennett, H.E. (1960). School Efficiency, Boston Gin Company.
19. Burki, S.J. (1986). *Pakistan: A Nation in the Making.* Karachi: Oxford University Press.
20. Bryk, A.S., Lee, V.E. and Holland, P.B. (1993). Catholic Schools and the Common Good. Cambridge, MA: Harvard University Press.
21. Boyer, E. (1992).*School choice*. Princeton, NJ: Carnegie Foundation.
22. Commission on National Education. (1959)
23. Christian, Morisson (2002). *Education and Health Expenditure, and Development: The Cases of Indonesia and Peru*. *Development Centre Studies*. (OECD Report 2002).
24. Coleman, J. and Hoffer, T. (1987).*Public and private high schools*: The impact of communities. New York: Basic Books.
25. Dronkers, J. and Robert, P. (2003). The Effectiveness of Public and Private Schools from a Comparative Perspective, *Working Paper SPS No. 2003/13*, Department of Political and Social Sciences, European University Institute, Florence, SAM DOMINICO.

26. Das, J., Pandey, P. and Zajonc, T. (2006). Learning levels and gaps in Pakistan (Policy Research Working Paper No. 4067). Washington DC: World Bank.
27. Davis, Ava. M. (2011). Why Do Parents Choose to Send Their Children To Private Schools? (2011). *Electronic Theses & Dissertations*. Paper 382.
28. Deani, A. et al. (2007). Who Chooses Them and Why?, Studies in Education policy, Ontario's Private Schools, The Fraser Institute, Vancouver, B.C, V6J 3G7 Canada.
29. David, E. Sahn, and Stephen D. Younger. (2000). Expenditure Incidence in Africa: Microeconomic Evidence. *Fiscal Studies* 21:3.
30. Demery, Lionel, and Mathew Verghis (1994). *The Incidence of Education Expenditure in Kenya*. World Bank: Education and Social Policy Department.
31. Draxler, Alexandra. (2008). *"New Partnerships for EFA: Building on Experience"* http://www.weforum.org/pdf/GEI/Partnerships.pdf
32. ESCAP (2003).The Role of Public Expenditure in the Provision of Education and Health. Economic and Social Survey of Asia and the Pacific (ESCAP).
33. Ellen, B. Goldringa and Kristie, J.R. Phillips. (2008). Parent preferences and parent choices: the public–private decision about school choice. *Journal of Education Policy Volume 23. Pages 209-230.*
34. Farida and Madiha (2000). A Comparative Study of Administrators' Role in Public and Private Secondary Schools. Unpublished Master thesis, Institute of Education and Research, University of Punjab, Lahore.
35. Flug, K., A. Spilimbergo., and E. Wachtenheim. (1998). Investing in Education: Do Economic Volatility and Credit Constraints Matter? *Journal of Development Economics* 55.
36. Global Monitoring Report. (2005). *Education for All the Quality Imperative*. UNESCO.
    Gupta, S., V. Marijn, and R.T. Erwin. (2002). The Effectiveness of Government Spending on Education and Health Care in Developing and Transition Economies. *European Journal of Political Economy* 18.
37. Gazdar, H. (1999). Policy failure, political constraints and political resources: basic education in Pakistan. *Asia Research Centre Working Paper 5*.
38. Gloman, G., and Ravikumar, B. (1992). Public versus Private Investment in Human Capital: Endogenous Growth and Income Inequality, *The Journal of Political Economy*, Vol. 100, No. 4 (Aug., 1992).
39. Gul, S. and. Mehrunnisa (2008). *Temporal Expansion of Non-Government Schools in NWFP: A Case Study of Peshawar*, (unpublished MSc research report), University of Peshawar, Pakistan.
40. Gul, S. and Mehrunnisa (2008). Temporal Expansion of Non-Government Schools in NWFP: A Case Study of Peshawar, (unpublished MSc research report), University of Peshawar, Pakistan.
41. Harlech-jones, B.M., Sajid, S. and Rehman, S. (2005). Private schooling in the Northern Areas in Pakistan: A decade of rapid expansion. *International Journal of Educational Development*, 25(5), 557-568.
42. Hoxby, C.M. (2002). Would School Choice Change the Teaching Profession? *The Journal of Human Resources*, 37, (4) (Autumn, 2002).

43. Hamilton, L. and Guin, K. (2006). Understanding how families choose schools. In J. Betts and T. Loveless (eds). *Getting Choice Right*. Washington, DC. The Brookings Institute.
44. Hannaway, J. (1991). The organizational and management of public and catholic schools: Looking inside the "black box". *International Journal of Educational Research*, 15(5), 463-481.
45. Hanushek, E.A. (1990). Issues in the public-private split of educational provision. Unpublished manuscript, University of Rochester, New York.
46. Ikoya, P.O. and Ikoya, O.V. (2009). Determinants of Rural-Urban Disparity in Private Sector Participation in the Provision and Management of Education in Nigeria *J Soc. Sci.*, 19(3), 225-231.
47. Irum, N., Hussain, Z., Anwar, S., Hussain, I. and Akram, W. (2008). Determinants of child school choice in Punjab: Policy implications. *European Journal of Scientific Research*, 223(2), 295-293.
48. ISCA Research Report (2008).*Factors Affecting School Choice*: Independent Schools Councils of Australia.
49. Iqbal, M.Z. (1996). Teachers Training: The Islamic perspective. Islamabad: *Institute of Policy Studies*. P.9.
50. Iqbal, Z, N. (2006). *A comparative study of English Medium Schools and Urdu Medium Schools of Sialkot City*, Unpublished thesis of master of Philosophy (Education) Department of Teacher Education, Faculty of Education: Allama Iqbal Open University.
51. Jimenez, E. and Lockheed, M.E. (1995). *Public and Private Secondary Education* in *Developing Countries. Comparative Study*, Washington D.C: World Bank.
52. Jemenez, E. and Tan, J.P. (1987). Decentralized and private education: The case of Pakistan, Comparative Education, Volume 23 No. 2 173-190.
53. Judith, A.V., Sherwood, J.J., Warner, D. and Clark, D. (2007). Comparing hand washing to hand sanitizers in reducing elementary school students' absenteeism. *Pediatric Nursing*, 33(4), 368-370.
54. James, E. (1991). Public policies toward private education. *International Journal of Educational Research*, 15 359-376.
55. James P., Kelly, J.D. and Benjamin, Scafidi (2013). MORE THAN SCORES An Analysis of Why and How Parents Choose Private Schools. *The Friedman Foundation for Educational Choice.*
56. James, E. and Birdsall, N. (1991). Public versus private provision of social services: Is there an efficiency-equity trade-off? In K. McCarthy (Ed.), *The Nonprofit Sector in the Global Community* (pp.51-69). New York: Jossey Bass.
57. Jimenez, E., Lockheed, M. and Wattanawaha, N. (1988). The relative efficiency of public and private schools: The case of Thailand. *The World Bank Economic Review*, 2(2), 139-164.
58. Khwaja, et al. (2005). *Private Schooling: Limits and Possibilities*. Retrieved July 6, 2011 from http://www.hks.harward.edu/fs/akhwaja/papers/PrivateSchool_Final_Nov5.pdf
59. Khalid, T. (1975). Education: An Introduction to Educational Philosophy and History. Karachi: National Book Foundation.
60. Kneller, George F. ed. (1963). Foundations of Education, New York, John Wiley and sons, Inc.

61. Kardar, S. (1995). Demand for education among Low and Middle Income Households in Karachi and Lahore. Memo the World Bank.
62. Khan, G.A., Azhar, M. and Shah, S.A. (2011). Causes of primary school dropout among rural girls in Pakistan. Working paper series No. 19. Islamabad.
63. Klonsky, M. (1995). Small Schools: The Numbers Tell a Story. A Review of the Research and Current Experiences. Chicago: Illinois University. (ERIC ED386517).
64. Kelley, J. and Evans, M. (2004).Choice between government, Catholic and independent schools-culture and community rather than class. *Australian Social Monitor* 7(2), 31-42.
65. Lai, F., Sadoulet, E. and Janvry A.D. (2009). The adverse effects of parents' school selection errors on academic achievement: Evidence from the Beijing open enrollment program *Economics of Education Review* 28, 485-496.
66. Lee, V.E. and Smith, J.B. (1997). High School Size: Which Works Best, and for Whom? *Educational Evaluation and Policy Analysis*, 19(3), 205-227.
67. Lodhi, R.A. (2014). Factors Affecting in Selection of School for Upcoming Generation: A Case Study of Karachi Urban Areas, Pakistan. *Research Journal of Educational Sciences*, ISSN 2321-0508 Vol. 2(4), 1-7.
68. Lubienski, C. and Sarah Theule Lubienski. (2006). *Charter, Private, Public Schools and Academic Achievement: New Evidence from NAEP Mathematics Data*. National Center for the Study of Privatization in Education, Teachers College, Columbia University, 525 West 120th Street, Box 181 New York.
69. Lloyd, C.B., Mete, C. and Sathar, Z.A. (2005).The effect of gender differences in primary school access, type and quality on the decision to enroll in rural Pakistan. Economic Development and Cultural Change, 53(3), 685-710.
70. Liaqat, S. (2009). Comparison of Quality of teaching between Government and Private schools. Unpublished Thesis of Master in Education. Division of Education, University of Education, Lahore.
71. Mastan, A. (2002-2003). Education of Private and Secondary Schools and District Swat, Ijaz Printers Peshawar.
72. Muralidharan, K. (2006). Public-private partnerships for quality education in India. Seminar, 565. Retrieved from http://www.india-seminar.com/2006/565/565_ karthic_muralidharan.htm
73. Mustaqeem, S. (2008). A comparative study of Staff Morale of Public and Private school in Lahore. Unpublished Thesis of Master in Education. Division of Education, University of Education, Lahore.
74. Multiple Indicator Cluster Survey (MICS), Punjab. (2011). Bureau of Statistics, Punjab.
75. Olaniyan, D.A. and Okemakinde, T. (2008). Human Capital Theory: Implications for Educational Development. *Pakistan Journal of Social Sciences*, 5(5) 479-483.
76. OECD (2009). Education at a Glance. Paris.
77. OECD (1990). *Education in OECD Countries. 1987-88: A Compendium of Statistical Information.* OECD: Paris.
78. Pakistan Education Conference. (1947).
79. Pakistan Education Statistics. (2004-2005). Islamabad: National Education Management Information System, Ministry of Education.

80. Planning Commission (2005). Mid-Term Development Framework 2005-10, Government of Pakistan, Islamabad.
81. Pakistan, Government of (2006). *Economic Survey of Pakistan 2005-06*. Islamabad: Ministry of Finance.
82. Punjab Education Foundation. (2008). Punjab Education Foundation: Briefing Document supplied by Foundation's Managing Director. Information also accessible on the website: http://www.pef.edu.pk/PEF-EVS-Scheme.htm
83. Patrinos, H.A. (2009). *Private Education Provision and Public Finance*: The Netherlands, World Bank Prepared for School Choice and School Improvement: Research in State, District and Community Contexts Vanderbilt University.
84. Quiggin, John. and Sheil, Christopher. (2002). «PPPs: Beneath the Rhetoric». http://evatt.org.au/news/23.html
85. Roth, G. (1987). *Private Provision of Public Services in Developing Countries*. New York: Oxford University Press.
86. Rasmus, H., S. Kenneth and T. Finn. (2001). Public Spending and Poverty in Mozambique. UNU/WIDER Project on New Fiscal Policies for Growth and Poverty Reduction 14 June.
87. Roberts, John. (2003). Poverty Reduction Outcomes in Education and Health: Public Expenditure and Aid. Center for Aid and Public expenditure, Overseas Development Institute, London, UK. *(Working Paper No. 210*)
88. Sabir, Muhammad (2003). Gender and Public Spending on Education in Pakistan: A Case Study of Disaggregated Benefit Incidence. Paper No. 48 Presented at *Conference of Social Policy Development Centre* (SPDC).
89. Saxema, Swaroop, N.R. (1993). *Philosophical and Sociological foundation of Education*, Meerut, R. Lall Book Depot.
90. Schneider, B., Schiller, K., & Coleman, J. (1996). Public school choice: Some evidence from the national education longitudinal study of 1988. *Education Evaluation and Policy Analysis*, 18, 19-29.
91. Shami, P.A. and Hussain, K.S. (2005). Professional Requirements of Education Managers under Devolution Plan. Islamabad: *Academy of Educational Planning and Management, Ministry of Education.*
92. Srivastava, P. (2007). Neither voice nor loyalty: School choice and the low-fee private sector in India (Occasional paper No. 134, Research Publications Series), New York, NY: National Centre for the Study of Privatization in Education.
93. Schofield, J.W. (2001). Maximizing the Benefits of Student Diversity: Lessons from School Desegregation Research. In G. Orfield (Ed.), *Diversity Challenged: Evidence on the Impact of Affirmative Action*. Cambridge, MA: Harvard Education Publishing Group, 2001. p99-109. See UD 034 365.
94. SPDC (2004). Social Development in Pakistan 2004: *Combating Poverty*: Is Growth Sufficient? Annual Report 2004, Karachi.
95. Sheil, (2002). Christopher. «The trouble with PPPs: an un-holy alliance». http://evatt.labor.net.au/publications/papers/51.html
96. The World Bank (1986). *Financing education in developing countries: An exploration of policy options.* Washington, D.C.: The World Bank.

97. Nechyba, T. (1999).The Impact of Family and Community Resources on Student Outcomes. *An Assessment of the International Literature with Implications for New Zealand*. Stanford University
98. UNESCO (1998). *The Costs and Financing of Education, Education in Developing Asia*, UNESCO.
99. UNESCO (2011). *Policy analysis of education in Punjab Province*. Islamabad.
100. Wilson, S.F. (1992). *Reinventing the schools: A radical plan for Boston*. Boston, MA: Pioneer Institute.
101. World Economic Forum (WEF). (2005). "Building on the Monterrey Consensus: *The growing Role of Public-Private Partnerships in Mobilizing Resources for Development*". http://www.weforum.org/pdf/un_final_report.pdf
102. Witte, J.F. (1996). Who benefits from the Milwaukee Choice Program? In B. Fuller, R. Elmore, & G. Orfield (Eds.), *Who chooses? Who loses? Culture, institutions, and the unequal effects of school choice* (pp. 25-49). NY: Teachers College Press.
103. Wells, A.S. and Crain, R.L. (1994).Perpetuation Theory and the Long-Term Effects of School Desegregation. *Review of Educational Research, 64: 531–555.*\
104. Younger, Stephen D. (1999). The Relative Progressivity of Social Services in Ecuador. *Public Finance Review*, 13(2).
105. Zaki, W.M. (1968). *Educational development in Pakistan.* West Pak publishing Co. Ltd, Islamabad.

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CAPTURING THE EFFECT OF SUPERVISORY SERVICES ON STUDENTS' ACADEMIC PERFORMANCE

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ABSTRACT

Using two research questionnaires, one for 150 randomly selected teachers and other one for all 8 supervisors, this research reveals that supervision directly and indirectly brings improvements in students' academic and non-academic performances. Supervision helps teachers improve their regularity and punctuality. In addition to the visit of the schools, supervisors talks with teachers about their problems and try to give suggestions to resolve them. After evaluating teachers 'tasks, supervisors give them their feedback. Supervision also focuses on the basic necessities of the schools including especially electrification, boundary wall, water supply system and group latrine, etc.

Supervisors on the other hand are not satisfied with the facilities provided for their supervision. Supervisors on average remained neutral on the question of their authorities; they neither agreed nor disagreed with the status of their authorities. Among the problems supervisors faced included: supervisors are over-burdened for proper supervision; the lack of resources hinders their supervision activities; and their numbers of supervisory visits are too much.

KEYWORDS

Supervision, supervision-contribution, contribution-towards-teaching, towards-school-physical facilities, towards-students' academics

INTRODUCTION

Every activity of human life needs a proper system. The same is true for formal education, including primary education. Supervision of formal education is a part of the total system. Supervision is the combination of two words 'Super' something big and deep and 'vision' means to see. It means to see something with deep look over it. Using proper words, Igwe (2001) defines "supervise means to direct, oversee, guide or to make sure that expected standards are met". Noor (2008) adds supervision also means to monitor and improve the quality of ongoing educational programs.

At primary level, there is a supervision system for government primary schools. There are many officers and officials at different levels to supervise the primary schools. Assistant District officer (ADO) supervises and controls the function of schools situated under his or her control. District Education Officer (DEO) and Sub-Divisional Education Officer (SDEO) supervise schools located in a sub division.

District Education Officer (DEO) is responsible for ensuring various visits to each and every school of the district but it seems a remote possibility due to lack of financial and human resources.

According to Charies et al. (2012), supervision has great impact over students' achievements as reflected in their grades. Malanga, Wadosang and Kurebwa (2012) explain that supervision has multilateral role in improving teaching learning process. However, some research reviews reveal that supervision at primary level has not been proved as fruitful as it should be. Because most of the supervisors are not well trained professionally, that is why they fail to raise the interest of teachers, students and head teachers. There is thus a need of carrying out a detailed study of evaluating the effect of supervisory services on students' academic performance at primary level.

Research theme and hypothesis

This study aims at evaluate the effect of supervisory services on students' academic performance at primary level; more specifically, the following hypothesis would be tested.

Hypothesis

Supervisory services positively affect students' academic performance.

METHODOLOGY

Population, sampling procedure and sample size

Since the aim of this piece of research was to analyze the effect of supervisory services on academic achievements and performance of the students and required data on effect of supervision on teachers and students were collected from supervisors and teachers of government primary schools, the population for this research therefore theoretically consists of all supervisors, teachers and students of all government primary schools all over Pakistan.

However, due to certain limitations on part of this researcher, district of Charsadda is chosen as research cite for this research. District Charsadda has 423 Government primary schools in all. A total of 51 schools and 150 teachers from these schools of this district were taken to include in the sample for this research. An area-wise breakup of the number of schools and number of respondent- teachers is provided in Table 1.

Table 1
Detail of research cite and sample size

Area	Number of Schools
Shaker Dandh	18
Charsadda Khas	17
Utmanzai	16
Total	51

Area	Number of Teachers
Shaker Dandh	**50**
Charsadda Khas	**50**
Utmanzai	**50**
Total	**150**

As far as supervisors are concerned, they were 8 in all and all 8 supervisors were included in the sample for collection of data from supervisors' side.

Research Instrument

Two research questionnaires, one for teachers and other one for supervisors, have been constructed and used.

Questionnaire for teachers:

This research assumed that improvements in students' academic and non-academic performances (ISAP and ISNAP) occurred due to many factors, including mainly supervisors' supervision which generates three types of effects, namely 'Contribution of supervision towards teachers' (SCT), 'Contribution of supervision towards students' (SCS) and 'Contribution of supervision towards physical facilities' (SCF), the research instrument therefore is consisted of various parts having relevant questions on these related parts. Details of the research instrument or questionnaire are provided as follows.

Improvement in students' academic performance (ISAP)

Sub-scale for 'Improvement in students' academic performance' (ISAP) consists of five items, namely:

Showed interest in learning (ISAP1)
Showed active participation in asking question (ISAP2)
Improvement exhibited in their routine test score (ISAP3)
Enjoyed group activities fully (ISAP4)
No changed observed (ISAP5)

Improvement in students' non-academic performance (ISNAP)

Sub-scale for 'Improvement in students' non-academic performance (ISAP) consists of four items, namely:

Exhibit positive behavior toward teacher (ISNAP1)
Exhibit sharing attitude in the class (ISNAP2)
Improved regularity in their daily attendance (ISNAP3)
Took full participation in co-curricular activities (ISNAP4)

Contribution of supervision towards teachers (SCT)

Sub-scale for 'Contribution of supervision towards teachers' (SCT) consists of nine items, namely:

Supervision is mostly suggestive (SCT1)
Supervision improves the regularity of the staff (SCT2)
Supervision is mostly helpful in improving the performance of school (SCT3)

Supervisors solve the problem faced by the teachers (SCT4)
Teachers get proper feedback from the supervisors (SCT5)
Number of visits of the supervisors in each academic year is satisfactory (SCT6)
Supervisors give positive remarks in the log book as a reward (SCT7)
Teachers follow the scheme of work properly as provided by D.E.O office (SCT8)
Supervisors give negative remarks for worse performance of the teachers (SCT9)

Contribution of supervision towards teachers (SCS)

Sub-scale for 'Contribution of supervision towards teachers' (SCS) consists of three items, namely:

The supervisors give written work to test the student's knowledge (SCS1)
The supervisors just test the knowledge of the students (SCS2)
The supervisors check the student's homework/class work note books (SCS3)

Contribution of supervision towards physical facilities (SCF)

Sub-scale for 'Contribution of supervision towards physical facilities' (SCF)consists of three items, namely:

Supervisors check the physical facilities provided to the school (SCF1)
Supervisors make recommendation for needed facilities (SCF2)
Recommended facilities are provided by the concern office (SCF3)

Though the scale/questionnaire was originally constructed in English (Annexure – I), it was also translated to Urdu so that the respondent-teachers could easily understand what was asked and answer it correctly. This researcher herself visited each of the selected schools, delivered questionnaires and then collected these after filled these by the teachers.

Questionnaire for supervisors:

The questionnaire relates to supervisors consists of three major parts including 'facilities provided to supervisors' (FPS), 'Authority of supervisor' (AOS) and 'Problems faced by supervisors' (PSF). The details of each of these parts are provided, as follows.

Facilities provided to supervisors (FPS)

The sub-scale for 'Facilities provided to supervisors' (FPS) consists of three items; these items are:

Supervisors are provided with government vehicle (FPS1)
Available resources are sufficient for effective supervision in your area (FPS2)
Assistants are available to help supervisors in the process of supervision (FPS3)

Authority of supervisor (AOS)

The sub-scale for 'Authority of supervisor' (AOS) consists of four items; the details of these items include:

Supervisors have sufficient authorities to exercise (AOS1)
Existing system of reward and punishment by supervisees is reasonable (AOS2)
School record is considered to be important during supervision (AOS3)
There should be some reasonable action against inefficient teachers (AOS4)

Problems faced by supervisors (PFS)

The sub-scale for 'Problems faced by supervisors' (PFS) consists of three items; these three items are:

Supervisors are over-burdened for proper supervision (PFS1)
Lack of resources hinders the supervisors' activities (PFS2)
The numbers of supervisory visits are too much (PFS3)

This scale/questionnaire was used as a self-administered questionnaire. The researcher herself visited each of the selected supervisors, delivered questionnaire and then collected these after filled by the supervisors.

Statistical tools and analysis

Several statistical tools have been used for analyzing data, collected from the respondents, using the two questionnaires/scales already introduced in the preceding section. These statistical tools include frequency analysis and descriptive statistics, one-sample t-test and regression analysis.

Frequency analysis and descriptive statistics:

Frequency analysis has been carried out for counting out the number of yes or no responses, like supervisory wing suggestion, periodic arrangements for in service teacher training and teacher appreciation for good performance, etc.

Descriptive statistics tool was used to measure average or mean value of various variables, along with its standard deviations and minimum-maximum ranges. These statistics have been developed for the variables like measurement of the improvement of students' academic and non-academic performance (ISAP, ISNAP), supervision contribution towards teachers (SCT), towards students (SCS) and contribution of supervision towards physical facilities as well as other such variables.

One sample t-test:

One sample t-test has been used to evaluate the statistical significance of various variables of interest already discussed, such as measurement of the improvement of students' academic and non-academic performance (ISAP, ISNAP), supervision contribution towards teachers (SCT), towards students (SCS) and contribution of supervision towards physical facilities as well as other such variables.

Regression analysis:

The two types of improvements in student's academic (ISAP) and non-academic performances (ISNAP) are further converted in to one measure of 'total improvement in student performance' (TISP), by taking mean values of improvements in students' academic performance (ISAP) and improvements in students' non-academic performance (ISNAP). The 'total improvement in student performance' (TISP) is then assumed to be affected by 'supervision contribution towards teachers' (SCT), 'supervision contribution towards students' (SCS) and 'supervision contribution towards school's physical facilities' (SCP), through direct and indirect effects, as depicted in the following regression model.

$$SCS = f(SCT, e) \quad (1a)$$
$$= \beta_0 + \beta_1 SCT + e \quad (1b)$$

$$TISP = f(SCS_{predicted}, SCF, e) \quad (2a)$$
$$= \beta_0 + \beta_1 SCS_{predicted} + \beta_2 SCF + e \quad (2b)$$

where

SCS = supervision contribution towards students
SCT =supervision contribution towards teachers
SCF = supervision contribution towards physical facilities
TISP = total improvement in student performance
$SCS_{predicted}$ = SCS predicted on the basis of equation 1 (a and b)

The above regression model (1 and 2) assumes that SCT positively affects SCS and then such predicted value of SCS along with SCF positively affects TISP.

RESULTS AND DISCUSSION

Measurement of variables and their evaluation

This research assumes that improvements in students' academic and non-academic performances (ISAP and ISNAP) occur due to many factors, including supervisors' supervision which generates three types of effects, namely 'Contribution of supervision towards teachers' (CST),contribution of supervision towards teachers (SCT), contribution of supervision towards students (SCS) and contribution of supervision towards physical facilities (SCF) in schools. These three types of contribution (CST, SCT and SCF) further affect students' academic and non-academic performance (ISAP and ISNAP). Hence, variables ISAP and ISNAP are treated as dependent and variables CST, SCT and SCF as independent variables for this study.

This section is devoted to generate data on the stated two dependent and three independent variables based on the respondents' responses collected through Likert-scale type questionnaire. This section also looks in to analyze whether so the generated variables turn out to be statistically significant, using the One-sample t-test.

Measurement of 'improvements in students' academic and non-academic performance

1. Assuming that supervisors' visit bring improvements in students' academic and non-academic performance, certain questions were asked from their respective teachers. To measure the improvements in students' academic performance (ISAP), the questionnaire contains five questions/items; these questions/items are:

Showed interest in learning (ISAP1)
Showed active participation in asking question (ISAP2)
Improvement exhibited in their routine test score (ISAP3)
Enjoyed group activities fully (ISAP4)
No changed observed (ISAP5)

In the same way, the following four questions have been used to measure improvements in students' non-academic performance (ISNAP).

Exhibit positive behavior toward teacher (ISNAP1)

Exhibit sharing attitude in the class (ISNAP2)
Improved regularity in their daily attendance (ISNAP3)
Took full participation in co-curricular activities (ISNAP4)

We used the data on responses of the teachers, obtained through the above stated questions/items, took their means and generated data on variables ISAP and ISNAP.
The descriptive statistics of these two variables are estimated and provided in the following table.

Table 1
Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
ISAP	150	2.20	4.80	3.4613	.46340
ISNAP	150	1.75	5.00	3.7817	.70252

The variable ISAP, which measures the improvement of students' academic performance, estimates at the mean value of 3.4613, with a minimum-maximum range of 2.20 to 4.80. The mean value of 3.4613 is higher than the mid-point = 3.00 (on Likert-scale providing options 1 to 5), which indicates that the respondents/teachers, on average, have agreed that students have improved their academic performance.

As far as the improvement in the students' non-academic performance (ISNAP) is concerned, the data was generated on the basis of four questions. Its mean has been estimated at 3.7817, with a minimum-maximum range of 1.75 to 5.00. The mean value of ISNAP=3.7817 is higher than the mid-point=3.00, hence it is inferred that teachers agree that students have improved their non-academic performance, also.

In both ISAP and ISNAP cases, the mean values have been found higher than mid-point =3.00. This fact shows that respondents have agreed with the questions. To further check this point using statistics, we use One-simple t test which is designed to check whether the means of ISAP and ISNAP statistically significantly differ from the midpoint. Using One-sample t test provides the following results:

Table 2(a)
One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
ISAP	150	3.4613	.46340	.03784
ISNAP	150	3.7817	.70252	.05736

Table 2(b)
One-Sample Test

	Test Value = 3					
	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
ISAP	12.193	149	.000	.46133	.3866	.5361
ISNAP	13.627	149	.000	.78167	.6683	.8950

The results provided in the above tables indicate that mean values of ISAP and ISNAP are 3.4613 and 3.7817, respectively and these differ from the midpoint by 0.46133 and 0.78167. Results also suggest that the stated differences of ISAP as well as ISNAP from the mid-points are statistically significant at significance level $\alpha < 0.01$.

Contribution of Supervision Towards Teachers

To measure the contribution of variable 'supervision' towards teachers' improvements (SCT), questionnaire contains nine questions/items; these questions are:

Supervision is mostly suggestive (SCT1)
Supervision improves the regularity of the staff (SCT2)
Supervision is mostly helpful in improving the performance of school (SCT3)
Supervisors solve the problem faced by the teachers (SCT4)
Teachers get proper feedback from the supervisors (SCT5)
Number of visits of the supervisors in each academic year is satisfactory (SCT6)
Supervisors give positive remarks in the log book as a reward (SCT7)
Teachers follow the scheme of work properly as provided by D.E.O office (SCT8)
Supervisors give negative remarks for worse performance of the teachers (SCT9)

We used the responses of teachers obtained through the above stated question, took their means and generated data on SCT. The descriptive statistics of this variable have been estimated and provided in the following table.

Table 3
Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
SCT	150	1.89	5.00	3.8793	.53232
Valid N (list wise)	150				

The variable SCT, which measures the supervisor contribution towards teachers, estimates at mean value = 3.8793 with a minimum-maximum range of 1.89 to 5.00. The mean value of 3.8793 is higher than the mid-point=3.00, which indicates that the respondents have agreed that the supervision has positive impact. Carrying out one-sample t-test, we get:

Table 4(a)

One-Sample Statistics				
	N	**Mean**	**Std. Deviation**	**Std. Error Mean**
SCT	150	3.8793	.53232	.04346

Table 4(b)
One-Sample Test

	Test Value = 3					
	T	**Df**	**Sig. (2-tailed)**	**Mean Difference**	**95% Confidence Interval of the Difference**	
					Lower	**Upper**
SCT	20.230	149	.000	.87926	.7934	.9651

The above tables indicate that mean value of SCT is 3.4613 and this differs from the mid-point by 0.87926; this difference is statistically significance at $\alpha < 0.01$. This positive impact happens because of supervisors' supervision helps teachers improve their regularity and punctuality. In addition to the visit of the schools, supervisors talks with teachers about their problems and try to give suggestions to resolve those problems. After evaluating teachers 'tasks, supervisors give their feedback verbally as well as through record in the school log books.

Contribution of Supervision towards Students

To measure the contribution of supervision towards students (SCS).Our questionnaire (Annexure iii) contains three questions/items; these questions are:

The supervisors give written work to test the student's knowledge (SCS1)

The supervisors just test the knowledge of the students (SCS2)

The supervisors check the student's homework/class work note books (SCS3)

We used the responses of teachers obtained through the above stated question, took their means and generated data on SCS. The descriptive statistics of this variable have been estimated and provided in the following table.

Table 4.5
Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
SCS	150	1.00	5.00	3.7800	.80715
Valid N (list wise)	150				

The variable SCS, which measures the supervisor contribution towards students, estimates at mean value = 3.7800, with a minimum-maximum range of 1.00 to 5.00. The mean value of 3.7800 is higher than the mid-point =3.00, which indicates that the respondents, teachers in this case, have agreed supervisors' supervision has improved students' contribution.

Carrying out One-sample t-test, we get:

Table 6(a)
One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
SCS	150	3.7800	.80715	.06590

Table 6(b)
One-Sample Test

	Test Value = 3					
	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
SCS	11.835	149	.000	.78000	.6498	.9102

The above tables indicate that mean value of SCS is 3.7800 and this differs from the mid-point by 0.78000 and this difference is statistically significance at $\alpha < 0.01$.

Contribution of supervision towards Physical facilities

To measure the contribution of supervision towards students (SCF).Our questionnaire (Annexure IV) contains three questions/items; these questions are:

Supervisors check the physical facilities provided to the school (SCF1)

Supervisors make recommendation for needed facilities (SCF2)

Recommended facilities are provided by the concern office (SCF3)

We used the responses of teachers obtained through the above stated question, took their means and generated data on SCF. The descriptive statistics of this variable have been estimated and provided in the following table.

Table 7
Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
SCF	150	1.00	5.00	3.7800	.80715
Valid N (list wise)	150				

The variable SCF, which measures the supervisor's contribution towards physical facilities, estimates at the mean value = 3.7800, with a minimum-maximum range of 1.00 to 5.00. The mean value of 3.7800 is higher than the mid-point =3.00, which indicates that supervisors' supervision also focuses on the basic necessities of the schools including especially electrification, boundary wall, water supply system and group latrine. During the visits basics facilities of the schools are also properly addressed. Carrying out One sample t-test, we get:

Table 8(a)
One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
SCF	150	3.3756	.77459	.06325

Table 8(b)
One-Sample Test

	Test Value = 0					
	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
SCF	53.372	149	.000	3.37556	3.2506	3.5005

The above tables indicate that mean value of SCF is 3.3756 and this differs from the midpoint by 3.37556 and this difference is statistically significance at $\alpha < 0.01$.

Regression analysis

Further analyzing relationship between students' improvement and supervision

The early preceding sections uses descriptive statistics and one-sample t-test and finds out that mean-values of academic and non-academic performances (ISAP and ISNAP) of the students happen to be statistically significantly higher than the mid-point, indicating the fact that teachers on average agree that students made improvements in both academic and non-academic affairs. In the same way, using the descriptive statistics and one-sample t-test, later sections reveal that teachers on average believe that supervisors' supervision has generated positive and statistically significant contribution towards teachers (SCT), towards students (SCS) and towards physical facilities (SCF) in schools.

This section, in addition, concentrates on analyzing a direct link between students' performance and its assumed causing factors, namely supervision contribution towards teachers (SCT), supervision contribution towards students (SCS) and supervision contribution towards school's physical facilities (SCF).

Let's first combine the two types of improvements in student's academic and non-academic performances in to one measure: total improvement in student performance (TISP).

Taking mean values of improvements in students' academic performance (ISAP) and improvements in students' non-academic performance (ISNAP), we get total improvement in students' performance (TISP). The descriptive statistics of this measure (TISP) is developed and One-sample t-test is carried out to analyze the significance level of the variable. Results are provided, as follows.

Table 9(a)
One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Mean of ISAP and ISNAP (TISP)	150	3.6215	.55253	.04511

Table 9(b)
One-Sample Test

	Test Value = 3					
	T	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Mean of ISAP and ISNAP (TISP)	13.776	149	.000	.62150	.5324	.7106

The above tables reflect that measure TISP averages at 3.6215 and is higher from mid-point = 3 by 0.6215. This positive difference 0.6215 is statistically significant at t = 13.776 (p-value < 0.01).

As far as measurement of dependency of this 'total improvement in student performance' (TISP) on 'supervision contribution towards teachers' (SCT), 'supervision

contribution towards students' (SCS) and 'supervision contribution towards school's physical facilities' (SCP) is concerned, it is presumed that variable 'supervision contribution towards teachers' (SCT) positively affects variable 'supervision contribution towards students' (SCS), which along with another variable 'supervision contribution towards school's physical facilities' (SCF) further affects 'total improvement in student performance' (TISP). So, regression equations adopt the following formulations.

$$SCS = f(SCT, e) = \beta_0 + \beta_1 SCT + e \quad (1)$$

$$TISP = f(SCS_{predicted}, SCF, e) = \beta_0 + \beta_1 SCS_{predicted} + \beta_2 SCF + e \quad (2)$$

Regressing SCS over SCT, using equation 4.1, yields following results.

Table 10(a)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.453	.205	.200	.72192

Table 10(b)
ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	19.941	1	19.941	38.261	.000
	Residual	77.133	148	.521		
	Total	97.073	149			

Table 10(c)
Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.114	.435		2.561	.011
	SCT	.687	.111	.453	6.186	.000

The results provided in the above tables are reproduced in the form of model 1, as follows.

$$SCS = \beta_0 + \beta_1 SCT + e$$
$$= 1.114 + 0.687SCT$$

(0.435) (0.111) (Standard error)
(2.561) (6.186) (t-statistic)
(0.110) (0.000) (Significant level/p-value)

$$F = 38.261 \text{ (p-value = 000)} \quad R^2 = 0.205 R^2_{adjusted} = 0.200 \quad (3)$$

The F-statistic = 38.261 is statistically significant at p-value < 0.01, suggesting model 1 as a whole is statistically significant. The t-statistic of explanatory variable SCT happens to be 6.186 and is statistically significant at p-value < 0.01, suggesting that

explanatory variable 'supervision contribution towards teachers' (SCT) significantly contributes toward dependent variable 'supervision contribution towards students (SCS).

In accordance with model 2, regressing TISP over predicted variable SCS (predicted in model 1) and SCF yields the following results.

Table 11(a)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.606[a]	.367	.358	.44256

Table 11(b)
ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	16.697	2	8.348	42.625	.000
	Residual	28.791	147	.196		
	Total	45.488	149			

Table 11(c)
Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	.384	.388		.992	.323
	Unstandardized Predicted Value SCS	.764	.126	.506	6.077	.000
	SCF	.103	.059	.144	1.734	.085

The results provided in the above tables are reproduced in the form of model 4.2, as follows.

$$TISP = \beta_0 + \beta_1 SCS_{predicted} + \beta_2 SCP + e$$
$$= 0.384 + 0.764 SCS_{predicted} + 0.103 SCF$$

(0.388) (0.126) (0.059) (Standard error)
(0.992) (6.077) (1.737) (t-statistic)
(0.323) (0.000) (0.085) (Significance level/p-value)

$F = 42.625$ (p-value = 000) $R^2 = 0.367 R^2_{adjusted} = 0.358$ (4)

The estimated model 4.2's F-statistic = 42.625 is statistically significant at p-value < 0.01, suggesting model 4.2 as a whole is statistically significant. The t-statistic of determinant $SCS_{predicted}$ happens to be 6.077 and is statistically significant at p-value < 0.01, suggesting that the predicted value of the said explanatory variable 'supervision contribution towards students' ($SCS_{predicted}$) significantly contributes toward dependent variable 'total improvement in student performance' (TISP). The t-statistic of the second explanatory variable 'supervision contribution towards physical facilities'

(SCF) estimates at 1.737 and is statistically significant at p-value < 0.10, suggesting that the said variable also contributes in determination of dependent variable TISP.

Analyzing supervisors' facilities and problems

Supervisor's problems:

Using a separate questionnaire, supervisors were asked to comment on the facilities they were provided and problems they had faced. Such information on facilities and problems is categorized in the following four groups.

Facilities provided to supervisors (FPS)
Authority of supervisor (AOS)
Problems faced by supervisors (PFS)
Supervisors' opinion on recommendations (SSFI)

Under each of the above areas (problems and facilities), certain questions were asked to the supervisors; details of these questions are provided, as follows.

Facilities provided to supervisors (FPS)

Supervisors are provided with government vehicle (FPS1)
Available resources are sufficient for effective supervision in your area (FPS2)
Assistants are available to help supervisors in the process of supervision (FPS3)

Authority of supervisor (AOS)

Supervisors have sufficient authorities to exercise (AOS1)
Existing system of reward and punishment of supervisees is reasonable (AOS2)
School record is considered to be important during supervision (AOS3)
There should be some reasonable action against inefficient teachers (AOS4)

Problems faced by supervisors (PFS)

Supervisors are over-burdened for proper supervision (PFS1)
Lack of resources hinders the supervisors' activities (PFS2)
The numbers of supervisory visits are too much (PFS3)

As in previous case, we take mean values of the responses of supervisors on questions asked and generate data on the three variables, namely 'Facilities provided to supervisors' (FPS), 'Authority of supervisor' (AOS) and 'Problems faced by supervisors' (PFS). The descriptive statistics of these three variables (FPS, AOS and PFS) are provided and discussed in the following paragraphs.

Facilities provided to supervisors (FPS)

Table 12
Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
FPS	8	1.00	4.00	2.8333	1.45297
Valid N (list wise)	8				

The mean value of variable 'Facilities provided to supervisors (FPS)', as provided in the above table, happens to lie in between 1 and 4 and averages at 2.8333, that is less than the mid-point on the Likert scale, which suggests that supervisors are not satisfied with the facilities provided.

Authority of supervisor (AOS)

Table 13
Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
AOS	8	2.75	3.25	3.0000	.28868
Valid N (list wise)	8				

The mean value of variable "Authority of supervisor (AOS)' lies exactly at the mid-point, which portrays the neutral position that means supervisors neither agree nor disagree with the status of their authorities.

Problems faced by supervisors (PFS)

Table 14
Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
PFS	8	4.00	5.00	4.5833	.41944
Valid N (list wise)	8				

The mean value of variable 'Problems faced by supervisors (PFS)', as per the above table, estimates at 4.5833, showing that supervisors on average agree that they face several problems, including that supervisors are over-burdened for proper supervision, the lack of resources hinders their supervision activities and their numbers of supervisory visits are too much.

Supervisors' opinion on recommendations

Supervisors' opinion on certain major recommendations regarding supervision and its effect on improvement in teaching was also sought, using the following three questions. Separate supervisory wing at district education administration should be created for Effective supervision (SSFI1)

Periodic arrangements for in-service teachers training should be strengthened (SSFI2) Teachers should be appreciated for their good performance (SSFI3)

Frequency analysis of the first recommendation (that is, Separate supervisory wing at district education administration should be created for effective supervision) has been carried out and results provided in Table 15. According to these results, majority of supervisors (75%) opted for option 1 and did not agree with the suggestion of creating a separate wing for supervision and only 25% agreed with the suggestion (option 4).

Table 15
A separate supervisory wing is suggested for effective supervision?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	6	75.0	75.0	75.0
	4.00	2	25.0	25.0	100.0
	Total	8	100.0	100.0	

As far as the second recommendation (Periodic arrangements for in-service teachers training should be strengthened) is concerned, 75% supervisors agreed with option 4, showing their agreement with the recommendation (Table 16): only 25% supervisors did not agree.

Table 16
Periodic arrangements for in-service teachers training be strengthened

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2.00	2	25.0	25.0	25.0
	4.00	6	75.0	75.0	100.0
	Total	8	100.0	100.0	

As far as the third recommendation (Teachers should be appreciated for their good performance) is concerned, all supervisors opted for agreeing-side; however 25% opted for option 4 (Agreed) and 75% for option 5 (Strongly agreed).

Table 17
Teachers should be appreciated for their good performance

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4.00	2	25.0	25.0	25.0
	5.00	6	75.0	75.0	100.0
	Total	8	100.0	100.0	

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

On the basis of the research findings summarized above, certain conclusions, including the following ones, are drawn.

First, supervision directly and indirectly brings improvements in student's academic and non-academic performances. Supervision helps teachers improve their regularity and punctuality. In addition to the visit of the schools, supervisors talks with teachers about their problems and try to give suggestions to resolve them. After evaluating teachers 'tasks, supervisors give them their feedback. Supervision also focuses on the basic necessities of the schools including especially electrification, boundary wall, water supply system and group latrine, etc.

Second, supervisors on the other hand are not satisfied with the facilities provided for their supervision. Supervisors on average remained neutral on the question of their authorities; they neither agreed nor disagreed with the status of their authorities. Among

the problems supervisors faced included: supervisors are over-burdened for proper supervision; the lack of resources hinders their supervision activities; and their numbers of supervisory visits are too much.

Recommendations

In light of conclusions arrived at, the following recommendations are in order.

- Since supervision positively contributes towards betterment of students' academic and non-academic performances, facilities for greater supervision should be extended.
- Supervisors should be facilitated with improvements in transport facilities.
- Arrangements for periodic in-service teachers training should be strengthened.
- Teachers should be appreciated for their good performance.
- The total number of supervisors should be increased so that to avoid heavy workloads.

REFERENCES

1. Behlol, G.M. (2011). Concept of Supervision and Supervisory practices at primary level in Pakistan. doi: 10.5539/ies.v4n4p28.
2. Beach, D. and Reinhartz, J. (2000). Supervisory Leadership: focus on Instruction, Boston, MA: Allyn and Bacon Inc, 133-134.
3. Dawood Shah (2009). Monitoring the Quality of Secondary Education in the Context of Decentralization in Pakistan. EdD Thesis, Unpublished. Islamabad: Quaid-e-Azam University.
4. Eya, P.E. and Chukwu, L.C. (2012). Effective Supervision of Instruction in Nigerian Secondary Schools: Issues in Quality Assurance. *Journal of Qualitative Education*, 8(1), 1-6.
5. Ehren, Melanie and Adrie Visscher. (2006). Towards a Theory on the Impact of School Inspections. In The *British Journal of Educational Studies*, 54(1) 51-72.
6. Faisal, K. (2013) Barriers to Effective school inspection in Pakistan and Way Forward. *Applied Science Journal*, 24(6), 814-821.
7. Gokce, A.T. and Kantos, Z.E. (2012). Primary School Students' Perception of Inspectors and Inspection Period in Turkey. Mediterranean Journal of Social Sciences, 3(3), 199-202.
8. Igwe, S.O. (2001). Supervision, Evaluation and quality control in Education in Nwagwu. N.A. Current Issues in Educational management in Nigeria. Benin City: AMBIK Press Ltd.
9. Igbo, R.O. (2002). *Fundamentals of school management*. Enugu: Cleston Ltd.
10. Iqbal, M. (2005). Essentials of educational Administration, (108-110). Peshawar.
11. Khan, F. (2013). Barriers to effective school inspection in Pakistan and way forward. *World Applied Science Journal*, 814-821.
12. Lee, J.C.K and Ding, D. (2008). School Supervision and evaluation in China: The Shanghai Perspective. Quality Assurance in Education, 148-163.
13. Luginbuhl, R., Webbink, D. and De Wolf, I.F. (2009). Do School Inspections Improve Primary School Performance? *Educational Evaluation and Policy Analysis*, 31(3), 221-237.

14. Malanga, T., Wadesango, N. and Kurebwa, M. (2012).The primary school Deputy Heads, Supervisory Role and its effects on the motivation of teachers at primary level in *Edu. Sci.*, 4(3), 215-222.
15. Mlilo, P. (2007). *Supervision of primary school teachers in Zimbabwe*. Harare: University of Zimbabwe.
16. Marzano, R.J. (2003). What works in schools: Translating research into action? Retrieved from http://pdonline.ascd.org/pd_online/whatworks/marzano2003_ch13.html US Department of Education. (2003). Confidence: Helping your child through early adolescence. Retrieved from http://www.ed.gov/parents/academic/help/adolescence/part 8.html
17. Negalay, R.L. and Evans, N.D. (1980). *Handbook for effective supervision of inst* (3rd ed). Englewood cliffs, New Jersey: Prentice Hall Inst.
18. Sharma, S., Yusoff, M. and Kannan, S. (2011). Instructional Supervision in Three Asian Countries-What Do Teachers and Principals Say? *International Conference on Education and Management Technology*, 13(2011), 34-38.
19. Shahid, M.S. (2002). Educational Administration An Introduction. Lahore: Majeed Book Depot.
20. Sultana, N. (2000). Educational Management and Supervision Code:6502. Islamabad: Abdul Wadood, AIOU.
21. Shah, D. (2003). Decentralization in the Education system of Pakistan: polices and stragies.
22. Onasanya, S.A. (2008). Continouse Assesment,Dossier,School Diary,Supervision and Records keeping in Public primary School in Kwara state. A publication of Kwara State Universal Basic education Board, ILORIN. Nigeria: ILORIN.
23. Thomas G. Ryan and Jodi Gohfried (2012). Elementary supervision and the supervisior: Teacher attitudes and inclusive education. Nipissing University, Canada.
24. Naizr, N. and Hussain, N. (2008). Exploring current practices of supervisors in government Primary Schools in Karachi, Pakistan. *Journal of Educational Research*, 11(1).
25. Wiles, K. (1955). *Supervision for Better schools*. New Jersey: Prentice Hall.
26. Wanzare, Z.O. (2002). Rethinking School Inspection in the Third World: The case of Kenya. *Educational Management, Administration and Leadership*, 30(2), 213-229. Doi: 10.1177/02611X02030002511.
27. Zafar, M. (2003). Fiscal Devolution in Education. A Case Study Reflecting Initial Responses. Ministry of Education, Islamabad, Pakistan.

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STATISTICAL MIS-MEASUREMENT ISSUES: CASE OF LONG-RUN UNDER PERFORMANCE OF INITIAL PUBLIC OFFERINGS IN PAKISTAN

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ABSTRACT

To observe the statistical differences in the measurement problems, the long run performance of Initial Public Offerings in Pakistan is measured from 2000 to 2012. The Cumulative Abnormal Returns (CARs), Buy & Hold Abnormal Returns (BHARs) and Jensen's alpha through Capital Asset Pricing Model for different time horizons after the period of three years of going public are statistically evaluated.

To further analyze the robustness, the performance of these IPOs is also measured on weekly and fortnightly basis in addition to the monthly basis. The results suggest that after awarding tremendous returns to the investors in new listed companies at first trading day, these IPOs did not sustain their initial returns and provided investors with negative abnormal returns over a long period of one to three years after listing. The investors earned market adjusted negative returns as well as risk adjusted negative returns accounting for market factor under CAPM. The results at Karachi Stock Market also validated the statistical misspecification of these models in the IPOs performance.

The differences of results under two different statistical models; CARs and BHARs are to be observed and the amount of level of underperformance was found to be excess in BHARs model as compared with the CARs model. On the other hand, in the regression model with regard to CAPM, Jensen's alpha is observed to be negative but insignificant under monthly, fortnightly and weekly basis analysis. This further suggest the statistical mis-specification of different models.

KEY WORDS

IPO, CAPM, Jensen's alpha, KSE, long-run

1. INTRODUCTION

The statistical mis-measurement problems was initially raised in Barber and Lyon (1997), in their study they noted the difference of two methodologies; CARs and BHARs, on the same set of data to observe the long run performance of IPOs. They preferred BHARs methodology over CARs model by arguing the return's pattern do

not observe the investment strategy of investor's return if shares (IPOs) are held for longer time period. Further, they also noted skewness problem in BHARs model. Differing to Barber and Lyon (1997) study Fama (1998) preferred the CARs model to observe long run performance of IPOs by arguing that CARs are easy to observe the linearity pattern of averages with the long run period of time. Zarafat and Vejzagic (2014), Ecker (2014), Brau (2012), Hoechle & Schmid (2008), Jain & Kini (1994), Shah (1995) and Ritter (1991) showed strong under-performance of IPOs.

To measure the long run performance, prior studies were criticized due to applying single factor models instead multifactor models. The misspecification of models is also highlighted in the study of Chen et al. (2002). He observed that Fama French 3-factor model is more appropriate to measure the long-run performance of IPOs by arguing that the model's return patterns are alike as of ordinary asset's return. Several studies used three factor Fama French model to observe long run performance of IPOs. On the other hand Brav (2000) criticized the use of Fama French model due to the reasons that on long run, abnormal returns do not hold the assumptions of independency and normality. Primarily, new firms prefer private placement to meet their funding need, after that they issue new securities. As a result, the value of firms are promoted. Generally, the prices of IPOs tend to decline after the listing. Investors usually observe negative patterns of returns if they held the new stocks for longer period, in contrast high returns if they sell the new stocks at first day of trading.

The history of IPOs in Pakistan show great expansion in 1990s. However in the sample period only 94 IPOs were listed. In term of number of IPO during the sample period, the year 2005 and 2005 show highest number of IPOs. IPOs in Pakistan was not explored, only five studies (Kiyani & Amjed, 2011; Sohail & Raheman, 2010; Sohail & Raheman, 2009; Rizwan & Khan, 2008 and Sohail & Nasr, 2007). In all these studies the long-run performance of IPOs was not measured for the period of three years after the listing. To address this gap, it provides a strong motivation for examination of the performance of IPOs in the long run. The main objective of the present study is to analyze the statistical mis-measurement issues in long run in addition to measure them with different maturity level. This study will significantly contribute to analyze the after- market performance of IPOs in Pakistan in the light of measurement problems. In addition, the GCT regression model will further check the robustness of results of underperformance.

2. LITERATURE REVIEW

To analyze the statistical mis-measurement problems, the study of Barber and Lyon (1997) is the first one where CARs model is criticized. However, in the earlier studies the under-performance of IPOs, has been observed extensively. Chambers & Dimson (2008) observed underpricing of 11.12% by taking 90-years data during 1917-2007. Brau (2012) showed underperformance of -17% after three years by applying BHARs methodology.

Although, due to application of different models to measure long run performance of IPOs, the subject remains debatable, on the other hand, underperformance of IPOs was observed worldwide. Recently, Zarafat and Vejzagic (2014) showed underperformance of IPOs in Malaysia. They documented underperformance of -32.8% after the period of three years. The US and UK markets remain leading in context of IPO's performance. Ritter (1991) showed -29.10% CARs in USA, that is validated in Loughran (1993) study to show -60% underperformance. In UK, Goergen et al. (2007), Levis (1990) and Espenlaub et al. (2000) also confirmed the strong underperformance. Bessler and Thies (2007) and Ljungqvist (1997) showed underperformance of IPOs in Germany. The magnitude of underperformance is different across the countries and depends upon the method and time period that is used for analysis for the long run period.

The underperformance of IPOs has also been observed in the developing countries, south Asian countries and emerging markets as well. Su, Bangassa and Brookfield (2011) analyzed the long run performance of IPO firms of China in 1996-2005 and concluded the misspecification of model with regard to benchmarks and validated the earlier researches of misspecification of the model. In Hong Kong, MacGiuinness (1993) showed underperformance of -18.3% by taking the 72 IPO firms in 1980-1990.

The controversial results with regard to underperformance of IPOs was presented in the study of Ritter and Welch (2002) by using two different bench marks for abnormal returns; market and matched firms. For matched firms they used book to market and market capitalization. In their study, market adjusted performance after three year was observed to be -23.4%, whereas this underperformance is observed to by -5.1% by using matched firm as benchmark. Eckbo and Norli (2005) in their study used Fama-French 3-factor model with modification by selecting a rolling portfolio strategy and came with different results. In their study Jensen's alpha was found to be insignificant to show that IPOs don not underperform in long run after adjusting the risk factors of market, size and value. However, Gompers and Lerner (2003) used the larger set of IPO firms from 1936 to 1976 and showed underperformance by using Fama-French 3-factor model. Ecker (2014) also showed underperformance of IPOs and argued that this underperformance is due to lack of information history of IPOs. Kothari and Warner (1997), Barber and Lyon (1997), Fama (1998), Lyon et al. (1999), and Loughran and Ritter (2000), Choi, Lee and Megginson (2006) and Gompers and Lerner (2003; all these researchers pointed out methodological and bench mark problems in long run performance of IPOs.

3. METHODOLOGY

Initially, 83 IPOs firms are selected covering the period of 2000-12, for long-run performance, only 61 IPOs were selected that have covered the period of three years

after the listing. For 1st day return market adjusted return model is used, while for the long run performance Ritter (1991) methodology has been adopted.

$$m\_ar_{it} = r_{it} - r_{mt} \tag{1}$$

where m_ar represents the market adjusted abnormal returns; first this model is used to measure the underprizing (first day return) and after that it is used to measure the long run performance in different time periods. The return for each firm is represented by r_i while r_m represents the market return for corresponding period. The average adjusted returns for the different time periods are calculated and then cumulated from event period *p* to event period *s* as:

$$Cum - AR_{p,s} = \sum_{t=p}^{s} \left(\frac{1}{n} \sum_{i=1}^{n} m\_ar_{i,t} \right) \tag{2}$$

In the same line, the market adjusted buy and hold abnormal returns (BH-AR) of each firm are calculated as.

$$BH - AR_{i,T} = \left[\prod_{t=1}^{T} \left(1 + r_{i,t}\right) - 1 \right] - \left[\prod_{t=1}^{T} \left(1 + r_{m,t}\right) - 1 \right] \tag{3}$$

The average BH-AR of IPOs (represented by BHAR) for different time periods are calculated as:

$$BHAR_t = \frac{1}{n} \sum_{t=1}^{n} BH - AR_{i,T} \tag{4}$$

To test the significance of Cum-ARs and BHARs, the t-statistics is employed in different event time period. *The first Hypotheses, "The market adjusted Buy hold abnormal returns and cumulative abnormal returns of firms after the listing in different time period are different from zero" is tested.*

$$t = \frac{cum - AR_{i,t}}{\sigma\left(cum - AR_{i,t}\right) / \sqrt{n_t}} \tag{5}$$

$$t = \frac{BAHR_t}{\sigma\left(BAHR_{i,T}\right) / \sqrt{n}} \tag{6}$$

where, $\sigma\left(cum-AR_{i,t}\right)$ is the cross sectional standard deviation of market adjusted cumulative returns, while $\sigma\left(BHAR_{i,T}\right)$ is the cross sectional standard deviation of the market adjusted buy-and-hold returns for the each IPO firms in the different time period.

Similarly Long-run performance is also being measured on the basis of Jensen's alpha obtained by applying the following Capital Pricing Model (CAPM).

$$r_{i,t} - r_{f,t} = \alpha_t + (r_{mt} - r_f)\,\beta_t + \varepsilon_{it} \quad (7)$$

where, α_t is the intercept in different time periods (12, 18, 24, 30 & 36 months, 24, 36, 48, 60 & 72 fortnights, 48, 72, 96, 120 and 144 weeks) for each IPO firm. On the basis of CAPM model, The Jensen's alpha is calculated by running the various regressions with the help of e-view software. To run these large numbers of regressions the programing module is written in the e-views software and tables are created in excel by writing different modules in the form of macros. The second Hypotheses, *"The Jensen's alpha in different time periods is different from zero"* is tested. *This means that the intercept $\alpha < 0$ against $\alpha >= 0$ is tested.*

4. RESULTS AND DISCUSSION

4.1 Descriptive Analysis

The descriptive analysis contains the average, median, variability and range of variables minimum to maximum are represented in table 1. These analysis are further divided into monthly, fortnightly and weekly basis from year 2000 to 2010. On average these returns show downward trend when moving monthly to fortnightly and fortnightly to weekly analysis as observed to 0.41%, 0.15% and 0.09% respectively.

Table 1: Descriptive Analysis

Period	Average	Med.	St. Dev.	Lowest	Highest
A. Returns of IPO firms					
1. Weekly	0.09%	-0.24%	8.45%	-69.27%	88.03%
2. Fortnightly	0.15%	-0.22%	11.77%	-63.25%	102.80%
3. Monthly	0.41%	-0.81%	17.55%	-67.96%	268.80%
B. Returns of Index (Market)					
1. Weekly	0.36%	0.78%	3.92%	-40.11%	16.84%
2. Fortnightly	0.73%	1.28%	5.76%	-46.44%	22.61%
3. Monthly	1.56%	2.35%	9.02%	-50.52%	39.20%
C. Market Adjusted Returns					
1. Weekly	-0.27%	-0.89%	7.80%	-60.69%	94.66%
2. Fortnightly	-0.58%	-1.48%	10.65%	-66.24%	97.94%
3. Monthly	-1.15%	-2.75%	15.23%	-75.82%	257.41%
D. Slope in CAPM (Market Factor)					
1. Weekly	0.17%	0.59%	4.02%	-40.37%	16.75%
2. Fortnightly	0.36%	0.92%	5.93%	-46.96%	22.41%
3. Monthly	0.80%	1.42%	9.28%	-51.68%	38.81%

4.2 Cumulative Abnormal Returns (CARs) Analysis

The market adjusted initial return on first trading of IPOs is found to be 28.28% for sample of 83 firms while this return goes up to 39.64%[1]. To observe these returns do sustain in the longer run, in first model, CARs are calculated using market adjusted returns, that is followed by BAHRs model. To tackle the effect of underpricing issues, first day of IPOs is not included in the long-run performance. The analysis is made on monthly, fortnightly and weekly basis. The summary of CARs model is displayed in Table 2, while detailed week-wise, fortnight-wise and month-wise performance is displayed as Appendix tables[2].

The panel-A of table 1 portrays that after one year the long-run performance is negative but not significant. The result is contrary to earlier study of Sohail and Nasr (2007), in which these IPOs underperform and significant negative returns was reported after one year. They selected a very small sample and evaluated the

[1] The detailed returns can be seen in Sohail (2015), PhD dissertations

[2] See Sohail (2015), PhD dissertations

performance after one year only of going public of these IPOs. In majority studies the long run performance is evaluated more than one year after going public. However, the results of this study also confirm the underperformance of these IPOs after one year going to public. The average market-adjusted cumulative abnormal returns are found to be negative and significant after listing of one & half years, two years, two & half years and three years period from year 2000 to 2010. The results are found to be -19.44%, -21.84%, -27.91% and -41.45% with associated *t*-statistic of (1.92055), (1.99300), (2.24547) and (3.30723) respectively. The results are significant at 10% level for the period one & half years, at 5% for the periods two years and two & half years and at 1% for the period three years of going after public. These results get higher significance level as performance period of IPOs increased.

The panel-B of table 2 portrays long-run performance of IPOs on fortnightly basis. The average market-adjusted cumulative abnormal returns are found to be negative and significant after listing of one year, one & half years, two years, two & half years and three years period from year 2000 to 2010. The results are found to be -14.73%, -20.87%, -23.09%, -29.05% and -41.81% with associated *t*-statistic of -1.768015, -2.294533, -2.298333, -2.506139 and -3.560222 respectively. All the results are significant at 10% level for the period one year, at 5% for the periods one & half years, two years and two & half years and at 1% for the period three years of after going public. Considering the volatile nature of KSE these results are made on fortnightly basis. All these results confirm the underperformance of IPOs in KSE and in accordance with the prior studies.

Table 2
Analysis of Cumulative Abnormal Returns

Time Period	Average	St. Dev.	t	P values
Part-A: Cumulative Abnormal Returns (Monthly)				
3-years	(0.41453) *	0.98	-3.31	0.00
2.5-year	(0.27914) **	0.97	-2.25	0.03
2-years	(0.21839) **	0.86	-1.99	0.05
1.5-year	(0.19438) ***	0.79	-1.92	0.06
1-year	-0.124	0.72	-1.34	0.18
Part-B: Cumulative Abnormal Returns (Fortnightly)				
3-years	(0.41808) *	0.92	-3.56	0.00
2.5-year	(0.29049) **	0.91	-2.51	0.01
2-years	(0.23088) **	0.78	-2.30	0.03
1.5-year	(0.20874) **	0.71	-2.29	0.03
1-year	(0.14730) ***	0.65	-1.77	0.08
Part-C: Cumulative Abnormal Returns (Weekly)				
3-years	(0.38291) *	0.90	-3.33	0.00
2.5-year	(0.26023) **	0.88	-2.31	0.02
2-years	(0.20814) **	0.76	-2.14	0.04
1.5-year	(0.20224) **	0.67	-2.35	0.02
1-year	(0.14708) ***	0.61	-1.87	0.07

*significant at 1% level, **significant at 5% level and ***significant at 10% level

Similarly, the panel-C of table 4 portrays long-run performance of IPOs on weekly basis. The average market-adjusted cumulative abnormal returns are found to be negative and significant after listing of one year, one & half years, two years, two & half years and three years period from year 2000 to 2010. The results are found to be -14.71%, -20.22%, -20.81%, -26.02% and -38.29% with associated *t*-statistic of -1.87340, -2.34579, -2.13938, -2.31004 and -3.32794 respectively. All the results are significant at 10% level for the period one year, at 5% level for the periods one & half years, two years and two & half years and at 1% level for the period three years of after going public. Considering the volatile nature of KSE these results are also made on weekly basis. All these results confirm the underperformance of IPOs in KSE and are in accordance with the prior studies.

By comparing the analysis on weekly, fortnightly and monthly basis, the results are little bit different after two & half years and three years periods. Specifically, after three years period, the slightly less underperformance is observed in weekly analysis as compared with fortnightly and monthly analysis. The null hypothesis is rejected in all the cases except after one year for monthly analysis of IPOs. The results suggest that IPOs do not sustain their initial level of underpricing and provide investors with negative abnormal returns over a long period of one to three years after listing.

The overall long run market adjusted CARs of IPOs are in accordance with the earlier studies as discussed in the literature part of thesis in detail. However, long run market adjusted CARs of IPOs are higher than the US, UK, Canada and some Asian countries. As reported by Brau (2012), Gregory et al., (2009) and Kirkulak (2008) etc. The results of month-wise, fortnight-wise and week-wise cumulate abnormal returns based on market adjusted model are presented in appendix tables. These results represent that none of the IPOs show positive returns for the entire sample of sixty one for the period 2000 to 2010. However, these cumulative abnormal returns are not significant for the months 1 to 14 out of 36 months, fortnight 1 to 14 out of 72 fortnights and weeks 1 to 27 out of 144 weeks. The significant cumulative abnormal returns are observed after 14 months in month-wise analysis, after 7 months in fortnight-wise analysis and after 6 months in week-wise analysis.

4.3 Buy and Hold Abnormal Returns (BHARs) Analysis

As in case of CARs, BHARs are calculated using market adjusted model. The period-wise summary of BHARs is displayed in table 3, while detailed week-wise, fortnight-wise and month-wise performance is displayed as Appendix tables[3]. The panel-A of table 4.3 portrays that in all periods the long-run performance is negative. The long run BHARs after one year and two and half years are not significant. The results of BAHRs is contrary to earlier study of Sohail and Nasr (2007), in which these IPOs underperform and significant negative returns was reported after one year. They selected the very small sample and evaluated the performance after one year only of going public of these IPOs. However, overall results of this study confirm the underperformance of these IPOs.

[3] See Sohail (2015), PhD dissertations

Table 3
Analysis of Buy and Hold Abnormal Returns (BHAR)

Time Period	Average	St. Dev.	t	P values
Part-A: Buy and Hold Abnormal Returns (Monthly)				
3-years	(0.42663) **	1.28	-2.60	0.01
2.5-year	-0.20277	1.62	-0.98	0.33
2-years	(0.24984) **	0.85	-2.29	0.03
1.5-year	(0.18628) ***	0.86	-1.70	0.09
1-year	-0.07967	0.84	-0.74	0.46
Part-B: Buy and Hold Abnormal Returns (Fortnightly)				
3-years	(0.45811) *	1.25	-2.85	0.01
2.5-year	-0.22268	1.50	-1.16	0.25
2-years	(0.22894) ***	0.91	-1.95	0.06
1.5-year	(0.18625) ***	0.88	-1.66	0.10
1-year	-0.10864	0.78	-1.09	0.28
Part-C: Buy and Hold Abnormal Returns (Weekly)				
3-years	(0.45933) *	1.24	-2.89	0.01
2.5-year	-0.20086	1.71	-0.92	0.36
2-years	(0.23728) **	0.89	-2.07	0.04
1.5-year	(0.18109) ***	0.87	-1.63	0.11
1-year	-0.08956	0.80	-0.87	0.39

*significant at 1% level, **significant at 5% level and ***significant at 10% level

The average market-adjusted buy and hold abnormal returns are found to be negative and significant after listing of one & half years, two years and three years period from year 2000 to 2010. The amount of level of underperformance is increased in BHARs as compared with the CARs. The results are found to be -18.63%, -24.98% and -42.66% with associated *t*-statistic of -1.69816, -2.29090 and -2.60354 respectively. The results are significant at 10% level for the period one & half years and at 5% level for the periods two years and three years of going after public.

The panel-B of table 3 portrays long-run performance of IPOs on fortnightly basis. The average market-adjusted buy and hold abnormal returns are found to be negative and significant after listing of one & half years, two years and three years period from year 2000 to 2010. The buy and hold abnormal returns are found to be highly

significant at 1% level of significance. The level of underperformances reaches at -45.81% which is higher than the underperformance level under CARs model. All these results confirm the underperformance of IPOs in KSE and are in accordance with the prior studies. Similarly, the panel-C of table 4.3 portrays long-run performance of IPOs on weekly basis. The average market-adjusted buy and hold abnormal returns are found to be negative and significant after listing of one & half years, two years and three years period from year 2000 to 2010. The level of underperformance of these IPOs increased to (-45.93%).

The comparison among weekly, fortnightly and monthly basis shows that the results are little bit different after two & half years and three years periods. Specifically, after three years period, the slightly less underperformance is observed in weekly analysis as compared with fortnightly and monthly analysis. The null hypothesis is rejected in all the cases except after one year and two and half years for monthly, fortnightly and weekly analysis of IPOs. The results suggest that IPOs not sustain their initial level of underpricing and provide investors with negative abnormal returns over a long period of one to three years after listing.

The results of month-wise, fortnight-wise and week-wise buy and hold abnormal returns based on market adjusted model are presented in appendix tables. These month-wise BHARs represent that none of the IPOs show positive returns for the entire sample of sixty one for the period 2000 to 2010. However, in fortnightly basis BHARs, one fortnightly return in fortnight 9 and in weekly basis BHARs, two weekly returns in weeks 17 & 18 are observed to be positive but remains insignificant. Alternatively, these buy and hold abnormal returns are not significant for the months 1 to 15 and 30 out of 36 months, fortnights 1 to 31, 35, 39, 59, and 60 out of 72 fortnights and weeks 1 to 62, 70, 71, 78, 117 to 119 out of 144 weeks.

The overall long run market adjusted BHARs of IPOs are accordance with the earlier studies as discussed in the literature part of thesis in detail. However, long run market adjusted BHARs of IPOs are higher than the US, UK, Canada and some Asian countries as in CARs analysis. Komenkul et al. (2012) the underperformance of IPOs in Thailand by selecting the 136 IPO firms during the period of 2001 to 2012 and showed -16.6% BHARs. In USA, Brau (2012) selected a large IPO sample of 3547 during the period of 1985 to 2003 and documented the BHARs of -17.1% after the period of three years.

4.4 Long-run performance using Jensen's alpha by CAPM

The results of IPOs which were selected for long run performance are displayed in table 4, representing Jensen's alpha in five different time intervals i.e. after 1, 1.5, 2, 2.5 and 3 years. Generally, CAPM represents the risk adjusted underperformance of these IPOs in long run. In all these regression models the intercept term i.e. Jensen's alpha is observed to be negative but insignificant after the periods of one and half years to three years under monthly, fortnightly and weekly basis analysis.

Table 4
Long run performance through Jensen's alpha

	1-year		1.5-years		2.0-years		2.5-years		3-years	
	Coeff.	**T**	**Coeff.**	**T**	**Coeff.**	**T**	**Coeff.**	**T**	**Coeff.**	**T**
Monthly										
Alpha	-0.010	-0.819	-0.011	-0.728	-0.009	-0.585	-0.010	-0.666	-0.010	-0.716
Beta	1.056	3.323	0.980	3.467	0.961	3.437	0.957***	3.904	0.961***	4.014
r^2	0.339		0.329		0.298		0.298		0.302	
Adj. r^2	0.273		0.287		0.266		0.273		0.282	
Fortnightly										
Alpha	-0.004	-0.502	-0.005	-0.541	-0.004	-0.423	-0.004	-0.424	-0.005	-0.532
Beta	0.872	3.058	0.855	3.505	0.855	3.701	0.854***	4.007	0.851***	4.046
r^2	0.240		0.240		0.227		0.225		0.224	
Adj. r^2	0.205		0.218		0.210		0.212		0.212	
Weekly										
Alpha	-0.002	-0.364	-0.002	-0.368	-0.002	-0.282	-0.001	-0.299	-0.002	-0.430
Beta	0.819	3.624	0.812***	3.897	0.798***	4.192	0.805***	4.557	0.811**	4.824
r^2	0.199		0.200		0.191		0.190		0.190	
Adj. r^2	0.181		0.188		0.182		0.183		0.184	

*significant at 1% level, **significant at 5% level and ***significant at 10% level

The controversial results with regard to underperformance of IPOs were presented in the study of Ritter and Welch (2002) and Eckbo & Norli (2005) in their study they used Fama-French 3-factor model and came with different results. The pattern of these results is also observed in KSE under different models. It is further evident that Jensen's alpha is found to be insignificant to show that IPOs don not underperform in long run after adjusting the risk factor of market. Different studies such as Kothari and Warner (1997); Barber and Lyon (1997); Fama (1998); Lyon et al. (1999); and Loughran and Ritter (2000) have shown different underperformance results of IPO firms depending upon the choice of method. Contrary to Barber and Lyon (1997) study, Fama (1998) preferred the CARs model to observe long run performance of IPOs. He argued that CARs can easily observe the linearity pattern of averages with the long run period of time.

The Jensen's alpha envisage the amount of monthly underperformance after three years -1.0%,. Similarly, the fortnightly underperformance after three years remains at -0.5% while weekly underperformance after three years remains at -0.2% showing some consistent performance. The under performance remains at deep downwards on monthly basis analysis as compared with fortnightly analysis from year one to year three.

Conversely, betas are found to be statistically significant after 2.5 years and 3 years in different time interval by CAPM. These betas remain at 0.95 to 0.97 in monthly analysis, 0.85 to 0.86 in fortnightly analysis and 0.81 in weekly analysis after three years. All these betas show less volatility of IPO portfolios after the period of three years. Overall, market effects are significant in CAPM. On the other hand after period of one year, in monthly analysis, these betas are a little bit higher than market betas but remain insignificant. The tendency of betas in different time intervals from year 1 to year 1.5, then year 1.5 to year 2 and onward up to year 3 drift downward under all the five models. The same tendency of betas is also observed from monthly analysis to fortnightly analysis and from fortnightly analysis to weekly analysis in all the models.

The results of CARs and BHARS of IPOs are found to be different from the results of Jensen's alpha. The results of misspecification of model are also validated in KSE. Even the results are found to be different when analyses are made on monthly, fortnightly and weekly basis.

5. CONCLUSION & RECOMMENDATIONS

In long run performance, it is observed that IPOs do not sustain their initial level of underpricing and provide investors with negative abnormal returns years after listing. The average market-adjusted CARs and BHARs are found to be negative and significant after listing of five different periods of one year, one & half years, two years, two & half years and three years. The risk adjusted performance through Jensen's alpha is obtained by using CAPM is observed to be negative but insignificant under monthly, fortnightly and weekly basis analysis. The overall, the risk adjusted performance is worst after the period of three years.

In the same line of international research for misspecification of model in the long run performance of IPOs, the results of misspecification of model are also validated in KSE. Even the results are found to be different when analyses are made on monthly, fortnightly and weekly basis irrespective of different maturity level of IPO firms after going public. After the long run performance of IPOs, now we are in position to answer the question that if investors purchased the shares from primary market and held it for longer period like one year, one and half years, two years, two and half years and three years. The investors earn market adjusted negative returns as well as risk adjusted negative returns accounting

for market factor for these longer period. Therefore, it is recommended to investors (individual & Institutional) that they should not retain the shares of IPO firms for longer period.

REFERENCES

1. Ahmad-Zaluki, N.A., Campbell, K. and Goodacre, A. (2007). The long run share price performance of Malaysian Initial Public Offerings (IPOs), *Journal of Business Finance & Accounting*, 34(1&2), 78-110.
2. Bessler, W. and Thies, S. (2007). The long-run performance of initial public offerings in Germany. *Managerial Finance*, 33(6), 420-441.
3. Boissin R. and Sentis P. (2012), Long-run performance of IPOs and the role of financial analysts: some French evidence. *The European Journal of Finance,* 1-25.
4. Brau, J.C and Fawcett, S.E. (2006). Evidence on what CFOs think about the IPO process: Practice, Theory and Managerial Applications. *Journal of Applied Corporate Finance,* 18(3), 107-117.
5. Chambers D. and Dimson E. (2008). IPO underpricing over the very long run. *Proceedings of the European Financial Management Association Conference 2008*, Oxford University, UK.
6. Chen, A., Chen, C.Y. and Pan, K.L. (2002). The performance of initial public offerings conditioning on issue information: The case of Taiwan. *Asia Pacific Management Review*, **7**, 167-190.
7. Choi, S.D., Lee, I. and Megginson, W. (2010). Do privatization ipos outperform in the long run? *Financial Management*, 39(1), 153-185.
8. Eckbo, B.E. and Norli, O. (2005). Liquidity risk, leverage and long-run IPO returns. *Journal of Corporate Finance*, 11(1), 1-35.
9. Ecker, F. (2014), Information Precision and Long-Run Performance of Initial Public Offerings. Contemporary Accounting Research, 31: 876–910. doi: 10.1111/1911-3846.12043.
10. Espenlaub, S., Gregory, A. and Tonks, I. (2000). Re-assessing the long-term underperformance of UK Initial Public Offerings. *European Financial Management*, 6(3), 319-342.
11. Fama Eugene F and Keenneth R. French, (1993). Common risk factors in the returns of stocks and bonds. *Journal of Financial Economics*, 33, 3-56.
12. Fama, E and French K. (1995). Size and Book-to-Market Factors in Earning and Return, *Journal of Finance*, 50, 131-155
13. Gregory, A., Guermat, C. and Al-Shawawreh, F. (2010). UK IPOs: long run returns, behavioral timing and pseudo timing. *Journal of Business Finance & Accounting*, 37(5-6), 612-647.

14. Hoechle D. and Schmid M. (2008). Which, why, and for how long do IPOs underperform?. *Proceedings of the European Financial Management Association Conference 2008, Oxford University, UK*.

15. Jain, B.A. and Kini, O. (1994). The Post-Issue Operating Performance of IPO Firms. *Journal of Finance*, 49, 1699-1726.

16. Kayani S. and Amjad, S. (2011). Investor Interest, Under-Pricing and Trading Volume in Pakistan Secondary Market. *Business and Economics Journal, BEJ-39*, 1-15.

17. Kirkulak, B. (2008). The initial and long-run returns of Japanese venture capital-backed and non-venture capital-backed IPOs. *International Journal of Managerial Finance*, 4(2), 112-135.

18. Komenkul K., Brzeszczyński J. and Sherif M. (2012). Re-Appraising the Long-Run Performance of Thai IPOs, *Working paper*.

19. Levis, M. (1990). The Winner's Curse Problem, Interest Costs and the Underpricing of Initial Public Offerings. *The Economic Journal*, 100, 76-89.

20. Ljungqvist, A. (2007). IPO underpricing. B.E. Eckbo (ed.), *Handbook of Corporate Finance, North-Holland*.

21. Loughran, T. (1993). NYSE vs NASDAQ returns: Market microstructure or the poor performance of initial public offerings?. *Journal of Financial Economics*, 33(2),
241-260.

22. Loughran, T. and Ritter J.R. (1995). The new issues puzzle. *Journal of Finance*, 50, 23-50.

23. McGuinness. P. (1993). The post-listing return performance of unseasoned issues of common stock in Hong Kong. *Journal of Business Finance and Accounting*, 20, 167-194.

24. Ritter, J. (1991). The long-run performance of initial public offerings. *Journal of Finance*, 46, 3-28.

25. Saleh, W. and Ahmad M. (2008). The Underperformance of IPOs: The Sensitivity of the Choice of Empirical Method. *East-West Journal of Economics and Business, XI, No. 1 & No. 2*, 34-52

26. Shah, Ajay, (1995). The Indian IPO market: Empirical facts, Social Science Research Network. *Technical Report, Centre for Monitoring Indian Economy*, Mimeo.

27. Sohail, M.K. and Nasr, M. (2007). Performance of Initial Public Offerings in Pakistan. *International Review of Business Research Papers*, 3(2), 420-441.

28. Sohail M.K. and Raheman A. (2009). Determinants of Underpricing of IPOs regarding Financial & Non-Financial Firms in Pakistan. *European Journal of Economic, Finance & Administrative Sciences*. 15, 62-73.

29. Sohail M.K. and Raheman A. (2010). Examining the Short run IPOs Performance in state of Economy: Normal, Boom and Recession. *International Research Journal of Finance and Economics*, 35, 173-186.

30. Su, Bangassa (2011). The impacts of underwriter reputation on initial returns and long-run performance of IPOs: further evidence. *Journal of International Financial Markets, Institutions and Money*, 760-791.

31. Welch, I. (1989). Seasoned Offerings, Imitation Costs and the Underpricing of Initial Public Offerings. *Journal of Finance*, 421-449.

32. Zarafat, H. and Vejzagic, V. (2014). The Long-Term Performance of Initial Public Offerings: Evidence from Bursa Malaysia, *Journal of Applied Economics and Business Research*, 4(1), 42-51.

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THE WAVELET INTERPRETATION OF IONOSPHERIC DYNAMICS AT PAKISTAN IONOSPHERIC REGION

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ABSTRACT

This paper presents the study of wavelet analysis of ionospheric dynamics that has been illustrated for electron concentration, refractive index and skip distance for radio wave propagation of the ionospheric F_2 layer at Pakistan Air Space. As we that the wavelet is a short term Fourier Transform convolved with data, gives some frequency information at a location, the skip distance is defined as the shortest distance from a transmitter, measured along the surface of the earth. The range of the skip distance depends on the frequency of the wave, the angle of incidence and the degree of ionization. We proposed to study the effectiveness of ionospheric dynamics and parametric estimation by developing a quantitative treatment for data covering a specific period during the years 1989-1990. The data sets are recorded on daily basis using Digisonde, DGS-256 installed at Space and Atmospheric Sciences (SPAS) division SUPARCO, Karachi, Pakistan. The aim here is to examine the periodicity in the electron concentration, refractive index and skip distance signals.

We have looked upon an idea to find hidden periodicities and a discontinuity analyzed by Fast Fourier Transformation (FFT) and wavelet technique in one dimension. Haar5-8 levels for approximation and details. This approach is implemented to theorize the physical process of the **e**lectronic communication terms such as **s**kip distance Fluctuations, refractive index and electron concentration. This study appraises the importance of this methodology for ionospheric research that is being carried out here in Pakistan.

KEYWORDS

Ionosphere F_2 layer, skip distance Fluctuations, wavelet, and Fast Fourier Transformation.

1. INTRODUCTION

The ionosphere is a superficial region of the atmosphere memorable by the reality that the particles in it are largely charged. It overlaps many of the thermal regions and contains ions positively charge atoms. This region is very important in radio wave communications, that absorbs large quantities of radiant energy from the sun it is earth's upper atmosphere and the F_2 layer is the outer layer of the ionosphere.

The concentration of ions increases with altitude although the particle density decreases. For upper region that is F_2 region the effects of ionization on these radio-waves provide an in valuable new tool of exploration. As will be seen in the following accounts of the work already achieved the radio transmitters on artificial satellites are providing new radio stars in the sky that are particularly useful.

The dynamics of the ionosphere can be understood by the transport processes that determine the transport term in the continuity equation where the electron density in the ionosphere is subject to the principles of conservation of mass, momentum and energy that are expressed mathematically by the continuity equation for the electron density, the equation of motion for the electrons and ions. The skip distance is defined as the shortest distance from a transmitter, measured along the surface of the earth as shown in the Figure 1 that shows the skip distance variations for radio wave propagation with different launch angles [1,2]

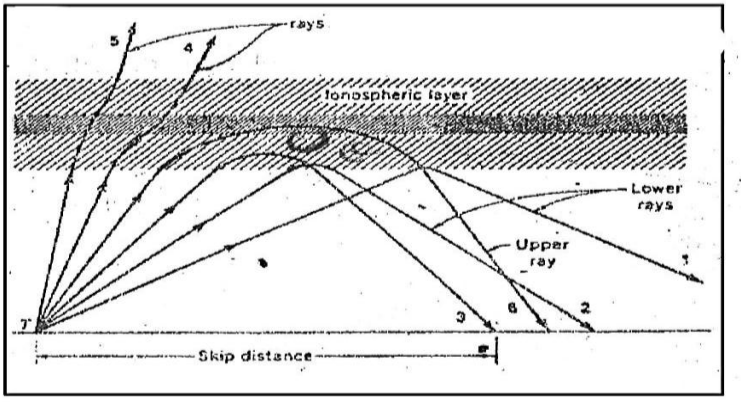


Figure 1

The data sets are recorded on daily basis using Digisonde, DGS-256 installed at Space and Atmospheric Sciences (SPAS) division SUPARCO, Karachi, Pakistan as depicted in Figure 2.

Digisonde 256 (1978)
(Information provided by the SUPARCO Officials on request)
Figure 2

2. ATMOSPHERIC CONDITIONS AFFECTING RADIO WAVES

Our ionosphere layers comprises D, E, Es, F1, F2 layers with different degree of ionizations with Total Electron concentration and temperatures and their temporal and Spatial Variations. Some undesirable phenomena of the solar terrestrial regions such as Solar Flares, coronal mass ejection sunspots dynamics considerations for sudden signal absorption, signal dispersion and signal fading Atmospheric conditions that have great effects on the ionosphere that primarily affects the behavior of these layers [3,4].

3. COMPUTATION OF REFRACTIVE INDEX

Refractive index

The ratio of the speed of light in a vacuity to the speed of light in the substance is called the refractive index. The refraction occurs when light greater the changes of speed, then greater the changes of direction. The variations of the refractive index are dependent on the function of frequency and electron concentration of the ionospheric F_2 layer. Refractive index is given as below:

$$\mu = 1 - \frac{\omega_p^2}{\omega^2}$$

In this formula ω^2 is the frequency of the propagating wave and ω^2_p is the plasma frequency.

4. COMPUTATION OF SKIP DISTANCE (d)

Skip Distance d = 2 $\sqrt{2a_e}$ h, a_e is radius of the earth that is equal to 8497 Km

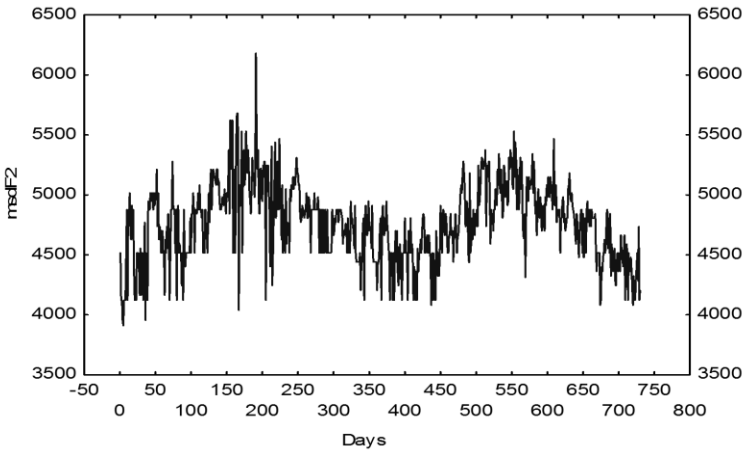


Figure 3: Depicts the Temporal Variations of Skip Distance

5. PERIODOGRAM ANALYSIS

We have presented ionospheric skip distance in form of astrophysical signals as depicted in fig 3. and listed their parameters in table 1. These are frequencies. Periods coefficient Cosine, coefficient Sine, Periodogram, Density and Hamming Weight. The aim of time series analysis in frequency domain is to separate, periodic oscillations from the random and a periodic fluctuation. Fourier analysis is one of familiar methods for identifying periodic components

Fourier series

$$f(t) = av.f(t) + \sum ap\ Cos(\omega,t) + bp\ Sin(\omega,t)$$

where (av.) f(t) is the mean value of the function, *ap*, *bp* are the coefficient of trigonometric function of Sin (ω,t) and Cos (ω,t) and the angular frequency ω are integer p =1,2,3….., multiples of the total length of the time series . This concept is central to spectral analysis technique, the collection of Fourier coefficient having amplitude, from a periodogram. [5-7] Fig. 4. Depicts the periodogram value and frequency for ionospheric skip distance F_2 layer data and Fig. 5. shows the relation of spectral density and frequency for ionospheric skip distance of F_2 layer

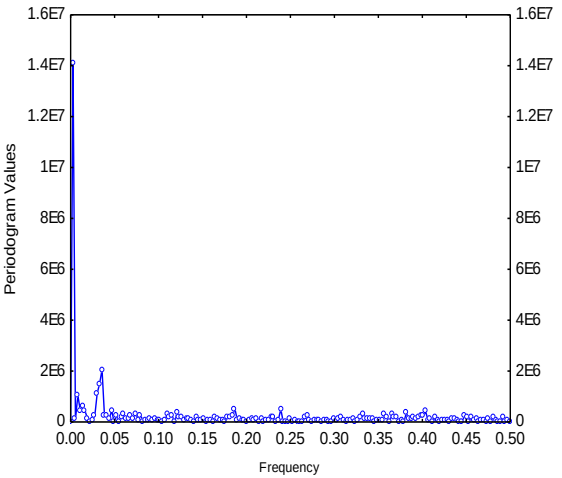


Figure 4

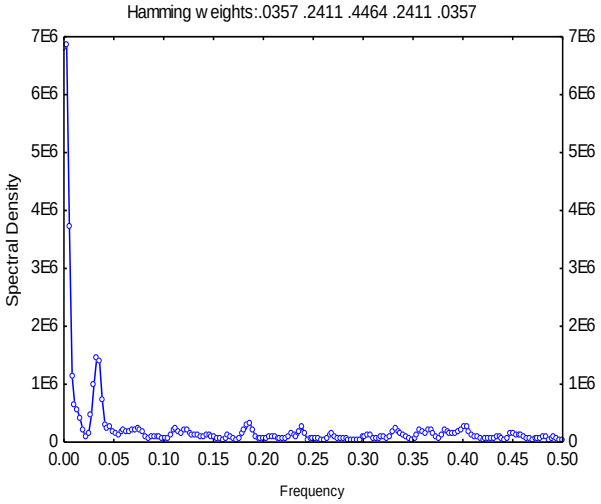


Figure 5

Table 1
Illustration of skip distance for radio wave propagation of ionospheric F_2 layer as a frequency (F), period (P), coefficient cosine and coefficient of sine and periodogram (Pgm)

Frequency	Period	Cosine	Sine	Periodogram	Hamming weights
.002	364.000	-278.247	3.53	14092959	0.035
.035	28.000	-44.205	-96.666	2056331	0.241
.033	30.333	-81.811	39.866	1507378	0.446
.030	33.090	-65.085	44.348	1128930	0.241
.008	212.33	-54.400	-35.171	1037772	0.035

Value	Frequency
141E5	.002
206E4	.035
151E4	.033
113E4	.030
104E4	.008

6. WAVELET ANALYSIS

The word wavelet was adopted to express the idea of small waves in an intuitive manner that is associated with localized waves like function whose values fluctuate in short period, in order to a function be called a wavelet. Wavelet analysis and synthesis are considered highly important in the field of signal processing. Wavelet analysis is a particular time-or space-scale representation of signals that has been found in atmospheric application like here in this case of skip distance fluctuations due to

ionosphere and the radio wave interactions. Wavelet approach is a recently developed signal processing tool enabling us on several time scales of the local properties of complex signals that can present non stationary zone. Wavelet analysis is used to find the mode of variations and also to study how it varies with time by decomposition time series in to frequency space.[8] Finally powerful multi resolution with respect to Haar is carried out. This decomposes actual signal in to different signals to be analyzed in to principle and residual part. By mathematical expression

It has been manifested that the coefficients of wavelet series interpret the properties like strong transient, discontinuity and unforeseen of the function or distribution precisely thus wavelets are considered as a mathematical microscope that detects the aspect of functions at different resolution [9,10]. These resolution can be expressed as

- $S = A_j + \sum D_j$
- $S = A_j + D_j$
- S, A_j and D_j are the signal principle j level and residual part j level. Mathematically, the relation between principle and residual part j level by ,
- $A_{j-1} = A_j + D_j$
- The wavelet used in the study by Haar of the level 1-5, the dyadic scale is a = 2 for levels 1-5 the resolution is given by 1/a or 2^{-j} . In order to approach the cyclic study maximum and minimum values, we have carried out wavelet analysis of ionospheric skip distance as shown in figure .6. the variation is presented in the form of different resolution at level 1-5, of Haar wavelet type in the detailed and approximated part the cyclic variation is also presented at different level. In the detailed and approximated part at the lowest resolution several peaks are appeared.

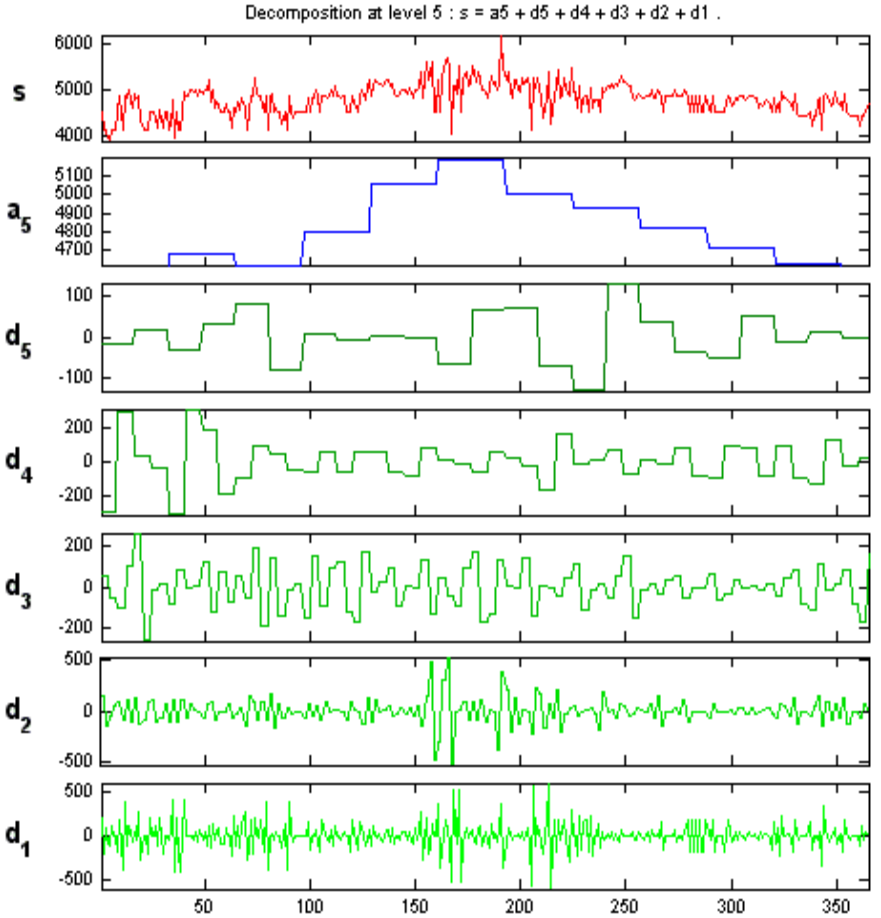


Figure 6: Decomposition at level 5, $s = a_5 + d_5 + d_4 + d_3 + d_2 + d_1$ of ionospheric F_2 layer skip distance at Pakistan air space.

We can also extend this illustration upto 8^{th} level as depicted in the following figure in order to strengthen our work.

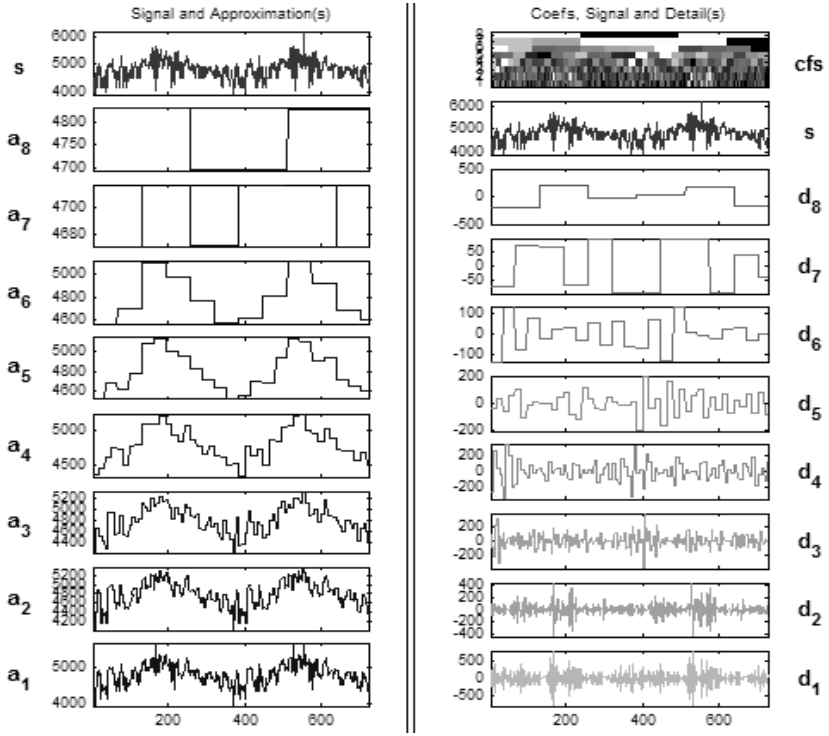
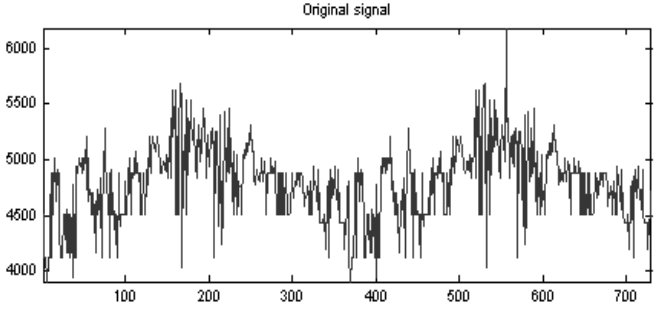
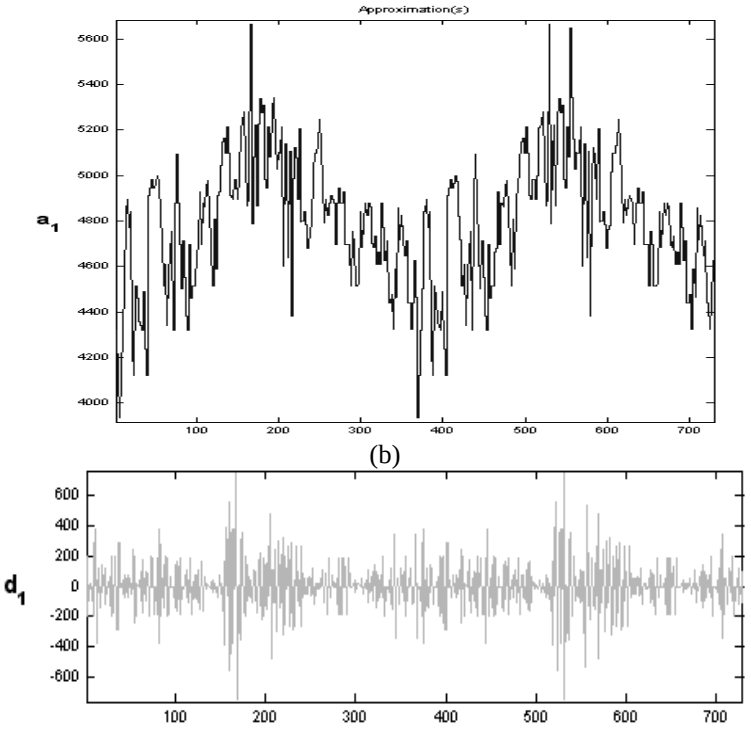


Figure 7: Plot of Decomposition level $a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8$ and $d_1, d_2, d_3, d_4, d_5, d_6, d_7, d_8$ of msdF$_2$

The figures 8 (a-c) manifest upper panel approximation level 1 and lower panel details level 1 of msdF$_2$



(a)

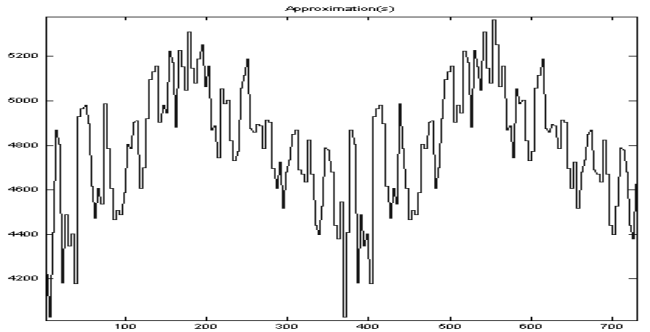


(b)

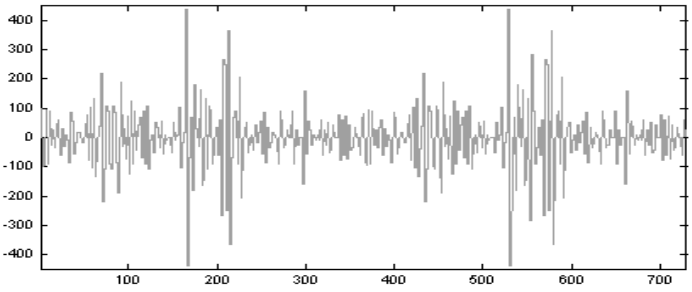
(c)

Figure 8

Figure 9 (a ,b) Plots of upper panel approximation level 2 and lower panel details level 2 of msdF_2



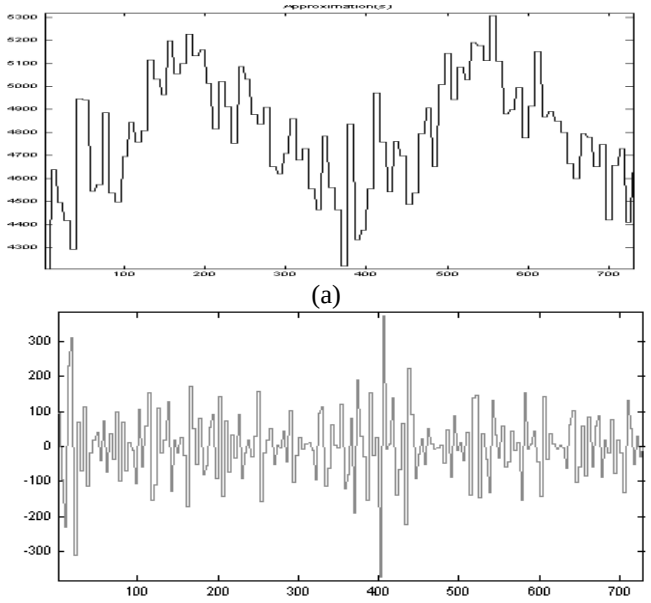
(a)



(b)

Figure 9

Similarly Figure 10. (a,b) of upper panel approximation level 3 and lower panel details level 3 of $msdF_2$

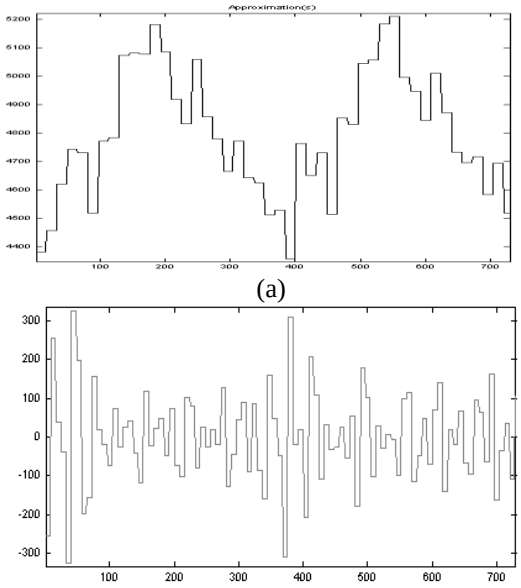


(a)

(b)

Figure 10

Figures 10 (a,b) show the Plot of upper panel approximation level 4 and lower panel details level 4 of $msdF_2$

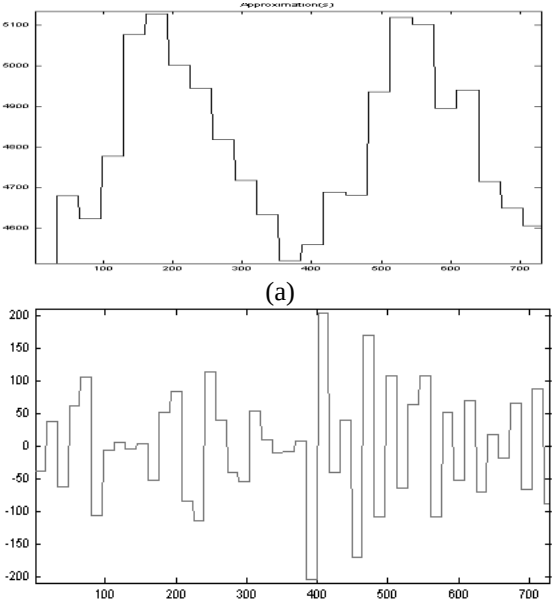


(a)

(b)

Figure 11

Figures 11. (a,b) depict the Plot of upper panel approximation level 5 and lower panel details level 5 of msdF_2

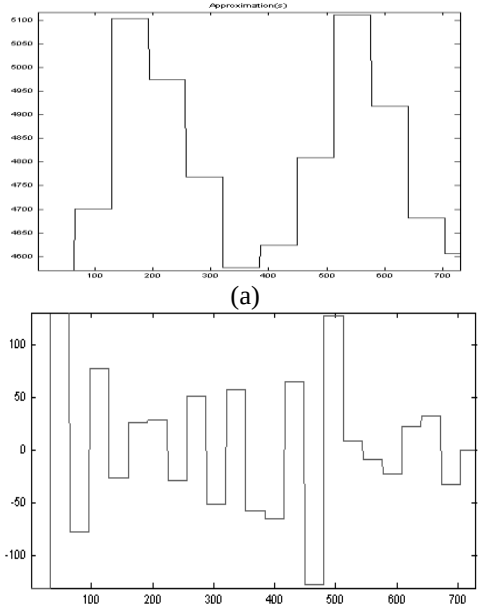


(a)

(b)

Figure 12

Figures 12.(a,b) illustrate the upper panel approximation level 6 and lower panel details level 6 of $msdF_2$

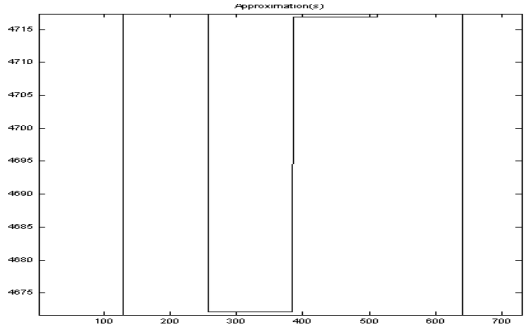


(a)

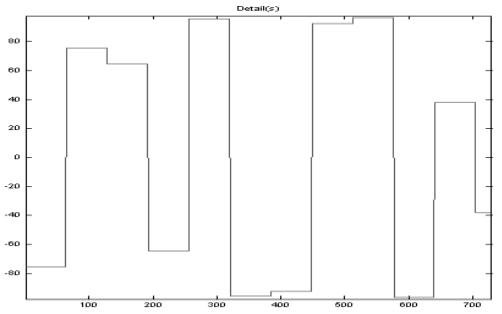
(b)

Figure 13

For showing the fineness in the periodic signals of the skip distance this plot 13. (a,b) of upper panel approximation level 7 and lower panel details level 7 of $msdF_2$ seem to be significant [8]



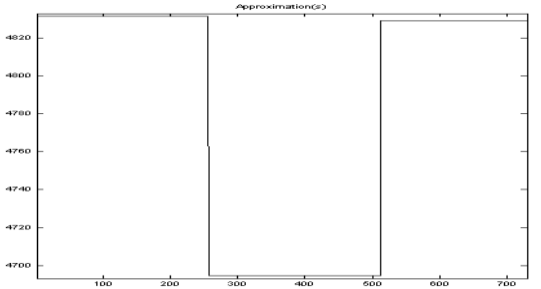
(a)



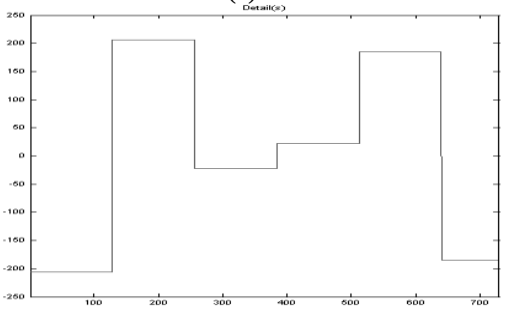
(b)

Figure 14

Figures 14, (a,b) depict the plot of upper panel approximation level 8 and lower panel details level 8 of msdF_2



(a)



(b)

Figure 15

CONCLUSION

In this paper we have presented an idea to find out the hidden periodicities in different processes quantifying the refractive index and skip distance for radio wave propagation of F_2 layer. The analyses have been carried out using FFT and wavelet techniques. I-D Haar 1-8 levels for approximation and decomposition details are obtained and other tests such as randomness and normality in data sets have been utilized. The results are verified that might be useful in Solar-terrestrial communication

We have constructed models expressions of refractive index and skip distance data. In the detailed and approximated parts at the lowest resolution several peaks are appeared that can be characterized. This paper will provide an insight for the personnel working in the field of ionospheric Physics and communication. The temporal fluctuations can be also identified in solar signals. We have constructed models of refractive index and skip distance data. In the detailed and approximated parts at the lowest resolution several peaks are appeared that can be characterized. This paper will provide an insight for the personnel working in the field of ionospheric Physics and communication. The temporal fluctuations can be also identified in solar signals.

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REFERENCES

1. Kennedy, G. (1985). *Electronic communication systems*. McGraw-Hill, Inc. New York.
2. Barclay, L.W. (2003). *Propagation of Radio Waves*. (2nd Ed.) Published by The institution of Electrical Engineers, London, United Kingdom.
3. Schunk, R.W. and Nagy, A.F. (2004). *Ionosphere, Physics, Plasma Physics and Chemistry*. Cambridge University Press.
4. Kato S. (1980). *Dynamics of the Upper Atmosphere*. D. Reidel, Boston.
5. Pandit, S.M. (1983). *Time Series and system analysis with application*. John Wiley & Sons, USA, P,24,29,119.
6. Chatfield, C. (1989). *The analysis of Time Series: An Introduction*. 4/e Chapman & Hall, London, 105-35.
7. Misiti, M., Misiti, Y., Oppenheim, G. and Poggi, J-M. (2007). *Wavelets and Their Applications*. ISTE, Ltd. USA, p13-23.
8. Van den Berg, J.C. (2004). Wavelets in Physics. Cambridge University Press, UK. P.8-15.
9. Shumway R.H. and Stoffer, D.S. (2008). Time series analysis and its applications. New Delhi, India. ISBN 978-81-8489-025-9.
10. Wall, J.V. and Jenkins, C.R. (2003). *Practical Statistics for Astronomers*. New York NY 10011-4211, USA. ISBN 0521 456169.

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Peshawar, Pakistan – March 16-18, 2015, Vol. 28, pp. 269-278

A NEW FRACTIONAL ORDER VARIATIONAL MODEL VIA WEIGHTED STATISTIC FOR MULTIPLICATIVE NOISE REMOVAL

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ABSTRACT

In this paper we proposed a new fractional order total variation (FOTV) based model via weighted statistic for restoration of images corrupted with multiplicative noise. Explicit time marching scheme is applied to find the solution of the corresponding Euler-Lagrange partial differential equation. Experimental results demonstrate that our proposed methodology improves the visual quality of the restored images as well as increase the peak signal to noise ratio (PSNR) over other existed methods.

KEY WORDS

Total Variation, Euler-Lagrange Equation, Discrete Fractional Order Differences, Speckle Noise, Image Restoration.

INTRODUCTION

Image de-noising is the inverse problem studied in signal and image processing community. An important task in image de-noising is the restoration or reconstruction of a original image u from an observation f. The problem includes additive and multiplicative noise removal. In many image formation models, the noise is often modeling as an additive Gaussian noise: given an original image u it is assume that it has been corrupted by some Gaussian additive noise v, the de-noising problem is then to recover u from the data $f = u + v$ where f is the observed image. There are many effective methods to tackle the problem like wavelets approach, stochastic approach, principal component analysis based approach, and variational approach.

In this paper we discuss the problem of multiplicative noise removal. The assumption is that the original image u has been corrupted by some multiplicative noise v the goal is then to restore u from the data as $f = uv$ where u is the original image and v is the multiplicative noise while f is the noisy image. Mostly multiplicative noise occur in active imaging system like laser images, microscopic images, synthetic aperture radar (SAR) images, signal particle emission computed tomography (SPECT) and positron emission tomography (PET). The problem of multiplicative noise removal has been discussed in many articles. In most useful articles the method of linear minimum mean square error approaches [1]-[2], Method of anisotropic diffusion [3]-[6]. We will focus on the variational based multiplicative noise removal, especially that our researches will emphasis on fractional-order total variation (TV) based method. Fractional-Order derivative has received considerable attention in signal and image processing fields. Fractional-Order model have been introduce [7]-[8]. Numerical results show that the

fractional-order model can eliminate spackle effect when the parameter are chosen appropriately. Moreover it preserve edges and textures of the image better than integer-order based total variation (TV). Also it perform well in reducing the staircase effect and minimizing the sign of artifacts around the edges. The total variation (TV) based variational model have received considerable attention in signal and image processing community. The 1st total variation-based multiplicative noise removal model (RLO) was presented by Rudin [9] which used a constrained optimization approach with two Lagrange multipliers. Multiplicative model (AA-model) with a fitted term derived from a maximum a posteriori (MAP) was introduce by Aubert and Aujal [10], Recently Shi and Osher [11] adopted the data term of AA-model but to replace the regularizer TV(u) by TV($logu$), steidl and teuber [12] introduce a variational restoration model consisting of the I-divergence as data fitting term and the TV semi-norm as a regularizer.

This paper is organized as follows. In section 2 we proposed a new variational model for image de-noising based on fractional order derivatives, including brief description of our multiplicative noise removal model. We use the new algorithm to solve the proposed model by introducing a weighted statistic in the fidelity term of AA-model. Applying the discrete fractional order differences to solve the Euler-Lagrange PDE of our proposed model in section 3. In section 4 we report experimental results which show that our proposed methodology cannot only better improve the peak signal to noise ratio but also perform better to eliminate the blocky effects, and the paper is concluded in section 5.

THE PROPOSED MODEL

Multiplicative noise removal is central to the study of coherent imaging system and appear in many applications, given a noisy image f we want to obtained decomposition as $f = uv$ where u is the original image and v is the multiplicative noise with mean 1 and different variancesδ^2. In this paper we propose fractional-order total variation based model for multiplicative noise removal as follows

$$\min_{\top}(u > 0)\ \{J\_\alpha\ (u) + \psi(u)|\log(u) + \frac{f}{u|,1<\alpha<2\}}\}, \tag{1}$$

where the 1st term $J_\alpha(u) = \int_\Omega \sqrt{(D_h^\alpha u)^2 + (D_v^\alpha u)^2}\, dxdy$ is the fractional-order ($\alpha^{th}\ order$) total variation of u, which imposes some prior constraints on the original image u and determines the quality of the recovery image f. $D_h^\alpha u$ and $D_v^\alpha u$ are the α^{th} order partial derivatives of u. The second term is the image fidelity or fitting term which measures the violation of the relation between original image u and noisy or observed image f, and we adopt $\psi(u) = \alpha_1 + \alpha_2(u)$, $\alpha_1$and α_2 are the regularization parameters.

The formal Euler-Lagrange equation of functional (1) can be written as

$$\partial J_\alpha(u) + \alpha_2\left(\log(u) + \frac{f}{u}\right) + \frac{\alpha_1+\alpha_2 u}{u^2}(u - f) = 0, \tag{2}$$

$$\frac{\partial u}{\partial t} = 0,$$

where $\partial J_\alpha(u) = \nabla^\alpha . \left(\frac{\nabla^\alpha(u)}{|\nabla^\alpha(u)|}\right)$ to simplify, we assume $u = R^{N\times N}$and $p = (p^1, p^2)$ with $p^1, p^2 \in R^{(N\times N)}$and used the discrete fractional-order gradient $\nabla^\alpha(u)$ and fractional-order divergence $div^\alpha(u)$ can be defined in [8] as

$$\nabla^\alpha u = \left[\left(\sum_{k=1}^{K-1}(-1)^\alpha C_k^\alpha u_{i-k}^j\right)_{i,j=1}^n, \left(\sum_{k=1}^{K-1}(-1)^\alpha C_k^\alpha u_{i-k}^j\right)_{i,j=1}^n\right],$$

$$div^\alpha p = \left[(-1)^\alpha \sum_{k=0}^{K-1}(-1)^k C_k^\alpha \left(p_{i+k,j}^1 + p_{i,j+k}^2\right)\right],$$

where $C_k^\alpha = \frac{\Gamma(\alpha+1)}{k!\Gamma(\alpha-k+1)}$ is the generalized binomial coefficients, $\Gamma(*)$ is the Gamma function and $k \in Z^+$, by using the Grunwald-Litnikov fractional-order partial differences which can be defined in [8].

The solution procedure uses a parabolic equation with time as an evaluation parameter. This means that we solve

$$\frac{\partial u}{\partial t} = \partial J_\alpha(u) + \alpha_2\left(\log(u) + \frac{f}{u}\right) + \frac{\alpha_1+\alpha_2 u}{u^2}(u - f), \tag{3}$$

where

$$\lambda(u) = \frac{\alpha_1+\alpha_2 u}{u^2}.$$

Solving this non-linear fractional partial differential equation by iteration method, we can obtained the approximate de-noised image.

NUMERICAL METHODS

In this paper, as an application we propose to use algorithm to solve numerically (3) as arisen from the minimization of our energy functional (1).

EXPLICIT TIME MARCHING SCHEME

The fractional partial differential equation (3) can be solved numerically using an iterative approach. Assuming a time step size of δt and space grid size of h. We quantize the space coordinates as follows

$$x = ih, y = jh \; here \; i, j = 0,1,2,3.... I.$$

or image problem we will take $h = 1$ and image size is $(I \times I)$.

Finally, Explicit time marching scheme for the fractional partial differential equation (3) is given by

$$u_{i,j}^{n+1} = u_{i,j}^n + \delta t\left\{\partial J_\alpha(u^n) + \alpha_2\left(\log(u^n) + \frac{f}{u^n}\right) + \lambda(u^n)(u^n - f)\right\}$$

With symmetric boundary conditions

$$u_{-1,j}^n = u_{0,j}^n, u_{i+1,j}^n = u_{i,j}^n \; j = 0,1,2 \ldots I$$

and

$$u_{i,-1}^n = u_{i,0,}^n u_{i,j+1}^n = u_{i,j,}^n \; i = 0,1,2 \ldots I$$

Algorithm

Explicit time marching scheme for FPDE (3)

1. Procedure
2. Input $\left(k, \alpha_1 > 0, \alpha_2 > 0, \in > 0, l_{\max\ ,u^0=f}\right)$
3. Let $u_0^n = u^{n-1}$, numerically calculated
4. Compute u^{n+1} as follows
   $$u_{i,j}^{n+1} = u_{i,j}^n + \delta t \left\{\partial J_\alpha(u^n) + \alpha_2 \left(\log(u^n) + \frac{f}{u^n}\right) + \lambda(u^n)(u^n - f)\right\}$$
   where
   $$\lambda(u) = \frac{\alpha_1 + \alpha_2 u}{u^2}$$
5. Checking stopping criteria $\frac{|f-u|^2}{|u|^2} \leq 10^{-1}$ or n attain $l\_\max$ stop iteration; otherwise $n = n + 1$
6. $u^n = u^{n+1}$

End procedure

We present numerical results for image de-noising obtained by our method. As an objective evaluation index of de-noising performance, and the parameter α_1 and α_2 are chosen so the best peak signal to noise ratio is obtained. For the PSNR, we use the expression as follows

$$PSNR = 10 \log_{10} \frac{\max_{0 \leq i,j \leq M-1} |f_{i,j}|^2}{\frac{1}{M^2} \sum_{i=0}^{M-1} \sum_{(j=0)}^{M-1} (f_{i,j} - u_{i,j})} .$$

NUMERICAL EXPERIMENTS

In this section, three experiments are given to assess the capability and effectiveness of removing noise and reducing staircase effect of our proposed fractional-order total variation model. We also compare it with some existing other one .we have tested our algorithm (ETMS) on different images (real and synthetic) of size (256^2) contaminated by Gamma distributed multiplicative noise with different variances (the noisy images with noise variance $\delta^2 = 0.1, 0.03$ and 0.01). The images in Fig.(a) is noisy image while Fig.(b) and Fig.(c) are noiseless(de-noised) images cleared by AA-model and our proposed model respectively.

Original Images

Fig. 1: Original image: (a) Face (b) Lena (c) Peppers

Experiment.1

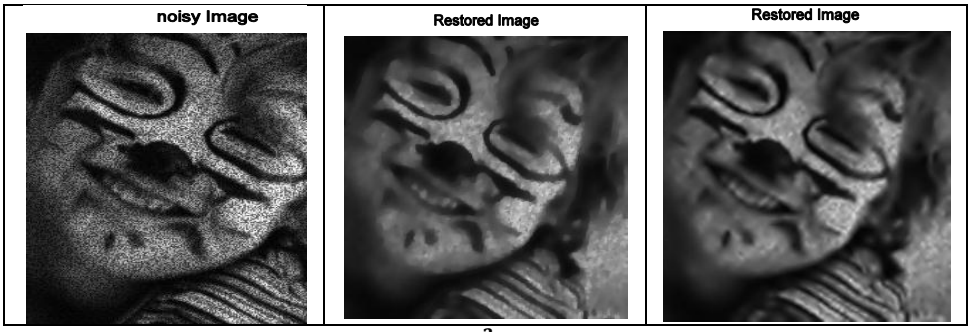

Fig. 2: (a) Problem.1 with variance δ^2=0.1 (b) De-noised image by AA-model with number of iterations = 26. (c) De-noised image by ETMS with number of iteration=970. Choosing regularization parameters are $\alpha_1 = 0.09$ and $\alpha_2 = 0.0003$.

Fig. 3: (a) Problem.1 with variance δ^2=0.01 (b) De-noised image by AA-model with number of iterations= 5. (c) De-noised image by ETMS with number of iteration=200. Choosing regularization parameters are $\alpha_1 = 0.09$ and $\alpha_2 = 0.0003$.

Fig. 4: (a) Problem.1 with variance δ^2=0.03 (b) De-noised image by AA-model with number of iterations= 12. (c) De-noised image by ETMS with number of iteration=450. Choosing regularization parameters are $\alpha_1 = 0.09$ and $\alpha_2 = 0.0003$.

Experiment.2

Fig. 5: (a) Problem.2 with variance δ^2=0.1 (b) De-noised image by AA-model with number of iterations= 32. (c) De-noised image by ETMS with number of iteration=1400. Choosing regularization parameters are $\alpha_1 = 0.09$ and $\alpha_2 = 0.0003$.

Fig. 6: (a) Problem.2 with variance δ^2=0.01 (b) De-noised image by AA-model with number of iterations= 10. (c) De-noised image by ETMS with number of iteration=250. Choosing regularization parameters are $\alpha_1 = 0.09$ and $\alpha_2 = 0.0003$.

Fig. 7: **(a) Problem.2 with variance δ^2=0.03 (b) De-noised image by AA-model with number of iterations= 16. (c) De-noised image by ETMS with number ofiteration=700. Choosing regularization parameters,$\alpha_1 = 0.09$ and $\alpha_2 = 0.0003$.**

Experiment.3

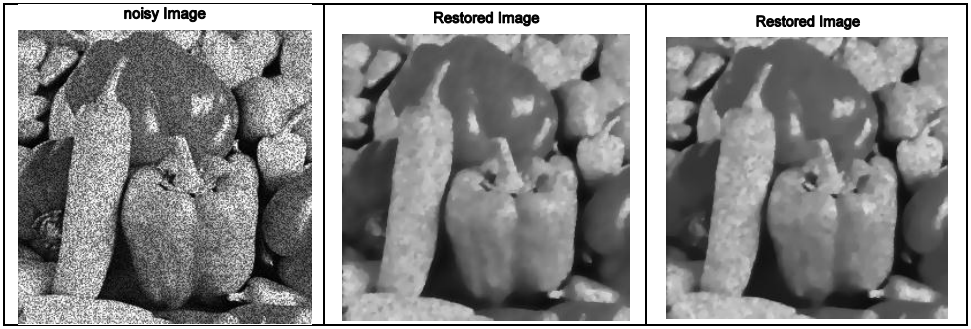

Fig. 8: **(a) Problem.3 with variance δ^2=0.1 (b) De-noised image by AA-model with number of iterations= 41. (c) De-noised image by ETMS with number of iteration=1500. Choosing regularization parameters are $\alpha_1 = 0.09$ and $\alpha_2 = 0.0003$.**

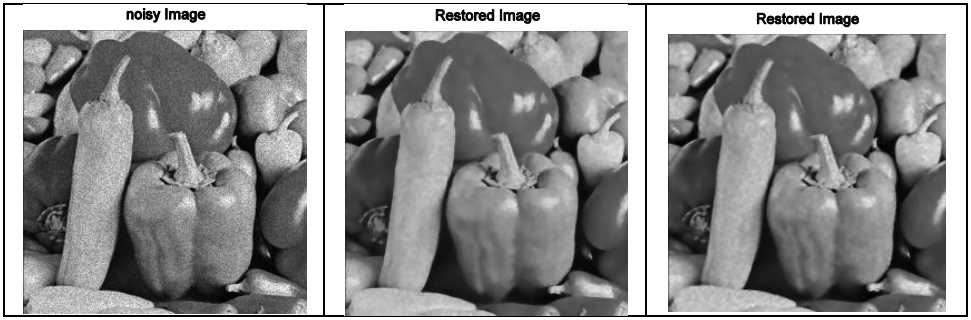

Fig. 9: **(a) Problem.3 with variance δ^2=0.01 (b) De-noised image by AA-model with number of iterations= 10. (c) De-noised image by ETMS with number of iteration=310. Choosing regularization parameters are $\alpha_1 = 0.09$and $\alpha_2 = 0.0003$.**

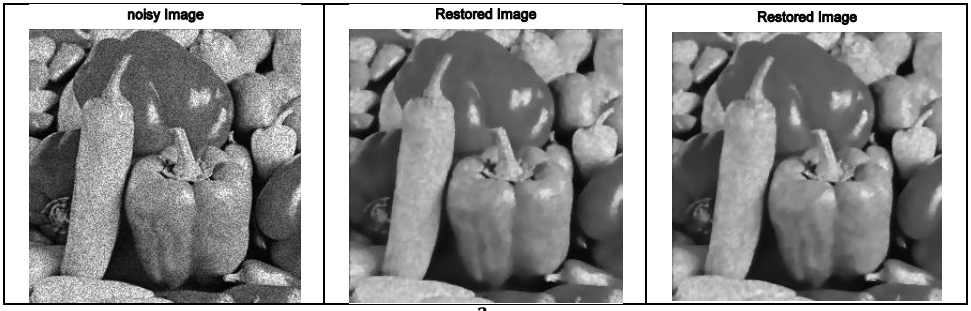

Fig. 10: (a) Problem.3 with variance δ^2=0.03 (b) De-noised image by AA-model with number of iterations= 22. (c) De-noised image by ETMS with number of iteration=750. Choosing regularization parameters, $\alpha_1 = 0.09$ and $\alpha_2 = 0.0003$.

Table for Problem.1

Images	Size n^2	Variance δ^2	alpha α	AA-Model		alpha α	Our Proposed Model	
				Iterations	PSNR		Iterations	PSNR
Face	256^2	00.1	1.2	26.00	28.715	1.9	970.0	29.852
Face	256^2	00.01	1.4	05.00	36.036	1.9	200.0	36.334
Face	256^2	00.03	1.3	12.00	31.901	1.9	450.0	33.240

Table 1: Comparison of AA-model, and our proposed model (256^2) with PSNR (peak signal to noise ratio).

Table for Problem.2

Images	Size n^2	Variance δ^2	alpha α	AA-Model		alpha α	Our Proposed Model	
				Iterations	PSNR		Iterations	PSNR
Face	256^2	00.1	1.3	32.00	25.761	1.1	1400.0	25.822
Face	256^2	00.01	1.0	10.00	31.358	1.6	250.0	31.447
Face	256^2	00.03	1.2	16.00	28.482	1.1	700.0	28.499

Table 2: Comparison of AA-model, and our proposed model (256^2) with PSNR (peak signal to noise ratio).

Table for Problem.3

Images	Size n^2	Variance δ^2	alpha α	AA-Model		alpha α	Our Proposed Model	
				Iterations	PSNR		Iterations	PSNR
Face	256^2	00.1	1.1	41.00	26.172	1.1	1500.0	26.339
Face	256^2	00.01	1.2	10.00	32.095	1.5	310.0	32.130
Face	256^2	00.03	1.0	22.00	29.235	1.1	750.0	29.346

Table 3: Comparison of AA-model, and our proposed model (256^2) with PSNR (peak signal to noise ratio).

CONCLUDING REMARKS

In this paper, we proposed a new variational model for image de-noising based on fractional-order derivative by introducing a weighted statistic in fidelity term of AA-model and use the discrete fractional-order difference to implement the numerical algorithm. Our iterative algorithm based on the linearization technique for the associated nonlinear Euler-Lagrange equation and demonstrate the good performance of the model on some experimental results. Our algorithm cannot only remove noise but also reduce the staircase effect, and therefore can improve the result (PSNR) as compare to the AA-model**.**

REFERENCES

1. Lee, J.S. (1980). Digital image enhancement and noise filtering by use of local Statistic. *IEEE Transaction on pattern Analysis and Machine Intelligence*, 2(2), 165-168.
2. Kuan, D.T., Sawchuk, A.A., Srand, T.C. and Chavel, P. (1985). Adaptive noise smoothing filter for image with signal dependent noise. *IEEE Transaction on pattern Analysis and Machine Intelligence*, 7(2), 165-177.
3. Yu, Y. and Acto, S.T. (2005). Speckle reducing anisotropic diffusion. *IEEE Transaction on Image Processing*, 15(9), 1260-1270.
4. Aja-Fernandez, S. and Alberola-Lopez, C. (2006). On the estimation of the Coefficient of variation for anisotropic diffusion speckle filtering. *IEEE Transaction on the Image Processing*, 15(9), 2694-2701.
5. Krissian, K., Westin, C.F., Kikinis, R. and Vosburgh, K.G. (2007). Oriented Speckle reducing anisotropic diffusion. *IEEE Transaction on Image Processing*, 16(5), 1412-1424.
6. Liu, G., Zeng, X., Tian, F. Li, Z. and Chaibou, K. (2009). Speckle reduction bye adaptive Window anisotropic diffusion. *Signal Processing*, 89(11), 2233-2243.
7. Bai, J. and Feng, X.C. (2007). Fractional-Order Anisotropic Diffusion for Image Denoising. *IEEE Transaction in Image Processing*, 16(10), 2492-2502.
8. Zang, J. and Wei, Z.H. (2011). A class of fractional-order multi-scale variational Models and alternating projection algorithm for image denoising. *Applied Mathematical Modeling*, 35(5), 2516-2528.
9. Rudin, L.I., Lion, P.L. and Osher, S. (2003). *Multiplicative denoising and deblurring: Theory and algorithm, in geometric level set Methods in Imaging, Vision*, and Graphics, S. Osher and N. Paragios, Eds., pp, 103-120, Springer, Berlin, Germany.
10. Aubert, G. and Aujol, J.F. (2008). A variational approach to remove multiplicative Noise. *SIAM Journal on Applied Mathematics*, 68(4), 925-946.
11. Shi, J. and Osher, S. (2008). A nonlinear inverse scale space method for a convex Multiplicative noise. *SIAM Journal on Imaging Sciences*, 1(3) 294-321.
12. Steidle, G. and Teuber, T. (2010). Removing multiplicative noise by Douglas – Rachford splitting method. *Journal of Mathematical Imaging and Vision*, 36(2), 168-184.

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IMPACT OF POLITICAL AND CATASTROPHIC EVENTS ON STOCK RETURNS

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ABSTRACT

This study intends to find the impact of political and catastrophic events on stock returns of Karachi Stock Exchange (KSE-100 Index). A total of forty three political and four catastrophic events have been considered from May 1998 to September 2013. Political events are further divided into two groups i.e., favorable political events and unfavorable political events. The impact is checked for political, catastrophic, favorable political and unfavorable political events for 1 day, 5 days, 10 days and 15 days event windows. The results suggest that mean returns before and after political events were different on 5 days window. Thus, political events do have an impact on stock returns, however, it does not last longer and returns are normalized afterwards. Similarly, favorable political events also have impact on stock returns only on 5 days window. Unfavorable political events show abrupt (one day) impact and 5 days impact. Catastrophic events show no impact on stock returns using 1 day, 5 days and 10 days event windows. However, the impact was observed on 15 days event window. These results indicate that Karachi Stock Exchange is inefficient in semi strong form.

KEY WORDS

Political Events, Catastrophic Events, Stock Returns.

1 INTRODUCTION

The stock market movements have been keenly studied by many researchers (e.g., Schwert, 1989; Cutler, Poterba & Summers, 1989; Fair, 2002; Kim, 2003). The purpose is to find out factors that have an impact on stock returns. This strand of research is thought to be connected with the Efficient Market Hypothesis[1]. The factors identified by researchers are economic factors (announcements about interest rates, foreign exchange rate, dividend policy etc.), political events and catastrophic events along with many others (Suleman, 2012).

Studies on catastrophic and political news suggest that these events affect stock markets. It is considered that news about political decisions, which could potentially influence domestic and foreign policy are responded by stock markets. According to Tan and Gannon (2002), news that increases investors' expectations should increase the prices and vice versa.

[1] This hypothesis assumes all news and announcements are fully accommodated in stock prices and that excessive earnings and abnormal returns are not possible.

Over the years, Pakistan has experienced active political issues and involvements and has witnessed many catastrophes (Chari, 2010). The control of government has oscillated between democratic parties and military dictatorship and the real concept of democracy still remains a paradox. It is the urge for power that drives military to be actively participating in politics (Taha, 2012).

In sixty six years there have been three constitutions and the latter one of 1973 yet facing amendments. However, in the last fifteen years i.e., 1998-2013, the country has gone through some major political and catastrophic events (e.g., Musharraf government's demise, earth quake and floods). After the nuclear tests in May 1998, Pakistan has faced excessive international pressure in the form of economic sanctions (Taha, 2012). The democratic government was dismissed and the military government of Musharraf took over on October 12, 1999. Even though in 2002, civilian government was restored yet Musharraf remained president for next five years. Further, he suspended the Chief Justice and announced emergency. However, after his resignation democratic government was formed, which for the first time in history completed its tenure. Unfortunately, Pakistan is also facing the menace of terrorism that creates anarchy (Kronstadt, 2008).

Pakistan was also badly hit by natural catastrophes including earthquakes in 2005 and floods in 2007 and 2010 (NDMA, 2010). The role of stability is of immense importance to economic development and growth (Memon, Memon, Shaikh, & Memon, 2011).

It is important to understand how the political and catastrophic events have affected the returns of Karachi Stock Exchange (KSE), which is the largest stock exchange of the country). The study contributes to the literature as it uses a more expanded time frame considering all the major political and catastrophic events. It observes the impact using four different event windows to get better results. It even observes the impact of favorable and unfavorable events separately.

We observe that political events do have an impact on stock returns in the short run, i.e., 5 days window and are normalized afterwards. The impact of catastrophic events is observed only on 15 days window. Thus, we conclude that KSE is inefficient in semi strong form.

The remaining paper is organized as follows. Section 2 discusses the literature review and hypothesis development. Section 3 describes the methodology. Section 4 contains data analysis and interpretation while section 5 concludes the paper.

2. LITERATURE REVIEW AND HYPOTHESES

2.1 Literature Review

Efficient Market Hypothesis states that stock prices contain the effect of all available information which restricts investors from earning extra than normal returns (Fama, 1970). Further Fama (1970) introduced the distribution of Efficient Market Hypothesis into three sub divisions, i.e. Weak form, Semi Strong form and strong form.

The view that historical information about stock prices and returns are entirely reflected in current prices is Weak form of Market Efficiency. It includes information about company announcements, dividend announcements, interest rates etc. (Fama,

1991). Semi strong form of efficiency is considered to exist when stock prices wholly adjust all publically available information and do not allow investors to earn over than normal returns. While when stock prices fully accommodate insider's information the market is said to be efficient in strong form.

Many studies suggest that markets may not be efficient allowing investors to earn abnormally. Researchers worked on market anomaly which is that exceptional condition of stock returns when they deviate from their normal or regular pattern (George & Elton 2001). Silver (2011) further elaborated financial market anomalies as the condition in which stock price behavior violates the concept of efficient market hypothesis. Many studies confirm the existence of market anomalies by comparing stock returns before and after an event (see also Ariel, 1987; Jaffe & Westerfield, 1989; Boudreaux, 1995). However some studies have reported non-occurrence of this abnormal behavior as well (Cadsby & Ratner, 1992).

Publically available information includes political, economic and catastrophic news along with other news which may end up violating semi strong form of market efficiency (Fama, 1970). So far, various studies have been done to find stock prices' sensitivity towards economic, political and catastrophic news using different stock markets (Cutler, Poterba & Summers, 1989; Shelor, Anderson, & Cross, 1990; Bittlingmayer, 1998).

Economic variables are considered to have an impact on stock prices and to check the relationship various studies have been conducted. The researchers concluded with mixed results. For example, Frank and Young (1972) & Patra and Poshakwal (2006) confirm that exchange rate either have no or very weak impact on stock prices. The opposite results were concluded too in some cases i.e. stock prices were strongly affected by exchange rate (Kim, 2003; Ahmad, Rehman & Raoof, 2010). Interest rate, another economic variable, has been reported to affect stock prices too (Kim, 2003; Rehman & Raoof , 2010). Likewise, other key economic variables like inflation and money supply have also been reported to have an impact on stock prices (Patra & Poshakwale, 2006).

Considering the importance of stock returns stability, the impact of political events on stock returns has been observed for both developed and emerging markets. Niederhoffer (1971) used 16 years data from 1950 to 1966 and concluded that stock prices do change due to political events. Liblang and Mukherjee (2005) used US and UK's Presidential and partisan elections as dummies for political events and checked its impact on the stock prices. They included all the presidential elections between 1930-2000. They ended up with the conclusion that stock prices are historically been affected by presidential elections and partisan political policies in the US and UK.

However, Fair (2002) came up with different results for the US stock market. After identifying big price changes he tried to find if they were because of any political and economic news. He used data from 1982 to 1999 which included future prices for 4417 trading days. He could only identify 220 days with any big price change and only 69 could be related with any political or economic news. So he concluded that events or news (political or economic) may not be the cause of big stock price movements.

Beaulieu, Cosset and Essaddam (2005) used the news (70 news announcements) about Quebec separation to find whether those political news have any impact on stock

returns and their volatility or not. They concluded that stock prices and their volatility were significantly affected by the political news announcement regarding Quebec separation.

Similar study was conducted for Germany by Bittlingmayer (1998) who used political events occurring between 1880 and 1940. He affirmed the impact of political events on stock prices in Germany for the mentioned period. However, Dopke and Pierdzioch (2004) while using all the presidential elections from 1960 to 2002 as proxies for political events find no strong evidence to conclude that political process and events causes stock market movements. Furthermore, average returns before and after the elections were reported to be not significantly different.

Fuss and Bechtel (2008) further advanced the case and tried to check this impact for small, mid and large cap firms. They concluded that only small firms are affected by political events while mid and large cap firms remain unaffected. However, Government changeover results in new policies which affect stock returns and their volatility.

Similarly Cutler et al., (1989) observed a very small and insignificant impact using 49 events from 1941 to 1987.

Onder and Mugan (2006) used two emerging markets i.e. Turkey and Argentina for their study. They analyzed the data from Jan 1995 to Dec 1997, and concluded that political events have an impact on stock prices but it was not reported to be much significant. Using Taiwan's stock market as their playground for their study Chen, Bin, and Chen (2005) reported that political events have a very significant impact on stock prices. Their dataset consisted of 9 political events from Jan 1995 to Dec 1997. They further reported that positive news causes positive while negative news causes negative abnormal returns.

Kim and Mei (2001) checked the mentioned affect for Hong Kong's Hang Seng Index. Using political events happening between 1989 and 1993 they reported a significant impact of political events on stock prices in Hong Kong stock market. Using three news related to Macedonian name issue Angelovska (2011) also confirmed a significant impact of these news on Macedonian Stock Exchange.

Zach (2003) considered events from 1993 to 1997 to find its impact on the Israeli Stock Exchange "The Mishtanim Index". He found significantly extreme and volatile stock returns on the days when a political event happened than non-event days. Kutan and Perez (2002) used Columbia as their playground to find this relationship. They considered 951 political events and 106 kidnapping events happening during 1996-2000. Their study showed that stock returns significantly changes due to political uncertainty, elections and violence like kidnapping.

Aggarwal, Inclan and Leal (1999) identified large shifts in stock returns from 1985 to 1987 in emerging markets and tried to relate them with political events as their cause. Their sample consisted of 10 emerging markets and 6 major markets. They concluded that all those identified stock returns' shifts were caused by local political events in emerging markets. While the only global event to cause any domestic stock returns' volatility in emerging markets was the 1987 Crash.

Ma, Sun and Tang (2003) conducted a similar study in an attempt to find the impact of Tiananmen Accident in China on US firms having joint ventures in China. They concluded that this event has a significant impact but small in magnitude on US firms having joint ventures in China. However, it was a short term rather than long term impact.

Very few studies have been performed in Pakistan in this area. Malik, Hussain and Ahmad (2009) compared 6 months data before Musharraf resignation with after resignation 6 months data. Their results showed that stock returns in KSE were significantly affected by Musharraf's resignation decision which confirms the impact of political events on stock prices.

The impact of natural disasters/catastrophes on stock returns has also been investigated by researchers. Shelor et al. (1990) studied the impact of 1989's Californian Earthquake on the stock returns of US real estate firms. Their results varied by regions; as stock returns of firms operating in San Francisco were affected while others were not. Overall, there was no significant impact of Californian Earthquake on stock returns.

Stock returns reaction to 42 catastrophic events happening in Australian has been tested by Andrew, Valadkhani and Worthington (2004). They use forty two events between 1982 and 2002. They conclude that stock returns before and after catastrophes are significantly different. However, it varies from sector to sector.

Wan (2011) used eighty two natural disasters happening in Japan between 1982 and 2011 to check whether these events have an impact on Nekkei 225. These events included Earthquakes, Tsunamis and volcano eruptions. He finds no direct impact of these events on Nekkei 225 returns.

Javid (2007) studied the impact of October 2007 Earthquake on stock returns for Pakistan. Using a sample of sixty firms listed on KSE, he found no significant impact of this Earthquake on the stock returns and volatility of the overall sample. However, stock returns of firms operating in cement, food, steel and banking sectors increased.

Stability of the stock market plays a vital role in the economic growth of a country (Levine & Zervos, 1998). Pakistani stock market (KSE) has got so much fluctuation in the recent years. It is important to know what could be the potential cause of this abnormal and instable behavior. According to Ball and Brown (1968) accounting numbers i.e., company specific information leads to stock market movements. However, the above discussed studies state other factors such as political and catastrophic events to be one of the causes as well. Therefore, this study intends to find whether political and catastrophic events have an impact on stock returns. It will also give an idea that how much time a market takes to absorb news about events.

From the above discussed literature it is obvious that this impact has been investigated using very limited dataset considering very few events. According to Ahmed et al. (2009), researchers should add more events and extend the time frame to get a better insight of this relationship in Pakistan. Also studies investigating the impact of catastrophes are very a few in number in Pakistan. Many catastrophes have struck Pakistan in the recent past and their impact needs to be observed. Considering several events in one study will bring more valuable insights regarding the stock returns'

response to these political and catastrophic events (Andrew, Valadkhani & Worthington, 2004).

2.2 Hypotheses

Based on the discussion so far, we form the following hypotheses.

H1: Mean Index returns before and after the occurrence of political events are different.

H2: Mean Index returns before and after the occurrence of catastrophic events are different.

H3: Mean Index returns before and after the occurrence of favorable events are different.

H4: Mean Index returns before and after the occurrence of unfavorable events are different.

3. METHODOLOGY

Two different variables are involved in this study. Political and catastrophic events as independent and stock returns as dependent variable. Political and catastrophic events are measured by dummy variables. Days before these events take value "0" and after the event days take value "1". This study used stock returns as the dependent variable as it tries to check whether stock returns are affected by political and catastrophic events or not. KSE-100 stock returns before and after the occurrences of political and catastrophic events were collected and investigated. This study used logarithmic returns to solve the problem of unit root making data stationary.

$$Rt = \ln (Pt/Pt-1)$$

where

Rt is the logarithmic return
Pt is the Current Day return
Pt-1 is the Previous Day return

Political and catastrophic events happening from May 1998 to September 2013 are considered in this study. The motive behind selecting this time frame is Pakistan's volatile political structure and catastrophic disturbances during these years. We observed much foreign political involvement in Pakistan during this era. Similarly, many high impact disastrous natural calamities and catastrophes struck Pakistan during this time frame. It accounts for the most current political and catastrophic events that have not been considered in the previous studies along with some earlier events that were missed previously.

4. DATA COLLECTION AND ANALYSIS

To test the hypotheses secondary data has been used. It required two kinds of data, one about stock prices while the other dataset about political and catastrophic events. Data about KSE stock returns has been obtained from Yahoo Finance. It consists of a total of 3790 observations from May 5, 1998 to September 30, 2013.

Data about Political and Catastrophic events has been obtained from Pakistan's leading newspapers and some international sources. Pakistani newspapers accessed were Dawn, Daily Times, The Nation and The Statesman. International sources included BBC and CNN.

Table 1 and 2 respectively, presents political and catastrophic events used in the study along with their days of occurrence and division as either favorable or unfavorable events. This study includes all those events that make a story in majority of the above mentioned sources of information. Events which were timely communicated across the country and appeared in international news and investors being aware of those were included.

The rationale behind this was to include all the authentic and publically known events. It increases the possibility that all investors have the knowledge of these events before making their investment decisions. Thus all these events could possibly have significance. A total of 43 political and 4 catastrophic events have qualified to be considered in the study (see in Table 1). Also the political events are sub-divided into 26 favorable and 17 unfavorable events.

Table 1: Date wise Political Events

No.	Event	Date of Occurrence	Nature
1	Mamnoon Hussain elected as President	09/09/2013	Favorable
2	Nawaz Sharif elected as Prime Minister	05/06/2013	Favorable
3	General Elections	11/05/2013	Favorable
4	Tahir-ul-Qadri set in	16/01/2013	Unfavorable
5	Yusaf Raza Gillani disqualified as Prime Minister	19/06/2012	Unfavorable
6	Memo case Scandal	17/11/2011	Unfavorable
7	NATO attack on Salala Check Post	26/11/2011	Unfavorable
8	Osama Bin Laden killed	02/05/2011	Favorable
9	Salman Taseer Assassination	04/01/2011	Unfavorable
10	18th Amendment	08/04/2010	Favorable
11	NRO abandoned	16/12/2009	Favorable
12	Swat Military Operation	12/05/2009	Unfavorable
13	Chief Justice restoration	16/03/2009	Favorable
14	Attack on Sri Lankan Cricket team	09/03/2009	Unfavorable
15	Asif Ali Zardari elected as President	09/09/2008	Favorable
16	PML(N) quit coalition with PPP	25/08/2008	Unfavorable
17	Musharraf Resignation	18/08/2008	Favorable
18	Yusaf Raza Gillani elected as Prime Minister	24/03/2008	Favorable
19	General Elections	18/02/2008	Favorable
20	Benazir Bhutto's Assassination	27/12/2007	Unfavorable
21	Emergency lifted	16/12/2007	Favorable
22	Elected Govt. tenure Completed	16/11/2007	Favorable
23	Benazir Bhutto back to Pakistan	18/10/2007	Favorable
24	Pervez Musharraf stepped down as Army Chief	18/09/2007	Favorable

No.	Event	Date of Occurrence	Nature
25	Nawaz Shareef back to Pakistan	10/09/2007	Favorable
26	Military Operation on Lal Masjid	3/07/2007	Unfavorable
27	Chief Justice suspended	09/03/2007	Unfavorable
28	Sardar Bugti killed	26/08/2006	Unfavorable
29	Shaukat Aziz elected as Prime Minister	28/08/2004	Favorable
30	Mir Zafar Ullah Jamali steps down to Ch. Shujaat Hussain as PM	26/06/2004	Unfavorable
31	Pakistan's readmission to Commonwealth	22/05/2004	Favorable
32	Musharraf won vote of confidence	01/01/2004	Favorable
33	Lahore-Delhi Bus service resumed	11/07/2003	Favorable
34	Senate elections	24/02/2003	Favorable
35	Mir Zafar Ullah Jamali elected as Prime Minister	23/11/2002	Favorable
36	General Elections	10/10/2002	Favorable
37	Musharraf wins Referendum	30/04/2002	Favorable
38	Daniel Pearl killed (WSJ reporter)	1/02/2002	Unfavorable
39	WTC and Pentagon attack (9/11)	11/09/2001	Unfavorable
40	Agra Summit (Musharraf Vajpayee talk)	15/07/2001	Favorable
41	Musharraf dismissed President	20/06/2001	Unfavorable
42	Musharraf dismissed Nawaz Sharif	12/10/1999	Unfavorable
43	Nuclear tests	28/05/1998	Favorable

Table 2: Date wise Catastrophic Events

No.	Event	Date of Occurrence
1	Earthquake	24/9/2013
2	Floods	26/07/2010
3	Floods	27/6/2007
4	Earthquake	8/10/2005

Fama (1991) titled studies which investigate the impact of publically available information on stock returns as an Event Study. This method compares the mean stock returns before and after the happening of an event or any publically available information. For this purpose Independent t-test has been used because it consists of two independent data groups i.e. before events data and after events data.

As discussed in the existing literature section that many studies have checked this impact however this research checked the impact considering four (4) different event windows. Cheng and Leung (2006) included six (6) different event windows in their study. They further suggested using different windows to get a better insight of events. It also helps in finding out when does stock prices reflect the information in case there is an impact.

Both of the data groups (i.e. political and catastrophic) have been separately analyzed for each of the four event windows. Also the same method was adopted for finding the impact considering favorable and unfavorable political events.

The four event windows used were (a) t= -1, t= +1 (b) t= -5, t= +5, (c) t= -10, t= +10 and (d) t= -15, t= +15. So the first window compares the mean returns for 1 day before and 1 day after the events. The second window compares mean returns for 5 day before and 5 days after the occurrence of the events. The third window considers comparing 10 days before and 10 days after the event mean returns. And finally event window four assumes finding 15 days before and after effect. Days before the occurrence of the events in each window takes value "0" while days after the event takes value "1".

Table 3 provides the descriptive statistics of the data being used.

Table 3: Descriptive Statistics

Observations	Mean	St. Deviation	Minimum	Maximum	Skewness	Kurtosis
489	0.0014	0.00890	-0.05	0.03	-.543	2.42
489	101.26	3.7	95.98	108.50	.572	1.047

The data consisted of 3790 observations from April 2, 1998 to Sep 30, 2013. The mean value for logarithmic returns was 0.0006 with a minimum value of -.1321 and maximum of .1276. The disparity in the minimum and maximum values for the data shows the wide range in stock returns on different days. The standard deviation is 1.61% which means that the data has some deviations from the average value. Also Kurtosis of 3.709 suggested the data to be slightly leptokurtic. The data has a skewness of -.322, which is close to 0 suggesting the data to be normal.

4.1 Impact of Political Events

Table 4 provides the empirical results for the tests observing the impact of political events.

Table 4: Empirical Results for Political Events

Test	1-day Window	5-days Window	10-days Window	15-days Window
Levene's test value	.045	0.025	0.105	0.155
P-value	0.2407	0.048	0.758	0.374

Levene's test was conducted to find whether the data would consider t-value for equal variances assumed or equal variances not assumed. The data is homoscedastic when there are equal variances and heteroscedastic when equal variances are not there. A value less than 5% means that there are no equal variances in the data i.e., heteroscedastic. In this case P-value stated in front of "Equal variances not assumed will be interpreted. While Levene's value greater than 5% means that the data is homoscedastic that is having equal variances. In this case P-value mentioned in front of "Equal variances assumed" would be interpreted.

Levene's value was less than 0.05 i.e. 0.045 and 0.025 for 1-day and 5-days event windows respectively. Thus in these two event windows P-values for equal variances not

assumed were considered. Levene's value was greater than 5% i.e. 0.155 and 0.105 for 10-days and 15-days event windows respectively. In those cases P-values for equal variances assumed were interpreted.

4.1.1 Impact of Political Events using 1-day Event Window

Referring to Table 4 the P-value using 1-day event window is 0.2407. This value is greater than 5% which means that the stock returns before and after political events were not different. So there is no impact of political events on stock returns using 1-day window.

4.1.2 Impact of Political Events using 5-days Event Window

The P-value for the study using a 5-days Event window is 0.048 which is smaller than 5%. The results suggest that stock returns after happening of political events changed significantly. Thus on 5-days window the study show the impact of political events on stock returns.

4.1.3 Impact of Political Events using 10-days Event Window

The result for 10-days event window is also in alignment with those for 1 and 5-days windows. The P-value 0.758>5% so even on 10-days window the study could not find any impact political events could have on stock returns.

4.1.4 Impact of Political Events using 15-days Event Window

Stock returns before and after the occurrence of political events are not different in case of 15-days window as the P-value 0.374>5%.

So using 5-days window the study confirmed the impact of political events on stock returns. That is the mean returns were reported to be different after political events. It showed the short term affect as the other windows fails to reject the null hypothesis.

4.2 Impact of Catastrophic Events

Table 5 summarizes the impact of catastrophic events on stock returns.

Table 5: Empirical results for catastrophic events

Test statistics	1-day Window	5-days Window	10-days Window	15-days Window
Levene's value	0.22	0.829	0.204	0.052
P-value	0.422	0.411	0.059	0.001

Table 5 presents the results about the impact of catastrophic events on the mean returns in KSE 100 index. Levene's values for all the four event windows were insignificant i.e. greater than 5%. This means that the data considered is homoscedastic. Thus P-values for "equal variances assumed" would be interpreted below.

4.2.1 Impact of Catastrophic Events using 1-day Event Window

Alike political events, the impact of catastrophic event has also been checked using four event windows. The P-value using 1-day window is 0.422 which is greater than 5%. This led to the conclusion that in case of 1-day window catastrophic events did not impact stock returns and thus not rejecting the null hypothesis.

4.2.2 Impact of Catastrophic Events using 5-days Event Window

The P-value for 5-days event window to determine the impact was 0.411. This value is again greater than 5% which led to the acceptance of the null hypothesis. Thus the mean returns before and after the occurrences of catastrophes were not different at 5-day windows.

4.2.3 Impact of Catastrophic Events using 10-days Event Window

The study could not find the impact of catastrophes on the mean returns as the P-value is 0.509 that is greater than 5%.

4.2.4 Impact of Catastrophic Events using 15-days Event Window

Using 15-days event window to check the impact of catastrophic events on mean returns the study showed different result than on the other event windows. The P-value of 0.001 is highly significant which indicates that the mean returns before and after the catastrophic events were significantly different. The mean returns before the events were 0.00343021 while it dropped significantly to -0.00410272 after the catastrophic events.

So catastrophic events did not impact the mean returns for 1, 5 and 10 days windows. The mean returns before and after the catastrophic events were not different. However, checking the impact using an event window of 15 days brought completely different results. In this case the mean returns were different before and after the events. The possible reason could be that for the first 10 days the investors were hoping the market to observe the pressure catastrophic events exerted. However the market could not adjust to the catastrophes and started showing abnormal returns as shown by the 15-days window results.

4.3 Impact of Favorable Political Events:

Table 6 summarizes the impact of favorable political events on stock returns.

Table 6: Empirical Results for Favorable Political Events

Test	1-day Window	5-days Window	10-days Window	15-days Window
Levene's test value	0.033	0.108	0.249	0.333
P-value	0.195	0.031	0.953	0.381

Table 6 shows results for the favorable events separately. Here also first we checked which P-value has to be interpreted. Levene's test indicated that except value for the 1-day window all values are insignificant. So the data in 1-day window is heteroscedastic and thus we will interpret the P-value for "equal variances not assumed". For the rest of the three event windows P-value for "equal variances assumed" will be interpreted.

4.3.1 Impact of Favorable Political Events using 1-day Event Window

Here one day before and one day after data has been used to study favorable events' impact on the mean stock returns. As shown in the table above the P-value is 0.195, which is greater than 5%. This lead us to conclude that mean stock returns before and after favorable political events are not different.

4.3.2 Impact of Favorable Political Events using 5-days Event Window

The P-value for the impact of favorable political events using 5-days event window is 0.031. This value is smaller than 5%. So, on the basis of this value it is concluded that the null hypothesis should be rejected. Thus, before and after mean returns are different and show an impact.

4.3.3 Impact of Favorable Political Events using 10-days Event Window

Moving on to find the impact using 10 days event window the study failed to find if favorable political events could have an impact on the mean stock returns. The P-value of 0.953>5%, thus, we could not reject the null hypothesis.

4.3.4 Impact of Favorable Political Events using 15-days Event Window

Even using 15-days before and after affect the study could not find any impact favorable political events could have on the mean returns. We accept the null hypothesis as the P-value 0.381>5%.

From the above stated results and discussions about the impact of favorable political events the study concluded that the mean returns before and after these events were not different using 1, 10 and 15 days windows. However, a significant impact was observed for 5 days window. Thus favorable political event only impact stock returns in shorter period. However this impact could not be confirmed in the longer period.

4.4 Impact of Unfavorable Political Events

Table 6 summarizes the impact of unfavorable political events on stock returns.

Table 6: Empirical Results for Unfavorable Political Events

Test	1-day Window	5-days Window	10-days Window	15-days Window
Levene's test value	0.697	0.082	0.187	0.247
P-value	0.023	0.037	0.681	0.759

Levene's values for all the four event windows used are greater than 5%. Thus, data was homoscedastic and P-values for equal variance assumed were referred to for interpretations.

4.4.1 Impact of Unfavorable Political Events using 1-day Event Window

Overall political events were divided into favorable and unfavorable events. Here the impact of unfavorable political events will be discussed. The P-value while using a 1-day event window is significant as this value 0.023<5%. Thus, we would accept the hypothesis i.e., the mean returns before and after unfavorable political events are different.

4.4.2 Impact of Unfavorable Political Events using 5-days Event Window

While using 5 days event window, the P-value is 0.037. This lead to the conclusion that even the impact of unfavorable political events is observed in the next five days after the events happens.

4.4.3 Impact of Unfavorable Political Events using 10-days Event Window

The P-value calculated suggests we cannot reject the null hypothesis even using 10 days event window. The P-value of 0.681, which is greater than 5% lead us to this conclusion.

4.4.4 Impact of Unfavorable Political Events using 15-days Event Window

The P-value 0.759 suggests that the mean returns before and after unfavorable political events are not different.

Based on the P-values calculated, the study concludes that unfavorable political events had abrupt impact on the mean returns for shorter periods of one and five days. However, by increasing the days of analysis the impact disappears.

5. CONCLUSION

The idea that stock prices absorb the effect of news and not allowing investors to make abnormal profit is termed as Efficient Market Hypothesis. This behavior of the market when observed during publically available information is considered to be the semi strong form of Market Efficiency. Political and catastrophic events also come in this category of publically available information.

During the last fifteen years many political and catastrophic events happened in Pakistan. Pakistan experienced both dictatorship and democracy in this era. Many important political and public figures got assassinated. Pakistan also experienced instability due to war on terror. Similarly there have been drastic catastrophes and natural calamities like earthquakes and floods. Because of these uncertain situations investors are pessimistic about the market. But there is a possibility that investors over weighted the impact of these events.

This research aimed to investigate the impact of political and catastrophic events happening in the last fifteen years in Pakistan on the KSE-100 Index returns. It considered forty three political and four catastrophic events from May 1998 to September 2009. The impact was checked using four different event windows to show when did stock prices started reacting to the news. Political events were reported to have a short time impact on stock returns. However, there was neither abrupt (one day) nor long lasting impact observed.

Political events included both favorable and unfavorable events collectively. Stock returns' response to both favorable and unfavorable events also were checked separately. There were twenty six favorable events and seventeen unfavorable events in the study. Favorable political events were reported to have an impact lasting for five days while unfavorable political events' impact was observed even on the first day after the events and lasting for five days. Therefore the impact of political events, favorable events could be observed for five days and not significant on 10 and 15 days window. While market responds to unfavorable events right on the next day till at least 5 days.

The results for catastrophic events were quite different. Stock prices did not respond to catastrophic events for the 1, 5 and 10-days event windows. However stock returns were reported to have been significantly affected by catastrophic events considering 15-days window. The possible reason could be the calculation of exact losses later on. This means that investors might have optimistic opinion about the catastrophic events that they would stop and won't cause much loss. However later on demand for stocks decreased which might be due to the uncertain and affected economic conditions resulting in negative stock returns.

In a nutshell, political events have an impact on stock returns for shorter period after which returns start adjusting. It makes KSE an inefficient market in semi strong form. While catastrophic events' impact on stock returns depend on the time when information about the exact severity and losses caused by catastrophic events were completely available to the investors. It means that stock returns do change because of political or catastrophic events. Investors should do cost and benefit analysis while investing in KSE for their fear regarding political and catastrophic uncertainty. They should invest only in sectors which prove to have no significant response to political and catastrophic events. They must also consider other factors (economic) that have a direct impact on stock returns.

REFERENCES

1. Aggarwal, R., Inclan, C. and Leal, R. (1999). Volatility in emerging stock markets. *The Journal ofFinancial and Quantitative Analysis,* 34(1), 33-55.
2. Angelovska, J. (2001). The Impact of political events -"Name issue" on an emerging Macedonian stock market. *Journal of Public Administration and Governance,* 01(02), 203-216.
3. Beaulie, M.C., Cosset, J.C. and Essaddam, N. (2005). The impact of political risk on the volatility of stock returns: The case of Canada. *Journal of International Business Studies,* 36(6), 701-718.
4. Bittlingmayer, G. (1998). Output, stock volatilty and political uncertainty in a natural experiment: Germany, 1880-1940. *Journal of Finance,* 53(06), 2243-2257.
5. Boudreaux, D.O. (1995). The monthly effect and international stock markets: Evidenceand implications. *Journal of Financial and Strategic Decision,* 8(1).
6. Cadsby, B. and Ratner, M. (1992). Turn-of-the-month and pre-holiday effects on stock returns: Some international evidence. *Journal of Banking and Finance,* 16(3), 497-509.

7. Chen, D.H., Bin, F.S. and Chen, C.D. (2005). The impact of political events on foreign institutional investors and stock returns: Emerging market evidence from Taiwan. *International Journal of Business*, 10(02), 165-188.
8. Cutler, D.M., Poterba, J.M. and Summers, L.H. (1989). What moves stock prices? *Journal of Portfolio Management*, 15(03), 8-12.
9. Dopke, J. and Pierdzioch, C. (2004). *Politics and the stock market- Evidence from Germany*. Working Paper, Kiel Institute of Working Papers.
10. Fair, R.C. (2002). Events that shook the market. *Journal of Business*, 75(4).
11. Fama, E.F. (1970). Efficient capital markets: A review of theory and emphirical work. *The Journal of Finance*, 25(2), 383-417.
12. Fama, E.F. (1991). Efficient capital markets: II. *The Journal of Finance*, 46(5), 1575-1617.
13. Franck, P. and Young, A. (1972). Stock price reaction of multi national firms to exchange reallignment. *Financial Management*, 1, 66-73.
14. Fuss, R. and Bechtel, M.M. (2008). Partisan politics and stock market performance: The effect of expected government partisanship on stock returns in the 2002 general federal elections. *Public Choice*, 135(3), 131-150.
15. George, M. and Elton, G. (2001). Anomolies in finance, what are they and what are they good for? *International Review of Financial Analysis*, 10, 22.
16. Grossman, S.J. and Shiller, R.J. (2001). *The determinants of the variability of stock market prices*. NBER Working Paper Series.
17. Javid, A.Y. (2007). Stock market reaction to catastrophic shock: Evidence from listed Pakistani firms. *PIDE Working Papers*, 37.
18. Jeffery, J.F. and Westerfield, K.D. (1989). Earnings yields, market values and stock returns. *Journal of Finance*, 44(1).
19. Kim, H.Y. and Mei, J. (2001). What makes the stock market jump? An analysis of political risk on Hong Kong stock returns. *Journal of International Money and Finance*, 20(07), 1003-1022.
20. Kim, K.H. (2003). Dollar exchange rate and stock price: Evidence from multivariate cointegration and error correction model. *Review of Financial Economics*, 301-313.
21. Kutan, A.M. and Perez, S.M. (2002). *Does organized crimes affect stock market development? Evidence from Colombia*. The Emerging Market Groups, Working Paper, Cass BusinessSchool, London.
22. Leblang, D. and Mukherjee, B. (2005). Government partisanship, elections, and the stock market: Examining American and British stock returns, 1930-2000. *Journal of Political Science*, 49(04), 780-802.
23. Levine, R. and Sara, Z. (1998). Stock markets, banks and economic growth. *The American Economic Review*, 88(3), 537-588.
24. Ma, Y., Sun, H.L. and Tang, A.P. (2003). The return and volume effects of political-risk event on foreign joint ventures: Evidence from the Tiananmen square crisis. *Global Financial Journal*, 49-64.
25. Malik, S., Hussain, S. and Ahmed, S. (2009). Impact of political event on trading volume and stock returns: The case of KSE. *International Review of Business Research Papers*, 05(04), 354-364.
26. Niederhoffer, V. (1971). The analysis of world events and stock prices. *Journal of Business*, 44(02), 193-219.

27. Onder, Z. and Mugan, C.S. (2006). How do political and economic news affect emerging markets? Evidence from Argentina and Turkey. *Emerging Markets Finance and Trade*, 42(04), 50-77.
28. Patra, T. and Poshakwale, S. (2006). Economic variables and stock market returns: Evidence from the Athens stock exchange. *Applied Financial Economics*, 993-1005.
29. Ray, B. and Brown, P. (1968). Emphirical evaluation of acconting income numbers. *Journal of Accounting Research*, 6(2), 159-178.
30. Shelor, R.M., Anderson, D.C. and Cross, M.L. (1990). The impact of California earthquake on real estate firms stock value. *The Journal of Real Estate Research*, 5(3), 335-340.
31. Silver, T. (2011). *Making sense of market anomolies.* Retrieved October 17, 2013, from Investopedia: www.Investopedia.com
32. Suleman, M.T. (2012). Stock market reaction to good and bad political news. *Asian journal of Finance and Accounting*, 04(01), 299-312.
33. Tan, O. and G.L., G. (2002). Information effect of economic news: SPI futures. *InternationalReview of Financial Analysis*, 11, 467-489.
34. Wang, L. and Kutan, A.M. (2013). The impact of natural disasters on stock markets: Evidence from Japan and the US. *Comparative Economic Studies*, 55, 672-686.
35. Worthington, A. and Valadkhani, A. (2004). Measuring the impact of natural disasters on capital markets: An empirical application using Intervention Analysis. *Applied Economics*, 36, 2177-2186.
36. Zach, T. (2003). Political events and the stock market: Evidence from Israel. *International Journal of Business*, 8(3), 244-266.

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COMPARATIVE FINANCIAL PERFORMANCE EVALUATION OF SUKUK VS EURO BOND

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ABSTRACT

This study investigates the financial performance evaluation of Sukuk and Euro bonds. The study is conducted in five countries including Malaysia, Bahrain, Pakistan, Bermuda and UAE. For each country two portfolios are made, one contains both Sukuk and Euro bonds whereas the other portfolio contains only Euro bonds. The evaluation of financial performance is done on the basis of VaR, a risk measurement tool. For this purpose, daily returns data for the bonds Sukuk and Euro, is collected from Data stream website. This data is then used in calculating VaR for each portfolio through Delta normal approach. From the calculated values of VaR, it is found that inclusion of Sukuk in a portfolio significantly affects the risk level of the portfolio. In case of all the countries included in a sample that is Malaysia, Bahrain, Pakistan, Bermuda and UAE, the VaR value significantly decreased by including Sukuk bond in the portfolio along with the Euro bond. With the inclusion of Sukuk bond in a portfolio along with the Euro bonds, the holdings are diversified (Segaf, 2012; Hassan, 2012; Fenech and Watson, 2009; Godlewski, Ariss & Weill, 2011; Cakir and Raei, 2007).

KEYWORDS

Sukuk Bonds, Euro Bonds, Value at Risk, Portfolio, Return, Modern portfolio theory.

INTRODUCTION

Background of the Study

Islam is a complete religion and it covers each and every aspect of the life. It is the perfect way of life and addresses all sort of problems related to the life. Human beings, by nature, are always in search of perfectness. Among other systems related to their lives, they also try for the best financial system in order to address all the financial issues of the individuals and the society. Islam has given the perfect financial system not now but 1400 years before (Usman and Khan, 2012). From the start of civilization, different modes of saving have been followed and these modes are kept on changing day by day. Among other modes of saving, investment is one of the most common modes of saving. Investment is basically using the funds for the purpose of getting extra or additional value.

There are different ways of investment like bonds, stocks, real estate etc. Among the bonds, there are two main types; Sukuk bonds and Euro bonds (Usmani, 2002). Euro bonds are the general conventional bonds used for investment purposes. Whereas Sukuk

are the Islamic financial instruments which provide a new way of investment under the principals of Shariah (Arif and Safari, 2012). According to IIFM (2010) "Sukūk are those commercial paper which provide an investor with opportunity of ownership in an underlying asset". The initiation of Sukuk bonds has given rise to new era in the financial world which leads to a novel way of attaining the financial stability (Shaikh and Saeed, 2010).

Sukuk has some similarity with conventional bond but it cannot be completely treated as simple bond (Safari, Arif and Muhammad, 2012). These two types of bonds have similarity in a way that they both are traded in secondary market under the same mechanism of trading. In Sukuk, a business gets the right to collect funds in accordance with the principal of Shariah (Safari 2013). According to Safari, Arif and Muhammad (2012) the main difference between Sukuk and conventional bond lie in the nature of financing and Shariah principle which are followed by Sukuk but not by the conventional bonds. There are many similarities between Sukuk and conventional Euro bonds. Like Euro bonds, Sukuk are also the secondary market instruments and provide the predictable return level. They are traded in secondary market lesser then Euro bonds. They are also rated by the international agencies of rating and most of the time cleared under the Euro clear (Cakir and Raei 2007). The popularity of Sukuk bonds among the investors is increasing day by day. The inclusion of Sukuk bond in a portfolio significantly decreases the risk level of that portfolio. That's why Sukuk bonds are getting familiarity outside the Muslim world as well (Segaf, 2012; Hassan, 2012; Fenech and Watson, 2009; Godlewski, Ariss & Weill, 2011; Cakir and Raei, 2007).

The basic purpose of this study is to determine any possible effect on risk level of the portfolio with the inclusion of Sukuk bond along with the Euro bond in the portfolio. In order to measure the risk level, VaR (Value at Risk) is used as a tool. For measuring VaR, Delta Normal approach is used. A sample of 5 countries; Malaysia, Bahrain, Pakistan, Bermuda and UAE is taken for study. In this study, two portfolios are constructed. In one portfolio both the Sukuk and Euro bonds are included while in other portfolio only Euro bonds are included in order to determine the risk level of both the portfolio. On the basis of values of VaR, it is concluded that inclusion of Sukuk bond in a portfolio along with Euro bond decrease the risk level of the portfolio. Thus Sukuk are different types of securities then Euro bonds and diversify the risk much more than the Euro bonds Ariss & Weill, 2011; Cakir and Raei, 2007). This study aimed at studying the risk level because risk is one of the most important factors for investor in taking the investment decision and it go side by side with return. As according to the Markowitz portfolio theory, if there are two portfolios with same expected return, the investor will go for the portfolio that is less risky. The investor will accept more risk only in a case of some increased expected return (Marling and Emanuelsson, 2012).

Modern portfolio theory or MPT was developed by Hary Markowitz in the 1950s through the early 1970s. This theory is an important advancement in mathematical modeling of the finance. According to Marling and Emanuelsson (2012) MPT is a finance theory based on maximization of the expected return of a portfolio for some given level of portfolio risk, or minimization of the risk of the portfolio for some given amount of expected return through the careful selection of percentages of various assets. This theory is the mathematical composition of the investment diversification concept

with focusing on collection of the assets for investment that is collectively less risky than the individual asset. MPT is based on the risk adverse assumption of the investors. It means that if there are two portfolios with same expected return, the investor will go for the portfolio that is less risky (Fama, 1970). The investor will accept more risk only in a case of some increased expected return. Thus to get more expected return, the investor will have to take some extra risk (Lintner, 1965).

Significances

This study investigates the effect of including Sukuk in the portfolio along with the Euro bonds. It also shows the changes occur in the VaR of that portfolio due to which

- Investors may get help in their investment decision.
- It will be helpful in making portfolio
- Another opportunity will provided to those who are planning to or wish to make investment according to Shariah.

Contribution

- The context for this study is Pakistan, Malaysia, Bahrain, Bermuda and UAE. Up till now no one has done this study with such sample.
- VaR is separately calculated for each country in a sample.

Limitation

- The data collected for this study is derived only for 5 countries, so the generalizability is compromised
- Sukuk bonds are quite new, therefore a large time period cannot be taken for the study.

Scope

- This study is concerned with the Bond market with emphasis on Sukuk and Euro bonds.
- It also emphasizes on the risk and return of these certain type of bonds
- The data for this study can be obtained only from data stream
- The results of this study can be generalized only up to the bond market of the sampled countries.

2. LITERATURE REVIEW

A research was conducted by Safari, Arif and Muhammad (2012) in order to determine the possible differences between the two important types of bonds Sukuk and conventional bonds. This study was empirically conducted to determine that whether Sukuk, the Islamic debt instruments should be treated similar to the conventional bond. For this purpose YTM (yield to maturity) was collected for the period of 2001 to 2012. Paired sample t-test and Granger causality was applied in methodology. Through Granger causality test it was found that Sukuk are quite different from the conventional bonds. The study concluded that by issuing Sukuk, the beta risk of that firm is significantly affected. Thus Sukuk are the new type of financial instruments and they are not simply bonds. Fathurahman and Fitriati (2013) also made comparison between Sukuk and

conventional bond on the basis of Yield to maturity (YTM) in Malaysia. Among the ten groups studied, average YTM of Sukuk was greater than that of conventional bond. Safari (2013) conducted a research on six different Sukuk securities that started in 1990s and traded in 11 markets and categorized them on the basis of their intrinsic nature. It also compared carious definitions presented for Sukuk contracts at different time. The paper concluded with identification of three main classes that are asset-backed, pure debt and equity based. The advent of Sukuk Islamic bonds has given rise to new era in financial world due to which a new way of achieving financial stability has obtained (Shaikh and Saeed, 2010).

Shahida and Sapiyi (2013) conducted a research to determine the reason that why firms issue Sukuk, then the bonds. The study was conducted in Malaysia. The variables studied include issuance experience, capital investment, market to book ratio, firm size, past bonds, return on asset and past Sukuk issuance experience. In methodology 2SLS, pooled regression, fixed effect and random effect model were applied. The study was conducted on 79 listed firms with the time period from 2001 to 2010. Three factors that are past Sukuk issuance experience, tax incentives and firm sizes were found significant in explaining determinants of firm to issue the Sukuk as compare to conventional bond.

According to Usmani (2007) nowadays Sukuk is similar to conventional bonds in term of lacking right of ownership, fixed return right and guaranteed principal repayment. But opposite results were obtained by Godlewski, Turk-Ariss and Weill (2010) in their study conducted in Malaysia. Their study was done on 77 Sukuk and 93 conventional bonds. It was found that these two types of bonds are different from each other especially in term of reaction of the stock market to the announcement of these bonds issues. Stock market reacts negatively to the announcement of the Sukuk issues but gives neutral reaction for the issue of conventional bond. They also found better operating and financial position of the companies that issue conventional bonds as compare to the companies that issue Sukuk bonds. Thus it was concluded that market do not react in the same way to both type of bonds and therefore Sukuk and conventional bonds cannot be considered as same. Regarding the reaction of stock market towards the Sukuk issues, Ahmad and Rusgianto (2013) found opposite results. They found that stock market reaction is positive but insignificant towards the issue of Sukuk bonds. The difference of their results from the previous studies may be due to the fact that they conducted an event study and examined the post crises reaction of the stock market towards the Sukuk issue. Same results were also supported by Arif and Safari (2012). They found in their study some similarity of Sukuk with Conventional bonds due to which Sukuk are usually referred as Islamic bonds. But they concluded with the fact that Sukuk are quite different from conventional bonds. The study was conducted on the basis of yield to maturity. Along with this causality was also tested between these two types of bonds on the basis of Granger causality test. They did not find any significant causal relationship between Sukuk and conventional bonds. At the end of the study, the effect of issuing Sukuk on beta of the firm was also analyzed. It was found that beta of the firm is significantly changed by issuance of the Sukuk. A research was conducted by Ahmad and Rusgianto (2013) in Malaysia to examine the post crises reaction of the stock market towards the Sukuk issues. An event study methodology with CAAR was conducted on a sample of 29 companies in Malaysia for the period of 2009 to 2010. It was found that the reaction of

stock market to the Sukuk issues was positive but insignificant. Sukuk shows the real economic strength and economic activities of the company. The same methodology was also employed by Ahmad and Rahim (2013) in order to study the stock market reaction toward the different rating announcements on the issuance of Sukuk. The study was conducted in Malaysia and the time period taken was 2004 to 2011. The significantly positive reaction of market was found on the Sukuk announcement for highest quality, good and excellent rating. While negative reaction of the market was found for the issuance of conventional bond.

An empirical study was conducted by Cakir and Raei (2007). They conducted a research in order to make comparison between Sukuk and Euro bonds on the basis of value at risk. A time period from 2000 to 2007 was taken for the study on the sample of four countries that are Pakistan, Qatar, Bahrain and Malaysia. For VaR methodology, clean price data was collected. For analysis, Monte-Carlo simulation and delta-normal approach were used in the methodology. It was concluded that as compare to the conventional Euro bonds, Sukuk are different types of financial instruments. The portfolio that contained Sukuk along with the conventional bonds significantly reduced the VaR of the portfolio as compare to the portfolio that contained only conventional bonds. By including Sukuk in a portfolio, holdings are diversified which lead to a reduction in the risk created by the financial institutions (Segaf, 2012; Hassan, 2012; Fenech and Watson, 2009; Godlewski, Ariss & Weill, 2011).

A research was conducted by Segaf (2012) in order to study the effect of financial crises (2008) on Sukuk and conventional bond. The research was done in Malaysia. It was found that Sukuk bonds are more stable income; asset backed tradable Shariah compatible certificates. Sukuk bonds are less affected by financial crises as compare to conventional bonds. The inclusion of Sukuk bonds in the portfolio diversifies the risk much then only conventional bonds in the portfolio. Rauf (2008) studied the Sukuk bonds in term of their usefulness and their growth. A time period of 2001 to 2011 was taken for the study. With empirical evidences he presented the result that though Sukuk bonds are new borne as compare to conventional bonds but due to their Islamic basis they are highly demanding in Islamic countries. Along with this they are spreading more quickly in west as well

A quantitative study was conducted by Fathurahman & Fitriati (2013) in order to compare the Sukuk and euro bond on the basis of yield to maturity. For this purpose secondary data was collected from IDX (Indonesian Stock Exchange) and IBPA (Indonesian Bond Pricing Agent). The study was done on the population of 243 bonds well with fixed as well as floating interest rate. The population was further classified into ten sample's groups. Each group contained was 31 bonds. The average, correlation coefficient, standard deviation, portfolio covariance and independent t test applied for the comparison. It was concluded from the study that overall there is a significant difference between average of Sukuk and conventional bond. Tariq (2004) conducted a research on the management of the financial risk of the Sukuk structure. In this study market risk (interest rate risk and exchange rate risk), Shariah compliance risk, credit risk and support and operational risk (default risk, coupon payment risk and specific risk investors) were explained. It was resulted from the study that Sukuk bonds are different from

conventional bonds. Whereas Wilson (2008) found that Sukuk are identical to the conventional bonds.

A research was conducted by Sayed (2013) in order to determine that among Sukuk and conventional bond, which one is more risky and also whether the risk measurement and management strategies of conventional bonds can be applied for Sukuk bond as well. It was concluded that Islamic finance is based on the justice equal distribution of the financial resources while conventional financial system is deprived of it. The conventional risk measurement tool (variance and beta) and management tools (hedging and diversification) are three main tools for the Sukuk bonds as well but the Shariah rules and principles must be kept in front.

Rauf and Ibrahim (2014) conducted a research in order to determine different types of risk related with Sukuk structure and their effect on returns on the Sukuk in market. A time period of 9 years was taken for study. The data of 2282 observations of each index closed values was used. OLS and multiple regression models were used for the study. Three dependent variables NASDAQ Dubai return of GCC Sukuk, NASDAQ Dubai return of GCC financial Sukuk and NASDAQ Dubai return of GCC corporate Sukuk were used. It was concluded that different types of risks i.e., liquidity risk operational risk, market risk and credit risk has significant effect on the return on Sukuk. Mehmood, Razaq & Haral (2010) also found that return on Sukuk is significantly affected by different types of risk including liquidity risk and Shariah compliance risk (operational risk). Razaq (2010) found that Sukuk market is legal risk. Thus these findings show that different risks are associated with Sukuk market.

Ahmad and Radzi (2011) investigated the sustainability of the Sukuk and conventional bond during the recent financial crises in Malaysia. Three variables are studied in this research including market liquidity, GDP and foreign exchange. OLS (ordinary least square) is applied and it was concluded that foreign exchange is the major cause for the issuance of both Sukuk as well as conventional bond. Along with this it is also found that issuance of the conventional bond as compare to Sukuk are not sensitive with respect of economic conditions (market liquidity and GDP). Daud and Kefeli (2012) also found that Sukuk issuance in Malaysia is significantly affected by GDP. Abdullah, Yazid, Abdullah & Kamarudin (2014) conducted a research on the risk associated with the funding of infrastructure projects by issuing Sukuk. It was found that Sukuk as compare to conventional bond is less risky in funding the infrastructure projects.

Rezaei (2013) also found that as compare to the conventional bond, Sukuk is a useful instrument for financing government agencies and private companies.
Tahmoures (2013) made comparison between Sukuk and conventional bond on the basis of risk and return features as well as the structure. It was concluded that Sukuk is an ideal choice for all those investors who wish to respect the Shariah principles. Rizvi (2014) conducted a research to determine the scope for the Islamic bond or Sukuk in India. It was found that there is a wide scope for Sukuk in India due to the two factors that are internal demand and external supply.

Diaw, Bacha and Lahsasna (2011) conducted a research in which first a GDP-linked Sukuk model is proposed and then it investigates the potential benefits and hurdles related with GLS (GDP-linked Sukuk model. The study was based on the risk return

profile and Forward Ijarah. The time period selected for the study was 1969 to 2009. In this study five countries Algeria, Malaysia, Senegal, Bahrain and Uzbekistan was taken. It was found that in case of the infrastructure projects (non-revenue generating) GDP-linked Sukuk is an effective instrument. GLS provide an opportunity to the governments of Islamic countries to bring diversification of fund raising as well as to address the issue of Sukuk bench marking against interest rate (Kamstra and Shiller, 2009). Ramasamy et al. (2011) also found that Sukuk bonds as compare to conventional bonds are less risky and generate more yield return to the investor (Nanaeva, 2010; Zin et al., 2011; Rauf & Ibrahim, 2014).

Research Objective

To investigate the financial performance of *Sukuk vs. Eurobonds*

Hypothesis

H1: Sukuk and Euro bonds issued are same in providing diversification benefit.

H2: VaR remains unaffected with the inclusion of Sukuk bonds in portfolio.

METHODOLOGY

Paradigmatic Influence

This study on *Comparative Financial Performance Evaluation of Sukuk vs. Euro bond is* completely quantitative and only observable realities can be considered. Therefore Positivism is the most suitable approach for conducting this study. As in positivism, a true knowledge is only that one which is based on facts and can be observed through five senses. It means that such social reality must be measurable. It should have a physical existence or have some presence in mind. So according to the nature of topic, data in the form of facts and figures are needed to be collected and only those realities will be considered that have physical existence and that can be observed through five senses, therefore positivism is the best approach.

Population

The population of this study is restricted to the bond market of that specific country whose sample has been taken.

Sample

The data used in this study is secondary in nature. The daily returns data for each bond, Sukuk and Euro, is obtained from the Data Stream. A sample of five countries including Pakistan, Bahrain, Malaysia, Bermuda and UAE is taken for the study.

Time period

Different time period is selected for each country due to unavailability of the data. For Malaysia the time period is from 2010 to 2012, for Bahrain the time period is from 2010 to 2012, for Pakistan the time period selected is from 2008 to 2010, for Bermuda the time period is from 2010 to 2013 and for UAE the time period is from 2011 to 2013.

Methodology

In this research paper, VaR methodology is used in order to determine whether the introduction of Sukuk bonds in a portfolio brings any change in the level of risk for the investors. VaR (Value at Risk) is the measurement of the worst expected loss of a portfolio over a specific holding period at some certain confidence level, under the normal market conditions (Jorion 2006). According to Cakir and Raei (2007), "VaR expresses the market risk of the portfolio and represents the maximum amount of loss in a holding period. For example VaR method can be stated with either 1% probability or 99% confidence level that a certain amount will be lost in a specific day, month or year. VaR is based on return's variance of the portfolio."

$$\boldsymbol{\sigma} = \boldsymbol{w}\,\Sigma\,\boldsymbol{w'} \tag{1}$$

where

w = weights 'vector for different securities in a portfolio
w' = weights' transposed vector in a portfolio
Σ = the variance-covariance matrix of the securities' return in a portfolio

The portfolio VaR can be computed from the combination of risks of the various securities in the portfolio. There are various methods for computing the VaR like Delta-normal approach, Monte-Carlo simulation technique etc. The Delta-normal approach or the variance-covariance approach is one of the most commonly used methods for the computation of VaR. This method is based on the following basic equation.

$$\mathrm{VaR_p} = -(\mu p - \alpha\,\sigma pW) \tag{2}$$

where

α = the standard normal deviate
μp = portfolio's average return
W = initial portfolio value

The above equation shows that lower volatility leads to smaller VaR. In case of portfolio of the assets; if the asset's returns have smaller or negative correlation then it leads to lower volatility. In this study VaR is calculated for equally weighted portfolios at significance level of 99% with the holding period of 5 days. Basically two portfolios are made for each country. The portfolio 1 contains both Sukuk and Euro bonds and the portfolio 2 contains only Euro bond with an equal investment of US$100,000,000 in each portfolio.

Table given in Appendix includes all those Sukuk and Euro bonds along with their issuer name, issuer date, maturity period and issue size that are taken under study.

Analysis

In this study, as sample of five countries is taken. For each country the daily returns data of Sukuk and Euro bonds is obtained from the Data Stream. Different time period is selected for each country in order to make sure the availability of relevant data (Daily Returns) for each bond (Sukuk bond and Euro bond) in that specific time period. The daily returns data is then converted to weekly returns data (5 days) for better results. The VaR of each portfolio is calculated at 99 % confidence level. For each country two hypothetical portfolios are made. One portfolio contains both Sukuk and Euro bonds,

whereas the other portfolio contains only Euro bonds. Equally weights are assigned to all the bonds in a portfolio with the assumption of equal investment of US$100,000,000 in each portfolio. This is done so in order to study and determine any effect of including Sukuk bond in the portfolio and the possible variation in the level of risk for the investor.

The correlation between Sukuk and Euro bonds in the portfolio

Table 1
Correlation Matrix

		Sukuk	Bond 1	Bond 2
MALAYSIA	Sukuk	1		
	Bond 1	-0.0019	1	
	Bond 2	0.112431	0.132626	1
BAHRAIN	Sukuk	1		
	Bond 1	0.050902	1	
	Bond 2	0.093275	-0.02864	1
PAKISTAN	Sukuk	1		
	Bond 1	0.050902	1	
	Bond 2	0.093275	-0.04739	1
BERMUDA	Sukuk	1		
	Bond 1	0.140906	1	
	Bond 2	-0.1829	0.047425	1
UAE	Sukuk	1		
	Bond 1	-0.05032	1	
	Bond 2	-0.03977	-0.12378	1

At first the correlation between the different bonds in a portfolio is determined. The above table shows the correlation between different bonds. The correlation value shows the extent to which the two securities are correlated. Its value ranges between -1 and +1. The -1 value shows perfect negative correlation. It means that the two securities are perfectly negatively correlated to each other. If one security moves up in value the other security will move down and vice versa. If the correlation value is +1 then it means that the two securities are perfectly positively correlated. It means that if one security moves up in value then the other security will also moves up and vice versa. The correlation value 0 shows that there is no correlation exists between two securities. In the above table, in case of Malaysia, the correlation between Sukuk and Bond 1 is -0.0019 which shows insignificant negative correlation between these two securities. The correlation value for Sukuk and Bond 2 is 0.112431, this also insignificant positive correlation between them. The correlation value between Bond 1 and Bond 2 is 0.132626, it also shows insignificant positive correlation. The correlation between Sukuk and Bond 1 for Behrain is -0.07154 which shows insignificant negative correlation between these two securities. The correlation value for Sukuk and Bond 2 is 0.399544, this also show positive correlation between them. The correlation value between Bond 1 and Bond 2 is -0.02864, it shows insignificant negative correlation. The correlation between Sukuk and

Bond 1 for Pakistan is 0.050902 which shows insignificant positive correlation between these two securities. The correlation value for Sukuk and Bond 2 is 0.093275, this also show insignificant positive correlation between them. The correlation value between Bond 1 and Bond 2 is -0.04739, it shows insignificant negative correlation. The correlation between Sukuk and Bond 1 for Bermuda is 0.140906 which shows insignificant positive correlation between these two securities. The correlation value for Sukuk and Bond 2 is -0.1829 which shows insignificant negative correlation between them. The correlation value between Bond 1 and Bond 2 is 0.047425; it also shows insignificant positive correlation. The correlation between Sukuk and Bond 1 for UAE is -0.05032 which shows insignificant negative correlation between these two securities. The correlation value for Sukuk and Bond 2 is -0.03977, this also show insignificant negative correlation between them. The correlation value between Bond 1 and Bond 2 is -0.12378, it also shows insignificant negative correlation. So overall, all the correlation results either positive or negative are not significant which means that such securities (Sukuk and Euro) in each portfolio are not significantly correlated with each other. After then the covariance matrix is calculated. The covariance between two securities is determined by calculating the product of deviation of the securities and then takes the weighted sum of that product.

The following table shows the Covariance Matrix of Sukuk and Euro bonds in the portfolio

Table 2
Covariance Matrix

		Sukuk	**Bond 1**	**Bond 2**
MALAYSIA	Sukuk	0.0000552	-0.0000465	0.0000118
	Bond 1	-0.0000465	0.000118	0.00001931
	Bond 2	0.0000118	0.00001931	0.000194
BAHRAIN	Sukuk	0.0000493	-0.00000134	0.0000240
	Bond 1	-0.00000134	0.0000125	-0.000000633
	Bond 2	0.0000240	-0.000000633	0.0000730
PAKISTAN	Sukuk	0.0000428	0.0000122	0.0000103
	Bond 1	0.0000122	0.001312	-0.000028
	Bond 2	0.0000103	-0.000028	0.000278
BERMUDA	Sukuk	0.00000530	0.000001746	-0.00000409
	Bond 1	0.000001746	0.00002048	0.0000205
	Bond 2	-0.00000409	0.0000205	0.0000973
UAE	Sukuk	0.00007072	-0.0000008020	0.00000612
	Bond 1	-0.0000008020	0.0000307	-0.0000184
	Bond 2	0.00000612	-0.0000184	0.000984

The above table shows the covariance between the bonds. Covariance is basically measurement of amount by which the two variables moves together. If the covariance between the two variables is positive then this sign shows the direct relation between the

two variables means that if one variable increase then other will also increase with the same amount. If the covariance is negative, than this sign shows inverse relation between the two variables. It means that if one variable increases in value the other variable will decrease in the value by the same amount.

In the above table, in case of Malaysia, the positive covariance values of Sukuk and bond 2 shows that these two are in the same direction if Sukuk bond return moves up then bond 2 return will also moves up with the same amount. The Sukuk and bond 1 have negative covariance value it shows that these two are in opposite direction if Sukuk bond return moves up then bond 1 return will moves down with the same amount. Bond 2 and bond 1 also have positive value so it will also have the same effect.

In case of Bahrain, the positive covariance values of Sukuk and bond 2 shows that these two are in the same direction if Sukuk bond return moves up then bond 2 return will also moves up with the same amount. The Sukuk and bond 1 have negative covariance value it shows that these two are in opposite direction, if Sukuk bond return moves up then bond 1 return will moves down with the same amount. Bond 2 and bond 1 also have negative value so it will also have the same effect.

In case of Pakistan, the positive covariance values of Sukuk and bond 1 shows that these two are in the same direction if Sukuk bond return moves up then bond 2 return will also moves up with the same amount. The Sukuk and bond 2 have also positive covariance value it shows that these two will also move in same direction, if Sukuk bond return moves up then bond 2 return will also moves up with the same amount. Bond 2 and bond 1 have negative covariance value; it shows that these two are in opposite direction if bond 1 return moves up then bond 2 return will moves down with the same amount.

In case of UAE, the positive covariance values of Sukuk and bond 2 shows that these two are in the same direction if Sukuk bond return moves up then bond 2 return will also moves up with the same amount. The Sukuk and bond 1 have negative covariance value it shows that these two are in opposite direction, if Sukuk bond return moves up then bond 1 return will moves down with the same amount. Bond 2 and bond 1 also have negative value so it will also have the same effect.

The following table shows Mean, Variance, S.D & VaR

Table 3
Value at Risk (VaR) of Portfolios
Holding Period = 5 days, α = 99% (2.33)

		PORTFOLIO 1 (Conventional Bonds + Sukuk)	PORTFOLIO 2 (Conventional Bonds)
MALAYSIA	MEAN	3.21%	3.22%
	VARIANCE	0.0000476466	0.0000876926
	S.D	0.006902653	0.009364433
	VAR	1.14%	1.54%
BAHRAIN	MEAN	-5.36%	-4.89%
	VARIANCE	0.0000199098	0.000021071
	S.D	0.004462036	0.004590311
	VAR	0.73%	0.76%
PAKISTAN	MEAN	0.05%	0.06%
	VARIANCE	0.000180164	0.000383389
	S.D	0.01342251	0.019580311
	VAR	2.20%	3.22%
BERMUDA	MEAN	-3.61%	-2.93%
	VARIANCE	0.00001.36105	0.00003.04711
	S.D	0.003689246	0.005520066
	VAR	0.61%	0.91%
UAE	MEAN	-0.17%	-0.19%
	VARIANCE	0.000114939	0.000244396
	S.D	0.010720975	0.015633156
	VAR	1.76%	2.57%

In the above table, VaR value for each portfolio is presented. VaR is basically the maximum expected loss that may occur to an investor in a portfolio in a holding period. VaR is basically a tool for measurement of risk. The value of VaR shows the risk level of a portfolio. In this study, VaR is calculated through Delta Normal approach for the holding period of 5 days, at the confidence level of 99%. VaR is calculated to make comparison between the two portfolios to determine the less risky portfolio. In one portfolio Sukuk and Euro, both types of bonds are included and in other portfolio, only Euro bonds are included. In case of Malaysia, the VaR value (1.14%) shows that the maximum expected loss for the investor in such portfolio containing both Sukuk and Euro bonds is 1.14% which is less than the VaR value (1.54%) of the portfolio containing only Euro bonds. It means that portfolio containing both Sukuk and Euro bond is less risky as compare to the portfolio containing only Euro bonds. In case of Behrain, the VaR value (0.73%) shows that the maximum expected loss for the investor in such portfolio containing both Sukuk and Euro bonds is 0.73% which is less than the VaR value (0.76%) of the portfolio containing only Euro bonds. It means that portfolio containing both Sukuk and Euro bond is less risky as compare to the portfolio containing only Euro bonds. In case of Pakistan, VaR value (2.20%) shows that the maximum expected loss for the investor in such portfolio containing both Sukuk and Euro bonds is 2.20% which is less than the VaR value (3.22%) of the portfolio containing only Euro bonds. It means that portfolio containing both Sukuk and Euro bonds is less risky as compare to the

portfolio containing both Sukuk and Euro bonds. In case of Bermuda, VaR value (0.61%) shows that the maximum expected loss for the investor in such portfolio containing both Sukuk and Euro bonds is 0.61% which is less than the VaR value (0.91%) of the portfolio containing only Euro bonds. It means that portfolio containing both Sukuk and Euro bonds is less risky as compare to the portfolio containing only Euro bonds. In case of UAE, VaR value (1.76%) shows that the maximum expected loss for the investor in such portfolio containing both Sukuk and Euro bonds is 1.76% which is less than the VaR value (2.57%) of the portfolio containing only Euro bonds. It means that portfolio containing both Sukuk and Euro bonds is less risky as compare to the portfolio containing only Euro bonds.

RESULTS

This study concluded that both the hypotheses i.e., H1 and H2 are rejected in case of all the countries included in the sample.

Thus it is concluded that as compare to the conventional Euro bonds, Sukuk are different types of financial instruments. VaR value is significantly affected by including Sukuk bonds in a portfolio and its value decreases with the inclusion of Sukuk bond in a portfolio. Thus by including Sukuk in a portfolio, holdings are diversified. (Segaf, 2012; Hassan, 2012; Fenech and Watson, 2009; Godlewski, Ariss & Weill, 2011; Cakir and Raei, 2007).

CONCLUSION AND RECOMMENDATION

The study is conducted on the evaluation of the financial performance of Sukuk and Euro bond. Two hypothetical portfolios are constructed in which one portfolio contains both Sukuk and Euro bond whereas the other portfolio contains only Euro bonds. In order to determine the risk level of the two portfolios, VaR is used as a measurement tool. In order to calculate the VaR of the portfolio, Delta Normal approach is used. From the calculated values of VaR, it is found that inclusion of Sukuk in a portfolio significantly affects the risk level of the portfolio. In case of all the countries included in a sample that is Malaysia, Bahrain, Pakistan, Bermuda and UAE, the VaR value significantly decreased with the inclusion of Sukuk bond in the portfolio along with the Euro bond. With the inclusion of Sukuk bond in a portfolio along with the Euro bonds, the holdings are diversified (Segaf, 2012; Hassan, 2012; Fenech and Watson, 2009; Godlewski, Ariss & Weill, 2011; Cakir and Raei, 2007).

In future, the results of the study on Sukuk and Euro bond's financial performance can be made more reliable by increasing the time period and the sample size. Along with this by applying other methods of calculating VaR, different results can be generated

REFERENCES

1. Abdullah, A.A., Yazid, A.S., Abdullah, A. and Kamarudin, M.S. (2014). R Risk in Funding Infrastructure Projects through Sukuk or Islamic Bonds.
2. Ahmad, N. and Rusgianto, S. (2013). Information Content of Post-Crisis Sukuk Announcement in Malaysia.

3. Ahmad, N., Daud, S.N.M. and Kefeli, Z. (2012). Economic Forces and the Sukuk Market. *Procedia-Social and Behavioral Sciences*, 65, 127-133.
4. Ahmad, N. and Rahim, S.A. (2013). Sukuk Ijarah vs. Sukuk Musyarakah: Investigating Post-Crisis Stock Market Reactions.
5. Ahmad, W. and Radzi, R. M. (2011). Sustainability of Sukuk and Conventional Bonds during Financial Crisis: Malaysian Capital Market. *Global Economy and Financial Journal*, 4(2), 33-45.
6. Alam, N. and Hassan, M.K. (2007). Sukuk Issuance and Firm Value: Global Evidence.
7. Al-Sayed, O. (2013). Sukuk Risk: Analysis and Management.
8. Ariff, M. and Safari, M. (2012). Are Sukuk Securities the Same as Conventional Bonds? *Afro Eurasian Studies*, 1(1), 101-125.
9. Diaw, A., Bacha, O.I. and Lahsasna, A. (2011). Public Sector Funding and Debt Management: A Case for GDP-Linked Sukuk.
10. El Mosaid, F. and Boutti, R.R. (2014). Sukuk and Bond Performance in Malaysia. *International Journal of Economics and Finance*, 6(2), p226.
11. Fathurahman, H. and Fitriati, R. (2013). Comparative Analysis of Return on Sukuk and Conventional Bonds. *American Journal of Economics*, 3(3), 159-163.
12. Fenech, J.P. and Watson, J. (2009). The use of fixed income in emerging markets: empirical evidence. *Banks and Bank Systems [P]*, 4(1), 11-18.
13. Godlewski, C.J., Turk Ariss, R. and Weill, L. (2010). Are Islamic Investment Certificates Special? Evidence on the Post-Announcement Performance of Sukuk Issues.
14. Godlewski, C.J., Turk Ariss, R. and Weill, L. (2011). Do markets perceive sukuk and conventional bonds as different financing instruments?
15. Godlewski, C.J., Turk-Ariss, R. and Weill, L. (2011). Do markets perceive sukuk and conventional bonds as different financing instruments? Bank of Finland (BOFIT) Discussion Papers, 6, 2011.
16. Hassan, K.A. (2012). Comparison between Sukuk and conventional bonds*: Value at risk approach*. Master thesis, Westminster University, UK. http://dx.doi.org/10.2139/ssrn.2215194
17. Kamstra, M. and Shiller, R. (2009). The Case for Trills: Giving the People and their Pension Funds a Stake in the Wealth of the Nation. Cowles Foundation Discussion Papers No. 1717.
18. Kaptan, S.S. (2001). Investment management. Sarup & Sons.
19. Miller, N.D., Challoner, J. and Atta, A. (2007). UK Welcomes the Sukuk-How the UK Finance Bill Should Stimulate Islamic Finance in London, Much to the Delight of the City's Banks. *Int'l Fin. L. Rev.*, 26, 24.
20. El Mosaid, F. and Boutti, R.R. (2014). Sukuk and Bond Performance in Malaysia. *International Journal of Economics and Finance*, 6(2), p226.
21. Muhammad, I. and *Adrian, W. (undated); The Corporate Bond Market in Malaysia;* BIS papers No. 26, 114-128.
22. Nanaeva, Zhamal (2010), How Risky Sukuk Are: *Comparative Analysis of Risks Associated with Sukuk and Conventional Bonds, The British University in Dubai.*
23. Raei, F. and Cakir, S. (2007). *Sukuk vs. Eurobonds: Is there a difference in value-at-risk?*. International Monetary Fund.

24. Ramasamy, R., Munisamy, S. and Helmi, M.H.M. (2011). *Relative risk of Islamic sukuk over government and conventional bonds.* Global Journal of Management and Business Research, 11(6), 4-12.
25. Rauf, A.L.A. (2008). Emerging role for Sukuk in the capital market.
26. Rauf, A.L.A. and Ibrahim, Y. (2014). Determinants of risk and return performance with special reference to GCC Sukuk market structure.
27. Razaq, A. (2010). *Finance Manager, Sultan Group Health care member of Sultana Group Investment, Dubai.[Telephonic, 10 March 2010]*
28. Rezaei, Z. (2013). Sukuk: An Islamic Financial Instrument. *Management and Administrative Sciences Review*, 2(3), 261-267.
29. Rizvi, S. (2014). Relevance and scope of Islamic finance in recent era. *Management Insight*, 9(2).
30. Saad, N.M. (2013). A delve into performance of Sukuk (Islamic bonds) and conventional bonds issued by PLCs in Malaysia. European Journal of Accounting Auditing and Finance Research, 1(4), 83-94.
31. Safari, M. (2013). Contractual structures and payoff patterns of Sukūk securities. *International Journal of Banking and Finance*, *10*(2), 7.
32. Safari, M. (2013). Contractual structures and payoff patterns of Sukūk securities. *International Journal of Banking and Finance*, 10(2), 7.
33. Segaf, S. (2012). Islamic bonds in financial crisis. *Iqtishoduna*.
34. Shahida, S. and Saharah, S. (2013). Why Do Firms Issue Sukuk Over Bonds? Malaysian Evidence. In *Proceeding of the 15th Malaysian Finance Association Conference* (pp. 2-4).
35. Shaikh, S. and Saeed, S. (2010). Sukuk bond: The global Islamic financial instrument.
36. Tahmoures, A.A. (2013). *Compare and contrast Sukuk (Islamic Bonds) with conventional bonds, Are they compatible?* The Journal of Global Business Management, 9(1), 44-52.
37. Tariq, Ali Arsalan (2004). Managing Financial Risk of Sukuk Structures. Disertasi Master (UK: Masters of Science, Loughborough University)
38. Usman, A. and Khan, M. (2012). Evaluating the Financial Performance of Islamic and Conventional Banks of Pakistan: A Comparative Analysis. *International Journal of Business and Social Science*, 3(7).
39. Usmani, M.T. (2007). Sukuk and their Contemporary Applications. (Translated from the original Arabic by Sheikh Yusuf Talal DeLorenzo), AAOIFI Shari'a Council meeting, Saudi Arabia.
40. Wilson, R. (2008). Innovation in structuring of sukuk securities. *Humanomics*, 24(3), 170-181.
41. Zin, M.Z.M., Sakat, A.A., Ahmad, N.A., Nor, M.R.M., Bhari, A., Ishak, S. and Jamain, M.S. (2011). The effectiveness of Sukuk in Islamic finance market. *Australian Journal of Basic and Applied Sciences*, 5(12), 472-478.

APPENDIX 1

Table 4
Characteristics of Sukuk and Euro Bonds

MALAYSIA			
Malaysian Global Sukuk	25/06/2002	5 years	USD 600,000,000
Rafflesia Capital LTD	4/10/2006	5 years	USD 750,000,000
Cherating Capital LTD	5/7/2007	5 years	USD 8500,000,000
BAHRAIN			
CCBB INTL.SUK	5/7/2001	90 days	USD 100,000,000
PCFC DEVELOPMENT	29/9/2005	10 years	USD 400,000,000
BAHRAIN 2003 (Bond 1)	21/01/2003	5 years	USD 500,000,000
PAKISTAN			
Pakistan International Sukuk	18/01/2005	5 years	USD 600,000,000
International bonds: Pak, 2006	3/30/2006	10 years	USD 300,000,000
International bonds: Pak, 2007	6/1/2007	10 years	USD 750,000,000
Bermuda			
GE Capital Sukuk Ltd	27/11/2009	5 years	USD 500,000,000
CBQ Finance Ltd	18/11/2009	5 years	USD 100,000,000
Int bonds: Bermuda	7/3/2012	10 years	USD 475000000
UAE			
ADIB Sukuk Co LTD	12/12/2006	5 years	USD 800,000,000
Mashreq bank PSC	4/6/2006	5 years	USD 300,000,000
Emirates Airlines	24/3/2004	7 years	USD 500,000,000

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ESTIMATING DEMAND FOR HEALTH WORKFORCE THROUGH POPULATION PROJECTION

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ABSTRACT

Increased life expectancy in Pakistan is expected to result in larger number of elderly in the coming decades. Health requirements of individuals change with increasing age; therefore, the change in demographics should be accommodated in Human Health Resource. In this paper the demand for the required workforce is estimated with the help of population projection. An estimated number of elderly in Khyber Pakhtunkhwa, after three decades, is projected with the help of Cohort Component Method. The results are presented through Population Pyramids to show proportion of elderly in the population. However, the curriculum of MBBS, approved by PMDC, or Postgraduate training of medical officers, do not take into account this emerging change in the population. Therefore, strategy formulation is required to provide improved healthcare services with the changing demographics in Khyber Pakhtunkhwa.

1. INTRODUCTION

Health workforce is an important component in successful implementation of health systems and is directly related with the success of health interventions (WHO, 2006). The structure of the health workforce is determined by a country's health system. In Pakistan the provinces govern health system. The Government of Pakistan's Ministry of Health proposes and designs strategies. However, the realization of such strategies is the domain of provincial governments. Most of the population is provided healthcare services by the public sector through a three-tiered approach.

Figure 1 shows that at foundational level rural and far-flung areas are covered with the help of Basic Health Unit (BHUs) and Rural Health Centers (RHCs) (Cassam and Shah, 2012). Therefore, the doctors appointed at BHUs and RHCs treat majority of masses and a large segment of the population. Their ability to treat individuals in multiple age groups is important to the health of the population specially those residing in rural areas. With increasing population the role of doctors appointed at the foundational level is gaining importance.

The rise in the Pakistani Population has been double fold due to high fertility rate and increased life expectancy. Although fertility rate is expected to decrease in the coming future, life expectancy will still increase with rise in population living above the age of 75 years. Currently, life expectancy at birth in Pakistan is 63 years (WHO, 2013). Pakistan is, currently, the sixth most populous country in the world, with 4 percent of the population living to an age of 65 years or above. However, data about geriatrics in the country is limited (Qidwai, 2009).

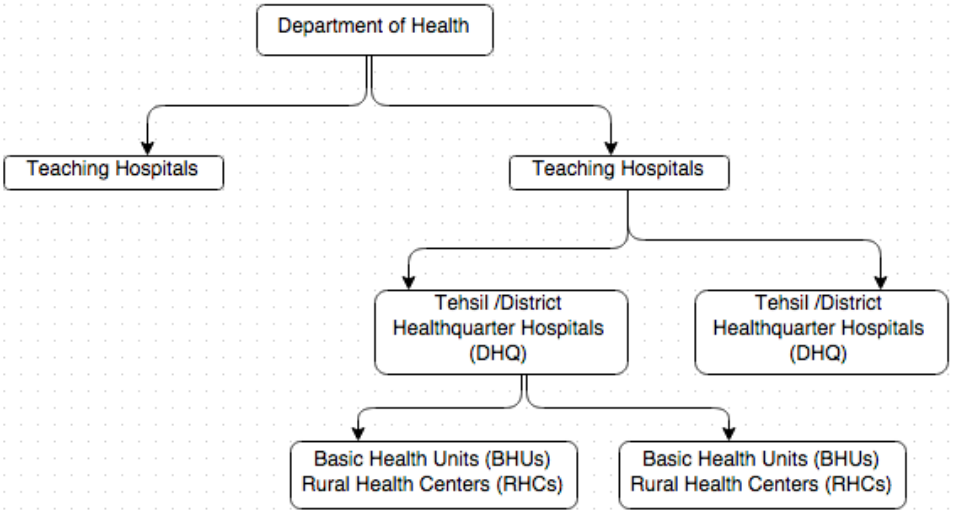

Fig. 1: Three-Tiered Health System in Pakistan

2. LITERATURE REVIEW

As an individual ages, their body degenerates and they become more susceptible to age related diseases such as Diabetes, Coronary Artery Diseases, etc. Such diseases are called Non-communicable diseases (NCDs) and are reported to be on rise in Pakistan (WHO, 2013). Pakistan is ranked in the top ten countries hosting diabetes. The estimated number of diabetics in Pakistan was 5.2 million in 2000 which is expected to reach 13.9 million in 2030 (Wild et l., 2004).A hospital survey in Karachi indicated that over 72 percent of the elderly had five or more health problems that could develop into multiple morbidities if preventive approach was not adopted. Among these diabetes mellitus, hypertension and arthritis were among the most commonly reported health problems (Zafar, 2006).

2.1 Health Workforce Planning Required

Targeting the increasing burden of NCDs will require Pakistan to increase investment in the development of the health workforce. Unfortunately, Pakistan is categorized among countries that faced a critical shortage of qualified workforce in health sector and would require intervention to be able to achieve Millennium Development Goals by 2015 (WHO, 2009). In such a situation, blindly investing in the health sector to produce doctors and nurses will not be enough. Population studies should be conducted and epidemiological transitions monitored. As a result those sectors would be identified that need urgent attention. Matching the skills of the workforce with the requirements of the health sector is an important element of workforce management.

According to the Health Strategy Report of Khyber Pakhtunkhwa, Pakistan (2010-17) a total of 30,000 healthcare staff is registered with the province. This report suggests improvement of Human Resources in Health Sector, by forecasting workforce demand to

counter the short fall in Health Sector (Health Department KP, 2010). Such a strategy focuses on addressing the workforce shortage administratively by hiring more doctors. However, there is a lack of vision and future focus.

Mostly, the total number of doctors and nurses available per 1000 people represent the human resource for health (HRH) of a region. However, that is not a proper depiction of the workforce that can deal with the changing health demands of the population in transition. The number of doctors trained in a specific field of expertise should reflect the demand of the population (Birch et al., 2007). Besides the number of staff, their proper training, recruitment and retention is necessary to ensure effective healthcare services. Health Human Resource Planning (HHRP) emphasizes on right number of personnel available to provide required services at the right time to the right people. This puts emphasis on predicting future requirements and taking steps accordingly (Birch et al., 2009). Therefore, analyzing the present and predicting the future would help deal with upcoming demands.

2.2 Forecasting Required Workforce Specialization

Forecasting Health Human Resource accordingly is an important element in efficient healthcare service provision. Because, unless timely actions are taken, lengthy process of recruitment and training medical staff can result in long delays in healthcare management (Teljeur et al., 2010).

Different researchers have used different methods to forecast the health Human Resource. These models can be divided into three basic types based on the approach of the calculation i.e. demand based approach, supply/utilization based approach and econometrics approach (O'brien-Pallas et al., 2001). Effective planning as a result of these forecasts will help in policy making, implementation, improvising and stabilizing the health system further (Cameron Health Strategies Group, 2009).

Denton et al. (2001) emphasize the importance of including population change while projecting the future of health personnel. They studied the effect of population change and combination of population growth and ageing and found out that population growth is one of the most important factors with the help of which future health human resource can be predicted. Similarly, determinant in need based approach is the target population with population size, age and gender as its major elements (Fakhri et. 2014).

It is expected that by the year 2025 70 percent of the ageing population, over 60 years, of the world will be residing in the developing countries (Khan and Ghosh, 2003). Even then there is no up to date demographic data available in Pakistan with the help of which the ageing population in the region can be analyzed. It is expected that with the increase of age, chronic diseases will appear in the population. Therefore, preemptive strategies should be made with population forecasts and the available options should be studied to be able to deal with future population demands.

One of such options is medicine of old age, which is a separate branch of the general medicine. It adopts holistic approach to ensure health in the middle age and beyond, also focusing on rehabilitative and social aspects of illness in addition to clinical and preventative approaches. There is need to focus on proactive strategy as a result of the

ageing population (Khan and Ghosh, 2003). The increasing population across the country requires strategic improvement in the workforce planning (Hafeez et al., 2010).

2.3 Training GPs according to population dynamics

Jafar et al. (2005) conducted a survey in which 1,000 doctors participated from around Pakistan. They found that most of the General Practitioners (GPs) under diagnosed and undertreated high Blood Pressure in patients. It was revealed that more than 70 percent of the patients themselves were not aware about the nature of their disease. According to the Survey, the practitioners ignored guidelines by Pakistan Hypertension League (that are in agreement with those of the World Hypertension League) while diagnosing Hypertension, especially when dealing with elderly patients. Moreover, the physicians use sedatives, sometimes in combination with anti-hypertensive agents to treat hypertension. This is considered inappropriate because it not only results in under treatment of hypertension but also causes sedative dependency in the patients. Such treatment procedures give rise to cardiovascular problems and create complications. Jafar et al. (2005) emphasize on introducing research, and wider array of treatment options in curriculum of medical students. With increasing number of elderly, such behavior can lead to serious issues in future.

Research Questions

The above arguments show that forecasting health human resource is an important factor of effective healthcare system. For long-term performance efficiency, forecasting health care demand and planning accordingly is a logical step. In data deficient countries the population can be used as a proxy for determination of demand in health sector. Therefore, this study focuses on the following questions in the Pakistani context:

- What demographic changes are expected in the coming decades?
- How do these changes affect the demand for human resource in healthcare services?
- Are the healthcare providers going in the right direction to meet the future demands in health sector?

Answering these questions will help us in determining the gaps arising in the future and enable us to tackle the situation proactively.

3. METHODOLOGY

The research questions stated above can be answered serially. Therefore the first step is population projection, which will then be analyzed for posing future healthcare demands helping us to find the right direction for long term effective healthcare services.

As established previously, changes in the age of the population affects the demand for healthcare. Therefore, a projection method that classifies population into age groups and then projects them accordingly is to be preferred over other extrapolation models. Hence, in this study population is projected with the help of Cohort Component Method (CCM). It first classifies the population of a region into age and sex cohorts and then based on some basic assumptions (Mortality, Fertility and Migration) project the size of the cohort (O'Neil et al., 2001). CCM method is preferred over others because the method gives a

deterministic outcome as a result of mathematical application of specific assumptions (Preston et al., 2001). The following formula is used in application of CCM:

$$P_t = P_{t-1} + B_{t-1,t} - D_{t-1,t} + M_{t-1,t}$$

where:

P_t = population at time t;
P_{t-1} = population at time t-1;
$B_{t-1,t}$ = births, in the interval from time t-1 to time t;
$D_{t-1,t}$ = deaths, in the interval from time t-1 to time t; and
$M_{t-1,t}$ = net migration, in the interval from time t-1 to time t.

To fit this formula, data was collected from reports of Pakistan Bureau of Statistics i.e. Pakistan Demographic Survey. Data included in this study is taken from Demographic Surveys of 2001, 2003, 2006 and 2007.

- Stationary population divided into age-sex cohorts
- Number of deaths
- Number of children born
- Number of women in the reproductive age
- Sex ratio

With the help of these variables, mortality rate, survival rate, fertility rate and migration rates are calculated according to World Bank definitions of these variable (World Bank Development Indicators):

- Survival Rate = 1- Mortality rate
- Mortality rate= age-sex specific deaths/ age-sex specific cohort population
- Migration Rate= Observed growth – natural growth
- Age specific Fertility rate = number of live births per cohort/age specific female population of childbearing age

These projections are done with the assumption that population changes with the indicators remaining the same i.e. the fertility and mortality rate continue to remain same in the coming years. This is done to see if the current healthcare system will be able to provide sufficient services to the individuals or not. Therefore, once the data is projected in classifications of age and sex. They are presented in the form of population pyramids, helping us to visually present our results.

This study focuses on Khyber Pakhtunkhwa and projects the information for this area. International Organizations (WHO) have done projections for Pakistan on the whole, and estimation at the country level is available. However, the provincial information needs to be studied closely after the 18th amendment. After the 18th amendment, health sector has been devolved and each province has been delegated the authority of managing the healthcare services. Therefore, separate population projection is required to estimate the requirement of health sector of the province and help the government in better health service provision.

After we have a sense of the changing demographics in province, we tally the allocation of the qualified students in different specializations by Postgraduate Medical

Institute. Popularity of different fields is studied and future direction is highlighted for a better healthcare service.

4. RESULTS

Applying the Cohort Component Method on the collected data, we first estimate the population for 2012. It is preferable because projected values can be compared with the official estimates of the provincial population. According to the estimates Khyber Pakhtunkhwa hosted 22-23 million of individuals in 2012 (KP Government, 2013). According to our model, a total of 22.96 million individuals are projected in 2012. This synchronizes with the official estimates, confirming that the results for the succeeding years can be relied upon. The result for 2012 is presented in Table 1. Collective results for both male and females are reported in the table to give a holistic view of the population division per age group. Division by age and gender of the population is reported in the next section of population pyramids.

The third column of Table 1 represents the projected population of 2037. The increase in population in the coming decades and the division of the population per age is reflected in the table. However, to visually represent the data in an easier format, population pyramids are presented in the next section for both, 2012 and 2037 to show the changing population dynamics over the years.

Table 1
Projected Population of Khyber Pakhtunkhwa

Age	2012	2037
0-4	3,202,318	4,622,869
5-9	3,854,242	5,685,497
10-14	3,498,571	5,066,459
15-19	2,810,402	4,210,526
20-24	1,967,824	3,105,618
25-29	1,464,078	2,470,423
30-34	976,875	1,698,113
35-39	957,940	1,623,578
40-44	849,632	1,345,933
45-49	837,435	1,342,509
50-54	645,772	1,011,039
55-59	513,487	775,289
60-64	471,390	632,644
65-69	370,976	511,243
70-74	239,864	359,991
75-79	115,932	173,912
80-84	88,861	150,628
85+	97,465	1,075,594
Total	**22,963,062**	**35,861,865**

The first population pyramid shows the visual distribution of population by division of their age and sex in 2012. The age of the population is presented on the vertical axis with the size of population on the horizontal axis. We can see that the high fertility rate is resulting in a large number of individuals that are now classified as youth (below the age of 35). As these individuals grow old, with the changing lifestyle and urbanization observed in different studies, they are going to face many health problems that will need physicians trained for a holistic health management approach.

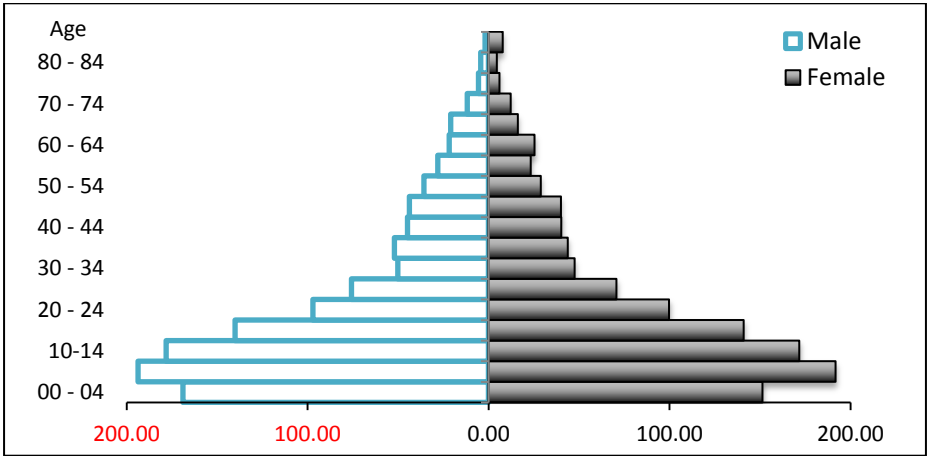

Fig. 1: Population Pyramid, 2012, KPK (10,000)

Where Figure 1 shows the current situation, Figure 2 shows the distribution of the population after three decades. With the same formatting on both the axis, age and gender distribution is represented in the figure. It indicates that in the coming decades, the number of elderly is going to increase immensely. If the population dynamics do not change, fertility is not controlled and proactive actions are not taken to manage this ageing population, then huge trouble for healthcare providers can be expected to arise.

As we have already established, that as population ages, individuals require more healthcare. Moreover, the increasing trend of NCDs in Pakistan will burden the nation even more when the population, most susceptible to these diseases, increases. This indicates that in the coming three decades, we should be able to provide geriatric healthcare services; general practitioners should be properly educated in family medicine to properly treat NCD susceptible population; and adults should be made aware of the risks of sedentary lifestyle, unhealthy nutritional intake, and avoidance of destructive habits (e.g. smoking). If ignored, this can result in dire consequences for the province in more than one sector.

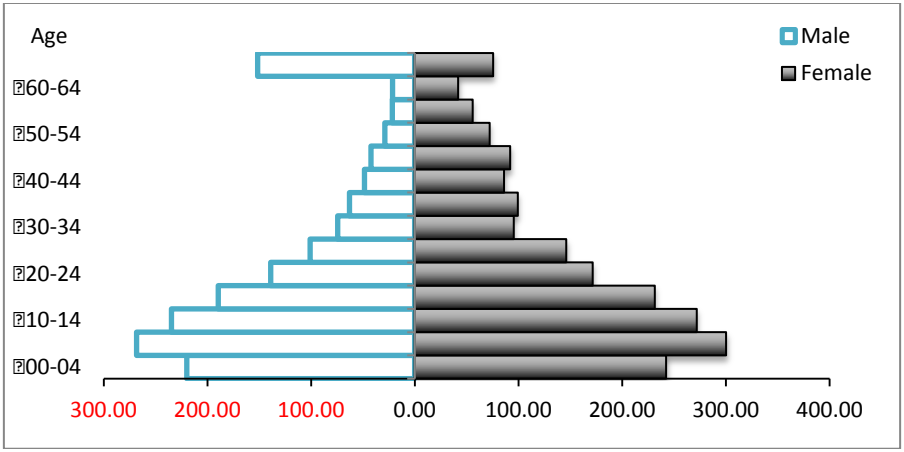

Fig. 2: Population Pyramid, 2037, KPK (10,000)

The above results show that requirement for doctors in the future is going to increase not only for the general healthcare services but also in some of the fields ignored currently. The above results show that an integrated approach from healthcare providers is needed. For this purpose we reviewed the current situation. According to the revised curriculum of 2011, there is no course in Bachelor of Medicine and Surgery that educate the students about family medicine or geriatrics. If we expect the graduates to choose the path of geriatrics in the future, it is imperative that they are informed about the options they have and the importance of the field in the coming decades. As reported by Iqbal (2010) in her study at Shifa College of Medicine, Islamabad, Pakistan, only 15 out of 46 medical students were aware of Family medicine as a field of specialization and could give its correct definition (Iqbal, 2010). She states that once rotation in family medicine was introduced, students expressed interest in pursuing family medicine as a career. This indicates that introducing the specialization in Family Medicine at undergraduate level is an important factor in future planning for geriatrics management.

It is also encouraging that College of Physicians and Surgeons, Pakistan, offers specialization in Family Medicine. Therefore, with proper guidance and introduction of family medicine in undergraduate curriculum some advancement can be expected in this field. Example of Agha Khan University Medical College and Fatima Memorial College Lahore can be useful in this regard. They provide their graduates with opportunity to train in family medicine. Ziauddin Medical College has also included family medicine in their undergraduate curricula, which is an encouraging step. According to a study in Ziauddin Medical College, although family medicine was part of undergraduate curriculum final year students did not prefer general practice to other specializations. Most preferred specializations were internal medicine, pediatrics and general surgery (Huda and Yousaf, 2006). This trend has been observed in other developed countries as well. Reasons for such behavior are concern of students about financial soundness, prestige symbol and knowledge base associated with family medicine (Campos et al., 2003, McGaha et al., 2007).

To review the trend in Khyber Pakhtunkhwa, the allocation of doctors in different specializations in 2014 was studied. It is noted that the field preferred by most of the students is Medicine and Allied Sciences:

Table 2
Number of Postgraduate Trainees per specialization

Specialization	No. of Postgraduate Trainees
Medicine and Allied Sciences	41
Surgery and Allied Sciences	22
General Surgery	10
Ophthalmology	8
Radiology	5
Orthopedic	3
Gynecology and Obstetrics	37
Dentistry	12
Pediatrics	10
General Medicine	8
Urology	3
Hematology	2

Other than these Neurology, Psychiatry, Maxillofacial Surgery, ENT, Gastro endocrinology, Vitreoretina, Orthodontics, and Cardiology had one candidate each. Seeing these results, one can easily deduce that the future is going to see a large number of specialist physicians, gynecologists and surgeons and a dearth of specialists in Endocrinologists, Family Medicine, etc. will be seen. The thought that physicians and fresh graduates will be able to treat these patients is refuted with the evidence provided by Jafar (2005) as discussed earlier in the study. However, a shortage of specialists in Family Medicine and Geriatrics can be critical with the increasing number of elderly in the population, if prompt actions are not taken. Policies and Strategies should be designed to ensure that this gap is filled in time.

Internationally family medicine is taught as a three year long post graduate specialization and the graduating doctors are equipped with all the necessary skills required to serve as family physicians. Similarly, Geriatrics is a separate field of specialization, especially designed to treat the elderly, both of these fields will become a necessity to deal with the future health demands. Family medicine should also be given the due importance because the doctors serving in Basic Health Units and Regional Health Centers would need the basics of this field to ensure that they treat different segments of population in rural areas. If not full-fledged specialization, they can be at least given diploma courses before posting them in these facilities.

DISCUSSION

The above results show that it is imperative to take steps from now to fill the arising gaps, as it will take a long period of time to produce doctors trained in Family Medicine and Geriatrics. Teaching undergraduates about the importance of these fields, graduates selecting these as specializations and then training them accordingly, will take time as

reported by Huda and Yousaf (2006). Although Ziauddin Medical University provides rotations in Family Medicine at the undergraduate level, the number of students selecting the field for specialization is still low as compared to the other fields. But once the students are given proper incentives, they will prefer general practice (Singh, 2013). These complications indicate a long process of introducing the two fields of Family Medicine and Geriatrics in Khyber Pakhtunkhwa, but fortunately if we focus on the situation immediately, it can be handled easily.

Similarly, Biggs (2008) has pointed to a number of deficiencies in postgraduate training of medical students. He argues that the criteria of qualification for postgraduate training need to be revised and the quality of the training needs improvement. He reports that family doctors provide approximately 70 percent of health care services in the country. Therefore, family physicians need to be trained rather more rigorously to enable them to attend to the diverse needs to the services required by the masses. As they are the first physicians contacted at appearance of symptoms, their ability to perform well are essential to health of patients (Gutkin, 1999). However, in Pakistan it is believed that undergraduate qualification enables graduates to practice family medicine. Further steps should be taken by respective authorities to amend this gap for an improved health system in country (Shaikh, 2013). Recognizing this need Punjab Government has taken steps to mend this gap and took initiative to develop a university postgraduate course in the province to train family physicians in future. Khyber Pakhutnkhwa government should also try to replicate the effort and start focusing on this issue proactively.

Due to unavailability of the updated databases of doctors, more elaborate results could not be achieved in this research paper. Future researchers could contribute in this area and try to explore the proxies that can be used until the data is updated.

CONCLUSION

Demographic changes are imminent in Khyber Pakhtunkhwa if similar population dynamics as today continue to play their role in future. In such a situation, the number of elderly will increase significantly along with the demand for specialists in geriatric and family medicine. Currently Medicine, Gynecology and Obstetrics, and General Surgery are the preferred specializations of the students. However, this will result in dearth of specialists in other fields. To be able to cater to future demands in healthcare, Khyber Pakhtunkhwa government and Postgraduate Medical Institute should focus on introducing Family Medicine and Geriatrics in its undergraduate curriculum and put efforts in maintaining data in healthcare to analyze it for future demands. This will help them in counseling students to opt for a specialization that can be helpful in the future.

REFERENCES

1. Akram, M. and Khan, F.J. (2007). *Health Care Services and Government Spending in Pakistan* (No. 32) (p. 25). Islamabad.
2. Alam, M. and Karim, M. (2005). Looking Beyond The Current Demographic Scenario: Changing Age Composition, Ageing And Growing Insecurity Issues for the Aged in India and Pakistan Moneer. In *25th IUSSP International Population Conference* (p. 27). Tours.

3. Ali, Z. (2011). *Curriculum of MBBS*. Pakistan Medical and Dental Association and Higher Education Commission of Pakistan, Islamabad.
4. Aslam, F., Shakir, M. and Qayyum, M.A. (2005). To the Future of Research in South Asia. *PLoS Medicine*, *2*(11), 1110–1111. doi:10.1371/journal.pmed.0020322.
5. Aslam, M., Ali, A., Taj, T., Badar, N., Mirza, W., Ammar, A. and Kauten, J.R. (2011). Specialty choices of medical students and house officers in Karachi, Pakistan. *Eastern Mediterranean Health Journal*, 17(1), 74-79.
6. Aslam, M., Taj, T., Ali, A., Badar, N., Saeed, F., Abbas, M., Muzaffar, S. and Abid, B. (2009). Psychiatry as a career: A survey of factors affecting students' interest in Psychiatry as a career. *McGill Journal of Medicine : MJM*, 12(1), 7-12.
7. Biggs, J.S.G. (2008). Postgraduate Medical Training in Pakistan : Observations and Recommendations. *Journal of the College of Physicians and Surgeons Pakistan*, 18(1), 58-63.
8. Birch, S., Kephart, G., Murphy, G.T., Brien-pallas, L.O., Alder, R. and Mackenzie, A. (2009). Health Human Resources Planning and the Production of Health: Development of an Extended Analytical Framework for Needs-Based Health Human Resources Planning. *Journal of Public Health Management Practice*, *Suppl.*, 56-61.
9. Birch, S., Kephart, G., Tomblin-Murphy, G., O'Brien-Pallas, L., Alder, R. and MacKenzie, A. (2007). *Health human resources planning and the production of health: Development of an analytical framework for needs-based health human resources planning Ontario*: McMaster University.
10. Butt, S.M., Ihsan-ul-Haq, Amjad, M., Soomro, I.A., Majeed, S. and Ilyas, M. (2013). *National Health Accounts Pakistan 2009-10* (p. 106). Islamabad.
11. Campos, D., Senf, J. and Kutob, R. (2003). Comments heard by U.S Medical students about family practice. *Family Medicine*, 35, 573-578.
12. Cassum, L.A. and Shah, M. (2014). Comparative Assessment of Health Care Delivery Systems of Developing Countries : Pakistan versus. *International Journal of Science and Research*, 3(8), 984-990.
13. Cecchini, M., Sassi, F., Lauer, J.A., Lee, Y.Y., Guajardo-Barron, V., et al. (2010). Tackling of unhealthy diets, physical inactivity and obesity: health effects and cost-effectiveness. Lancet 376: 1775-1784. Available: http://www.ncbi.nlm.nih.gov/pubmed/21074255. Accessed 2012 Nov 18. 5.
14. Denton, F.T., Gafni, A. and Spencer, B.G. (2001) Population Change and the Requirements for Physicians: The case of Ontario, *Canadian Public Policy*, 27(4), 469-85.
15. Doris, K.L.L. (2008). *Family Physician Work Force Projections In Saskatchewan*. University of Saskatchewan.
16. Fakhri, A., Seyedin, H. and Daviaud, E. (2014). A Combined Approach for Estimating Health Staff Requirements, 43(1), 107-115.
17. Fasola, B.G., Aprile, G. and Aita, M. (2012). A Model to Estimate Human Resource Needs for the. *Journal of Oncology Practice*, 8(1), 13-17.
18. Ghaffar, A., Zaidi, S., Qureshi, H. and Hafeez, A. (2013). Medical education and research in Pakistan. *The Lancet*, *381*, 2234-2236. doi:10.1016/S0140-6736(13) 60146-4.
19. Global atlas of the health workforce. Geneva, World Health Organization (http://www.who.int/globalatlas, accessed 12 December 2009).

20. Greenberg, L. and Cultice, J.M. (1997). Forecasting the Need for Physicians in the United States: The health Resource and Services Administrations Physician Requirement Model, *Health Service Research*, 31(6), 723-737.
21. Gutkin C. (1999) The specialty of family medicine. *Canadian Family Physician*; 45, 231-2.
22. Hafeez, A., Khan, Z., Bile, K.M., Jooma, R. and Sheikh, M. (2010). Pakistan human resources for health assessment. *Eastern Mediterranean Health Journal*, 16, 145-151.
23. Huda, N. and Yousuf, S. (2006). Career preference of final year medical students of Ziauddin Medical University. *Education for Health (Abingdon, England)*, 19(3), 345-53. doi:10.1080/13576280600984087.
24. Iqbal, S.P. (2010). Medicine in Undergraduate Medical Curriculum : A Cost-Effective Approach to Health Care in Pakistan. *Journal of Ayub Medical College Abbottabad*, 22(4), 207-209.
25. Jafar, T.H., Jessani, S., Jafary, F.H., Ishaq, M., Orakzai, R., Orkazai, R. and Chaturvedi, N. (2005). General practitioners' approach to hypertension in urban Pakistan: disturbing trends in practice. *Circulation*, 111(10), 1278-83. doi:10.1161/01.CIR.0000157698.78949.D7
26. Khan, F.S., Lotia-farrukh, I., Khan, A.J., Siddiqui, S.T., Sajun, S.Z., Malik, A.A. and Fisher-hoch, S.P. (2013). The Burden of Non-Communicable Disease in Transition Communities in an Asian Megacity : Baseline Findings from a Cohort Study in Karachi, Pakistan. *PLoS ONE*, 8(2). doi:10.1371/journal.pone.0056008
27. Khan, S.A. and Ghosh, P. (2003). Ageing : The Demographic Volcano. *Journal of Pakistan Medical Association*, 53(10).
28. McGaha AL et al. (2007). Responses to medical students' frequently asked questions about family medicine. American Family Physician, 76, 99-106.
29. Mullan F. (2005). The metrics of the physician brain drain. *The New England Journal of Medicine*, 353, 1810-8.
30. Nishtar, S. (2006) Population-based Surveillance of Non-Commincable Diseases: 1st round, 2005; Heartfile, Ministry of Health and WHO.
31. O'Brien-Pallas L., Baumann, A., Donner, G., Murphy, G.T., Lochhaas-Gerlach, J. and Luba, M. (2001) Forecasting models for Human Resources in Health Care, *Journal of Advanced Nursing*, 33(1), 120-129.
32. O'Neill, B.C., Balk, D., Brickman, M. and Ezra, M. (2001). A Guide to Global Population Projections. Demographic Research, 4, 203-288. doi:10.4054 /DemRes. 2001.4.8
33. Preston, S.H., Heuveline, P. and Guillot, M. (2001). Demography: Measuring and Modeling Population Processes. Malden, Mass.: Blackwell.
34. Qidwai, W. (2009). Ageing population: status, challenges and opportunities for health care providers in Pakistan. *Journal of the College of Physicians and Surgeons Pakistan*, 19(7), 399-400.
35. Rehman, A., Rehman, T., Shaikh, M.A., Yasmin, H., Asif, A. and Kafil, H. (2011). Students' Corner Original Article Pakistani medical students' specialty preference and the influencing factors. *Journal of Pakistan Medical Association*, 61(7), 713-718.
36. Roberfroid, D., Leonard, C. and Stordeur, S. (2009). Human Resources for Health Physician supply forecast : better than peering in a crystal ball ? *Human Resources for Health*, 7(10), 1-13. doi:10.1186/1478-4491-7-10

37. Shahab, F., Hussain, H., Inayat, A. and Shahab, A. (2013). Attitudes of medical students towards their career — perspective from. *Journal of Pakistan Medical Association*, 63(8), 1017-1020.
38. Shaikh, S.H. (2013) A Reform Agenda Outline for Medical Education in Pakistan, *Journal of the College of Physicians and Surgeons Pakistan*, 19(6), 331-332.
39. Singh, K. (2013). Factors that influence Australian Medical Gradiates to become General Practitioners. *Australian Medical Student Journal*, 4(2), 37-39.
40. Smith, K.D., Perez-Johnson, I., Wooldridge, J. (2000). Uncertainty and Forecasting Local Health Professional Shortages, *Population Research and Policy Review*, 19, 477-503.
41. Teljeur, C., Thomas, S., Kelly, F.D.O. and Dowd, T.O. (2010). General practitioner workforce planning : assessment of four policy directions. *Health Services Research*, 10, 148. doi:10.1186/1472-6963-10-148.
42. The World Health Report 2006: working together for health. Ge- neva, World Health Organization, 2006.
43. WHO. (2013). *Glance, Country Cooperation Strategy at a Glance* (pp. 0-1). Pakistan.
44. Wild, S., Roglic, G., Green, A., Sicree, R. and King, H. (2004). Global Prevalence of Diabetes: Estimates for the year 2000 and projections for 2030. *Diabetes Care*, 27, 1047-1053; doi:10.2337/diacare.27.5.1047.
45. World Health Organization (2011) Global status report on no communicable diseases 2010. Available: http://www.who.int/nmh/publications/ncd_report2010/en/. Accessed 30 October 2012.
46. Zafar, S.N., Ganatra, H.A., Tehseen, S. and Qidwai, W. (2006) Health and needs assessment of geriatric patients: results of a survey at a teaching hospital in Karachi. *Journal of Pakistan Medical Association*, 56, 470-4.

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A REVIEW OF DYNAMICS OF INSTRUCTIONAL DESIGN: DESIGNING OF LIFE SKILLS TRAININGS FOR YOUTH

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ABSTRACT

This paper provides a systematic critical review of 34 conceptual and empirical studies discussing the dynamics of Instructional design for life skills development of youth. It also includes literature from three books. Whereas, there are a number of emerging small businesses running consultancies or skills enhancing schools etc., these small businesses are providing services while giving life skills trainings to youth. Furthermore, this paper discusses the concepts and theories that are generally used by designers during the designing of training programs for better effectiveness, these are: Instructional design (ID), Gagne-Briggs model of instructional design, ADDIE model of instructional design and other important tools, advancements, approaches and theories such as, motivational theories, innovative approaches, technological advancements and learning tools for effective learning during training program. However, literature shows that there are still some objectives that are not achieved at the end of these training programs. Hence, this literature review reveals space for more concepts, tools and advancement that can help small businesses and training designers while designing of training programs. Furthermore, the paper also discusses necessary life skills required by today's youth for living a better life. In addition to, this developmental paper is inspired by prior research of researcher at the bachelor's level i.e. "Effect of Gagne-Briggs theory of Instructional Design on Life Skills Trainings of Youth" (Rahman, 2012).

KEYWORDS

Instructional training design, Gagne-Briggs Theory, ADDIE, Life skills.

INTRODUCTION

Different emerging small businesses such as, life skills consultancies are providing life trainings on almost daily basis. Moreover, different educational consultancies and learning communities/centers are also providing life trainings to youth. Moreover, these consultancies and communities are designing training programs according to instructional design, instructional design. Instructional design (ID) is defined as "the science and art of creating detailed specifications for the development, evaluation, and maintenance of situations which facilitate learning and performance" (Richey, Klein, & Tracey, 2011, p. 3). There are a number of concepts of ID; however, the two of them are used repeatedly in designing of training programs. These are: (1) ADDIE model and (2) Gagne-Briggs theory. It has been observed that often times both of these are used together or independently while designing of life skills trainings for youth. However, literature shows that life skills trainings programs are not achieving all the objectives,

when they are designed according to instructional design theories therefore reason behind it needs to be investigated for better effectiveness of consultancies and skills enhancing schools etc. Furthermore, effectiveness of training program can also be increased through evaluation of training programs. Therefore, smalls businesses can improve the quality and profitability of their business by understanding the gap between achievement of all the objectives of life skills trainings programs and designing of life skills training programs for youth.

Contribution of Study

This study will contribute to the "book of knowledge" in three ways. These are: (1) helping the educational and life skills trainings consultancies to increase the quality and profitability of their training programs, (2) it will help designers of youth training programs to design better and effective training events, and (3) it will also provide updated information to researchers for future studies.

Significance of Study

This study will be significant in three ways: (1) it will guide the training designers to include all the important factors required for designing of training programs, (2) it will increase the profitability of educational and life skills trainings consultancies and, (3) it will also help young trainees to participate actively and efficiently in life skills training programs.

Purpose of Study

The purpose of this study is to help small business enterprises such as, educational consultancies, life skills training consultancies and learning communities/centers to increase the profitability and effectiveness of training programs through brining changes in their training designs.

LITERATURE REVIEW

Educational/learning consultancies and Training Programs

Training is known as a process to advance individual learning through practical tasks and events. Moreover, there are no such specified training theories therefore designers of training programs are trying to manage the learning processes of trainees through managing the conditions of training program(Ahmad, Jehanzeb, & Alkelabi, 2012). Furthermore, when it comes to the development, improvement and learning of skills or knowledge Instructional Design (ID) is widely used while designing of training programs (Oh & Reeves, 2010). Training program is generally composed of sequential events and interventions, which consists of certain self-generated and imposed tasks (Gross, Latham, & Armstrong, 2011).

Now-a-days, different small businesses are running educational consultancies, skills enhancing schools and learning consultancies. These small businesses are providing training programs to youth and adults for better enhancement, improvement and learning of skills. However, literature shows that most of the time these training programs are designed according to "Instructional Design" (ID) models. Whereas, literature also shows that following ID does not result in achieving all the objects of training programs, this will definitely affect the profitability, effectiveness and efficiency of small businesses.

Moreover, to improve the quality and attainment of all of the objectives, designing of training programs should be revised and new methods, tools or events should be incorporated.

Dynamics of Instructional Design (ID):

ID helps in the designing of such events which helps the learners to attain knowledge. Each event is knowledge and task based and is used to find the answers of what, why, how and who questions. ID comprises of a model known as "ADDIE". The concept of ADDIE facilitates a linear model for learning and impart knowledge through five basic steps, these include: analysis, design, development, implementation, and evaluation (Richey et al., 2011). ADDIE is followed by all the models of ID to have better learning opportunities (Zierer & Seel, 2012). The use of ID is not only limited to learning and impartment of knowledge. It can be utilized in several other dimensions. For example, Ellis & Levy (2010) proposed a six phase design and development framework for systematic research and during the third phase, researcher is suggested to follow ADDIE.ID designers are skillful people. They have the prior knowledge to design certain tasks and to evaluate learning events (Richey et al., 2011). Furthermore, "ongoing evaluation" can help the designer to "pilot test" all the events of training program before implementation (Johnson, 2012). In spite of, designers should keep in view the contributions of the people to instruction design and use their added knowledge and theories. For example, "they would know of Robert Gagne's contributions to the field" (Richey et al., 2011, p. 5). Furthermore, following ADDIE in all ID models shows the effectiveness of training programs. However, designing of events according to ID does not confirm impartment of knowledge and skills among trainees.

Another approach explains ill-structured ADDIE model instead of linear. It explains the use of design cycle defining all the decisions that are going to be taken in cycle and also influenced by the thinking processes of the designers under certain principals (Jonassen, 2008; Chyung, 2008). Furthermore, Chyung (2008) also added that a comparison of all the ID models is required before designing a training program in order to choose the one that would provide better effectiveness. Other approaches suggests certain factors, during designing of ID events supporting better learning opportunities these include; the need for motivational theories (Colakoglu, Akdemir, & Karaelmas, 2010), integration of technological advancements along with web-based tools (Bodzin, Anastasio & Kulo, 2012; Bianco, 2009; Neo, Neo & Kwok, 2009) and innovative approaches along with learning tools (Mai & Theng, 2011). In case of effective learning, a systematic approach is suggested followed by using instructional system design (ISD-ADDIE) model along with web-based model or use of technology for effective learning. Furthermore, due to the involvement of learning materials, ID models can be differentiated from one another (Singh, 2009). However, comparison of all the ID models, applying motivational theories, innovative approaches for effective learning before designing any kind of training program and then pilot testing every training event is going to be time and cost consuming. In addition, different ID models should be designed with motivational theories, innovative approaches, technological advancements and learning tools for effective learning. In addition to, Gross, Latham, & Armstrong (2011) suggests following an Instructional Strategy i.e. considering different models of ID while designing of training interventions, for example, Gagne-Briggs nine events of ID.

Relationship between ID and Gagne-Briggs Theory:

Gagne-Briggs theory of instructional design provides a set of nine events for ID to enhance the learning of learners during a training program. It is applicable to "cognitive, behavioural, and attitudinal learning" (Blanchard & Thacker, 2007, p. 198). The theory suggests that while designing a training program, nine sets of instructional design events should be designed in relation with social learning theory. The nine ID events are: "gain attention", "informing the learner about the goals and objectives of the training", "stimulating recall of prior relevant knowledge", "present material to be learned", "providing guidance to learning", "elicit the performance", "providing feedback", "assessing performance", and "enhancing retention and transfer" (Blanchard & Thacker, 2007, p. 198-201). In addition to, Kulo (2011) gave another name to Gagne-Briggs model and mentioned it as "Behaviourist instructional model". He also mentioned that direct instruction is followed in these nine events. Trainer asks the trainees to follow his/her instructions for better learning and skill enhancement. Furthermore, developments of procedural ID models are highly influenced by Gagne-Briggs theory (Zierer & Seel, 2012). Gagne-Briggs theory of instructional design has been used in several ways. It is influencing ID and many researchers are following this theory for designing of models and modules etc. for example, Harris, Sadowski, & Birchman (2006) introduced "Gagne learning style indictor", Ellis & Levy (2010) added gagne-briggs theory to promote a sequence for conduction of research, Olsen & Dupin (2012) designed a learning module following all the nine events, Mai &Theng (2011) suggests Gagne-Briggs nine events for "life-long learning". However, the theory does not emphasize on pilot testing of training events, implementation of motivational theories, innovative approaches and usage of technology along with learning tools. Moreover, Johnson (2012) explains ID as a systematic process designed according to the perspective of trainees, on the other hand, ADDIE and Gagne-Briggs models does not seem to be emphasizing more upon the trainees perspective or perceptions.

Is ADDIE and Gagne-Briggs Theory Sufficient Enough for Effective Training Program?

Research studies have shown that, when training programs are designed upon ID models (ADDIE and Gagne-Briggs) some training objectives are seem to be not achieved and trainees fail to learn all the skills. For instance, Johnson (2012) accomplished 2-3 training objectives (program planning and team bonding) out of 73; Nicoll-Senft & Seider (2010) accomplished 6 out 8 objectives. Moreover, studies have also shown the use of ADDIE and Gagne-Briggs theory either together or independently while designing of a training program. There are multiple number of studies designing training programs on either ADDIE model (Zierer & Seel, 2012; Johnson, 2012; Singh, 2009; Cui, Lockee, & Meng, 2012; Jonassen, 2008) or Gagne-Briggs nine events (Harris, Sadowski, & Birchman, 2005; Nicoll-Senft & Seider, 2010; Bodzin, Anastasio, & Kulo, 2012; Kulo, 2011; Theng & Mai, 2011; Harris Y. F., 2010; Bianco, 2009; Gross, Latham, & Armstrong, 2011; McLaughlin, 2004). Moreover, there are research studies combining both ADDIE and Gagne-Briggs model (Ellis & Levy, 2010; Latham & Gross, 2013; Colakoglu, Akdemir, & Karaelmas, 2010; Schoor & Körndle, 2012; Reinicke & Janicki, 2010; Neo, Neo, & Kwok, 2009; Pereira, Mesquita, & Graça, 2009; Siragusa & Dixon, 2005; Chyung, 2008; Nicoll-Senft & Seider, 2010).

Designing of effective training program is required because of lack of specific training theory (Ahmad, Jehanzeb, & Alkelabi, 2012)therefore training designers prefer the use of ID models to make it effective. In addition to, there are some studies trying to introduce a new concept of Design Research (DR) instead of ID (Oh & Reeves, 2010).Furthermore, training designers are trying to align the objectives of training programs with ID models (Nicoll-Senft & Seider, 2010). Whereas, some studies aligned trainers and trainees objectives (Kulo, 2011), some aligned trainees objectives with learning module of training program (Olsen & Bryant, 2012). Hence, there is something else, which is required by life skills training programs to achieve all the objectives.

Life Skills Trainings

Life skills trainings are important for the healthy cognitive, physical and behavioural development of young people. Therefore, different educational consultancies, learning centers/communities and life skills trainings consultancies are providing trainings to young people on almost daily basis. Moreover, trainees show a positive attitude towards life skills trainings and appreciate its learning in learning community centers. Learning community centers helps youth in learning of life skills are important for youth as they help youth to stand up in this changing environment. They can be(1) physical, (2) behavioural and (3) cognitive skills. Furthermore, life skills consists of range of skills, necessary for "successful living" and have received quite attention because it is explained as the "abilities" that helps people to become thoughtful, productive and to live a satisfying life. These skills consists of "self-awareness building skills, empathy, interpersonal communication skills, decision making skills, problem solving skills, critical thinking skills, skills for managing feelings" (Abolghasemi, Alavi, & Nobarian, 2010). However, according to Bailey & Deen (2002) Among 35 life skills, 8 are identified by Hendricks (1998) as necessary for individuals. These are "decision making, wise use of resources, communication, accepting differences, leadership, marketable skills, healthy life style choices and self-respect". Despite of, research is still under progress in order to define 10 life skill sub-domains out of these 35 for measurement of life skills (Duerden & Witt, 2011).

Relationship between ID and Life Skills Trainings

Instructional design techniques in the development of youth trainings can be a worthy use of resources, because it acts as a proper guidance to meet the needs and requirements for learning and enhancement of basic and advanced skills, for example, leadership skills (Johnson, 2012), mental skills, such as "self-confidence, negative energy control, attention control, visual and imaginary control" can be improved through different interventions (Sheard & Golby, 2011). Moreover, providing practical trainings to trainees (problem solving tasks) is considered to be effective (Goudas & Giannoudis, 2008). Although, there is still space left for more learning programs to focus on life skills trainings (Abolghasemi et al., 2010). Whereas, aligning training objectives with the trainees needs brings a positive effect on training (Johnson, 2012), Kulo (2011) suggests aligning of trainer's instruction with trainee's actions. Pereira, Mesquita & Graça, (2009) agreed on this point and further suggested "accountability" of the trainees towards trainers and vice versa. Gross, Latham, & Armstrong (2011) designed and developed long term 3 years educational intervention through following nine ID events of Gagne-Briggs theory. They are also trying to measure the "skills", "self-assessment" and "the

effect of workshop (intervention). Furthermore, students with low literacy skills prefer "self–generated and imposed" information and knowledge through working with freedom in their own manner. However, designing an ID intervention along with a combination of demonstration, practice and incentives motivates and encourages them to improve literacy skills (Latham & Gross, 2013). Furthermore, to overcome cognitive skills weakness, workshops/trainings should be held to increase learner's meta-cognitive skill (Kolb & Kolb, 2005). In spite of, psychological skill trainings can also increase cognitive ability (Sheard & Golby, 2011).

More importance is now-a-days, given to the skills that are mentioned by trainees themselves because trainees are observed to be more interested and better involved in self-generated tasks rather than imposed tasks. These skills consists of: technological skills, research skills, search skills, communication skills, math skills, organizational, skills, planning skills, cognitive skills, information literacy skills and life management skills. Furthermore, Life management skills consist of the following: self-discipline, time management, and money management etc. (Latham & Gross, 2013). Despite of, it has been seen that trainees with lack of skills are unaware of the abilities and styles in themselves and in others that will be required to learn those skills (Gross & Latham, 2011) therefore it is also considered necessary for the trainees to change their perceptions about skills and acquisition of skills and in order to change these perceptions identification of learning styles and abilities play a major role (Gross, Latham, & Armstrong, 2011).

Relationship between ID and Motivational Theories

Motivational theories in ID events are also important for trainees to learn new skills and to stay interested in training program (Latham & Gross, 2013)as it supports better learning because ID lacks the ability to agitate motivational stimulus inside trainees. Moreover, ARCS Motivational Theory has been given quite importance especially when it is aligned with ID design (Colakoglu, Akdemir, & Karaelmas, 2010). Moreover, aligning trainees interests with learning environment decreases learning gaps and increases motivation among trainees (Kolb & Kolb, 2005). Where as, motivation only comes during self-generated tasks, different trainees have different learning abilities (Latham & Gross, 2013).

Evaluation of Training Programs and Life Skills

Evaluation of these training programs is also necessary. In order to measure the effectiveness of learning modules applied in training programs, Schoor & Körndle (2012) introduced a "formative evaluation tool". This tool comprised of a checklist based upon ADDIE and Gagne-Briggs nine events. They further suggested that, using this tool can help the designers to evaluate as well as improve the current learning program. Furthermore, "Donald Kirkpatrick's Four-Level Model of Evaluation" can be used as well. This standardize evaluation model has its own evaluation forms and questionnaires (Chyung, 2008). In addition to this, a likert scale questionaire can be used to measure the life skills. Basic skills covered in the questionnaire can be "self-awareness building skills, empathy, interpersonal communication skills, decision making skills, problem solving skills, critical thinking skills, skills for managing feelings". The improvement of these life skills can be easily asked from the learners through questionnaires (Abolghasemi,

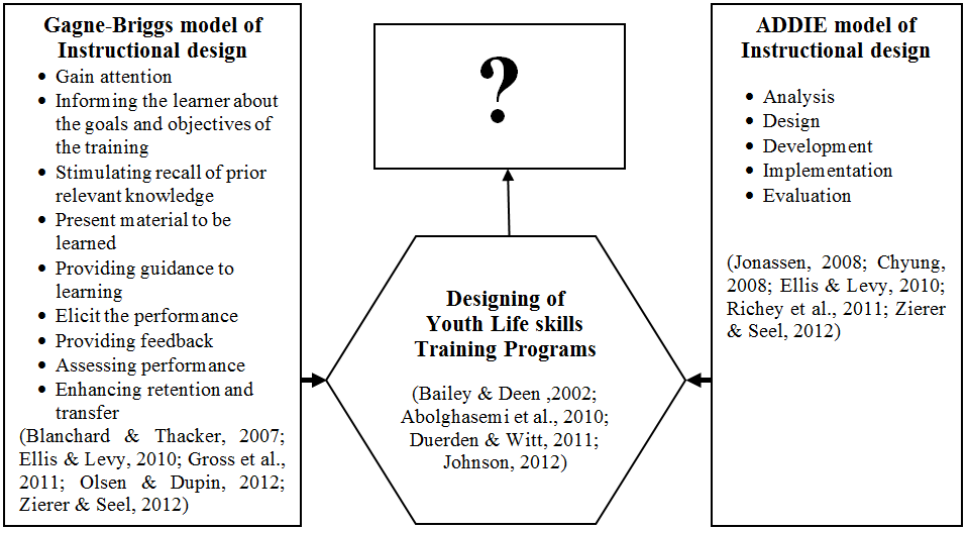
Alavi, & Nobarian, 2010; Bailey & Deen, 2002). However, the use of standardized tools does not confirms the enhancemenet and impartment of knowledge among learners. Furthermore, trainees can be reluctant to answer the truth.

Findings from the Review

Instructional Design (ID) along with the use of different models, theories, approaches and concepts can be used for designing effective training programs, which will ultimately help in the ranking and profitability of life skills trainings consultancies. ADDIE, the five steps model is followed in every model of ID. Followed by ADDIE, the use of Gagne-Briggs theory is also considered to be important. Whereas, learning and teaching of life skills is recommended more for today's youth, teaching of life skills is focused to live a better life. Furthermore, basic and advanced learning of these skills can occur through ID trainings. However, evaluation of these trainings is also suggested. Certain evaluation tools such as, "Donald Kirkpatrick's four-Level Model of Evaluation" can be used to evaluate training program. Besides these tools, the use of likert scales is also suggested to measure trainee's skills.

A gap exists between the achievement of objective of life skills training programs and designing of training programs through ID models. ADDIE and Gagne-Briggs theory designed training programs does not provide any information about lack of achievement of all the objectives of training program. Furthermore, ID mainly seems to be providing knowledge about designing effective training programs. Even though, if one particular training program is kept for one skill, still there is lack of evidence that all the trainees will be able to reach all the objectives of training program. Therefore, more research is required to fulfill this gap between attainment of objectives and designing of training programs.

Conceptual Framework



Explanation

The above conceptual framework elicits the use of two ID models such as, Gagne-Briggs model (Blanchard & Thacker, 2007; Ellis & Levy, 2010; Gross et al., 2011; Olsen & Dupin, 2012; Zierer & Seel, 2012) and ADDIE model (Jonassen, 2008; Chyung, 2008; Ellis & Levy, 2010; Richey et al., 2011; Zierer & Seel, 2012) while designing of life skills training programs for youth. The framework further shows the use of nine events of Gagne-Briggs theory such as, "gain attention", "informing the learner about the goals and objectives of the training", "stimulating recall of prior relevant knowledge", "present material to be learned", "providing guidance to learning", "elicit the performance", "providing feedback", "assessing performance", and "enhancing retention and transfer" (Blanchard & Thacker, 2007, p. 198-201) and five steps of ADDIE such as, analysis, design, development, implementation, and evaluation (Richey et al., 2011).Moreover, the framework explains that designing of youth life skills training programs should be on the basis of the two models of ID for better knowledge impartment and skill enhancement among trainees or learners. However, the "question mark" in the conceptual framework refers to identification of the gap, which will help the life skills training programs in attainment of all the objectives i.e. it will help the trainees to achieve all the skills that are taught during life skills training programs.

Conclusions and Directions for Future Research

Training is known as a process to advance individual learning through practical tasks and events therefore educational consultancies and life skills training centers are providing skills development and enhancement trainings to youth. Moreover, there are no such specified training theories (Ahmad et al., 2012) therefore designers of training programs are using ID to design training events, interventions and tasks to help learners in attain knowledge and skills (Richey et al., 2011). Furthermore, two of ID models are "ADDIE" and "Gagne-Briggs theory" seemed to be highly used while designing of training program. Whereas, the concept of ADDIE facilitates a linear model for learning and impart knowledge through five basic steps, these include: analysis, design, development, implementation, and evaluation (Richey et al., 2011), Gagne-Briggs theory suggest nine events for designing of training program, these include: "gain attention", "informing the learner about the goals and objectives of the training", "stimulating recall of prior relevant knowledge", "present material to be learned", "providing guidance to learning", "elicit the performance", "providing feedback", "assessing performance", and "enhancing retention and transfer" (Blanchard & Thacker, 2007, p. 198-201). Furthermore, a gap exists between achievements of several objectives of training programs and designing of training programs therefore this research paper will try to investigate this gap.

Research Questions

This study will investigate the following question:

- What else should be incorporated in the designing of youth life skills training programs?

RESEARCH METHODOLOGY

Due to the availability of less literature, this study comes into the domain of exploratory research and it will take a qualitative approach for inquiring instructional

design models (ADDIE & Gagne-Briggs). This study is based on review of updated literature and uses it as secondary data. Moreover, this secondary data comprises of research articles, article reviews, developmental papers and books related to instructional design. Furthermore, on the basis of secondary data this study is identifying the gap between training design and achievement of objectives of life skills training programs.

This study is following certain steps in order to complete the findings:

Step I:

The first task to conduct literature review was to search for relevant articles on Instructional Design (ID), ADDIE, Gagne-Briggs theory, learning styles, learning abilities and youth life skills training programs.

- **Time span:**
  All the publications are restricted under a specific time span i.e. maximum 2009-2013 and minimum 2002-2013. Time span is necessary in order to gather the updated information on the concepts.

- **Jstor and Google scholar search:**
  Different phrases and words are searched in Jstor and Google scholar for finding the relevant articles. These will be: "instructional design", "ADDIE model", "Gagne-Briggs Theory", Gagne-Briggs nine events", "youth training programs", "life skills", "youth life skills", "designing of training program", "definition of instructional design", "evaluation of training programs", "evaluation of life skills training programs", "effect of instructional design on training programs", "effect of Gagne-Briggs theory on training programs".

Step II:

These articles are downloaded using digital library at Im|sciences, Hayatabad, Peshawar. Furthermore, snowball technique also helped the researcher in locating more research articles.

- **Journals:**
  Moreover, the following journals were used to download the articles, these are: Academy of Management, Information System Education Journal, Elearning papers, Review of Business Information Systems, Learning and Performance Quarterly, Journal of Research in Innovative Teaching, Engineering Design Graphics Journal, Taylor & Francis, Springer Plus, World Applied Sciences Journal, International Journal of Academic Research in Business and Social Sciences, Australasian Journal of Engineering Education, Family Relations, Journal of Computer Assisted Learning, Journal of Extension, Educational Sciences: Theory & Practice, Learning and Instruction, The Library Quarterly, Engineering Design Graphics Journal, Academy of Management Learning & Education, Theses and Dissertations, School of Library & Information Studies, International Journal of Instructional Media etc.

- **Books:**
  In addition to journal, books were also used to search for relevant information, these are: Foundations of Instructional and Performance Technology, In Effective Training: Systems, Strategies, and Practices,The Instructional Design Knowledge Base: Theory, Research, and Practice, Research methods for business students.

Step III:

In order to conduct a systematic critical literature review "Six Steps to Inducing Systematicity in Literature Review" (Nouman, 2013) was consulted. Following steps from the paper were followed to conduct systematic review:

a) Formulating the LR Table
b) Paraphrasing the Table
c) Identifying Similarities/Dissimilarities among Research Papers (Moving Towards "Critical" Literature Review)
d) The Write-Up I
e) The Write-Up II
f) Identifying 'Knowledge Gaps' Relevant to the Research Topic (Refining Research Questions) and Concluding the LR

Justification of Methodology

There are two reasons behind this methodology, these are: (1) training programs are not achieving all of their objectives and a few of the objectives are left behind without any proper explanation i.e. trainees fail to achieve all the skills. This shows that there is something wrong with the designing of training events (2) this study is a continuation of a previous study therefore reviewing the literature will help in investigating of core issues.

Direction for Future Research

- Training program can be designed according to new design
- Small businesses can implement the identified gap and can increase their profitability
- More research can be used to incorporate new theories and models

REFERENCES

1. Abolghasemi, M., Alavi, H.A. and Nobarian, M.T. (2010). Community Learning Centers Beyond the Traditional Role. *World Applied Sciences Journal*, 8(9), 1060-1064.
2. Ahmad, A., Jehanzeb, K. and Alkelabi, S.A. (2012). Role of Learning Theories in Training While Training the Trainers. *International Journal of Academic Research in Business and Social Sciences*, 2(11), 188-189.
3. Bailey, S.J. and Deen, M.Y. (2002). Development of a Web-Based Evaluation System: A Tool for Measuring Life Skills in Youth and Family Programs. *Family Relations*, 51(2), 138-147.
4. Blanchard, N.P. and Thacker, J.W. (2007). Gagne-Briggs Theory. In *Effective Training: Systems, Strategies, and Practices* (3rd Edition ed., pp. 198-201). India: Pearson Education International.
5. Bodzin, A.M., Anastasio, D. and Kulo, V. (2012). Designing Google Earth Activities for Learning Earth and Environmental Science. *Teaching Science and Investigating Environmental Issues with Geospatial Technology: Designing Effective Professional Development for Teachers*, 1-25.

6. Chyung, S.Y. (2008). Evaluation of Training Programs. In S.Y. Chyung, *Foundations of Instructional and Performance Technology* (pp. 63-77). U.S: HRD Press.
7. Chyung, S.Y. (2008). Systematic Instructional Design. In S.Y. Chyung, *Foundations of Instructional and Performance Technology* (pp. 43-60). U.S: HRD Press.
8. Chyung, S.Y. (2008). Systems Approaches to Instructional Development. In S.Y. Chyung, *Foundations of Instructional and Performance Technology.* HRD Press.
9. Colakoglu, O.M., Akdemir, O. and Karaelmas, Z. (2008). Motivational Measure of the Instruction Compared: Instruction Based on the ARCS Motivation Theory versus Traditional Instruction in Blended Courses. *World Conference on Educational Multimedia, Hypermedia and Telecommunications (EDMEDIA)* (pp. 48-53). J. Luca & E. Weippl.
10. Cui, G., Lockee, B. and Meng, C. (2012). Building modern online social presence: A review of social presence theory and its instructional design implications for future trends. *Education and Information Technologies,* 18(4), 661-685.
11. Duerden, M.D. and Witt, P.A. (2011). Assessing the Need for the Development of Standardized Life Skills Measures. *Journal of Extension,* 5, 49.
12. Ellis, T.J. and Levy, Y. (2010). A Guide for Novice Researchers: Design and Development Research Methods. *Informing Science & IT Education Conference* (pp. 108-118). Florida: Informing Science Institute.
13. Goudas, M. and Giannoudis, G. (2008). A team-sports-based life-skills program in a physical education context. *Learning and Instruction,* 18(6), 528-536.
14. Gross, M. and Latham, D. (2011). Experiences with and perceptions of information: A phenomenographic study of first-year college students. *The Library Quarterly* 81(2), 161-186.
15. Gross, M., Latham, D. and Armstrong, B. (2011). Improving Below-Proficient Information Literacy Skills: Designing an Evidence-Based Educational Intervention. *Taylor & Francis* (60), 104-111.
16. Harris, L.V., Sadowski, M.S. and Birchman, J.A. (2006). A Comparison of Learning Style Models and Assessment Instruments for University Graphics Educators. *Engineering Design Graphics Journal,* 70(1), 6-15.
17. Johnson, M.L. (2012). Developing a student leadership retreat using instructional design techniques. *Learning and Performance Quarterly,* I(2), 2-29.
18. Jonassen, D.H. (2008). Instructional Design as Design Problem Solving: An Iterative Process. *Educational Technology,* 48(3), 22-26.
19. Kolb, A.Y. and Kolb, D.A. (2005). Learning Styles and Learning Spaces: Enhancing Experiential Learning in Higher Education. *Academy of Management Learning & Education,* 42(2), 193-212.
20. Kulo, V. (2011). Design, Development, and Formative Evaluation of a Geographic Information System-supported Science Web-based Inquiry Module. *Theses and Dissertations*, 1-389.
21. Latham, D. and Gross, M. (2013). Instructional Preferences of First-Year College Students with Below-proficient Information Literacy Skills: A Focus Group Study. *School of Library & Information Studies*, 1-44.
22. McLaughlin, K.D. (2004). Toward a New Paradigm for Teaching and Learning: A Case Study of the Process of Integrating Instructional Design and Technology at Florida Community College at Jacksonville. 1-352.

23. Neo, T.-K., Neo, M. and Kwok, J.W. (2009). *Engaging students in a multimedia cooperative-learning environment: A Malaysian experience.* Retrieved from http://www.ascilite.org.au/conferences/auckland09/procs/neo.pdf
24. Nicoll-Senft, J.M. and Seider, S.N. (2010). Assessing the Impact of the 4MAT Teaching Model Across Multiple Disciplines in Higher Education. *College Teaching,* 58, 19-27.
25. Oh, E. and Reeves, T.C. (2010). The implications of the differences between design research and instructional systems design for educational technology researchers and practitioners. *Educational Media International,* 47(4), 263-275.
26. Olsen, D.H. and Bryant, P.-D. (2012). Business Intelligence And Information Systems: Enhancing Student Knowledge In Database Courses. *Review of Business Information Systems–First Quarter,* 16(1), 1-14.
27. Pereira, F., Mesquita, I. and Graça, A. (2009). Accountability systems and instructional approaches in youth volleyball training. *Journal of Sports Science and Medicine,* 8, 366-373.
28. Rahman, M. (2012). *Effect of Gagne-Briggs Theory of Instructional Design on Life Skills Trainings for Youth.* Imsciences Peshawar. Peshawar: Imsciences Library.
29. Reinicke, B.A. and Janicki, T.N. (2010). Increasing Active Learning and End-Client Interaction in the Systems Analysis and Design and Capstone Courses. *Information Systems Education Journal Information Systems Education Journal,* 8(40), 1-10.
30. Richey, R.C., Klein, J.D. and Tracey, M.W. (2011). The Definition of Instructional Design. In *The Instructional Design Knowledge Base: Theory, Research, and Practice* (p. 3). New York: Routledge.
31. Saunders, M., Lewis, P. and Thornhill, A. (2009). *Research methods for business students* (5th Edition ed.). Pearson Education.
32. Schoor, C. and Körndle, H. (2012). Checklist for a Didactically Sound Design of eLearning Content. *eLearning Papers*, 1-6.
33. Sheard, M. and Golby, J. (2006). Effect of a psychological skills training program on swimming performance and positive psychological development. *International Journal of Sport and Exercise Psychology,* 4, 149-169.
34. Singh, O.B. (2009). Development and validation of a web-based module to teach metacognitive learning strategies to students in higher education. *Graduate School Theses and Dissertations*.
35. Siragusa, L. and Dixon, K.C. (2005). A theoretical framework for research and development into sound online learning in higher education. *Australian Association for Research in Education*, 1-10.
36. Theng, L.F. and Mai, N. (2011). Designing a Multimedia-mediated Student-centred Learning Environment (MMSLE) with Gagne's 9 Events: Students' Perceptions. *International Journal of Instructional Media,* 38(4), 1-12.
37. Zierer, K. and Seel, N.M. (2012). General Didactics and Instructional Design: eyes like twins A transatlantic dialogue about the past and the future of two sciences of learning and teaching. *SpringerPlus*, 1-22.

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BLIND SIGNCRYPTION SCHEME BASED ON HYPER ELLIPTIC CURVE FOR UNTRACEABLE PAYMENT SYSTEM

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ABSTRACT

Sender anonymity and privacy have become basic requirements for anonymous communication in electronic commerce (e-commerce). In this paper we proposed blind Signcryption scheme based on hyper elliptic curve cryptosystem. It satisfied the security requirements of anonymous confidential communication like transaction confidentiality, integrity, un-forgeability, sender anonymity, bank non-repudiation, Un-traceability and forward secrecy. Our scheme has low computation and communication cost as compared to existing schemes. It is more suitable for anonymous e-commerce such as electronic payment system.

KEYWORDS

Anonymity, Signcryption, Blind Signcryption, Elliptic Curve, Hyper Elliptic Curve

INTRODUCTION

In electronic commerce (e-commerce) digital transactions plays a vital role. In many environment peoples asked to obtain some services to provide identification of information for themselves. During transactions the customers want to confidentially communicate with the system, in which his identity cannot be revealed. Therefore, anonymity is used to ensure the privacy of the customers in untraceable payment system. It is used to make the payments transaction secure between the customers and service provider (bank). In anonymity customers take confidential his information and able to share it without revealing his identity. Chaum [2] proposed e-cash scheme, which has a vital role in e-commerce. In electronic domain Chaum scheme allow people for commercial activities. For anonymous communication scheme [2, 3] is more suitable to protect identity and privacy of the voter or customer in electronic voting or electronic payments systems. Eslami, [4] scheme is based on DLP problem and factoring-problem. The limitation of Eslami scheme is not providing the security property. Wang [5] scheme the bank is off line, this scheme is not suitable for on line type of transactions.

Our contribution: The proposed Wang, [5] is complicated for on line type of transactions. To remove the limitation of Wang scheme, we propose blind Signcryption scheme based on hyper elliptic curve for untraceable payment system, to digitally satisfy all the requirements of electronic commerce and electronic payments systems with respect to all the security properties like transaction confidentiality, Un-traceability,

transaction integrity, non-repudiation, and blindness. Communication and computational costs of the proposed scheme is less as compared to existing schemes.

Let field F and $\bar{F}$ algebraic closure of the field F. The HEC $C$of $g = 2$, over the field F represents a solution set $(x, y) \in F \times F$, where,

$$C: y + h(x)y = f(x) \quad (1)$$

So $h(x)\ and\ f(x) \in F[x]$, $h(x)$ having a polynomial of degree of genus$g$ and $f(x)$ is a monic-polynomial of deg $2g + 1$, which not satisfies the equation (1), because it has no solution $(x, y) \in \bar{F} \times \bar{F}$. Scheme [15] used a Jacobian J, ith as the equivalent set of divisors and divisor is the set of finite formal sum of point on the curve $P_i \in C$,

$$D = \sum_{P_i \in C} m_i P_i, m_i \in Z$$

Jacobian reduced divisors, its form of representation is,

$$D = \sum_{P_i \in C} m_i P_i - (\sum_{P_i \in C} m_i)\infty \quad (2)$$

where m_i is non-zero, which consist only one opposite points $\sum_{p_i \in C} m_i < g$.

RELATED WORK

Chaum [2] firstly present blind signature for untraceable payment. This scheme certifies the anonymity as well as privacy properties. In this scheme customer blind the coins and bank blindly signs it. The bank cannot provide a link for user with coins after blind signature. When user tries for a double spending of coins, bank detects it and refuse for double transaction. Chaum et al. [3] proposed anonymous communication scheme, in this scheme customer no need to go the bank for each transaction. It only extracts e-cash from bank and send to shop. Privacy of the customer is maintained in a single transaction, but in double transaction its identity will be revealed. Brand [6] proposed new primitive scheme known as "blind signature". Scheme is used for increasing the efficiency of offline cash system.

Bao and Robert [1] proposed a signcryption scheme with signature directly verifiable by public key, in which the private key of the recipient's is no longer required for signature verification.

Pushpendra et al. [9] present an efficient un-traceable blind signature scheme; its security is based on elliptic curve discrete log problem (ECDLP). Time complexity of the proposed scheme significantly reduced as compared to existing schemes, and is best suitable for limited computational resources like smart card and mobile phone. Zhou and Yang [7] scheme proposed to improve blind signature scheme based on HECC.

Chakraborty and Mehta [8] scheme provide guaranteed to a customer that blinded the transaction from customer, which is the designated receiver of the blinded message, it also efficient up-to three multiplication and one hash operation. A singer signs a valid vote of the voter, for validity of the bank Vendor use bank public key for verification. If valid count the vote of the voter else reject. Jena et al., [10] suggested a novel blind signature based on elliptic curve discrete logarithm problem (ECDLP), and achieves

same security as compared to RSA. Additional property of the proposed scheme is low computational requirements.

Awasthi and Lal [11] present blind Signcryption scheme that combine functionality of blind signature and signcryption. Proposed scheme is suitable for those applications which based on anonymity, un-traceability and un-linkability. Yu and He [12] present a new efficient blind Signcryption scheme that provides the properties of confidentiality, integrity, un-forgeability, nonrepudiation and public verifiability. It also offers authentication and confidentiality of the transaction simultaneously. The limitation of the scheme is that it having high computational cost. Riaz et al. [13] present blind signcryption scheme based on EC. Proposed scheme is provides confidentiality, integrity, un-forgeability, singer non repudiation, un-linkability, anonymity as well as forward secrecy and also suitable for low constrained devices such as mobile phone voting system and e-commerce. Riaz et al. [14] scheme having all the properties of scheme [13], but additional property is that it is efficient on customer side using ECDLP.

We proposed blind Signcryption scheme using hyper elliptic curves for confidential untraceable payment system. It fulfills the properties of security like confidentiality, un-traceability, integrity, non-repudiation as well as blindness.

PROPOSED SCHEME

Step 1: Key Generation Phase

In this phase customer chooses private keys and compute the public keys.

Customers choose an integer $pr_{cu} < n$ as his private key and compute his public key$pb_{cu} = pr_{cu}.D$. Bank chooses an integer $pr_b < n$ as his private key and compute his public key $pb_b = pr_b.D$. Vendor also select an integer $pr_v < n$ as his private key and compute his public key such as $pb_v = pr_v.D$.

Step 2: Blind Signcryption Phase

In Signcryption phase Customer and Bankare two participants. In which Customer is sender, bank is sign and also customer is a vendor of the cash.

Customer

Select an integer $\alpha, \beta, \in \{1, 2, \ldots \ldots . n - 1\}$

Compute $r = \beta . D$

Compute $sk_{cu} = h\,(r.pb_b)$

Send r, c' to Bank

Bank

Select $\gamma \in_R \{0,1,2, \ldots \ldots . n - 1\}$

Compute $cer = \gamma . D$

Compute $r = E_{sk_{cu}}(csh)$

Sendcer, rback to customer

Customer

Compute $csh = D_{sk_{cu}}(r)$

Compute $c' = (csh - c) mod\ n$

Customer send (c', csh) to vendor

Step 3: Unsigncryption Phase

In Unsigncryption phase vendor checks the validity of the total amount in a bank and his payable amount. If valid than vendor will send it into the payment and deposit phase otherwise reject.

Vendor

Randomly generate $w \in \{0,1,2, \ldots . n-1\}$

Compute $c = \mathrm{w.D}$

Compute $csh' = (\mathrm{w}.c) mod\ n$

Compute certificate $cer' = (\mathrm{csh}'.sk_{cu}) mod\ n$

Vendor Check validity of $cer' < csh$

If valid than send to the payment and deposit phase, else reject.

Step 4: Payment and Deposit Phase

Generate $cl \in \{0,1,2, \ldots . n-1\}$

Payment of the vendor has (csh', cer', cl)

If yes" payment" else reject.

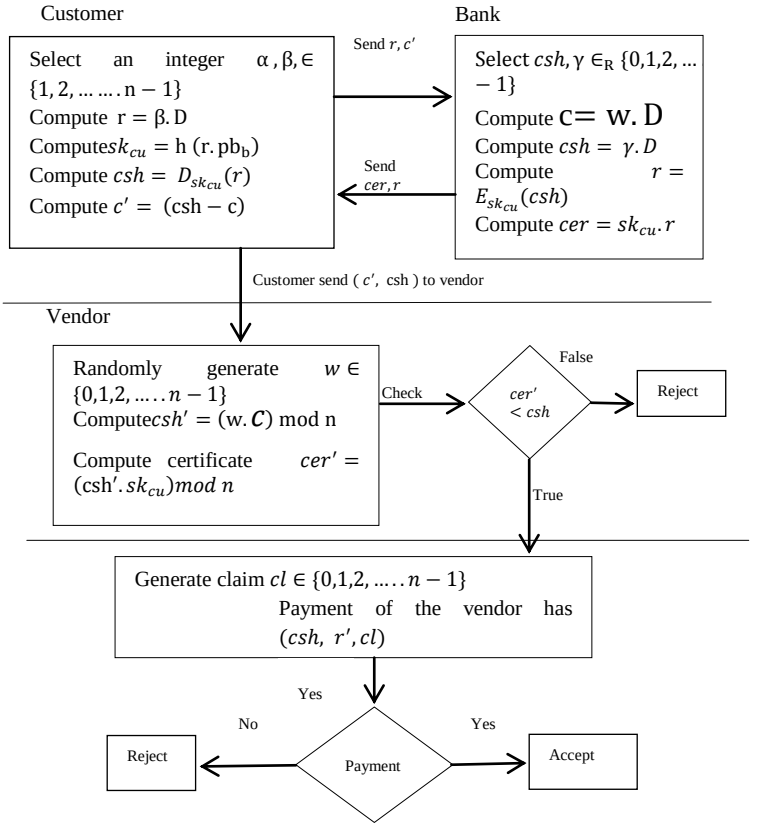

Figure 1: Flow Diagram of Proposed Scheme

SECURITY ANALYSIS

A. Transaction Confidentiality

In transaction confidentiality the total amount of cash csh is depend on the customer secret keysk_{cu}. Without this key anyone cannot find the amount of the customer in a bank. Secret key sk_{cu} can be compute from$sk_{cu} = \mathrm{h}\,(\alpha.\mathrm{P_b})$ and αcan be compute from$\alpha = \beta.\mathrm{D}$.Which are infeasible based on HCDLP.

B. Transaction Integrity

In transaction integrity vendor verify, that the sending transaction is original or not. In digital cash system it is impossible to change the amount / price of transaction. Therefore, integrity remains constant during transactions.

C. Authentication

Bank provides authentication using own Private Key pr_b, to compute $pr_{cu}$from $pb_b = pr_{cu}.D$. Which is computationally hard for intruder, equivalent to solve HCDLP?

D. Non-Repudiation

Customer payment to vendor by bank, therefore non-repudiation cannot be occurred.

E. Un-forgeability

When customers use his private key pr_{cu}anyone cannot be forge it, without knowing the customer private key, it computes from $pb_{cu} = pr_b.D$. To compute pr_b, it is computationally hard for eavesdroppers based on HCDLP.

F. Un-traceability

Untraceability of transactions during a process under observation of an attacker is the property that the attacker cannot follow the trace of the transaction as it moves from one participant or location to another.

G. Transactions Forward Secrecy

Customer and Bank are used private keys and compromise together. Third party can't recover the original transaction from their keys because Customer blindly sends the transaction to Bank, then eavesdropper can try to compute but its solution is computationally hard based on HCDLP.

COST ANALYSIS

In cost analysis phase, we compare our scheme with Z. Eslami et al. [5] and C. Wang et al. [6]. In which we calculate computational and communication costs as compare to existing schemes. Domain parameter of our proposed scheme is given in Table 1:

Table 1
Domain parameters

Symbols	Description
G_q	Subgroup of order q
C	Hyper Elliptic curves over finite fields
n	A large prime number where $n \leq 2^{80}$
D	A base point of hyper elliptic curves F_q with order n
h	One-way hash function
$(E/D)sk_{cu}$	Encryption / Decryption algorithm with private key
c	Cost

A. Computational Cost

The comparative cost of our proposed scheme with existing schemes is presented in Table 2.

Table 2
Computation Cost Comparison

Author	*Side*	*Major Operations*			*Minor Operations*		
		M-E	*HECPM*	*M-M*	*M-A/S*	*S-E/D*	*h*
Proposed Scheme	Customer	-	1	-	2	2	1
	Bank	-	2	-	-	1	-
	Vendor	-	-	2	-	-	-
Z. Eslami et al. [5]	Customer	5	-	9	-	-	1
	Bank	1	-	2	-	-	1
	Vendor	6	-	3	-	-	2
C. Wang et al. [6]	Customer	6	-	8	-	-	1
	Bank	2	-	2	-	-	1
	Vendor	5	-	3	-	-	3

B. Communication Cost

In communication cost different transactions are securely transmitted during anonymous communication of proposed scheme with the existing schemes as shown in Figure 2.

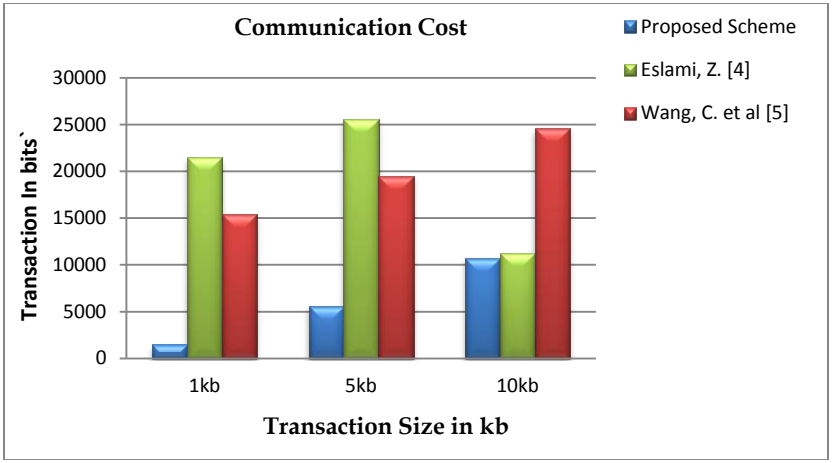

Figure 2: Communication Cost Comparison

CONCLUSION

We proposed blind Signcryption scheme based on hyper elliptic curve cryptosystem (HECC). Our scheme fulfills all the properties of transaction confidentiality, transaction integrity, Unforgeability, customer anonymity, non-repudiation, un-traceability as well as forward secrecy. It is more suitable for customer anonymous communication in electronic commerce.

REFERENCES

1. Bao, F. and Robert, H.D. (1998). *A signcryption scheme with signature directly verifiable by public key*. Public Key Cryptography. Springer Berlin Heidelberg, 55-59.
2. Chaum, D. (1983). Blind signatures for untraceable payments. *Advances in Cryptology*. Springer US, 199-203.
3. Chaum, D. (1985). Security without identification: Transaction systems to make big brother obsolete. *Communications of the ACM*: 28.10, 1030-1044.
4. Eslami, Z. and Mehdi, T. (2011). A new untraceable off-line electronic cash system. *Electronic Commerce Research and Applications*, 10.1, 59-66.
5. Wang, C. Hongxiang, S. Hua, Z. and Zhengpin, J. (2013). An improved off-line electronic cash scheme. Computational and Information Sciences (ICCIS): *IEEE Fifth International Conference*, 438-441.
6. Brands, S. (1994). Untraceable off-line cash in wallet with observers. *Advances in Cryptology—CRYPTO'93*. Springer Berlin Heidelberg, 302-318.
7. Zhou, X. and Xiaoyuan, Y. (2009). Hyper-Elliptic Curves Cryptosystem Based Blind Signature. Knowledge Engineering and Software Engineering (KESE): *IEEE Pacific-Asia Conference*, 186-189.
8. Chakraborty, K. and Jay, M. (2012). A Stamped Blind Signature Scheme based on Elliptic Curve Discrete Logarithm Problem. *IJ Network Security*, 14.6, 316-319.

9. Pushpendra, K. Archana, S. and Aditya, D.T. (2012). Implementation of blind digital signature using ECC. *International Journal of Computer Science and Network (IJCSN)*, www.ijcsn.org SSN 2277-5420, 1.5, 1329-1332.
10. Jena, D. Sanjay, K.J. and Banshidhar, M. (2007). *A novel untraceable blind signature based on elliptic curve discrete logarithm problem*, 269-275.
11. Amit, K.A. and Sunder, L. (2005). *An Efficient Scheme for Sensitive Transaction Transmission using Blind Signcryption.*arXiv preprint cs/0504095.
12. Yu, X. and He, D. (2008). A new efficient blind Signcryption scheme. *Wuhan University Journal of Natural Sciences*, 13.6, 662-664.
13. Riaz, U. Nizamuddin. Arif, I.U. and Noor, A. (2014). Blind Signcryption Scheme Based On Elliptic Curves. *IEEE Conference on Information Assurance and Cyber Security*, 51-54.
14. Riaz, U. Nizamuddin. Arif, I.U. and Noor, A. (2014). Customer Efficient Blind Signcryption Scheme Based on Elliptic Curves. *International Journal of Advanced Research in Computer science and Software Engineering*.
15. Anna, N. and Tatyana, F. (2006). Usage of Hyperelliptic Curves in the Digital Signature Protocol. IEEE *International Conference on Modern Problems of Radio Engineering, Telecommunications, and Computer Science* (TCS), 51-53.

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IMPROVING THE QUALITY OF STUDENTS' INTAKE PROCESS THROUGH APPLICATION OF SIX SIGMA METHODOLOGY- A STUDY OF AN ENGINEERING SCHOOL OF PAKISTAN

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ABSTRACT

Quality management models in education focuses on inculcating abilities in students to demonstrate the stated outcomes of the respective academic programs. This research seeks to identify the critical factors for improving quality of admission process through aligning entry parameters with that of academic program's outcomes. Six Sigma model of quality management i.e. Define, Measure, Analyze, Improve, and Control has been used to improve the quality of admission process. The unit of analysis is an engineering school of Pakistan. Data set of students' admission process involves parameters such as entry test score, current CGPA, academic background etc. for the last five years have been used to find out the critical areas for enhancing quality of admission process. Correlations, Regression Analysis, and Frequency Test have been applied to the data set. It is found that the existing admission test score variable has very fragile correlation with CGPA construct. More studies may be done to apply more sophisticated statistical techniques to further quantify the relationship between admission test score and existing CGPA of students.

KEY WORDS:

Six Sigma, Outcome Based Education, Higher Education, Critical Factors, Admission Process.

1. INTRODUCTION

Cecily et al. (1996) say that TQM encompasses concepts and practices that are in the best organisational interest for all stakeholders. (Wharton School, 2007) further takes ahead this point by saying that TQM is a strategy in which an entire organisation is focused on continuous improvement. More over Wiklund et al. (2003) say about the stakeholder orientation of TQM in these words: "TQM is said to be a management approach of an organisation, centered on quality, based on the participation of all its members and aiming at long-run success through customer satisfaction, and benefits to all members of the organisation and to society". Too, Hackman R et al. (1995), Mile et al. (1996), Zairi et al. (2000), Zairi et al. (2000a) and Terziovski et al. (1999) argue about the fundamental role of TQM in focusing on and paving the way for best practices in organisations. Some authors declare it as a social movement. As according to Hackman et al. (1995), "TQM has become a social movement. Today, it has spread from its

manufacturing origins to educational institutions, health care organisations, hotel organisations, and government agencies. TQM has become increasingly popular in the press, with consultants, and in Academia."

Most of the TQM champions claim that TQM helps a company in improving both tangible and intangible aspects of an organisation like customer satisfaction, employee satisfaction, market share, return on investment, lowering manufacturing costs, conformance to requirements and increasing productivity. That in turn, contributes to performance excellence by bringing a focused approach on both soft and hard aspects of the business (Garvin, 1983, Wollner, 1992, Cole, 1983; Phillips et al. 1983, Tenner et al. 1992 Overman, 1990, Norman 1991, Holusha 1993, Garbutt 1996, Olian, et al. 1991, Zairi, 1993, Silverman 1996 and Sutter 1996, Shao 2005 and Jarrar et al. (1999). However, some services organisations are conscious about TQM concept and the associated cost of its programmes. Yet, proponents believe that TQM pays, many firms especially in USA are not involving in TQM programmes because of confusion with its cost benefit analysis, as they are not convinced about the higher potential benefits of TQM implementation than its costs (Mathew et al. 1992, Greising 1994). Notwithstanding, regardless of the counter opinions about TQM, it is still generating its potential benefits provided implemented correctly.

Taylor et al. (2003) in their longitudinal study in U.K. argue that TQM practices generate performance. Moreover Jayaram et al. (2010); Lemak et al. (2000) have declared a connection of TQM programs and firms' success. In addition to it, Dangayach et al. (2006) in their study on Indian manufacturing companies have proved TQM as a strategy to bring success for an organization. Many other researchers are of the opinion that quality generates performance e.g. Prajogo et al. (2001) in their research argued that TQM fosters innovation. Moreover Zairi, 1993 has declared TQM as a tool which can improve both tangible and intangible aspects of an organization like customer satisfaction, employee satisfaction, market share, return on investment, lowering manufacturing costs, conformance to requirements and increasing productivity.

1.1 Tools of TQM:

There are several tools of TQM to achieve the above mentioned goals e.g. benchmarking, excellence models, performance measurement tools (e.g. Balanced Scorecards), Six Sigma, ISO Standards, etc. the scope of this study revolve around the application of six sigma in an engineering school of Pakistan named "FAST School of Engineering". Six sigma is a statistical approach to problem solving by reducing variations and improving process mean. Wharton School (2007) says about its background in these words: "SS started at Motorola and gained popularity in the mid-1990s largely because of GE's visible efforts. The goal is to improve a company's quality to only three defects per million through systematic incremental changes in processes and careful statistical measurement of outcomes" (Wharton School, 2007). Moreover, Quality Digest (2007) admits about the same thing by saying that one of the Motorola's most significant contributions is to change the unit of measurement from percentages to parts per million. Too, Motorola highlights the dynamic relation of technology and acceptable quality standards correctly to remain competitive in market. In essence SS was started by

Motorola. This management technique shifted the scale of measurement from percentages to parts per million.

Six Sigma methodology is one of the most famous problem solving tools of TQM aiming to achieve higher level of excellence (Kumar et al. 2008) in organizations. Falcon et al. (2011) in their study have declared that "Six Sigma is a methodology supported by a handful of powerful statistical tools in order to reduce variation through continuous improvement." Moreover Cimaetal (2011) in their research have stated that six sigma is the method to eliminate the non-value added steps in a process. Six Sigma has brought dramatic performance improvement breakthroughs in organizations through various techniques in each phase of DMAIC (i.e. Define, Measure, Improve, and Control). In some cases it has used: Fuzzy Logic to bring improvement; Data Envelopment Technique for decision making; Benchmarking for identifying the best practices etc.

1.2 Six sigma in Higher Education (HE):

Global forces have also impacted the higher education like any industry. As Tsai et al. (2007) say, "In tracing the contexts of changes in higher education, research into globalisation may shed some light. For example, Cerny (1996) considers globalisation as chiefly a political phenomenon. On the other hand, globalisation may be viewed as a set of political and economic changes which can put pressure on policy-makers of higher education for changes or reforms (Slaughter et al., 1997; Baltodano, 1997; Flynn, 1997). Indeed, Clark (1998) asserts that globalization has led to the considerable increase in the number of universities and calls for strengthened entrepreneurial changes among all universities across the world."

More over Beldwin (2002) further takes the discussion of global forces impact on higher education by arguing that colleges and universities in 21st century are feeling increased pressure to reform and improve. This need for reform is strongly backed by increased competition in higher education (Bryan, 1996; Carey, 1998; Cornesky, 1993; Cornesky et al., 1992; Deming, 1994; Hommes, 1997: Kanji et al., 1999; Karathanos, 1999; Lewis et al., 1994; Macchia, 1992; Marchese, 1992; Rinehart, 1993; Seymour, 1994; Seymour et al., 1991; Sherr et al., 1991).

To respond to the above mentioned forces universities have embraced the six sigma philosophy. As many acknowledge it by saying that in response to the afore mentioned threats many colleges and universities enter in to TQM programs (Birbaum, 1988; Brower, 1992; Coate, 1990; Cornesky et al. 1992; Entin, 1993; Kanji et al., 1999; Lewis et al. 1994; Mergen et al. 2000; Seymour. 1994). Moreover, SHU (2003) further explains the six sigma background in higher education and says, "In 1996 Ron Dearing expressed his 'deep concerns about the way our society is going.' In 1998 he chaired the National Inquiry into higher education which concluded that Higher Education should be leading the transformation of society to 'a learning society.' Although the potential for this clearly existed the capacity did not, as Garvin (1993) concluded from his investigations five years earlier. He found that the duty of universities to promote learning was not reflected in their own organisational learning behaviour which led him to conclude that unless they can transform themselves into learning organisations there is little hope of them contributing much to the transformation required for a learning society."

But literature suggests that there are only a few cases where entire universities have entered in to TQM programme. Al-Lawatia (2006) says, "TQM has mainly been adopted as a perspective for improvements in higher education in the USA, with a number of cases in Europe and Australia. But unfortunately, there are only few cases where entire universities have taken the TQM route. Total Quality Management is often assumed as an approach to quality improvements in departments such as administration, libraries or similar. However in academics areas where TQM perspectives have been adopted seem to be most prevalent in areas as engineering, business studies or higher studies." The very famous examples are EQUIS, AACSB accreditations in the academic world where universities have adopted the TQM philosophies in whole.

1.3 Six Sigma application similarities between Higher Education and Industries:

Efforts to adopt practices of six sigma are spreading to the institutions of higher learning (Dexelar et al. 2000). There are many similarities of the application of six sigma in higher education and industries. For example Al-Lawatia (2006) argues that administrative functions in higher education are not so different from counterparts in business or elsewhere in the public sector. Therefore, it is logical that there are a number of cases where six sigma has been used as a framework for improvements in administrative areas.

In addition to above, Al-Lawatia (2006) further argues about it in this way: "First of these similarities is observed that contemporary higher education is a system for mass production. An increasing share of the youth in most countries attends some form of education. The structure in higher education is also similar to a structure which formerly was common in yesterday's industry: specialised units with limited contacts between them."

Moreover, Jaideep et al. (1997) put the light on the higher acceptance of TQM concepts in higher education and say, "A recent survey (Rubach, 1994) showed that 415 educational institutions in the USA are implementing either quality improvement practices in their administration or quality-related courses in their curricula, or both. This total represents a 43.1 per cent increase from last year. Best practices framework can indeed be applied to higher education but it must be modified to fully recognize some unique aspects of education: namely, that education is a service industry with no visible, tangible "product", per se (as in manufacturing) and that it serves multiple customers."

1.4 Success Stories of Six Sigma in Higher Education:

Several authors have contributed towards the successful implementation of six sigma in higher education. For instance, Jaideep et al. (1997) argue that other success stories of six sigma implementation programmes at universities include: Boston, Columbia, LeHigh, Northern Arizona, and Tennessee (Entin, 1993; Kolesar, 1994; Likins, 1993; McNeil, 1993; Mahoney et al., 1993; Pickett, 1993). Moreover they say that "success" is not a narrowly definable measure, but an amalgamation of many different small goals reached with the implementation of total quality tools, and attributable to TQM as a whole. The success or failure of TQM hinges on the goals set by the TQM teams and the degree to which they are attained.

In addition to above, Jaideep et al. (1997) further proceed the discussion by arguing that Harvard (Hubbard, 1994b) has also joined the TQM bandwagon and touts its

success. The programme, which began with its Office for Information Technology, has resulted in a $70,000 per year savings on software licenses from the elimination of unused or unnecessary software packages, a $120,000 credit from New England Telephone from reconciling reporting processes, a 40 per cent reduction in paper used for billing, new billing formats, a reduction in Harvard University's copy centre data entry training time from two days to one and-a-half hours, and the creation of a telephone service, among other things.

Too, Lewis et al. 1994 report, "Over 200 institutions of higher learning are involved in total quality management throughout the USA. The rapid growth of the concept in higher education can be judged by the fact that from 1991 to 1992, the number has grown from 92 to 220 institutions and is expected to increase substantially in the future." For example Bemowski, (1991) argue that Columbia University has redesigned its curriculum around six sigma after having a thorough customer survey (including students, company senior management, recruiters, students etc.). Too it has created the Deming Centre for Quality Management and has become actively involved in total quality management.

1.5 Difficulties in Six Sigma Application in Higher Education:

There are several things which are contributing towards creating the hindrance for the application of six sigma in higher education. More over Elmuti et al. (1996) further takes this discussion ahead and say, "While institutions of higher education have been much slower than businesses to embrace the total quality management philosophy, a number of universities have attempted to implement it in whole or in part. The major reason for this is the rigid culture of the universities."

Chinen (2000) says that while many western organisations have adopted TQM, but their implementation has not always been successful. The implementation failure has been attributed to unfocused improvement efforts without specific product or process improvement. For instance, training programmes, without understanding their impact on quality, likely end up with the implementation failure (Schaffer et al., 1992). More over on top of all of the failure reasons, most people who become involved with TQM expect to see results immediately, and this is usually not the case. It takes time to plan, organize and implement a total quality plan (Babson College, 1994).

In short, there are many factors which are creating difficulties for the implementation of six sigma in higher education. They include rigid cultural values, unfocused approach for adoption of TQM etc.

1.6 Background of FAST School of Engineering:

The school is based in FAST National University of Computer and Emerging Sciences Islamabad which was constituted in year 2000. The school offers BS, MS and PhD in Electrical Engineering. The school has a well-structured quality management cells. That that cell, various periodic quality management survey questionnaires are launched with the mandate to analyze conformance of practices with the standards e.g. Student course evaluation questionnaire, Faculty course review report, survey of graduating students, research students' progress review, faculty satisfaction survey, alumni survey, employers survey, faculty resume, and teachers' evaluation. Reports against these survey questionnaires are prepared and discussed with relevant bodies for

uplifting the quality of education through alignment of practices with objectives of programs. Apart from these surveys, the data generated through various information gathering activities e.g. online admission form filling, semester performance of faculty, CGPA performance of students etc. are also used to generate statistical reports for aiding decision making process.

The present study deals with the utilization of DMAIC methodology to improve admission process of BS Electrical Engineering program. The admission process is completely computerized in FAST School of Engineering. The description of the process is given below in Figure 1. This research intends to improve the highlighted activity of the process i.e. preparation of admission test questions:

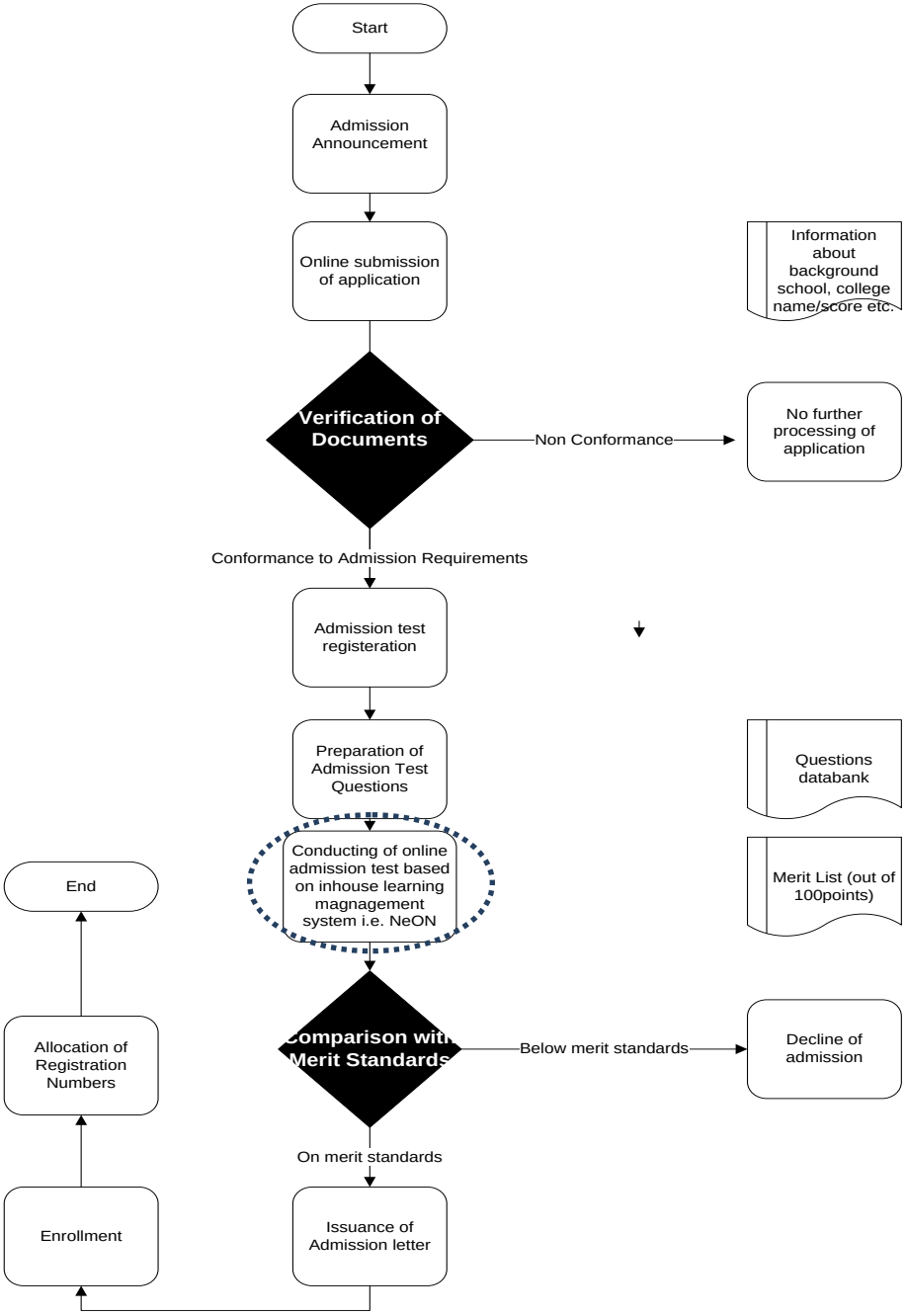


Figure 1: Admission Process

1. The process is conducted on annual basis. The assumed objectives of the admission test are to measure following four abilities in the candidates:

i. Technical skills (through Physics section of the admission test)
ii. Analytical skills (through Mathematics part of the admission test)
iii. Communication skills (through English part of the admission test)

2. Problem Statement:

The project title "improving quality of students' intake process through six sigma" is selected on the results of a comprehensive internal quantified self-assessment process of BS Electrical Engineering Program based on Higher Education Commission's quality assurance protocols. Through that exercise, it was found that admission process may need to be quantified through statistical means for predicting the quality of engineering students via their CGPA performance.

3. Research Questions:

Following are three research questions being addressed in this report:

i. What are the KIPVs impacting CGPA the most?
ii. How can we improve those most significant KPIVs to improve CGPA?
iii. How can we sustain that improvement?

4. Hypotheses

Following are the 15 hypothesis which are drawn from the industry norms:

i. H1: Students CGPA has a positive relationship on admission test score.
ii. H2: Students' CGPA has a positive relationship with intermediate score.
iii. H3: Students' CGPA has a positive relationship with matric score.

5. Methodology

Table 1
Methodology

What?	**How?**
Measurement approach	Online admission test software
Dimensions measured	CGPA, Admission test score, SSC score, HSSC score, School name, College name
Population surveyed	About 500 students
Measurement instrument	Admission test based on multiple choice questions
Response rate	100%
Data analysis software	SPSS
Data analysis technique	Frequency tables/bar charts
Communication of findings to questioned people	Online(charts plus text)

Six sigma framework is applied through DMAIC (Define, measure, analyze, improve, and control) methodology.

6.1 Define

Currently CGPA score of about 500 students in an engineering school have negative correlation with their corresponding admission test score. This shows a dire need to align admission test process for facilitating decision makers in predicting students' performance through their CGPA scores.

6.2 Measure

Following figure 2 shows "Cause and effect diagram" to highlight potential independent variables impacting dependent variable i.e. CGPA score of students.

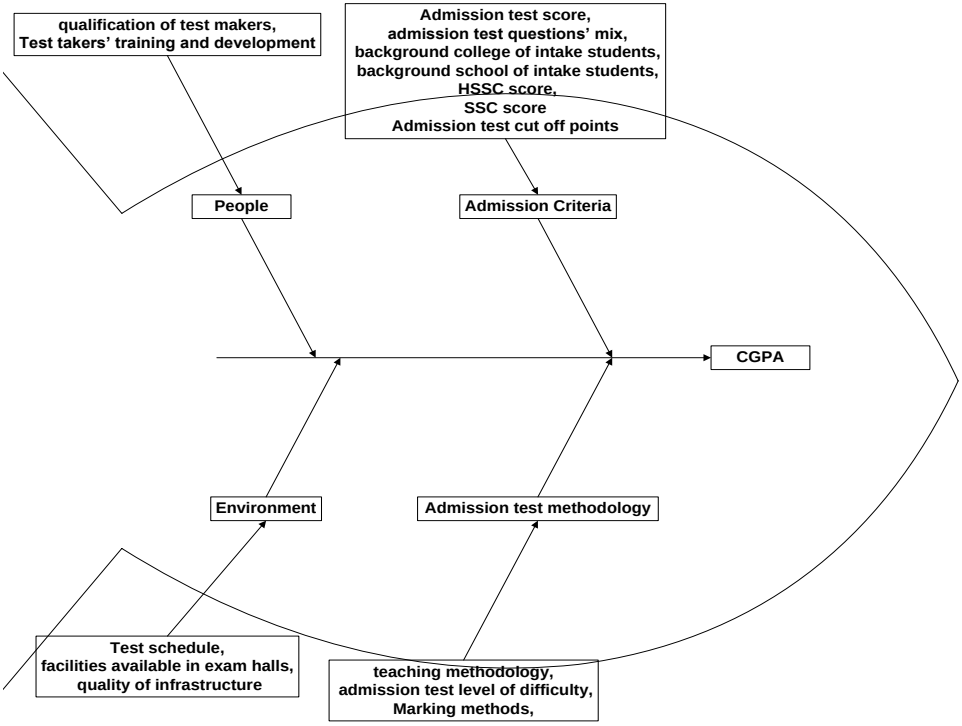


Figure 2: Cause and Effect Diagram

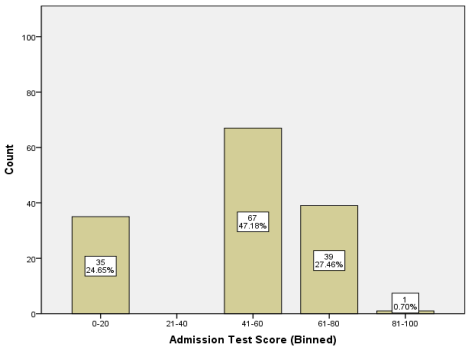
6.3 Analyze

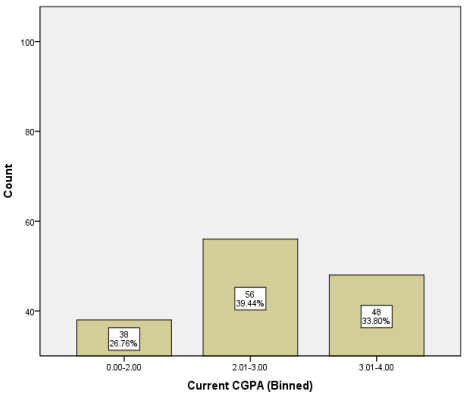
Correlation between admission test score and CGPA was found to be negative that is "-.017".

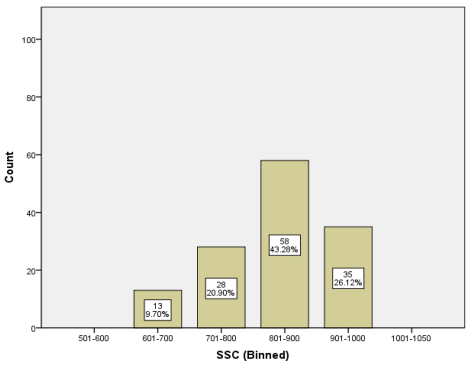
Followings bar charts regarding descriptive statistics (average of SSC score, HSSC score, Admission test score, CGPA) reveals that there is no clear trend in managing quality of intake students expect that of positive improving trend in HSSC scores of students.

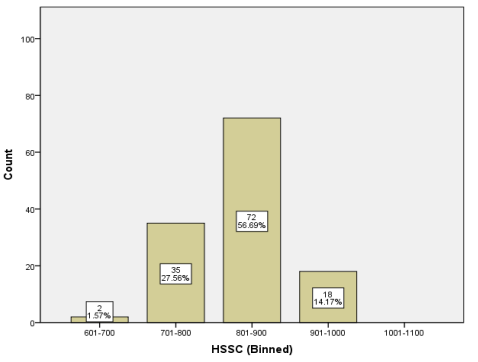
Analyze Phase

2013





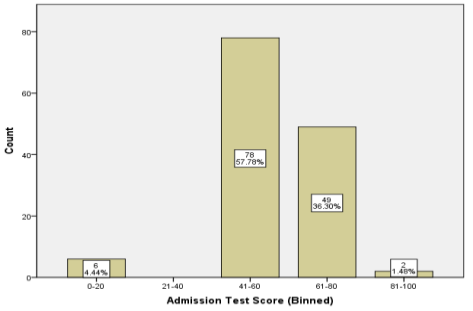


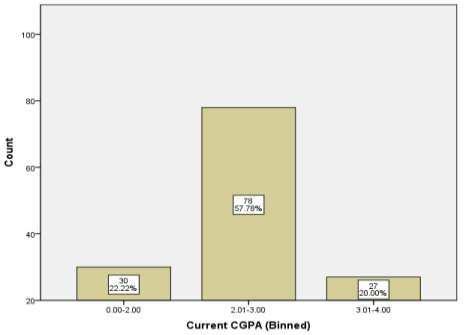


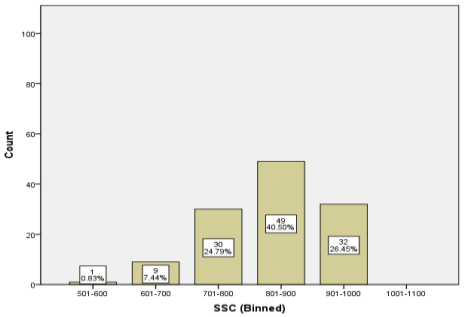
Analysis

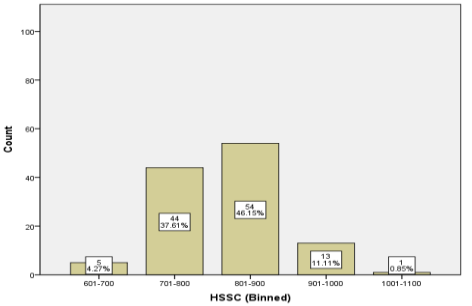
The batch has the best SSC distribution, second best HSSC distribution, and the weakest admission test distribution.

2012





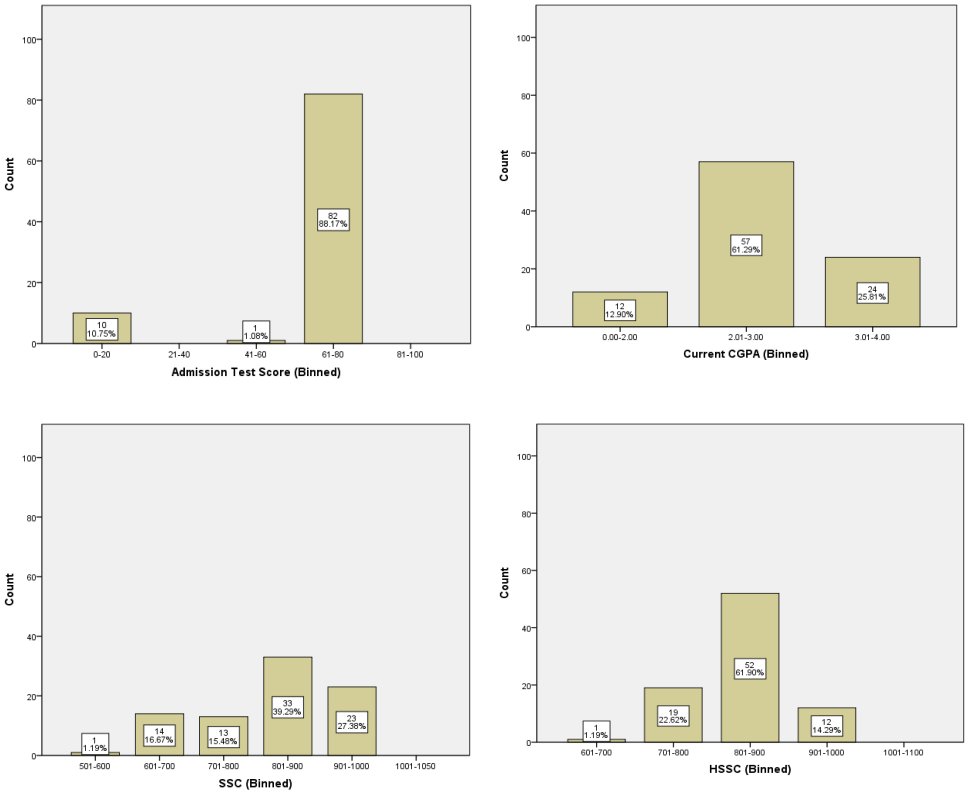




Analysis

The batch has the second best admission test distribution and the weakest CGPA distribution

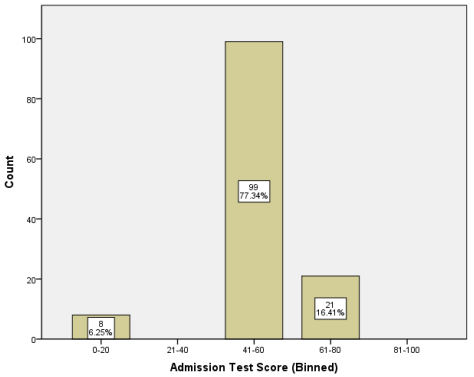
2011

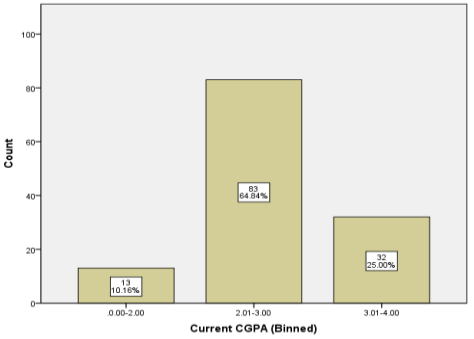


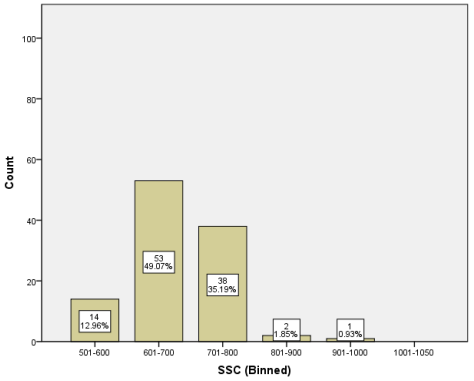
Analysis

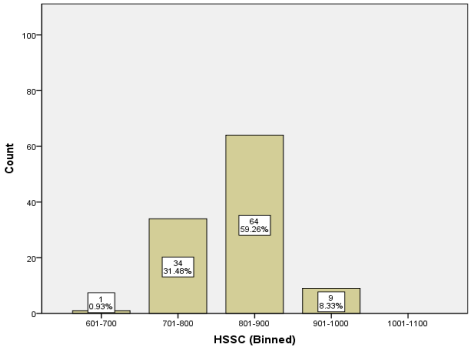
The batch has the best admission test distribution and HSSC distribution.

2010





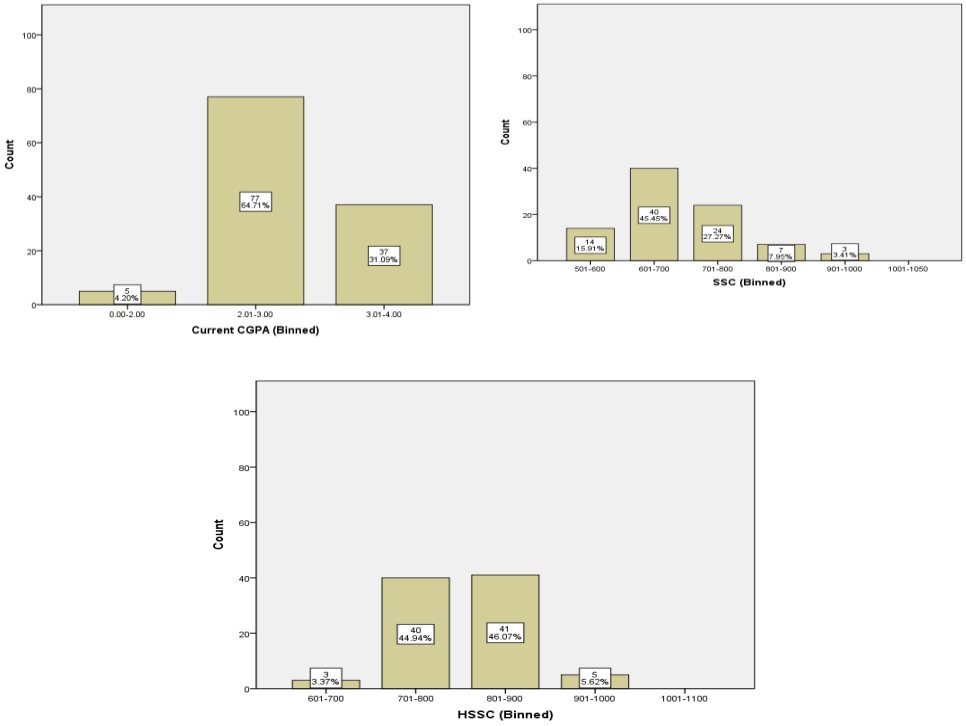




Analysis

The batch has the weakest SSC score distribution.

2009*

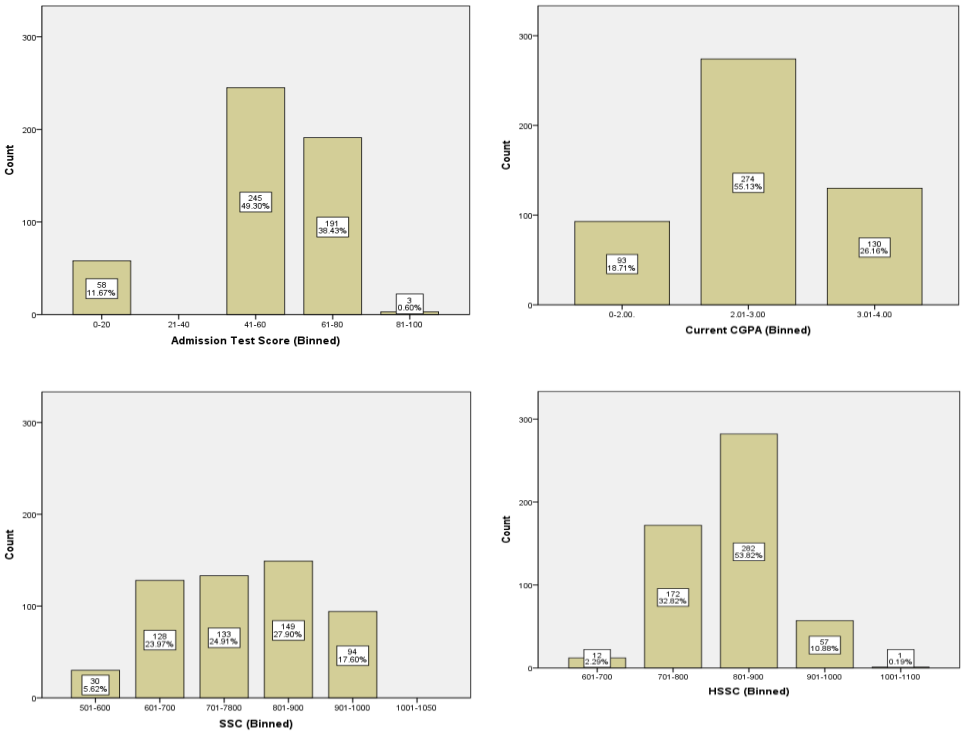


Analysis

The batch has the best CGPA distribution and the weakest HSSC distribution.

*No admission test data is available for 2009 batch.

Overall (2009-2013)



Analysis

About 38% students have above average score in admission test but there is a lot of approximately 26% students who are in 3-4 CGPA band.

The descriptive statistics show that apparently there is no clear trend among variables i.e. average of SSC score, HSSC score, Admission test score, and CGPA. Overall scoring of intake at HSSC level is depicting gradual upward trend. However by conducting the following one way ANOVA among variables of admission test score, HSSC score, and SSC score it is found that HSSC has a significant impact on CGPA variable (dependent variable).

Table 2
ANOVA Table

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Admission Test Score (Binned)	Between Groups	.956	2	.478	.561	.571
	Within Groups	420.843	494	.852		
	Total	421.799	496			
HSSC (Binned)	Between Groups	11.561	2	5.781	11.975	.000
	Within Groups	209.026	433	.483		
	Total	220.587	435			
SSC (Binned)	Between Groups	.131	2	.066	.121	.886
	Within Groups	240.983	443	.544		
	Total	241.114	445			

Further admission test and SSC score are discovered to have not significant impact on CGPA score of students. This shows a dire need to align admission test contents/questions and its methodology etc. with the outcomes of engineering program to make this crucial variable a true reflector of students' academic performance.

6.4 Improve

After funneling down key input variables in analyze phase by realigning admission test process and by taking in to consideration the other variables (mentioned in measure phase under admission process domain of cause and effect figure) for which data is not currently available, "Experimentation" is proposed for checking the correlation among outcome based admission test variables and CGPA of students.

6.5 Control

Standard operating procedures for developing outcome based admission tests which are aligned with objectives and outcomes of BS Electrical Engineering program.

CONCLUSION AND RECOMMENDATIONS

1. As per the findings of the study, there is a dire need to align the outcomes of admission test with the BS Electrical Engineering program's objectives and outcomes because there is very weak correlation between the above two constructs. Admission data (SSC score, HSSC score, and admission test score) has found to have no significant relationship with that of CGPA results of the subject batches. For example, the 2013 batch has the best SSC distribution, second best HSSC distribution, the weakest admission test distribution and the second weakest CGPA distribution; the batch 2012 has the second best admission test distribution and the weakest CGPA distribution
2. Further analysis may be conducted by exploring the individual dimensions of the admission test i.e. Physics, Mathematics, and English through their correlation with CGPA construct of the study.

3. The procedures may be developed to standardize marking criteria to further improve accuracy of the collected data i.e. CGPA, and the admission test score.
4. The CGPA construct may further be explored in terms of impact of admission test results on scoring/performance in technical courses, humanities subjects, mathematics and basic sciences courses etc.
5. A comparative report for multi campuses of FAST National University may be prepared to base the thesis of aligning admission test with that of BS Electrical Engineering program's objectives and outcomes. That may abet in identifying the key factors impacting CGPA performance of students to better achieve BS Electrical Engineering program's outcomes.
6. Steps are required to be taken at the data entry point to capture standardized information about background colleges and school of BS EE applicants.
7. Schools at SSC level with higher frequency include Army Public School, Beacon house School System, Bahria College, Fauji Foundation, Fazaia Inter College, Islamabad Model College for Boys, Islamabad Model College for Girls, OPF Boys College, OPF Girls College, Siddique Public School, and City School etc.
8. Colleges at HSSC level with higher frequency include Army Public College, Bahria College, Beacon house College, F.G. Sir Syed College, Fauji Foundation College, Fazaia Inter College, Islamabad Model College for Girls, Islamabad Model College for Boys, OPF College, Punjab College, The City School, University of Cambridge U.K. etc. Further data mining is required to explore the nature of these schools e.g. private vs. public schools, geographic area of schools.

REFERENCES

1. Agus, A. and Hassan, Z. (2011) Enhancing Production Performance and Customer Performance through Total Quality Management (TQM): Strategies for Competitive Advantage, *Procedia-Social and Behavioral Sciences*, 24, 1650-1662.
2. Al-Lawatia, D. (2006). *A study of TQM implementation in higher education*, MA Dissertation, School of Management, University of Bradford.
3. Baltodano A (1997). The study of public administration in terms of global interpretation: a historical rationale for a theoretical mode. *Journal of Public Administration, Research and Theory*, 7(4), 623-6.
4. Beldwin, L. (2002). TQM in higher education: internal and external stakeholder perception. (44)
5. Birnbaum, R. (1988). *How Colleges Work: The cybernetics of academic organisation and leadership.* San Francisco, CA: Jossey-Bass Publications.
6. Brower. M (1992). The second half of student integration: The effects of life task predominance on student persistence. *Journal of Higher Education*, 63(4), 464
7. Bryan, W. (1996). What is total quality management? *New Directions for Student Services.* 76, 3-15.
8. Carey, R. (1998). Total quality management in higher education: Why it works, why it does not. *Dissertation Abstracts International, 5901A.*
9. Cerny, P. (1996). Paradoxes of competition state: the dynamic of political globalisation. *Governance and Opposition*, 2(2), 251-71.

10. Cima, R., Brown, M., Hebl, J., Moore, R., Rogers, J., Kollengode, A., Amstutz, G., Weisbord, C., Narr, B. and Deschams, C. (2011). Use of Lean and Six Sigma Methodology to Improve Operating Room Efficiency in a High Volume Tertiary-Care Academic Medical Center. *Journal of the American College of Surgeons*, 213(1), 83-92.
11. Clark, R. (1998). *Creating Entrepreneurial Universities. Organisational Pathways of Transformation*, New York, NY: Open University Press.
12. Coate, E. (1990). Implementing total quality management in a university setting: TQM at Oregon State University. *Journal of Quality and Participation*.
13. Cole, E. (1983). Improving product quality through continuous feedback. *Management Review*, 72(10), 8-12.
14. Cornesky, A. and McCool, S. (1992). *Total Quality improvement guide for institutions of higher education* (Madison, *WI.:* Magna Publications: Library of Congress Cataloging Card Number: 92-15863.
15. Deming, E. (1994). *The New Economics for industry, government, education,* Cambridge, Mass.: Massachusetts Institute of Technology.
16. Dexelar, J. and Kliensorge, I. (2000). Using total quality processes and learning outcome assessment to develop management curricula. *Journal of Management Education*, 24(2).
17. Entin, H. (1993). Boston: less than meets the eye. *Change,* 25(3), 28-31.
18. Flynn, N. (1997). Public Sector Management, Hemel Hempstead; Harvester-Wheat Sheaf.
19. Garbutt, S. (1996). Transfer of TQM from industry to education. *Education and Training*, 38(7), 16(2)
20. Garvin, A. (1983). Quality on the line. *Harvard Business Review*, 61(5). 6575
21. Greising, D. (1994). Quality: how to make it pay. *Business Week*, 08.08.1994, 54-7.
22. Hackman, R. and Wageman, R. (1995). Total Quality Management: Empirical, Conceptual, and Practical Issues. *Administrative Science Quarterly*, Vol. 40
23. Holusha, J. (1993). W. Edwards Deming, expert on business management, dies at 93, *The New York Times*, 21 December, p. A13.
24. Hommes, A. (1997). Management of instructional innovation: The case of problem-based education. Paper presented at the *Annual Meeting of the America Educational Research Association*, Chicago, IL.
25. Jarrar, Y. and Aspinwall, E. (1999). Integrating TQM and BPR, Is it enough? *Total Quality Management*, 10(4/5), 584-593.
26. Jayaram, J., Ahire, S. and Dreyfus, P. (2010). Contingency relationships of firm size, TQM duration, unionization, and industry context on TQM implementation—A focus on total effects. *Journal of Operations Management*, 28(4), 345-356.
27. Kanji, K. and Tambi, A. (1999). Total quality management in UK higher education institutions. *Total Quality Management*, 10(1), 129-153.
28. Karathanos, D. (1999). Quality: is education keeping pace with business? *Journal of Education for Business*, 74(4), 231-235.
29. Lemak, D. and Reed, R. (2000). An application of Thompson's typology to TQM in service firms. *Journal of Quality Management*, 5(1), Spring 2000, 67-83.
30. Lewis, G. and Smith, H. (1994). *Total quality in higher education.* Delray Beach, Fla: St. Lucie Press.

31. Macchia, P. (1992). Total quality education and instructional systems development. *Educational Technology*, 32(7), 17-21.
32. Marchese, T. (1992). TQM at Penn: A report on first experiences. *AAHE Bulletin*, 45(3), 3-14.
33. Mergen, E., Grant, D. and Widrick, M. (2000). Quality management applied to higher education. *Total Quality Management*, 11(3), 345-352.
34. Terziovski, M., Sohal, A. and Samson, D. (1996). Quality Assurance & Total Quality Management. *Total Quality Management & Business Excellence*, 7(5) 459-482.
35. Norman, R. (1991). Xerox on the move. *Forbes*, 10 June, pp. 70-71.
36. Olian, D. and Rynes, S. (1991). Making total quality work: aligning organisational processes, performance measure, and stakeholders. *Human Resource Management*, 30, 303-34.
37. Overman, S. (1990). Leader helps improve competitiveness. *HR Magazine*, 58-60.
38. Paiva, E., Roth, A. and Fensterseifer, J. (2008). Organizational knowledge and the manufacturing strategy process: A resource-based view analysis. *Journal of Operations Management*, 26(1), 115-132.
39. Phillips, W., Chang, D. and Buzzell, D. (1983). Quality, cost position and business performance: A test of some key hypotheses. *Journal of Marketing*, 47(2), 26-43.
40. Prajogo, D. and Sohal, A. (2001). TQM and innovation: a literature review and research framework. *Technovation*, 21(9), 539-558.
41. Quality Digest (2007). http://www.qualitydigest.com/dec97/html/motsix.html Accessed on 20th August, 07.
42. Rinehart, G. (1993). *Quality Education: Applying the philosophy of Dr. W. Edwards Deming to transform the educational system.* Milwaukee, WI.: ASQC Quality Press.
43. Seymour, D. and Collett, C. (1991). *Total quality management in higher education: a critical assessment.* MA: Methuen.
44. Shao, K. (2005). *The application of balanced scorecard in China*, MSc Dissertation, School of Management, University of Bradford.
45. Sherr, A. and Lozier, J. (1991). Total quality management in education. *New Directions for Institutional Research*, 71, 18, 3.
46. SHU (2003). (Shaffield Hallam University) Organisation Learning and Future of Higher Education, Shaffield; Shaffield University Press.
47. Slaughter, S. and Leslie, G. (1997). *Academic Capital*, Baltimore, MD; Johns Hopkins University Press.
48. Sutter, R. (1996). Rethinking traditional quality assurance. *Quality Progress*, July, 40-41.
49. Taylor, W. and Wright, G. (2003). A longitudinal study of TQM implementation: factors influencing success and failure, *Omega*, 31(2), 97-111.
50. Tenner, A. and Detoro, J. (1992). *Total Quality Management: Three Steps for Continuous Improvement*, MA; Reading Addison-Wesley.
51. Tsai, Y. and Beverton, S. (2007). Top down management, a effective tool in higher education? *International Journal of Educational Management*, 21(1), 6-16.
52. Wiklund, H., Klefsjo, B., Wiklund, P. and Edvordsson, V. (2003). Innovation and TQM in Swedish higher education institutions-possibilities and pitfall. *The TQM Magazine*, 15(2), 99-107.

53. Wollner, E. (1992). The law of producing quality. Quality Progress, January, 35-40.
54. Zairi, M. (1993). *Total Quality Management for Engineers*, Gulf, Houston, TX,
55. Zairi, M. and Jarrar, Y. (2000a). Internal Transfer of Best Practices for Performance Excellence. *Benchmarking; An International Journal*, 7(4), 239-246.
56. Zairi, M. and Whymark, J. (2000). The transfer of best practices: how to build a culture of best practices and continuous learning, *An International Journal*, 7(2).

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STATISTICAL ANALYSES OF UNIVERSITY LEVEL EXAMINATION SYSTEMS IN PAKISTAN

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ABSTRACT

An analyses of examination system at University level in Pakistan i.e. perception about semester system and annual system among different groups, perception about objective and subjective type of test and to compare grades of students among annual system and semester system and to identify main dimensions of examination system. A sample of 1229 respondents was selected from 106 different universities all over Pakistan. Among 1229 respondents, 336 were teachers and 893 were students. Among these 106 universities, 31 universities were from Punjab, 22 universities were from Sindh, 21 universities of KPK, 5 universities of Balochistan, 1 university of Gilgit-Baltistan, 23 universities of Islamabad capital territory and 3 universities of Azad Jamu and Kashmir. The data was reliable found to be consistent with cronbach alpha 0.862. Using chi-square test, universities-wise and educational classification-wise respondents have significant opinion discriminating objective type of test and subjective type of test. Using chi-square test, geo-graphical location-wise, educational classification-wise, among teacher-student and universities-wise respondents have significant perception about annual and semester system. Using the principal component analysis, prompting teaching and learning practices (explaining 46% of variation) and measuring instrument of knowledge, skill and efficiency (explaining 16% of variation) were found to be over-all two main component of examination system. Using Pearson Chi-Square, it's concluded that an evaluation criterion under semester system and annual system is consistent.

KEY WORDS

Semester system, annual system, Cronbach alpha, Chi-square, logistic regression, principal component analysis.

INTRODUCTION

The goal of achieving universal primary education (UPE) has been on the international agenda since the Universal Declaration of Human Rights in 1948 that elementary education was to be made freely and compulsorily available for all children in all nations (UNESCO global monitoring report, 2005). Pakistan remained neglecting quality of education since 1947. According to latest united nation's development index 2012; Pakistan ranked at 146 out of 189 countries of the world.

University is an institution of higher quality of research and education. University grants academic degree at grade 15 and above. University Education is very important for

human development worldwide. Its leads to skilled labor market and provide training to researchers, social scientist, teachers, doctors, lawyers, civil servants, and engineers and all others. University trains the individuals to develop their aptitude and analytical skills. University education motivates and trains the new economist, civil society supporters, professionals, teachers, government servants to make critical decisions which affect whole society (Pakistan Education Statistics, 2012).

According to Pakistan education statistics 2011-212, total enrollment in 139 universities of Pakistan is 1.319 million. Among these 1.130 million (86%) students are enrolled in 79 public universities of Pakistan and 0.189 million (14%) students are studying in 60 private universities. In spite of enrollment of 1.130 million (3.21%) students in Pakistan the universities have the least share in education sector i.e., 0.05% on the bases of number of institutions in Pakistan given in table 1.

Table 1
Distribution of Educational Intuitions and Enrollment

Intuition	Number of institutions	Distribution of institutions	Number of enrollments	Distribution of enrollment
Pre-primary	505	0.19%	8,512,998	20.72%
Primary	154,145	59.05%	17,567,581	42.76%
Middle	41,945	16.07%	5,952,831	14.49%
High	28,655	10.98%	2,691,595	6.55%
Higher Secondary / Inter-Colleges	4,515	1.73%	1,251,787	3.05%
Degree Colleges	1,384	0.53%	497,152	1.21%
Universities	139	0.05%	1,319,799	3.21%
Technical and Vocational Institutions	3,257	1.25%	289,780	0.71%
Teacher Training Institutions	189	0.07%	692,692	1.69%
Non-Formal basic Education	13,213	5.06%	551,579	1.34%
Deeni Madaris	13,075	5.01%	1,759,141	4.28%
Total	261,022	100%	41,086,935	100%

Note: From "Pakistan Education Statistics 2011-12," by Ministry of Education: Government of Pakistan.

Examination is an instrument that is used to test the student's skills, abilities and knowledge as well as teaching skills and abilities. Examination test what was delivered to students in certain period of time. To estimate knowledge student has gain. Hence it is a device to test the multi-dimensions of teaching and learning process. Hence, examination is a measuring instrument, intended to verify both a candidate's value and value of the teaching he has received. It is an indicator of the training given and received. It motivates both students as well as teachers to bring improvement in teaching and learning process. Examination is the major component of education process. Teaching and learning process is insignificant without examination system. Examination is the only yardstick to measure achievement and process of education.

Mohammad and Chaudhry (1983), Rehmani (2000), Shirazi (2004), Yousaf and Hashim (2012), Buzdar et al. (2013) have discussed different aspects of examination system in Pakistan.

The objectives of the research are comparing grades of student among semester system and annual system, compare perception of semester system vs. annual system, to compare perception about subjective type of test vs. objective type of test and identifications of main dimensions of examination system.

SAMPLE DESIGN AND METHODOLOGY

Targeted population for this research is 1,319,799 students and 70,053 teachers across four province of Pakistan among 139 universities where 79 universities are public universities and 60 are private universities.

To determine sample size using Cochran's formula to determining sample size for categorical data without population correction is used. This formula is quiet similar to Cochran's formula for determining sample size for continuous data (Bartlett at el., 2001).

$$\textbf{Sample size} = \boldsymbol{no} = \frac{\boldsymbol{Z^2(pq)}}{\boldsymbol{d^2}}$$

where Z = value for selected alpha level of .025 in each tail = 1.96. Where (p) (q) = estimate of variance = .25; (Maximum possible proportion (.5) * 1-maximum possible proportion (.5) produces maximum possible sample size) Where d = acceptable margin of error for proportion being estimated = .03 (error researcher is willing to except).

$$\boldsymbol{Sample\ size} = \boldsymbol{no} = \frac{\boldsymbol{(1.96)^2(0.5*0.5)}}{\boldsymbol{(0.03)^2}} \cong \boldsymbol{1067}$$

Pakistan Education statistics is used for deigning the sample across different geographical locations of Pakistan. Proportionate sample design for this research among different geographical locations of Pakistan is in table 2. Finally a sample of 1228 was selected across all regions of Pakistan.

Table 2
Sample Design

Province/ Regions	Targeted population		Proportionate Stratified Sample (Planned)		Proportionate Stratified Sample (Achieved)	
	Population	Share	Sample	Share	Sample	Share
Total	1,389,852	100%	1,067	100%	1,228	100%
Punjab	329,482	23.71%	253	23.71%	291	23.647%
Sindh	261,594	18.82%	201	18.82%	231	18.818%
KPK	113,064	8.13%	87	8.13%	100	8.160%
Balochistan	18,094	1.30%	14	1.30%	16	1.332%
Gilgat Baltistan	2,432	0.17%	2	0.17%	2	0.167%
Islamabad Capital Territory	657,376	47.30%	505	47.30%	581	47.294%
Azad Jamu and Kashmir	7,810	0.56%	6	0.56%	7	0.583%

A sample 1229 respondents was collected from 106 different universities of Pakistan through online mode of interviewing. Among these universities 31 universities were from Punjab, 22 universities were from Sindh, 21 universities of KPK, 5 universities of Balochistan, 1 university of Gilgit-Baltistan, 23 universities of Islamabad capital territory and 3 universities of Azad Jamu and Kashmir. Detailed sample profile of the study is as follow:

Table 3
Sample Profile

		N	N % (Percentage)
Total (Over-all)		**1228**	**100%**
Gender of Respondents	Male	802	65%
	Female	426	35%
Age of Respondents	18-20	120	10%
	20-25	558	45%
	26-30	214	17%
	31-35	115	9%
	36-40	86	7%
	40+	135	11%
Geographical Location of Respondents	Punjab	291	24%
	Sindh	231	19%
	Khyber Pakhtunkhwa	100	8%
	Balochistan	16	1%
	Gilgit-Baltistan	2	<1%
	Islamabad Capital Territory	581	47%
	Azad Kashmir	7	1%
Educational Classification	B.A/B.Sc/B.Com/BCS	179	15%
	M.A/M.Sc/M.Com/MBA/MCS	477	39%
	M.Phil./Ph.D./Post Ph.D	403	33%
	Professional Degree (M.B.B.S/L.L.B/C.A and all others)	91	7%
	Technical Degree/Diploma	18	1%
	Others	61	5%
Faculty/Academics	Sciences (Chemistry, Physics, Mathematics, Biology, Statistics and all other)	663	54%
	Management Sciences	134	11%
	Information technology	138	11%
	Veterinary and Animal Sciences	12	1%
	Agriculture	26	2%
	Humanities and social sciences	140	11%
	Others	115	9%
Type of University	Public	1033	84%
	Private	196	16%

		N	N % (Percentage)
Status of Respondents	Student	893	73%
	Teacher	336	27%
Top 15 Universities (Who have maximum coverage in sample)	Allama Iqbal Open University	23	2%
	Bahria University	57	5%
	Comsats Institute of Information Technology	31	3%
	International Islamic University (IIU)	91	7%
	National University of Modern Languages	101	8%
	Quaid-i-Azam University (Qau)	146	12%
	University of Peshawar	29	2%
	Bahauddin Zakariya University	24	2%
	Fatima Jinnah Women University	48	4%
	PMAS University of Arid Agriculture	97	8%
	University of the Punjab	26	2%
	Aga Khan University	24	2%
	Quaid-e-Awam University of Engineering, Science and Technology	42	3%
	University of Karachi	22	2%
	University of Sindh	33	3%
	All others Universities	435	35%

According to sample profile majority of respondent (65%) were males as compared to females (35%). Majority of respondents belong to 20-25 years old age group (45%). As per planned and achieved sample majority of sample belong to Islamabad territory (47%). Majority of respondents belong to master level (39%) followed by M.Phil. and Ph.D. (33%). More than half (54%) of the respondents belong to facility of sciences. Round about two-third (74%) of respondents were students as compared to teachers (27%). Top 5 universities who have maximum coverage in sample are Quaid-i-Azam University (Qau) (12%), National University of Modern Languages (8%), University of Arid Agriculture, International Islamic University (IIU) and Bahria University.

CRONBACH'S ALPHA

Cronbach's Alpha, the reliability coefficient indicates the degree to which the results on the scale can be considered internally consistent, reliable (Brown, 1996). The Cronbach alpha was used in this study. It ranges from 0.00 to 1.00. Cronbach's alpha shows data was reliable for all aspects of examination system given in table 4.

Over-all cronbach's Alpha is 0.862. Cronbach's Alpha for in general examination system (0.804), transparency of examination system (0.730), Objective test's compatibility against subjective test (0.784), Practical Examination (0.816), Internal and External Examination (0.734), Semester system and annual system (0.754) found to be consistent. Hotelling T-square for each group is also highly significant reporting scales means are statistically significant to each other.

Table 4
Cronbach Alpha

	Cronbach's Alpha	N of Items	Hotelling's T-Squared	Sig
Over-all	0.862	37	2846.017	.000
In general examination System	0.804	8	701.7999	.000
Transparency of examination system	0.730	8	87.439	.000
Objective test's compatibility with Subjective test	0.784	9	452.833	.000
Practical Examination	0.816	5	83.287	.000
Internal and external examination	0.734	5	309.333	.000
Semester system and annual system	0.754	5	139.878	.000

GRADES COMPARISON ANNUAL SYSTEM VS SEMESTER SYSTEM

One of the objectives of research was comparison of performance of students across annual system and semester system. A question was asked from sample of 893 students was collected from all over Pakistan that "What is the percentage marks you have achieved in annual system?. Among them, 731 students have reported their percentage score whereas 162 didn't respond for this question. Among 731 students have reported their percentage marks obtained in annual system. 33% of students have obtained A+ grade in annual system. 35% have obtained A grade, 22% have obtained B grade, 8% have obtained grade C, 2% have obtained grade D and <1% have obtained grade E. These students were further asked that "What your current GPA or CGPA in semester system? Among them, 3% obtained A+ grade, 23% have obtained A Grade, 23% have obtained B grade, 37% have obtained C grade and 14% have obtained D grade given in table 5.

Table 5
Grades of Students in Annual System vs Semester System

		All		Grades in semester system				
				A+ (4 GPA)	A (3.63-3.99)	B (3.25-3.62)	C (2.88-3.24)	D (2.50-2.87)
		count	Col %	Row %				
All Students		**731**	**100%**	**3%**	**23%**	**23%**	**37%**	**14%**
Grades in Annual System	A+ (80% and above)	244	**33%**	4%	40%	22%	27%	7%
	A (70%-79%)	257	**35%**	2%	14%	30%	42%	12%
	B (60%-69%)	157	**21%**	6%	10%	21%	42%	21%
	C (50%-59%)	56	**8%**	5%	10%	13%	53%	19%
	D (40%-49%)	12	**2%**	0%	66%	6%	28%	0%
	E (33%-39%)	5	**1%**	0%	0%	0%	0%	100%

Non symmetric shape of distribution of students in annual system represents that most of students who were enrolled in universities were bright students. Among 33% (n=244) students who have obtained A+ grade in Annual system, 4% have achieved A+ grade, 40% have achieved A, 22% have achieved B, 22% C grade and 7% D in semester system. Among 35% students who obtained A grade in annual system, 2% achieved A+, 14% grade A, 30% grade B, 42% grade C, 12% Grade D in semester system,. Among 21% who achieved B grade in annual system, 6% obtained A+ grade, 10% grade A, 21% grade B, 42% grade C, 21% grade D in semester system. Among 8% who obtained grade C in annual system, 5% grade A+, 10% grade A, 13% grade B, 53% achieved grade C, 19% grade D in semester system. Among 2% who obtained grade D in annual system, achieved 66% grade A, 6% grade B, 28% grade C in semester system. Among 1% who obtained E grade in annual system, 100% have achieved grade D in semester system.

It's assumed that students achieve better grades in semester system as compared to annual system. Hence the following hypothesis was tested to compare marks of students in semester system and annual system.

H_o = Marks of students in semester system are not associated (independent) with marks of students in annual system.

H_1 = Marks of students in semester system are associated (dependent) with marks of students in annual system.

Pearson Chi-Square Test

Pearson Chi-Square	df	Asymp. Sig. (2-sided)
127.214	20	.000

Pearson Chi-Square test was found to be significant hence rejecting null hypothesis and accepting alternative hypothesis that there is significant association between marks of students in semester system and annual system. Hence we can conclude that Students achieve same scores in annual and semester system. So we can conclude that evaluation criteria of both annual and semester system are consistent. Hence we can reject a myth that students achieve higher grades in semester system as compared to annual.

Subjective Test vs Objective Test

A sample of 1228 respondents across the four provinces was asked "Which is more effective test?" Responding to this question, subjective type of test is preference of 30% respondents as compared to objective type of test (70%) given in table 6.

Table 6
Subjective Test vs Objective Test
Figures are row percentages

		Which is more effective test?		Chi-square
		Subjective Type	Objective Type	
Over-all (All Pakistan average)		30%	70%	
Gender of Respondent	Male	32%	68%	3.464
	Female	27%	73%	
Age of respondent	18-20	24%	76%	4.602
	20-25	32%	68%	
	26-30	27%	73%	
	31-35	32%	68%	
	36-40	33%	67%	
	40+	27%	73%	
Geo-graphical Location of respondents	Punjab	31%	69%	4.472
	Sindh	31%	69%	
	Khyber Pakhtunkhwa	31%	69%	
	Balochistan	12%	88%	
	Gilgit-Baltistan	0%	100%	
	Islamabad Capital Territory	29%	71%	
	Azad Kashmir	42%	58%	
Educational Classification of respondents	B.A/B.Sc/B.Com/BCS	29%	71%	12.855*
	M.A/M.Sc/M.Com/MBA/MCS	27%	73%	
	M.Phil./Ph.D./Post Ph.D.	32%	68%	
	Professional Degree (M.B.B.S/L.L.B/C.A and all others)	29%	71%	
	Technical Degree/Diploma	62%	38%	
	Others	34%	66%	
Faculty/Academics of respondents	Sciences (Chemistry, Physics, Mathematics, Biology, Statistics and all other)	29%	71%	11.262
	Management Sciences	23%	77%	
	Information technology	27%	73%	
	Veterinary and Animal Sciences	31%	69%	
	Agriculture	39%	61%	
	Humanities and social sciences	39%	61%	
	Others	32%	68%	
Type of University	Public	30%	70%	0.00
	Private	30%	70%	
Status of Respondents	Student	29%	71%	1.827
	Teacher	33%	67%	

		Which is more effective test?		Chi-square
		Subjective Type	Objective Type	
Top 15 Universities	Allama Iqbal Open University	50%	50%	29.963*
	Bahria University	20%	80%	
	Comsats Institute of Information Technology	42%	58%	
	International Islamic University (IIU)	30%	70%	
	National University of Modern Languages	31%	69%	
	Quaid-i-Azam University (Qau)	29%	71%	
	University of Peshawar	41%	59%	
	Bahauddin Zakariya University	42%	58%	
	Fatima Jinnah Women University	32%	68%	
	PMAS University of Arid Agriculture, Rawalpindi	28%	72%	
	University of the Punjab	35%	65%	
	Aga Khan University	55%	45%	
	Quaid-e-Awam University of Engineering, Science and Technology	16%	84%	
	University of Karachi	10%	90%	
	University of Sindh	40%	60%	
	All others Universities	28%	72%	

Gender wise analysis shows that preference of objective type of test to me more effective for Pakistan is greater in female (73%) as compared to male (68%). Gender wise perception for most effective test found to be statistically significant. Respondents who are up to 20 years of age group prefer objective type of test (76%) more as compared to respondents of age 40+ (73%). There isn't significant difference in perception regarding most effective test across age groups. Majority of students or teachers in Punjab (69%), Sindh (69%), KPK (69%), Balochistan (88%), GB (100%), ICT (71%) and AJK (58%) prefer objective type of test to be more effective in Pakistan. Geographical location wise there isn't significant difference in preference to be more effective test. As per educational classification of respondents, 71% of students who belong to bachelors prefer objective type of test to be more effective. 73% of master's students prefer objective type of test. 68% of M.Phil./Ph.D. respondents (Students and teachers) prefer objective type. 71% of students who belong to professional degree prefer objective type of test. 62% of students who are registered for technical diploma or degree prefer subjective type of test. 66% of students who are registered in other different degrees or diplomas prefer objective type of test. As per chi-square test there is significant difference among different educational classification. 71% of respondents of science faculty, management science (77%), Information technology (73%), Veterinary and animal science (69%), agriculture and social science and humanity (61%) and other facilities (68%) prefer objective type of test. There isn't significant difference among different facilities for preference of subjective or objective test to be more effective.

Among students and teachers, Students (71%) more prefer objective type of test as compared to teachers (67%). Respondents (teachers and students) of AIOU (50%), BU (80%), COMSATS (58%), IIU (70%), NUML (69%), QAU (71%), UP (59%), BZU (58%), FJWU (68%), PMAS (72%), UP (65%), AKU (45%), QUEST (84%), UK (90%), US (60%) and all others universities (72%) consider objective type of test to be more effective.

LOGISTIC REGRESSION - SUBJECTIVE TEST VS OBJECTIVE TEST

Logistic model was developed preference of subjective test vs. objective test as dependent variable and gender, educational classification along with universities as independent variable. There were two outcomes to dependent variable of type of the test either subjective type or objective type. Where, Subjective type=0 and objective type=1. The classification is given in the table 7.

Table 7
Classification Table

Observed		Predicted		
		Which is more effective test?		Percentage Correct
		Subjective type	Objective type	
Which is more effective test?	Subjective type	25	342	6.9
	Objective type	19	843	97.8
Overall Percentage				70.7

b. The cut value is .500

In the model 25 respondents were correctly classified who prefer subjective type of test and 342 respondents were misclassifies who prefer objective type of test (it correctly classified 6.9% of respondents). Model correctly classified 843 respondent who prefer Objective type of test and 19 respondents were misclassified who prefer subjective type of test (it correctly classified 98% of respondents). Over-all correct classification, weighted average is 71%. Hence 71% of respondents were correctly classified.

The significance of the variables is given the table 8.

Table 8
Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp(B)
Gender -Male	-.309	.147	4.396	1	.036	.734
Educational classification			14.272	5	.014	
B.A/B.Sc/B.Com/BCS	.353	.329	1.148	1	.284	1.423
M.A/M.Sc/M.Com/MBA/MCS	.505	.314	2.578	1	.108	1.657
M.Phil./Ph.D./Post Ph.D	.185	.305	.366	1	.545	1.203
Professional Degree (M.B.B.S/L.L.B/C.A and all others)	.237	.369	.411	1	.522	1.267
Technical Degree/Diploma	-1.255	.564	4.949	1	.026	.285
Universities			32.572	15	.005	

	B	S.E.	Wald	df	Sig.	Exp(B)
Allama Iqbal Open University	-.997	.433	5.304	1	.021	.369
Bahria University	.230	.351	.429	1	.512	1.258
Comsats Institute of Information Technology	-.622	.382	2.647	1	.104	.537
International Islamic University (IIU)	-.127	.259	.242	1	.622	.880
National University of Modern Languages	-.427	.258	2.737	1	.098	.652
Quaid-i-Azam University (Qau)	-.251	.230	1.192	1	.275	.778
University of Peshawar	-.630	.399	2.487	1	.115	.533
Bahauddin Zakariya University	-.628	.434	2.090	1	.148	.534
Fatima Jinnah Women University	-.661	.362	3.334	1	.068	.516
PMAS University of Arid Agriculture	-.242	.265	.838	1	.360	.785
University of the Punjab	-.467	.427	1.197	1	.274	.627
Aga Khan University	-1.386	.431	10.332	1	.001	.250
Quaid-e-Awam University of Engineering, Science and Technology	.752	.448	2.821	1	.093	2.122
University of Karachi	1.071	.722	2.205	1	.138	2.920
University of Sindh	-.645	.379	2.900	1	.089	.525
Constant	.967	.311	9.673	1	.002	2.630

From the table 8, Wald statistics for Gender was found to be statistically significant from zero. Among gender, where 0 is female and 1 is males, coefficient -0.309 shows preference for objective test to be more effective decline when person is male. Preference for objective type test to be more effective for Pakistan decline by 26% when person is male or preference of objective test to be more effective for Pakistan decline by -0.309 log of odd ratios when person is male. Among the educational classification, in comparison to other educational classifications (reference category), preference for objective test more effective for Pakistan increase by 42% when educational classification of respondent is bachelors or preference increases by 0.353 log of odd ratios when respondents belong to bachelor's degree. In comparison to other classification, preference of objective test more effective for Pakistan increase by 65% when respondents belongs to master level or increase by 0.505 log of odd rations. Similarly preference increase by 20% when respondent belong to M.Phil./Ph.D. level or increase by 0.185 log of odd ratio. Preference of objective test more effective for Pakistan increase by 27% when respondents belong to professional degree or increase by 0.237. preference of objective test to be more effective for Pakistan decline by 72% when person respondent belongs to technical education or diploma or decline by -1.255 log of odd ratios. Among universities, in a comparison of all other universities of Pakistan (reference category), preference for objective test to be more effective decline by 63% when respondent belongs to AIOU or decline by -0.997 log of odd ratio. Preference of objective test to be more effective increase by 26% when person belongs to BU or increase by 0.230 log of odd ratios. Preference for objective test decline by 46% when person belongs to Combats or decline by -0.622 log of odd ratio. Preference of objective test to be more effective decline by 12% when person belongs to IIU or decline by -0.127 log of odd ratio. Prerace for objective test decline by 35% when person belong to NUML

or decline by -0.427 log of odd ratios. Preference of objective type of test decline by 22% when person belongs to QAU or decline by -0.251 log of odd ratio. Preference of objective type of test more effective for Pakistan decreases by 47% when person belong to UoP or decline by -0.63 log of odd ratios. Preference of objective test objective test decline by 47% when person belong to BZU or decline by -0.628 log of add ratios. Preference of objective test objective test decline by 48% when person belong to FJWU or decline by -0.661 log of add ratios. Preference of objective test objective test decline by 22% when person belong to PMAS or decline by -0.242 log of add ratios. Preference of objective test objective test decline by 37% when person belong to UoP or decline by-0.467 log of add ratios. Preference of objective test objective test decline by 75% when person belong to AGK or decline by -1.386 log of add ratios. Preferences of objective test objective test increases by 3 times when person belong to QUEST or increase by .752 log of odd ratios. Preference of objective test objective test decline by 48% when person belong to UK or decline by -.645 log of add ratios. Preference of objective test objective test decline by 48% when person belong to U Sindh or decline by -0.645 log of add ratios.

ANNUAL SYSTEM VS SEMESTER SYSTEM

A sample of 1228 respondents across the four provinces was asked "Which system is most effective for Pakistan?" Responding to this question, wide majority of 86% respondents prefer semester system more effective as examination system of Pakistan whereas only, 14% of respondents prefer annual system effective for Pakistan given in table 9.

Table 9
Annual System vs Semester System

		Which system is most effective for Pakistan?		Chi-square
		Annual system	Semester system	
Over-all (All Pakistan average)		14%	86%	
Gender	Female	12%	88%	1.894*
	Male	15%	85%	
Age	18-20	13%	87%	7.416
	20-25	14%	86%	
	26-30	11%	89%	
	31-35	9%	91%	
	36-40	18%	82%	
	40+	18%	82%	
Geo-Graphical location	Punjab	18%	82%	25.255**
	Sindh	10%	90%	
	Khyber Pakhtunkhwa	26%	74%	
	Balochistan	4%	96%	
	Gilgit-Baltistan	0%	100%	
	Islamabad Capital Territory	11%	89%	
	Azad Kashmir	25%	75%	

		Which system is most effective for Pakistan?		Chi-square
		Annual system	Semester system	
Educational Classification	B.A/B.Sc/B.Com/BCS	10%	90%	17.958**
	M.A/M.Sc/M.Com/MBA/MCS	12%	88%	
	M.Phil./Ph.D./Post Ph.D	17%	83%	
	Professional Degree (M.B.B.S/L.L.B/C.A and all others)	22%	78%	
	Technical Degree/Diploma	3%	97%	
	Others	6%	94%	
Faculty/ Academics	Sciences (Chemistry, Physics, Math., Biology, Statistics and all other)	16%	84%	21.105**
	Management Sciences	7%	93%	
	Information technology	5%	95%	
	Veterinary and Animal Sciences	16%	84%	
	Agriculture	9%	91%	
	Humanities and social sciences	14%	86%	
	Others	21%	79%	
Status of Respondents	Teachers	18%	82%	5.390*
	Students	12%	88%	
Universities	Allama Iqbal Open University	11%	89%	38.832*
	Bahria University	11%	89%	
	Comsats Institute of Information Technology	25%	75%	
	International Islamic University (IIU)	9%	91%	
	National University of Modern Languages	10%	90%	
	Quaid-i-Azam University (Qau)	10%	90%	
	University of Peshawar	30%	70%	
	Bahauddin Zakariya University	19%	81%	
	Fatima Jinnah Women University	15%	85%	
	University of Arid Agriculture	14%	86%	
	University of the Punjab	40%	60%	
	Aga Khan University	18%	82%	
	Quaid-e-Awam University of Engineering, Science and Technology	11%	89%	
	University of Karachi	0%	100%	
	University of Sindh	13%	87%	
	All others Universities	14%	86%	

Gender wise analysis shows that females (88%) more prefer semester system as compared to males (85%). Gender wise there is statistically difference in preference of annual system and semester system. Preference of semester system as more effective in Pakistan with in the age group 18-20, 20-25, 26-30, 31-35, 36-40, 40+ is 87%, 86%, 89%, 91%, 82% and 82% respectively. Age wise preference of examination system as more effective examination system for Pakistan is non-significant. Geo-graphic location wise, 82% respondents of Punjab, 90% respondents of Sindh, 74% respondents from Khyber Pakhtunkhwa, 96% respondents of Balochistan, 100% respondents of Gilgit-Baltistan, 89% respondents of Islamabad Capital Territory and 75% respondents of Azad Kashmir prefer semester system to be more effective for Pakistan. Geo-graphical location wise perception is statistically significant regarding most effective system for Pakistan. Among educational classification 90% of respondents of bachelors, 88% respondents of masters, 83% of M.Phil. or Ph.D., 78% of respondents who belong to professional degree, 97% of respondents who belong to technical education or 94% of respondents who belong to other educational classification prefer semester system to be most effective for Pakistan. Education classification wise difference in perception is statistically significant. Faculty wise, preference of semester system as most effective for Pakistan, 84% in Sciences faculty, 93% in Management Sciences, 95% in Information technology, 84% in Veterinary and Animal Sciences, 91% in Agriculture, 86% in Humanities and social sciences and 79% in Others facilities. Faculty wise difference in perception is statistically significant. Among teacher-student, 82% of Teachers and 88% of Students prefer semester system to be more effective for Pakistan. Among teacher and student difference in perception is statistically significant. Among universities preference of semester system most effective for Pakistan is 89% in AIOU, 89% in BU, 75% in Comsats, 91% IIU, 90% in NUML, 90% in QAU, 70% in UP, 81% in BUZ, 85% in FJWU, 86% in PMAS, 60% in UoP, 82% in AKU, 89% in QUEST, 100% in UK, 87% in U Sindh and 86% in All others Universities of Pakistan. Among universities, difference in perception is statistically significant.

LOGISTIC REGRESSION - ANNUAL SYSTEM VS SEMESTER SYSTEM

Logistic model was developed preference of annual system vs. semester system as dependent variable and educational classification and faculty as independent variable. There were two outcomes to dependent variable of type of the test either annual system or semester system. Where, Annual system=0 and Semester system=1. The classification table is given in the table 10.

Table 10
Classification Table

Observed		Predicted		
		Which system is most effective for Pakistan?		Percentage Correct
		Annual system	Semester system	
Which system is most effective for Pakistan?	Annual system	4	166	2.6
	Semester system	5	1054	99.5
Overall Percentage				86.1

b. The cut value is .500

In the model 4 respondents were correctly classified who prefer annual system and 166 respondents were misclassifies who prefer semester system (it correctly classified 3% of respondents). Model correctly classified 1054 respondent who prefer semester system and 4 respondents were misclassified who prefer semester system (it correctly classified 99.5% of respondents). Over-all correct classification, weighted average is 86%. Hence 86% of respondents were correctly classified.

The significance of the variables is given the table 11.

Table 11
Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp(B)
Educational classification			17.395	5	.004	
Bachelors	-.783	.634	1.522	1	.217	.457
Masters	-1.098	.626	3.079	1	.079	.334
M.Phil./Ph.D.	-1.682	.635	7.012	1	.008	.186
Professional degree	-1.802	.641	7.903	1	.005	.165
Technical Education	.780	1.559	.250	1	.617	2.181
Faculty			20.346	6	.002	
Sciences	.378	.296	1.630	1	.202	1.460
Management Sciences	1.456	.435	11.204	1	.001	4.287
Information technology	1.509	.474	10.147	1	.001	4.522
Veterinary and Animal Sciences	.814	.863	.890	1	.346	2.257
Agriculture	1.193	.774	2.374	1	.123	3.297
Humanities and social sciences	.746	.385	3.763	1	.052	2.109
Constant	2.321	1.129	4.224	1	.040	10.185

Wald statistics for educational classification was found to be statistically significant from zero. Among the educational classification, in comparison with others (reference category) preference for semester system decrease by 54% when student belong to bachelors group or decline by -0.783 log of odd ratio. In a comparison of others educational classification preference for semester system decline by 66% when student belongs to master or decline by -1.098 log of odd ratio. In comparison of other degrees preference for semester system decline by 81% when respondent belong to M.Phil. Or Ph.D. or perception decline by -1.682. In comparison to other educational classification, preference for semester system decline by 84% when respondent (either student or teacher) belong M.Phil. or Ph.D. or perception decline by -1.802 log of odd ratios. In comparison to other classification, preference of semester system to be more effective for Pakistan increase by 2 times when student belong to technical education or increases by .780 log of odd ratios. Wald Statistics for Faculty was found to be statistical significant from zero. In comparison with other faculties (reference category), preference for semester system most effective for Pakistan increase by 46% or increase by 0.378 log of odd ratio. In comparison with other faculties, preference for semester system increase by 4 times when respondent belong to management sciences or increases by 1.456 log of odd ratios. In comparison to other, preferences for semester system increase by 5 times or 1.509 log of odd ratio when respondent belong to faculty of information and technology.

Preference for semester system increase by 2 times or 0.814 log of odd ratio when respondent belong to faculty of Veterinary and Animal Sciences. Preference for semester system increases by 3 times or 1.193 log of odd ratio when respondent belongs to faculty of agriculture. Preference of semester system increase by 2 times or 0.746 log of odd ratio when person belongs to faculty of Humanities and social sciences.

DIMENSIONAL SCALING - OVERALL EXAMINATION SYSTEM

Eight questions were designed to analysis Over-all analysis examination system at university level. These questions were:

q1_1. Examination system in Pakistan is rising the standard of education
q1_2. Examination system enhances the command of student over the subject
q1_3. Examination system enhances the command of teacher over the subject
q1_4. Examination system improves the learning process
q1_5. Examination system improves the teaching process
q1_6. Existing examination system focuses on the preparation for exam instead of giving knowledge
q1_7. Examination system helps to attain the aim of education.
q1_8. Present examination system measures the knowledge, skills and efficiency of student

The correlation matrix given in the table 12 explaining the clustering the variables in meaningful way.

Table 12
Correlation Matrix

	Q1_1	Q1_2	Q1_3	Q1_4	Q1_5	Q1_6	Q1_7	Q1_8
Q1_1	1	.552**	.450**	.518**	.410**	-.075**	.475**	.396**
Q1_2	.552**	1	.526**	.589**	.493**	.011	.481**	.363**
Q1_3	.450**	.526**	1	.489**	.554**	.023	.406**	.309**
Q1_4	.518**	.589**	.489**	1	.685**	.097**	.554**	.357**
Q1_5	.410**	.493**	.554**	.685**	1	.074**	.510**	.283**
Q1_6	-.075**	.011	.023	.097**	.074**	1	-.020	-.242**
Q1_7	.475**	.481**	.406**	.554**	.510**	-.020	1	.431**
Q1_8	.396**	.363**	.309**	.357**	.283**	-.242**	.431**	1

a. Determinant = .052

Correlation matrix shows that many of correlation coefficient insignificant but highest correlation was found regarding examination system improves teaching and learning process (0.685) found to be highly significant. Followed by second highest correlation examination system improves learning process and examination system improves the command of student on a subject (0.589) found to be highly significant. The KMO and Bartlett's Test is given in table 13.

Table 13
Kmo and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.860
Bartlett's Test of Sphericity	Approx. Chi-Square	3611.283
	Df	28
	Sig.	.000

Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy for the set of variables included in the analysis was 0.860, which exceeds the minimum requirement of 0.50 for overall MSA. Bartlett's Test of Sphericity found to be highly significant represents that factors computed are appropriate. The probability associated with the Bartlett test is $p<0.05$, means that correlation matrix is not identity matrix that data is approximately normal and acceptable for actor analysis.

The communalities computed are given in the table 14.

Table 14
Communalities

	Initial	**Extraction**
Examination system in Pakistan is rising the standard of education	1.000	.558
Examination system enhances the command of student over the subject	1.000	.613
Examination system enhances the command of teacher over the subject	1.000	.536
Examination system improves the learning process	1.000	.718
Examination system improves the teaching process	1.000	.656
Existing examination system focuses on the preparation for exam instead of giving knowledge	1.000	.790
Examination system helps to attain the aim of education	1.000	.560
Present examination system measures the knowledge, skills and efficiency of student	1.000	.610

Extraction Method: Principal Component Analysis.

Examination of the principal components model extracted communalities are all greater than 0.50 (minimum requirement).58.8% of variation in factor model is explained by Examination system in Pakistan is rising the standard of education, 61.3% of variation is explained by Examination system enhances the command of student over the subject, 53.6% of variation is explained by examination system enhances the command of teacher over the subject, 71.8% of variation is explained by examination system improves the learning process, 65.6% of variation is explained by examination system improves the teaching process, 79% of variation is explain in the factor model by existing examination system focuses on the preparation for exam instead of giving knowledge, 56% of variation in factor model is explained by examination system helps to attain the aim of education, 61% of variation is explained by present examination system measures the knowledge, skills and efficiency of student.

Total Variance is explained is given in the table 15.

Table 15
Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.840	47.995	47.995	3.840	47.995	47.995	3.748	46.851	46.851
2	1.202	15.020	63.015	1.202	15.020	63.015	1.293	16.164	63.015
3	.655	8.189	71.205						
4	.613	7.662	78.866						
5	.544	6.800	85.666						
6	.451	5.632	91.298						
7	.424	5.303	96.601						
8	.272	3.399	100.000						
Extraction Method: Principal Component Analysis.									

The latent root criterion for number of factors to extract would indicate that there were 2 components to be extracted for these variables, since there were 2 eigen values greater than 1.0 (3.840, and 1.202). These two factors are explaining the 63% of variation.

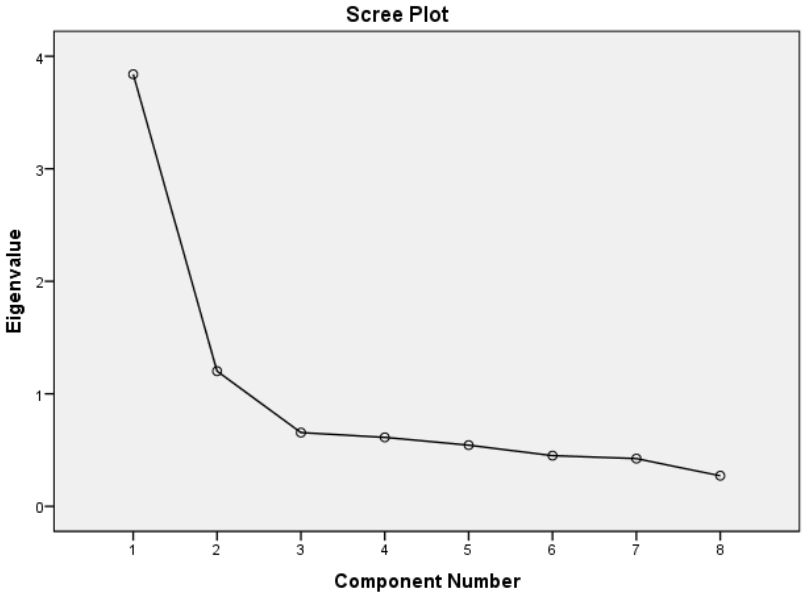

Figure 1: Principal Component Screen Plot

Using the varimax rotation, Rotated component matrix is given in the table 16.

Table 16
Rotated Component Matrix[a]

	Component	
	1	2
Examination system improves the learning process	.847	
Examination system improves the teaching process	.804	
Examination system enhances the command of student over the subject	.776	
Examination system enhances the command of teacher over the subject	.732	
Examination system helps to attain the aim of education	.722	
Examination system in Pakistan is rising the standard of education	.695	
Existing examination system focuses on the preparation for exam instead of giving knowledge		-.876
Present examination system measures the knowledge, skills and efficiency of student	.468	.625

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.

By examining the pattern of factor loadings (loadings greater than 0.50) to make certain that each variable loads on one and only one component. Examination system improves the learning process, Examination system improves the teaching process, Examination system enhances the command of student over the subject, Examination system enhances the command of teacher over the subject, Examination system helps to attain the aim of education, Examination system in Pakistan is raising the standard of education is part of first component with title "Prompting teaching and learning practices" and second component contains variables Existing examination system focuses on the preparation for exam instead of giving knowledge and Present examination system measures the knowledge, skills and efficiency of student with title "Measuring instrument of knowledge, skill and efficiency".

Using the varimax rotation, component transformation matrix is given in the table 17.

Table 17
Component Transformation Matrix

Component	**Prompting teaching and learning practices**	**Measuring instrument of knowledge, skill and efficiency**
Prompting teaching and learning practices	.982	.186
Measuring instrument of knowledge, skill and efficiency	.186	-.982

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

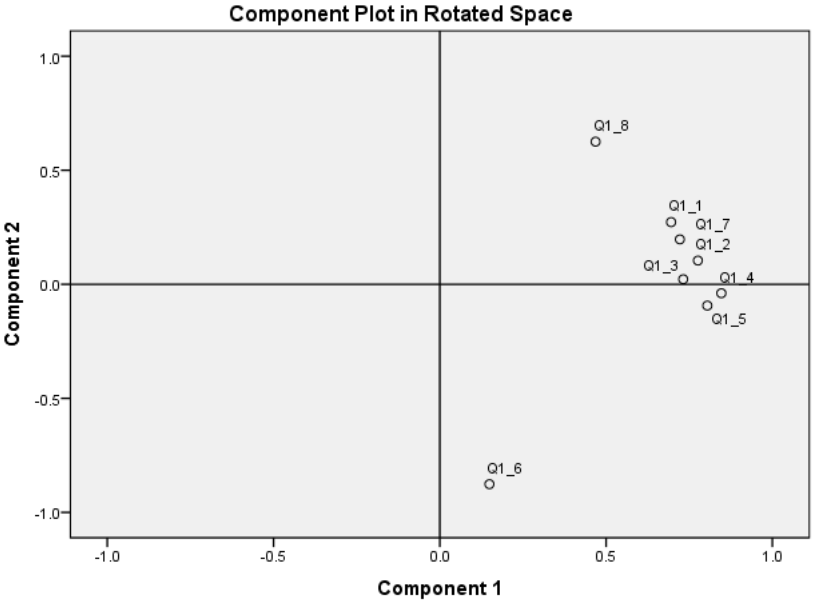

Figure 2: Component Plot In Rotated Space

Table 18
Component Score Coefficient Matrix

	Component	
	1	2
Examination system in Pakistan is rising the standard of education	.166	.149
Examination system enhances the command of student over the subject	.207	.003
Examination system enhances the command of teacher over the subject	.203	-.059
Examination system improves the learning process	.241	-.120
Examination system improves the teaching process	.235	-.160
Existing examination system focuses on the preparation for exam instead of giving knowledge	.133	-.727
Examination system helps to attain the aim of education	.182	.085
Present examination system measures the knowledge, skills and efficiency of student	.066	.459

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Hence our two main dimensions of objective systems are:

1. Prompting teaching and learning practices
2. Measuring instrument of knowledge, skill and efficiency

COMMENTS AND CONCLUSION

As association between students marks in semester system are dependent or associated with marks of students in annual system hence it could be concluded that

marks of students are compareable across different system of examinions. Bright or average students of annual system achive similar scores in semester systenm as well.

All over pakistan, majority of respondents (70%) have prefered objective type of test to be more effective for pakistan. 71% of students and 67% of teachers have prefered objective type of test more effective for pakistan. Hence it is suggested share of objective type of question in question paper be increased. This can be more efficint in testing knewlege and skills of students which may leads in enhancing reasoning skills of students.

All Over pakistan, majority of respondents (86%) prefer subjective type of test to be more effective for pakistan. 82% of respondents from punjab, 90% of respondent from sindh, 74% of respondents from KPK and 96% of respondents from Balochistan prefer semester system, 100% of respondents from Gilgit-Baltistan and 75% of respondents from Azad Jamu and Kashmir prefer semester system to be more effective for pakistan. 82% of teachers and 88% of students prefer semester system. Althought across the different geo-graphic location wise there is significant difference amoung prefrence of more effective system and loction but still wide majority of respondents prefer semester system. Hence it is suggested that semester system shoude be more achnewledge, which by lead to students and teacher towards puntuality. Teachers may play their more effective role in semester system and semester semester may be more conveniant in criculam management.

Using the principal component analysis it was concluded that two main dimensions of examintion system and main objective of examination system as evaluation tool are improving teaching and learning practices and measuring knowledge, skill and efficiency of students. Hence, to raise the stander of examintion system and qualtiy of examintion system, we may first need to improve teaching and learing proces which can improve quality of examination system as an instrument or tool of meauring the skill, knewledge and efficiency of student.

REFERENCES

1. Bartlett, J.E., Kotrlik, J.W. and Higgins, C. (2001). Organizational Research: Determining Appropriate Sample Size in Survey Research. *Information Technology, Learning, and Performance Journal*, 19(1), 43-50.
2. Buzdar, M.A., Ali, D.A., Akhtar, D.J.H., Maqbool, S. and Buzdar, M.N. (2013). Assessment of Students' Learning Achievements under Semester System in Pakistan. *Journal of Basic and Applied Scientific Research*, 3(6), 79-86.
3. Cronbach, L.J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*. 16, 297-334.
4. Hashim, M. (2013). A Case study of Annual and Semester Systems of Examination on Government College of Management Sciences, Peshawar, Pakistan. *Journal of Educational Research*, 2(3), 034 - 048.
5. Muhammad, F. and Chaudhry M.A. (1983). Evaluation criteria under different systems of examination. *Science technology and development*, 2(4), 41-42, 1983.
6. Pakistan Education Statistics (2012). Ministry of Education: Government of Pakistan, Islamabad.

7. Rehmani, A. (2000). *Impact of public examination system on teaching and learning in Pakistan*: Aga Khan University Examination Board.
8. Shirazi, M.J.H. (2004). Analysis of examination system at university level in Pakistan. (Unpublished Doctoral Dissertation). *University of Arid Agriculture, Rawalpindi.*
9. Statistical annex from *United Nations human Development Program Report (2013).*
10. *UNICEF Global Monitoring Report* (2005).
11. Yousaf, A. and Hashim, M. (2012). A Case study of Annual and Semester Systems of Examination on Government College of Management Sciences, Peshawar, Pakistan. *International Journal of Academic Research in Business and Social Sciences*, 12(9), 53-73.

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THE QURANIC PERSPECTIVE OF PROBABILITY, CERTAINTY AND REALITY

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ABSTRACT

Our acquired information on any branch of knowledge is basically of either probability nature or at the best with some level of unknown certainty. To generate the knowledge of absolute certainty or true reality of matters is beyond the scope of human mind. However it does exist in the Divine scriptures that has been revealed for our guidance by our Creator through the Prophets in the form of Divine books. The last and final book of such knowledge is the Quran that was revealed to the Prophet Muhammad (*pbuh*) about 1500 years ago. In the current paper the Quranic perspective of the concepts of probability, certainty and the reality is discussed.

INTRODUCTION

Human beings are curious by nature right from the birth till death. Allah (*swt*) has granted this curiosity to human mind so that he may be able to seek and recognize the truth. This curiosity inspires every person to acquire knowledge from different sources and store it in his subconscious memory. At the same time, however, he always remains suspicious to a certain extent. In order to satisfy his curiosity and to reduce his suspicions he acquires more and more knowledge and by doing so he gradually becomes wiser and wiser in the decision making processes of life. The knowledge a person acquires by different means is shared with the society in which he is living. The next generation advances that knowledge further by doing more investigations and research. This way the collective knowledge has been gradually advancing in the human society. Based on the acquired knowledge and the suspicious nature of human beings the concepts of probability and certainty developed by researchers and the subject of statistics emerged on the canvas of acquired knowledge. Even today all the information in various branches of knowledge is standing merely on various levels of probability when we compare it with the absolute realities found in the Divine scripts. However the probability based scientific and technological knowledge has been good enough to create material things that would make the material life more comfortable. With further advancement of statistical knowledge the error level in the probability could be decreasing and may further decrease. However, we cannot be sure that this process is leading us closer to any level of true certainty or the true reality of matters.

DISCUSSION

There exist only two sources of original knowledge and these are:

1. The Acquired Knowledge though five senses.
2. The Divine Knowledge revealed through the chosen Prophets.

1. An Acquired Knowledge is that which is acquired by our five senses namely, hearing, seeing, touching, tasting, and smelling. This primary acquired knowledge is often processed by applying logic or the existing scientific laws to obtain the derived or the processed knowledge. The acquired knowledge and the processed knowledge are advancing every day and probably moving in the direction of true knowledge, the reality of which is known only to the Creator of the universe. History shows that many times we wrongly believe that we are advancing our knowledge in the right direction, only to find it latter that we were wrong.

2. The Divine knowledge is that which has been revealed by our Creator through the chosen Prophets for our guidance. Although the Divine scriptures basically deal with the moral values for the guidance of individuals and the society, many scientific information has also been beautifully amalgamated within the structure of moral guidance. This way some absolute knowledge has been revealed to the human beings through the Prophets and a large percentage of that knowledge has been revealed to the Prophet Muhammad that has been preserved in the form of the Quranic verses. Such knowledge may be defined as the ultimate Divine scientific knowledge. There is no chance of that revealed knowledge to be changed any time in the future as it has been declared in the Quran that Allah (*swt*) is going to protect it from any attempt by human beings to change this scripture. This is indicated in the following verse:

إِنَّا نَحۡنُ نَزَّلۡنَا ٱلذِّكۡرَ وَإِنَّا لَهُۥ لَحَٰفِظُونَ (٩)

Indeed, it is We who sent down the Qur'an and indeed, We will be its guardian.
(Al-Hijr-15:9 Sahih International)

The ancient Greek philosophers described the ultimate substance of all reality to be the true morality. The German philosophers like Johann Gottlieb Fichte (1762–1814) and Immanuel Kant have also considered morality to be the basis of Ultimate Reality. But the question arises what is a true morality and what is not? The Quran provides a very straight forward answer to this question in the following verse:

ٱلۡحَقُّ مِن رَّبِّكَ فَلَا تَكُن مِّنَ ٱلۡمُمۡتَرِينَ (٦٠)

The truth is from your Lord, so do not be among the doubters.
(Al-e-Imran-3:60- Sahih International)

The verse tells that the ultimate realities and moralities are those which are revealed by your Lord. All the knowledge revealed by Allah (*swt*) is of ultimate reality. Some of these realities are moral and some of the realities are scientific. The way Allah (*swt*) provides the information is of following style:

1. Providing information. Giving awareness. For example in the following verses our Lord is providing us the information and telling us to believe and have faith in that information.

قُلۡ هُوَ ٱللَّهُ أَحَدٌ (١) ٱللَّهُ ٱلصَّمَدُ (٢) لَمۡ يَلِدۡ وَلَمۡ يُولَدۡ (٣) وَلَمۡ يَكُن لَّهُۥ كُفُوًا أَحَدُۢ (٤)

Say, "He is Allah, [who is] One, Allah, the Eternal Refuge.
He neither begets nor is born, Nor is there to Him any equivalent."
(Al-Ikhlas-112:1-4 Sahih International)

2. Giving adequate information or knowledge on an issue to develop certain belief of the matters through advanced knowledge. This is called faith through knowledge or (عِلۡمَ ٱلۡيَقِينِ) (*Ilmul-Yaqeen*).
3. Showing the reality of matters for our observation. A faith through observation is called (عَيۡنَ ٱلۡيَقِينِ) (*Ainul-Yaqeen*).
4. Personally experiencing the reality of matters. This is called faith by understanding the reality of matters or (حَقُّ ٱلۡيَقِينِ) (*Haqul-Yaqeen*).

The following verses of the Quran indicate that the word '*Al-Yaqeen*' has been used to tell about the reality of death. The two levels of the reality of death are '*Ilmul-Yaqeen*' (عِلۡمَ ٱلۡيَقِينِ) and '*Ainul-Yaqeen*' (عَيۡنَ ٱلۡيَقِينِ).

فَسَبِّحۡ بِحَمۡدِ رَبِّكَ وَكُن مِّنَ ٱلسَّٰجِدِينَ (٩٨) وَٱعۡبُدۡ رَبَّكَ حَتَّىٰ يَأۡتِيَكَ ٱلۡيَقِينُ (٩٩)

So glorify the praises of your Lord and be of those who prostrate themselves (to Him).
(98) And worship your Lord until there comes unto you the certainty (i.e. death)
(Al-Hijr-15:98-99-Dr. Mohsin)

قَالُواْ لَمۡ نَكُ مِنَ ٱلۡمُصَلِّينَ (٤٣) وَلَمۡ نَكُ نُطۡعِمُ ٱلۡمِسۡكِينَ (٤٤) وَكُنَّا نَخُوضُ مَعَ ٱلۡخَآئِضِينَ (٤٥)
وَكُنَّا نُكَذِّبُ بِيَوۡمِ ٱلدِّينِ (٤٦) حَتَّىٰٓ أَتَىٰنَا ٱلۡيَقِينُ (٤٧)

They will say: "We were not of those who used to offer the Salât (prayers) (43)
"Nor we used to feed Al-Miskin (the poor); (44) "And we used to talk falsehood
with vain talkers (45) "And we used to belie the Day of Recompense (46)
"Until there came to us (the death) that is certain." (47)
(Al-Mudasser-74:43-47 Dr. Mohsin)

In the Quran the three levels Certainty are described as follows:

أَلۡهَىٰكُمُ ٱلتَّكَاثُرُ (١) حَتَّىٰ زُرۡتُمُ ٱلۡمَقَابِرَ (٢) كَلَّا سَوۡفَ تَعۡلَمُونَ (٣) ثُمَّ كَلَّا سَوۡفَ تَعۡلَمُونَ (٤)
كَلَّا لَوۡ تَعۡلَمُونَ عِلۡمَ ٱلۡيَقِينِ (٥) لَتَرَوُنَّ ٱلۡجَحِيمَ (٦) ثُمَّ لَتَرَوُنَّهَا عَيۡنَ ٱلۡيَقِينِ (٧) ثُمَّ لَتُسۡـَٔلُنَّ يَوۡمَئِذٍ عَنِ ٱلنَّعِيمِ (٨)

The mutual rivalry (for piling up of worldly things) diverts you, (1) Until you visit the graves (i.e. till you die). (2) Nay! You shall come to know! (3) Again, Nay! You shall come to know! (4) Nay! If you knew with a sure knowledge (the end result of piling up, you would not have been occupied yourselves in worldly things) (5) Verily, You shall see the blazing Fire (Hell)! (6) And again, you shall see it with certainty of sight! (7) Then, on that Day, you shall be asked about the delights (you indulged in, in this world)! (8)
(Al-Takasur-102:1-8 Sahih International)

فَأَمَّآ إِن كَانَ مِنَ ٱلۡمُقَرَّبِينَ (٨٨) فَرَوۡحٞ وَرَيۡحَانٞ وَجَنَّتُ نَعِيمٖ (٨٩) وَأَمَّآ إِن كَانَ مِنۡ أَصۡحَٰبِ ٱلۡيَمِينِ (٩٠)
فَسَلَٰمٞ لَّكَ مِنۡ أَصۡحَٰبِ ٱلۡيَمِينِ (٩١) وَأَمَّآ إِن كَانَ مِنَ ٱلۡمُكَذِّبِينَ ٱلضَّآلِّينَ (٩٢) فَنُزُلٞ مِّنۡ حَمِيمٖ (٩٣)
وَتَصۡلِيَةُ جَحِيمٍ (٩٤) إِنَّ هَٰذَا لَهُوَ حَقُّ ٱلۡيَقِينِ (٩٥) فَسَبِّحۡ بِٱسۡمِ رَبِّكَ ٱلۡعَظِيمِ (٩٦)

Then, if he (the dying person) be of the Muqarrabûn (those brought near to Allâh), (88) (There is for him) rest and provision, and a Garden of Delights (Paradise). (89) And if he (the dying person) be of those on the Right Hand, (90) Then there is safety and peace (from the Punishment of Allâh) for those on the Right Hand. (91) But if he (the dying person) be of the denying (of the Resurrection), the erring (away from the Right Path of Islâmic Monotheism), (92) Then for him is entertainment with boiling water. (93) And burning in Hell-fire. (94) Verily, this! This is an absolute Truth with certainty. (95) So glorify with praises the Name of your Lord, the Most Great. (96)

(Al-Waqia-56:88-96)

وَإِنَّهُۥ لَتَذۡكِرَةٞ لِّلۡمُتَّقِينَ (٤٨) وَإِنَّا لَنَعۡلَمُ أَنَّ مِنكُم مُّكَذِّبِينَ (٤٩) وَإِنَّهُۥ لَحَسۡرَةٌ عَلَى ٱلۡكَٰفِرِينَ (٥٠)
وَإِنَّهُۥ لَحَقُّ ٱلۡيَقِينِ (٥١) فَسَبِّحۡ بِٱسۡمِ رَبِّكَ ٱلۡعَظِيمِ (٥٢)

And verily, this (Qur'ân) is a Reminder for the Muttaqûn (pious - see V.2:2) (48) And verily, We know that there are some among you that belie (this Qur'ân). (Tafsir At-Tabarî) (49) And indeed it (this Qur'ân) will be an anguish for the disbelievers (on the Day of Resurrection). (50) And Verily, it (this Qur'ân) is an absolute truth with certainty (51) So glorify the Name of your Lord, the Most Great. (52)

(Al-Haqqa-69:48-52)

Certain aspects of the ultimate and absolute reality of the things however, have been gradually revealed by our Creator, Allah (*swt*) through His Prophets. In this regard the last Prophet was Muhammad (*pbuh*) and the last revelation was made in the form of the Quran. Consider for example the two realities revealed by Allah (*swt*) in the following verses:

وَجَعَلۡنَا مِنَ ٱلۡمَآءِ كُلَّ شَيۡءٍ حَيٍّۖ أَفَلَا يُؤۡمِنُونَ

And We made from water every living thing. Then will they not believe?

(Al-Anbiya-21:30)

وَمِن كُلِّ شَيۡءٍ خَلَقۡنَا زَوۡجَيۡنِ لَعَلَّكُمۡ تَذَكَّرُونَ (٤٩)

And in all things We have created pairs, so that you may reflect.

(Adh-Dariyat-51:49)

The scientists have recently confirmed these realities by their scientific experiments. However the belief in these realities has different level of certainty as follows:

The scientists' faith is only of *Ilmul Yaqeen* while the Allah's revelation is based on *Haq-ul-Yaqeen*. The Prophets faith is though close to *Haqul Yaqeen*, it is not that of *Haq-ul-yaqeen* level of Allah (*swt*). The level of *Haqul-Yaqeen* has been mentioned in the Quran only of few realities while *Haqul-Yaqeen* of vast majority of matters will be granted only in the hereafter as willed by Allah (*swt*).

A statistical scientist would be curious to know whether there is anything in the universe that is absolute and not relative because he knows that the existence of everything in this universe is based upon probability.

The probability theory in general deals with the chance of occurrence of random events or phenomena. For example if a person tosses a coin then the occurrence of its head up will exhibit a certain pattern that can be studied and predicted. The study can predict only a probability of occurrence of certain event but it cannot determine certainty. The discoveries of the twentieth century physics such as quantum mechanics and behavior of atomic and subatomic particles is all of probabilistic nature.Statistics is more concerned with how we handle available and acquired data using different analytical techniques and collection methods. Statistical analysis of ten uses probability distributions, and the two topics are often studied together.

وَجَعَلۡنَا مِنَ ٱلۡمَآءِ كُلَّ شَيۡءٍ حَيٍّۚ أَفَلَا يُؤۡمِنُونَ

And We made from water every living thing. Then will they not believe?
(Al-Anbiya-21:30)

وَمِن كُلِّ شَيۡءٍ خَلَقۡنَا زَوۡجَيۡنِ لَعَلَّكُمۡ تَذَكَّرُونَ (٤٩)

And in all things We have created pairs, so that you may reflect.
(Adh-Dariyat-51:49)

The laws expressed in these verses are the ultimate realities without any error or exception. These realities also speak about the truth expressed in the Quran and that is why Allah (*swt*) declared in the very beginning of the Quran that this book provides the information in which there is no room for doubt.

CONCLUSIONS

Based upon the Quranic verses and the thoughts of Allama Iqbal the following conclusions may be derived regarding Probability and Certainty:

1. Allah (*swt*) is absolutely the only Creator of this universe. No possibility of emerging any other Creator ever.
2. Allah (*swt*) is the Absolute Scientist.
3. Certainty (ٱلۡيَقِينِ) is of three levels, '*Ilmul-Yaqeen*' (عِلۡمَ ٱلۡيَقِينِ), '*Ainul-Yaqeen*' (عَيۡنَ ٱلۡيَقِينِ) and '*Haqul-Yaqeen*' (حَقُّ ٱلۡيَقِينِ). The certainty of '*Haqul-Yaqeen*' is the Absolute Reality.
4. Quran is absolutely a unique book. Statistically there is absolutely no possibility of a book like that to be written.
5. The scientific realities of physical and metaphysical nature expressed in the Quran are absolute. These realities will never change. Period.
6. Everything is moving, in the universe absolutely no stationary entity.

7. The sun will never rise from west and set in the east because the rotation of the planets and stars are absolute.
8. Every created entity will eventually face death, no exception.
9. Every living entity is created out of water. Without water absolutely no possibility of any living entity.
10. Everything has been created in pair. Absolutely no exception.
11. Every created entity has an ego (Material-'*Nafs*'). Human beings have been additionally granted a special '*Roohani Nafs*' or '*Khudi*' the term used by Allama Iqbal.

The Quran deals not only with material realities but also with spiritual realities that are also absolute in their nature. Allah (*swt*) says that His established methods are never changed.

When mercy is included in any other good deed, it increases the effect of that deed several fold. For example when mercy is included in the act of justice, it raises the level of justice to the level of '*Ihsan*'. Similarly when mercy is included in love it raises the level of love to the level of 'compassion'. We can describe this effect of mercy in the form of following equations:

Justice + Mercy = Ihsan
Love + Mercy = Compassion

Scientists are working on probabilities. Prophets took the people from probabilities towards certainties. Good Sufis are doing the follow up work of the Prophets (*pbuh*). Allah (*swt*) seems to have His own plans to bring the people towards certainties (We will ultimate show the people in the universe and in their bodies and they will be convinced of the signs of Allah).

CONCLUSION

The Statistical Science works like a good Sufi, It narrows the bridge between Probability and Certainty.

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IMPACT OF SOCIO-ECONOMIC AND DEMOGRAPHIC VARIABLES ON FERTILITY PATTERN OF PAKISTAN

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ABSTRACT

Population and its change always remained the attractive areas for the researchers, especially for the demographers. The philosophy is that all research projects are planned directly or indirectly only for the better management of the living organisms, particularly for the human beings. That is why; the current study was conducted to investigate the effect of socio-economic and demographic variables on the general fertility in terms of total number of children ever born (CEB). To execute this idea, the secondary data have been taken from Pakistan Demographic and Health Survey 2006-07 (NIPS, 2008). Keeping in view the objectives of the study, the Poisson regression and logistic regression models were fitted. There were total eight study variables which are used in Poisson as well as in logistic regression analysis. Poisson regression analysis demonstrated the significance of six variables i.e. age at marriage, women education, marriage duration, use of contraceptive, wealth index and province of residence Whereas, the place of residence and work status of women were found to be insignificant. The results also revealed the negative relation between total number of children ever born and age at marriage, women education and wealth index. On the other hand, the Binomial logistic regression had also been used to study the impact of all these variables on the family size with respect to the grouping of number of children. The age at marriage, marriage duration; women education and use of contraceptive were found to have significant impact on family size. It has also been observed a negative relation between the odds ratio and the age at marriage and education of the respondents. The Nagelkerke' value was used to test the goodness of the fitted model. The fitted parsimonious logistic regression model correctly classified the 75.9% cases of small family and 87.8% cases of large family respectively. The overall correct prediction percentage was calculated to be 83.3%.

KEYWORDS

Fertility, Women education, Age at marriage, Contraceptive, wealth index

I. INTRODUCTION

The population may be defined as the number of inhabitants in a well-defined area (Agarwal, 2007). Now-a-days, the drastic increase in population has become a severe problem all over the world and particularly in developing countries like Pakistan, India and Bangladesh etc. Pakistan, even more than six decades of its creation is facing with the problem of drastic increase of human beings. At the time of independence during 1947, Pakistan was the 13th most populous country in the world with a population of 32.5 million whereas it was ranked seventh populous country with a population of 140 million in 1996. But today, Pakistan is the 6th most populous country in the world with a population of more than 180 million along with the total fertility rate 3.3 and population growth rate 2.0. It is expected that in 2020, the Pakistan's population will touch up to 210 million. Actually, it is an indication towards an alarming situation regarding an extra ordinary burden over its limited resources (Elahi, 2012).

Population and its composition always remained attractive areas for the researchers, especially for the researchers involve in vital Statistics. Similarly, the issues related to population like fertility, mortality, education and social status etc. are also of great concern for the Statisticians as well population growth. The study of population growth without these variables is not only difficult but impossible and particularly the fertility rates. The average number of children born per woman during her childbearing period is usually calculated by total fertility rate (TFR). Total fertility rates are closely tied to growth rates for countries and may be considered an excellent indicator of future population pattern of a country (Getis and Fellmann, 2004). Basically, fertility analysis provides important information about the women's attitude and reproductive behavior. In other words, it gives comprehensive information about the population densities and its social status. Government of any territory usually considers the finding of such studies in developing the future five years planning and population polices.

It is fact, that since 1960, all the provincial and capital Governments of Pakistan during their tenures tried to limit population growth in the country and launched Population Welfare Programs with a limited resources, but their efforts could not so successful as much as desired (Sathar and Casterline, 1998). Although the current Government of Pakistan has severe problem in energy sector i.e. gas, electricity etc. and much more resources are being utilized in energy and traffic sector. At the same time, the Government is also trying to launch and regulate various health programs including birth control programs e.g. contraception, pills, sterilization, etc. The problem is that the greater percentage of illiterate population is not convinced in reducing the family size or population. So there is need to educate the rural illiterate communities about family planning in real sense. The implementation of these programs requires detailed information about those factors which influence the fertility behavior directly or indirectly.

The socio-economic, demographic and culture factors have diverse nature effect on fertility in different territories. The identification of these fertility effecting factors are not very important only research point of view but also for countries developments. The impact of social, cultural, demographical and attitudal factors on individual's fertility should be scientifically studied. The reliable demographic data on many fertility related

factors and covariates are available in Pakistan to model the factors which affect individual's fertility (Hakim, 1994; Kamal and Pervaiz, 2011). The survey data on all proximate determinants of fertility is impossible to collect. Socio-economic and demographic factors are also the indicators of fertility assessment.

Zakria *et al.* (2013) studied the fertility pattern of Pakistan during 1984-2007 by using two parametric models i.e. Hadwiger function as well as Peristera and Kostaki model. The age specific fertility rate (ASFR), TFR, Gross reproduction rates (GRR) are also discussed in this article. Nesa and Islam (2009) also examined the fertility transition of Bangladesh using only four variables i.e., women education, wealth index, place of residence and region of residence. Muhammad *et al*. (1999) investigated the contraceptive behavior of married females. The parsimonious log-linear model was suggested to identify the factors associated with that of the contraceptive behavior. The women education and family income were found to be associated with contraceptive whereas husband education has not strong evidence of associated with contraceptive.

Zakria *et al.* (1999) discussed the association of different socio-economic and demographic variables in fertility pyradym. The most important variable in reducing the population growth was found to be education, particularly the female education. Keeping in view the importance of population issues, in this study, a large set of socio-economic and demographic variables is used to view the fertility pattern of Pakistani women. The main objectives of the present study are to examine the general behavior of women fertility as well as family size with that of the socio-economic and demographic variables. The most suitable techniques i.e. Poisson regression and logistic regression models have been used to achieve the said objectives.

II. MATERIALS AND METHODS

The Pakistan Demographic and Health Survey (PDHS) published by National Institute of Population Studies (NIPS), Islamabad is considered the most reliable resource of population data. For the present study, the data have been taken from PDHS 2006-07 (NIPS, 2008). It consists of total 10,023 ever married women along with many demographic and socio-economic variables. Out of these, only eight variables have been used in the current study. There are so many statistical techniques to analyze the population data. But the most suitable statistical techniques, the Poisson and logistic regression models have been used to model the general fertility and family norms of ever married women of Pakistan. Zhang (2011) illustrated the following mathematical form of Poisson regression model:

$$\mu_i = \exp(a + X_{1i}b_1 + X_{2i}b_2 + \cdots + X_{ki}b_k)$$

where μ_i is the mean of the distribution, a is the constant, b represent deviation from mean of the reference category of each group. The X variables are nonlinearly related to μ.

Similarly, the general mathematical form of logistic regression model can be written as:

$$\log\left(\frac{p}{1-p}\right) = logit(p) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ \ldots\ldots\ldots\ldots\ + \beta_p X_p$$

In Poisson regression analysis, the total number of children ever born (CEB) to a woman is considered as dependent variable. Similarly in logistic regression, the family size (total number of children ever born) is used as dependent variable and categorized into two groups; small family and large family. Small family means up to two children and large family means more than two children. The other seven variables are considered as independent variables which include age at marriage, marriage duration, women education, wealth index, work status, contraceptive use, region and place of residence.

III. RESULTS AND DISCUSSION

Table 1
Summary Statistics of Total Number of Children Ever Born

Total No. of Women	Mean CEB	S.D.	Mode	Median	$X_{(1)}$	$X_{(n)}$
10,023	3.890	2.833	2.000	4.000	0.000	16.000

Table 1 reveals the summary statistics of total number of CEB. There are total 10,023 numbers of women. The minimum number of CEB is zero whereas the maximum number of CEB is 16. The mean and median number of CEB is approximately 4 whereas the most frequent cases have two total numbers of children. The overall dispersion among all cases is 2.883. The categorized summary statistics of all these variables using Poisson regression and logistic regression have been given in Tables 2-3 respectively.

Table 2
Estimates of Poisson Regression Model and Test Statistics

Categorized Variables		Women %	Mean CEB	B	Wald Chi-Square	d.f	P-value	Exp(B)
Intercept		-	-	0.563	1051.430	1	0.000	1.756
Age at Marriage					1834.750	3	0.000	-
< 20		67.40%	4.3	Ref	-	-	-	1.000
20 – 24	(AM_2)	24.80%	3.2	-0.092	50.476	1	0.000	0.912
25 – 29	(AM_3)	6.60%	2.4	-0.240	84.484	1	0.000	0.787
30+	(AM_4)	1.20%	1.8	-0.398	33.824	1	0.000	0.672
Marriage Duration					6077.070	1	0.000	-
<10		38.70%	1.6	Ref	-	-	-	1.000
10+	(D_2)	61.30%	5.4	1.132	6077.070	1	0.000	3.101
Women Education					231.833	3	0.000	-
Illiterate		66.50%	4.4	Ref	-	-	-	1.000
Primary	(WE_2)	13.40%	3.4	-0.111	44.355	1	0.000	0.895
Secondary	(WE_3)	13.40%	2.8	-0.209	120.267	1	0.000	0.811
Higher	(WE_4)	6.60%	2.3	-0.346	148.363	1	0.000	0.708
Wealth Index					26.723	2	0.000	-
Low		39.80%	4.1	Ref	-	-	-	1.000
Medium	(WI_2)	19.40%	4.0	-0.029	4.126	1	0.000	0.927
High	(WI_3)	40.80%	3.6	-0.076	26.656	1	0.040	0.971

Categorized Variables		Women %	Mean CEB	B	Wald Chi-Square	d.f	P-value	Exp(B)
Work Status					0.085	1	0.770	-
Not Working		74.90%	3.8	Ref	-	-	-	1.000
Working	(W)	25.10%	4.3	0.003	0.085	1	0.770	1.003
Contraceptive					363.974	1	0.000	-
Non User		72.90%	3.5	Ref	-	-		1.000
User	(C_U)	27.10%	5.0	0.214	363.974	1	0.000	1.238
Region					16.386	3	0.001	-
Punjab		42.50%	3.8	Ref	-	-	-	1.000
Sindh	(R_S)	27.10%	3.9	0.021	2.712	1	0.100	1.021
KPK	(R_K)	18.60%	4.1	0.052	13.115	1	0.000	1.053
Balochistan	(R_B)	11.80%	3.8	-0.009	0.273	1	0.601	0.991
Place of Residence					1.001	1	0.315	-
Rural		61.80%	4.0	Ref	-	-	-	1.000
Urban	(PR_U)	38.20%	3.8	0.013	1.011	1	0.315	1.013

Ref: Reference Category

The descriptive statistics of eight socio-economic and demographic variables along with the test Statistics of parameter estimates of Poisson regression model are calculated and presented in Table 2. All these variables are of categorical nature having two to four categories. The variables marriage duration, work status, contraceptive use and place of residence variables have two categories each. The age at marriage, women education and region have four categories each, whereas the only wealth index variable is classified into three categories. Approximately 67.4% women got marry before their 20^{th} birthday and having a mean CEB i.e. 4.3. Similarly, there are 24.8%, 6.6% and 1.2% women who got marry during the age 20-24, 25-29 and 30+ having mean CEB 3.2, 2.4 and 1.8 respectively. It indicates a negative relation between the age at marriage and mean CEB. The results also demonstrate the positive relation between the mean CEB and marriage duration.

The overall literacy rate in Pakistan is about 60%, while the female literacy rate is only 48% (Ministry of Finance. 2014). There are total 66.5% illiterate women which indicate the frightening circumstances. The percentage of primary, secondary and higher educated women is only 13.4%, 13.4% and 6.6% respectively. The calculated mean CEB to illiterate, primary, secondary and higher educated women are 4.4, 3.3, 2.8 and 2.3 respectively. It indicates the negative relation between mean CEB and education. It has also been observed a negative relation between the wealth index and mean CEB. On the average, the women belonging to lower income group have more children than the higher income group women. Results also indicate that only one fourth respondents belong to working category. While the remaining seventy five percent respondents play their role in domestic matters of the household. It is very surprising that working females have more mean number of CEB than the housewives. Similar pattern has been observed in contraceptive user group. The mean number of CEB of contraceptive user group is

greater than the non-users. The logic behind it may be that the respondents start contraceptive methods after attaining a desired family size. It indicates that the contraceptive methods are not used to reduce the family size but to stop pregnancies after enquiring desired family size. Approximately 42.5% respondents belong to Punjab, 27.1% to KPK, 19.6% to Sindh and only 11.8% to Balochistan. KPK mean number of CEB is significant and slightly higher than the other three provinces of Pakistan. Around 61.8% women living in rural areas have average 4.0 CEB while the other 38.2% respondents are living in urban areas with average CEB 3.8.

The Poisson regression model was applied to examine the effect of different socio-economic variables on mean number of CEB. The analysis indicates that out of these eight variables, two variables i.e. work status and place of residence have non-significant effect on the fertility pattern of Pakistan. While the other six variables i.e. age at marriage, marriage duration, women education, wealth index, contraceptive, region have significant effect on the fertility pattern of Pakistan. The following Poisson regression model was found to be parsimonious.

$$\mu_i = \exp(0.563 - 0.092AM_2 - 0.240AM_3 - 0.398AM_4 + 1.132MD_2 - 0.111WE_2 - 0.209WE_3 - 0.346WE_4 - 0.029WI_2 - 0.076WI_3 + 0.214C_U + 0.021R_S + 0.052R_K - 0.009R_B)$$

The model indicates the negative and significant relation between age at marriage and mean CEB. The relative rate having more children is 0.912, 0.787 and 0.672 times among women who got marriage at the age 20-24, 25-29 and 30+ years respectively with respect to reference category keeping the effect of other variables constant. These results are consistent with (Hakim, 1994, 1999; Kamal and Pervaiz, 2011; Khraif, 2001; Maitra, 2004; Weerasinghe and Paar, 2002).

Women's marriage duration is highly significant and has a positive association with fertility among women having marriage duration 10+ years. The relative rate having more children considering marriage duration is 3.101 times than the reference category. It is not very surprising about the strong positive relationship between fertility and marriage duration. Similar pattern exhibits in some other polygamy Muslim countries like Bangladesh, UAE, Kingdom of Saudi Arabia etc. The Muslim ecclesiastics motivate the couples to have long run family relations to get more number of children. The results are in agreement with the studies (Atella and Rosati, 2000; Hashmi and Zafar, 1997; Khraif, 2001).

The women's education is highly significant and has negative relation with that of fertility. The relative rate having more children is 0.895, 0.811 and 0.708 times among women having Primary, secondary and higher education respectively as compared to illiterate women. These results are consistent (Akpa and Ikpotokin, 2012; Bbaale and Mpuga, 2011; Hakim, 1994; Hashmi and Zafar, 1997; Kamal and Pervaiz, 2011; Nesa and Islam, 2009).

There is significant negative relationship between wealth index and fertility pattern of women. The relative rate having more children is 0.927 and 0.971 times among the women of low and high income group respectively as compared to poor women. The logic behind is that poor couples believe that our children are our assets and will help us

in difficult days. That's why; child labor among poor families is not considered an unpleasant action. These results are also consistent with that of studies (Akpa and Ikpotokin, 2012; Hakim, 1999; Kamal and Pervaiz, 2011; Nesa and Islam, 2009; Weerasinghe and Paar, 2002).

The relative rate of having more children is 1.238 times in contraceptive users group as compared to non-users. The results reveal that in Pakistan, the contraceptives methods are used only after achieving a desired family size around 3-4 not towards small family size. The religious beliefs also discourage the couples to use contraceptive to reduce the fertility. These results are in agreement with the studies (Adhikari, 2010; Butt and Jamal, 1993; Dwivedi and Rajaram, 2004; Hashmi and Zafar, 1997; Kamal and Pervaiz, 2011; Khraif, 2001).

The relationship between region of residence and fertility is significant for KPK but insignificant for Sindh and Balochistan as compared to Punjab. The results reveal that KPK's women are more likely to have more number of children than Sindhi, Punjabi and Balochi women. The results are in agreement with that of the study (Hakim, 1994).

The Governments should not only try to limit the population by reducing the growth rate, it should also promote the idea of small family norms up to two children. It is a fact that a large family size has a heavy pressure on the limited available resources and affects the quality of life. Keeping in mind the importance of small family norms, the researcher was motivated to identify the factors affecting the fertility. Consequently to achieve the objectives of the study, the response variable has to be divided into two groups i.e. small family (CEB≤2) and the large family size (CEB>2).

Table 3:
Parameter Estimates of Logistic Model and Test Statistics

Categorized Variables		Percentage of Women		B	Wald Chi-Square	d.f	P-value	Exp(B)
		Small Family Size (≤2)	Large Family Size (>2)					
Intercept		-	-	-1.092	207.506	1	0.000	0.336
Age at Marriage					58.064	3	0.000	-
<20		21.00%	46.40%	Ref	-	-	-	1.000
20 – 24	(AM_2)	11.60%	13.30%	-0.282	17.599	1	0.000	0.755
25 – 29	(AM_3)	3.80%	2.80%	-0.587	26.566	1	0.000	0.556
30+	(AM_4)	0.90%	0.30%	-1.372	26.053	1	0.000	0.254
Marriage Duration					2742.230	1	0.000	-
<10		29.70%	9.00%	Ref	-	-	-	1.000
10+	(D_2)	7.50%	53.80%	3.020	2742.230	1	0.000	20.488
Women Education					52.690	3	0.000	-
Illiterate		21.10%	45.40%	Ref	-	-	-	1.000
Primary	(WE_2)	5.60%	7.80%	-0.284	10.493	1	0.000	0.753
Secondary	(WE_3)	6.70%	6.70%	-0.484	26.425	1	0.000	0.616
Higher	(WE_4)	3.80%	2.80%	-0.811	40.294	1	0.000	0.444

Categorized Variables		Percentage of Women		B	Wald Chi-Square	d.f	P-value	Exp(B)
		Small Family Size (≤2)	Large Family Size (>2)					
Wealth Index					2.285	2	0.319	-
Low		14.70%	25.20%	Ref	-	-	-	1.000
Medium	(WI_2)	6.60%	12.80%	0.055	0.451	1	0.502	1.056
High	(WI_3)	15.90%	24.90%	-0.078	0.844	1	0.358	0.925
Work Status					0.925	1	0.336	-
Not Working		29.10%	45.90%	Ref	-	-	-	1.000
Working	(W)	8.20%	16.90%	-0.066	0.925	1	0.336	0.936
Contraceptive					368.464	1	0.000	-
Non User		32.60%	40.20%	Ref	-	-	-	1.000
User	(C_U)	4.60%	22.60%	1.438	368.464	1	0.000	4.213
Region					5.733	3	0.125	-
Punjab		15.50%	27.00%	Ref	-	-	-	1.000
Sindh	(R_S)	10.30%	16.80%	-0.038	0.289	1	0.591	0.962
KPK	(R_K)	6.60%	11.90%	0.041	0.259	1	0.610	1.042
Balochistan	(R_B)	4.70%	7.10%	-0.196	4.350	1	0.037	0.822
Place of Residence					0.225	1	0.635	-
Rural		23.10%	38.70%	Ref	-	-	-	1.000
Urban	(PR_U)	14.10%	24.10%	0.033	0.225	1	0.635	1.034

Ref: Reference Category

The descriptive statistics of eight socio-economic and demographic variables and test statistics of parameters of logistic regression model are given in Table 3. All these variables are exactly same as that of acronyms and categorization given in Table 2. There is a negative relation between the age at marriage and family size. It implies that with the increase of age at marriage, the family size decreases. The percentage frequency distribution of large family size with respect to age at marriage is 20-24, 25-29 and 30+ years is 46.4%, 13.3%, 2.8% and 0.3% respectively. Approximately 53.8% women who stay marry for 10+ years have large family size whereas the women who stay marry for <10 years have only 9.0%. It indicates the positive relation between family size and marriage duration.

The most important variable concerning to fertility is found to be the number of schooling years of the respondent. The relationship between the large family size and education of the women can be accessed from the following outcomes. The women having no education, primary, secondary and higher education have 45.4%, 7.8%, 6.7% and 2.8% large families respectively. On the other hand with the increase in wealth, the percentage of large families slightly fall from the women belonging to lower income group class to higher income group class i.e. 25.2% to 24.9%. Approximately 45.9% housewives have large family size whereas working women have only 16.9% large families. The outcomes of contraceptive user respondents are very surprising. About 22.6% contraceptive users have large families while only 4.6% have small families. The percentages of women having large family size are 27.0%, 16.8%, 11.9% and 7.1% with respect to their province Punjab, Sindh, KPK and Balochistan respectively. The rural

women have large family size than urban women. The percentage of rural women is 38.7% while the urban women are 24.1%.

The logistic regression model is also used to classify a respondent into a small family or large family based on the socio-economic and demographic variables. Out of these eight variables, four variables i.e. work status, wealth index; region and place of residence have non-significant effect on fertility, whereas the other four variables i.e. age at marriage, marriage duration, women education and contraceptive have significant effects. The parsimonious logistic regression model is found to be as under:

$$logit\left(\frac{p}{1-p}\right) = -1.092 - 0.282AM_2 - 0.587AM_3 - 1.372AM_4 + 3.02MD_2 - 0.284WE_2 - 0.484WE_3 - 0.811WE_4 + 1.438C_U$$

The results indicate the significant and negative relation between age at marriage and family size. The odds ratio having large family increases by a factor 0.755, 0.556 and 0.254 of the respondents who got marry at the age 20-24, 25-29 and 30+ years respectively with respect to the reference category keeping the effect of other variables constant. The results are consistent with the studies (Hasan and Sabiruzzaman, 2008; Rahman *et al.*, 2008).

The marriage duration of women has significant positive relation with that of the CEB. The odds ratio of large family is increased by a factor 20.488, if the respondent stays marry 10+ years keeping the effect of other variables constant. It implies that as the marriage duration increases, the higher the chances of large family. In addition, the religious and social values of Islam encourage and motivate the couples for a long run relation to have a more number of children consequently the Muslim Ummah. These results are in agreement with the studies (Atella and Rosati, 2000; Hashmi and Zafar, 1997; Khraif, 2001).

The women's education has negative and significant relationship with that of the number of CEB. The findings show that the higher the education, the lower the fertility. It is clear from the results that women with primary, secondary and higher education have less chances of large family as compare to illiterate women. The similar results have been reported in the studies (Hasan and Sabiruzzaman, 2008; Rahman *et al.*, 2008).

The contraceptive has significant and positive relation with that of fertility, particularly in Muslim countries. The odds ratio of contraceptive user women to have large family is 4.213 times than the non-users. Although the results seem very surprising but it points out that contraception methods are used only after receiving a certain number of children/family not to reduce the fertility. It also might be possible, the contraception methods be used for spacing purposes not for stopping pregnancies. In addition, the religious beliefs also do not encourage the couples categorically to use contraception methods. These findings are in agreement with the studies (Butt and Jamal, 1993; Hashmi and Zafar, 1997; Kamal and Pervaiz, 2011).

Table 4
Comparison of Null and Parsimonious Logistic Model

Observed		Predicted (Null)		Predicted (Logistic Model)	
		Family Size		Family Size	
		Small (≤ 2)	Large (>2)	Small (≤ 2)	Large (>2)
Family Size	Small (≤ 2)	0	3729 (37.2 %)	2829 (75.9 %)	900 (24.1 %)
	Large (>2)	0	6294 (100 %)	771 (12.2 %)	5523 (87.8 %)
Overall Correct (%)		62.8 %		83.3 %	

Table 4 reveals that overall 62.8% cases are correctly classified whereas, 37.2% cases are misclassified of the null model. It means the null model does not have any practical significance in identifying the case for classification. On the other hand, in parsimonious logistic regression model, there are total 3729 women having small family size. Out of these, 75.9% cases are correctly classified and 24.1% are not correctly classified. Similarly, there are total 6294 women having large family size. Out of these, 87.8% cases are correctly classified and 12.2% are not correctly classified. The overall percentage of correct prediction is calculated 83.3%. According to Peng *et al*. (2002), a logistic model is said to provide a better fit to the data if it describes an improvement over the null model. Approximately, 20.5% increase in overall percentage of correct prediction reflects the model's strength and good fit.

The Nagelkerke R^2 is used for the goodness of fit of the model. The fitted model was found to be parsimonious with that of the value of R^2 = 53.60%. Islam and Rahman (2010) also used the Nagelkerke R^2 for goodness of fit of logistic regression model and discussed the minimum limit of R^2. The parsimonious logistic regression model was used to classify the respondents in classification table.

IV. CONCLUSIONS

The Poisson regression and logistic regression models were fitted on the eight socio-economic and demographic variables to achieve the objectives of the study. The secondary data have been taken from PDHS 2006-07 (NIPS, 2008). Poisson regression model revealed that age at marriage, marriage duration, women education; wealth index and contraceptive use have significant effect on fertility. The women education, age at marriage and wealth index was inversely related to children ever born. However, contraceptive use and marriage duration were found to be positively related with children ever born. On the other hand, logistic regression model showed that age at marriage, marriage duration; women education and use of contraceptive have significant impact on family size. It has also been observed a negative relation between the odds ratio and the age at marriage and education of the respondents. Also, the family size was found to be positively related with contraceptive use and marriage duration. The fitted parsimonious logistic regression model correctly classified the 75.9% cases of small family and 87.8% cases of large family respectively. The overall correctly classified percentage was found

to be 83.3%. In addition, Nagelkerke R^2 also legalizes the goodness of fit of the logistic model.

The overall conclusion is that the age at marriage and education of women are the most important variables which can play their vital role in determining the desired fertility. In other words, by increasing the women education, the age at marriage will automatically be increase as well as the awareness of the contraceptive etc. Keeping in view the finding of the studies, The Government of Pakistan should revise the women education policies in the scenario e.g. security and safety, motivation, subsidies fee structure as well as job opportunities etc. In addition, counseling should also provide to women regarding the availability and use of contraceptives. It will not only helpful to limit the family size, it will also helpful for healthy and prosperous family life.

REFERENCES

1. Adhikari, R. (2010). Demographic, socio-economic, and cultural factors affecting fertility differentials in Nepal. *BMC Pregnancy and Childbirth*, 10(19), 1-11.
2. Agarwal, B.L. (2007). *Basic Statistics* (4th ed.). New Delhi: New Age International.
3. Agresti, A. (1996). *An introduction to categorical data analysis* (2nd ed.). New York: John Wiley and Sons, Inc.
4. Akpa, O.M. and Ikpotokin, O. (2012). Modeling the Determinants of Fertility among Women of Childbearing Age in Nigeria: Analysis Using Generalized Linear Modeling Approach. *International Journal of Humanities and Social Science*, 2(18), 106-107.
5. Atella, V. and Rosati, F.C. (2000). Uncertainty about children's survival and fertility: A test using indian microdata. *Journal of Population Economics*, 13(2), 263-278.
6. Bbaale, E. and Mpuga, P. (2011). Female Education, Contraceptive Use, and Fertility: Evidence from Uganda. *The Journal of Sustainable Development*, 6(1), 20-47.
7. Butt, M.S. and Jamal, H. (1993). Determinants of marital fertility in Pakistan: An application of the synthesis framework. *The Pakistan Development Review*, 32(2), 199-220.
8. Dwivedi, S.N. and Rajaram, S. (2004). Some Factors Associated with Number of Children Ever Born in Uttar Pradesh:A Comparative Results under Multiple Regression Analysis and Multilevel Analysis. *Indian Journal of Community Medicine*, 29(2), 72-76.
9. Elahi, M.F. (2012). Pakistan Observer. Retrieved from http://pakobserver.net/detailnews.asp?id=148610
10. Getis, J. and Fellmann, J.D. (2004). *Introduction to Geography* (9th ed.). Boston: McGraw-Hill Higher Education.
11. Hakim, A. (1994). Factors Affecting Fertility in Pakistan. *The Pakistan Development Review*, 33(4), 685-709.
12. Hakim, A. (1999). Demographic, Socio-economic, and Regional Fertility Differentials in Pakistan. *The Pakistan Development Review*, 38(4), 643-660.
13. Hasan, M. and Sabiruzzaman. (2008). Factors affecting fertility behavior in Bangladesh: A probabilistic approach. *Research Journal of Applied Sciences*, 3(1), 70-76.
14. Hashmi, N. and Zafar, I.M. (1997). Determinants of marital fertility in Pakistan. *Pak. J. Agri. Sci.*, 34(1-4), 58-61.

15. Islam, M.R. and Rahman, M.M. (2010). Desire for a Child in Rural Area of Bangladesh:A Logistic Regression Analysis. *Journal of Sciences*, 38, 75-86.
16. Kamal, A. and Pervaiz, M.K. (2011). Factors Affecting the Family Size in Pakistan: Clog-log Regression Model Analysis. *Journal of Statistics*, 18(1), 29-53.
17. Khraif, R.M. (2001). Fertility in Saudi Arabia: levels and determinants. *XXIV General Population Conference*, (1-23). Salvador - Brazil.
18. Maitra, P. (2004). Effect of Socioeconomic Characteristics on Age at Marriage and Total Fertility in Nepal. *Journal of Health, Population and Nutrition*, 22(1), 84-96.
19. Ministry of Finance (2014). *Pakistan Economic Survey 2013-14.* (2014). Retrieved November 2, 2014, from http://www.finance.gov.pk/survey/chapters_14/10_Education.pdf
20. Muhammad, F., Zakria, M. and Pasha, G.R. (1999). Factors Affecting The Contraceptive Behaviour of Married Females. *Journal of Research*, 10(1-2), 57-61.
21. National Institute of Population Studies. (2008). *Pakistan Demographic and Health Survey 2006-07*. Macro International Inc. Calverton, Maryland, USA.
22. Nesa, M.K. and Islam, S. (2009). Fertility Transition in Bangladesh: The Role of Education. *Pakistan Academy of Sciences*, 46(4), 195-201.
23. Peng, C.-Y.J., Lee, K.L. and Ingersoll, G.M. (2002). An Introduction to Logistic Regression Analysis and Reporting. *The Journal of Educational Research*, 96(1), 1-13.
24. Rahman, M., Ahmad, T. and Hoque, A. (2008). Factors affecting children ever born in slum areas of Rajshahi city corporation, Bangladesh. *Middle East Journal of Nursing*, 2(4), 5-10.
25. Sathar, Z.A. and Casterline, J.B. (1998). The Onset of Fertility Transition in Pakistan. *Population and Development Review*, 24(4), 773-796.
26. Weerasinghe, D.P. and Paar, N.J. (2002). Effect of Wealthon Marital Fertility in Sri Lanka. *Journal of Health, Population and Nutrition, 20*(2), 112-119.
27. Zakria, M., Yaseen, M., Muhammad, F. and Mahmood, S. (2013). Modelling Fertility Patterns of Pakistan During 1984-2007. *Pak. J. Statist.*, 29(4), 479-486.
28. Zakria, M., Muhammad, F., Iqbal, M.Z. and Asif, F. (1999). Modelling The Contraceptive Behaviour of Married Females. *Pak. J. Agri. Sciience*, 36(2-3), 149-153.
29. Zhang, L. (2011). *Male Fertility Patterns and Determinants.* Springer.

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PERCEPTIONS OF SECONDARY SCHOOL STUDENTS ABOUT MATHEMATICS TEACHERS' INSTRUCTIONAL PRACTICES TO ENDORSE ACHIEVEMENT GOAL ORIENTATIONS

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ABSTRACT

Major purpose of this survey study was to identify the secondary school students' perceptions about instructional practices of their mathematics' teachers in the context of TARGET model. TARGET model presents patterns of six instructional practices (i.e. Task, Authority, Recognition, grouping, Evaluation, and Time) in classroom to endorse mastery or performance goals orientation in student. Population of the study was secondary school students in the province of Punjab. Multi stage random sampling technique was used for the selection of sample. An adapted questionnaire "Achievement Goal Orientations and Perceptions about Teachers' Instructional Practices Questionnaire (AGOPTIPQ)" from "Patterns of Adaptive Learning" Midgley et al., (2000) was used for to elicit students' responses. A pilot study was conducted to validate the instrument. Reliability index (Cronbach Alpha) was .76. Descriptive statistic was used to identify the students' achievement goal orientations and their perceptions about instructional practices of mathematics teachers. Pearson correlation coefficients were calculated to identify the relationship among students' perceptions about teachers' instructional practices and students' achievement goal orientations. It was found that teachers emphasized students' relative performance on the tasks, they also put more emphasis on marks rather than effort. It was also evident that mathematics teachers asked frequent questions and they also adapt their teaching method according to students need but element of relevance (of the topic with students' practical life) was week. It was found that students have greater performance-approach goal orientation mean score than mastery goal orientation. Results also showed that, students' perceptions about their mathematic teachers' instructional practices and their achievement goal orientations were statistically significantly correlated. Recommendations were made in the light of major findings.

KEY WORDS

Achievement goal orientation, instructional practices, mathematics teachers, Target model, patterns of instructional practices.

INTRODUCTION

There is long history of research to know about the environments for its effectiveness to endorse motivation among individuals (Brophy 2008). Achievement goal orientation is a general theory of motivation. Ames (1992 a) described achievement goals as integrated patterns of thoughts, perception and pressures that lead the intentions for some behaviors. These goals are represented by the methods of perusing, engaging in and reacting to the achievement tasks. Initially theorists Dweck and Leggett (1988); and Meece (1991) proposed achievement goal orientation framework that presented two types of achievement goals a mastery goal orientation and performance goal orientations.

The mastery goal orientation MGO includes one's will to enhance knowledge, gain understanding and skills. Persons with MGO valued learning. As compare to this a performance-approach goal orientation PAGO includes the intention to outperform as compare to others (Elliot and Church, 1997). Conroy, Elliot and Hofer (2003) have further differentiated between performance-approach (PAGO) and performance-avoidance goal orientation (PAVGO). Students have PAGO focus on outperforming others and try to look competent as compare to others. Students with PAVGO avoid looking incompetent or inferior to other students. Motivational theorists also hypothesized goal orientations differentiable into four types, by distinguishing both mastery and performance goal orientations in approach and avoidance direction (Pintrich, 1999, 2000a, 2000b; Elliot and McGregor, 2001).

Students having mastery-avoidance goal orientation (MAVGO) try to avoid failure from an intra-personal context. They want to perform as much as they absolutely need, and put modest effort to do their work. They are well aware of their passing criterion and somehow try to manage to meet that minimum level of passing grade (Meece, Blumenfeld, and Hoyle, 1988).

Theorists working in the domain of achievement goal orientation have given attention on the dimensions of TARGET model, presented by Anderman et al., (2002) and Turner et al., (2002). It presented the key pattern of instructional practices within classroom. Abbreviation represents six core environmental factors that cause the endorsement of different achievement goal orientations. These include Task, Authority, Recognition, Grouping, Evaluation and Time.

Task factor describe the nature of the task being taught and the extent to which it has importance and relevance with learners' life. Authority describes the extent to which learners have freedom within classroom by the instructor. Recognition factor discusses the instructional practices within classroom for recognizing and admiring learners' progress. Grouping describes the learners' cooperative activities. Evaluation highlights the principles, procedures, and focus of attention towards learners' assessment and progress. Time explains the flexibility of pace of instruction and activities.

While developing this model, researchers found that the instructional practices in classrooms where students adopt MGO and had low PAGO as compare to MGO, were different from those classrooms in which students' adopt PAGO and have low MGO (Pantziara and Philippou, 2007).

Urdan 2010 argued that different researchers have studied the effect of presence and absence of these environmental factors for preventing or endorsing specific goals, goal orientations and other related outcomes. Many researchers have investigated the effect of goal structure on learners' educational outcomes (Gutman 2006; Karabenick 2004; Ryan, Gheen and Midgley. 1998; Urdan, Midgley and Anderman 1998; Ames and Archer 1988). There are also a number of researches which investigated effect of educational environment to shape students goals and their goal orientations. For example Church (2001) investigated how students' perceptions about the classroom environment effect their goal endorsement. In classroom where students had thought that lectures were interactive and harsh evaluation was avoided, students had tended to endorse mastery goal orientation. As compare to this, in which classrooms evaluation was focused on comparison, students had adopted performance-approach goal orientation. Students endorsed performance-avoidance goal orientation when they perceive that evaluation was harsh.

Research has also proven that students' perceptions about classroom goal structure and endorsement of goal orientations by their teachers and parents, effected goal orientations endorsement of individuals (Ciani, Middleton, Summer and Sheldon 2010; Friedel, Cortina, Turner and Midgley 2007; Kaplan and Maehr 1999; Midgley and Urdan 2001; Murayama and Elliot 2009; Urdan 2004; Wolters 2004).

Working in the domain of classroom goal structure, Patrick et al. (2001) and Urdan (2004) have further explored that variations in classroom structures can be identified by students and observers. On the whole, it may be concluded that it is apparent by the empirical evidences that endorsement of personal goals is strongly related to perceived structures of classroom goals. Urdan (2010) argued that mastery goal classroom structures are more useful for achievement and achievement related thought and behaviors than performance-goal classroom structures.

In this study approach and avoidance both dissection were incorporated for the study. All four goal orientations were considered as: a MGO (considered as enhancing knowledge or acquiring new skills), a PAGO (tendency to demonstrate competence), a PAVGO (aimed at avoiding to demonstrate incompetence), and MAVGO (desire to work as much as absolutely needed).

It revealed the tendencies of personal goal endorsements among students and its relevance with instructional practices of their mathematic teachers in the context of TARGET model. It may help to provide ground for students' low performance in the subject of mathematics.

OBJECTIVES OF THE STUDY

Keeping in view the importance of classroom instructional environment for the endorsement of achievement goal orientation the present study was aimed to:

- Identify the achievement goal orientations of secondary school students in Punjab.
- Identify the instructional practices of mathematics teachers in the light of perceptions of secondary school students.
- Identify the relationship among instructional practices of mathematics teachers and achievement goal orientations of students.

METHODOLOGY

This was a survey research. Following procedures were followed to conduct the study:

Population

The population of the study was consisted of all the secondary school students enrolled in public schools of Punjab province.

Sample

Nine districts (Chakwal, Narowal, Kasure, Okara, Chiniot, Bakhar, Jhung, Bahawalnagar) were selected randomly from the list of 36 districts of Punjab. From each district four government high schools (two boys, two girls') were selected. Subjects of the study were selected randomly from the students enrolled in class IX of these schools. 25 subjects were selected from each school. In this way 100 subjects were selected from each district.

Table 1
Table of Sample Descriptive

Variables	Description	Details	Total
Subjects	Male Female	428 446	874
Age	Range	13-18	
Schools	Male Female	18 18	36

Table 1 showed that there were 428 male and 446 female students in sample of the study. Age ranged from 13 to 18 years. Data were collected from 18 male and 18 female public schools.

Instrument

An adopted questionnaire "Patterns of Adaptive Learning Scales (PALS)″ developed by Midgly et al. (2002) was used to identify the students' achievement goal orientations. The reliability index of the scale was 0.94. To know the students' perceptions about instructional practices of mathematic teachers regarding six environmental factors addressed in TARGET model, a self developed questionnaire was used. There were 37 statements in the questionnaire. There were six sub sections of the questionnaire, one for each factor of TARGET model. Instrument is being presented in tabular form.

Table 2
Descriptive Table of the Questionnaire

Factor	Sub-Factors	Items	Number of Items	Total Items
Task	Relevance	13, 15	2	8
	Questioning	38, 24	2	
	Teaching method	10, 37, 60	4	
Autonomy	Generating rules	58, 25	2	7
	Willingness	57, 59	2	
Recognition	Appreciation	2, 26, 29	3	5
	Encouragement	19, 22	2	
Grouping	Grouping	2, 3, 30	3	3
Evaluation	Relative performance	56, 3	2	10
	Individual performance	39, 47, 55	3	
	Marks	48, 18	2	
	Efforts/ improvement	8, 26, 54	3	
Time	Time	44, 4, 53, 11	4	4

Questionnaire was validated through pilot study. Reliability index Cronbach alpha was 0.760.

DATA COLLECTION AND ANALYSIS

Data was collected by the researchers and a team of five volunteer students. After random selection of the districts, students from the relevant areas were identified who were studying in University of Education. After gaining their consent they were trained to collect the data. To avoid the error in data collection, same written instructions were given to all students. Data was analyzed through SPSS. Mean scores and standard deviations were calculated to identify students' achievement goal orientations and instructional practices of teachers regarding six factors of TARGET model. Pearson correlation co-efficient were calculated to identify the relationship among students' perceptions about their mathematic teachers' instructional practices and their achievement goal orientations.

RESULTS

Following are the results of the study.

Table 2
Achievement goal orientations of secondary school students

Variable	Mean	Standard Deviation
Mastery-approach goal orientation	2.83	0.81
Performance-approach goal orientation	3.00	0.78
Performance-avoidance goal orientation	2.74	0.69
Mastery-avoidance goal orientation	2.16	0.89

Table 2 showed mean scores of different types of achievement goal orientations secondary school students have adopted. It showed that students have multiple orientations at the same time. It is evident that students have strong performance-approach goal orientation, than they have mastery-approach goal orientation. Mean score of performance-avoidance goal orientation is less than performance-approach orientation and they have mean score for mastery-avoidance goal orientation weaker than all the orientations.

Table 3
Instructional Practices of Mathematic Teachers Related to Task, Autonomy and Recognition

Variables	Factors	Mean	Standard Deviation
Task	Relevance	1.16	0.89
	Questioning	2.08	1.39
	Teaching Method	2.78	0.65
Autonomy	Generating Rules	2.23	1.3
	Willingness	2.49	0.88
Recognition	Appreciation	2.82	0.65
	Encouragement	2.97	0.91

Table 3 showed the mean score of students' responses regarding instructional practices of their mathematic teachers. It is evident that mean score for the factor relevance of the mathematic concepts with their daily life and its use is low (M = 1.16, SD = 0.89). Mean score for the factor "questioning" is (M = 2.08, SD = 0.39). mean score for the factor of teaching method is (M = 2.78, SD = 0.65).

Table 4
Instructional Practices of Mathematic Teachers Related to Grouping, Evaluation and Time

Variables	Factors	Mean	Standard Deviation
Grouping	Grouping	2.05	1.05
Evaluation	Relative Performance	2.35	0.59
	Individual Performance	1.07	1.13
	Marks	2.90	0.67
	Efforts	1.97	0.70
Time	Time	2.74	0.70

Table 4 showed mean scores of students' responses for instructional practices of their mathematics teachers related to Grouping, Evaluation and time factor. Mean score for grouping is (M = 2.05, SD = 1.05), mean score for the factor of teaching method is (M = 2.78, SD = 0.65), regarding evaluation factor, mean score of teachers' instructional practices focusing on relative performance of students is (M = 2.35. SD = 0.59), mean score for individual performance is (M = 1.07, SD = 1.13). table also showed that mean score for teachers' focus on marks is (M = 2.90, SD = 0.67) greater than mean score for their efforts (M = 1.97, SD = 0.07)

Table 5
Correlation Matrix for Achievement Goal Orientations and Instructional Practices of Mathematic Teachers

Variables	PAGO	MAGO	PAVGO	MAVGO	Instructional Practices
PAGO	1	.357**	.178**	-.210**	.478**
MAGO	.357**	1	.303**	-.051	.546**
PAVGO	.178**	.303**	1	.093**	.434**
MAVGO	-.210**	-.051	.093**	1	.208**
Instructional practices	.478**	.546**	.434**	.208**	1

Table 5 showed the correlation of different achievement goal orientations and instructional practices of their mathematic teachers. It is evident that PAGO was statistically significantly correlated with mathematic teachers' instructional practices on positive side (r = .478). Table also revealed that MAGO was also strongly correlated (r = .546) with instructional practices. It can be observed that PAGO, MAGO and PAVGO were statistically significantly positively correlated. Correlation coefficient for PAVGO and MAVGO was also statistically significant with (r = .434) and (r = .208) respectively. It is evident that MAVGO was significantly negatively correlated with PAGO (r = -.210) and have r = -.051 correlation with MAGO which was not statistically significant.

DISCUSSION

Results showed that students at secondary level had strong performance-approach goal orientation than mastery goal orientation. Results also revealed that there were positive relationship among teachers' instructional practices and students' achievement goal orientations. It showed that teachers' instructional practices strongly effect the endorsement of achievement goal orientations. This is consistent with the findings of other researches in which it was found that learners' perceptions about classroom and school environment shape their endorsement of achievement goal orientations (Ciani et al. 2010; Friedel et al. 2007; Kaplan and o 1999; Midgley and Urdan 2001; Murayama and Elliot 2009; Roeser et al. 1996; Urdan 2004; Wolters 2004).

Another major finding is the achievement goal orientations of students. Higher performance-approach goal orientation showed that students wanted to get higher achievement scores anyways. Low mastery goal orientation mean score showed that the urge to get higher score was dominating their desire for learning. This may be a strong reason of students' weaker performance in mathematics in secondary school exams in Punjab. As many researchers found the strong effect of achievement goal orientations on

students' academic outcomes (Ames and Archer 1988; Gutman 2006; Karabenick 2004; Ryan et al. 1998; Urdan et al. 1998).

Regarding mathematic teachers' instructional practices related to six environmental factors, analysis revealed important findings. Results showed that among sub-factors of Task, mathematic teachers' instructional practices to make relevance of the task with students' practical life were weaker. It is evident that teachers' practices of asking questions are better and greater SD. showed that some teachers asked much questions while some asked very few. Higher mean score for teaching method showed that teachers used to adapt their teaching method according to the nature of the topic and students level of understanding. Students perceptions about teachers' practices related to classroom rules showed that teachers moderately involve the students to generate rules within their classrooms. Higher standard deviation depicts that some teachers involved students for class rules while some impose their rules on them. Teachers also cared for students' willingness for class work, home work and class tests. Teachers highly appreciate students for their performance and strongly encourage them.

Mean score for grouping factor showed that teachers moderately follow the pattern of grouping students, for cooperative learning, on the basis of their interests and friendships. Evaluation practices showed that teachers strongly put focus on students' marks and advise them to get higher marks. Teachers also appreciate students' efforts on the average. Instructional practices regarding time factor showed that teaches had given flexibility in time to complete the tasks and activities within classroom.

RECOMMENDATIONS

In the light of above findings following recommendations were made:

- Teachers must develop relevance of mathematic topics with daily life, in order to develop interest among students.
- Teachers must focus on students' individual performance rather than relative performance.
- Teachers should focus on students' efforts by comparing their current performance with their previous performance.
- Teachers should consider students mistakes as part of learning process and must focus on their efforts.

REFERENCES

1. Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology*, 84, 261-271.
2. Ames, C. (1992a). Achievement goals and the classroom motivational climate. In D.H. Schunk and J.L. Meece (Eds.), *Student perceptions in the classroom* (pp. 327-348). Hillsdale: Lawrence Erlbaum Associates.
3. Ames, C. (1992b). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology*, 84(3), 261-271.
4. Ames, C., and Archer, J. (1988). Achievement goals in the classroom: Students' learning strategies and motivation processes. *Journal of Educational Psychology*, 80(3), 260-267.

5. Ames, C. and Archer, J. (1988). Achievement goals in the classroom: Students' learning strategies and motivation processes. Journal of Educational Psychology, 80(3), 260-267.
6. Anderman, L., Patrick, H., Hruda L. and Linnenbrink, E. (2002). Observing Classroom Goal structures to Clarify and Expand Goal Theory. In C. Midgley (Ed.), *Goals, Goal Structures, and Patterns of Adaptive Learning* (pp 243-278). Mahwah: Lawrence Erlbaum Associates.
7. Brophy, J. (2008). Developing Students' Appreciation for What Is Taught in School. *Educational Psychologist*, 43(3), 132 141.
8. Church, M.A., Elliot, A.J. and Gable, S.L. (2001). Perceptions of classroom environment, achievement goals, and achievement outcomes. *Journal of Educational Psychology*, 93(1), 43-54.
9. Ciani, K.D., Middleton, M.J., Summers, J.J. and Sheldon, K.M. (2010). Buffering against performance classroom goal structures: The importance of autonomy support and classroom community. *Contemporary Educational Psychology*, 35, 88-99.
10. Conroy, D.E., Elliot, A. and Hofer, S.M. (2003). A 2×2 achievement goals questionnaire for sport: Evidence for factorial invariance, temporal stability, and external validity. *Journal of Sport and Exercise Psychology*, 25, 456-47.
11. Dweck, C.S. and Leggett, E.L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review*, 95(2), 256-273.
12. Elliot, A.J, and McGregor, H. (2001). A 2×2 achievement goal framework. *Journal of Personality and Social Psychology, 80*, 301-51.
13. Friedel, J.M., Cortina, K.S., Turner, J.C. and Midgley, C. (2007). Achievement goals, efficacy beliefs and coping strategies in mathematics: The role of perceived parent and teacher goal emphases. *Contemporary Educational Psychology*, 32, 48-73.
14. Gutman, L.M. (2006). How student and parent goal orientations and classroom goal structures influence the math achievement of African Americans during the high school transition. *Contemporary Educational Psychology*, 31(1), 44-63.
15. Kaplan, A. and Maehr, M.L. (1999). Achievement goals and student well-being. *Contemporary Educational Psychology*, 24(4), 330-358.
16. Karabenick, S.A. (2004). Perceived achievement goal structure and college student help seeking. *Journal of Educational Psychology*, 96, 569-581.
17. Meece, J.L. (1991). The classroom context and students' motivational goals. In M.L. Maehr and P.R. Pintrich (Eds.), *Advances in motivation and achievement* (Vol. 7). Greenwich, CT: JAI Press.
18. Meece, J.L., Blumenfeld, P. and Hoyle, R. (1988). Students' goal orientations and cognitive engagement in classroom activities. *Journal of Educational Psychology*, 80, 514-523.
19. Midgley, C., and Urdan, T. (2001). Academic self-handicapping and achievement goals: A further examination. *Contemporary Educational Psychology*, 26(1), 61-75.
20. Murayama, K. and Elliot, A.J. (2009). The joint influence of personal achievement goals and classroom goal structures on achievement- relevant outcomes. *Journal of Educational Psychology*, 101(2), 432-447.
21. Murayama, K., and Elliot, A.J. (2009). The joint influence of personal achievement goals and classroom goal structures on achievement-relevant outcomes. *Journal of Educational Psychology*, 101(2), 432-447.

22. Pantziara, M. and Philippou, G. (2007). Students' Motivation and Achievement and Teachers' Practices in the Classroom. In J. Woo, H., Lew, K. Park and D. Seo. (Eds.), Proc. *31st PME Conference*, 4, 57-64.
23. Patrick, H., Anderman, L.H., Ryan, A.M., Edelin, K.C. and Midgley, C. (2001). Teachers' communication of goal orientations in four fifth-grade classrooms. *The Elementary School Journal*, 102(1), 35-58
24. Pintrich, P.R. (1999). The role of motivation in promoting and sustaining self-regulated learning. *International Journal of Educational Research*, 31, 459-470.
25. Pintrich, P.R. (2000a). An achievement goal theory perspective on issues in motivation terminology, theory, and research. *Contemporary Educational Psychology*, 25, 92-104.
26. Pintrich, P.R. (2000b). Multiple goals, multiple pathways: The role of goal orientation in learning and achievement. *Journal of Educational Psychology*, 92, 544-555.
27. Pintrich, P.R. (2000c). The role of goal orientation in self-regulated learning. In M. Boekarts, P.R. Pintrich, and M. Zeider (Eds.), *Handbook of self-regulation* (pp. 451-502). San Diego, CA: Academic Press.
28. Pintrich, P.R. and De Groot, E. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology*, 82, 33-40.
29. Ryan, A., Gheen, M. and Midgley, C. (1998). Why do some students avoid asking for help? An examination of the interplay among students' academic efficacy, teachers' social-emotional role, and classroom goal structure. *Journal of Educational Psychology*, 90, 528-535.
30. Turner, J., Meyer, D., Anderman, E., Midgley, C., Gheen, M., Yongjin, K. and Patrick, H. (2002). The classroom environment and students' reports of avoidance strategies in mathematics: A multi-method study. *Journal of Educational Psychology*, 94(1), 88-106.
31. Urdan, T. (2004). Using multiple methods to assess students' perceptions of classroom goal structures. European Psychologist, 4, 222-231.
32. Urdan, T. (2010). The challenges and promise of research on classroom goal structures. In J.L. Meece and J.S. Eccles (Eds.), *Handbook of research on schools, schooling, and human development* (pp. 92-108). New York: Routledge.
33. Urdan, T., Midgley, C. and Anderman, E.A. (1998). The role of classroom goal structure in students' use of self-handicapping. *American Educational Research Journal*, 35, 101-122.
34. Wolters, C.A. (2004). Predictors of academic self-handicapping and achievement: Examining achievement goals, classroom goal structures, and culture. *Journal of Educational Psychology*, 96, 251-264.

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SMART SECURITY PROTOCOL FOR BODY AREA NETWORKS

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ABSTRACT

Secure and authentic patient information communication is pivotal. We proposed an efficient and secure protocol. It is suitable for securing small amount of in terms of efficiency and memory consumption. It enhances the security requirement of the system without causing extra overload to the system.

KEYWORDS

Body Sensor Network; memory consumption

1. INTRODUCTION

The graph of the popularity of Wireless communication has rise much higher due to their low weight, less cost and quick responsiveness. The major areas where WBAN are used along with healthcare is for assisted living environment and their use or in entertainment and games. A WBSN comprises of several components such as sensors, base stations and medical server.

2. REQUIRED FEATURES OF WBAN

2.1 Confidentiality of Data

It is always important to keep data secure in this regards many algorithms have been designed for the secure transmission of data in WBAN which are able to transmit data safely. Data is encrypted using cryptographic techniques to make the data confidential.

2.2 Data Integrity

It is also important to make it sure that original data is transmitted. Data integrity makes it sure that the attacks like data digest cannot be launched and data only from the authentic sender is sent and same reaches at the target. Node authentication and data authentication are necessary to confirm that the data is coming from the right source and not from any hacker.

2.3 Energy Saving

WBSN devices have low power low size devices, it is important to use the energy of those sensors in economic way, shortage of energy may result in loosing critical alarms on physical conditions in some crucial sign monitoring applications.

3. RELATED WORK

Liu in [5] gave a hybrid security framework for WBAN. They proposed an algorithm by combining both asymmetric and symmetric algorithms. They gave a concept of tradeoff among security and resource constraints.

Liu et al. [4] security is the key and proper security means are needed for body sensor networks to provide confidentiality of data authenticity of information, integrity and availability of resources. It is also required to have a mechanism of key exchange which must be light weight. Symmetric cryptography can ensure light weight security function but cannot provide sender authentication, while asymmetric cryptography provides all security functions but uses resources extensively, so a tradeoff between the two types of cryptography is needed in body sensor networks [2] used very small key which is easy to be cracked and the vital patient information is at risk. Key size is only 4 bits.

[8] Ayushi proposed to design a new technique (that is not cost efficient) for the purpose of encrypting small amount of data our proposed technique can simulate the work as well.

4. PROPOSED SOLUTION

We have focused in our work on security and proposed change in the algorithm which will not only secure the without additional burden in terms of resource utilization. We have taken one step towards providing security of the valuable patient data by adding a feature of key refreshing.

A table with symptom id, symptom name and the value against each symptom. In our proposed techniques 4 bits are reserved for symptom id , 10 bits for symptom value and a key in size m x n to securely encrypt our message and send it to the medical server. 4 bits of symptom id and 10 bits of the symptom value are concatenated together to form a 14 bit long string. here a special consideration is made that one 1 symptom id is reserved to send key refresh message to the is receiver. Key of 1025 values is preloaded to both ends and key need not to be transferred to the medical server. Key contains multiple values each of which is < 128. 14 bit concatenated string is divided to equal substrings of 7 bits. Against each sub string decimal value is calculated the value is searched in the key.

The location address is calculated. The location number at which value resides is then transmitted the medical serve. The same way second value is transmitted after the same encryption procedure. At the receiver end reverse of above is performed to do the decryption of the message. When the symptom id received after decryption is 0 it means it is special message for the key refresh and 2 values are generated and encrypted to be transmitted.

5. KEY REFRESH ALGORITHM

Although the large size of the keys ensures the security in WBAN to some extent but still there persist some security it is not free from the threat of being hijacked. Therefore it is necessary that key must be refreshed after a specific time in order to protect the valuable patient information from attacker. If transmitted message has symptom id =0 this becomes evident that it is key refresh instruction for medical server end and symptom

value part of the message contains those random values which have been generated by encryption algorithm this is the key refresh instruction .First random value received in the symptom value part means change first column with the column that comes after adding message part and perform the same operation to every column. Similarly the second random value is the instruction to change rows the same way.

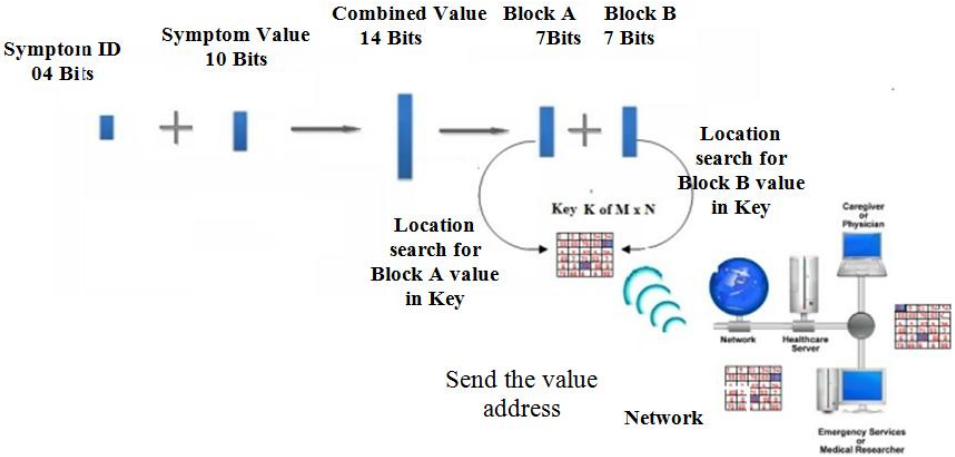

Fig 2: Block Model of Proposed Scheme

a) Encryption Technique

Step 1: Start
Step 2: Get device ID/Symptom ID
Step 3: Get value of symptom
if (symptom id = = 0)
Generate 2 random numbers ≤ 25
then concatenate symptom id with each random number
else concatenate symptom id with symptom value
Step 5: Divide the concatenated string into equal parts i.e. 7 bit each
Step 6: Get input key
(key: predefined array of 2025 elements where the value of each element < 128)
Step 7: Find the location of message part in the key and get the locations
Step 8: Message part length => $\log_2$ (Key Length)
Step 9: Represent the binary values of locations in message parts length
Step 10: Send binary values
Step 11: Stop

b) Decryption Technique

Step 1: Start
Step 2: Get message
Step 3: Find its binary value and represent it into 7 bits
Step 4: Concatenate both values
if (first 4 bits are 0)
Refresh key according to the rules
else got to step 5
Step 5: Get the value from the locations
Step 6: Represent the value in decimal
Step 7: Stop

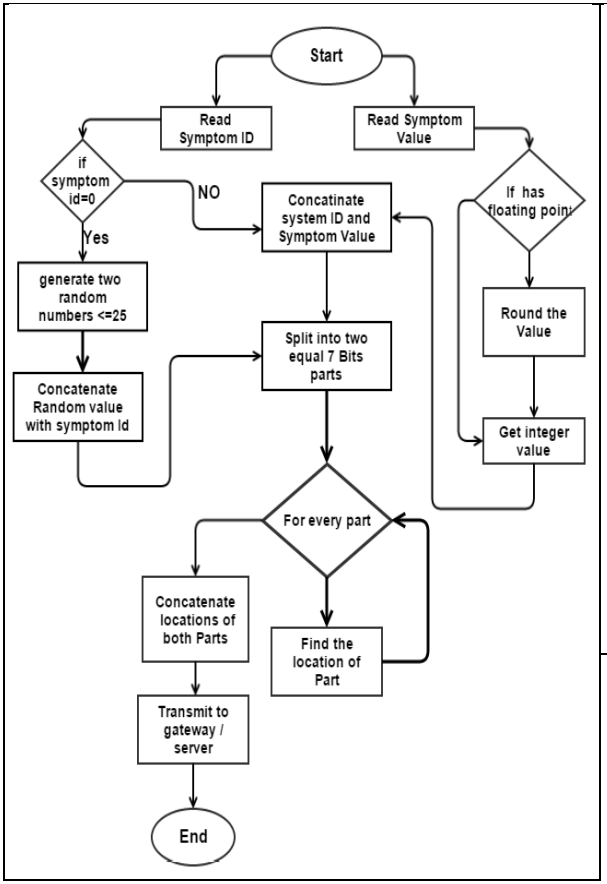

Fig 3: Process at the Sender End

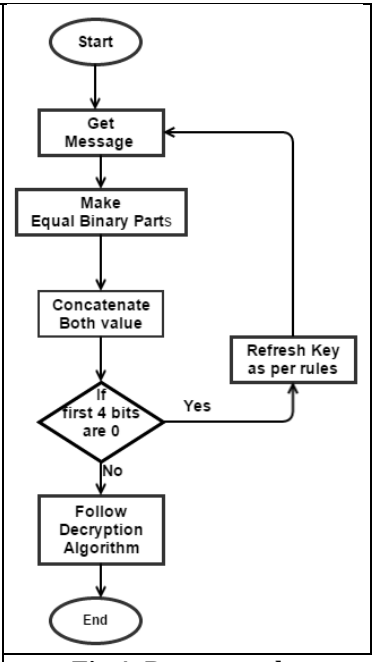

Fig 4: Process at the Receiver End

CASE STUDY:

Table 2: Symptom Parameters

Symp ID	Symptom	Symp Value
1	Blood Pressure Upper	120
2	Blood Pressure Lower	80
3	Heart Beat	75
4	Body Temperature	100
5	Pulse Oximetry	70
6	Arterial Gases	79
7	Blood Flow	99
9	Muscle Power	150
10	Respiratory Rate	30
0	Key Refresh	00

Table 3: Guide for Notations

Notation	Description
K	Key
Symid	Symptom id
Rnd	Random number
Conc	Concatenate
Str	String
Substr	Substring
Loc 1	Location 1
Loc 2	Location 2
$\overline{K}$	Refreshed Key

At Sender End

$key\ Ksympid == 0$
$Gen\ Rnd\ X1, X2$
$Conc\ symid\ , X1 = str1$
$Str1 = substr1, substr2 (Divide\ intoequal\ parts)$
$find\ decimal\ value\ of\ substr1, substr2$
$Locate\ substr1, substr2\ in\ K\ i.e\ loc1, loc2$
$send\ loc1, loc2$

At the Receiver End

$Rec\ loc1, loc2$
$find\ value\ at\ loc1, loc2 = Y1, Y2$
$find\ binary\ of\ Y1, Y2$
$Conc\ Y1, Y2$
$first\ 4\ bit, Symp\ id, last\ 10\ bits\ rnd\ X1$
if sumpid=0
change Col with Y2 sequence
Now repeat same for X2
$Rec\ loc1, loc2$
$find\ value\ at\ loc1, loc2 = Y1, Y2$
$find\ binary\ of\ Y1, Y2$
$Conc\ Y1, Y2$
$first\ 4\ bit, Symp\ id, last\ 10\ bits\ rnd\ X2$
$change\ row\ with\ Y2\ sequence$

We have new key $\overline{K}$ with columns changed with X1 sequence and rows changed with X2 sequence.

Symptom id is obtained from the shared table. Against the symptom value the medical data is sent the medical server. At the receiver end these values are fetched from the key and reverse of the above mentioned operation is performed to get the sent symptom id and symptom value. If the symptom id sent is 0 this is predefined that 0 is meant to change the key order as per sent instruction. During encryption if the symptom id is 0 it means the other part of the message contains instruction for the key refresh.

Example

Step 1: Get Symptom ID

0	0	0	0

Binary of symptom no (4)

Step 2: Generate two random numbers < 25
X1= 19 and X 2= 23
For X1
10 bit binary of 19

0	0	0	0	0	1	0	0	1	1

Step 3: Concatenate both

0	0	0	0	0	0	0	0	0	1	0	0	1	1

Symptom ID 04 Bits **Symptom Value 10 Bits**

Step 4: Divide 14 Bits in equal blocks of 7 bits

0	0	0	0	0	0	0		0	0	1	0	0	1	1

7 Bits value = 0 **7 Bits value = 19**

Step 4: Get input key of size m x n

107	91	124	41	115	121	32	70	64	68	35	19
81	17	8	24	105	104	65	2	52	106	37	28
34	77	102	56	30	38	127	12	116	95	21	9
27	28	37	71	90	57	94	72	48	53	18	6
93	98	45	83	92	118	23	110	113	39	70	20
108	7	125	5	73	25	59	122	47	120	76	46
127	14	57	1	29	51	111	11	15	114	82	88
13	97	26	62	85	4	101	96	112	22	44	49
79	84	74	75	43	80	47	3	67	14	100	32
40	55	9	78	89	39	126	33	69	92	63	92
58	87	10	0	31	86	117	42	16	54	66	56
119	67	61	50	60	52	36	109	123	103	14	124

Fig 5: A portion of key (key size 45 x 45)

Step 5: 0 is located at loc 47 and 19 is located at 133. Send both loc1 and loc 2 to the receiver.

At Receiver End

Step 1: Get loc1 and loc 2
loc1 47
loc2 133

Step 2: Find values at loc1 and loc 2
0 is located at 47
19 is located at 133

Step 3: convert both loc1 and loc 2 into binary
loc 1

0	0	0	0	0	0	0

loc 2

0	0	1	0	0	1	1

Step 4: Concatenate loc 1 and loc 2

0	0	0	0	0	0	0		0	0	1	0	0	1	1

Step 5: As the first 4 bits are so refresh the key according to rule predefined that

6. PERFORMANCE ANALYSIS

As compared to exiting algorithm for small amount of data our algorithm is much more efficient .The processing speed of our algorithm is faster and further more it shows more resistance against brute – force attack. Our block size is very small as compared to existing techniques [2] and key is not to be transferred thus saving 25% of computation cost, as most of the energy is consumed during transmission and we only need to send 28 bit which is very less as compared to previous techniques, and security is additional feature by having a refreshing key after specific amount of time with routine message.

7. CONCLUSION

Our encryption and key refreshing technique provides security for transmission of small data. The length of the key enhances the security without being overload as key is pre shared and not needed to be transmitted through link. Only two instructions are enough to shuffle the key after specific interval of time. The binary conversion, concatenation and then division in other order increase toughness for any unauthorized user to access the data.

REFERENCES

1. Amin, N., Asad, M., Nizamuddin and Chaudhry, S.A. (2012). An Authenticated Key Agreement with Re keying for Secured Body Sensor Networks Based on Hybrid crypto system. *9th IEEE International Conference on Networking, Sensing and Control*, 118 121.

2. Ayushi (2010). A Symmetric Key Cryptographic Algorithm. *International Journal of Computer Applications*, 1(15).
3. Coppersmith, D. (1994). The Data Encryption Standard (DES) and Its Strength against Attacks. *IBM Journal of Research and Development*.
4. Monton, E., Hernandez, J.F., Blasco, J.M., Herve, T., Micallef, J., Grech, I., Brincat, A. and Traver, V. (2008). Body area network for wireless patient monitoring. *IET Commun*., 2(2), 215-222.
5. Hu, C., Zhang, N., Li, H., Cheng, X. and Liao, X. (2013). Body area network security: A fuzzy attribute-based signcryption scheme. *Selected Areas in Communications, IEEE Journal* 31.9, 37-46.
6. He, D., Chun, C., Chan, S., Jiajun B. and Pingxin, Z. (2013). Secure and lightweight network admission and transmission protocol for body sensor networks. *Biomedical and Health Informatics, IEEE Journal*, 17.3, 664-674.
7. Kumar, R.S., Pradeep, E. Naveen, K. and Gunasekaran, R. (2010). A Novel Approach for Enciphering Data of Smaller Bytes. *International Journal of Computer Theory and Engineering*, 2.4, 1793-8201.
8. Liu, J. and Kwak, K.S. (2010). Hybrid security mechanisms for wireless body area networks. Ubiquitous and Future Networks (ICUFN), *Second International Conference on. IEEE*.
9. Chen, M., Gonzalez, S., Vasilakos, A., Cao, H., Victor C.M. Leung (2010). Body Area Networks: A Survey August 2010.
10. Kumar, S. Pradeep, E., Naveen, K. and Gunasekaran, R. (2010). Enhanced Cost Effective Symmetric Key Algorithm for Small Amount of Data. *IEEE International Conference on Signal Acquisition and Processing*, 354-357, DOI 10.1109/ICSAP.2010.13
11. Sarker, M.Z.H. and Parvez, M.S. (2005). A Cost Effective Symmetric Key Cryptographic Algorithm for Small Amount of Data. *9th IEEE INMIC*, 1-6, DOI 10.1109/INMIC.2005.334435
12. Soomro, A.W., Nizamuddin, Umar A.I, Noor-ul-Amin (2013). Secured Symmetric Key Cryptographic Algorithm for Small Amount of Data. *3rd International Conference on Computer & Emerging Technologies (ICCET 2013).*
13. Rongxing (2013). SPOC: A Secure and Privacy-Preserving Opportunistic Computing Framework for Mobile-Healthcare Emergency. *Parallel and Distributed Systems, IEEE Transactions*, 24(3), 614-624.

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THE SUCCESS OF A MANAGEMENT INFORMATION SYSTEM IN HEALTH CARE SECTOR OF PAKISTAN

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ABSTRACT

Health informatics is the combination of different fields including information science, medicine and information technology for the sole purpose of formulating various systems to generate, validate, secure and integrate health-related data. The main purpose health informatics is to deliver an effective, integrated high quality health care system for patients. Health informatics bring together different, techniques, resources and systems for maximizing the usage of available wealth of technological advances, medical knowledge and drug breakthroughs. There has been a large scale usage of health informatics in a variety of health-related fields, including pharmacy, dentistry, nursing, public health and medical research clinical care

This exploration is depict viewpoint on particular information and data utilizes by clients of a data game plan in one specific social insurance association. The administration data framework (MIS) is characterized as the data framework that gives administration data about budgetary and operational parts of clinic administration.

The Pakistan Government Under the head of Health Affairs and Services, a total allocation of Rs 9,863 million has been made in the budget estimates 2013-14, which is higher by 25.7% and 24.9% respectively when compared with budget and revised estimates 2012-13. The allocation for hospital services forms the major component under this classification [12].

INTRODUCTION

Information systems are a recurrently contentious national conversation in health care organizations the act of educations focus on management data systems is comparatively minor. This article is to define perspectives on information availableness and information usage between exploiters of a management information system in any particular health care organization [1].

The utilization of information building science is required and crucial for clinical concern and the path work because of entropy. The perniciousness of development putting resources into data innovation, still numerous troubles in the execution, and convenience of human services data associations. Identified with different divisions, the inside IT aptitudes in medicinal services administering body are the powerful

development of data framework to meet the expanding requests for consideration, quality and productivity. Social insurance is a complex situations for data frameworks for the fast changes in the working circumstance and qualities for expert rationality, composite association structure and administration framework [2, 3].

THE SUCCESS OF MANAGEMENT INFORMATION SYSTEMS IN HEALTH CARE ORGANIZATIONS

The major recurrence component for the achievement of information association may be the degree to which a wellbeing upkeep association thinks of it as' procedures in data administration and comprehends the part of its data plan s in accomplishing key targets [4, 5, 6]. As confirm in late age studies, vital data administration and data framework doing is a real test to wellbeing apprehension associations because of an absence of key point of view as prove in late studies [4, 7, 8, 9].

Van der Meijden et al. [10] wrote in field of medicinal services data frameworks and DeLone & McLean [11] in the field of administration data frameworks have available (1) data quality, (2) framework quality, (3) client fulfillment, (4), use (5) individual effect and (6) authoritative effect. The measures of data quality incorporate data framework generation e.g. handiness, unwavering quality, data precision, coin, courses of events and arrangement. The framework quality measurement comprises of the qualities of the data framework itself and is evaluated regarding properties like framework adaptability and exactness, reaction time, convenience, comfort of access and coordination of frameworks. Framework quality and data quality impact one another, and together or independently these measurements impact utilization and client fulfillment

RESEARCH METHOD

The data for this study was collect for personal visit to take interview the heads of all sections and submitting Questionnaire to collect data of hospitals at Pakistan. The hospital was developed HMIS recently. The Questionnaire has three sections. 1) Background information of hospital 2) Use of Information Technology at Hospital 3) Manual method of hospital

We required approval for research from related health care culture as per official procedures. Managers had variable experiences as well as views of the management information system since subject of this study was quite sensitive. Thus both the organizational and interviewees anonymity has been cautiously ensured all over the research process.

RESULTS

After interviews and questionnaire study the following results are come out from organization using HMIS.

Employees	2000+
Computer Access	1500+
LAN	GIGA BIT ATM WiFI
Purpose of Network	E-Mail Printing File sharing Web Access Application
System Architecture	PC Based File Server Client Server Web based
Internet and purpose	LAN & DSL Access HMIS Browsing Social Media Research
Information System in organization	HRMS CRM HMIS
Training of staff	In House Hands on Formal Class Room
Facilitated others	Provides HMIS Implementation Services to Other Hospitals
ICT System Architecture	Critical Substantial Marginal
Types of Computers	PCs Laptops Database Servers File Servers
ICT Items	1400+ Hardware HMIS, PACS Software's
ICT Investment	2 Million US$ Annually Development Cost 1 Million US$ Annually for Maintenance
Terminals for Staff	Pathology, Radiology Equipment Interface
Data Gathering	Using HMIS or Integrated interface
Types of Checks	Ranges Values Reasonable Values Decision Support

Results shows that organization is paperless now and work well after HMIS implementation.

CONCLUSION

Obtained results raise the need of some ideas for further research in this area. An in depth and detailed study is needed for the usage of information by health care managers. Special focus is need to address the related questions such as, where, in what way the information is developed and what kind of particular information used. Although the usability problems of information systems and its integration with health care are vital for operators, further research need to focus more on the perspective of information culture, the community and strategic information management. Furthermore, it is required to dig out more about the information needs of health care management systems in future, as to design special information systems for upcoming information needs. It is observed that the related issues to MIS, thus for expansion of information systems is to look further for the information philosophy intensely rooted in history.

REFERENCES

1. D. Naranjo-Gil, F. Hartmann (2007). How CEOs use management information systems for strategy implementation n in hospitals. *Health Policy*, 81(1), 29-41.
2. S. Cho, L. Mathiassen, A. Nilsson (2008). Contextual dynamics during health information systems implementation: an even-based actor-network approach. *Eur. J. Inform. Syst.*, 17, 614-630.
3. N. Khatri (2006). Building IT capability in health-care organizations. *Health Serv. Manage. Res*., 19, 73-79.
4. D. Wainwright and T. Waring (2000). The information management and technology strategy of the UK National Health Service. Determining progress in the NHS acute hospital sector. *Int. J. Public Sector Manage*., 13(3), 241-259.
5. M. Bush, A.L. Lederer, X. Li, J. Palmisano and S. Rao (2009). The alignment of information systems with organizational objectives and strategies in health care. *Int. J. Med. Inform*., 78 (7), 446-456.
6. D. Waldman, S.A (2007). Your stone, Learning—the only way to improve health-care outcomes. *Health Serv. Manage. Res*., 20, 227-237.
7. M. Carney (2004). Middle manager involvement in strategy development in not-for profit organizations: the director of nursing perspective—how organizational structure impacts on the role. *J. Nurs. Manage*., 12 (1), 13-21.
8. T. Kivinen (2008). *Knowledge management in health care organizations*, Kuopio University Publications, E. Social Sciences 158, Kuopio (in Finnish).
9. J. Lammin Takanen, T. Kivinen, K. Saranto and J. Kinnunen, (2009). Strategic management of health care information systems: nurse managers' perceptions, in: K. Saranto, P.F. Brennan, H.A. Park, M. Tallberg, A. Ensio (Eds.), Connecting Health and Humans—Proceedings of NI2009. *The 10th International Congress on Nursing Informatics. Studies in Health Technology and Informatics*, Vol. 146, IOS, Amsterdam, Helsinki, 29th June to 1st July 2009, pp. 86-90.
10. M.J. van der Meijden, H.J. Tange and J. Troost, (2003). A. Hasman, Determinants of success of inpatient clinical information systems: a literature review. *J. Am. Med. Inform. Assoc*., 10(3), 235-324.
11. W.H. DeLone and E.R. McLean, (1992). Information systems success: the quest for the dependent variable. *Inform. Syst. Res*., 3(1), 60-95.
12. Government of Pakistan, *Federal Budget, Budget in Brief 2013-14*, Finance Division, Islamabad, Pakistan. http://www.brecorder.com

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GLOBALIZED LOCAL BINARY FITTING MODEL FOR IMAGE SEGMENTATION

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ABSTRACT

Many works have been developed in the field of image segmentation. A milestone model in variational segmentation models is the Chan-Vase (CV) model which shows its significance when segmenting images having objects of homogeneous and constant intensities. However, CV results in poor detection when segmenting images having inhomogeneous intensities. It only captures global details and leave minute valuable small details. On the other hand, the famous local binary fitting (LBF) model based on local information gives more narrow and tiny details but unfortunately it ignores global details in given images. Furthermore the LBF model provides un-necessary details. Thus, we propose a new model which inherits the advantages of both the models which handle their drawbacks by proportionality mixing up the image global and local information. The test result validate that the proposed model is robust than the CV and LBF models in terms of accurate detection.

KEYWORDS

Image segmentation, Active contour, Level set, Binary fitting energy, Functional minimization.

1. INTRODUCTION

Image segmentation is a fundamental task for separating foreground from background in images. The function of segmentation is to partition an object into disjoint sub-regions, which are homogeneous according to their properties i.e. intensities, color, texture. One of the most successful technique for image Segmentation is the active contour model (ACM) proposed by kass et al. [3]. The basic idea of ACM is to evolve a curve to extract the desired object based on an energy–minimization method. The existing active contour models can be categorized into two main types edge-based models [1, 3,6] and region-based models [2,7,8]. Each of them has its own pros and cons. One of the most popular region-based model is the Chan-Vese (CV) model [2], based on Mumford shah functional. This model has been successfully used for segmenting images with regions based on the assumption that each region is statistically homogeneous. However, the region of interest in images are not often statistically homogeneous, CV model is not to segment images with intensity inhomogeneities.

To overcome the limitations of CV model, Chan and Vese [8] and Tsai et al. [9] Proposed two similar region based active contour models, which are called piecewise smooth models. These methods are computationally expensive, and consider the global details information rather than local details information. Thus, it needs a term of a local fitting energy to improve the performance of segmentation in the inhomogeneous region.

Li et al. proposed a local binary fitting model (LBF) model, which is able to segment images with intensity inhomogeneity [4, 5]. The basic idea is the introduction of a kernel function which denotes the range of the local area. LBF model, clearly detect local details of an image, but are often ignores global details.

To handle this difficulty, we proposed a new region-based active contour model named as Globalized Local Binary Fitting (GLBF) Model, for image segmentation. By introducing the global image information in the proposed model, the images with intensity inhomogeneity can be effectively segmented. Moreover, comparisons with well-known LBF model, shows that our proposed method is more computationally efficient and robust to initialization.

2. THE CHAN-VESE MODEL

Chan and vese [2] proposed the following model;

$$E^{CV}(k_1, k_2, \Gamma) = \mu\, Length\,(\Gamma) + \nu\, Area\, inside(\Gamma) + \lambda_1 \int (Z - k_1)^2\, dxdy + \lambda_2 \int (Z - k)^2\, dxdy \quad (1)$$

where the coefficients λ_1, λ_2 >0, are fixed parameters and $\boldsymbol{\Gamma}$ represents the variable curve. The constants k_1, k_2 represents the average intensities inside and outside the variable curve $\boldsymbol{\Gamma}$. Keeping k_1, k_2 fixed and minimizing E with respect to Φ yields the following,

$$\frac{\partial \emptyset}{\partial t} = \delta_{\varepsilon(\emptyset)}\left[\mu \nabla.\left(\frac{\nabla \emptyset}{|\nabla \emptyset|}\right) - \nu - \lambda_1 \quad (Z-k_1)^2 + \lambda_2 (Z-k_2)^2\right], in\ (0,\infty)\times\Omega$$

$$\emptyset(t,x,y) = \emptyset_0(x,y), in\ \Omega$$

$$\frac{\delta_\varepsilon \emptyset}{\nabla \emptyset}\frac{\partial \emptyset}{\partial \vec{n}} = 0\ on\ \partial\Omega\ . \quad (2)$$

where $\vec{n}$ is the unit exterior normal to the boundary ∂Ω, and $\frac{\partial \phi}{\partial \vec{n}}$ is the normal derivative of ϕ at the boundary. Keeping ϕ fixed and minimizing $E\epsilon(\phi, k1, k2)$ with respect to $k1$ and $k2$, we have

$$k_1 = \frac{\int_\Omega Z H_\varepsilon(\phi)\, dxdy}{\int_\Omega H_\varepsilon(\phi)\, dxdy},\quad k_2 = \frac{\int_\Omega Z\left(1 - H_\varepsilon(\phi)\right) dxdy}{\int_\Omega \left(1 - H_\varepsilon(\phi)\right) dxdy}.$$

First two terms in the above equation the global binary fitting energy. This global fitting energy will not be accurate if the image intensities in either inside or outside are not homogeneous. That is why Chan-Vese piecewise constant model cannot handle inhomogeneity.

2.1 Local Binary Fitting Active Contour Model (LBF)

To overcome this difficulty caused by intensity inhomogeneity, Li et al., proposed the local binary fitting (LBF) model [4, 5] utilizing the local intensity information. Two local fitting functions g_1, g_2 are introduced to approximate the intensities inside and outside the contour in LBF model. In contrast to the two constants k_1, k_2 in CV model. They proposed the following energy,

$$E^{LBF}(\Gamma, g_1, g_2) = \lambda_1 \int K(x,y)(Z - g_1)^2 \, dy + \lambda_2 \int K(x,y)(Z - g_2)^2 \, dy . \quad (3)$$

where λ_1, λ_2 are positive constants, and 'K' is a Gaussian kernel with standard deviation δ>0. Using level set formulation the energy minimization problem becomes,

$$E^{LBF}\left(\emptyset, g_1, g_2\right) = \lambda_1 \int \left[\int K_\sigma(x,y) \, |Z - g_1|^2 \, H\big(\emptyset(y)\big) \, dy \right] dx + \int \left[\int K_\sigma(x,y) |Z - g_2|^2 \left(1 - H\big(\emptyset(y)\big)\right) dy \right] dx,$$

where H is the Heaviside function. Now to add the regularizing terms the energy minimization problem is defined as:

$$F(\emptyset, g_1, g_2) = E^{LBF}(\emptyset, g_1, g_2) + \mu\rho(\emptyset) + \nu\varsigma(\emptyset). \quad (4)$$

as in papers [2, 9], we take (ε=1.0) for good approximation of H, δ by H_ε, δ_ε. Regularized terms are,

$$\rho(\phi) = \frac{1}{2}\int_\Omega \left|\nabla\phi(x) - 1\right|^2 dx, \text{ and } \varsigma = \int_\Omega \delta\big(\phi(x)\big)\left|\nabla\phi(x)\right| dx.$$

For a fixed level set function∅, minimizing the above functional in equation (4) with respect to g_1, g_2 are given by,

$$g_1 = \frac{K_\sigma(x) * [\, H_\varepsilon(\emptyset(x)) Z \,]}{K_\sigma(x) * [\, H_\varepsilon(\emptyset(x))]}, \; g_2 = \frac{K_\sigma(x) * [\, 1 - H_\varepsilon(\emptyset(x)) Z \,]}{K_\sigma(x) * [1 - H_\varepsilon(\emptyset(x))\,]},$$

Using Gradient descent method procedure minimizing the energy functional with respect to ∅ we have,

$$\frac{\partial\emptyset}{\partial t} = \delta_\varepsilon(\emptyset)(\lambda_1 e_1 - \lambda_2 e_2) + \nu\delta_\varepsilon(\emptyset)\nabla\left(\frac{\nabla\emptyset}{|\nabla\emptyset|}\right) + \mu\left(\nabla^2\emptyset - \nabla\left(\frac{\nabla\emptyset}{|\nabla\emptyset|}\right)\right). \quad (5)$$

where e_1, e_2 are the functions as follows,

$$e_1 = \int K_\sigma(y - x)|Z - g_1|^2 dy, and \; e_2 = \int K_\sigma(y - x)|Z - g_2|^2 dy .$$

The complexity is still very high. The main drawback in LBF method is that, it gives us only local details and leaves global details of a given image. Therefore, we go to the next modified model.

3. THE PROPOSED MODEL

To handle the above difficulty, we proposed a Globalized Local Binary Fitting Active contour (GLBF) model which can utilize both Local and Global image information of image segmentation, because it is the combination of CV model and LBF model.

3.1 Two Phase Level Set Formulation

In two phase-level set formulation, we define the energy functional as,

$$E^{GLBF}\left(\Gamma, g_1, g_2, k_1, k_2\right) = \mu Length + \int_{inside(\Gamma)} \left(Z-\lambda g_1-(1-\lambda)k_1\right)^2 dy + \int_{outside(\Gamma)} \left(Z-\lambda g_2-(1-\lambda)k_2\right)^2 dy$$

where $\boldsymbol{\lambda}$ is the trade-off parameter, g_1, g_2 are the two functions approximates local intensities on the opposite sides of the contour $\boldsymbol{\Gamma}$ and k_1, k_2 are the two constants that approximate intensities inside and outside the contour $\boldsymbol{\Gamma}$ respectively. In the level set representation the energy functional can be rewritten as,

$$\begin{aligned} \mathrm{E}^{\mathrm{GLBF}}(\emptyset, \mathrm{g}_1, \mathrm{g}_2, \mathrm{k}_1, \mathrm{k}_2) &= \mu \int \delta(\emptyset(\mathrm{x})|\nabla\emptyset(\mathrm{x})|)\,\mathrm{dx} \\ &+ \int_{\Omega} [\int (\mathrm{Z}-\lambda \mathrm{g}_1-(1-\lambda)\mathrm{k}_1)^2\, \mathrm{H}(\emptyset)(\mathrm{y}))\mathrm{dy}]\mathrm{dx} \\ &+ \int_{\Omega} [\int (\mathrm{Z}-\lambda \mathrm{g}_2-(1-\lambda)\mathrm{k}_2)^2\, (1-\mathrm{H}(\emptyset)(\mathrm{y})))\mathrm{dy}]\mathrm{dx} \end{aligned} \quad (6)$$

where H is the Heaviside function, for accurate computation use regularized version H_ε. Use standard gradient descent method, minimizing the energy functional $F^{G-LBF}(\emptyset, g_1, g_2, k_1, k_2)$ leads the following;

$$\begin{aligned} &\frac{\partial \emptyset}{\partial t} = \delta_{\varepsilon(\emptyset)}\left[\mu\, \nabla.\left(\frac{\nabla\emptyset}{|\nabla\emptyset|}\right) + (Z-\lambda g_1-(1-\lambda)k_1)^2 + (Z-\lambda g_2-(1-\lambda)k_2)^2\right], in\ (0,\infty)\times\Omega \\ &\Phi(t,x,y) = \emptyset_0(x,y), in\ \Omega \\ &\frac{\delta_\varepsilon \emptyset}{\nabla\emptyset}\frac{\partial\emptyset}{\partial\vec{n}} = 0\ on\ \partial\Omega\,. \end{aligned} \quad (7)$$

where $\vec{n}$ is the unit exterior normal to the boundary $\partial\Omega$, and $\frac{\partial\emptyset}{\partial\vec{n}}$ is the normal derivative of $\emptyset$ at the boundary.

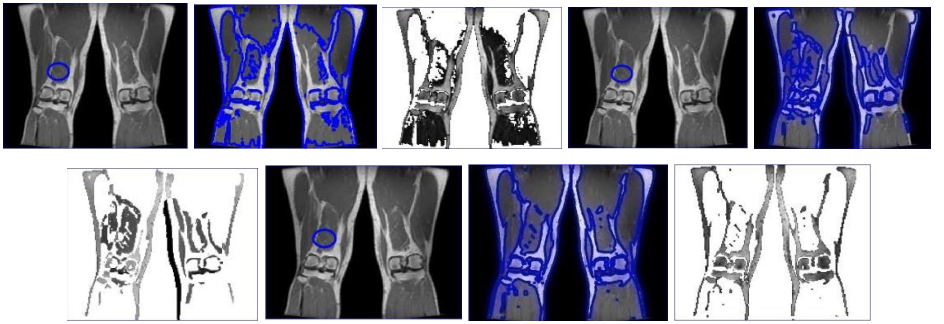
We use similar solutions of the CV and the LBF model as follows:

$$g_1 = \frac{K_\sigma(x) * [H_\varepsilon(\emptyset(x))Z]}{K_\sigma(x) * [H_\varepsilon(\emptyset(x))]},\ g_2 = \frac{K_\sigma(x) * [1-H_\varepsilon(\emptyset(x))Z]}{K_\sigma(x) * [1-H_\varepsilon(\emptyset(x))]},$$

$$k_1 = \frac{\int_\Omega \mathrm{ZH}_\varepsilon(\phi)\,dxdy}{\int_\Omega \mathrm{H}_\varepsilon(\phi)\,dxdy},\ k_2 = \frac{\int_\Omega \mathrm{Z}(1-\mathrm{H}_\varepsilon(\phi))\,dxdy}{\int_\Omega (1-\mathrm{H}_\varepsilon(\phi))\,dxdy}.$$

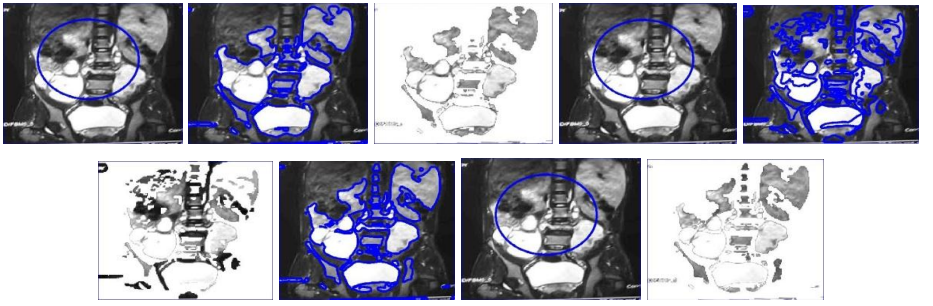
4. EXPERIMENTAL RESULTS

In this section, we evaluate and compare the results of proposed G-LBF model with the Chan-Vese model [2] and LBF model [4] using MR, synthetic and real images. Throughout the experiments row 1 represents CV model and LBF model while row 2 represents our proposed model. From all the experiments we can observed that our proposed model works more accurately and efficiently as compared to these models. For the proposed model the supported parameter are mentions in the caption.



A medical image of knee with intensity inhomogeneity. First and second row indicate the results of CV, LBF and GLBF respectively. It can be easily observed that the performance of our model satisfactory as compared to the other two. The parameter used for our proposed model are; $\boldsymbol{\lambda}$=0.69, $\boldsymbol{\mu}$ = 0.0065 and iteration is 1300.

Using real image, results of the three models are displayed. From the figures it can be easily observed that our model successfully completed the task. Parameters used for proposed model are : $\boldsymbol{\lambda}$= 0.69, $\boldsymbol{\mu}$= 0.0082, and Iteration= 2400.



Segmentation results of medical chest image, First and second row indicates results of CV, LBF and GLBF model respectively. The Parameters used for our proposed model are: $\boldsymbol{\lambda}$= 0.87, $\boldsymbol{\mu}$=0.033 and Iterations is 1300.

5. CONCLUSIONS

In this paper, we proposed a new region-based active contour model, i.e., Globalized Local Binary Fitting (G-LBF) model, for image segmentation. We define an energy functional with a local intensity fitting term, to attract the contour towards the object boundary and global intensity fitting term to improve the robustness of the proposed method. Our model can handle intensity inhomogeneity and allows for flexible re-initialization. Experimental results on both synthetic and real images demonstrated that the proposed G-LBF model is very robust and efficient, as compared to the well-known local binary fitting (LBF) model and Chan-Vese (PC) model. In future we plan to extend our two-phase G-LBF model into a multi-phase level set formulation.

REFERENCES

1. Caselles, V., Kimmel, R. and Sapiro, G. (1997). Geodesic active contours. *International Journal of Computer Vision*, 22, 61-79.
2. Chan, T.F. and Vese, L.A. (2001). Active contours without edges. *IEEE Transactions on Image Processing*, 10, 266-277.
3. Kass, M., Witkin, A. and Terzopoulos, D. (1987). Active contour model (snake). *International Journal of Computer Vision*, 1, 321-331.
4. Li, C.M., Kao, C., Gore, J. and Ding, Z. (2007). Implicit active contours driven by local binary fitting energy. In *IEEE Conference on Computer Vision and Pattern Recognition*.
5. Li, C., Kao, C.Y., Gore, J.C. and Ding, Z. (2008). Minimization of region-scalable fitting energy for image segmentation. *IEEE Transactions on Image Processing*, 17, 1940-1949.
6. Li, C., Xu, C., Gui, C. and Fox, M.D. (2005). Level set evolution without re-initialization, A new variational formulation. In *IEEE Conference on Computer Vision and Pattern Recognition*, 1, 430-436.
7. Paragios, N. and Deriche, R. (2002). Geodesic active regions and level set methods for supervised texture segmentation. *International Journal of Computer Vision*, 46, 223-247.
8. Tsai, A., Yezzi, A. and Willsky, A.S. (2001). Curve evolution implementation of the Mumford-shah functional for image segmentation, denoising, interpolation, and magnification. *IEEE Transactions on Image Processing*, 10, 1169-1186.
9. Vese, L.A. and Chan, T.F. (2002). **A** multiphase level set framework for image segmentation using the Mumford and Shah model. *International Journal of Computer Vision*, 50, 271-293.

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A CONCEPTUAL FRAMEWORK FOR THE ANALYSIS OF DETERMINANTS OF M-COMMERCE ACCEPTANCE

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ABSTRACT

With the emergence of internet and World Wide Web, traditional businesses got a new opportunity to compete globally. Traditional bricks-and-mortar businesses became electronic business (e-business) with the help of Information and Communication Technology (ICT) tools. Smart phone technology brought a new revolution in e-business market. A new term of Mobile Commerce (M-Commerce) emerged and set a new trend in commerce and business. M-commerce usage trend in developing economies still seems to take very slow steps as compared to developed countries like USA, UK, Australia and others. The purpose of this study is to extend research on the acceptance of M-Commerce in context of developing economies. A conceptual framework of some widely used technology adoption and social psychology theories including, Technology Acceptance Model (TAM), Innovation Diffusion Theory (IDT), Unified Theory of Acceptance and Use of Technology (UTAUT), is proposed to diagnose the significant factors of M-Commerce acceptance in developing economies.

KEY WORDS

Mobile Commerce, TAM, Conceptual framework, Behavioral Intention (BI), Perceived Usefulness (PU), Perceived Ease of Use (PEOU).

1. INTRODUCTION

Mobile Commerce can be defined as an extended division of electronic commerce. M-Commerce includes buying or selling of products and services or exchange of goods and services with devices which use wireless technology. The term M-Commerce refers to the exchanging of goods and services or buying or selling of goods and services by using wireless based handheld devices which may include smart phones, personal data assistants, tablet computing devices and other electronic gadgets (Wei et al., 2009). On a narrower scale M-Commerce is defined as various monetary transaction using mobile networks and on a wider scale it can be defined as, services or applications which are supported by mobile devices and mobile networks (Qingfei et al., 2008). M-Commerce is now capable of providing mobile data services such as sharing information contents, doing communication and commercial transactions, and availing entertainment services

(Jurevičiūtė, 2011). M-Commerce consists of all about wireless electronic Commerce (E-Commerce) in which mobile devices are used to do business on the internet, no whether matter it is Business-to-Consumer (B2C) commerce or Business-to-Business (B2B) commerce (Wong & Hsu, 2006).

M-Commerce is now being widely accepted by both consumers and business communities not only in B2C commerce prospectus but also in large scale B2B commercial transaction. M-Commerce is expected to make an important impact on today's mortar and brick businesses and the number of mobile phone subscription has surpassed the internet users in many countries (Mishra, 2014). It is creating a new era in current business norms and is expected to broaden the scope and approaches, organizations are using in their traditional businesses. M-Commerce is also motivating the interest of the business communities to extend their reach to customers at all times and at all places. It is now evident that accessibility to market space through M-Commerce is on a growing track which can be traced back to the developments in both, the technological and the demographical prospectus which have influenced significant aspects of the socio-cultural behavior in today's world (Qingfei et al., 2008).

With enhanced reach, wide scale diffusion of wireless technology, diversified features of new mobile devices, and mobile value added services, M-commerce is expected to have a huge potential in near future (Mishra, 2014). In today's busy life, consumer intend to find an easy, cheap, less time consuming and ubiquitous access to products, information and services (Jurevičiūtė, 2011). Security concerns, privacy, unfamiliarity, lack of trust, late deployment of wireless technology, unfamiliarity with mobile operating systems and applications are among the most significant effecting factors for the late adoption of M-Commerce in under developed countries. As per technology expert's prediction, wireless communication services will likely be available to everyone at any place on the globe at extremely low cost by the year 2020 (Layade, 2012). Today, the number of mobile phone users has surpassed the internet user in most countries and M-commerce will have a great role in reshaping the business landscapes (Mishra, 2014).

In spite of huge list of benefits of M-Commerce, it is evident from literature that the technological developments alone cannot guarantee the acceptance and the usage of IS/IT systems. Although the potential benefits of M-Commerce have been described in detail in by various research studies (Wei et al.; 2009 Wei et al., 2009; Layade, 2012; Jurevičiūtė, 2011; Pavlou, 2007), lot of expected outcomes are still awaited to reap the real benefit and achieve the targets in response to the invested done. Thus, it is important to understand the main reasons behind the acceptance and rejection of any new information systems (Davis, et al., 1989). Similarly, there is a need to dig out the factors that influence acceptance of M-Commerce.

Keeping in view the importance of customer acceptance of IS/IT systems, Lot of models has been developed by researchers to understand, investigate and predict user acceptance and usage behaviour. Technology Acceptance Model (TAM) by F. Davis (Davis, 1989) is one of the most accepted model among the various models developed by IS researchers to predict and explain users' acceptance behaviour. As per TAM individuals' perceptions are based on perceived ease of use (PEOU) and perceived usefulness (PU) which, in turn, influence users' intention and usage behaviour of any

IS/IT system (Davis, et al., 1989; Davis, 1989). TAM has gotten huge acceptance and widespread usage due to its robustness, simplicity and parsimony (Abbasi, et al., 2011; Venkatesh, V., & Bala, 2008; Chandio, 2011). However, some researchers (Abbasi et al., 2011; Wang et al., 2003; Moon & Kim, 2001) argue that the TAM's core constructs (i.e. PEOU and PU) are insufficient to explain IS/IT system's user acceptance, as some other factors which influence the acceptance of a new IS/IT systems (such as an M-Commerce, which is focus of this study) can vary with target users, the technology and context. Thus, to better understand the potential users' acceptance behaviour of M-Commerce, this study intends to use a framework of some widely used technology adoption and social psychology theories including, TAM, IDT and UTAUT, specifically in the context of a developing economy context (i.e. Pakistan)

On one hand, M-Commerce promises a vast market potential for both consumers and businesses, but on other hand, promised benefits have yet not been realized and adopted in real means by every mobile user around world specifically in developing economies where potential of M-commerce is gaining huge attention (Chong, 2013b). Therefore, understanding the factors that determine the acceptance of M-Commerce by consumers in developing economies could lead to more effective and meaningful strategies that would allow M-Commerce to expand significantly and remain competitive (CHEN, 2007). Although much trend is seen towards early consumption in developed countries, but very little growth is observed in under developed economies (Deshmukh et al., 2013; Chong, 2013a; LAI Chi Fai, 2011).

The purpose of the study is to understand, examine and measure the significant factors causing the slow acceptance and delayed consumption of existing potentials of M-Commerce in developing economies. This study will empirically examine the essential factors that influence the potential users from accepting or rejecting the use behavior of M-Commerce.

2. BEHAVIOR INTENTION AND TECHNOLOGY ACCEPTANCE IDENTIFICATION TECHNIQUES

In last few years technology adoption by individuals as well as by organizations has seen an immense growth. It is necessary to know why consumers are reluctant or keen to use new technologies and information systems. Research is required to dig out practical techniques to assess and evaluate new IT systems, as to forecast the consumer acceptance and application of IT and IS (Davis, 1989; Jurevičiūtė, 2011). Various methods have been adopted to analyze the important factors which predict the user's intention behavior. Well-known theoretical models like IDT, TAM and UTAUT provide good understanding of most influential factors in acceptance, adoption, usage or rejection of IT and IS (Jurevičiūtė, 2011). Although, research on these theories in context of IT and IS adoption has made great contribution but none of these theories alone is considered good fit and answer all the research problems. Despite many similarities in these widely used theories, each has its own limitations and is not complementary of another.

i. Technology Acceptance Model

Technology acceptance model (TAM) (Davis, 1989) developed by Davis in 1989 is an eminent theory in the field of IT and IS research at this time. TAM is a theoretical

extension of TRA (Jurevičiūtė, 2011). Various empirical tests have proved TAM a strong model in terms of technology acceptance for variety of IT-related fields (Eze, 2008). Primary purpose of developing this model was to predict the acceptance of IS/IT and diagnose problems when potential users use that new technology or system (Chandio, Irani, Abbasi, & Nizamani, 2013). In recent research TAM has been extensively used in predicting the use of various information technology fields like World Wide Web, word processing software, E-commerce and M-commerce(Chong, Chan, & Ooi, 2012).

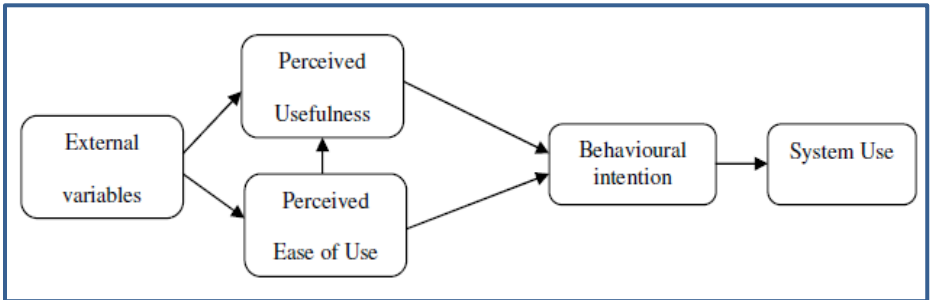

Figure 1: Technology Acceptance Model (Chandio, 2011)

As per TAM in figure 1, perceived usefulness, perceived ease of use and attitude influences the behavioral intention of people which leads towards the actual use of the system or technology (Davis, 1989; Sun et al., 2010) .

ii. Innovation Diffusion Theory (IDT)

E.M Rogers (E.M. Rogers, 1995) presented Innovation Diffusion Theory (IDT) in 1995 and stated that technology diffusion can be influenced by innovative attributes like complexity, relative advantage, trainability, compatibility, and observability (Chong et al., 2012). As per IDT, innovation is "an idea, practice or an object which is perceived as new by individual or any other unit of adoption" (Vasileiadis, 2013). Figure 2 depicts the conceptual model of IDT.

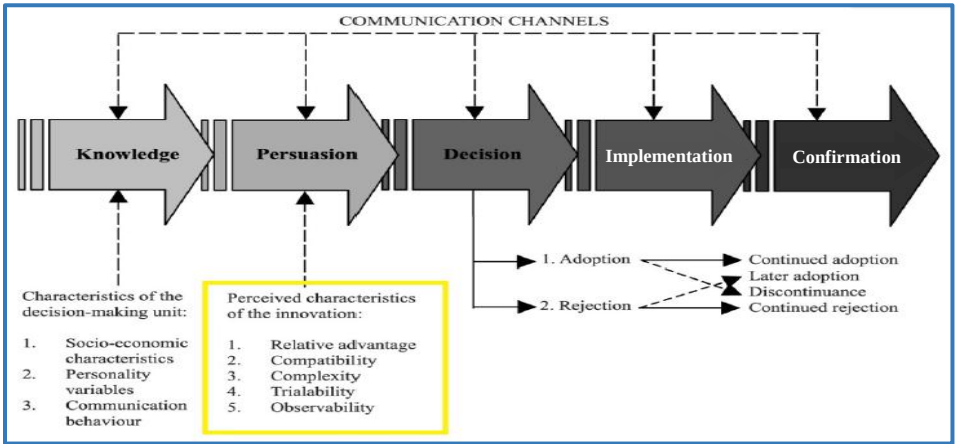

Figure 2: Innovation Diffusion Theory (Sahin & Rogers, 2006)

Diffusion is " the process in which an innovation is communication through certain channels, over time , among the members of social systems" (Wu & Wang, 2005) Research has identified only three main attributes including complexity, compatibility and relative advantage as the most significant factors in the adoption of innovative products (Koenig-Lewis, et al., 2010). Due to successful results IDT has been used widely by IT and IS researchers (Koenig-Lewis et al., 2010; Zheng, et al., 2012; Wu & Wang, 2005). There is an extreme similarity between IDT and TAM in some constructs and both theories supplement each other (Wu & Wang, 2005).

iii. Unified Theory of Acceptance and Use of Technology (UTAUT)

In year 2003, Venketash (Viswanath V. et al., 2003) compared and merged eight well known models including TRA, TPB, TAM, IDT, Motivation Model (MM), combination of TPB and TAM (TT), Model of PC Utilization (MPCU) and created a model named Unified Theory of Acceptance and Use of Technology (UTAUT) (Rutherford, 2010). Figure 3 show the factors affecting behavioral intention in UTAUT include effort expectancy, performance expectancy, facilitating conditions and social influence, along with some additional moderating factors as age, gender, voluntariness of use and experience from social psychology perspective (Qingfei et al., 2008).

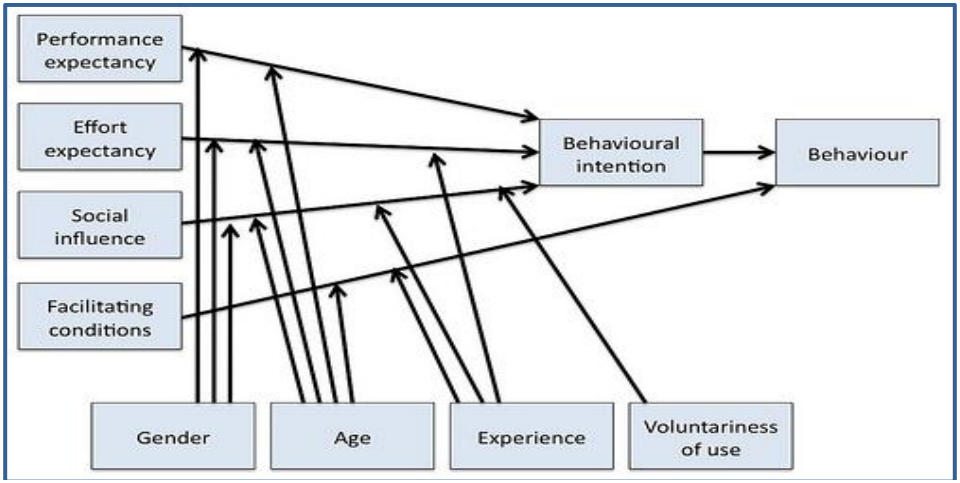

Figure 3: UTAUT----------Source (Viswanath V. et al., 2003)

The UTAUT model without revision cannot be applied to m-commerce user acceptance research since all IT adoption theories or models, including UTAUT, were developed for PC and/or fixed line Internet systems/applications (Viswanath V. et al., 2003; Carlsson, C. et al., 2006).

Lots of academic literature is available on acceptance of different technologies as research community is engaged in finding the reasons for acceptance and rejection of newly introduced technologies and scientific innovations. There are different acceptance models contributed and tested by research community to find the most significant factors in the acceptance of any product and system. On the basis of reviewed literature, the most

suitable and widely used theory in IS and IT field is TAM. Thus in this research TAM will be used as a basic theory to extend it further by adding few other variables. The proposed integrated framework is based on TAM as a core theory; however other constructs are taken from other theories. For example the compatibility construct is added from IDT, Social influence and facilitating conditions are added from UTAUT along with risk, cost and trust as external variables.

3. PROPOSED CONCEPTUAL FRAMEWORK

Among the IS/IT adoption theories and models, TAM (Davis, 1989) is one of the most used and cited model . Although TAM is the dominant model for the acceptance research on IS/IT, more research is required to find how other variables may influence ease of use, usefulness,, and acceptance (W. Wang & Benbasat, 2005).In addition to the constructs in TPB and TRA, some other factors that can contribute to the explanatory power of TAM need to be added in light of tasks contexts, user characteristics, and the nature of technologies in context (Moon, 2001; W. Wang & Benbasat, 2005).

However, TAM has also been regarded as to have limitations as of being too simple and over studied (Barki, 2007). TAM has been extended by adding facilitating characteristics, social influence etc. as additional constructs to become TAM2 (F. D. Venkatesh, V. et al., 2000) and TAM3 (Venkatesh, V., & Bala, 2008). In spite of these extensions, TAM is still considered to be limited and not fit for every technological acceptance contexts (Qingfei et al., 2008). As per (Lu, J. et al., 2005), TAM and its extension TAM2, are only able to explain approximately 40% of an IS/IT usage. Some other studies (Jeyaraj, A. et al., 2006) and (Lu, J. et al., 2005) suggest that TAM need to be integrated with other broader models for better and improved results for testing its predictive power. Others believe that, given the complexity of behavioral research, it is difficult to cover all or majority of the adoption factors by using a single model (Ra'ed (Moh'd Taisir) Masa'deh 1 et al., 2013). Thus TAM, IDT, TPB suffer has their own limitations and are not complement each other. On the basis of literature review, influencing factors of consumers' adoption or acceptance vary and determinants of any one theory like TAM, IDT, TRA, TPB, UTAUT, are considered insufficient (Qingfei et al., 2008). Extension or integration of theories and models is suggested as a better option (Viswanath V. et al.; Qingfei et al., 2008). Figure 4, demonstrates the conceptual framework and hypothesized relationships among various constructs.

Due to large scale acceptance, robustness and clear focus on IT/IS usage (Chandio, 2011), TAM is taken as a baseline model in this research. Some widely used IS/IT related constructs are added in the proposed integrated framework including Behavior Intention (BI), Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) from TAM, Compatibility from IDT, Social influence and facilitating condition from UTAUT and some additional external variables like trust, risk, and cost.

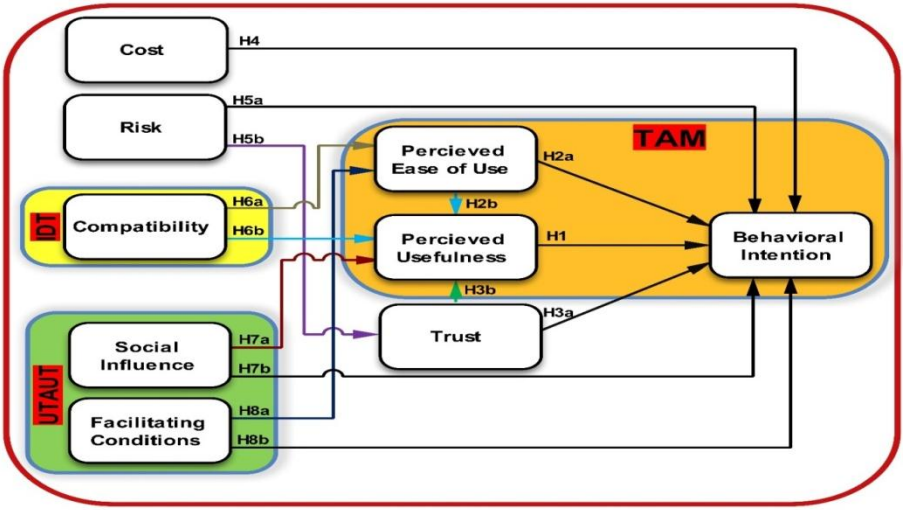

Figure 4: proposed framework for research

i. Dependent Variable-Behavioral Intention

Behavioral intention is defined as the extent to which an individual intends to perform a specific behavior (Davis, 1989). Most of the IS and IT system usage theories and literature define "Actual usage" as a key construct in their framework. However new research focused on TAM, often use Behavior Intention (BI) to measure the individual's acceptance and adoption of IT and IS (Chandio, 2011). Thus, as per TAM the impact of usefulness and ease of use is fully mediated towards the behavioral intention. In M-Commerce context it is the user's likelihood to engage in online transaction using their handheld mobile devices.

ii. Factors affecting acceptance of M-Commerce

a. Perceived Usefulness

Perceived usefulness (PU) is the extent to which a person believes that using the technology will enhance his or her performance (Davis, 1989). As per TAM, PU is a degree to which individual rely that the use of M-Commerce can improve his daily activities (Wei et al., 2009)[13]. PU is said to capture the perceived benefits related with using M-Commerce adoption (Khalifa & Shen, 2008). PU is found to have an positive effect on the adoption of mobile data services (Faziharudean & Li-ly, 2011; Chong et al., 2012). Many researchers identified that PU is a major factor that influences the adoption of ICT oriented services (Shah, et al., 2014; Qingfei et al., 2008; Davis, 1989; Gitau & Nzuki, 2014; Lin & Wang, 2006; Wu & Wang, 2005; LAI Chi Fai, 2011). Perceived usefulness plays a pivotal role in usage of web portals and acceptance of mobile commerce services (C. Liao et al., 2011). Consistent with the prior studies, it is hypothesize that:

H1. *Perceived usefulness will have positive effect on behavioral intention to accept M-Commerce*.

b. Perceived Ease of Use

Perceived ease of use (PEOU) is the extent to which a person believes that using the technology will be free of effort (Davis, 1989). Perceived ease of use reflects the perceived efforts in using M-Commerce (Khalifa & Shen, 2008). Perceived ease-of-use has been considered as the most important construct, perceived usefulness and has positive relationship with M-Commerce usage intention (Gu, et al., 2009). As per research on TAM perceived ease-of-use has direct or indirect effect on behavioral intention through perceived usefulness (Gu et al., 2009). Literature show that PEOU is an important determinant for the acceptance and adoption of IT Systems like 3G (C.-H. Liao, et al., 2007), online banking (Guriting & Ndubisi, 2006; Chandio, et al. 2011), Mobile services (Sun et al., 2010), M-Payments (Chong et al., 2012) and M-Commerce (Dai & Palvia, 2010; Mallat, et al., 2006). Thus, we hypothesize that:

H2a *Perceived ease of use will have positive effect on behavioral intention to accept M-Commerce.*

H2b *Perceived ease of use will have positive effect on perceived usefulness to accept M-Commerce.*

c. Trust

Trust is the willingness to make oneself susceptible to actions taken by the party under trust on the basis of feelings of confidence and assurance (Gefen, D. et al., 2003). Research community has been using trust as a topic of universal interest, both in theory and in research, but its meaning and concept is taken differently (Chandio et al., 2013). Current literature provides both empirical and theoretical evidence regarding the significant association of trust on BI and PU (Chandio et al., 2013; Gitau & Nzuki, 2014; Shahnawaz et al., 2014; Gu et al., 2009). Trust play an important role when transaction is being done with mobile commerce and electronic commerce using information technology enabled systems (Shah et al., 2014). Trust become crucial under some circumstances like transactional relationship between a buyer and seller, especially in situations such as an interaction with the unknown e-vendor (Lee & Ahn, 2013). Thus, on the basis of prior research, it is hypothesized as follows:

H3a *Trust will have positive effect on behavioral intention to accept M-Commerce.*

H3b *Trust will have positive effect on perceived usefulness to accept M-Commerce.*

d. Cost

Cost in M-Commerce is measured to be the cost of the mobile device, the cost of certain services usage, and applications download cost (Ra'ed (Moh'd Taisir) Masa'deh 1 et al., 2013). In context of M-Commerce, cost is a possible expense incurred in the usage of M-Commerce facility including equipment cost, transaction fees and access cost (Wu & Wang, 2005). A. Y.-L. Chong et al. (Chong et al., 2012), found that cost factor is among many other factors that can slow down the development of M-Commerce. Few other researchers found that cost significantly influence consumers' intention to use mobile commerce (Dai & Palvia, 2010; Wu & Wang, 2005; Gu et al., 2009). Furthermore, few other studies (Shahnawaz, 2014; Gitau & Nzuki, 2014) say that, high price actually induces consumers to the minimize its usage thus high purchase prices and high maintenance costs have direct effect on the intent of usage of M-Commerce (Wei et al., 2009).J.-H. Wu et al. (Wu & Wang, 2005), identified that cost has negative effect on consumer's intentions to use M-

Commerce. Thus there is a need to examine the cause of cost which may affect consumer's perceived usefulness in general and behavioral intention in specific. Therefore, it is hypothesized that:

H4 *Cost will have a negative effect on behavioral intention to accept M-Commerce.*

e. Risk

M-Commerce users may have subjective expectations about some uncertainty or loss of personal information while conducting any kind of online transaction. Risk is the "purchaser insight of unpredictability or the changeableness regarding unfavorable outcomes of products and services" (Mohsin, Ali, Shah, & Yousaf, 2012). As M-Commerce uses wireless communication as a medium for making any kind of transaction, risk concerns might arise in consumer's mind (Chong, 2013a). As per S. Mohsin et al. (Chong, 2013a), since in M-Commerce personal information is stored on users' mobile devices, security risks can be considered as quite high. In his research, Chen, L.-D.(Chen, 200AD), concluded that risk has negative effect on consumers' intention to adopt mobile payment. As per Wessels et al.(Wessels, L. & J. Drennan, 2010), if consumers perceive high risk in conducting an online transaction via mobile phone, it has negative effect on behavior intention. Similarly Koenig-Lewis et al. (Koenig-Lewis et al., 2010), found the inverse relationship between risk and trust in M-commerce context. Thus it can be hypothesized that:

H5a *Risk will have negative effect on behavioral intention to accept M-Commerce.*

H5b *Risk will have a negative effect on trust to accept M-Commerce.*

f. Compatibility

Compatibility is defined as the consistency of adopted technology with users' traditions, culture, beliefs, values, norms, needs & wants, and experiences(Wu & Wang, 2005). Some claim that, it is "the degree to which innovation is perceived as being consistent with the existing values, needs and past experience of potential adopters" (Gary C. Moore, 1991). Studies on M-Commerce verify the relative advantages of compatibility over perceived ease of use and perceived usefulness. The compatibility of Mobile services' with user needs and lifestyles have a positive effect towards its adoption (C. Kim et al., 2010). PU of technology is often predicted through compatibility which usually directs towards behavioral intention of the technology in subject (Koenig-Lewis et al., 2010). Therefore, it is hypothesized that:

H6a *Compatibility will have positive effect on perceived ease of use to accept M-Commerce.*

H6b *Compatibility will have positive effect on perceived usefulness to accept M-Commerce.*

g. Social Influence

Social influence is "an extent of an individual perception about how important others including his family, friends and colleagues believe he or she should use the new system" (Viswanath V. et al., 2003). In UTAUT, Social influence is found to be a significant determinant of user's behavioral intention(Jokar, Safarzadeh, Parhizgar, & Noroozi, 2013). UTAUT combined the basic constructs i.e. Subjective norm (from TPB , TRA, TAM2),Social factors (from PC Utilization Theory), and Image (from IDT) and named as social influence (Rutherford, 2010). L. Gitau (Gitau & Nzuki,

2014), found influence that one gets from peers or mass media may easily effect the adopting decision of M-Commerce. There is a significant relationship between social influence and intention towards the usage of M-commerce along with mobile social networks (Jokar et al., 2013; Carlsson et al., 2006; Chong et al., 2012; Qingfei et al., 2008). Many researchers in their empirical research indicate positive effect of social influence on perceived usefulness (Hsu, C. et al., 2004; F. D Venkatesh et al., 2000; Gu et al., 2009). Thus, hypothesized that:

H7a *Social influence will have positive effect on perceived usefulness to accept M-Commerce.*

H7b *Social influence will have positive effect on behavioral intention to accept M-Commerce.*

h. Facilitating conditions

Facilitating conditions are defined as "the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system" (Viswanath V. et al., 2003). Facilitates such as a data processing capabilities, speed, better interface in mobile phone device scan enable consumers to avail mobile shopping services in an easy and efficient manned (Yang & Forney, 2013). Many research studies conclude that facilitating conditions have direct influence on perceived usefulness and perceived ease of use (Gu et al., 2009; Viswanath V. et al., 2003). Similarly other found that, there is direct impact of facilitating conditions on behavioral intention of consumers (Chong et al., 2012; Carlsson et al., 2006; C. Kim et al., 2010; Jokar et al., 2013). If M-Commerce service provider and merchandisers make their site's easier to use and provide extra facilities, it will encourage new consumers, who then will suggest others (Jokar et al., 2013; Gu et al., 2009; Y. Wang et al., 2004). Hence it is hypothesized that:

H8a *Facilitating conditions will have positive effect on perceived ease to accept M-Commerce.*

H8b *Facilitating conditions will have positive effect on behavioral intention to accept M-Commerce.*

4. CONCLUSION

With significant growth, maturity and unique advantages of wireless technology, mobile phone penetration ratio has touched the global population. Business entities have taken great advantages of IS and IT in expanding their consumer market, attracting and competing globally to maximize their sales by reshaping their sales strategies. Being a new trend of electronic commerce, M-commerce has received huge market attraction for both, the business organizations and consumers in a short span of time. M-Commerce is a better choice for conducting daily commerce activities from anywhere and at any time. It is very important to analyze the main reasons of delay in large scale penetration of M-Commerce adoption in developing economies.

Having realized the real benefits and huge market penetration in developed economies, M-Commerce seems to have huge market potential. Limited academic research is conducted on M-commerce acceptance in developing economies, as it is still new and consumers have not had the much chance to use or adopt this technology in their routine life. Therefore, in this paper we propose a novel conceptual framework which aims to find

the main determinants causing the slow acceptance of M-commerce in developing economies. The proposed conceptual framework is based on some most commonly used social psychology and IS/IT theories including, IDT, TAM and UTAUT. Proposed model is still in theoretical phase and can be evaluated in future research. Synopsis of crucial factors identified by this study will be used as a guideline by all stake holders including merchandisers, sales promoters, technology specialist, business communities, service providers and software firms in optimizing their marketing, advertising and sales strategies to make proactive and feasible decisions towards best utilization of their resources as to reap the real benefits of this new and alternate business opportunity.

REFERENCES

1. Abbasi, M.S., Chandio, F.H., Soomro, A.F. and Shah, F. (2011). Social influence, voluntariness, experience and the internet acceptance: An extension of technology acceptance model within a south-Asian country context. *Journal of Enterprise Information Management*, 24(1), 30-52.
2. Barki, H. (2007). Quo vadis TAM? *Journal of the AIS*, 8(1), 211-218.
3. Carlsson, C., Carlsson, J., Hyvönen, K., Puhakainen, J. and Walden, P. (2006). Adoption of Mobile Devices / Services - Searching for Answers with the UTAUT. *Hawaii International Conference on System Sciences*, 1-10.
4. Chandio, F.H. (2011). *Studying Acceptance of Online Banking Information System: A Structural Equatıon Model*. Ph.D. Thesis-Brunel Business School, Brunel University London, (June).
5. Chandio, F.H., Irani, Z., Abbasi, M.S. and Nizamani, H.A. (2013). Acceptance of online banking information systems: An empirical case in a developing economy. *Behaviour & Information Technology*, (October 2013), 37-41.
6. Chen, J. (2007). Acceptance of Mobile Payments: A Theoretical Model and Empirical Validation. University of Portsmouth.
7. Chen, L.D. (200AD). A model of consumer acceptance of mobile payment. *International Journal of Mobile Communications*, 6(1), 32-52.
8. Chong, A.Y.-L. (2013a). A two-staged SEM-neural network approach for understanding and predicting the determinants of m-commerce adoption. *Expert Systems with Applications*, 40(4), 1240-1247.
9. Chong, A.Y.-L. (2013b). Predicting m-commerce adoption determinants: A neural network approach. *Expert Systems with Applications*, 40(2), 523-530.
10. Chong, A.Y.-L., Chan, F.T.S. and Ooi, K.-B. (2012). Predicting consumer decisions to adopt mobile commerce: Cross country empirical examination between China and Malaysia. *Decision Support Systems*, 53(1), 34-43.
11. Dai, H. and Palvia, P.C. (2010). Mobile Commerce Adoption in China and the United States : A Cross-Cultural Study. *The Database for Advances in Information Systems*, 40(4), 43-61.
12. Davis, F.D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*, 13(3), 319-340.
13. Davis, F., Bagozzi, R. and Warshaw, P. (1989). User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. *Management Science*, 35(8), 982-1003.

14. Deshmukh, S.P., Deshmukh, P. and Thampi, G.T. (2013). Transformation from E-commerce to M-commerce in Indian Context, 10(4), 55-60.
15. Rogers, E.M. (1995). *Diffusion of Innovations*, Free Press, New York.
16. Eze, U.C. (2008). Modelling User Trust and Mobile Payment Adoption : A Conceptual Framework. *Communications of the IBIMA*, 3, 224-231.
17. Faziharudean, T.M. and Li-ly, T. (2011). Consumers' behavioral intentions to use mobile data services in Malaysia. *African Journal of Business Management*, 5(5), 1811-1821.
18. Fred, D. and Davis, R.P.B.P.R.W. (1989). User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. *Management Science*, 35(8), 982-1004.
19. Gary, C. and Moore, I.B. (1991). Development of an Instrument to Measure the Perceptions of Adopting an Information Technology Innovation. *Information Systems Research*, 2(3), 192-222.
20. Gefen, D., Karahanna, E. and Straub, D. (2003). Trust and TAM in online shopping: an integrated model. *MIS Quarterly*, 27, 51-90.
21. Gitau, L. and Nzuki, D. (2014). Analysis of Determinants of M-Commerce Adoption by Online Consumers. International Journal of Business, Humanities and Technology, 4(3), 88-94.
22. Gu, J.-C., Lee, S.-C. and Suh, Y.-H. (2009). Determinants of behavioral intention to mobile banking. *Expert Systems with Applications*, 36(9), 11605-11616.
23. Guriting, P. and Ndubisi, N.O. (2006). Borneo online banking: evaluating customer perceptions and behavioural intention. *Management Research News*, 29(1/2), 6-15.
24. Hsu, C.L. and Lu, H.P. (2004). Why do people play on-line games? An extended TAM with social influences and flow experience. *Information and Management*, 4(7), 853-868.
25. Jeyaraj, A., Rottman, J.W. and Lacity, M.C. (2006). A review of the predictors, linkages, and biases in IT innovation adoption research. *Journal of Information Technology*, 21(1), 1-23.
26. Jokar, A.A., Safarzadeh, H., Parhizgar, M.M. and Noroozi, A. (2013). Designing and Examination of Mobile Commerce Diffusion Model in Iran. *World of Sciences Journal*, 1(12), 95-105.
27. Jurevičiūtė, E. (2011). Key Factor Affecting Consumers' Intention to Use Mobile Commerce in Lithuania. Masters Thesis - ISM Unıversıty of Management and Economıcs.
28. Khalifa, M. and Shen, K.N. (2008). Explaining the adoption of transactional B2C mobile commerce. *Journal of Enterprise Information Management*, 21(2), 110-124.
29. Kim, C., Mirusmonov, M. and Lee, I. (2010). An empirical examination of factors influencing the intention to use mobile payment. *Computers in Human Behavior*, 26(3), 310-322.
30. Koenig-Lewis, N., Palmer, A. and Moll, A. (2010). Predicting young consumers' take up of mobile banking services. *International Journal of Bank Marketing*, 28(5), 410-432.
31. LAI Chi Fai. (2011). *Extended UTAUT Model of Mobile Commerce : An Empirical Study of Negative User Acceptance Behaviours of Mobile Commerce in Hong Kong*. Ph.D. Thesis-Macquarie University, Sydney, Australia.
32. Layade, A.A. (2012). Mobile Commerce (M-Commerce): A future driver of business growth in Nigeria. Master's Thesis.

33. Lee, H. and Ahn, H. (2013). The Role of Trust in the Adoption of Mobile Commerce: Comparison to the Adoption of E-Commerce. *Journal of Convergence Information Technology (JCIT)*, 8, 136-147.
34. Liao, C., To, P.-L., Liu, C.-C., Kuo, P.-Y. and Chuang, S.-H. (2011). Factors influencing the intended use of web portals. *Online Information Review*, 35(2), 237-254.
35. Liao, C.-H., Tsou, C.-W. and Huang, M.-F. (2007). Factors influencing the usage of 3G mobile services in Taiwan. Online Information Review, 31(6), 759-774.
36. Lin, H.-H. and Wang, Y.-S. (2006). An examination of the determinants of customer loyalty in mobile commerce contexts. *Information & Management*, 43(3), 271-282.
37. Lu, J., Yao, J.E. and Yu, C.S. (2005). Personal innovativeness, social influences and adoption of wireless Internet services via mobile technology. *The Journal of Strategic Information Systems*, 14(3), 245-268.
38. Mallat, N., Rossi, M., Tuunainen, V.K. and Öörni, A. (2006). The Impact of Use Situation and Mobility on the Acceptance of Mobile Ticketing Services. *39th Hawaii International Conference on System Sciences*, 1-10.
39. Mishra, S. (2014). Adoption of M-commerce in India: Applying Theory of Planned Behaviour Bodel. *Journal of Internet Banking and Commerce*, 19(1), 1-17.
40. Mohsin, S., Ali, A., Shah, H. and Yousaf, U. (2012). Hesıtancy Towards Online Shoppıng , A Study of Pakistani Consumers. *Management & Marketing Craiova*, (2), 173-284.
41. Moon, J.W. and Kim, Y.G. (2001). Extending the TAM for a World-Wide-Web Context. *Information and Management*, 38(4), 217-230.
42. Pavlou, P.A. (2007). What drives mobile commerce ? A nantecedent model of mobile commerce adoption.
43. Qingfei, M.I.N., Shaobo, J.I. and Gang, Q.U. (2008). Mobile Commerce User Acceptance Study in China: A Revised UTAUT Model. *Tsinghua Science and Technology*, 13(3), 257-264.
44. Ra'ed (Moh'd Taisir) Masa'deh, Rifat O. and Shannak, M.M.M. (2013). A Structural Equation Modeling Approach for Determining Antecedents and Outcomes of Students' Attitude toward Mobile Commerce Adoption. *Life Science Journal*, 10(4), 2321-2333.
45. Rutherford, B.N. (2010). *Factors that Influence Consumer's Adoption Behavior in M-Commerce*. Master Thesis-Purdue University, Indiana, 9.
46. Sahin, I. and Rogers, F. (2006). Detailed Review of Roger' Diffusion of Innovations Theory and Educational Technology-Related Studies Based on Rogers, 5(2), 14-23.
47. Shah, M.U., Fatimee, S. and Sajjad, M. (2014). Mobile Commerce Adoption: An Empirical Analysis of the Factors Affecting. *Journal of Basic and Applied*, 4(4), 80-88.
48. Shahnawaz, M. (2014). Adoption of E-Commerce amongst Pakistani Consumers A Case of Mobile Banking. *International Review of Management and Business Research*, 385-396.
49. Sun, Q., Cao, H. and You, J. (2010). Factors influencing the adoption of mobile service in China: An integration of TAM. Journal of Computers, 5(5), 799-806.
50. Vasileiadis, A. (2013). *Security Concerns and Trust in the Adoption of M-Commerce*. Master's Thesis-Mykolas Romeris University.

51. Venkatesh, V. and Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. *Decision Sciences*, 39(2), 273-315.
52. Venkatesh, V. and Davis, F.D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, 46(2), 186-204.
53. Venkatesh, V. and Davis, F.D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, 46(2), 186-204.
54. Viswanath Venkatesh, Michael G. Morris, Fred D. Davis, Gordon B. Davis. (2003). User Acceptance of Information Technology : Toward a Unified View. *MIS Quarterly*, 27(3), 425-478.
55. Wang, W. and Benbasat, I. (2005). Trust in and Adoption of Online Recommendation Agents. *Journal of the Association for Information Systems*, 6(3), 72-101.
56. Wang, Y., Lo, H.-P. and Yang, Y. (2004). An Integrated Framework for Service Quality, Customer Value, Satisfaction: Evidence from China's Telecommunication Industry. *Information Systems Frontiers*, 6(4), 325-340.
57. Wang, Y.S., Wang, Y.M., Lin, H.H. and Tang, T.I. (2003). Determinants of user acceptance of Internet banking: an empirical study. *International Journal of Service Industry Management*, 14(5), 501-519.
58. Wei, T.T., Marthandan, G., Chong, A.Y.-L., Ooi, K.-B. and Arumugam, S. (2009). What drives Malaysian m-commerce adoption? An empirical analysis. *Industrial Management & Data Systems*, 109(3), 370-388.
59. Wessels, L. and J. Drennan. (2010). An investigation of consumer acceptance of M-banking. *International Journal of Bank Marketing*, 28(7), 547-568.
60. Wong, Y.K. and Hsu, C.J. (2006). A confidence-based framework for business to consumer (B2C) mobile commerce adoption. *Personal and Ubiquitous Computing*, 12(1), 77-84.
61. Wu, J.-H. and Wang, S.-C. (2005). What drives mobile commerce? *Information & Management*, 42(5), 719-729.
62. Yang, K. and Forney, J.C. (2013). The Moderating Role Of Consumer Technology Anxiety in Mobile Shopping Adoption: Differential Effects Of Facilitating. *Journal of Electronic Commerce Research*, 14(04), 334-347.
63. Zheng, H., Li, Y. and Jiang, D. (2012). Empirical Study and Model of User's Acceptance for Mobile Commerce in China. *International Journal of Computer Science Issues*, 9(6), 278-283.

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FORMAL METHOD: A DIVIDEND DRAWN FROM HIGH PERFORMANCE COMPUTING (HPC) ENVIRONMENT

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ABSTRACT

Inspite of the complexity in developing a high performance software system, the major purpose of Software Engineering is to develop a system that should be reliable. Formal Methods can lead towards this goal. Formal Methods are mathematical based techniques which are used to specify and verify system requirements. Inspite of their world-wide recognition and number of advantages, they are still not widely used in commercial software industry. Number of evidences exemplify that the results of Formal Methods applications are much better in quality and reliability. This paper summarizes some success stories of High Performance Computing (HPC) systems, emerged by applying Formal Methods rather than traditional approach including CUTE, SATS, SRT division algorithm, Pentium IV processor design, Motorola 68020, AMD5K86, Motorola CAP, AAMP5, Tokeneer ID Station, DIPLODOCUS etc. The purpose of this research work is to motivate software engineers to use Formal Methods in general purpose software.

KEYWORDS

Formal Methods, System requirments, Formal Specification, HPC etc.

1. INTRODUCTION

Rapid increase in software requirements for new systems results in complexity of modern systems. This complexity increases the difficulty of system development process. This becomes more crucial for a system where high performance is required (Roslina, M.S. et al., 2010). In a well-known article published in 1987, (Brooks, F.P., 1987) states that *"The hardest single part of building a software system is deciding what the requirements are…… No other part of the work so cripples the resulting system if done wrong …..[or] is as difficult to produce and hard to fix later on."* So it is an understood fact that requirement phase of any software development process should be handled seriously.

2. BACKGROUND

It is found in literature that the most of the problems identified in safety-related software from inadequate or misunderstood requirements (Lutz, R.R. 1993). In another study, it is also evident that conventional techniques fail to catch many requirements errors (Kelly et al., 1992).

Formal Methods are appropriate solutions of these problems. Formal methods are mathematical based techniques for specification, development and verification of software and hardware systems. Specific formal languages are used to represent these methods (Pressman Roger S, 2000). Formal methods also form the foundations of developing more trustworthy software for critical/high performance systems (Nami, M.R. et al., 2008).

Formal methods are not widely used in industry for commercial applications due to their complexity. Software engineers hesitate to implement formal methods because of unambiguous concepts of discrete mathematics and lack of skills (Jabeen, J. et al., 2014). Still number of evidences illustrate that the performance of software improves by applying Formal Methods in the High-performance computing (HPC) environment (Bowen, J. et al., 1993).

HPC is the use of parallel processing for running advanced application programs efficiently, reliably and fast. High Performance Computing Applications consist of concurrent programs designed using multi-threaded as well as multi-process models.

To address the benefits of formal methods in HPC, the systematic literature review is performed which seeks to collect and compare existing evidence on formal methods. The aim of this research work is to provide direction and motivation to researcher and developers with advice in adoption of formal methods. In this review, the authors only look into papers which exclusively focus on success stories of Formal Methods applications.

The paper is structured as follows: Section 2 describes the background. In Section 3, research method used in this systematic review. In Section 4, success stories regarding formal methods where high performance is required, while Section 5 discusses findings and observations from the review regarding improvements in software requirements through formal methods and the paper concluded with future work in section 6.

3. RESEARCH METHOD

We followed the principles of a systematic literature review (Kitchenham, B., 2007), which is a well-defined approach to identify, evaluate and interpret all relevant studies regarding a particular research question, topic area or phenomenon of interest.

Literature study has been carried out, review protocol was defined, which includes search strategy and scope. The search criteria express the research topics of interest in this literature review, according to which screening of related papers has been done. The scope of the review was based on the identification of the main workshops, conferences, and journals in the field. As search strategy, we combined automatic with manual search. Automatic search was defined as a two-step process for which two search strings were

defined. The first string aims to select the studies on use of Formal Methods in Industry, and the second string aims to filter the studies on success stories of formal methods. For the manual search, inclusion and exclusion criteria were defined.

3.1 Data Sources and Search Strategies

The electronic databases that we have included to search relevant material related to success stories of formal methods specially on high performance computing environment were:

- ACM Digital Library (portal.acm.org)
- Science Direct– Elsevier (www.sciencedirect.com)
- IEEE Xplore (ieeexplore.ieee.org)
- Springer Link (www.springerlink.com)
- Citeseer (citeseerx.ist.psu.edu)

Moreover, the proceedings of the International Symposiums on Formal Methods were manually searched. Besides it, volumes of International Requirements Engineering Conference which is the major event in requirements engineering were also searched.

3.2 Publication Selection & Screening

We further refined the studies resulting from automatic search using a manual search step. The goal of this step is to identify the primary studies that are directly related to the research questions. Therefore, we defined the following inclusion/exclusion criteria:

- ✓ **Inclusion criterion 1:** We included studies which employ some formal terms, but do not actually employ formal methods for a particular purpose related to high performance as well as safety critical systems.
- ✓ **Inclusion criterion 2:** Papers of journals having good impact factors and well known conferences have been included, that gives sufficient material on the domain.
- × **Exclusion criterion 1:** Short papers in which much relevant information was not provided are excluded while doing this study.
- × **Exclusion criterion 2:** We mainly focus on the use of formal for high-performance computing concerns, rather than techniques/languages of formal methods. As these studies do not provide information regarding the research questions.

On the basis of the above screening criteria, 72 papers left after title screening, 41 after abstract and 23 after the screening of complete papers, out of total 112 papers.

4. FORMAL METHODS - SUCCESS STORIES

Significant advances in the practical use of formal methods have relied on fundamental results drawn from all areas in computer science, not necessarily directly intended for formal methods. We have illustrated some of the success stories of Formal Methods for motivation in HPC environment.

4.1 CUTE - A Concolic Unit Testing Engine

CUTE, a Concolic Unit Testing Engine for C and Java is a tool to systematically and automatically test sequential C programs (including pointers) and concurrent Java

programs. CUTE combines concrete and symbolic execution in a way that avoids redundant test cases as well as false warnings. The tool also introduces a race-flipping technique to efficiently test and model check concurrent programs with data inputs. CUTE was used to automatically test SGLIB, a popular C data structure library used in a commercial tool. CUTE took less than 2 seconds to find two previously unknown errors i.e. a segmentation fault and an infinite loop.

4.2 SATS - Small Aircraft Transportation System

It is designed to facilitate transportation between small General Aviation airports using small aircraft as an alternative to traditional airline travel. A software system was designed in 1995 that will sequence aircraft into the SATS airspace in the absence of an airport controller. There were serious safety issues associated with these software systems and their underlying key algorithms. Formal Methods were then applied in order to address these security related problems.

4.3 SRT Division Algorithm

In 1995, Clarke, German, and Zhao used automatic theorem-proving techniques based on symbolic algebraic manipulation to prove the correctness of an SRT division algorithm similar to the one in the Pentium. This verification method runs automatically and could have detected the error in the Pentium, which was caused by a faulty quotient digit selection table.

4.4 Processor design

The Pentium IV processor was the first project of its kind at Intel to apply Formal Verification (FV) on a large scale. Whereas IBM uses Verity verification tool widely in the design of many processors such as the PowerPC and System/390, the tool can handle entire processor designs containing millions of transistors. By using this tool, the functional behavior of a hardware system at the register transfer level, gate level, or transistor level is modeled as a Boolean state transition function. Algorithms based on BDDs are used to check the equivalence of the state transition functions for different design levels.

4.5 Motorola 68020

The formal specification of Motorola 68020 microprocessor used to prove the correctness of many binary machine code programs produced by commercial compilers from source code in such high-level languages as Ada, Lisp, and C.

4.6 AMD5K86

Starting from an informal proof of correctness, designers of the system formalized their argument in the ACL2 logic and checked it with the ACL2 mechanical theorem prover. Gaps and mistakes were found in the informal “proof” but in the end the microcode was mechanically shown to be correct the entire effort took about nine weeks. The mechanical proof ended doubt about the code’s correctness and allowed testers to focus on other routines. In 1996 Russinoff used ACL2 to check the correctness of the floating-point square root microcode. He found bugs in the microcode itself; after they

were fixed, the final version of the square root microcode was also mechanically proved correct.

4.7 Motorola CAP

Yet another advancement of Motorola in the field of processing was Complex Arithmetic Processor (CAP), a microprocessor for digital signal processing (DSP). The CAP was the most intricate microprocessor developed at that time, with a three-stage pipeline, six independent memories, four multiplier-accumulators, over 250 programmer visible registers, and an instruction set allowing the simultaneous modification of well over 100 registers in a single instruction. The formal specification tracked the evolving design and included a simpler non pipelined view that was proved equivalent on a certain class of programs.

4.8 AAMP5

Avionics AAMP5 microprocessor used PVS to specify 108 of the 209 AAMP5 instructions and verified the microcode for 11 representative instructions with model checking, an increase in the number and kinds of theorem provers provides evidence for a growing interest in theorem proving.

4.9 The Tokeneer Secure Entry System

Another achievement of Formal Methods is Tokeneer system, was originally developed by the NSA, to investigate various aspects of biometrics in access control. Users of this system have security tokens (e.g., smartcards) in order to gain access to the workstations. Users present their security tokens to a reader outside the enclave, which uses information on the token to carry out biometric tests (e.g., fingerprint reading) of the user. If the user passes these tests, then the door to the enclave is opened and the user is allowed entry.

4.10 DIPLODOCUS

DIPLODOCUS is a UML profile intended for the modeling and verification of real-time and embedded applications meant to be executed on complex Systems-on-Chip. Application tasks and architectural elements (e.g., CPUs, bus and memories) are described with a UML-based language, using an open-source toolkit named TTool. Those descriptions may be automatically transformed into a formal hardware and software specification. From that specification, model-checking techniques may be applied to evaluate several properties of the system, e.g., safety, schedulability, and performance properties. The approach is exemplified with an MPEG2 decoding application.

5. FINDINGS AND OBSERVATIONS

From the success stories/reviews presented in previous section it can be inferred that there is growing interest in formal methods because they offer precise support of computer system development. Formal methods are particularly desirable in safety-critical / HPC applications such as process control, aviation, medical systems, railway signaling and many others.

Formal Method is a very active research area with a wide variety of methods and mathematical models. In current scenario, there is not available any one method that fulfills all the security related needs of building a secure formal specification. Researchers and practitioners are continuously working in this area and thereby gaining the benefits of using formal methods.

Formal Specifications and verification are not easy or cheap, but the real cost has to be considered in the long term. On the other hand, their conclusions have to be taken with care, formal methods can only be used to specify or prove what was carefully stated beforehand, and cannot be used to reason about what was not. Formally specifying and verifying a whole system is unlikely to be feasible or even reasonable. The advisable practice is to determine the critical parts of the system to be designed and validated, and to apply formal methods on those parts only.

6. CONCLUSION AND FUTURE WORK

Formal methods in the high performing systems are mainly used for modeling and reasoning. However, the full power of formal methods comes with automation, in particular for model checking and theorem roving. Tools are currently under-exploited and provide an opportunity to further mature the field.

This paper helps the researcher/s and developers to understand the potential usefulness of formal methods along with challenges usually faced in making formal methods practical. This work motivates software engineers to incorporate formal methods in HPC as well as in general purpose software.

In many studies, authors introduce custom modeling language constructs. Often, the mathematical underpinning and soundness of these languages is assumed for granted (but usually not provided). This aspect requires attention as mathematical underpinning is the foundation of any formal method.

REFERENCES

1. Roslina, M.S. and Noraziah, A. (2010). A Venn Requirement Language for User Requirement. *IEEE International Conference on Electronic Computer Technology* (ICECT-2010), Kaula Lumpur, 223-227.
2. Brooks, F.P. (1987). No Silver Bullet: Essence and Accidents of Software Engineering. *IEEE Computer*, 20(4), 10-19.
3. Lutz, R.R. (1993). Analyzing Software Requirements Errors in Safety-Critical Embedded Systems. *Proc. of the IEEE International Symposium on Requirements Engineering*, San Diego, 126-133.
4. Kelly, J.C., Sherif, J.S. and Hops, J. (1992). An Analysis of Defect Densities Found during Software Inspections. *Journal of Systems and Software*, 17(2), 111-117.
5. Pressman Roger S. (2000). *Software Engineering - A Practitioner's Approach*. McGraw Hill, 5th edition. 2000.
6. Nami, M.R. and Malekpour, A. (2008). Formal Specification of a Particular Banking Domain with RAISE Specification Language. *IEEE Symp. on Computers and Communications, Marrakech*, 695-699.

7. Jabeen, J., Abbasi, M.A. and Minhas, N.M. (2014). A Comparative Analysis of Formal languages Based upon Various Parameters. *International Journal of Engineering Research & Technology* (IJERT).
8. Bowen, J. and Stavridou, V. (1993). Safety-critical methods and systems, formal standards, *Software Engineering Journal*, 8(4), 189-209.
9. Kitchenham, B.A. (2007). Guidelines for performing Systematic Literature Reviews in Software Engineering, *Tech. Rep.*, EBSE-2007-001.
10. Batra, M., Malik, A. and Dave, M. (2013) Formal Methods : Benefits, Challenges and Future Direction. *Journal of Global Research in Computer Science*, 4, 2-6.
11. Bowen, J.P. and Hinchey, M.G. (2006) Ten Commandments of Formal Methods... Ten Years Later. *Computer*, 39, 40-48.
12. Clarke, E.M. and Wing, J.M. (1996). Formal methods: State of the art and future directions. *ACM Computing Surveys*, 28, 4, 626-643.
13. F.P. Brooks (1987). No Silver Bullet: Essence and Accidents of Software Engineering. *IEEE Computer*, 20, 4, 10-19.
14. I. Dubravk (2007). Deriving Formal Specifications from Informal Requirements. Proceedings of the *31st IEEE Annual International Computer Software and Applications Conference*, Beijing, 145-152.
15. Groote, J.F., Osaiweran, A.A.H. and Wesselius, J.H. (2011). Benefits of Applying Formal Methods to Industrial Control Software. 1-10.
16. K. Daniel, A. Ludovic and P. Renaud (2010). Formal System-level Design Space Exploration. *IEEE* 978-1-4244-7068-6/10.
17. S.W.A Rizvi, R.A. Khan and R. Asthana (2013). Improving Software Requirements through Formal Methods: A Review. *International Journal of Information and Computation Technology*. 3(11), 1217-1224.
18. Weyns, D., Iftikhar, M.U., Iglesia, D.G. and Ahmad, T. (2012). A Survey of Formal Methods in Self-Adaptive Systems. *Proceedings of the Fifth International Conference on Computer Science and Software Engineering*, 67-79. DOI 10.1145/2347583.2347592
19. Singh, M. (2013) Formal Methods: A Complementary Support for Testing. *International Journal of Advanced Research in Computer Science and Software Engineering*, 3, 320-322.
20. Bibi, S., Mazhar, S., Minhas, N.M. and Ahmed, I. (2014). Formal Methods for Commercial Applications Issues vs Solutions. *Journal of Software Engineering and Applications*, 7, 679-685.
21. Holloway, C.M. (1997). Why Engineers should consider Formal Methods. *16th Digital Avionics Systems Conference*.
22. Saiedian, H. (1996). An Invitation to Formal Methods. *IEEE Computer*, 16-30.

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EFFECT OF ENGLISH AS A MEDIUM OF INSTRUCTION ON ENROLMENT OF STUDENTS AT ELEMENTARY LEVEL IN LAHORE

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ABSTRACT

This study was designed to investigate the "Effects of English as a medium of instruction on Enrolment of students at elementary level in Lahore". The study was survey based. The population of the study was all the students of elementary level in Lahore. Convenient sampling technique was employed by the researcher. The data was collected from eight public schools by using survey research method. The data was taken from the enrolment of students of class one for the year of 2009 to 2012. For the data analysis simple percentage method was used. After the data analysis the result shows that the enrolment of students in public schools is increase after the implement of the policy.

INTRODUCTION

The present study focuses on "Effects of English as a medium of instruction on Enrollment of students at elementary level in Lahore". The learning environment is of very critical importance to the educational enterprises. Language is the most vital component in imparting education. It makes it easier or difficult for a student to understand the knowledge given. Since independence, policy makers have not been able to decide which language is to be accepted as medium of instruction and teaching.

> *"The medium of instruction is the bases of any education. By medium of instruction we mean the language we use in our Scholastic and educational career as the prime way through which we acquire knowledge of different arts and science"* (Unpublished, 2006, M.A Edu, thesis).

Not all education or training is essentially an instruction, but instruction is an obligation and an important part of education and training system.

> *"I shall use the term 'instruction' to mean an aim – focused teaching process which is more or less pre – planned"* (Romiszowski, 1988).

According to the newspaper "Pakistan times" (2001) national language must be top priority, china has Chinese, Arabia has Arabic, and Iran has Persian, why Pakistan should be left in introducing its own language. Urdu is not only the international language, but it is also the mother tongue and a child understands best in his mother tongue. It is very convenient medium for higher education with other language of the world one easily admits its vitality and richness because of life. Nearly two third of the world's news pattern and other periodicals are printed partly or entirely in national language. English as a medium of instruction would make teaching rather difficult for teachers. It is not easy to teach any subject, because a teacher must have the skill that is required and it is essential

for them to know the in and out of that higher education examined 1956. As English gained prestige and importance and knowledge of this language provided increased scope for employment, it needs a place of special attention in the education system (The Pakistan times Lahore, 5/3/2001).

Communication is the dire need of man. He uses language to fulfill his requirement. Not only human being but almost all the creations exchange their feelings, ideas and desires either via signs or words .A child may show his joys and sorrow with excretions, motions and other means, he actually expresses his thoughts, this can be called a language. Language is a proficiency, knowledge or a medium, used to inculcate the thoughts and emotions (Ajmal, 2005).

Language is very conjoint phenomenon. Everybody, whoever he may be, is learning something. Even animals are no exception to this statement. Learning is incessant process. Throughout life man goes on learning new things (Mumtaz, 2003).

According to J. Whitemouth;

> "Language is human… a verbal systematic representation … a means of conveying information… a form of social behavior…(With a) high degree of convention"

According to B. Bloch and G.L. Trager (1942)

> "Language is a system of subjective vocal symbols by mean of which a social group of co-operates"

In today's world, English has become the first international language , English speaking countries thinks that the world has realized if English as medium of instruction is ignored, the decline in the field of science, technology and commerce is unavoidable (Mueen, 1992).

Since 1947, we as being Pakistani have been trying to analyze and find a solution to the problem of medium of instruction. In actual practice two parallel streams of education has been functioning in the country. One stream followed the syllabi through the medium of Urdu and other through the medium of English.

Moreover, the use of English as medium of instructional communication is not confined to such countries. In the past few hundred years the English speaking people have played a large part in seafaring international trade, and English has become one of the essential commercial languages of the world. Of course, English is not the only international language. Arabic, French, German, Malay, and Spanish all play important part in certain areas. Russian has become of greater international importance than ever before, and will undoubtedly continue to go up; and we can confidently expect that Chinese will be followed soon. But at the moment it does seem that English is the most important for international language in medium of instruction (Barber, 1964, The story of language).

English as medium of instruction has achieved the status of the language of international communication. It is only widely spoken language in the world. In 75 territories of the world, it holds a special place. About 1800 million people use English throughout the world. It is one of the languages used in the UN. The travelers, tourists advertising agencies use this language of international air traffic control. We can study

world literature through translation if we know English. International trade and business are carried out in this language (Ahmad, 2003, Teaching of English).

English is undoubtedly the most important and widely spoken language in the world today. It is the most extensively used language of the commonwealth countries, USA, the African states, china, Japan, Indonesia and most of the European and Asian countries. The latest statistics show that more than half the world directly makes use of English. By the time some international medium of speech is eventually evolved; English can safely serve the purpose. The world has shrunk in size and a trip round the globe hardly takes more than two days (Ahmad, 1968, Teaching of English as a second language).

The national commission on education (1959) strongly recommended the use of English from class 6 to 12 in school and at the graduate level in 1980, all the school including the English mediums were ordered to impart instruction in Urdu and the education board decided to conduct examination in Urdu but the policies regarding the change of the medium of instruction from English to Urdu announced from time to time could not be implemented. Thousands of schools continued imparting instruction in English even universities allowed the language option to students either to adopt Urdu or English at graduate level (1964) and postgraduate level (1966).(Ahmad, 2003, Teaching of English)

The change over from English to our national language undoubtedly one of the cardinal Principles of our national policy. This is clearly laid down in article 215 of the constitution of Pakistan which also prescribes a clear cut procedure to attain the ultimately objective. We shall have to retain English as a compulsory language at the secondary stage and at the graduate level. This view was also advocated by the commission on national education (1959) which has observed that English will continue to be the only effective means of communication with the outside world and the most adequate source of information on the latest developments in science and technology. Therefore all educated persons in the country should have a sound knowledge of this language (Ahmad, 1968, Teaching of English as a second language).

English is the sole language of courts and administration. Judgments are written in English, appeals of law books are in English. Brochures for the foreign tourists are published in English. Major newspapers Dawn, The News, The Nation are published in English. In general public, there is a craze for English. In every street, English medium schools have mushroomed. English has become the life style of people. Who feel proud to know and speaking English. Even those who do not know English try to use English worlds in their speech (Baumgartner, 1993 The English Language).

IT is really that we need English because it is a great to the acquisition of knowledge in science and technology. There for it should be taught as a compulsory subject from first great to graduate level. The commission of national education subscribes that English yield to the place of national language in our educational system. English should be taught as a workable language rather than as a literary language. On the other hand it is said that English should be taught as a medium of instruction for various purposes. This is necessary to enable our students to study science subjects. (Baumgartner, 1993, The English Language)

The end product of reading is comprehension and communication. Like listening, it seems a receptive skill, being passive in nature. But actually, reading involves various activities and demands a very conscious effort on the part of the reader. The reader's role is that of a recipient and decoder. His responsibility is to bring-sense and understanding to the text by making use of what he already knows. This knowledge is referred to as the shared knowledge between the reader and the writer. The degree of reader comprehension is directly proportioned to the extent of this shared knowledge. The reader recreates what the writer has constructed and through his knowledge, extends it in a creative way. The reader performs a sequence of activities while reading.

"Reading is an active interrogation of a text. It is an interactive process; a psycho linguistic game" (Mueen, 1992).

The story of adopting English as medium of instruction is way old. It was initially accepted as the language for air traffic control, later it become very popular in international organization, media, music, industry, space science and computing technology. It has also become a 'library language' making knowledge readily reachable to scholars all over the world. English language now enjoys the status of the 'lingua franca' (language use for communication among people of different mother tongues) of the new academic world. The English language finds itself in the unique position in which non-native speakers out number native speakers, there being, reportedly, about 350 million native speakers and 1 to 2 billion non-native users which is a huge achievement.

English as medium of instruction being the language of science and Technology, Its importance can neither be denied nor ignored. The recent revolution in the information technology is almost entirely based on English language. Therefore, in order to remain in step with the expanding frontiers of human knowledge, the use of English as medium of instruction in Pakistan needs to be actively sponsored by the educated and patronized by the policy makers. It is the crying need of today to face these challenges for our existence. English as medium of instruction is one of the most important challenge that we are facing today. To get command over English as medium of instruction, an understanding of basic speaking skills is necessary.

Thus, this study was designed to investigate the "Effects of English as a medium of instruction on Enrollment of students at elementary level in Lahore".

METHODOLOGY

A self-structured questionnaire was issued to the students and teachers at elementary level from public schools. The researcher personally visited different schools to observe the effects of English as a medium of instruction on enrollment at elementary level.

All the students and teachers of elementary level schools of Lahore were the population of this study. Eight public schools were selected as sample where 75 students and 15 teachers of public school in Lahore were selected by using convenient sampling technique. At the same time the enrollment for the year of 2009 to 2012 is also collected from the schools selected as a sample.

Keeping in view the nature of the sample it was decided to develop questionnaire as an instrument of data collection. It consisted of 22 items of teachers and 22 items of students. In these statements there were three options, positive, neutral and negative. To analyze the data simple percentage method was used in tabulated form and conclusions were drawn. These responses were interpreted after the statistical treatment.

RESEARCH QUESTIONS

The following were the research questions of study:

Research Question 1:

Enrolment of student of class 1 in 2009/10 before implementation of policy of English as a medium of instruction.

Year Wise Enrollment in Class 1 in Different Schools of Lahore

Table 1

Year	School 1	School 2	School 3	School 4
2009	48	42	28	32
2010	54	45	30	37

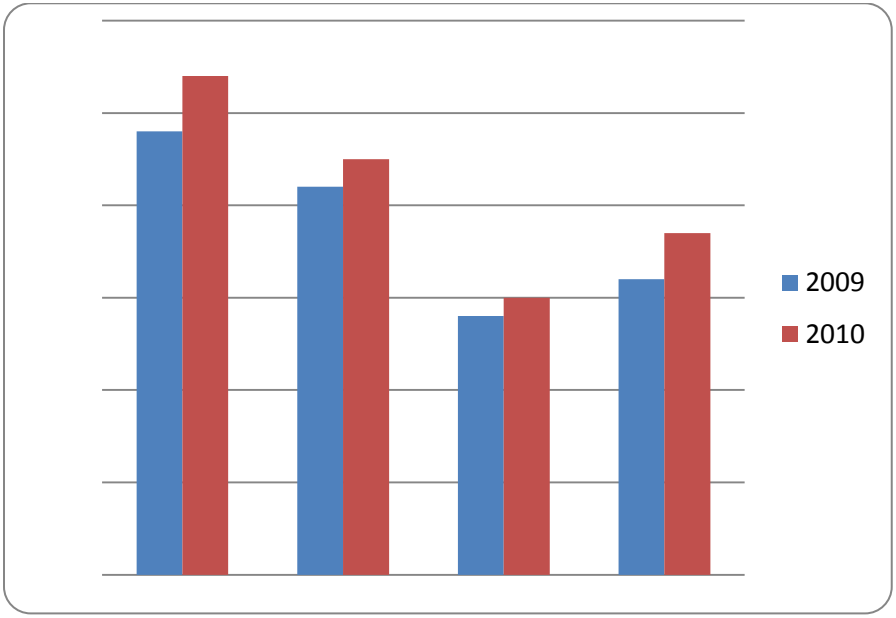

Figure 1

The above graph shows the enrolment data of class 1. Data is shown year wise the above chart shows that the enrolment of the students is increased after the implementation of the English language as the medium of instruction in public schools.

Research Question 2:

Enrolment of student of class 1 in 2011/12 after implementation of policy of English as a medium of instruction.

Table 2

Year	School 1	School 2	School 3	School 4
2011	61	71	38	40
2012	70	75	42	46

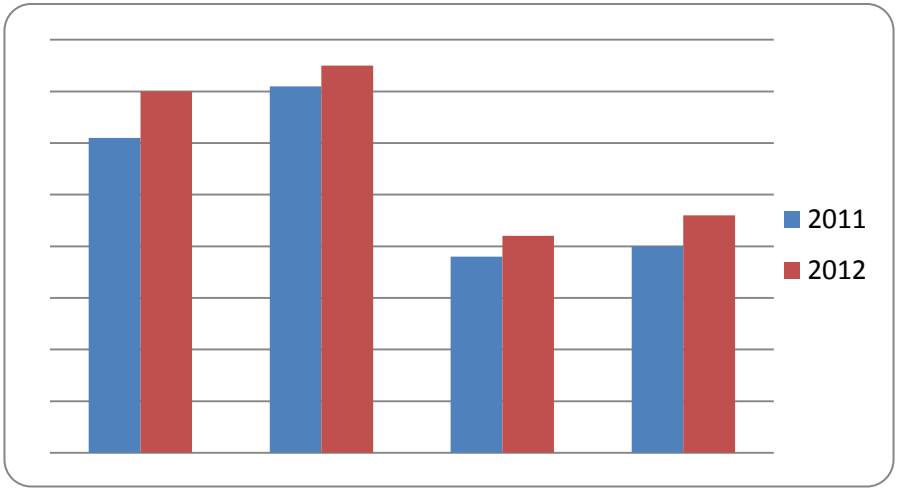

Figure 2

The above graph shows the enrolment data of class 1. Data is shown year wise. The above chart shows that the enrolment of the students is increased after the implementation of the English language as the medium of instruction in public schools.

Research Question 3:

Difference of Enrolment of student of class 1 in before and after implementation of policy of English as a medium of instruction.

Table 3

Year	School 5	School 6	School 7	School 8
2009	82	13	168	80
2010	95	15	158	58

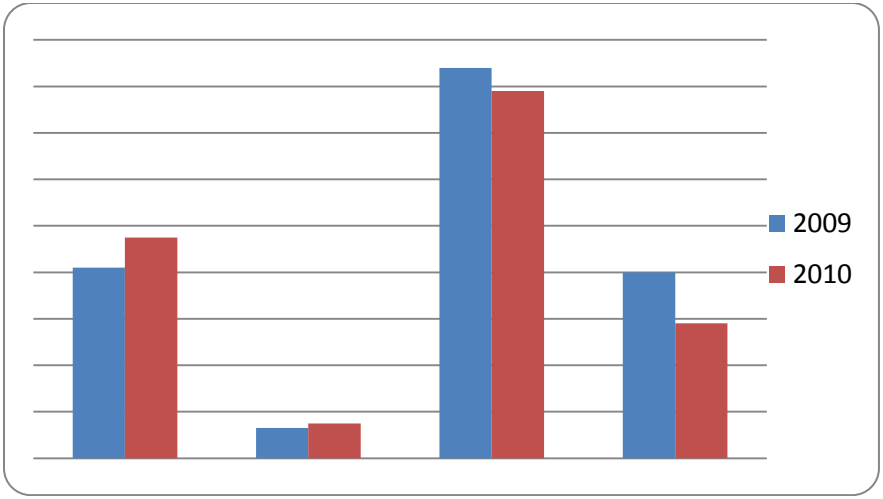

Figure 3

The above graph shows the enrolment data of class 1. Data is shown year wise the above chart shows that the enrolment of the students is increased after the implementation of the English language as the medium of instruction in public schools.

VIEW POINTS

Questions	% Positive	% Neutral	% Negative
English is more suitable for clarification of concept	44	37.33	18.67
You can easily understand your teacher's talk	70.63	26.67	2.67
You play an active role in writing	66.67	30.67	2.67
Delivery of lecture in English is understandable for you.	57.33	40.00	2.67
You lay more emphasis on listening	61.33	24.00	14.67
You think that English facilitate learning process	72.00	25.33	2.67
Completely switching over to English is more helpful in understanding the curse content	44.00	36.00	20.00
Reading of English books required more time as compare to Urdu books.	61.33	29.33	9.33
You would prefer doing work in English	56.00	26.67	17.33
You would prefer to attempt your examination paper in English.	48.00	38.67	13.33
You would prefer to talk to your class fellows in English.	46.67	34.67	18.67
You play an active role in reading.	56.00	41.33	2.67

BIBLIOGRAPHY

1. Ahmad, Mumtaz (2003). *Teaching of English*, College Book Depot, Lahore.
2. Barber L.C. (1964). *Story of Language*, Pan Book Ltd, London.
3. Baumgardner J. Robert (1993). *The English Language*, Oxford University Press, London.
4. Khan, A.M. (2005). *Teaching of English*, Majeed Book Depot, Lahore.
5. Mueen Ayeshe (1992). English Language Teaching in Pakistan, National Book Foundation, Islamabad.
6. Romiszowski, J.A. (1988). Designing Instructional System, Nichols Publishing Company, USA.
7. Saif-ul-Haq, M.M. (1982). An Approach to Study of Linguistics, New Kitab Mahal, Lahore
8. Sh. Nazeer Ahmad (1968). Teaching of English as a Second Language, Lahore: The Caravan Book House.
9. Sweet Henry (1989). The Practical Study of Language, Oxford University Press, London.
10. Taleme Jaiza. Lahore. (December 15, 2007).
11. The Pakistan Time. Lahore. (March 5, 2001).

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ON ESTIMATION OF FINITE POPULATION VARIANCE IN SIMPLE RANDOM SAMPLING

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ABSTRACT

In this paper, we have developed three new estimators for the variance of finite population in simple random sampling. Algebraic comparison of the new estimators of population variance is made with some available estimators and empirical study has also been conducted to see the performance of the proposed estimators.

KEYWORDS

Auxiliary variable, dual estimator, bias, mean square error, relative efficiency.

1. INTRODUCTION

In survey sampling, the use of supplementary information increases the precision of the estimators of population parameters like population mean, population variance and population total etc. The studies regarding estimation of population variance are made by Das and Tripathi (1978), Srivastava and Jhajj (1980), Isaki (1983), Singh et al. (1988), Searls and Intarapanich (1990), Singh et al. (1999), Singh and Singh (2001), Kadilar and Cingi (2006a, 2006b), Gupta and Shabbir (2008), Singh et al. (2011), Subramani and Kumarapandiyan (2012a, 2012b and 2013) and Yadav and Kadilar (2013) etc.

In this paper, we have developed three new estimators of the finite population variance. We have obtained the expressions for the mean square errors of the suggested estimators. The conditions under which the new estimators are more efficient than the available estimators have also been derived. We have also carried out an empirical study in the support of our results.

2. SOME AVAILABLE ESTIMATORS

Let $U_1, U_2, \ldots, U_N$ be the units of a finite population U of size N and a sample of size n is selected from the population with the help of a simple random sampling without replacement method. Let a highly positive correlation co-efficient exists between the variable of interest Y and the auxiliary variable X.

i) The simple unbiased estimator of the variance of a finite population is given as:

$$t_0 = s_y^2 = \frac{1}{n-1}\sum_{i=1}^{n}\left(y_i - \bar{y}\right)^2 . \tag{2.1}$$

The variance of t_0 is given by

$$Var\left(t_0\right) = fS_y^4\left(\lambda_{40} - 1\right), \tag{2.2}$$

where

$$\lambda_{rs} = \frac{\mu_{rs}}{\mu_{r0}^{\frac{r}{2}}\mu_{0s}^{\frac{s}{2}}},\ \mu_{rs} = \frac{1}{N-1}\sum_{i=1}^{N}\left(Y_i - \bar{Y}\right)^r\left(X_i - \bar{X}\right)^s \text{ and } f = \frac{1}{n} - \frac{1}{N}.$$

ii) Isaki (1983) suggested the following estimator

$$t_1 = s_y^2\left(\frac{S_x^2}{s_x^2}\right), \tag{2.3}$$

where

$$s_y^2 = \frac{1}{n-1}\sum_{i=1}^{n}\left(y_i - \bar{y}\right)^2,\ s_x^2 = \frac{1}{n-1}\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2,\ S_x^2 = \frac{1}{N-1}\sum_{i=1}^{N}\left(X_i - \bar{X}\right)^2,$$

$$\bar{Y} = \frac{1}{N}\sum_{i=1}^{N}Y_i,\ \bar{X} = \frac{1}{N}\sum_{i=1}^{N}X_i,\ \bar{y} = \frac{1}{n}\sum_{i=1}^{n}y_i \text{ and } \bar{x} = \frac{1}{n}\sum_{i=1}^{n}x_i .$$

The mean square error of t_1 is

$$MSE\left(t_1\right) = fS_y^4\left[\left(\lambda_{40} - 1\right) + \left(\lambda_{04} - 1\right) - 2\left(\lambda_{22} - 1\right)\right], \tag{2.4}$$

iii) Singh et al. (2011) suggested an exponential-type estimator of population variance as:

$$t_2 = s_y^2 \exp\left(\frac{S_x^2 - s_x^2}{S_x^2 + s_x^2}\right). \tag{2.5}$$

The mean square error of t_2 is given by

$$MSE\left(t_2\right) \approx fS_y^4\left[\left(\lambda_{40} - 1\right) + \frac{1}{4}\left(\lambda_{04} - 1\right) - \left(\lambda_{22} - 1\right)\right]. \tag{2.6}$$

iv) As mentioned by Yadav and Kadilar (2013), a dual-to-ratio estimator of population variance is

$$t_3 = s_y^2\left(\frac{s_x^{*2}}{S_x^2}\right), \tag{2.7}$$

where

$$s_x^{*2} = \frac{NS_x^2 - ns_x^2}{N-n}. \tag{2.8}$$

The mean square error of t_3 is

$$MSE(t_3) = fS_y^4\left[(\lambda_{40}-1)+g^2(\lambda_{04}-1)-2g(\lambda_{22}-1)\right], \tag{2.9}$$

where

$$g = \frac{n}{N-n}.$$

v) Yadav and Kadilar (2013) suggested the following estimator

$$t_4 = s_y^4\left[\alpha\left(\frac{S_x^2}{s_x^2}\right)+(1-\alpha)\left(\frac{s_x^{*2}}{S_x^2}\right)\right], \tag{2.10}$$

where α is a constant to be suitably chosen.

The mean square error of t_4 is

$$MSE(t_4) \approx fS_y^4\left[(\lambda_{40}-1)+\alpha_1^2(\lambda_{04}-1)-2\alpha_1(\lambda_{22}-1)\right], \tag{2.11}$$

where

$$\alpha_1 = g+\alpha(1-g). \tag{2.12}$$

3. PROPOSED ESTIMATORS

We suggest the following new estimators of finite population variance

i) $$t_{n1} = s_y^2\frac{s_x^{*2}}{S_x^2}\frac{s_x^{*2}}{s_x^2}, \tag{3.1}$$

ii) $$t_{n2} = s_y^2\frac{s_x^{*2}}{S_x^2}\exp\left(\frac{s_x^{*2}-s_x^2}{s_x^{*2}+s_x^2}\right), \tag{3.2}$$

and

iii) $$t_{n3} = s_y^2\exp\left(\alpha\frac{s_x^{*2}-S_x^2}{s_x^{*2}+S_x^2}\right), \tag{3.3}$$

where α is a constant to be suitably chosen.

In order to obtain the bias and the mean square errors of our suggested estimators, we define

$$\left.\begin{aligned} &s_y^2 = S_y^2(1+e_0),\quad s_x^2 = S_x^2(1+e_0),\\ &E(e_0) = E(e_1) = 0,\\ &E(e_0^2) = f(\lambda_{40}-1),\\ &E(e_1^2) = f(\lambda_{04}-1),\\ &\text{and}\\ &E(e_0e_1) = f(\lambda_{22}-1). \end{aligned}\right\} \tag{3.4}$$

i) Using (3.4) in (3.1), the estimator t_{n1} may be written as:

$$t_{n1} = S_y^2\left(1+e_0\right)\frac{NS_x^2 - nS_x^2\left(1+e_1\right)}{\left(N-n\right)S_x^2}\frac{NS_x^2 - nS_x^2\left(1+e_1\right)}{S_x^2\left(1+e_1\right)}. \tag{3.5}$$

On simplification up to the first order of approximation, (3.5) may be written as:

$$t_{n1} - S_y^2 \approx S_y^2\left[e_0 - \left(1+2g\right)e_1 - \left(1+2g\right)e_0e_1 + \left(1+g\right)^2 e_1^2\right]. \tag{3.6}$$

Taking expectation on both sides of (3.6) and after simplification, the bias of t_{n1} up to the first order of approximation is

$$Bias\left(t_{n1}\right) \approx fS_y^2\left[\left(1+g\right)^2\left(\lambda_{04}-1\right) - \left(1+2g\right)\left(\lambda_{22}-1\right)\right]. \tag{3.7}$$

Squaring both sides of (3.6) and taking expectation, the mean square error of t_{n1} up to the first order of approximation is

$$MSE\left(t_{n1}\right) \approx fS_y^4\left[\left(\lambda_{40}-1\right) + \left(1+2g\right)^2\left(\lambda_{04}-1\right) - 2\left(1+2g\right)\left(\lambda_{22}-1\right)\right]. \tag{3.8}$$

ii) Using (3.4) in (3.2), the estimator t_{n2} may be written as:

$$t_{n2} = S_y^2\left(1+e_0\right)\frac{NS_x^2 - nS_x^2\left(1+e_1\right)}{\left(N-n\right)S_x^2}\exp\left(\frac{\dfrac{NS_x^2 - nS_x^2\left(1+e_1\right)}{N-n} - S_x^2\left(1+e_1\right)}{\dfrac{NS_x^2 - nS_x^2\left(1+e_1\right)}{N-n} + S_x^2\left(1+e_1\right)}\right). \tag{3.9}$$

On simplification up to the first order of approximation, (3.9) may be written as:

$$t_{n2} - S_y^2 \approx S_y^2\left[e_0 - \left(\frac{3g+1}{2}\right)e_1 - \left(\frac{3g+1}{2}\right)e_0e_1 + \frac{3}{8}\left(1+g\right)^2 e_1^2\right]. \tag{3.10}$$

Taking expectation on both sides of (3.10) and after simplification, the bias of t_{n2} up to the first order of approximation is

$$Bias\left(t_{n2}\right) \approx fS_y^2\left[\frac{3}{8}\left(1+g\right)^2\left(\lambda_{04}-1\right) - \left(\frac{3g+1}{2}\right)\left(\lambda_{22}-1\right)\right]. \tag{3.11}$$

Squaring both sides of (3.10) and taking expectation and on simplification, the mean square error of t_{n2} up to the first order of approximation is

$$MSE\left(t_{n2}\right) \approx fS_y^4\left[\left(\lambda_{40}-1\right) + \left(\frac{3g+1}{2}\right)^2\left(\lambda_{04}-1\right) - 2\left(\frac{3g+1}{2}\right)\left(\lambda_{22}-1\right)\right]. \tag{3.12}$$

iii) Using (3.4) in (3.2), the estimator t_{n3} may be written as:

$$t_{n3} = S_y^2\left(1+e_0\right)\exp\left(\alpha\frac{\dfrac{NS_x^2 - nS_x^2\left(1+e_1\right)}{N-n} - S_x^2}{\dfrac{NS_x^2 - nS_x^2\left(1+e_1\right)}{N-n} + S_x^2}\right). \tag{3.13}$$

On simplification up to the first order of approximation, (3.13) may be written as:

$$t_{n3} - S_y^2 \approx S_y^2 \left[e_0 - \alpha \frac{g}{2} e_1 - \alpha \frac{g}{2} e_0 e_1 + \frac{\alpha(\alpha-2)}{8} g^2 e_1^2 \right]. \tag{3.14}$$

Taking expectation on both sides of (3.14), the bias of t_{n3} up to the first order of approximation is

$$Bias(t_{n3}) \approx fS_y^2 \left[\frac{\alpha(\alpha-2)}{8} g^2 (\lambda_{04} - 1) - \alpha \frac{g}{2} (\lambda_{22} - 1) \right]. \tag{3.15}$$

Squaring both sides of (3.14) and taking expectation, the mean square error of t_{n3} up to the first order of approximation is

$$MSE(t_{n3}) \approx fS_y^4 \left[(\lambda_{40} - 1) + \alpha^2 \frac{g^2}{4} (\lambda_{04} - 1) - \alpha g (\lambda_{22} - 1) \right]. \tag{3.16}$$

Differentiating (3.16) with respect to α and equating to zero, the optimum value of α is

$$\alpha = 2\frac{K}{g}, \tag{3.17}$$

where

$$K = \frac{\lambda_{22} - 1}{\lambda_{04} - 1}. \tag{3.18}$$

Using (3.17) and (3.18) in (3.16), the minimum mean square error of t_{n3} is

$$MSE_{\min}(t_{n3}) \approx fS_y^4 \left[(\lambda_{40} - 1) - \frac{(\lambda_{22} - 1)^2}{\lambda_{04} - 1} \right]. \tag{3.19}$$

In practice, if the value of K is unknown, it may be estimated as:

$$\hat{K} = \frac{\hat{\lambda}_{22} - 1}{\hat{\lambda}_{04} - 1}. \tag{3.20}$$

4. EFFICIENCY COMPARISON

The proposed estimator t_{n3} is more efficient than the proposed estimator t_{n1} if

$$MSE_{\min}(t_{n3}) \le MSE(t_{n1}),$$

or if

$$fS_y^4 \left[(\lambda_{40} - 1) - \frac{(\lambda_{22} - 1)^2}{\lambda_{04} - 1} \right] \le fS_y^4 \left[(\lambda_{40} - 1) + (1 + 2g)^2 (\lambda_{04} - 1) - 2(1 + 2g)(\lambda_{22} - 1) \right].$$

On simplification, we get

$$\left[\left(1+2g\right)-K\right]^2 \geq 0. \tag{4.1}$$

We note that condition (4.1) always holds.

The proposed estimator t_{n3} is more efficient than the proposed estimator t_{n2} if

$$MSE_{\min}\left(t_{n3}\right) \leq MSE\left(t_{n2}\right),$$

or if

$$fS_y^4\left[\left(\lambda_{40}-1\right)-\frac{\left(\lambda_{22}-1\right)^2}{\lambda_{04}-1}\right] \leq fS_y^4\left[\left(\lambda_{40}-1\right)+\left(\frac{3g+1}{2}\right)^2\left(\lambda_{04}-1\right)-2\left(\frac{3g+1}{2}\right)\left(\lambda_{22}-1\right)\right].$$

On simplification, we get

$$\left[\left(\frac{3g+1}{2}\right)-K\right]^2 \geq 0. \tag{4.2}$$

We note that condition (4.2) always holds.

Thus we find that the proposed estimator t_{n3} is more efficient than the proposed estimators t_{n1} and t_{n2}. We now compare the proposed estimator t_{n3} with some available estimators.

The suggested estimator t_{n3} is more efficient than the simple variance estimator t_0 if

$$MSE_{\min}\left(t_{n3}\right) \leq Var\left(t_0\right),$$

or if

$$fS_y^4\left[\left(\lambda_{40}-1\right)-\frac{\left(\lambda_{22}-1\right)^2}{\lambda_{04}-1}\right] \leq fS_y^4\left(\lambda_{40}-1\right).$$

On simplification, we get

$$\lambda_{22} \geq 1. \tag{4.3}$$

The suggested estimator t_{n3} is more efficient than the Isaki (1983) estimator t_1 if

$$MSE_{\min}\left(t_{n3}\right) \leq MSE\left(t_1\right),$$

or if

$$fS_y^4\left[\left(\lambda_{40}-1\right)-\frac{\left(\lambda_{22}-1\right)^2}{\lambda_{04}-1}\right] \leq fS_y^4\left[\left(\lambda_{40}-1\right)+\left(\lambda_{04}-1\right)-2\left(\lambda_{22}-1\right)\right].$$

On simplification, we get

$$\left[\left(\lambda_{04}-1\right)-\left(\lambda_{22}-1\right)\right]^2 \geq 0,$$

or

$$\left(1-K\right)^2 \geq 0. \tag{4.4}$$

We note that condition (4.4) always holds.

The suggested estimator t_{n3} is more efficient than the Singh et al. (2011) estimator t_2 if

$$MSE_{\min}\left(t_{n3}\right) \leq MSE\left(t_2\right),$$

or if

$$fS_y^4\left[\left(\lambda_{40}-1\right)-\frac{\left(\lambda_{22}-1\right)^2}{\lambda_{04}-1}\right] \leq fS_y^4\left[\left(\lambda_{40}-1\right)+\frac{1}{4}\left(\lambda_{04}-1\right)-\left(\lambda_{22}-1\right)\right].$$

On simplification, we get

$$\left[\frac{1}{2}\left(\lambda_{04}-1\right)-\left(\lambda_{22}-1\right)\right]^2 \geq 0,$$

or

$$\left(\frac{1}{2}-K\right)^2 \geq 0. \tag{4.5}$$

We note that condition (4.5) always holds.

The suggested estimator t_{n3} is more efficient than the dual-to-ratio variance estimator t_3 if

$$MSE_{\min}\left(t_{n3}\right) \leq MSE\left(t_3\right),$$

or if

$$fS_y^4\left[\left(\lambda_{40}-1\right)-\frac{\left(\lambda_{22}-1\right)^2}{\lambda_{04}-1}\right] \leq fS_y^4\left[\left(\lambda_{40}-1\right)+g^2\left(\lambda_{04}-1\right)-2g\left(\lambda_{22}-1\right)\right].$$

On simplification, we get

$$\left[g\left(\lambda_{04}-1\right)-\left(\lambda_{22}-1\right)\right]^2 \geq 0,$$

or

$$\left(g-K\right)^2 \geq 0. \tag{4.6}$$

We note that condition (4.6) always holds.

5. EMPIRICAL STUDY

In order to study the performance of the suggested and some available estimators of finite population variance, we use the data of five populations from different sources.

Population 1 Source: Cochran (1977), page 152
Y: Number of inhabitants in 1930.
X: Number of inhabitants in 1920.
N=196, n=49, λ_{40} =8.5362, λ_{04} =7.3617, λ_{22} =7.8780, ρ =0.9820.

Population 2 Source: Sukhatme and Sukhatme (1970), page 185
Y: Wheat acreage in 1937.
X: Wheat acreage in 1936.
N=170, n=10, λ_{40} =3.1842, λ_{04} =2.2030, λ_{22} =2.5597, ρ =0.9770.

Population 3 Source: Singh et al. (1988)
Y: Number of agriculture labourers in 1971.
X: Number of agriculture labourers in 1961.
N=278, n=30, λ_{40} =24.8969, λ_{04} =37.8898, λ_{22} =25.8142, ρ =0.7273.

Population 4 Source: Singh (2003)
Y: Amount (in $ 1000) of real estate farm loans in different states in 1997.
X: Amount (in $ 1000) of non-real estate farm loans in different states in 1997.
N=50, n=8, λ_{40} =3.5822, λ_{04} =4.5247, λ_{22} =2.8411, ρ =0.8038.

Population 5 Source: Kadilar and Cingi (2006b)
Y: Apple production level (1 unit = 100 tones).
X: Number of apple trees (1 unit = 100 trees).
N=106, n=20, λ_{40} =80.13, λ_{04} =25.71, λ_{22} =33.30, ρ =0.8200.

The Percent Relative Efficiencies of various estimators with respect to the simple estimator t_0 are given in Table 1.

Table 1
Percent Relative Efficiencies of Different Estimators with respect to t_0

Estimator	Population				
	1	2	3	4	5
$t_0 = s_y^2$	100.00	100.00	100.00	100.00	100.00
t_1	5,310.92	815.61	214.16	106.50	201.66
t_2	335.15	236.07	287.74	159.17	149.28
t_3	206.04	109.54	129.64	128.55	120.91
t_4	7,536.32	1,347.98	331.65	159.34	214.39
t_{n1}	330.40	1,106.36	124.72	61.20	210.87
t_{n2}	5,310.92	288.85	331.52	138.46	187.96
t_{n3}	7,536.32	1,347.98	331.65	159.34	214.39

6. COMMENTS AND DISCUSSION

We note that our proposed estimator t_{n3} and the Yadav and Kadilar (2013) estimator t_4 are equally efficient and the most efficient estimators for all populations. For population 1, the suggested estimator t_{n2} is equally efficient to the Isaki (1983) estimator t_1 and more efficient than the estimators t_2, t_3 and t_{n1}. In the case of population 2 and population 5, the suggested estimator t_{n1} is the second best estimator. It is also observed that for population 3, the proposed estimator t_{n2} is almost equally efficient to the proposed estimator t_{n3} and the Yadav and Kadilar (2013) estimator t_4 and more efficient than the rest of the estimators.

REFERENCES

1. Cochran, W.G. (1977). *Sampling Techniques*, New York: John Wiley and Sons.
2. Das, A.K. and Tripathi, T.P. (1978). Use of auxiliary information in estimating the finite population variance. *Sankhya*, 40, 139-148.
3. Gupta, S. and Shabbir, J. (2008). Variance estimation in simple random sampling using auxiliary information. *Hacettepe Journal of Mathematics and Statistics*, 37, 57-67.
4. Isaki, C.T. (1983). Variance estimation using auxiliary information. *J. Amer. Stat. Assoc.*, 78, 117-123.
5. Kadilar, C. and Cingi, H. (2006a). Improvement in variance estimation using auxiliary information. *Hacettepe Journal of Mathematics and Statistics*, 35(1), 111-115.
6. Kadilar, C. and Cingi, H. (2006b). Ratio estimators for population variance in simple and stratified sampling. *Applied Mathematics and Computation*, 173, 1047-1059.
7. Searls, D.T. and Intarapanich, P. (1990). A note on an estimator for the variance that utilizes the kurtosis. *The American Statistician*, 44, 295-296.
8. Singh, H. and Singh, R. (2001). Improved ratio-type estimator for variance using auxiliary information. *Journal of Indian Society of Agricultural Sciences*, 54(3), 276-287.
9. Singh, H.P., Upadhyaya, U.D. and Namjoshi, U.D. (1988). Estimation of finite population variance. *Current Science*, 57, 1331-1334.
10. Singh, R., Chauhan, P., Sawan, N. and Smarandache, F. (2011). Improved exponential estimator for population variance using two auxiliary variables. *Italian Journal of Pure and Applied Mathematics*, 28, 101-108.
11. Singh, S. (2003). *Advanced Sampling Theory with Applications*, Kluwer Academic Press.
12. Singh, S., Horn, S., Chowdhury, S. and Yu, F. (1999). Calibration of the estimators of variance. *Australian and New Zealand Journal of Statistics*, 41, 199-212.
13. Srivastava, S.K. and Jhajj, H.S. (1980). A class of estimators using auxiliary information for estimating finite population variance. *Sankhya C*, 42, 87-96.
14. Subramani, J. and Kumarapandiyan, G. (2012a). Variance estimation using median of the auxiliary variable. *International Journal of Probability and Statistics*, 1(3), 36-40.

15. Subramani, J. and Kumarapandiyan, G. (2012b). Variance estimation using quartiles and their functions of the auxiliary variable. *International Journal of Probability and Statistics*, 2(5), 67-72.
16. Subramani, J. and Kumarapandiyan, G. (2013). Estimation of variance using known co-efficient of variation and median of an auxiliary variable. *Journal of Modern Applied Statistical Methods*, 12(1), 58-64.
17. Sukhatme, P.V. and Sukhatme, B.V. (1970). *Sampling Theory for Surveys with Applications*. Asia Publishing House, New Delhi.
18. Yadav, S.K. and Kadilar, C. (2013). A class of ratio-cum-dual to ratio estimator of population variance. *Journal of Reliability and Statistical Studies*, 6(1), 29-34.