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**Dr. Munir Ahmad  
Editor**

## CONTENTS

1.	002: On Modifications of L-Estimators of Dispersion in the Case of Self-Inverse Distributions	Syeda Shan-e-Fatima and Saleha Naghmi Habibullah	1-8
2.	006: Computer and Control	Irshad Ullah	9-14
3.	007: Comparison of Different Syllabus System in Pakistan	Irshad Ullah	15-18
4.	009: The Role of Brand Orientation, Internal Marketing on Strengthening Internal Brand Equity: Evidences From Banking Sector of Pakistan	Naveed Ahmad, Imran Sharif Chaudhry and Noman Ahmad Bashir	19-24
5.	012: Femtocell - A Vehicle to Mobile Communications	Nadia Qasim, M. Qasim Rind and M. Saleem Sheikh	25-36
6.	032: Postpartum Depression among Working and Non-Working Women	Kalsoom Fatima, Shazia Khalid, Firoza Ahmed and Summya Malik	37-42
7.	034: Tourism as Conjoint Decision	Faisal Afzal Siddiqui, Ghulam Hussain and Mudassir Uddin	43-50
8.	060: An Empirical Relationship Among HIV/Aids Awareness and Poverty Related Socioeconomic Indicators	Syed Wasim Abbas Khalil Ahmad And Munir Ahmad	51-64
9.	072: The Role of Intellectual Capital for Sustaining Competitive Advantage for Corporations: (An Insight from Banking Institutions of D.G. Khan, Pakistan)	Naveed Ahmad, M. Shokat Malik, Nadeem Iqbal and Komal Javaid	65-74
10.	073: Impact of Information Technology on Terrorism in Pakistan	Salma Bibi, Saira Ashraf and Talat Yasmin Khosa	75-80
11.	074: An Empirical Study on Modified Maximum Likelihood Estimator and Maximum Likelihood Estimator for Inverse Weibull Distribution by Using Type-II Censored Sample	Muhammad Aleem, Farrukh Jamal and Muhammad Akbar Ali Shah	81-92
12.	075: Kumaraswamy Double Inverse Exponential (Kw-Die) Distribution	M. Aleem, M. Sufyan, N.S. Khan and Kashif Ali	93-104

## ON MODIFICATIONS OF L-ESTIMATORS OF DISPERSION IN THE CASE OF SELF-INVERSE DISTRIBUTIONS

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### ABSTRACT

A random variable  $X$  is said to be ‘Self-Inverse at  $\beta$ ’ when the probability distribution of  $\beta/X$  is identical to that of  $X/\beta$ . The case  $\beta=1$  yields a distribution for which the  $(1-q)^{\text{th}}$  quantile is the reciprocal of the  $q^{\text{th}}$  quantile and, as a result, the median of which lies at unity. (See Habibullah et al. (2010).) Habibullah and Saunders (2011) and Habibullah et al. (2013) propose self-inversion-based modifications to well-known estimators of the cumulative distribution function and the cumulative hazard function respectively. Fatima and Habibullah (2013a) take up the estimation of measures of *central tendency* of reciprocal-invariant distributions, and propose self-inversion-based modifications of *L-estimators* including the *mean*, *mid-hinge* and *mid-range*. Fatima and Habibullah (2013b) focus on the asymmetry of distributions defined on the positive half-line, and propose a self-inversion-based modification of the *Bowley’s coefficient of skewness*. By performing simulation studies based on well-known distributions, Fatima and Habibullah (2013a) and (2013b) demonstrate that, by adopting the proposed modified formulae, *gains in efficiency* can be achieved in the estimation of the corresponding population parameters when sampling from a distribution self-inverse at unity. In this paper, we focus on measures of variability, and present self-inversion-based modifications to *L-estimators of dispersion* including the *range*, *interdecile range* and *interquartile range*. We carry out simulation studies based on 255 samples of size 10 each drawn from the Birnbaum Saunders and lognormal distributions self-inverse at unity and show that the proposed modifications *increase* the precision of the estimators of dispersion which, evidently, has *important implications* for accurate modelling.

### 1. INTRODUCTION

One class of probability distributions that is useful in Reliability Theory is the category of distributions ‘*Self-Inverse at unity*’ i.e. when the probability distribution of  $X$  is identical to that of  $1/X$ . For details, see Seshadri (1965), Saunders (1974), Saunders (2007), Habibullah et al. (2010) and Habibullah and Saunders (2011). The median of Self-Inverse distributions lies at unity (also called the point of reciprocity) and, for each such distribution, the ‘upper’ quantile is the reciprocal of the corresponding ‘lower’ quantile.

Habibullah and Saunders (2011) propose self-inversion-based modifications to well-known estimators of the *cumulative distribution function*. Fatima et al. (2013) take up

the estimation of the *cumulative hazard function* of reciprocal-invariant distributions, and propose a self-inversion-based modification to the formula of the *Nelson-Aalen estimator*. Fatima and Habibullah (2013a) take up the estimation of measures of *central tendency* of reciprocal-invariant distributions, and propose self-inversion-based modifications of *L-estimators* including the *mean, mid-hinge* and *mid-range*. Fatima and Habibullah (2013b) focus on the *asymmetry* of distributions defined on the positive half-line, and propose a self-inversion-based modification of the *Bowley's coefficient of skewness*. By performing simulation studies based on well-known distributions, Fatima and Habibullah (2013a) and (2013b) demonstrate that, by adopting the proposed modified formulae, *gains in efficiency* can be achieved in the estimation of the corresponding population parameters when sampling from a distribution invariant under the reciprocal transformation.

In this paper, we propose self-inversion-based modifications to the formulae of *L-estimators of dispersion* such as the *Range, Interquartile Range* and *Interdecile Range*, and use simulation studies to demonstrate that the modified estimators are likely to be *more efficient* than the well-known L-estimators of dispersion when sampling from a distribution self-inverse at unity.

## 2. L-ESTIMATORS

L-estimator is a linear combination of order statistics. It is also known as L-statistic. Evidently, L-estimators are very simple to compute, robust in nature and resistant to outliers. It is known that, in general L-estimators are inefficient but in some condition they are adequate for initial estimation.

Fatima and Habibullah (2013a) utilize the property of self-inversion at unity and propose the following *modifications* to well-known L-estimators of central tendency:

$$\text{Mid-Range}_{(\text{Self-Inverse at Unity})} = \frac{1}{4} \left[ (Y_0 + Y_m) + \left( \frac{1}{Y_0} + \frac{1}{Y_m} \right) \right] \quad (2.1)$$

$$\text{Mid-Hinge}_{(\text{Self-Inverse at Unity})} = \frac{1}{4} \left[ (Q_1 + Q_3) + \left( \frac{1}{Q_1} + \frac{1}{Q_3} \right) \right] \quad (2.2)$$

$$\text{A.M.}_{(\text{Self-Inverse at Unity})} = \frac{1}{2n} \left[ \sum_{i=1}^n Y_i + \sum_{j=1}^n \frac{1}{Y_j} \right] \quad (2.3)$$

## 3. L-ESTIMATORS OF DISPERSION IN THE CASE OF SELF-INVERSION

In this section, we focus on three different measures of Dispersion i.e. the Range, Inter-Quartile Range and Inter-Decile Range. The modification of these measures are given by

$$\text{Range} = X_m - X_o \quad (3.1)$$

$$\text{IDR} = D_9 - D_1 \quad (3.2)$$

$$\text{IQR} = Q_3 - Q_1 \quad (3.3)$$

Utilizing the property of self-inversion at unity, we propose the following modifications to formulae (3.1), (3.2) and (3.3) respectively:

$$Range_{(self-inverse\ at\ unity)} = \frac{1}{2} \left[ (X_m - X_o) + \left( \frac{1}{x_o} - \frac{1}{x_m} \right) \right] \quad (3.4)$$

$$IDR_{(self-inverse\ at\ unity)} = \frac{1}{2} \left[ (D_9 - D_1) + \left( \frac{1}{D_1} - \frac{1}{D_9} \right) \right] \quad (3.5)$$

$$IQR_{(self-inverse\ at\ unity)} = \frac{1}{2} \left[ (Q_3 - Q_1) + \left( \frac{1}{Q_1} - \frac{1}{Q_3} \right) \right] \quad (3.6)$$

#### 4. EFFICIENCY

In this section, simulation studies have been carried out in order to demonstrate that the modified estimators improve the efficiency of the estimators. Lognormal distribution and Birnbaum Saunders distribution are considered to carry out simulation study.

##### 4.1 Sampling from the Lognormal Distribution

A comparison of sampling distributions of L-estimators and (self-inversion-based) modified estimators of the three measures of dispersion is presented in this section. Simulation study is carried out by taking 255 samples each of size 10 from lognormal distribution with  $\mu = 0, \sigma^2 = 1$ .

##### a) Comparison of Means:

Table 4.1 presents a comparison of the means of the sampling distributions of the three L-estimators and (self-inversion-based) Modified L-estimators obtained by drawing 255 samples of size 10 each from the lognormal distribution with  $\mu = 0, \sigma^2 = 1$ .

**Table 4.1**  
**Means of the sampling distributions**  
**of the L-Estimators and Modified L-Estimators of Dispersion**  
**when sampling from the lognormal distribution  $\mu = 0, \sigma^2 = 1$ .**

Estimation of ↓	Mean of Well-Known Estimator	Mean of Newly Proposed Estimator	True Mean
Range	5.6352	5.352	1.6487
Inter Quartile Range	1.771196	1.81487251	1.6487
Inter Decile Range	4.897111	4.87907934	1.6487

It is well-known that, in the case of the lognormal distribution, the distribution mean is given by  $\exp(\mu + \frac{\sigma^2}{2})$  which, for  $\mu = 0, \sigma^2 = 1$ , converts to  $\exp(0.5) = 1.64872$ . From Table 5.1 we see that not only is the mean of the sampling distribution of  $\bar{X}$  close to the true mean but also the mean of the sampling distributions of the newly proposed estimator is very close to the distribution mean.

But Madam these are measures of dispersion they will not hold the property of unbiasedness.....

### b) Comparison of Ranges:

Table 4.2 presents a comparison of Maximum and Minimum Values as well as the Ranges of the sampling distributions of L-estimators and (self-inversion -based) Modified L-estimators based on 255 samples of size 10 each drawn from a lognormal distribution with  $\mu = 0, \sigma^2 = 1$ .

**Table 4.2**  
**Minimum and Maximum values and Ranges of the sampling distributions of the L-Estimators and Modified L-Estimators of Dispersion when sampling from the lognormal distribution  $\mu = 0, \sigma^2 = 1$ .**

Estimation of ↓	Well-Known Estimator			Newly Proposed Estimator		
	Minimum	Maximum	Range	Minimum	Maximum	Range
Range	1.1343	23.295	<b>22.161</b>	1.128	17.6	<b>16.47</b>
Inter Quartile Range	0.3237	7.4042	<b>7.0805</b>	0.57296213	4.25964125	<b>3.68667912</b>
Inter Decile Range	0.886	22.2307	<b>21.3447</b>	1.10322308	15.7746141	<b>14.671391</b>

In the case of each of the three measures of dispersion, the range of the sampling distribution of the newly proposed estimator come out to be smaller than the range of the sampling distribution of the well-known L-estimator of dispersion.

### c) Comparison of Variances:

Table 4.3 presents a comparison of the variances of the sampling distributions of the well-known L-estimators of dispersion and the modified estimators based on the 255 samples of size 10 each from the lognormal distribution with  $\mu = 0, \sigma^2 = 1$ .

In each of the three cases, the variance of the sampling distribution of the modified estimator is smaller than the variance of the sampling distribution of the well known L-estimator of dispersion.

**Table 4.3**  
**Variances of the sampling distributions of the L-Estimators and Modified L-Estimators of Dispersion when sampling from the lognormal distribution with  $\mu = 0, \sigma^2 = 1$ .**

Estimation of ↓	Variance of Well-Known Estimator	Variance of Newly Proposed Estimator
Range	13.374	6.866
Inter Quartile Range	1.009143	0.53169292
Inter Decile Range	11.35045	4.66728165



**d) Comparison of Coefficients of Variation:**

Table 4.4 presents a comparison of the coefficients of variation of the sampling distributions of the well-known L-estimators of dispersion and the corresponding modified estimators based on the 255 samples of size 10 each from the lognormal distribution with  $\mu = 0, \sigma^2 = 1$ .

**Table 4.4**  
**Coefficient of variation of the sampling distributions**  
**of the L-Estimators and Modified L-Estimators of Dispersion**  
**when sampling from the lognormal distribution with  $\mu = 0, \sigma^2 = 1$ .**

Estimation of ↓	Coefficient of Variation of Well-Known Estimator	Coefficient of Variation of Newly Proposed Estimator
Range	0.649	0.49
Inter Quartile Range	0.567166	0.4017763
Inter Decile Range	0.687965	0.44278625

Once again, we see that, in each of the three cases, the coefficient of variation of the sampling distribution of the modified estimator is smaller than the coefficient of variation of the sampling distribution of the well known L-estimator of dispersion.

**4.2 Sampling from the Birnbaum Saunders Distribution**

The procedure adopted in the case of the lognormal distribution is replicated in the case of the Birnbaum Saunders distribution with  $\alpha = \beta = 1$ .

**a) Comparison of Means:**

Table 4.5 presents a comparison of the means of the sampling distributions of the three L-estimators and Modified L-estimators obtained by drawing 255 samples of size 10 each from the Birnbaum Saunders distribution with  $\alpha=\beta=1$ .

**Table 4.5**  
**Means of the sampling distributions**  
**of the L-Estimators and Modified L-Estimators**  
**when sampling from the Birnbaum Saunders distribution with  $\alpha=\beta=1$ .**

Estimation of ↓	Mean of Well-Known Estimator	Mean of Newly Proposed Estimator	True Value of Population Mean
Range	4.5951	4.1818	1.5
Inter Quartile Range	2.6747	1.69	1.5
Inter Decile Range	0.8492	3.9197	1.5

It is well-known that in the case of the Birnbaum Saunders distribution, the distribution mean is given by  $\beta(1 + \frac{\alpha^2}{2})$  which in the case of  $\alpha=\beta=1$  comes out to be 1.5. From Table 6.4 we see that the mean of the newly proposed estimator is closer to the distribution mean than the mean value of the sampling distribution of the Arithmetic Mean.

**b) Comparison of Ranges:**

Table 4.6 contains maximum, minimum and as well as values of ranges of the sampling distributions of the well-known L-estimators of dispersion and the modified estimators. Simulation study is based on 255 sample of size 10 each drawn from Birnbaum Saunders distribution with  $\alpha=\beta=1$ .

**Table 4.6**  
**Minimum and Maximum values and Ranges of the sampling distributions**  
**of the Well-Known and the Newly Proposed Estimators when sampling**  
**from the Birnbaum Saunders distribution with  $\alpha=\beta=1$ .**  
**when sampling from the lognormal distribution  $\mu = 0, \sigma^2 = 1$ .**

Estimation of ↓	Well-Known Estimator			Newly Proposed Estimator		
	Minimum	Maximum	Range	Minimum	Maximum	Range
Range	1.1728	11.928	10.755	1.114	9.8469	8.7329
Inter Quartile Range	0.989	7.6589	6.6699	0.57	3.74	3.17
Inter Decile Range	1.0895	9.0884	7.999	1.0895	9.0884	7.999

For each of the three estimators, the range of the self-inverse-based modified estimator has come out to be less than that of the well-known L-estimator of dispersion.

**c) Comparison of Variances:**

Table 4.7 contains variances of the sampling distributions of the well-known L-estimators of dispersion and the modified estimators based on the 255 samples of size 10 each drawn from Birnbaum Saunders Distribution with  $\alpha=\beta=1$ .

**Table 4.7**  
**Variances of the sampling distributions**  
**of the Well-Known and Newly Proposed Estimators**  
**when sampling from the Birnbaum Saunders distribution with  $\alpha=\beta=1$ .**

Estimation of ↓	Variance of Well-Known Estimator	Variance of Newly Proposed Estimator
Range	4.127	2.0285
Inter Quartile Range	0.9759	0.37
Inter Decile Range	3.5159	1.5946

In each of the three cases, the variance of the modified estimator of dispersion is smaller than that of the well-known L-estimator of dispersion.

**d) Comparison of Coefficients of Variation:**

Table 4.8 contains a comparison of the coefficients of variation of the sampling distributions of the well-known L-estimators of dispersion and the corresponding modified estimators based on the 255 samples of size 10 each drawn from Birnbaum Saunders Distribution with  $\alpha=\beta=1$ .

**Table 4.8**  
**Coefficient of Variations of the sampling distributions of the Well-Known and Newly Proposed Estimators of Dispersion when sampling from the Birnbaum Saunders distribution with  $\alpha=\beta=1$ .**

Estimation of ↓	Coefficient of Variation of Well-Known Estimator	Coefficient of Variation of Newly Proposed Estimator
Range	0.4421	0.3406
Inter Quartile Range	0.3693	0.3601
Inter Decile Range	2.2081	0.3222

In each of the three cases the coefficient of variation of the modified estimator is smaller than that of the well-known L-estimator of dispersion.

## 5. CONCLUDING REMARKS

The property of invariance under the reciprocal transformation was noticed in some of the continuous probability distributions defined on the positive half-line during the twentieth century. For example, Seshadri (1965) provided a methods for generating random variables possessing this property i.e. setting  $T = e^Y$  for any  $Y$  symmetric about zero. Saunders (1974) generalized Seshadri (1965)'s reciprocal property for the normal family of distributions and showed that the Birnbaum Saunders distribution, a family of distributions of great practical interest for modeling fatigue failure, possesses this property.

Only very recently, this property has begun to be utilized for developing estimators that are likely to be *more efficient* than the well-known estimators. Habibullah and Saunders (2011) show that self-inversion at unity carries implications for estimating the *cumulative distribution function* more efficiently; Fatima et al. (2013) present a similar result regarding the estimation of the *cumulative hazard function*. Fatima and Habibullah (2013a) take up the estimation of measures of *central tendency* of reciprocal-invariant distributions, and propose self-inversion-based modifications of *L-estimators* including the *mean*, *mid-hinge* and *mid-range* which provide *gains in efficiency*. By performing simulation studies based on well-known distributions, they (2013a) demonstrate that, by adopting the proposed modified formulae, *gains in efficiency* can be achieved in the estimation of the corresponding population parameters when sampling from a distribution self-inverse at unity. Fatima and Habibullah (2013b) focus on the

*asymmetry* of distributions defined on the positive half-line, and propose a self-inversion-based modification of the **Bowley's coefficient of skewness**.

In this paper, we have focused on the phenomenon of *variability*, and have presented self-inversion-based modifications to *L-estimators of dispersion* including the *range*, *interdecile range* and *interquartile range*. By carrying out simulation studies based on 255 samples of size 10 each drawn from the Birnbaum Saunders and lognormal distributions self-inverse at unity, we have shown that the proposed modifications *increase* the precision of the estimators of dispersion which, evidently, has *important implications* for accurate modelling.

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## COMPUTER AND CONTROL

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### ABSTRACT

Computer is a modern device which is used by different organization for different purpose. Control is an important factor within any organization. Without control it is not possible to make the work consistent. Just like control unit of the CPU control the whole work of it. Same like that computer can be used to control the work of any organization. In this research it will be discussed that how computer play its role in the control of any organization. Data will be collected from different sources. The data will be analyzed and the results will be discussed.

### KEY WORDS

Control; Source; Tool; Organization; Data.

### 1. INTRODUCTION

Controlling is one of the managerial functions like planning, organizing, staffing and directing. It is an important function because it helps to check the errors and to take the corrective action so that deviation from standards are minimized and stated goals of the organization are achieved in a desired manner.

According to modern concepts, control is a foreseeing action whereas earlier concept of control was used only when errors were detected. Control in management means setting standards, measuring actual performance and taking corrective action.

In 1916, Henri Fayol formulated one of the first definitions of control as it pertains to management:

Control of an undertaking consists of seeing that everything is being carried out in accordance with the plan which has been adopted, the orders which have been given, and the principles which have been laid down. Its object is to point out mistakes in order that they may be rectified and prevented from recurring. [1]

According to EFL Breach: Control is checking current performance against pre-determined standards contained in the plans, with a view to ensure adequate progress and satisfactory performance.

According to Harold Koontz: Controlling is the measurement and correction of performance in order to make sure that enterprise objectives and the plans devised to attain them are accomplished.

According to Stafford Beer: Management is the profession of control.

Robert J. Mockler presented a more comprehensive definition of managerial control: Management control can be defined as a systematic effort by business management to compare performance to predetermined standards, plans, or objectives in order to determine whether performance is in line with these standards and presumably in order to take any remedial action required to see that human and other corporate resources are being used in the most effective and efficient way possible in achieving corporate objectives. [2]

Also control can be defined as "that function of the system that adjusts operations as needed to achieve the plan, or to maintain variations from system objectives within allowable limits". The control subsystem functions in close harmony with the operating system. The degree to which they interact depends on the nature of the operating system and its objectives. Stability concerns a system's ability to maintain a pattern of output without wide fluctuations. Rapidity of response pertains to the speed with which a system can correct variations and return to expected output.[3]

A political election can illustrate the concept of control and the importance of feedback. Each party organizes a campaign to get its candidate selected and outlines a plan to inform the public about both the candidate's credentials and the party's platform. As the election nears, opinion polls furnish feedback about the effectiveness of the campaign and about each candidate's chances to win. Depending on the nature of this feedback, certain adjustments in strategy and/or tactics can be made in an attempt to achieve the desired result.

From these definitions it can be stated that there is close link between planning and controlling. Planning is a process by which an organization's objectives and the methods to achieve the objectives are established, and controlling is a process which measures and directs the actual performance against the planned goals of the organization. Thus, goals and objectives are often referred to as Siamese twins of management. The managerial function of management and correction of performance in order to make sure those enterprise objectives and the goals devised to attain them being accomplished.

Control is a continuous process

Control is a management process

Control is embedded in each level of organizational hierarchy

Control is forward looking

Control is closely linked with planning

Control is a tool for achieving organizational activities

Control is an end process

Control compares actual performance with planned performance

### **Man and Machine Control**

The elements of control are easy to identify in machine systems. For example, the characteristic to be controlled might be some variable like speed or temperature, and the sensing device could be a speedometer or a thermometer. An expectation of precision exists because the characteristic is quantifiable and the standard and the normal variation to be expected can be described in exact terms. In automatic machine systems, inputs of information are used in a process of continual adjustment to achieve output specifications. When even a small variation from the standard occurs, the correction process begins. The automatic system is highly structured, designed to accept certain kinds of input and produce specific output, and programmed to regulate the transformation of inputs within a narrow range of variation.[6]

For an illustration of mechanical control: as the load on a steam engine increases and the engine starts to slow down, the regulator reacts by opening a valve that releases additional inputs of steam energy. This new input returns the engine to the desired number of revolutions per minute. This type of mechanical control is crude in comparison to the more sophisticated electronic control systems in everyday use. Consider the complex missile-guidance systems that measure the actual course according to predetermined mathematical calculations and make almost instantaneous corrections to direct the missile to its target.

Machine systems can be complex because of the sophisticated technology, whereas control of people is complex because the elements of control are difficult to determine. In human control systems, the relationship between objectives and associated characteristics is often vague; the measurement of the characteristic may be extremely subjective; the expected standard is difficult to define; and the amount of new inputs required is impossible to quantify. To illustrate, let us refer once more to a formalized social system in which deviant behavior is controlled through a process of observed violation of the existing law (sensing), court hearings and trials (comparison with standard), incarceration when the accused is found guilty (correction), and release from custody after rehabilitation of the individual has occurred.[6]

The speed limit established for freeway driving is one standard of performance that is quantifiable, but even in this instance, the degree of permissible variation and the amount of the actual variation are often a subject of disagreement between the patrolman and the suspected violator. The complexity of our society is reflected in many of our laws and regulations, which establish the general standards for economic, political, and social operations. A citizen may not know or understand the law and consequently would not know whether or not he was guilty of a violation.

Most organized systems are some combination of man and machine; some elements of control may be performed by machine whereas others are accomplished by man. In addition, some standards may be precisely structured whereas others may be little more than general guidelines with wide variations expected in output. Man must act as the controller when measurement is subjective and judgment is required. Machines such as

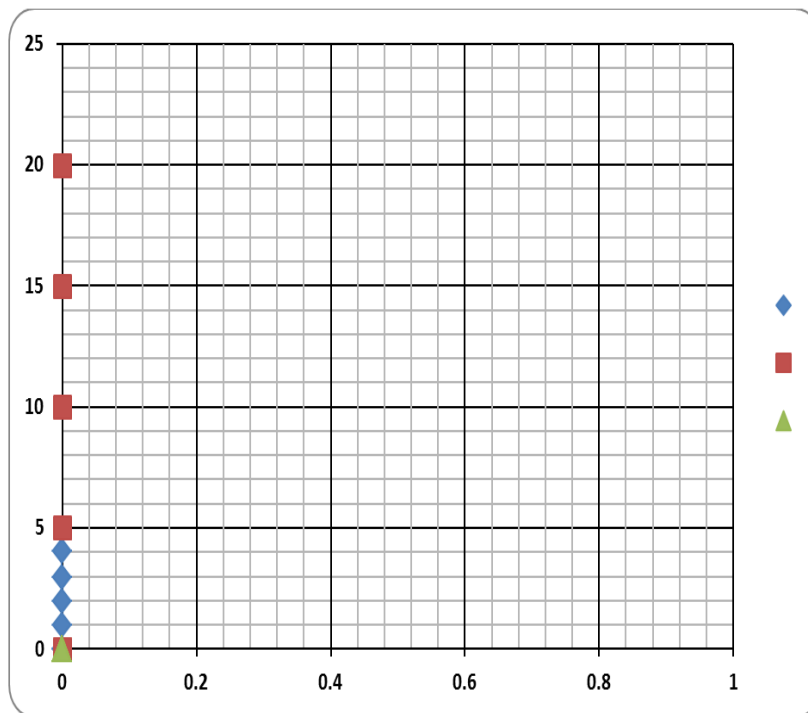
computers are incapable of making exceptions from the specified control criteria regardless of how much a particular case might warrant special consideration. A pilot acts in conjunction with computers and automatic pilots to fly large jets. In the event of unexpected weather changes, or possible collision with another plane, he must intercede and assume direct control.[4]

## 2. ANALYSIS

In daily life control is an important factor while doing any type of work. In some situation it's very dangerous for the human to work so computer may be used to cope with the situation. With the help of robots it's possible to work where it's impossible for the human to do it. Systems may be controlled by using computer as it is easy by using it just like in transport systems computer is used for control. Also computer controlled is used by the organization for security purpose. Computer control also used by defense authorities for efficient work.

## 3. RESULTS AND DISCUSSION

How computer control is effective the data was gathered and analyzed from different sources using the method of interviews, observation and questionnaire.



**Figure 3.1**



#### 4. CONCLUSION AND FUTURE WORK

It is clear that computer systems play a vital role in control of different systems. But in some situation that computer is a machine so may be its fail to work. So in future it's possible to work specially by using artificial intelligence it's possible to make the improvement.

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## COMPARISON OF DIFFERENT SYLLABUS SYSTEM IN PAKISTAN

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### ABSTRACT

As education play a very significant role in the development of any country. If the education is standard then the country will be in a good condition. As syllabus is a very important component of the education system. As Education system based on syllabus. In this study it will be discussed that how it's possible to make it equal. Means that how to adopt same syllabus for the setup to make the process standard. Role of computer will also be discussed that how computer can help to improve it. Analysis will be performed and suggestion will be given after the discussion. Data will be gathered by applying different techniques and strategies. Results produces will be discussed.

### KEYWORDS

Syllabus, Computer, Discussion, Equal, Study.

### 1. INTRODUCTION

Syllabus A syllabus (pl. syllabuses, or syllabi as a hypercorrection; [1] [2] from modern Latin syllabus "list", in turn from a misreading (σίλλυβος sillubos) of the Greek σίττυβας sittubas "parchment label, table of contents"), [3] [4] is an outline and summary of topics to be covered in an education or training course. It is descriptive (unlike the prescriptive or specific curriculum). A syllabus is often either set out by an exam board, or prepared by the professor who supervises or controls the course quality. It may be provided in paper form or online.

Both syllabus and curriculum are often fused, and usually given to each student during the first class session so that the objectives and the means of obtaining them are clear. A syllabus usually contains specific information about the course, such as information on how, where and when to contact the lecturer and teaching assistants; an outline of what will be covered in the course; a schedule of test dates and the due dates for assignments; the grading policy for the course; specific classroom rules; etc.[citation needed]

Within many courses concluding in an exam, syllabuses are used to ensure consistency between schools and that all teachers know what must be taught and what is not required (extraneous). Exams can only test knowledge based on information included in the syllabus.

**a. Uses**

The syllabus serves many purposes for the students and the teacher such as ensuring a fair and impartial understanding between the instructor and students such that there is minimal confusion on policies relating to the course, setting clear expectations of material to be learned, behavior in the classroom, and effort on student's behalf to be put into the course, providing a roadmap of course organization/direction relaying the instructor's teaching philosophy to the students, and providing a marketing angle of the course such that students may choose early in the course whether the subject material is attractive.

Many generalized items of a syllabus can be amplified in a specific curriculum to maximize efficient learning by clarifying student understanding of specified material such as grading policy, grading rubric, late work policy, locations and times, other contact information for instructor and teaching assistant such as phone or email, materials required and/or recommended such as textbooks, assigned reading books, calculators (or other equipment), lab vouchers, etc., outside resources for subject material assistance (extracurricular books, tutor locations, resource centers, etc.), important dates in course such as exams and paper due-dates, tips for succeeding in mastering course content such as study habits and expected time allotment, suggested problems if applicable, necessary pre-requisites or co-requisites to current course, safety rules if appropriate, and objectives of the course.

**b. Contract**

Slattery & Carlson (2005) [5] describe the syllabus as a "contract between faculty members and their students, designed to answer student's questions about a course, as well as inform them about what will happen should they fail to meet course expectations" (p. 163). Habanek stresses the importance of the syllabus as a "vehicle for expressing accountability and commitment" (2005, p. 63). [6] Wasley states that "the notion of a syllabus as a contract has grown ever more literal", but also notes that "a course syllabus is unlikely to stand as an enforceable contract", according to Jonathan R. Alger, general counsel at Rutgers University (2008). [7]

**c. Notional-functional**

A notional-functional syllabus is a way of organizing a language-learning curriculum, rather than a method or an approach to teaching. In a notional-functional syllabus, instruction is not organized in terms of grammatical structure, as had often been done with the audio-lingual method (ALM), but instead in terms of "notions" and "functions".

In this model, a "notion" is a particular context in which people communicate. A "function" is a specific purpose for a speaker in a given context. For example, the "notion" of shopping requires numerous language "functions", such as asking about prices or features of a product and bargaining.

Proponents of the notional-functional syllabus (Van Ek & Alexander, 1975; Wilkins, 1976) claimed that it addressed the deficiencies they found in the ALM by helping students develop their ability to effectively communicate in a variety of real-life contexts. [8]

**d. Other Types**

- i. Grammatical syllabus
- ii. Lexical syllabus
- iii. Situational syllabus
- iv. Text-based syllabus
- v. Skill-based syllabus
- vi. Task-based syllabus
- vii. Learner-generated syllabus
- viii. Mixed syllabus
- ix. Online course syllabus

**2. ANALYSIS OF DIFFERENT SYLLABUS SYSTEM**

As different syllabus systems are present here in Pakistan. In a broad sense it's may be observed that different syllabus systems are studied in different education system. The two systems one is called madrasa and the other is school madrasa is better because the language of instruction is same throughout (Arabic) and also the medium is same but here there is no concept of science and on the other hand in school system the medium is native till 5<sup>th</sup> then national till 10<sup>th</sup> and then change to international after 10<sup>th</sup> especially in govt. sector.

The syllabus of these two systems is very different from each other. And when its compare with the private sector then the difference is seem to be very high.

**3. PROPOSED APPROACH**

For understanding and analyzing the situation different methods like interview, observation and questionnaire will be used.

Different personnel will be interviewed. Different organization and institutions will be observed.

**4. RESULTS AND DISCUSSION**

As the process was start by observing different institution for the purpose of syllabus analysis. Different personnel were interviewed with the help of structured and unstructured interview. For the solution and analysis of the problem different questions were asked. As a target that how to make a different and standard syllabus to minimize the gape among different style institution the answer was to give equal like opportunities to all the students and to teach courses of science in madrasas and also Arabic courses to the students of schools. As just like vacancies are there in schools for the students of madrasas so same sciences teachers must be encouraged and give the opportunity to teach to the students of madrasas.

### Graphical Analysis of the Data

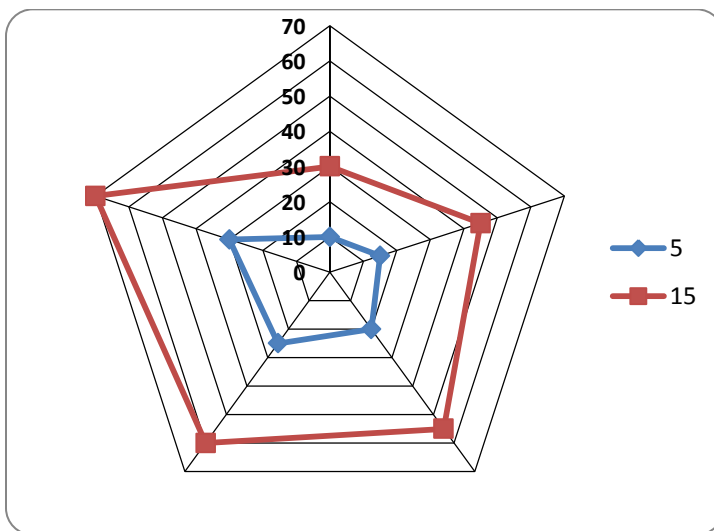


Figure 4.1

### 5. CONCLUSION AND FUTURE WORK

This is clear that everyone is ready for the improvement. But start must be taken especially by the high level authority to overcome these difficulties. It's possible to work gradually. In future it's possible to do more research for more deep analysis of the situation

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**THE ROLE OF BRAND ORIENTATION, INTERNAL MARKETING  
ON STRENGTHENING INTERNAL BRAND EQUITY:  
EVIDENCES FROM BANKING SECTOR OF PAKISTAN**

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**ABSTRACT**

Internal branding has been emerging recently as an important issue in marketing field. The purpose of this study is to investigate whether brand orientation and internal marketing practices produce any effect on shaping internal brand equity. A structured questionnaire was prepared for collection of data in banking sector of south Punjab, Pakistan. Based on the findings of this research it is observed that brand orientation and internal marketing practices produce a positive impact on internal brand equity. Partial least square (PLS) regression technique was used to test the model fitness. PLS path model was consisting of two models. One model was describing the relationship among variables while other model was used to test the hypothesis. The findings of this research contribute in existing literature by examining the impact of internal marketing and brand orientation on internal brand equity. Furthermore managers of banking institutions specifically and managers of non-banking institution in general, can utilize the findings of this research study to enhance their financial growth through internal brand equity.

**KEYWORDS**

Internal Brand Equity; Brand Orientation; Internal Marketing; Bank.

**1. INTRODUCTION**

Consumers give prime importance to a brand because it leaves a distinctive positioning in the mind of customers; this distinctive position in the minds of customer is associated with specific benefits and perceived emotions (Raj and Jyothi, 2011). So the importance of brand is obvious in this perspective. During last two decades, brand management has been central for all marketing activities (Rajiv, Kumar and noble, 2002), which is in realization to brand effectiveness and perception of consumers (Keller, 1998) and plays an important role in enhancing financial performance of firms (Kerin and Sethuraman, 1998). Corporations are trying to utilize the advantages of brand in aligning the personnel so that they can achieve a competitive advantage (Pringle and Thomsan, 2011). It is recognized fact that corporations should be internally coherent in order to achieve external success because workers should get to know how they can be customer conscious (Mudie, 2003). Customer relationship with marketing personnel is very crucial because marketing agents

manage brand for customers (Alexander et al., 2002). There has been a debate on defining brand equity and many theorists agree that it is implicitly a strategic issue. In the past brand equity is mainly discussed with external aspects but very few researchers have discussed internal aspect of branding (Lynch and de Chernatony, 2004). This research is of the opinion that researchers have not yet investigated influential factors of internal brand equity such as brand orientation and internal marketing. This study attempts to explore impact of influential factors like internal marketing and brand orientation on internal brand equity with the help of proposed model.

## 2. LITERATURE REVIEW

According to Baumgarth and Schmidt (2009) internal brand equity is an approach that measures the positive effects of branding on employees attitude and it attempts to prepare the employees to behave in a specific manner in order to support brand building activities. Researchers are also of the opinion that an important predecessor of loyalty is brand equity (e.g. Vogel et al., 2008; Taylor et al., 2004). In addition, to achieve loyal employees it is important that internal brand equity practices should be given top most priority (Backhouse, 2004). So managers/owners of organizations should give central importance to influential factors of internal brand equity like internal marketing and brand orientation.

According to Urde (1999) brand orientation is a process in which firms attempts toward creation, protection, development of brand and healthy interaction with customer to achieve competitive advantage. Elements of brand orientation have a positive impact on corporate culture (Trice and Beyer, 1993). Employees of a firms also acknowledge that corporate culture guides their behaviour towards job (Williams and Attaway, 1996) so corporate culture needs to be in line with brand values. (Piercy and Peattie, 1988; Hatch and Schultz, 2001). In their study Baumgrth and Schmidt (2009) explored that internal brand equity is highly affected with brand oriented corporate culture. They developed a model for this purpose. The basis for their model was drawn from the influential model by Schein (1992). Based on above discussion it can be observed brand orientation is positively associated with internal brand equity. So it is suggested that

H1: Internal brand equity is positively affected by brand orientation

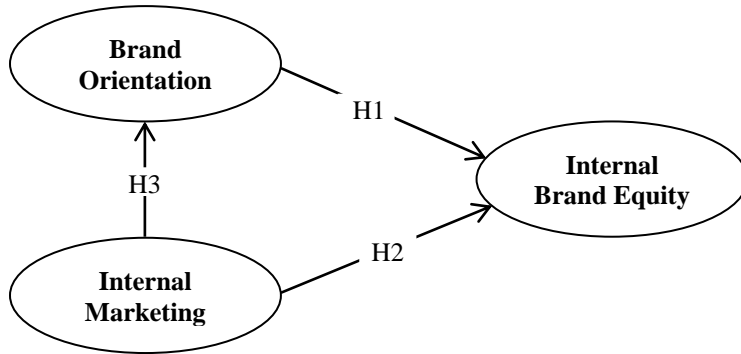
Internal marketing can be regarded as an approach in which employees of the organization are motivated by satisfying their work related needs Dennis (1995). Majority of researchers is of the opinion that internal marketing practices encourage workers to display positive behaviour when they are interacting with customers (Gronroos, 1981; Gummesson, 1991). Internal marketing is a tool that may bring a change in attitudes of workers and lays the foundation of corporate culture Gronroos (1990). Lee and Chen (2005) accepted that there is considerable impact of internal marketing practices on corporate culture. Internal marketing is all about treating employees as internal customers (Berry and Parasuraman, 1991). There are seven components of internal marketing: external communication, support from management, internal communication, training, human resource management, market research and market dividers (Gronroos, 1990). In existing literature of internal marketing the major emphasis is given to employee motivation and satisfaction. According to Froom (2001), internal marketing practices transfer brand promise to the employees and it is also important for brand orientation



because it attempts to develop a motivated workforce to achieve organizational objectives. Wilson (2001) recognized that internal marketing and organizational culture produce positive effect about brand perception in customer mind. Based on above discussion it is suggested that

H2: Internal-brand-equity is positively affected by internal marketing practices

H3: Internal marketing practices influence brand orientation positively



**Figure 1: Conceptual Model**

### 3. METHODOLOGY AND DATA COLLECTION

A questionnaire was developed for exploring the effects of internal marketing and brand orientation on internal brand equity. First part of the questionnaire was adopted from Caruana and Tasi (2008). Similarly the items to measure internal brand equity and brand orientation were derived from, Baumgrth and Schmidt (2009). After developing the questionnaire it was submitted to experts to examine the face validity and content validity and then the final version of questionnaire was prepared. Likert scale was followed to collect the response of questions from respondents. All questions were close ended. One part of questions was about the respondent information like gender, age, education etc. The second part was to investigate the aim of this research study. Author has selected banking industry of south Punjab Pakistan the reason for this selection is that in Pakistan the banking industry is flourished excellently in Pakistan. For sampling purpose respondents were selected from top level of management and mid-level so that proper response can be collected because the idea of internal brand equity is not easily understandable for non-managers so for this reason top level management and mid-level management was selected. 80 bank branches from the region of south Punjab were selected from private and public sector. Questionnaires were sent out through emails. From each bank one manager from top level (branch manager) and two mid-level managers were selected. A total of 240 questionnaires were distributed and 120 fully completed questions were returned so the response rate being 50%.

#### **Analysis**

Table 1 displays the results of standard deviation and mean. It is observed that internal marketing receives highest mean value (3.65) while internal brand equity is

second in mean value (3.42) similarly brand orientation is lowest in terms of mean (3.25). Standard deviation of internal marketing is 0.655 and for internal brand equity it is 0.551 and for brand orientation the value of S.D. is 0.582

**Table 1: Mean and Standard Deviation**

Variables (V)	Standard deviation (SD)	Mean (M)
Internal Marketing	0.655	3.65
Internal Brand Equity	0.551	3.42
Brand Orientation	0.582	3.25

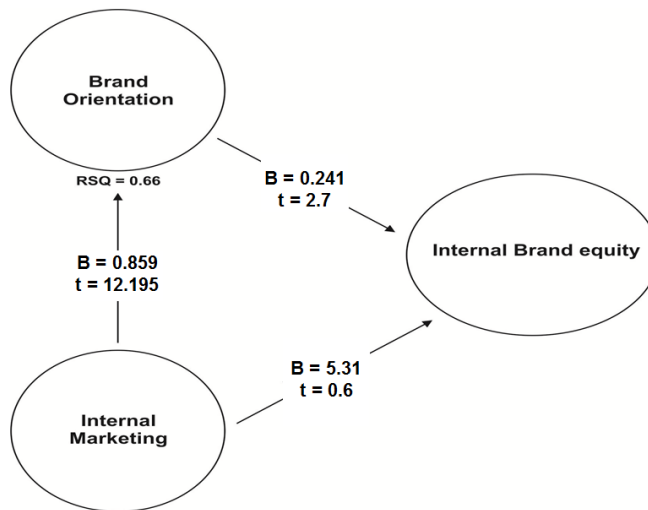
**Table 2: Results of Correlation**

	Brand Orientation	Internal Brand Equity	Internal Marketing
Brand Orientation	1	--	--
Internal Brand Equity	0.635***	1	--
Internal Marketing	0.558***	0.552**	1

P<0.05 level of significance

Table 2 shows the results of correlation analysis. It is clear from results of table 2 that a high correlation exist between brand orientation and internal brand equity ( $r=0.635$ ,  $p<0.05$ ). Furthermore internal marketing practices have high correlation with brand orientation and internal brand equity ( $r=0.558$  and  $r=0.552$  at  $p<0.05$ ). So it is verified that these variables are correlated with each other.

To investigate the suggested hypothesis, author applied multiple regression analysis with the help of Statistical package for social sciences. The results of model are shown in figure 2.



**Figure 2: Model with Standard Estimates and t Values**

Multi Regression analysis suggested that brand orientation has a positive effect on internal brand equity ( $\beta = 0.241$ ,  $t=2.7$ ,  $P=.0001***$ ) where ( $\beta$ ) is standardized path coefficients So H1 is accepted because P-value is less than .05. Based on the findings of multi regression analysis, it is suggested that brand orientation is essential for enhancing internal brand equity. Likewise it is also suggested that internal marketing practices create influential effects on internal brand equity because standard estimates are ( $\beta=0.6$ ,  $t=5.31$ ,  $P=.000***$ ) H2 is also accepted on the basis of findings of multi regression analysis. The relationship between internal marketing and brand orientation is also positive ( $\beta = 0.789$ ,  $t= 11.15$ ,  $P=.01**$ ) H3 is also accepted hypothesis. So all H1, H2 and H3 are accepted hypothesis.

## 6. CONCLUSIONS AND IMPLICATIONS FOR MANAGERS

The effects of brand orientation on internal brand equity and accepted that brand orientation positively effects internal brand equity so the fact of brand orientation on internal brand equity is already recognized by (Baumgarh and Schmidt, 2009). This research contributes in existing literature by introducing internal marketing practices as an influential factor on internal brand equity. Empirical significance of proposed model is also verified and it is observed that if managers/owners emphasize on internal marketing practices and brand orientation then this can increase employee's level of motivation and commitment toward brand. This study provides an insight about the influential factors of internal marketing but further investigations on this study area is necessary. Author is of the opinion that further researches should be conducted with some new variable like employee retention, employee motivation and market orientation and the impact of these variables on internal brand equity. Future research should be conducted in different industries for supplementary authentication.

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## FEMTOCELL - A VEHICLE TO MOBILE COMMUNICATIONS

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### ABSTRACT

The popularity of mobile devices is growing at a feverish pace. The advent of smart phones and laptop data cards is the current driving force in mobile communications. Femtocell is a small, low-power cellular base station, typically designed for use in a home or small business. It provides a feasible and low cost alternative to microcell deployment for improving indoor signal coverage at homes and small buildings. Hence, femtocells enable a new generation of femtozone that take advantage of the femtocell's presence detection and connection to the home network. Despite of many benefits that can be offered by wide scale femtocell deployment by network operators, but there are some issues of the end users about adopting this technology in Pakistan. In this paper, a survey was conducted to know views of consumers from urban and rural areas of Pakistan regarding deployment of femtocells. Data was compiled, analyzed, presented and conclusions were drawn. It was observed that the users have showed their interest in utilizing femtocells; if better and low cost packages for using data services are provided. Keeping in view the requirements of the users, the survey results will help and guide the network operators to deploy this technology. Hence the future of femtocells lies on remote control system - One remote will controls all devices at home and offices.

### KEYWORDS

Small cells; Femtocell technology; Microcell cells; Mobile Operators network.

### 1. INTRODUCTION

The popularity of mobile devices is growing at a feverish pace. The United Nations expects that more than five billion people will use mobile phones in 2010 [1]. This number is amazing when one considers that thirty years ago, cell phones didn't even exist outside the laboratory. While mobile phone usage will continue to grow, new technology is morphing mobile phones into mobile computers. The advent of smart phones and laptop data cards is the current driving force in mobile communications. Voice calling is still an important aspect, but many individuals are changing their habits. More and more wireless subscribers are spending time using data services such as surfing the Internet and text messaging.

In telecommunication terminologies a femtocell is a small, low-power cellular base station, typically designed for use in a home or small business. A broader term which is more widespread in the industry is small cell, with femtocell as a subset. Small cells provide improved cellular coverage, capacity and applications for homes and enterprises

as well as metropolitan and rural public spaces. Femtocells are small 3G base stations that dramatically improve indoor voice coverage and 3G data performance for subscribers. Femtocells also help operators cope with the exploding usage of mobile data by offloading traffic from the macro radio access network (RAN), leveraging existing fixed broadband internet connections for backhaul. Many operators have launched femtocell service, including Vodafone, SFR, AT&T, Sprint, Nextel, Verizon and Mobile TeleSystems. In 3GPP terminology, a Home Node B (HNB) is a 3G femtocell. A Home eNode B (HeNB) is an LTE femtocell.

## 2. TYPES OF SMALL CELLS

There are different types of small cells in the market which include femtocells used in homes, picocells, used in enterprise, metrocells used in urban area and microcells used in rural areas. Thus, range of small cells varies from smallest (femtocells) to largest (microcells). Any or all of these small cells can be based on 'femtocell technology' - i.e. the collection of standards, software, open interfaces, chips and know-how that have powered the growth of femtocells [4]. Hence, femtocells enable a new generation of femtozone applications that take advantage of the femtocell's presence detection and connection to the home network. It connects to the service provider's network via broadband (such as DSL or cable); current designs typically support two to four active mobile phones in a residential setting, and eight to 16 active mobile phones in enterprise settings. A femtocell allows service providers to extend service coverage indoors or at the cell edge, especially where access would otherwise be limited or unavailable.

Femtocells are an alternative way to deliver the benefits of fixed-mobile convergence. Typically the range of a standard base station may be up to 35 kilometers (22 mi), a microcell is less than two kilometers wide, a picocell is 200 meters or less, and a femtocell is on the order of 10 meters, [2] although AT&T calls its product, with a range of 40 feet (12 m), a "microcell" [3].



**Fig. 1: Use Wise Types of Small Cells**

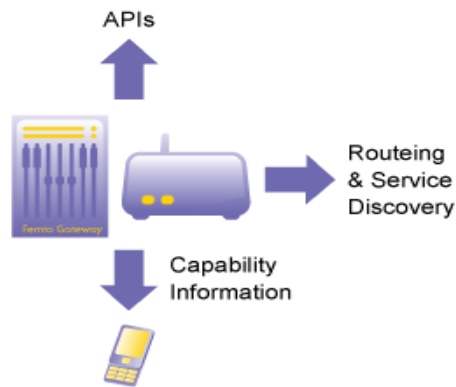
## 3. WORKING OF SMALL CELL

The small cell works by sending information through small cell access points. The information can be received by applications in handsets (sent by the air interface), by applications hosted on the local network or by applications on the internet or in the mobile operator's network [4].

The key pieces of information that the femtocell can provide are:

- **Presence information:** when a user enters leaves or is present on the femtocell.
- **Routeing information:** access to the routeing table for the local network.
- **Service Discovery information:** the ability to discover services on the local or wide area network.
- **Capability information:** what throughput the femtocell can support and who can use it.
- **Secure remote access:** the ability to connect remotely to the home network from a mobile device.

The working of small cells is shown in the following figure.



**Fig. 2: Shows Working of Small Cells**

#### 4. ARCHITECTURES FOR FEMTOCELLS

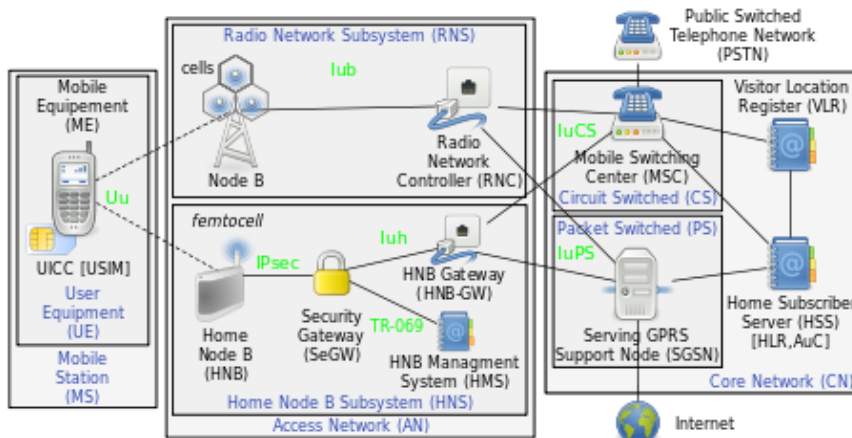
The standards bodies have published formal specifications for femtocells for the most popular technologies, namely Wideband Code Division Multiple Access (WCDMA), CDMA2000 (The CDMA2000 standard is a 3G mobile technology), Long Term Evolution (LTE) and Worldwide Interoperability for Microwave Access (WiMAX). These all broadly conform to architecture with three major elements:

- i) The femtocell access points themselves, which embody greater network functionality than found in macrocell base stations, such as the radio resource control functions. This allows much greater autonomy within the femtocell, enabling self-configuration and self-optimization. Femtocells are connected using broadband internet protocol (IP), such as Digital subscriber line DSL or cable modems, to the network operator's core switching centers.
- ii) The femtocell gateway, comprising a security gateway that terminates large numbers of encrypted IP data connections from hundreds of thousands of femtocells, and a signaling gateway which aggregates and validates the signaling traffic, authenticates each femtocell and interfaces with the mobile network core switches using standard protocols, such as Iu.

- iii) The management and operational system which allows software updates and diagnostic checks to be administered. These typically use the same TR-069 management protocol published by the Broadband forum and also used for administration of residential modems.

The key interface in these architectures is that between the femtocell access points and the femtocell gateway. Standardization enables a wider choice of femtocell products to be used with any gateway, increasing competitive pressure and driving costs down. For the common WCDMA femtocells, this is defined as the Iuh interface. In the Iuh architecture, the femtocell gateway sits between the femtocell and the core network and performs the necessary translations to ensure the femtocells appear as a radio network controller to existing mobile switching centers (MSCs). Each femtocell talks to the femtocell gateway and femtocell gateways talk to the CNE (MSC for circuit-switched calls, SGSN for packet-switched calls). This model was proposed by the 3rd Generation Partnership Project (3GPP) and the Femtocell Forum [5]. In March 2010, the Femtocell Forum and The European Telecommunications Standards Institute (ETSI) conducted the first Plugfest to promote interoperability of the Iuh standard [6].

The CDMA2000 standard released in March 2010[7] differs slightly by adopting the SIP protocol to set up a connection between the femtocell and a femtocell convergence server (FCS). Voice calls are routed through the Federation of communication services (FCS) which emulates an MSC. The Session Initiation Protocol (SIP) is not required or used by the mobile device itself. In the SIP architecture, the femtocell connects to a core network of the mobile operator that is based on the SIP/IMS Independent Media Support architecture. This is achieved by having the femtocells behave toward the SIP/IMS network like a SIP/IMS client by converting the circuit-switched 3G signaling to SIP/IMS signaling, and by transporting the voice traffic over the Real-time Transport Protocol (RTP) as defined in the Internet Engineering Task Force (IETF) standards the key interface in these architectures is that between the femtocell access points and the femtocell gateway. Standardization enables a wider choice of femtocell products to be used with any gateway, increasing competitive pressure and driving costs down.



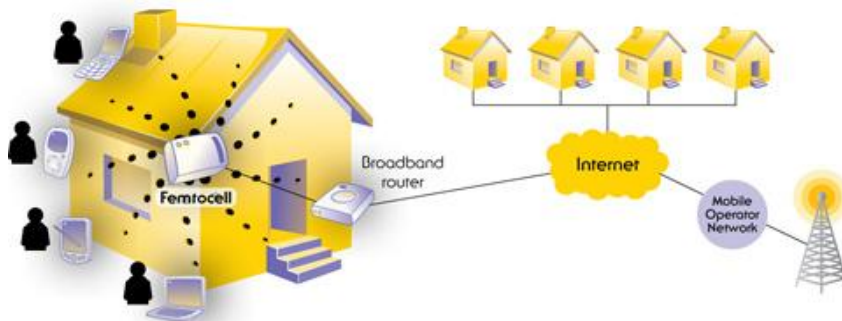
**Fig. 3: Simplified version of traditional Node B and Home Node B (3G femtocell) in 3G architecture**



## 5. SMALL CELL APPLICATIONS

Small cell applications allow consumers to access a wide variety of services from home or office networks, mobile operators and the web, that make life simpler and more fun. There are software applications which allow mobile handsets and network applications to benefit from the cheap and fast data connections and location-awareness provided by small cells. For example, small cell applications can enable consumers to automatically synchronise their music collection on their mobile device with their home PC when a customer returns home control their TV from their mobile device. Remotely control home appliances such as air conditioning when out of the house in a secure manner. These types of applications offer tangible benefits for consumers, applications developers, operators and vendors.

Small cells provide application developers with a new environment to monetize new or existing applications. Operators can generate new service revenue and/or differentiate their proposition from competitors while also installing a base for a new generation of content distribution and home automation services. Femtocell vendors benefit by widening the appeal of their products. Femtocells not only solve the issue of poor indoor cellular coverage, but also increase wireless carrier's network capacity. Fig. 4 showing femtocell application at home.



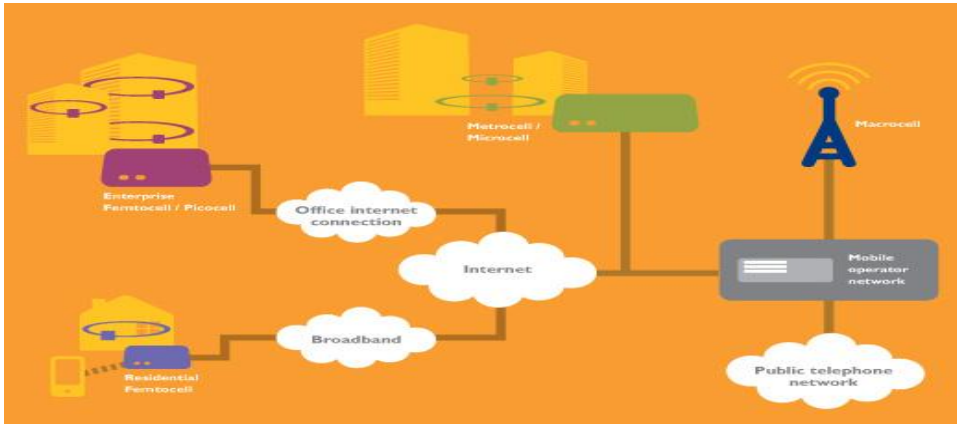
**Fig. 4: Femtocell Applications at Home**

There are so many benefits of small cells; the user wise and location wise benefits of small cells are as under:

**Home:** Femtocells solves residential challenges with a device that employs power and backhaul via the user's existing resources. It also enables capacity equivalent to a full 3G network sector at very low transmit powers, dramatically increasing battery life of existing phones, without needing to introduce WiFi enabled handsets.

**Office:** Enterprise femtocells enable business users to take advantage of high-quality mobile services in the office, while improving coverage, accelerating data rates and significantly reducing capital costs.

**Public & Rural Area:** Due to their low cost and easy deployment, small cells are also a viable and cost-effective alternative to traditional macro networks in remote rural areas with little or no terrestrial network infrastructure. Femtocells provide a high quality, high speed signal in home or office, giving an excellent quality voice calls and fast downloads when you use your mobile phone. Your mobile operator may also offer attractive service bundles for femtocell user. See Fig. 5



**Fig. 5: Source of Acquiring Residential or Enterprise Small Cells**

Rather like mobile phones, you may be able to acquire residential or enterprise small cells (usually femtocells) through a variety of shops and online stores, but it will be linked to your mobile phone service. List of operators currently offering residential or enterprise small cells services may be seen at appendix-A. It was last updated February 2012. Installation will be simple. In some cases the femtocell will come pre-installed in a home gateway device with other features (for example a DSL modem and Wi-Fi), and you'll simply activate it via a web page. Alternatively, if you already have a home network you will be able to plug in a standalone femtocell. If your operator needs to upgrade the software or settings in your femtocell, this will normally happen automatically without you even needing to be aware [4].

## 6. FEMTOCELL TECHNICAL ISSUES

Any new technology is going to have its share of issues, and the same applies with femtocells. Wireless communication networks are extremely complicated, and the use of femtocells just adds to this complexity. Additionally, the unpredictability of wireless communications will add to the growing pains associated with femtocells. While problems will be discovered as femtocell adoption increases, many of the technical limitations of femtocells have been well studied. The main technical issues are:

### 6.1 Interference with Macrocell Networks

Interference with macrocell networks is the largest issue to wireless providers when it comes to deploying femtocells [8]. The reason for this is simple – femtocells have the potential to bring down the existing macrocell network, leaving wireless users without

service. While this is extremely unlikely, interference is a major issue and a major technical hurdle to overcome. Interference in femtocell networks originates because many network operators use the same spectrum for femtocells and macrocells. This is done to increase the wireless carrier's spectral efficiency [9]. Wireless carriers could use a separate band just for the femtocell network, thus minimizing a majority of interference issues. While this would be the best solution, most wireless carriers don't have the spectrum available to devote solely for femtocell use. Interference occurs when a mobile device connected to a macrocell is in close proximity to a femtocell. In this situation both devices are using the same frequencies to communicate.

The mobile device would simultaneously receive information originating from both the femtocell and macrocell, even though it was only communicating with the macrocell. This could possibly cause errors at the mobile's receiver and result in garbled voice or corrupted data packets. Interference doesn't only have to occur between a macrocell and femtocell, it can also occur between two femtocells. This occurs when two femtocells are located in the same vicinity, such as two nearby apartments. This is a likely scenario, especially if femtocells gain popularity. Looking at the largest personal wireless networking technology, Wi-Fi, it is common to see numerous access points operating on the same channel. Many Wi-Fi networks perform poorly due to high levels of interference, and to avoid this issue with femtocells, interference minimizing technologies need to be implemented.

## **6.2 Restricted Access to Femtocell**

A growing concern as femtocell usage increases is how to deal with restricted access. Many femtocells on the market today allow the owner to restrict access to certain set of mobile devices. This is done as consumers currently have to purchase and subscribe to femtocell service, and thus they should be able to restrict access to this service.

Additionally, femtocells are limited in the number of users they can support, so access restrictions are put into place to ensure that an entire apartment complex isn't using one individual's femtocell. While access restrictions are a great concept, it creates many technical problems. Currently, mobile devices do not know they are restricted until they try to authenticate with the network [8]. When a device fails to authenticate, it then floods the network with authentication attempts which also drains the battery of mobile devices. Eventually, the device should connect to the macrocell, but in some situations a mobile will receive the registration rejection and then stop searching for wireless networks on the same frequency. This could prevent the mobile device from accessing the macrocell and in turn temporarily lose wireless service. This issue isn't a big deal today as femtocell deployments are scarce, but if femtocells gain popularity this could result in poor mobile handset performance.

## **6.3 Reliability of the Internet as a Backhaul**

The last major technical issue with femtocells is the backhaul used to connect the femtocell to the wireless carrier's network. Wireless carriers connect microcells to their core networks by utilizing backhaul connections such as T1 lines, SONET rings, and Metropolitan Ethernet. These backhaul connections are considered carrier grade as they

Offer service level agreements in regards to reliability and quality of service. Femtocells on the other hand use a home broadband connection to communicate over the Internet. The Internet doesn't guarantee either a high level of reliability or quality of service, or these two aspects are dependent on the ISP. Consumers expect a femtocell to deliver the same quality of service that is provided by a macrocell. While an Internet connection might work fine for surfing the Internet and sending emails, it can perform poorly for delay sensitive applications such as voice over internet protocol (VOIP).

This makes it appear to the average Internet user that their broadband connection is working correctly, even though the user might be experiencing high delay and packet loss. This puts wireless carriers in a difficult situation, as consumers won't want to hear that femtocell related issues are actually caused by the ISP, which they have no control over. Overall, this means it is difficult for wireless carriers to offer a high-level of performance and reliability for femtocell deployments. To measure the real world effects of using the Internet as a backhaul and the issues associated with it, a company called Epitiro performed femtocell testing in Europe. The objectives of these tests were to measure the performance of femtocells over extended periods of time utilizing different ISP. The test spanned six countries, and each country included four to six ISPs. The results revealed that the quality of service from different ISPs varied greatly. The femtocell performance was based on both mean opinion score (MOS), which measures the quality of a voice call, and packet loss [10].

## **7. FEMTOCELL ECONOMICS**

While the technology behind femtocells is important, they will never gain wide adoption unless they are priced correctly. Many technologically advanced products, such as the Segway, have failed due to pricing that is out of reach of the average consumer. In fact, cell phones didn't gain wide adoption until 2G networks were deployed, which allowed cellular pricing to dramatically decrease. Femtocells are currently in the introductory portion of the product life cycle. Market researchers predict that femtocells will be a high growth market, and that millions of femtocells will be sold in the next couple of years. Reaching the growth stage would be a monumental step for the femtocell industry, but getting there will not be easy.

The largest issue femtocells currently face is their cost. In the past, availability of femtocells has been limited, but in 2010 this has changed and the four largest US mobile carriers now offer femtocell solutions. Consumers have the capability to purchase femtocells, but their popularity isn't making front page news. Instead, femtocell sales continue to be a disappointment as late last year ABI Research cut their expected femtocell sales number for 2009 by 55%. There are multiple reasons for the poor sales, such as the technical limitations, but one of the main reasons is their high cost. Most wireless carriers charge an upfront hardware fee along with other carriers charge just a hardware fee, but in many cases the cost of the femtocell hardware is more expensive than even high end cell phones.

## 8. THE WI-FI SOLUTION

The traditional way of network upgrades will most likely prove too costly as data usage explodes. While femtocells are the only solution today that works with all existing mobile devices, Wi-Fi could be a major competitor to femtocells when 4G networks are deployed. A Wi-Fi solution known as Unlicensed Mobile Access (UMA) has been around since 2005, and provides similar functionality to that of femtocells. The limited number of UMA enabled handsets along with the lack of promotion by wireless carriers has prevented the technology from taking off. The success of standards such as UMA could change in the future as they provide many benefits over femtocells. Wi-Fi already has an extremely high penetration level that would be impossible for femtocells to match.

Additionally, Wi-Fi is not carrier specific, so mobile devices from a wide range of wireless providers could all utilize a single Wi-Fi access point. Wi-Fi does provide some technical disadvantages compared to femtocells, specifically battery life, security, and compatibility. Battery life and security can both be addressed as technology improves, leaving compatibility as the major issue with a Wi-Fi solution. Most phones don't have support for Wi-Fi, and those that do, don't have a mechanism to make calls over the data connection. This means that Wi-Fi solutions would have to wait until the future where all devices come integrated with a Wi-Fi chipset and use VOIP for voice calling. This shouldn't take long as the number of Wi-Fi handsets is rapidly growing, and by the time 4G networks become Mainstream, Wi-Fi should be a standard feature monthly service plan, just like a cell phone.

## 9. DEPLOYMENT OF FEMTOCELLS

According to market research firm Informa and the Femtocell Forum, as of December 2010 18 operators have launched commercial femtocell services, with a total of 30 committed to deployment. At the end of 2011, femtocell shipments had reached roughly 2 million units deployed annually, and the market is expected to grow rapidly with distinct segments for consumer, enterprise, and carrier-grade femtocell deployments [11], within the United States, the most significant deployments up to December 2010 were by Sprint Nextel, Verizon Wireless and AT&T Wireless. In January 2009, Verizon rolled out its Wireless Network Extender, based on the same design as the Sprint/Samsung system. In late March 2010, AT&T announced nationwide roll-out of its 3G MicroCell, which commenced in April. The equipment is made by Cisco Systems and ip. Access, and was the first 3G femtocell in US, supporting both voice and data HSPA. Both Sprint and Verizon upgraded to 3G CDMA femtocells during 2010, with capacity for more concurrent calls and much higher data rates. In July 2009, Vodafone released the first femtocell network in Europe.

In Asia, several service providers have rolled out femtocell networks. In Japan, Soft Bank Mobile launched its residential 3G femtocell service in January 2009 with devices provided by Ubiquity's. In May 2010, Soft Bank Mobile launched the first free femtocell offer, providing open access femtocells free of charge to its residential and business customers. In Singapore, Star hub rolled out its first nation-wide commercial 3G femtocell services with devices provided by Huawei Technologies, though the uptake is

low, while Singtel's offering is targeted at small medium enterprises. In 2009, China Unicom announced its own femtocell network.

## **10. DEPLOYMENT OF FEMTOCELL IN PAKISTAN**

In Pakistan, the Telecom sector is in the process of evolution and new standardized technologies are being adopted. End users can opt for different broadband packages that utilize ADSL with cheaper and more attractive offers and bandwidths of up to 50 Mbps. Above 60% of the population has access to voice and data services using either the cellular network or DSL. Since many popular internet applications especially streaming voice and video applications have high throughput requirements, the cellular network operators in Pakistan are gradually expanding their coverage and improving their capacity to accommodate more users and offer them higher data rates. However to fully satiate the requirements of the end users and encourage them to utilize the cellular networks for data services, the operators have to provide better packages and improve the link budget for indoor environments. In order to improve the indoor coverage and signal quality, implementation of femtocell base stations shall prove to be a viable and low cost solution from the network operator's perspective.

Pakistan Telecommunication Authority (PTA) seems to be planning on deploying 'Femtocell' technology in order to improve indoor signal reception for voice and data access and also to provide wireless data at lower cost in Pakistan. PTA claims that deployment of Femtocells is the best solution to for operators to provide better wireless services in indoor environments. After execution of Femtocell, high speed wireless data services and applications can be used by indoor consumers where macrocell network may not provide same speed. PTA is trying to provide users with higher data rates indoor in order to further increase mobile data usage all the while reducing spectrum usage at cheaper rates, in addition to various other applications. Realization of all this is not possible without a liberal wireless spectrum and strong radio engineering. However, to find out the feasibility of mass deployment in the urban and rural areas surveys have been conducted in 9 major cities of Pakistan as well as the rural areas. In the survey, the opinion was inquired from more than 150 participants. The questions asked in the survey were prepared in such a way that the results can be utilized and prove to be useful to network operators outside Pakistan. Majority of respondents says that the cost of femtocells be reduced [12].

## **11. THE FUTURE OF FEMTOCELLS**

As you walk into your house, you press a button on your phone to turn on the living room lights. While sitting on your couch, you remember you need to bake a pot roast. No problem, you aim your phone at the oven and set it to 400 degrees. In the coming years it'll be possible to do this with femtocells, the technology is currently being used to amplify cell-phone reception and Wi-Fi signals, but the next logical step for femtocells is to get the household devices to interact with one another. "Your phone will be the coordinator of all your home devices," the femtocell hub provides an internet gateway to enter a cell-phone network, thereby reducing the amount of power and distance your handset would need to communicate with a remote tower. In doing so, femtocell hubs such as the Sprint Airave expand and improve your cell-phone reception. Airvana's

HubBub CDMA, set for release is already taking femtocells another step further by boosting your Wi-Fi data signal as well. Other competitors are working on similar products set for release around the same time frame. And with competition we can expect to see further innovation of this seemingly malleable technology. Since a femtocell hub is primarily used in a home and utilizing an internet bridge it makes sense to eventually use it with other home appliances as well. It is expected in future, all domestic devices will have an IP address. Fig .6 showing kitchen menu to be operated through remote control.



**Fig. 6: Showing Kitchen Menu to be Operated through Remote Control**

The potential of femtocells will doubtlessly raise some concerns among users, the main worry being security. It would be a hacker's dream come true to be able to transcend cyber-space sabotage by controlling a victim's physical appliances. The imagined possibilities of femtocells are as frightening as they are exciting. But new technology always introduces new fears, and if this foretelling becomes a reality, we'll likely have adequate security measures in place by then.

## 12. CONCLUSION

The wireless industry is undergoing a revolutionary change. The use of cell phones is changing from a device to make telephone calls to one which is a mobile communications and entertainment hub. This is an issue for wireless carriers which have billions of dollars invested in network infrastructure built around supporting telephone calls. Upgrading networks to support new data related services is extremely expensive. Additionally, it is difficult for wireless carriers to build out the networks quick enough to support the massive increase in data consumption of mobile users. Femtocells are a new tool that wireless carriers can use to supplement traditional network upgrades. Femtocells benefit wireless carriers as they improve wireless coverage and offload the wireless network. The test results of the current femtocells on the market reveal that femtocells can greatly improve coverage and the data throughput of mobile devices. While the performance of

femtocells is impressive, some technical issues such as handoffs and restricted access need to be resolved before the technology is ready for wide scale deployment.

The femtocell is a simple concept that can make a major impact: initially conceived as a box similar to a WiFi access point connected to broadband, its scope has now expanded to encompass small-cell solutions for home, metropolitan, rural, enterprise and hot-spot applications. The results of the survey carried out show that the users are willing to acquire femtocell based solutions if cost effective and better packages are offered by the network operators.

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## POSTPARTUM DEPRESSION AMONG WORKING AND NON-WORKING WOMEN

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### ABSTRACT

The present study was designed to explore the postpartum depression among working and non-working women. Sternberg Kruchman (1983) has reported that women of western culture develop postpartum depression because they live in busy, geographically mobile culture. Accordingly, the present study was designed to compare postpartum depression among working and non-working women in Pakistan. In addition, demographic predictors of postpartum depression were also assessed. Urdu translated version of Edinburg Postpartum Depression Scale was administered to measure postpartum depression among women along with a demographic sheet to gain information about participants including age, number of children, education level, income and year of marriage. It was hypothesized that working women will have more postpartum depression compared to non-working women. The sample for study comprised of 60 women in which there were 30 working and 30 non-working women. The sample was selected from hospital settings. *t* –test was applied to verify the hypothesis. Contrary to expectations, postpartum depression was found to be significantly higher among non-working women than working women. It is expected that the present study will add to the existing literature on postpartum depression and will be helpful in providing the psychological support to the women suffering from postpartum depression.

### 1. INTRODUCTION

Postpartum depression is moderate to severe depression in a woman after she has given birth. It may occur soon after delivery or up to a year later. Most of the time, it occurs within the first 3 months after delivery (Cohen, Wang, 2010).

“Postpartum depression is a serious illness and has been seen to negatively affect the life of women” (Beck 2002). Its onset may persist for many months and tends gradually. Sometimes it also develops into a second but following a subsequent pregnancy. The effects of postpartum depression are 15% for all childbearing women approximately and sometime women remain fail to recognize the effects of postpartum depression. There are many women who feel ashamed if they are not coping and so may conceal their difficulties. “The result of postpartum depression is that it disrupts women's lives and can have effects on the baby, other children, her partner as well as relationships” (Dictionary of Medicine, MCG raw, 2002).

Postpartum depression is broadly categorized into two types: early onset and late onset. The early onset most often seems like the "blues," a mild brief experience. Within the first week after the birth up to 80% of mothers experience the "baby blues." This is usually a period of extra sensitivity. The symptoms include tearfulness and irritability with mood changes. (Dictionary of Medicine, McGraw, 2002). Late onset occurs several weeks after the birth. The symptoms of late onset includes "slowly growing feelings of sadness, depression, lack of energy, chronic tiredness, inability to sleep, change in appetite, significant weight loss or gain, and difficulty caring for the baby" (Dictionary of Medicine, MCG raw, 2002).

Postpartum depression also affects the mental and cognitive health of child as well as family (Beck, 1998: Cooper & Muray, 1998). Most extreme effect of postpartum depression may include infant murder in some cases. Postpartum depression has become a major health problem. Postpartum depression is one of the three main illnesses with varying degree of severity that effect women after childbirth (Beck & Driscoll, 2002).

Linda and Berry (2007) found through their research that normal to severe depression symptoms continue throughout for first 2 years after childbirth in some cases. In another study, Michael and Rebecca reported that the self-esteem of women became very low as a result of postpartum depression. While, Sutan and Rusli reported that working mothers with parietal loss are vulnerable to depression during postpartum period.

Beck and Gable (2000) have reported that more than 400,000 mothers in the United States experience depression every year. Rates of postpartum depression during the first six months postpartum are reported to be 10-22% in all women and up to 26% among adolescent mothers (Cox, Murray & Chapman, 1993; Llewellyn, Stowe & Nemeroff, 1997).

The rate of postnatal depression in developing countries ranges from 16% to 35% (Ghubash & Abou-Saleh, 1997; Patel et al., 2002; Ayden et al., 2005; Cooper et al., 1999) and "play a role of major contributor to the burden of disease in developing countries. Postpartum depression results in impaired weight gain in the first year of the infant's life" (Rahman et al., 2004). "However, literature review has also highlighted the discrepancy in reported prevalence of postpartum depression indicating that reported prevalence ranges from 0% to 60% in various culturally specific samples" (Halbreich & Karkun, 2006). Further complicating the issue, it is estimated that up to 50% of all cases go undetected (Beck & Gable, 2001).

There are relatively fewer studies conducted which have examined the long-term outcome of postpartum depression. A recent review of studies from developed countries concluded that in about 30% women with postpartum depression, symptoms persist for up to a year after giving birth (Goodman, 2004).

### ***The Present Study***

All the studies mentioned before, have been conducted in western culture. The present study is unique in the sense that it is aimed to measure depression as well as its intensity among working and nonworking women during postpartum period in Pakistan.

## **2. METHOD**

### ***Participants***

The sample for present study was comprised of 30 working women and 30 nonworking women. The inclusion area for participant was at least 25 to 35 year of: (a) age, (b) 10000 to 25000 monthly income. Their education level was minimum intermediate for both. The research was conducted in hospital setting and it was government sector.

### ***Instrument***

Details of the instruments used to measure the study variables are presented below.

#### ***Edinburgh Postpartum Depression Scales (Edinburgh, 1987).***

“The Edinburgh Postpartum Depression Scale (Edinburgh, 1987) was developed to help in order to determine whether a mother may be suffering from postpartum depression. The scale has since been validated. There are evidence from a number of research studies has confirmed the tool to be both reliable and sensitive in detecting depression” (Edinburgh, 1987).

“Postpartum depression scale consists of 10 items (Edinburgh, 1987). Each item is anchored on 5-point rating scale. Three items are negatively worded”.

#### ***Demographic Information Performa***

Information on background variables was acquired through demographic information proforma. Following information was obtained: age, number of children, education level, income, year of marriage.

### ***Procedure***

The participants were approached individually and after ensuring complete confidentiality and taking their informed consent, the questionnaires were handed over to participants. Questionnaire was given to women after one week of delivery to obtain valid results as Gnash and Christine (2011) pointed out that it's too early to measure postpartum depression after two days of delivery. For completing the form specific instructions were given separately. For statistical verification the data was entered into SPSS17.

### 3. RESULTS

In order to answer the research question related to postpartum depression *t* test was applied.

**Table 1**  
**Means, Standard Deviations, and t-value for Working and Non-working**  
**Women on Postpartum Depression (N = 60)**

	N	M	SD	SEM	t-value	p-value
Working Women	30	25.53	2.1	0.39	1.89	0.002
Non-working Women	30	27.00	3.7	0.68		

This table displays means, standard deviations, and standard errors for the postpartum depression among working and non-working women. There is a significant difference of postpartum depression among working and non-working women. Mean of postpartum depression among working women is 25.5 and among non-working women is 27.00. The mean difference was found to be significant at 0.002 *p*-values. Contrary to expectations, non-working women reported higher postpartum depression than working women.

### 4. COMMENTS AND CONCLUSION

As reported by Beck (2002), postpartum depression is a serious illness. Present study was designed to measure postpartum depression among working and non-working women in Pakistan. A research conducted by Janel and Joseph (2010) reported that mothers with significant depressive symptoms had poor physical and mental health related quality of life. They also reported great pain for their infants and had more health concerns about their children. In another study, Beck and Tatno (1996) found that women with postpartum depression failed to maintain their relationship with their children and to understand their children cues. In addition, a study suggested important relations between mental depressions symptoms and parenting practices (Kathryn 1999).

According to EPDS (1987), the range for diagnosis of postpartum depression has been reported as 9 to 13. In reference to this range, the mean values for the groups suggest that both working and non-working women have a high level of postpartum depression.

Emphasizing upon the link between working women and postpartum depression, Stern (2000) explained that women in western culture are depressed because they live in busy, geographically culture. However, the results of the present study were found to be in contradiction to this research. The results of the present study showed that in Pakistan non-working women are more depressed than working women. These findings may be due to cultural differences in reporting system. Mothers with low postpartum depression in working environment may also be because of several work related variables, including

lower level of job stress, increased perceived control over work activities and more coworker support.

This is also seen that postpartum depression among non-working women is due to lack of social interaction or increasing ratio of breaking interpersonal relationship. Lack of social support and low experience to face challenges of life may be one reason of it. Social supports also vary from situation to situation. Some women feel depression in joint family system and some women feel depression in nuclear family system. A future research can be conducted on postpartum depression among working women, non-working women in different family systems (nuclear, joint family system) in Pakistan. Beck (2002) has reported that postpartum depression also increases in fathers significantly. Thus, it can be one of the directions for future research.

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## **TOURISM AS CONJOINT DECISION**

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### **ABSTRACT**

Tourism has been developed an important economic activity to use of vacation. While the growth in tourism has been increasing, Pakistan's share in international tourism arrivals and earnings is quite insignificant and same surveillance in domestic tourism too. It is an established fact that Pakistan has magnificent potential for development of tourism. This difference and the variety of fundamental reasons responsible for it. These are the focus of our study.

The objective being determination of customer preferences for multi attribute, so as to enable the state tourism to deliver a desired combination of fundamental attributes, helping it to able to be maintained aggressive benefit, leading to larger number of tourists satisfaction.

Faisal conjoint model has been used for this purpose, which estimates the structure of a consumer`s preferences, given tourist overall evaluations of a set of alternatives that are specified in form of levels and its different attributes.

### **1. INTRODUCTION**

Tourism is a service industry; therefore, there are inherent challenges with service marketing that affect how the tourism product is passed on to the consumer (Tripathi & Siddiqui, 2010). According to Williams (Williams, 2006), tourism and hospitality have become global economic key activities as expectations with regard to our use of leisure time have evolved, attributing greater meaning to our release time. This result in marketing having potentially greater importance in tourism than in other industries but unfortunately it is not always fulfilled (Morgan & Pritchard, 1999). Williams (Williams, 2006) believes that a foremost for such unconvinced potential lies in most tourism marketing focusing on the destination and missing motivation on the potential consumer. While Tourism Boards may already use a number of planned and controlled marketing activities, this research purports that tourism marketing could also develop the destination image enhancement opportunities that exist through raising an insight about the customer/tourist preferences and providing the desired services.

### **2. CONJOINT ANALYSIS**

Conjoint Analysis (CA) is one of the most popular statistical technique that engages the measurement of psychological judgments (consumer preferences, or accept abilities) or perceived similarities or differences between choice alternatives. The name ``conjoint analysis" implies the study of the joint effects. Conjoint analysis has become one of

today's most widely used marketing research tools. It goes beyond simple surveys, providing a more realistic approach to understanding customer's attitudes, opinions, and behaviors. According to Orme (Orme, 2010) the consumer preferences are changing constantly with an increasing speed. Therefore many marketing managers ask themselves, how they could assess client preferences? Which product characteristics are most important to the customer and what price brings the maximum profit? From Wilcox (Wilcox, 2003) point of view conjoint analysis gives answers to these most critical questions of marketing research. The conjoint analysis is a marketing research technique designed to help managers determine the value system of clients and potential customers (Wilcox, 2003). Introduced as a fundamental measurement method by the mathematical psychologists Luce and Tukey (Luce & Tukey, 1964), more than forty years ago, conjoint analysis presents combination of features in product profiles and ask people to rank or make choice among of them. Finally, the results can be used for new product design, targeting, pricing and market segmentation (Dolan 1990).

Conjoint analysis is a technique that functions to determine unknown rules people work with to make trade-offs between different products and services, also the estimates they place on different features. By recognizing correctly the psyche involved in consumers' decisions and the attributes they look for in products and services optimal height of characteristics and services balancing importance for the customer against the cost to the company can be formulated.

### 3. METHODOLOGY

The objectives of this study were (i) to determine the relative importance of attributes of tourism and (ii) to identify segments of consumers that differ in terms of the importance attached to tourism attributes. The research incorporated both qualitative and quantitative components. Three travels and twenty five tourist interviews were first conducted to identify the most salient attributes of the study as well as the most appropriate levels of these attributes. The qualitative phase also included product observation in different places. The quantitative phase of the study used conjoint analysis to measure the relative influence of the studied attributes that were identified.

Conjoint analysis has been widely used in marketing to evaluate consumer preferences for products and services (Hair et. al, 2009) and is frequently applied in examining preferences for food product attributes (Gil & Sanchez, 1997). The necessary data to carry out conjoint analysis consist of consumer preference rankings of product profiles described as sets of attributes levels.

#### 3.1 Selection of Attributes and Their Levels

The qualitative phase of the study enabled the identification of major attributes of tourism which the Information, Security, Location, Arrival, Importance were retained (Tripathi & Siddiqui, 2010).

The attribute levels were determined based on levels that consumers might realistically face. Following Hair recommendation (Hair et. al, 2009), we also wanted to balance the number of levels between attributes in order to avoid over or under estimate the importance of some attributes. The attributes and their levels are presented in Table 1.



**Table 1: Selected Attributes and their Levels for Study**

S#	Attributes	Levels
1	Information	Web & TV Media
		Print Media
		Tour Operators
2	Security	Law & Order
		Medical
		Luggage
3	Location	Natural Sides
		Historical
		Modern
4	Arrival	Air
		Road
		Rail
5	Importance	Greater Quality
		Greater Comfort

### 3.2 Conjoint Survey

Seven profiles consisting of different combinations of attribute levels were selected. Respondents were asked to rank each profile from 1 to 7, where 7 represents the most preferred profile and 1 the least preferred. To simulate the choices in a realistic situation where consumers would be evaluating many products, the profiles were all presented all on the same page. Ranked data are likely to be more reliable since it is easier for a respondent to say which he prefers more as compared to expressing the magnitude of his preferences (Green & Srinivasan, 1978). The surveyed profile and their ranks are shown in Table 2.

This research used a sample of adults tourist (18 years-old and over) drawn from the cities of Pakistan i.e. Karachi, Lahore and Islamabad. A total of 527 respondents completed the questionnaire. This is well above the minimum recommended sample size to obtain reliable results from conjoint analysis. In fact, according to (Hair et al., 2009), sample sizes of 200 have been found to provide an acceptable margin of error for typical applications of conjoint analysis.

**Table 2: Surveyed Profile and their Rank**

Profile	Information	Security	Location	Arrival	Importance	Rank
1	1	1	3	1	1	5
2	2	2	2	2	1	4
3	3	3	1	3	2	7
4	3	1	3	2	1	3
5	1	2	2	3	2	2
6	2	3	1	1	2	1
7	1	1	1	2	1	6

#### 4. FAISAL CONJOINT MODEL

Faisal Conjoint Model (FCM) is an integrated model of conjoint analysis and random utility models developed by Faisal Afzal Siddiqui, Ghulam Hussain, and Mudassir Uddin in 2012. Its algorithm was written in R statistical language and available in R (Siddiqui, et. al, 2012). Its design is independent of design structure. It could be used for any research design i.e. full profile, orthogonal, factorial, supersaturated etc. Another important point about FCM is rank procedure. It works for every kind of ranks i.e. unique ranks, percentage ranks, tight ranks, missing ranks etc. It has been tested for many published data i.e. (Orme, 2005; Green & Wind, 1973, Baheri, et al. 2011; SAS, 1993; SPSS20, 2011; SAS 9.3 Manual, 2011; Sawtooth, 2009, 2010; Hair et al., 2009; Orme & King, 1998; Huak, 2005; Lilien & Rangaswamy, 2006; Hair, et. al, 1998) etc. Most of the times, FCM results are same with same magnitudes, often the rank of results are in same order with little difference of magnitudes. Also FCM is applied in academics and research one of the reference is (Siddiqui & Awan, 2008).

#### 5. RESULTS

##### 5.1 Commends in R

```
library(faisalconjoint)
cdata <- read.csv(file="Tourism_data.csv",head=TRUE,sep=",")
clevels <- read.csv(file="Tourism_levels.csv",head=TRUE,sep=",")
faisalconjoint(cdata,clevels)
```

##### 5.2 Output in R

```
Factor Levels Utility
** Faisal Conjoint Model: Part-worth utilities **
 1 Info. Web & TV Media 0.41666667
 2 Info. Print Media -1.41666667
 3 Info. Tour Operators 1.08333333
 4 Security Law & Order 0.75000000
 5 Security Medical -0.91666667
 6 Security Luggage 0.08333333
 7 Location Natural Sides 0.75000000
 8 Location Historical -0.91666667
 9 Location Modern 0.08333333
10 Arrival Air -0.91666667
11 Arrival Road 0.41666667
12 Arrival Rail 0.58333333
13 Importn. Greater Quality 0.58333333
14 Importn. Greater Comfort -0.58333333
15 Constant <NA> 3.91666667
```

**\*\* Faisal Conjoint Model: Factor Importance \*\***

Factor 1 Percentage

1 Info. 30.70175

2 Security 18.42105

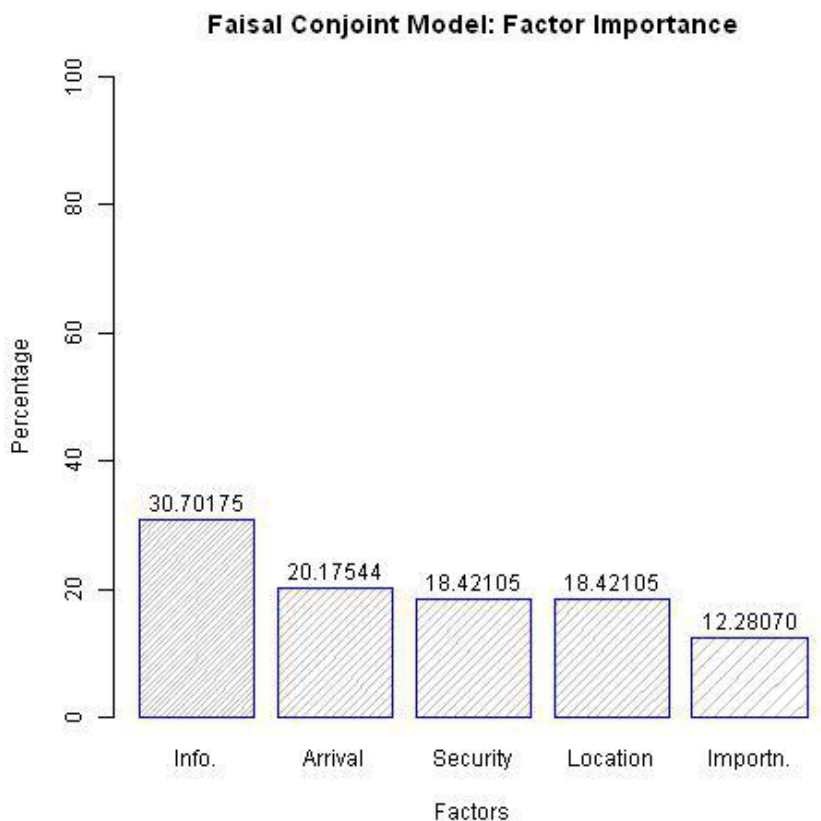
3 Location 18.42105

4 Arrival 20.17544

5 Importn. 12.28070

Note: Graph FCMgraph.jpg is automatically save in current working directory.

Results are also shown in the R window which pop-up on screen too. Graph is automatically saved in file "FCMgraph.jpeg" in current working directory, shown as in Figure 1. This could be included the research report.



**Figure 1: FCM: Factor Importance**

## 6. COMMENTS AND CONCLUSION

The conjoint results show that the most important aspect of the relationship between service providers and customers is that the service providers lack an in depth insight into customer preferences. There is often a disconnect between what customers want and what service providers offer in term of number it is around 30%, while security, location, arrival are approximately equal which is 20% any one of them is control with information of service offer, it will become 50% this will be great achievement in Pakistan tourism industry, the Pakistan is lucky that by the control of one factor, its tourism industry will boots-up by 50%, if any two factors control, grow by 70% and so on.

Now the utilities results are more important, because they are informing that to control leading factor (information), officials have to facilitate the tour operators also by the increasing the number of tour operators it will increase. the control of next 20%, they should control law and order condition only, than for next 20%, to save and promote the natural sides for tourism also for next 20% finding are telling the tourism prefer travel by train, so the train system should be improve and should be more facilitate. The railways authorities may build new station and track to promote the industry and it should be helpful to get more train business too.

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## AN EMPIRICAL RELATIONSHIP AMONG HIV/AIDS AWARENESS AND POVERTY RELATED SOCIOECONOMIC INDICATORS

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### ABSTRACT

There is an empirical relationship among the diseases and poverty. Many studies sustain this relationship. The perspective of this study is to explore the connection between HIV/AIDS awareness and poverty. Poverty is a complex phenomena itself which consist of many indicators related to affecting the awareness level of the individuals and the factors providing the causal relationship with the prevalence of HIV/AIDS. The present study is designed to best address the issues related to the spread of its prevalence. It is necessary to first establish an empirical relationship among poverty and HIV/AIDS awareness. This study therefore aims to develop an understanding of the relationship among the awareness of HIV/AIDS and poverty and poverty related socioeconomic factors by empirically testing the relationship using MICS 2007-08, conducted by Punjab Bureau of Statistics, P&D Department in collaboration with UNICEF Pakistan. This study is restricted to the married women age 15-49.

### KEY WORDS

HIV/AIDS; Poverty; HIV/AIDS awareness; MDG's; Logistic Regression; MICS Punjab;

### 1. INTRODUCTION

Pakistan lies in the center of the epidemiological transition. Here near about 40% of total burden of diseases (BOD) are accounted for infections / communicable diseases. These diseases are ARI<sup>1</sup>, Malaria, Tuberculosis, Hepatitis B&C, HIV/AIDS and childhood diseases. (PMDGR 2010)<sup>2</sup>

Target 7 of MDG's goal 6 is to stop the spread of HIV /AIDS and to reverse it by 2015. PMDGR (2010) shows that different indicators testify HIV prevalence among 15-24 years of old age pregnant women is 0.1% which is not very significant, but the HIV / AIDS prevalence among vulnerable group shows increasing trend. Especially IDU's (Injection Drug Users) and HSW's (Hijra Sex Workers) resulted in a significant rise that is alarming. Statistics shows a significant rise among both cases. HIV / AIDS prevalence among IDU's has increased 10.8% to 20.8% from 2005-06 to 2008-09 whereas among

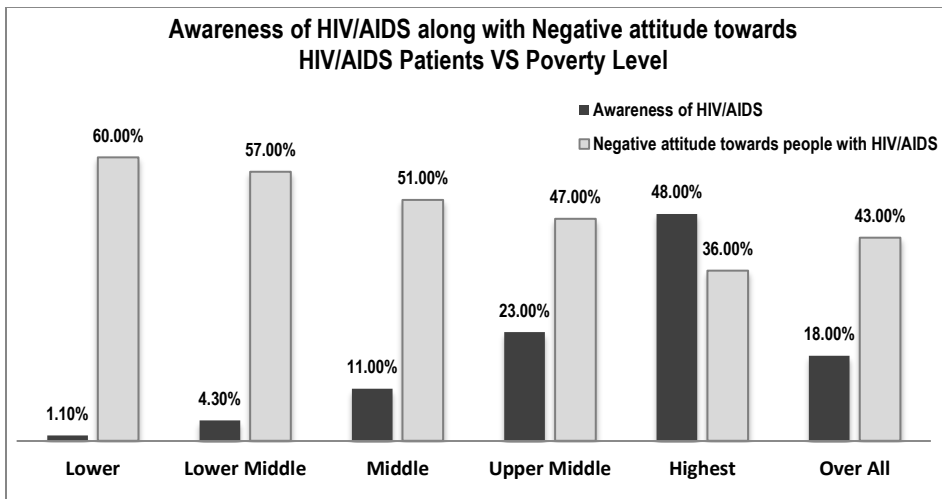
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<sup>1</sup> Acute Respiratory Infection

<sup>2</sup> Pakistan Millennium Development Goals Report 2010

HSW's this percentage has increased from 0.8 % to 6.4% in the same period. The significant rise occurred due to multiple factors include literacy, education, high migration, refugees and due to various social and economic shortcomings.

Since 2000 NGOs and Government organizations are working over these issues, according to the NACP<sup>3</sup> estimation 7400 people are living with HIV / AIDS in the country with HIV / AIDS prevalence rate of less than 1%. 4900 deaths by the epidemic have been taken place and 4500 HIV positive cases have been registered to National and Provincial AIDS control programs until now. This figure includes 2000 full blown AIDS cases. Keeping in view of this critical situation this study has been divided into two parts. At the 1<sup>st</sup> part the poverty factors influencing over the knowledge of HIV/AIDS awareness are explored out and in next step the factors causing HIV prevalence are studied.



Source: *MICS Punjab 2007-08*

The awareness level shows that the individuals having low knowledge have more negative attitude towards people having HIV/AIDS than the individuals having more knowledge. Although the current facts and figures of HIV prevalence show insignificant portion of the Population but the poor knowledge of HIV /AIDS and the rising statistics of IDU's and HSW's are the alarming signals for future challenges. Therefore a research over these issues is necessary and proper planning at national level is too necessary to meet the upcoming challenges. Current statistics shows that the poverty and especially literature has significant impact over the knowledge/awareness of people regarding HIV/AIDS but the entire extraneous factors construct this bridge are necessary to be explored.

Poverty and diseases are empirically correlated and testified by many researches, a huge literature is available over this association. Here are few most recent developments in this connection;

<sup>3</sup> National AIDS Control Program



Booyesen (2002) work on poverty, knowledge of HIV/AIDS and risky sexual behavior, in which he explored that a small percentage of women (4%) having good knowledge of HIV/AIDS involve in more risky sexual behavior than the women having poor knowledge. While the logistic regression model suggests that, poverty plays little role in explaining risky sexual behavior.

Were & Nafula (2003) assess the impact of HIV/AIDS on the economic growth of Kenya. In this study Author explores different channels through which HIV/AIDS affects on productivity and labour force supply, asset, accumulation of human social and physical capital and gender channel.

Taldi (2006) shows in study that poverty and its associated factors like low education and low decision making power can indeed increase the risk of HIV infection. Also the unsafe sexual behavior among poor increases the risk of susceptibility to the infections. The author also explains that the stereotype associated with the high economic status, such as the view of AIDS as a disease of the non-poor, as they discourage the adoption of the safer sexual behaviors.

Rena (2008) gives the idea of reverse impact of HIV/AIDS on poverty and education in Sub-Saharan African countries. Author states that HIV/AIDS spread based on poverty indicators and in turn it boosts up poverty. The author suggests that HIV/AIDS infection increasing heavily in Education Sector, and to cope with these matters education sectoral reforms are necessary to be adopted, to control the spread of HIV/AIDS infection and hence in turn poverty can be controlled.

Bouare (2009) develop two models of contextual determinants of HIV/AIDS prevalence to alert the policy makers. In this study author suggests fearlessness / low perception, poverty and hopelessness risks are determinants of the risk factors of HIV infection.

Sikander and Ahmed (2008) worked and explored the Household determinants of poverty in Punjab, in this study authors work on MICS 2003-04 data set of the Punjab and perform a logistic regression analysis to set the house hold poverty determinants.

Fawzi et al., (2010) suggests that poverty and poverty related factors like food insecurity and partner occupation are associated with HIV/AIDS positive status among women in rural Haiti. In this study the author suggests that the economic vulnerability and gender inequality may increase the risk of HIV Infection among women in rural Haiti. According to the study the access to the basic education, adult literacy programs, and income generating opportunities may lead a positive impact on reducing the risk of HIV infection.

Fako (2010) investigates that poverty in terms of low socio economic status affects sexual activity, knowledge about HIV/AIDS and willingness to test for HIV infection among young people. In this study author discuss that the knowledge about HIV/AIDS and willingness to test for HIV/AIDS are associated with different indicators of poverty including residence status, low socioeconomic status, having unemployed parents, emotional instability and unsatisfied life status.

Ahmed, Gilani and Kamal (2010) worked over poverty and Infant mortality Rate in Punjab. In this paper a ridge regression model for near collinear factors of IMR<sup>4</sup> are determined in respect of poverty. A ridge regression method was used as a remedial measure of multicollinearity problem.

## 2. THEORETICAL FRAMEWORK

Poverty and diseases are closely related to each other and this relationship is empirically tested by the number of researches. In this study the objectives are to explain the different factors that might cause the lack of awareness of the HIV/AIDS among individuals. Therefore keeping the objectives in mind, in this study the awareness of HIV/AIDS is the dependent variable which is expected that, it is greatly influenced by the poverty related socioeconomic indicators. Poverty is a complex phenomenon and number of researches has been developed to measure it with different indicators. Poverty is actually the deprivation of the necessities of life, like food, shelter, health facilities etc.

HIV/AIDS infection has three basic sources of its spread (1) Blood transfusion (2) Reuse of disposable Syringes (3) Unsafe Sexual relationship. Pakistan is an Islamic country, here cultural, social, and religious norms greatly affect over the 3<sup>rd</sup> factor of the spread of HIV/AIDS. Therefore HIV/AIDS prevalence rate in Pakistan is though very low i.e. below 0.1% (PMDGR, 2010) which is not significant but if we have a glance over the awareness of HIV/AIDS awareness, that is too critical and alarming for the future threats of its spread. Therefore the awareness of HIV/AIDS leads individuals to protect themselves for HIV infections.

In this study some suggested independent variables ( $X_i$ ) along with respective description and the dependent variable ( $Y_i$ ) awareness of HIV/AIDS are given below:

*Y: Awareness of HIV / AIDS*

Number of currently married women who correctly state three main ways of avoiding HIV/AIDS infection [safe blood transfusion, use of disposable syringe and safe sex]

Coding: 0 = Poor Awareness  
1 = Good Awareness

*X<sub>1</sub>: Poverty*

Principal components analysis was performed by using information on household goods and amenities (assets), assigning weights to each asset and thus obtaining wealth scores. Each house hold has been assigned a Wealth Index Score. These scores are grouped into 5 Quintiles (Lowest, Second, Middle, Fourth, Highest)

Coding: 0 = Very Poor “Lowest”  
1 = Non Very Poor “Second + Middle+ Fourth + Highest”

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<sup>4</sup> Infant Mortality Rate

*X<sub>2</sub>: Education of Married Females Age 15-49*

Educated and uneducated, where educated means the individuals passed primary and above primary level and the rest are considered as uneducated

Coding: 0 = below primary and not attended school  
1 = Primer level and above

*X<sub>3</sub>: Media access (TV, Radio, Computers, etc.)*

Have media (TV, Radio/Tape, Internet) at home

Coding: 0 = Have access to Media  
1 = Have no access to Media

*X<sub>4</sub>: Physical Access to Health Facilities (within half an hour distance)*

Any Govt. or Private Health facility available in the distance of below half an hour

Coding: 0 = Have access to Health Facility  
1 = Have no access to Health Facility

*X<sub>5</sub>: Employment Status*

Women working at Government sector, Semi Government Sector, Private sector (Non-Laborer) are considered as Employed women

Coding: 0 = House wives / Laborer women  
1 = Employed at Educated environment

### 3. RESEARCH HYPOTHESIS

This research raised a research question that poor individuals have poor awareness of HIV / AIDS and hence more chances of prevailing HIV / AIDS than non-poor ones.

General hypothesis along with sub hypotheses are as follows:

H<sub>A</sub>: Poverty and Poverty related socioeconomic indicators have negative impact on the awareness regarding HIV / AIDS prevention.

H<sub>A1</sub>: Very poor individuals are more likely to have less awareness than non-poor ones regarding HIV/AIDS prevention.

H<sub>A2</sub>: Education leads to positive impact over the awareness of preventing HIV/AIDS among individuals.

H<sub>A3</sub>: Media access has positive impact towards the awareness of preventing HIV/AIDS among individuals.

H<sub>A4</sub>: Health facility access has positive impact among individuals regarding the awareness of preventing HIV/AIDS.

H<sub>A5</sub>: Employment at educated environment leads to positive impact over the awareness of preventing HIV/AIDS among individuals.

#### 4. DATA AND METHODOLOGY

This study is conducted through utilizing the data set provided by (Multiple Indicator Cluster Survey) MICS 2007-08 (Punjab), conducted by Punjab Bureau of Statistics, P&D Department in collaboration with UNICEF Pakistan. The survey was conducted from November 2007 to March 2008 in order to collect the information about various socio-economic indicators in the Punjab as well as to access the MDG's<sup>5</sup>. The selection of the sample was made by FBS<sup>6</sup>, Statistics Division Pakistan. The sampling technique used was two stage stratified sampling. At first stage the Clusters (EB's and villages) are selected, then at the next stage a systematic sample of 12 and 16 HH's<sup>7</sup> are selected from the clusters (EB's<sup>8</sup> and Villages respectively). The total no clusters and HH's selected are 6368 and 91280 respectively. The sample size of the variable of interest understudy is 87,279 (Married women age 15-49) from 91,280 households. (See Annex-1)

Here the objective of this study is to predict the independent variable on the basis of the multiple independent variables (Poverty, Education, Media access, Health access and Employment Status). Various multivariate statistical techniques are available for this purpose. Discriminant analysis and Logistic regression analysis make it possible to predict a categorical dependent variable on the basis of predictors. Because in this study the independent variables are not of continuous nature rather categorical type therefore Logistic regression is more appropriate analysis technique that can be implemented. Also Discriminant analysis makes various assumptions about the predictor variables, including the normality assumption. Whereas logistic regression don't require such assumptions, another justification to use this type of data analysis in the output interpretation of Discriminant analysis, that gives the Discriminant function to calculate a value that is used to predict category membership. The value of Discriminant function is arbitrary which provides little information for the prediction. Whereas Logistic regression though a complex procedure but the output is easily interpretable. Logistic regression gives the probability (log odds) that a case will belong to particular category. Therefore the Logistic Regression model is used here to obtain the probability of having poor awareness and good awareness.

The general expression of the function is;

$$Y_i = f(X_{1i}, X_{2i}, X_{3i}, \dots X_{ki})$$

Here  $Y_i$  is the dependent variable which represents the awareness of HIV/AIDS and  $X_{ki}$  shows the Independent Variable, which represents the poverty and poverty related socioeconomic indicators determines the awareness among individuals.

The response variable  $Y_i$  (aware or unaware of HIV) can be expressed in the form of regression equation as:

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<sup>5</sup> Millennium Development Goals

<sup>6</sup> Federal Bureau of Statistics

<sup>7</sup> House Hold

<sup>8</sup> Enumeration Blocks in City Regions

$$Y_i = \sum_{i=1}^k X_{ki} \beta_i + \varepsilon$$

Here  $Y_i$  is not observable and is a latent variable; it can be observe as dummy variable  $Y$  that takes the value 1 if  $Y_i > 0$  and takes the value 0 otherwise.  $\beta$  is the vector parameter and  $\varepsilon$  is the error term.  $E\langle Y | X \rangle = \beta_0 + \beta_1 X_i + \varepsilon$

For convenience let  $E\langle Y | X \rangle = \theta(x)$ , here  $\theta(x)$  and  $x$  are nonlinear in logistic regression and the relationship among both is usually monotonic. Agresti (1996) gives the Logistic Regression function as

$$\log \left( \frac{\theta(x)}{1-\theta(x)} \right) = \beta_0 + \beta_1 X_i$$

Logistic Regression is special case of GLM's and  $0 < \theta(x) < 1$ .

In order to analyze the data set of MICS -2007-08, the software SPSS version 19 has been used to regress the model.

## 5. RESULTS AND DISCUSSION

Data collected from MICS 2007-08 shows the descriptive about the data set is that, the sample selected 19.06 % people are very poor and the remaining lies in the non-very poor category. The educational statistics shows that 40.94 % people are educated whereas 59.06 % are uneducated. 24.58 % and 28.44% people have no Health and Media access respectively. 96.73% female population is unemployed (working as house wives, or working in uneducated environment like farms, fields, cottage industry etc.) and 3.27% population of female is working in educated environment (schools, government Semi-government and private sector).

### Overall Punjab:

The overall model has been developed in two dimensions, in the first model the independent variables belonging to category 1 (Non- very Poor, Educated, Have Media Access, Employed at Educated Environment) are considered as reference category, whereas in second model independent variable belonging to category 0 (Very Poor, Uneducated, No Media Access, No Access to health facility, Unemployed) are considered as reference category.

The empirical model shows the results; (See Annex-II)

Model 1:

$$\begin{aligned} \ln(\text{Odds of having Good awareness of HIV/AIDS}) \\ = 0.85 + (-1.54) (\text{Very Poor}) + (-2.09) (\text{Non-Education}) \\ + (-0.98) (\text{No Media access}) + (-0.52) (\text{No access to health facility}) \\ + (-1.26) (\text{Unemployed}) \end{aligned}$$

**Model 2:**

$$\begin{aligned} \ln(\text{Odds of having Good awareness of HIV/AIDS}) \\ = -5.53 + (1.54) (\text{Non-Very Poor}) + (2.09) (\text{Educated}) \\ + (0.98) (\text{Media access}) + (0.52) (\text{Access to health facility}) \\ + (1.26) (\text{Employed}) \end{aligned}$$

All the variables in the model are highly significant shows a close bound with the awareness of HIV/AIDS among individuals. In model 1 the individual belonging to non-poor category is likely to be 4.6 times more aware than the individuals belongs to poor category. Similarly the educated individual is 8.05 times more likely to be aware than uneducated. The individual having access to media is 2.7 times more likely to be aware than the individual have no access to media. In the same way the individual have access to health facility is 1.7 times more likely to have awareness than the individual have no access to health facility. Similarly the employed individual is 3.5 time more likely to have awareness than unemployed one's.

**REGION WISE ANALYSIS:**

Data set is divided into geographical regions of the Punjab and the same set of analysis has been performed again to confirm the model adequacy. 36 districts of the Punjab have been divided into 4 geographical regions as Northern Punjab, Western Punjab, Southern Punjab, and Central Punjab. Descriptive Statistics shows that Northern Punjab contains 11.9% of female population of the sample whereas Western, Southern and Central Punjab contains 20.2%, 25.1% and 42.8% respectively.

**Northern Punjab:**

Northern Punjab contains a sample of 10294 Married Females of age 15 to 49. Out of this sample size 2.60% female population belongs to very poor category, 20.90% have no access to health facility, 12.22% have no access to media at home, 95.01% population of the sample is either worked as house wives or working in uneducated environment, and 41.03% are uneducated.

The empirical model shows the results; (See Annex-III)

$$\begin{aligned} \ln (\text{Odds of having Good awareness of HIV/AIDS}) \\ = -5.073 + (1.326) (\text{Non-Very Poor}) + (1.926) (\text{Educated}) \\ + (1.043) (\text{Media access}) + (0.877) (\text{Access to health facility}) \\ + (0.994) (\text{Employed}) \end{aligned}$$

All the variables in the model are highly significant and show a close bound with the awareness of HIV/AIDS among individuals. This model shows the better fit than the model fitted to the overall Punjab.

**Western Punjab:**

Western Punjab contains a sample of 17653 Married Females of age 15 to 49. Sample selected from the Western Punjab contains 33.10% belongs to very poor category, 39.71% and 28.99% people has no access to media and health facility respectively,

96.79% population of female selected in the sample is either house wife or working in uneducated environment as laborer, and 70.43% females are found uneducated. The empirical model shows the results;

$$\begin{aligned} \ln (\text{Odds of having Good awareness of HIV/AIDS}) & \text{ (See Annex-IV)} \\ & = -4.633 + (1.446) (\text{Non-Very Poor}) + (1.891) (\text{Educated}) \\ & \quad + (0.667) (\text{Media access}) + (-0.003) (\text{Access to health facility}) \\ & \quad + (1.243) (\text{Employed}) \end{aligned}$$

All the variables in the model are highly significant shows a close bound with the awareness of HIV/AIDS among individuals except the variable Access to Health Facility. This shows that the health facility does not lead a significant impact over the awareness of HIV/AIDS among individuals in the Western Punjab.

### **Southern Punjab:**

Southern Punjab contains a sample of 21891 Married Females of age 15 to 49. Sample of Southern Punjab contains 31.54% of the population falls in very poor category. 37.41% and 38.07% of the sampled population have no access to health facility and media respectively. 97.29% sampled female population is either unemployed or employed at uneducated environment. 71.52% sampled population is uneducated.

The empirical model shows the results;

$$\begin{aligned} \ln (\text{Odds of having Good awareness of HIV/AIDS}) & \text{ (See Annex-V)} \\ & = -6.706 + (1.902) (\text{Non-Very Poor}) + (2.168) (\text{Educated}) \\ & \quad + (0.878) (\text{Media access}) + (0.521) (\text{Access to health facility}) \\ & \quad + (1.284) (\text{Employed}) \end{aligned}$$

All the variables in the model are highly significant shows a close bound with the awareness of HIV/AIDS among individuals. This model is also better than the model fitted to the overall Punjab. The minimum value of Chi-square and the higher level of significance shows the model strength also the Nagelkerke R Square and the percentage of correct prediction shows that the model adequately represents the phenomena under study.

### **Central Punjab:**

Central Punjab contains a sample of 37345 Married Females of age 15 to 49. Out of which 9.76% belongs to very poor category, 16.05% and 22.05% have no access to health facility and media respectively. 96.84% sampled population falls in unemployed category and 51.47% of the sampled population is uneducated.

The empirical model shows the results; (See Annex-VI)

$$\begin{aligned} \ln (\text{Odds of having Good awareness of HIV/AIDS}) & \\ & = -5.750 + (1.480) (\text{Non-Very Poor}) + (2.146) (\text{Educated}) \\ & \quad + (1.080) (\text{Media access}) + (0.583) (\text{Access to health facility}) \\ & \quad + (1.389) (\text{Employed}) \end{aligned}$$

All the variables in the model are highly significant shows a close bound with the awareness of HIV/AIDS among individuals. This model also shows the results similar to the results of Southern Punjab.

## 6. COMMENTS AND CONCLUSION

In respect of the objectives of the study, the research is aimed to establish a connection among Poverty and HIV/AIDS prevalence. For this purpose in the first instance the influence of the poverty and poverty related socio-economic indicators (education, employment status, media access and physical access to health facility ) over the awareness of HIV/AIDS has been modeled and empirical findings strengthen this phenomena. This result is consistent with the result of (Taldi, 2006) study. In the light of statistical analysis it is confirmed that poverty itself plays a vital role over the awareness of individuals regarding HIV/AIDS. This research presents analytical evidences at regional level as well as at province Punjab, to identify discrete reasons using logistic regression. Analysis shows that awareness is linked with poverty as poor individuals are more likely to have less awareness than the non-poor ones and in turn have more chances of prevailing HIV/AIDS infection. Similarly education plays significant role over the awareness of individuals regarding HIV/AIDS in the Punjab at regional level. Educated individuals are more likely to have awareness than uneducated ones. In the same way other factors associated with poverty like, employment at educated environment, access to health facility and access to media plays significant role over the awareness status. However in western Punjab analysis shows insignificance of access to health facility over the awareness related to HIV/AIDS that raise another explore able area to identify the reasons linked with insignificance of access to health facility.

The current study provides evidence that by improving literacy, eradicating extreme poverty, using suitable media campaigns and by spreading the health facilities can improve the awareness of individuals, and in turn this leads to save the nation by the possible threats of the spread of HIV prevalence. This research also provides indicators and tangible results for suitable policy development related to health, education and economic developments.

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## APPENDIX

## Annex-1

Clusters Selected			HH Selected		
Total	Villages	EB Urban (Enumeration Block)	Total	Villages	EB Urban (Enumeration Block)
6,368	3,716	2,652	91,280	59,456	31,824

Source: Tehsil based multiple indicator cluster survey (MICS) 2007-08 Report, Volume-I

## Annex-II

**Table: Odds of Having Good HIV Knowledge by the Poverty & Poverty related Socio-economic Indicators (Overall Punjab)**

		Model 1		Model 2	
		B	Exp(B)	B	Exp(B)
<b>Poverty Status</b>					
Very Poor	*	-1.535	0.215		
Non-very Poor	*			1.535	4.643
<b>Education Status</b>					
Uneducated	*	-2.086	0.124		
Educated	*			2.086	8.053
<b>Media Access</b>					
No Media Access	*	-0.983	0.374		
Have Media Access	*			0.983	2.672
<b>Access to Health Facility</b>					
No Access to Health Facility	*	-0.516	0.597		
Have Access to Health Facility	*			0.516	1.676
<b>Employment Status</b>					
Laborer and House Wife	*	-1.255	0.285		
Employed at Educated Environment	*			1.255	3.508
Constant		0.851	2.342	-5.525	0.004
<b>Model Chi-Sq. (Hosmer and Lemeshow)</b>		18.39**		18.39**	
** Significant at 0.2% level					
* Highly Significant					
-2 Log Likelihood		61695.1			
Nagelkerke R Square		0.33			
Percentage of Correct Prediction		83.0			

**Annex-III**

<b>Northern Punjab</b>				<b>95% C.I. for EXP(B)</b>			
		<b>B</b>	<b>S.E.</b>	<b>Wald</b>	<b>Exp(B)</b>	<b>Lower</b>	<b>Upper</b>
Have Media Access	*	1.043	0.11	98.037	2.838	2.309	3.489
Have Access to Health Facility	*	0.877	0.07	159.955	2.403	2.098	2.752
Employed at Educated Environment	*	0.994	0.1	92.98	2.701	2.207	3.306
Educated	*	1.926	0.06	1122.098	6.859	6.128	7.677
Non-very Poor	*	1.326	0.4	10.977	3.765	1.718	8.247
Constant		-5.07	0.4	160.001	0.006		
Model Chi-Sq. (Hosmer and Lemeshow)	**	<b>4.309</b>					
** Significant at 36.6 % level							
* Highly Significant							
-2 Log Likelihood	10759.284						
Nagelkerke R Square	0.283						
% of Correct Prediction	66.6						

**Annex-IV**

<b>Western Punjab</b>				<b>95% C.I. for EXP(B)</b>			
		<b>B</b>	<b>S.E.</b>	<b>Wald</b>	<b>Exp(B)</b>	<b>Lower</b>	<b>Upper</b>
Have Access to Health Facility	***	-0.003	0.068	0.002	0.997	0.872	1.139
Have Media Access	*	0.667	0.073	83.114	1.949	1.688	2.249
Employed at Educated Environment	*	1.243	0.097	165.128	3.464	2.866	4.187
Educated	*	1.891	0.056	1122.015	6.629	5.935	7.405
Non-very Poor	*	1.446	0.118	149.894	4.245	3.368	5.351
Constant		-4.633	0.115	1622.984	0.010		
Model Chi-Sq. (Hosmer and Lemeshow)	**	<b>16.737</b>					
** Significant at 3.3 % level							
* Highly Significant							
*** Insignificant							
-2 Log Likelihood	10201.331						
Nagelkerke R Square	0.311						
% of Correct Prediction	87.9						

**Annex-V**

<b>Southern Punjab</b>				<b>95% C.I. for EXP(B)</b>			
		<b>B</b>	<b>S.E.</b>	<b>Wald</b>	<b>Exp(B)</b>	<b>Lower</b>	<b>Upper</b>
Have Media Access	*	0.878	0.079	122.219	2.406	2.059	2.811
Have Access to Health Facility	*	0.521	0.064	66.550	1.684	1.486	1.909
Employed at Educated Environment	*	1.284	0.096	179.831	3.612	2.994	4.358
Educated	*	2.168	0.059	1358.206	8.740	7.788	9.808
Non-very Poor	*	1.902	0.174	119.578	6.698	4.764	9.419
Constant		-6.076	0.174	1219.629	0.002		
Model Chi-Sq. (Hosmer and Lemeshow)	**	<b>6.105</b>					
** Significant at 41.2% level							
* Highly Significant							
-2 Log Likelihood	10679.385						
Nagelkerke R Square	0.360						
% of Correct Prediction	89.6						

**Annex-VI**

<b>Central Punjab</b>				<b>95% C.I. for EXP(B)</b>			
		<b>B</b>	<b>S.E.</b>	<b>Wald</b>	<b>Exp(B)</b>	<b>Lower</b>	<b>Upper</b>
Have Media Access	*	1.080	0.056	371.875	2.946	2.640	3.288
Have Access to Health Facility	*	0.583	0.051	130.440	1.792	1.621	1.981
Employed at Educated Environment	*	1.389	0.068	415.379	4.009	3.508	4.582
Educated	*	2.146	0.038	3144.083	8.547	7.930	9.213
Non-very Poor	*	1.480	0.165	80.420	4.391	3.178	6.067
Constant		-5.750	0.169	1160.446	0.003		
Model Chi-Sq. (Hosmer and Lemeshow)	**	<b>7.529</b>					
** Significant at 11.0% level							
* Highly Significant							
-2 Log Likelihood	29385.665						
Nagelkerke R Square	0.299						
% of Correct Prediction	80.9						

**THE ROLE OF INTELLECTUAL CAPITAL FOR SUSTAINING  
COMPETITIVE ADVANTAGE FOR CORPORATIONS:  
(An Insight from Banking Institutions of D.G. Khan, Pakistan)**

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**ABSTRACT**

Present era belongs to knowledge based economy in which modes of competition are different as compared to past. Firms of today have developed intellectual capital as a strategic resource that enables a firm to create a sustainable competitive advantage. This research study investigates the relationship of intellectual capital with creation of sustainable competitive advantage for corporations. In this research study a sample of 280 employees (manager and non-manager) was selected from banking sector in the area of district DG Khan. Three determinants of intellectual capital were used, human capital, relational capital and structural capital were included in this research study. Data analysis was performed on SPSS software. Based on empirical evidences it is suggested that there is positive relation of human capital on structural and structural on relational and relational on human capital. It is also observed that the effect of relational capital on sustainable competitive advantage is insignificant.

**KEYWORDS**

Intellectual capital; human capital; structural capital; relational capital; sustainable competitive advantage.

**1. INTRODUCTION**

Tools of competition in modern world are very dynamic, corporations are using intellectual capital for value maximization and heavily depends on this intangible asset. Maintenance of intellectual capital is the main concern of today's corporations as this valuable asset can be used for creating sustainable competitive advantage. There is common consent among researchers that intellectual capital has a significant impact on organizational growth and it leverages competitive advantage for organizations. (Pulic, 2004; Chen et al. 2005). So the management of intellectual capital is very important. Thus, intellectual capital's identification, evaluation, and management is very important (Chang, 2007).

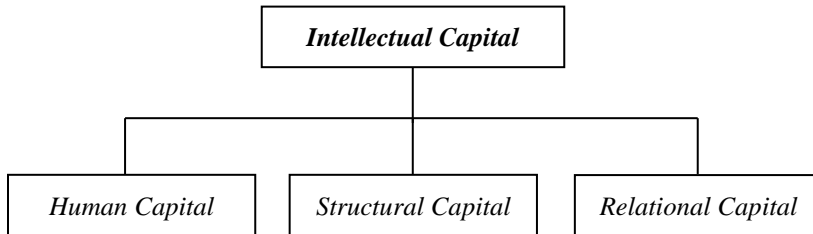
Previous research studies have focused on one aspect of intellectual capital structure or these studies explored the impact of intellectual capital on financial performance of organizations. This research study contributes in existing literature in two ways. First, it includes different important facets of intellectual capital (structural, relational and human) to explore intellectual capital, second, it attempts to find out the impact of intellectual capital on creating sustainable competitive advantage for corporations. So the idea to use intellectual capital as a tool to gain competitive advantage over rivals provide newness for this study and its exploration in the context of Pakistan also adds new things in existing literature because to the good knowledge of authors no research study is found on this area in the context of Pakistan.

## 2. LITERATURE REVIEW

### *Intellectual Capital*

According to Roos et al. (1997), intellectual capital means all those assets that are intangible and not included in balance sheets. Roos et al. (1997) further extend their definition that it is the sum of corporate people's knowledge and how efficiently corporate utilize this knowledge. Zeghal et al. (2010) defined intellectual capital as the sum total knowledge that a firm can apply to its processes for value creation. The concept of intellectual capital is not limited to the knowledge of people of an organization but it also considers the stored knowledge in the shape of organizational database so the structure of intellectual capital is multidimensional. Roos et al. (1997) explained that intellectual capital is divided into two categories one is human capital and other is structural capital. Edvinson et al. (1997) contributed further advancement in the area of intellectual capital they were of the opinion that intellectual capital is knowledge driven.

Chang (2007) extended the structure of intellectual capital by including relational capital along with human and structural capital.



**Fig. 1: Three Structures of Intellectual Capital (Roos & Roos, 1997)**

So the above discussion leads authors to the following points:

1. Human capital: it means technical knowledge and skills of organizational personnel
2. Structural capital: it includes structures and process of an organization
3. Relational capital: it includes customers and communication with product/service provider (Brennan et al. 2000)

### **Human Capital**

Human capital means the knowledge of individuals of an organization for value creation and problem solving (Norma, 2005). Most of the theorists considered human capital on individual level but Bontis (1998), considered human capital as an intellectual essence of organization. According to Longo (2007), the intellectual capital provides the basis for innovation for an organization and creates advantages for the organizations. Human capital can be divided into two categories: hard part and soft part. Hard part deals with knowledge and skills of people in the organization whereas soft part considers the attitude of the people with job. Soft part of human capital is the major concern of today's corporations (Chen et al. 2004).

### **Structural Capital**

Structural capital relates to the processes of an organization through which an organization runs its operations (Vergauwen et al. 2005). This capital considers all non-human knowledge of an organization. This capital is possessed by an organization and can be used to achieve business objectives of a firm. This capital helps the personnel of an organization in performing their work related duties so the structural capital possesses human capital and develops human skills for their survival as indicated by (Peppard, 2001).

### **Relational Capital**

Relational capital is regarded to have more direct effect as compared to human and structural capital and plays a pivotal role in marketing communication channels (Chen et al. 2004). According to Roos et al. (1997) the relational capital communicates between organization and external stakeholders and it also provides the basis for good relationship with providers (Marr, 2005).

According to Guthrie et al. (2004) the relational capital includes: customer's loyalty, customer orientation, customer service and support. Guthrie et al. (2004) further explored that these indicators are helpful for customer retention and satisfaction.

### **Sustainable Competitive Advantage**

In today's global economy, firms need to maintain competitive advantage over rivals to win the competition. Today, every firm tries to sustain its competitive advantage over rivals for a longer period of time (Tsai et al. 2008). Porter (1985) explored that the value of competitive advantage is higher than the customer expenditures. Mintzberg (1991) was of the opinion that a firm achieves competitive advantage over rivals when its goods and services are well differentiated with competitors. According to Tsai et al. (2008) competitive advantage includes, resources, communications and capabilities that pave the way of an organization to explore new opportunities to expand its business. Competitive advantage is all about the creation of superior value for customers (Zhang et al. 2008). According to Chen et al. (2009), the competitive advantage leads an organization towards success as compared to rivals. Zhang et al. (2008) concluded that sustainable competitive advantage has more value for customers of an organization. According to Grant (1997), sustainable competitive advantage means how long a firm maintains its competitive advantage over rivals.

The sustainable competitive advantage has more value for its customers (Zhang et al. 2008). So there is no ending point for sustainable competitive advantage in fact it is endless journey (Evans et al. 1997).

This research study seeks support from Wernerfelt (1995) and Barney's (1991) theories. They concluded that resources and capabilities of a firm determine its performance in competitive environment. Chen et al. (2009) stated that a firm can sustain competitive advantage when it gets benefit of internal strengths and external opportunities and in the same way it avoids from internal weaknesses and external threats. So the resources and capabilities of a firm provides basis for competitive advantage (Barzelay, 2003). Effective utilization of resources and capabilities produces more value creation.

According to Barney (1991), there are four types of resources 1) rare resources 2) imitable resources 3) valuable resources and 4) sustainable resources. He says an organization should have these four resources to gain sustainable competitive advantage.

### 3. MATERIALS AND METHODS

#### Development of Hypotheses and Conceptual Model

Corporations of today rely heavily on human capital to grow their business. Different theorist explored the importance of human capital in different ways. Long et al. (2011) suggested a model for intellectual capital in which they concluded that human capital affects structural capital positively. Same kind of findings were observed by Martinz (2006) when he designed a structural human capital model in which he proved positive significant relation of human capital to structural capital. So in the light of above study it is proposed:

H1: Human capital positively affects structural capital

According to Fornell (1992) customer satisfaction can grow financial performance of a business and customer satisfaction results from relational capital. Similarly, Martinz (2006) in his study found that the effect of structural capital on relational capital is positive and in the same way the effect of relational capital on human capital is also positive and significant. Same observations were acknowledged by Baxter et al. (2004) in a research study. So it can be suggested that:

H2: there is positive effect of structural capital on relational capital

H3: the relational capital positively effects human capital

These three intellectual capital structures produce a positive impact on competitive advantage as indicated by Bataineh et al. (2011). The study conducted by Memon et al. (2009) also supports the finding of Bataineh et al. (2011). So in the light of these research studies it can be suggested that:

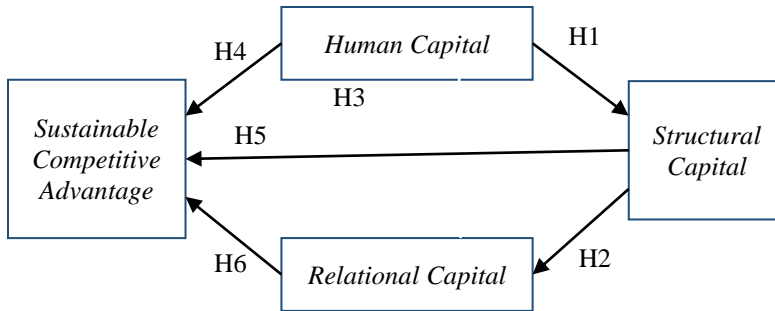
H4: Human capital is positively related with sustainable-competitive-advantage

H5: Structural capital is positively related with sustainable-competitive-advantage

H6: Relational capital is positively related with sustainable-competitive-advantage



So the conceptual model of this research study is given in figure 2:



**Fig. 2: Conceptual Model of the Study**

**Methodology**

Sample of this study was 280 staff members from different Banking institutions in the region of district D. G. Khan. Sample of study included both managers and non-managers. Convenient sampling method was chosen for this purpose. A questionnaire was distributed among these people for data collection. The sample population could easily comprehend the statements of questionnaire so the content validity of questionnaire is acknowledged.

Questionnaire was build on five choice Liker scale ranging from completely disagree to completely agree. The questionnaire was prepared by considering the indices of Roos et al. (1997). Questionnaire included 28 questions to measure four variables of study as described in table 1

**Table 1: No. of variables' question**

<i>Variables</i>	<i>N of Question</i>
Demographic Variables	3
Human- capital	8
Structural –capital	4
Relational –capital	7
Sustainable – competitive – advantage	9

A pretest was implemented to maintain the reliability of the questionnaire and the results are shown in table 2. These results indicate that the reliability of questionnaire is confirmed.

**Table 2: Results of Reliability Test**

	<i>N of Items</i>	<i>Cronbach's Alpha</i>
Human – capital	30	0.766
Structural – capital	30	0.742
Relational – capital	30	0.873
Sustainable – competitive – advantage	30	0.878
Total	30	0.930

#### 4. RESULTS AND DISCUSSION

##### Demographic Variables

Table 3 explains results of descriptive statistics.

**Table 3: Descriptive Statistics**

		<b>Frequency</b>
Sex	Male	60.8%
	Female	39.2%
Age	Under 30	27.9%
	30-35	11.9%
	35-40	12%
	40-45	11%
	Upper 45	37.9%
Educational	Under graduate	44.2%
	Master	55.8%
	Ph.D.	0.0

##### Correlation Analysis

Table 4 describes the results of correlation analysis. A moderate and significant relation was observed among all variables of the study the results of correlation analysis were drawn with the help of SPSS while causal effect was tested through multiple regression analysis.

**Table 4: Results of Correlation**

	<i>Human Capital</i>	<i>Structural Capital</i>	<i>Relational Capital</i>	<i>Sustainable Competitive Advantage</i>
Human capital	1			
Structural capital	0.51	1		
Relational capital	0.47	0.43	1	
Sustainable competitive advantage	0.42	0.56	0.58	1

### ***Structural Model and Research Hypotheses***

For structural model analysis, authors used SPSS software the results are displayed in table 5.

Human capital is having positive and significant impact on structural capital as confirmed by results. T value is above 2.06 that is above 2 so it is significant similarly  $B = 0.54$  that is positive and significant ( $P = .000^{***}$ ) hence H1 is confirmed.

Structural capital is also producing positive impact on relational capital as confirmed by the results of analysis. T value is 2.86 that is above 2 and is significant similarly  $B = 0.69$  that is positive and significant ( $P = .047^{**}$ ) and hence H2 is also accepted.

Relational capital has significant impact on human capital as T value in this analysis is 2.41 that is above the average value of 2 so the T value is significant and the value of  $B = 0.62$  and  $p$ -value ( $.05^{***}$ ) that support H3 to accepted. Human capital is also positively associated with competitive advantage as T value is 2.01 that is above average level and significant,  $B = 0.41$  and  $P = .000^{***}$  that is positive so H4 is also accepted. The relationship of structural capital on sustainable competitive advantage is also positive and significant as the value of T is 2.89,  $B = 0.68$  and  $P = .000^{***}$  that is positive and significant and thus the proposition of H5 is also true and accepted.

The relationship of relational capital with sustainable competitive advantage is not confirmed as the value of T is less than 2 and  $p$ -value is .253 so H6 is not accepted and this relationship is not significant and true.

**Table 7: Significant Coefficients and T-Values**

<i>Hypothesis</i>	$\beta$	<i>T-value</i>	<i>P-Value</i>	<i>Results</i>
Human capital- Structural capital	0.54	2.01	.000***	Confirm
Structural capital- Relational capital	0.69	2.95	.047**	Confirm
Relational capital- Human capital	0.62	2.36	0.05**	Confirm
Human capital- Sustainable competitive advantage	0.41	1.98	.000***	Confirm
Structural capital -Sustainable competitive advantage	0.68	2.07	.000***	Confirm
Relational capital -Sustainable competitive advantage	0.22	1.21	0.253	Not confirm

## **6. COMMENTS AND CONCLUSION**

This research study aims at examining the effect of intellectual capital on sustainable competitive advantage in different banking institutions of district D. G. Khan. The results of the study are evident that the effect of human capital on structural, structural on relational, relational on human capital is positive the finding of H1 is also confirmed by Longo et al. (2011) so it means that banking staff can improve their performance with the improvement in processes.

According to the findings of H2 structural and relational capitals are positively associated with each other. It means that other sources of knowledge in banks have positive impact on personnel of a particular bank. According to H3, relational capital positively effects human capital these findings are also confirmed by Baxter et al. (2004). It means that external intangible elements have positive impact to enhance the skills of banking staff.

According to H4, human capital produces significant effect on sustainable competitive advantage as indicated by Bataineh et al. (2011) and Memon et al. (2009). It means that the knowledge of staff members of a specific bank is very important for gaining and sustaining a competitive edge. Similarly H5 states that structural capital and sustainable competitive advantage are positively associated. This result is in line with the findings of Bataineh et al. (2011). It means processes and procedures of a bank also provide basis for sustainable competitive advantage. In the end the supposition of H6 is not confirmed by the results of analysis. This result is inconsistent with Bataineh et al. (2011). Perhaps this differentiation is due to population of this study and theory that is used in this study but further research should be conducted for further investigation.

### **Implications for Policy Makers**

Intellectual capital is gaining more and more importance in today's dynamic environment and it is becoming a strategically important tool of competition. The policy makers of banking institutions should more and more emphasize to protect and develop their intellectual capital especially human capital and structural capital.

Although H6 of this study is not confirmed but it is suggested not to ignore this factor as the effect of relational capital on human capital is positive and significant so it is suggested that though direct effect of relational capital on sustainable competitive advantage is not confirmed but indirectly it plays important role as it is positively associated with human capital so this factor should not be ignored. This study provides good help to top managers and policy makers as it indicates the importance of intellectual capital. Though this study is conducted from banking institutions but the findings of this study may not be limited to banking institutions and may stand correct in other sectors as well.

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## **IMPACT OF INFORMATION TECHNOLOGY ON TERRORISM IN PAKISTAN**

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### **ABSTRACT**

Information Technology is growing rapidly with the passage of time and now is being used in Terrorist activities. IT is paying a contributory role in terrorism activities in Pakistan. Specially, Internet is a dynamic means to make terrorism activities more effective. There are different means by which IT is often utilized to promote and support Terrorism activities in Pakistan. The Study describes the increasing use of the IT by terrorists and their supporters for seeking their purposes as recruitment, financing, propaganda and training. This study gives strengthen of the concept that an anti-terrorism law to seize mobile phones and download personal internet data must also be enforced in Pakistan.

### **KEYWORDS**

Terrorism; Information Technology; Internet; Financing.

### **INTRODUCTION**

Terrorism means unlawful violence acts. Like many other parts of the world, Terrorism is going to be occurring on many different scales with different range of impacts in Pakistan also. While a terrorist act can involve a lone suicide bomber or a rental truck loaded with explosives. In one single day, many lives and high volume of public property lost to terrorism.

From many years IT has promoted the social, political, and economic context surrounded modern terrorism -- by providing a means of transnational hard-to-detect communication, and by providing the means of terror attacks. Government of Pakistan also believes that terrorists use internet (emails, chat, video conference to share information and intelligence and I.T. played a role in terrorist attacks in Pakistan, especially in Karachi and Islamabad where Cyber facilities and use is more.

Many criminal justice practitioners have indicated that almost every case of terrorism prosecuted involved the use of Internet technology. One of the primary uses of the Internet by terrorists is for the dissemination of propaganda, Financing, Training, Planning, and Execution. Propaganda generally takes the form of multimedia communications providing ideological or practical instruction, explanations, justifications or promotion of terrorist activities. [Use of internet in Terrorism United Nations, September 2012]

Terrorist acts are planned and perpetrated by collections of loosely organized people operating in shadowy networks that are difficult to define and identify. They move freely throughout the world, hide when necessary, and exploit safe harbors proffered by rogue entities. They find unpunished and oftentimes unidentifiable sponsorship and support, operate in small independent cells, strike infrequently, and utilize weapons of mass effect and the media's response in an attempt to influence governments [Counter Terrorism Information Technology, Robert Pop].

A side benefit of digital cryptography is its potential as a tool for extortion and blackmail. Since cryptographic technology is available free to anyone with an Internet connection, it is entirely possible to fashion computer viruses which encrypt selected files on a targeted hard drive, rendering them useless to anyone without the key. Depending on the sensitivity or value of the encrypted files, this type of scheme could generate significant resources for the perpetrator in terms of hard cash, or in-kind transfers of goods and services vital to a terrorist organization's operations. [Terrorist Use of the Internet and Related Information Technologies, Col Patrick S. Tibbetts U.S. Air Force]

This study is focus on the uses of Information Technology in Terrorism. Data is collected from different reports, recorded facts, questionnaires about different terrorism attacks held in different parts of Pakistan and analysis is made to identify the use of IT in those attacks. Population of the study includes major affected cities in Pakistan which have already faced terrorist attacks. Sample size was 200 of population using Stratified random sampling to analysis the data. So, the research is not focus on hacking and other cyber-crimes but it considers the larger threat occurred by the terrorists where information technologies are used.

The purpose of study is to identify and highlight the different information technology aspects which terrorist exploited and use in terrorism activities in Pakistan. The results of the study would may help to aware the public about exploiting use of Information Technology and in some extents, may help the concerned investigators to get some clues. The report will help to measure and prevent terrorism in the country.

## **LITERATURE REVIEW**

As innovation and enhancement Information technology is increasing rapidly and the nature of Internet is not a centralized. It is nearly impossible to identify how wide is the rule of internet in Terrorism. The different reports around the world highly identified the terrorists highly use the Information Technology (Internet specially) for terrorism activities.

According to report of United Nations Counter-Terrorism Implementation Task Force (CTITF), as technology is developing rapidly, it is being a challenge to prevent it as a tool for efforts at global level to counter terrorism. Terrorist now use technical tools to organize, plan, run, finance their terrorist activities. Large volume of suspected websites related to terrorism has been catalogued by many different entities in all over the world. Terrorists use technological tools as social media networks, online video and chat rooms etc. [1]



Terrorists use internet strategically and tact fully. International insurgents, jihadists, and terrorist organizations use the Internet as a tool for radicalization, recruitment, propaganda distribution, communication, and for training. In future, Internet can become a tact cause any incident of cyber-attack on critical infrastructure. They have “jihadist websites” on internet. [2]

Information Technology played a sufficient role in Terrorism activities in Pakistan. Government of Pakistan has been realizing this highly from previous 5 years. Ministry of Interior also requested to seek help from cyber community in this regard.

A request to Google has also made to provide the data for a particular terrorist incident. To keep a watch on Internet, Telecommunication authority of Pakistan also banned the use of secure VPN.

## METHODOLOGY

In this study, Data set is consist of number of terrorist attacks and internet usage from year 2009 to 2012. Data Collection for the study is secondary in nature .The secondary data is collected about terrorism attacks the major cities in Pakistan and Internet users. Data was collected from different defense reports, analysis and articles and research papers.

The study is quantitative in nature as the data about use of IT Tools, services and software, Internet is recorded in number of users and percentage. Similarly, the no of attacks are also be recorded in form of numbers and percentage. The use of information technology, a great increase in terrorist attacks in Pakistan is observed and measured. The co- relation model for the study is used.

In Internet, Pakistan has highest growth rate of internet users. According to a World Bank report published in 2012, The Internet users in Pakistan reported at 29128969.67 in 2010 and The State Bank of Pakistan (SBP) publications quoted World Bank statistics by July 2012, that Pakistan internet users has double. Now over 20 million internet users are in Pakistan. In 2013, Pakistan hits 22 million internet users. I guess 70 million till 2030 is so much conservative target. According to current internet user trends in Pakistan it can be measured that 70 million user up to 2020.

<b>Year</b>	<b>No of Internet Users</b>
2009	18 m
2010	18.5 m
2011	20 m
2012	25 m

<b>INTERNET FACTS</b>	
• Internet users	25 million
• Mobile Internet users (GPRS)	15 million
• Broadband Connections	2 million (DSL, EVO etc.)
• Cost of IP Backbone connection	US\$ 400 p/m
• Internet bandwidth to Pakistan	130,000 Mbits
• ISPs providing DSL services	10
• Total ISPs	50

**Fig. 1: Number of Internet Users**

Mobile Technology as smart phone and 3 G technologies and different companies internet package also increase the internet use in Pakistan. Similarly, The number of terrorism attacks in Pakistan also increased in previous 4 years as use of internet growth increase.

#### **Terrorist Attacks**

<b>Year</b>	<b>No of Attacks</b>
2009	143
2010	164
2011	62
2012	195
Total	564

Collected Facts describe that during the year 2006-2009, even after 2009-2013 the usage of wireless network especially internet is increasing and similarly, the no of attacks in Pakistan are also increasing. Although political and international agenda, world global situation has more effect on increase and decrease of no of the terrorist attacks in Pakistan but this also shows the participatory role of IT technologies in terrorism.

#### **Model of Work:**

$$I = ITU + C$$

ITU= Internet Use

C= Dummy variable, other factors cause for terrorism

I=represents the Impact of IT in terrorism

## RESULTS

The purpose of the study was to analyze the impact of information Technology on terrorism in Pakistan. Data was collected in form of numbers with structured reports, recorded facts. Collected data is presented in the form of tables and analyzed by mean score and standard deviations. Data is inserted into SPSS to get the result and concluded that the use of internet has a great impact to increase the terrorism in Pakistan.

In table statistics, Standard deviation increased as there are many factors other than Internet use for increase in terrorism. However the co relation represents that Terrorism activities are exploiting the use of internet for terrorist activities in Pakistan.

## CONCLUSION

Although , It cannot be claimed that if use of internet is excluded , terrorist attacks can be end in Pakistan but it is not deniable that new technologies of IT plays a highly supporting role to terrorists in planning, moving information and financing activities in Pakistan. IT technologies provide some security breaches which highly increase the success percentage of terrorists. In Pakistan, at different events wireless communication means and services are blocked and stopped as a precaution to minimize the terrorist attacks. It is observed that stoppage of IT services made some problem for terrorists in coordination and communication. Measures will have to take for proper observation of the usage of IT services and tools, especially wireless services to minimize the risks of terrorism in Pakistan. Communication companies must also be made disciplined to cooperate government agencies.

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**AN EMPIRICAL STUDY ON MODIFIED MAXIMUM LIKELIHOOD ESTIMATOR AND MAXIMUM LIKELIHOOD ESTIMATOR FOR INVERSE WEIBULL DISTRIBUTION BY USING TYPE-II CENSORED SAMPLE**

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**ABSTRACT**

Parameter estimation become complicated when censoring is present in the sample. Some time it is not possible to give a mathematical expression of estimated values of parameters in Maximum Likelihood (ML) method. Dayyeh and Sawi (1996) used the Mehrotra and Nanda (1974) MML technique. They replaced the intractable term of likelihood equations with its expectation, to get the estimators of location parameter by considering the scale parameter equal to 1 of logistic distribution in right Type-II censored sample. Kambo (1978) derived the explicit solution for ML estimator of two parameter exponential distribution in the case of doubly type-II censored sample. In this paper MML estimator and ML estimator of inverse weibull distribution by using Type-II censored sample have been derived and compared in term of asymptotic variances and mean square error. The purpose of conducting the empirical study is to study the closeness of MML estimators to ML estimator, and relative efficiency of censored sample to complete sample.

**KEYWORDS**

Type-II censored sample; Modified Maximum Likelihood Estimator; Maximum Likelihood Estimator; Asymptotic Variances; Bias; Mean Square Error; Inverse Weibull distribution Order Statistics.

**1. INTRODUCTION**

The probability density function of inverse Weibull distribution is given as:

$$f(y) = \frac{m}{\theta} \frac{1}{y^{m+1}} \exp\left(-\frac{1}{\theta y^m}\right), \quad y > 0, m, \theta > 0. \quad (1.1)$$

= 0 other wise.

and the corresponding distribution function is:

$$F(y) = \exp\left(-\frac{1}{\theta y^m}\right) \quad (1.2)$$

where “m” is shape and “θ” is scale parameter.

## 2. THE MODIFIED MAXIMUM LIKELIHOOD ESTIMATOR (MMLE) OF THE SCALE PARAMETER OF THE INVERSE WEIBULL DISTRIBUTION BY USING TYPE-II CENSORED SAMPLE

For the doubly type-II censored sample with  $r$  samples censored on the left and  $s$  samples censored on the right. The likelihood function is given as

$$L = \frac{n!}{r!s!} [F(Y_{r+1})]^r [1 - F(Y_{n-s})]^s \prod_{i=r+1}^{n-s} f(y_i) \quad (2.1)$$

where  $r = [nq_1] + 1$  and  $s = [nq_2] + 1$ ,  $q_1$  is the proportion of left censored sample and  $q_2$  is the proportion of right censored sample. By using (1.2) in (2.1) as given in Aleem & Jamal (2009)

$$\frac{r}{y_{r+1}^m} + \frac{s}{y_{n-s}^m} \left[ 1 - \frac{1}{1 - \exp\left(-\frac{1}{z_{n-s}}\right)} \right] - (n-s-r)\theta + \sum_{i=r+1}^{n-s} \frac{1}{y_i^m} \stackrel{(set)}{=} 0 \quad (2.2)$$

By using  $E\left(\frac{1}{1 - \exp\left(-\frac{1}{z_{n-s}}\right)}\right) = \frac{n}{s}$  for intractable term in (2.2) see Walid and

Esam (2006).

$$\therefore z_{n-s} = \theta y_{n-s}^m$$

Solving (2.2) the modified maximum likelihood estimator of  $\theta$  is given as

$$\hat{\theta} = \frac{\frac{r}{y_{r+1}^m} + \frac{(s-n)}{y_{n-s}^m} + \sum_{i=r+1}^{n-s} \frac{1}{y_i^m}}{n-s-r} \quad (2.3)$$

$\hat{\theta}$  from (2.3) is Modified Maximum Likelihood estimator of the scale parameter  $\theta$  from inverse Weibull distribution of type-II censored sample. Which is different from estimation of  $\theta$  given by Aleem & Jamal (2009)

## 3. EXPECTATION AND ASYMPTOTIC VARIANCE OF $\hat{\theta}$

From Aleem & Jamal (2006) we have

$$z_{r+1} = -\frac{1}{\ln q_1} \quad (3.1)$$

$$z_{n-s} = -\frac{1}{\ln(1-q_2)} \quad (3.2)$$

$$\lim_{n \rightarrow \infty} E \left\{ \frac{1}{n} \sum_{i=r+1}^{n-s} \frac{1}{z_i} \right\} = 1 - \ln(1-q_2) - q_2 + q_2 \ln(1-q_2) - q_1 + q_1 \ln q_1 \quad (3.3)$$

$n \rightarrow \infty$

Putting  $z_{n-s} = \theta y_{n-s}^m$  for intractable term in equation (2.2) and replace intractable term with its expectation

$$= \frac{r}{\theta^2 y_{r+1}^m} + \frac{(s-n)}{\theta^2 y_{n-s}^m} - \frac{(n-s-r)}{\theta} + \frac{1}{\theta^2} \sum_{i=r+1}^{n-s} \frac{1}{y_i^m}$$

Again differentiate w.r.t.  $\theta$

$$\frac{\partial^2 \ln L}{\partial \theta^2} = \frac{-2r}{\theta^3 y_{r+1}^m} - \frac{2(s-n)}{\theta^3 y_{n-s}^m} + \frac{n-s-r}{\theta^2} - \frac{2 \sum_{i=r+1}^{n-s} \frac{1}{y_i^m}}{\theta^3}$$

$$\begin{aligned} \text{put } \dots z_{r+1} &= y_{r+1}^m \theta, z_{n-s} = y_{n-s}^m \theta, z_i = y_i^m \theta \\ &= \frac{1}{\theta^2} \left( -\frac{2r}{z_{r+1}} - \frac{2(s-n)}{z_{n-s}} + (n-s-r) - 2 \sum_{i=r+1}^{n-s} \frac{1}{z_i} \right) \\ &= \frac{n}{\theta^2} \left( -\frac{2q_1}{z_{r+1}} - \frac{2(q_2-1)}{z_{n-s}} + (1-q_1-q_2) - \frac{2}{n} \sum_{i=r+1}^{n-s} \frac{1}{z_i} \right) \end{aligned}$$

$$\text{where } \therefore q_1 = \frac{r}{n} \therefore q_2 = \frac{s}{n}$$

For large value of  $n$  from the equation (3.1) and (3.2) we get

$$= \frac{n}{\theta^2} \left( 2q_1 \ln q_1 + 2(q_2-1) \ln(1-q_2) + (1-q_1-q_2) - \frac{2}{n} \sum_{i=r+1}^{n-s} \frac{1}{z_i} \right)$$

Multiply by negative singe and apply expectation

$$-E \left( \frac{\partial^2 \ln L}{\partial \theta^2} \right) = \frac{n}{\theta^2} \left( -2q_1 \ln q_1 - 2(q_2-1) \ln(1-q_2) - 1 + q_1 + q_2 + 2E \left( \frac{1}{n} \sum_{i=r+1}^{n-s} \frac{1}{z_i} \right) \right)$$

From equation (3.3)

$$\begin{aligned} &= \frac{n}{\theta^2} \left[ -2q_1 \ln q_1 - 2(q_2-1) \ln(1-q_2) - 1 + q_1 + q_2 + 2 - 2 \ln(1-q_2) \right. \\ &\quad \left. - 2q_2 + 2q_2 \ln(1-q_2) - 2q_1 + 2q_2 \ln q_2 \right] \end{aligned}$$

So Asymptotic variance is given as

$$\text{var}(\hat{\theta}) = \frac{\theta^2}{n(1-q_1-q_2)} \quad (3.4)$$

From (3.4) we observe  $n \rightarrow \infty$ , then  $\text{var}(\hat{\theta}) \rightarrow 0$

Putting  $z_{r+1} = y^m_{r+1}\theta$ ,  $z_{n-s} = y^m_{n-s}\theta$ ,  $z_i = y^m_i\theta$  and applying expectation on (2.3) and using (3.1), (3.2) and (3.3) we get

$$E(\hat{\theta}) = \theta \quad (3.5)$$

#### 4. ESTIMATION OF THE MEAN SQUARE ERROR BY USING ORDER RANDOM VARIABLE

From Aleem (2004) we have

$$E\left(\frac{1}{y^m_{r:n}}\right) = \theta\alpha_r \quad (4.1)$$

where  $\alpha_r = \frac{n!}{(r-1)!(n-r)!} \sum_{j=0}^{n-r} \binom{n-r}{j} (-1)^j \left(\frac{1}{r+j}\right)^2$

$$\text{var}\left(\frac{1}{y^m_r}\right) = \theta^2\beta_r \quad (4.2)$$

where  $\beta_r = 2 \frac{n!}{(r-1)!(n-r)!} \sum_{j=0}^{n-r} \binom{n-r}{j} (-1)^j \left(\frac{1}{r+j}\right)^3 - (\alpha_r)^2$

We observe results (4.1) and (4.2) are same as given by Aleem and Jamal (2009). Applying expectation on (2.2) and using (4.2) we get

$$\text{Bias}(\hat{\theta}) = E(\hat{\theta}) - \theta = \frac{\theta \left( q_1\alpha_{r+1} + (q_2-1)\alpha_{n-s} + \frac{\alpha}{n} - 1 + q_1 + q_2 \right)}{1 - q_1 - q_2} \quad (4.3)$$

Applying variance on (2.2) and using (4.2) we get

$$\text{var}(\hat{\theta}) = \frac{\theta^2 \left( r^2\beta_{r+1} + (s-n)^2\beta_{n-s} + \beta \right)}{(n-r-s)^2} \quad (4.4)$$

where  $\beta = \sum_{i=r+1}^{n-s} \beta_i$   $\alpha = \sum_{i=r+1}^{n-s} \alpha_i$

By using equation (4.3) and (4.4), we have



$$MSE(\theta) = \frac{\theta^2}{(1-q_1-q_2)^2} \left[ \left( q_1 \alpha_{r+1} + (q_2-1) \alpha_{n-s} + \frac{\alpha}{n} - 1 + q_1 + q_2 \right)^2 + \left( q_1^2 \beta_{r+1} + (q_2-1)^2 \beta_{n-s} + \frac{\beta}{n^2} \right) \right] \quad (4.5)$$

### 5. THE MAXIMUM LIKELIHOOD ESTIMATOR (MLE) OF THE SCALE PARAMETER OF THE INVERSE WEIBULL DISTRIBUTION BY USING TYPE-II CENSORED SAMPLE

Kambo (1978) derived the explicit solution for ML estimator of two parameter exponential distribution in the case of doubly type-II censored sample. In this section ML estimator are given for two parameters inverse weibull distribution in the case of doubly type-II censored sample.

By putting  $z_{n-s} = \theta y_{n-s}^m$  and using (3.2) in (2.2) see Kambo (1978) then the maximum likelihood estimator of  $\theta$  is given as

$$\hat{\theta} = \frac{\left( \frac{r}{y_{r+1}^m} \right) - \frac{s}{y_{n-s}^m} \left( \frac{1-q_2}{q_2} \right) + \sum_{i=r+1}^{n-s} \frac{1}{y_i^m}}{n-r-s} \quad (5.1)$$

We observe that  $E(\hat{\theta}) = \theta$  in (5.1) and

$$\text{var}(\hat{\theta}) = \frac{\theta^2}{n[1-q_1-q_2]} \quad (5.2)$$

In (5.1) if  $n \rightarrow \infty$ , then  $\text{var}(\hat{\theta}) \rightarrow 0$

Using (4.1) and (4.2) in (5.1) we have

$$\text{Bias}(\hat{\theta}) = E(\hat{\theta}) - \theta = \frac{\left( q_1 \alpha_{r+1} - (1-q_2) \alpha_{n-s} + \frac{\alpha}{n} - 1 + q_1 + q_2 \right)}{(1-q_1-q_2)} \quad (5.3)$$

$$\text{var}(\hat{\theta}) = \frac{\left( q_1^2 \beta_{r+1} + \beta_{n-s} (1-q_2)^2 + \frac{\beta}{n^2} \right)}{(1-q_1-q_2)^2} \quad (5.4)$$

and

$$MSE(\theta) = \frac{\theta^2}{(1-q_1-q_2)^2} \left[ \left( q_1 \alpha_{r+1} + (1-q_2) \alpha_{n-s} + \frac{\alpha}{n} - 1 + q_1 + q_2 \right)^2 + \left( q_1^2 \beta_{r+1} + (1-q_2)^2 \beta_{n-s} + \frac{\beta}{n^2} \right) \right] \quad (5.5)$$

**Corollary:**

By substituting  $q_2 = \frac{s}{n}$  in (5.1) the of ML estimator of  $\hat{\theta}$  in (2.2) will become MML estimate i.e.

$$\hat{\theta} = \frac{\left( \frac{r}{y_{r+1}^m} \right) + \frac{(s-n)}{y_{n-s}^m} + \sum_{i=r+1}^{n-s} \frac{1}{y_i^m}}{n-r-s}$$

**6. COMPARISON OF CENSORED AND COMPLETE SAMPLE**

Maximizing log of likelihood function for the pdf given in (1.1) w.r.t.  $\theta$  we have

$$\hat{\theta} = \frac{\sum_{i=1}^n \frac{1}{y_i^m}}{n} \quad (6.1)$$

which is the estimator of complete sample.

The asymptotic, bias, variance and mean square error for  $\hat{\theta}$  given as

$$Bias(\hat{\theta}) = E(\hat{\theta}) - \theta = \frac{\theta \left( \sum_{i=1}^n \alpha_i - n \right)}{n} \quad (6.2)$$

$$Var(\hat{\theta}) = \frac{\theta^2 \left( \sum_{i=1}^n \beta_i \right)}{n^2} \quad (6.3)$$

$$MSE(\hat{\theta}) = \frac{\theta^2}{n^2} \left( \left( \sum_{i=1}^n \alpha_i - n \right)^2 + \left( \sum_{i=1}^n \beta_i \right) \right) \quad (6.4)$$

**7. RESULTS**

In this section the effects of censored sample, MML estimates, ML estimates and Reduction in efficiency has discussed below.

**Table 7.1**  
**The Asymptotic Variance of MML & ML Estimates from Doubly Type-II Censored**  
**Sample in term of  $\theta^2$  for n=10, 20, 30, 50 and 100 from the Equation (3.4) and (5.3)**

$q_1$	$q_2$	n=10	n=10	n=20	n=20	n=30	n=30
		$\text{var}(\theta_1)/\theta^2$	$\text{var}(\theta_2)/\theta^2$	$\text{var}(\theta_1)/\theta^2$	$\text{var}(\theta_2)/\theta^2$	$\text{var}(\theta_1)/\theta^2$	$\text{var}(\theta_2)/\theta^2$
0	0	0.1	0.1	0.05	0.05	0.0333	0.0333
0	0.1	0.1111	0.1111	0.0556	0.0556	0.037	0.037
0	0.2	0.125	0.125	0.0625	0.0625	0.0417	0.0417
0	0.3	0.1429	0.1429	0.0714	0.0714	0.0476	0.0476
0	0.4	0.1667	0.1667	0.0833	0.0833	0.0556	0.0556
0	0.5	0.2	0.2	0.1	0.1	0.0667	0.0667
0	0.6	0.25	0.25	0.125	0.125	0.0833	0.0833
0.1	0	0.1111	0.1111	0.0556	0.0556	0.037	0.037
0.1	0.1	0.125	0.125	0.0625	0.0625	0.0417	0.0417
0.1	0.2	0.1429	0.1429	0.0714	0.0714	0.0476	0.0476
0.1	0.3	0.1667	0.1667	0.0833	0.0833	0.0556	0.0556
0.1	0.4	0.2	0.2	0.1	0.1	0.0667	0.0667
0.1	0.5	0.25	0.25	0.125	0.125	0.0833	0.0833
0.2	0	0.125	0.125	0.0625	0.0625	0.0417	0.0417
0.2	0.1	0.1429	0.1429	0.0714	0.0714	0.0476	0.0476
0.2	0.2	0.1667	0.1667	0.0833	0.0833	0.0556	0.0556
0.2	0.3	0.2	0.2	0.1	0.1	0.0667	0.0667
0.2	0.4	0.25	0.25	0.125	0.125	0.0833	0.0833
0.3	0	0.1429	0.1429	0.0714	0.0714	0.0476	0.0476
0.3	0.1	0.1667	0.1667	0.0833	0.0833	0.0556	0.0556
0.3	0.2	0.2	0.2	0.1	0.1	0.0667	0.0667
0.3	0.3	0.25	0.25	0.125	0.125	0.0833	0.0833

where  $\text{var}(\theta_1)/\theta^2$  is the variance of ML estimator from (5.3)

and  $\text{var}(\theta_2)/\theta^2$  is the variance of MML estimator from (3.4)

$q_1$	$q_2$	<b>n=50</b>	<b>n=50</b>	<b>n=100</b>	<b>n=100</b>
		$\text{var}(\theta_1)/\theta^2$	$\text{var}(\theta_2)/\theta^2$	$\text{var}(\theta_1)/\theta^2$	$\text{var}(\theta_2)/\theta^2$
<b>0</b>	<b>0</b>	<b>0.02</b>	<b>0.02</b>	<b>0.01</b>	<b>0.01</b>
<b>0</b>	<b>0.1</b>	<b>0.0222</b>	<b>0.0222</b>	<b>0.0111</b>	<b>0.0111</b>
<b>0</b>	<b>0.2</b>	<b>0.025</b>	<b>0.025</b>	<b>0.0125</b>	<b>0.0125</b>
<b>0</b>	<b>0.3</b>	<b>0.0286</b>	<b>0.0286</b>	<b>0.0143</b>	<b>0.0143</b>
<b>0</b>	<b>0.4</b>	<b>0.0333</b>	<b>0.0333</b>	<b>0.0167</b>	<b>0.0167</b>
<b>0</b>	<b>0.5</b>	<b>0.04</b>	<b>0.04</b>	<b>0.02</b>	<b>0.02</b>
<b>0</b>	<b>0.6</b>	<b>0.05</b>	<b>0.05</b>	<b>0.025</b>	<b>0.025</b>
<b>0.1</b>	<b>0</b>	<b>0.0222</b>	<b>0.0222</b>	<b>0.0111</b>	<b>0.0111</b>
<b>0.1</b>	<b>0.1</b>	<b>0.025</b>	<b>0.025</b>	<b>0.0125</b>	<b>0.0125</b>
<b>0.1</b>	<b>0.2</b>	<b>0.0286</b>	<b>0.0286</b>	<b>0.0143</b>	<b>0.0143</b>
<b>0.1</b>	<b>0.3</b>	<b>0.0333</b>	<b>0.0333</b>	<b>0.0167</b>	<b>0.0167</b>
<b>0.1</b>	<b>0.4</b>	<b>0.04</b>	<b>0.04</b>	<b>0.02</b>	<b>0.02</b>
<b>0.1</b>	<b>0.5</b>	<b>0.05</b>	<b>0.05</b>	<b>0.025</b>	<b>0.025</b>
<b>0.2</b>	<b>0</b>	<b>0.025</b>	<b>0.025</b>	<b>0.0125</b>	<b>0.0125</b>
<b>0.2</b>	<b>0.1</b>	<b>0.0286</b>	<b>0.0286</b>	<b>0.0143</b>	<b>0.0143</b>
<b>0.2</b>	<b>0.2</b>	<b>0.0333</b>	<b>0.0333</b>	<b>0.0167</b>	<b>0.0167</b>
<b>0.2</b>	<b>0.3</b>	<b>0.04</b>	<b>0.04</b>	<b>0.02</b>	<b>0.02</b>
<b>0.2</b>	<b>0.4</b>	<b>0.05</b>	<b>0.05</b>	<b>0.025</b>	<b>0.025</b>
<b>0.3</b>	<b>0</b>	<b>0.0286</b>	<b>0.0286</b>	<b>0.0143</b>	<b>0.0143</b>
<b>0.3</b>	<b>0.1</b>	<b>0.0333</b>	<b>0.0333</b>	<b>0.0167</b>	<b>0.0167</b>
<b>0.3</b>	<b>0.2</b>	<b>0.04</b>	<b>0.04</b>	<b>0.02</b>	<b>0.02</b>
<b>0.3</b>	<b>0.3</b>	<b>0.05</b>	<b>0.05</b>	<b>0.025</b>	<b>0.025</b>

**Tables 7.2**  
**The MSE of MML & ML estimates from doubly Type-II censored sample**  
**in term of  $\theta^2$  for n=10, 20 and 30 from equation (4.5) and (5.6)**

$q_1$	$q_2$	n=10	n=10	n=20	n=20	n=30	n=30
		$MSE(\theta_1)/\theta^2$	$MSE(\theta_2)/\theta^2$	$MSE(\theta_1)/\theta^2$	$MSE(\theta_2)/\theta^2$	$MSE(\theta_1)/\theta^2$	$MSE(\theta_2)/\theta^2$
0	0	0.0493	0.0493	0.014	0.014	0.0067	0.0067
0	0.1	0.0707	0.0707	0.0225	0.0225	0.0118	0.0118
0	0.2	0.0989	0.0989	0.0336	0.0336	0.0184	0.0184
0	0.3	0.1371	0.1371	0.0484	0.0484	0.0272	0.0272
0	0.4	0.1917	0.1917	0.0692	0.0692	0.0394	0.0394
0	0.5	0.2747	0.2747	0.1003	0.1003	0.0575	0.0575
0	0.6	0.4129	0.4129	0.1511	0.1511	0.0865	0.0865
0.1	0	0.0485	0.0485	0.0148	0.0148	0.0078	0.0078
0.1	0.1	0.0739	0.0739	0.0254	0.0254	0.0144	0.0144
0.1	0.2	0.1087	0.1087	0.0397	0.0397	0.0233	0.0233
0.1	0.3	0.1589	0.1589	0.0603	0.0603	0.036	0.036
0.1	0.4	0.2361	0.2361	0.0916	0.0916	0.0553	0.0553
0.1	0.5	0.3668	0.3668	0.1441	0.1441	0.0875	0.0875
0.2	0	0.0629	0.0629	0.0218	0.0218	0.0124	0.0124
0.2	0.1	0.0985	0.0985	0.0372	0.0372	0.0221	0.0221
0.2	0.2	0.1507	0.1507	0.0596	0.0596	0.0363	0.0363
0.2	0.3	0.2328	0.2328	0.0947	0.0947	0.0585	0.0585
0.2	0.4	0.3751	0.3751	0.1556	0.1556	0.0968	0.0968
0.3	0	0.0863	0.0863	0.0321	0.0321	0.019	0.019
0.3	0.1	0.1397	0.1397	0.0555	0.0555	0.0338	0.0338
0.3	0.2	0.225	0.225	0.0929	0.0929	0.0576	0.0576
0.3	0.3	0.3761	0.3761	0.1591	0.1591	0.0997	0.0997

where  $MSE(\theta_1)/\theta^2$  is the variance of ML estimator from (5.6)

and  $MSE(\theta_2)/\theta^2$  is the variance of ML estimator from (4.7)

**Tables 7.3**  
**Comparison of censored sample as compare to complete sample**  
**for n=10, 20, 30 from (6.5)**

$q_1$	$q_2$	n=10	n=20	n=30
		$R(\theta)-1$	$R(\theta)-1$	$R(\theta)-1$
0	0	0.682594	0.555556	0.522727
0	0.1	1.417601	1.500425	1.6845
0	0.2	2.37101	2.729231	3.153493
0	0.3	3.673282	4.397115	5.191762
0	0.4	5.549246	6.671219	7.881781
0	0.5	8.377742	10.16331	11.88567
0	0.6	13.10931	15.81353	18.43215
0.1	0	0.656947	0.647619	0.76826
0.1	0.1	1.51881	1.82826	2.268224
0.1	0.2	2.709899	3.424953	4.267171
0.1	0.3	4.431667	5.738359	7.131333
0.1	0.4	7.066163	9.19339	11.50315
0.1	0.5	11.53934	15.02458	18.64322
0.2	0	1.147132	1.424471	1.784902
0.2	0.1	2.365832	3.137703	3.967589
0.2	0.2	4.144178	5.647302	7.161516
0.2	0.3	6.955068	9.515565	12.11939
0.2	0.4	11.80517	16.24951	20.76525
0.3	0	1.943873	2.56779	3.290438
0.3	0.1	3.766724	5.16937	6.637392
0.3	0.2	6.680099	9.317365	11.95566
0.3	0.3	11.84365	16.67126	21.41137

**R=Reduction in efficiency = (MSE of censored sample / MSE of complete sample) - 1**

### 8. DISCUSSION AND CONCLUSION:

- 1) In this paper a simple approximation has been proposed for intractable term (See Walid Esam 2006), to estimate scale parameter keeping shape parameter fixed of two parameter Inverse Weibull distribution from doubly type-II censored sample.
- 2) The Table (7.1) of asymptotic variance for  $n = 10, 20, 30, 50, 100$  and Table (7.2) of MSE by using theory of order statistics for  $n = 10, 20, 30$  are given for the MML estimator and ML estimator with maximum 0.6 total proportion of censored sample i.e.  $q_1 + q_2 = 0.6$ , where  $q_1$  is the proportion of left censored sample and  $q_2$  is the proportion of right censored sample. For any sample size there are three conditions for  $q_1$  and  $q_2$ .
  - i)  $q_1 > q_2$
  - ii)  $q_1 < q_2$
  - iii)  $q_1 = q_2$
- 3) For  $q_1 = q_2$ ,  $q_1 > q_2$  or  $q_1 < q_2$  the asymptotic variances are exactly same for the same sample size.  
For  $q_1 = q_2$ , mean square errors are same but less when  $q_1 > q_2$  as compare to  $q_1 < q_2$  for the same sample size
- 4) For  $q_1 = q_2 = 0$  no censoring scheme is involved in other words there is no missing element in the sample then the also asymptotic variances and MSE's of Modify Maximum Likelihood estimates are exactly same to Maximum likelihood estimates.
- 5) It is observed that Modify Maximum Likelihood (MML) estimator are exactly same to Maximum Likelihood (ML) estimator.
- 6) From the table (7.3) we observed that for  $q_1 = q_2 = 0$  as the sample size increases the reduction in efficiency decreases. And for rest of values the sample size increases the reduction in efficiency also increases with the same proportion of left and right censored sample.

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## KUMARASWAMY DOUBLE INVERSE EXPONENTIAL (Kw-DIE) DISTRIBUTION

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### ABSTRACT

We proposed so-called Kumaraswamy Double Inverse Exponential distribution (Kw-DIED), various properties of the new distribution are derived, which includes its moments, moment generating function, reliability functions. We also discuss maximum likelihood estimation of the model parameters.

### KEYWORDS

Double exponential distribution; Double Inverse Exponential distribution; generalized kumaraswamy distribution; Maximum likelihood estimation; fractional moments.

### 1. INTRODUCTION

Double exponential distribution is a continuous probability distribution. It is named after a French mathematician. The most outstanding characteristics of this distribution are that it is unimodal and symmetric. Double exponential distribution is also known as Laplace distribution. The double exponential distribution was discovered by Pierre Laplace in (1774). The Laplace distribution is known with different names, one of the most common ones is the double exponential. However, that this name has also been applied to the extreme value distribution.

The random variable  $X$  follows double exponential distribution then its probability density function is given as

$$f(x) = \frac{1}{2\delta} e^{-\frac{|x-\mu|}{\delta}} \quad -\infty < x < \infty, \delta > 0$$

Its standard form is obtained by putting  $\mu = 0$  and  $\delta = 1$ , giving

$$f(x) = \frac{1}{2} e^{-|x|}$$

(This form is sometime called Poisson's first law of error)

The double exponential distribution being heavier tailed than the normal distribution. The double exponential distribution has been used commonly as an alternative to the normal distribution in robustness studies. The double exponential distribution has found some interesting application on its own. Manly (1976) gave some examples of fitness

functions based on the double exponential distribution. Easterling (1978) considered a model for steam generated inspection as exponential responses with double exponential measurement error. Hsu (1979), while discussing the use of long-tailed distribution for position error in navigation, suggested the Double exponential distribution. Okubo and Narita (1980) used the double exponential for the distribution of extreme winds expected in Japan. The Double exponential-normal mixture distribution has been used to fit some winds shear data by Kanji (1985) and Jones and McLachlan (1990). Bagchi, Hayya, and Ord (1983) used the Double exponential distribution while modeling demand during lead time for slow-moving items. Dadi and Marks (1987) discussed detector relative efficiencies in the presence of double exponential noise.

Let  $Y = 1/X$  follows inverse double exponential then its probability density function is given by;

$$f(y) = \frac{1}{2\delta} |y|^{-2} \exp(-1/\delta|y|) \quad (1)$$

$-\infty < y < \infty$ ,  $\delta > 0$ , skewed form of (1) has been considered in Sufyan, (2013).

The cumulative distribution function corresponding to (1) is given by; see: Flaih et al., (2012) and Cordeiro, (2011).

$$F(y) = \begin{cases} 1/2(1 - \exp(1/\delta y)), & y < 0 \\ 1 - 1/2(1 - \exp(-1/\delta y)), & y \geq 0 \end{cases} \quad (2)$$

In this context, we propose an extension of the Double Inverse Exponential distribution based on the family of Kumaraswamy generalized (denoted with the prefix "Kw-G" for short) distributions introduced by Cordeiro and de Castro (2011). Studied some mathematical properties of this family. The Kumaraswamy (Kw) distribution is not very common among statisticians and has been little explored in the literature. Its cdf (for  $0 < x < 1$ ) is

$$F(x) = 1 - (1 - x^a)^b$$

where  $a > 0$  and  $b > 0$  are shape parameters, and the density function has a simple form

$$f(x) = abx^{a-1} (1 - x^a)^{b-1},$$

which can be uni-modal, increasing, decreasing or constant, depending on the parameter values. It does not seem to be very familiar to statisticians and has not been investigated systematically in much detail before, nor has its relative interchangeability with the beta distribution been widely appreciated.

If  $G(y)$  is the baseline cdf of a random variable  $y$ , Cordeiro and Castro (2011) defined the cdf of the Kumaraswamy-G (Kum-G) distribution by

$$G(y) = 1 - \{1 - F(y)^a\}^b \quad (3)$$

where  $a > 0$  and  $b > 0$  are two additional shape parameters. Their role is to govern skewness and generate a distribution with heavier tails. The density function corresponding to (3) is

$$g(y) = ab f(y) F(y)^{a-1} \left\{ 1 - (F(y))^a \right\}^{b-1}, \quad 0 < y < 1 \quad (4)$$

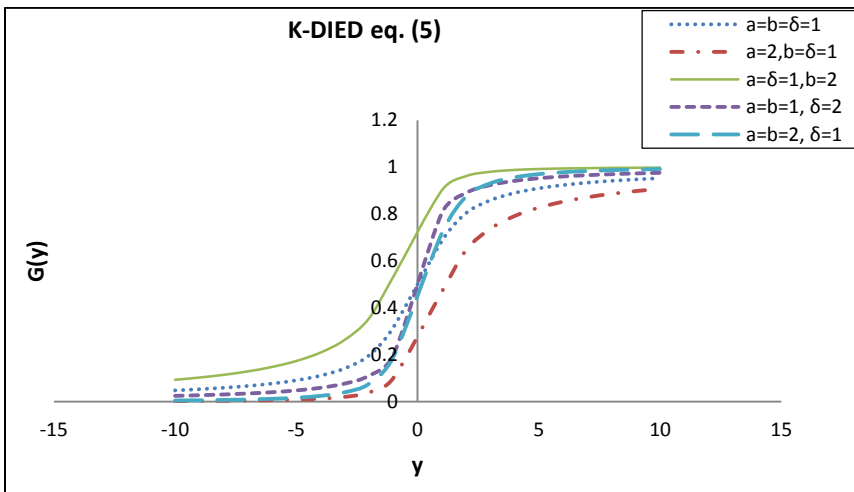
The density family (4) has many of the same properties of the class of beta-G distributions (see Eugene et al. 2002), but has some advantages in terms of tractability, since it does not involve any special function such as the beta function in its cdf, (3) can also be obtained by putting  $n = 2$  in Aleem (2013).

This paper is outlined as follows. In section 2, we define the Kw-DIE distribution and provide expansions for its cumulative distribution function (cdf) and probability density function (pdf). Some mathematical properties of this distribution are developed in sections 3-5. These include quantile function, moment generating and characteristic functions, Maximum likelihood estimation and fisher information matrix are performed in section 6 and 7. Finally, some conclusions are addressed in section 8.

## 2. THE KW-DIE DISTRIBUTION

Applying (1) and (2) in (3) we get the cdf of the proposed Kw-DIE distribution as;

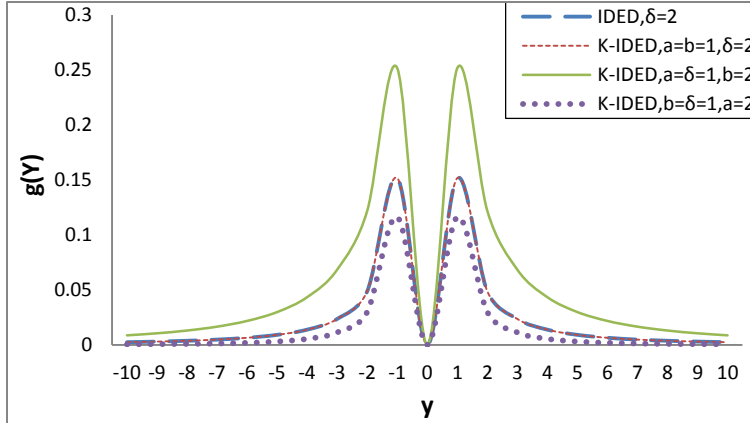
$$G(y) = 1 - \begin{cases} \left[ 1 - \left[ 1/2 \left[ 1 - \exp(1/\delta y) \right] \right]^a \right]^b & y < 0 \\ \left[ 1 - \left[ 1 - 1/2 \left[ 1 - \exp(-1/\delta y) \right] \right]^a \right]^b & y \geq 0 \end{cases} \quad (5)$$



**Fig. 1: Plot of the cumulative distribution function of Kw-DIE (5) for the different values of parameters for  $a, b$  and  $\delta > 0$**

The corresponding probability density function expressed as

$$g(y) = \frac{ab}{2\delta y^2} \begin{cases} \exp(1/\delta y) [1/2(1-\exp(1/\delta y))]^{a-1} [1 - [1/2[1-\exp(1/\delta y)]]^a]^{-b-1} & (y < 0) \\ \exp(-1/\delta y) [1 - (1/2(1-\exp(1/\delta y)))]^{a-1} [1 - [1 - [1/2[1-\exp(1/\delta y)]]^a]^{-b-1} & (y \geq 0) \end{cases}$$



**Figure 2: Plot of the probability density functions of DIE (1) and Kw-DIE (6) for the different values of parameters**

## 2.1 Expansion

We have the power series expansion as

$$(1-z)^{b-1} = \sum_{i=0}^{b-1} \binom{b-1}{i} (-1)^i z^i$$

Applying this expansion, we obtain

$$(1-F(y)^a)^{b-1} = \sum_i \binom{b-1}{i} (-1)^i (F(y)^a)^i \quad (7)$$

$$(1-e^{1/\delta y})^{a(i+1)-1} = \sum_{j=0}^{a(i+1)-1} \binom{a(i+1)-1}{j} (-1)^j (e^{1/\delta y})^j \quad (8)$$

We also have

$$e^{ty} = \sum_{i_2=0}^{\infty} \frac{T^{i_2}}{i_2!} y^{i_2} \quad (9)$$

The above expansions in (7), (8) and (9) are used to obtain rth moment, moment generating function and characteristic function of the purposed distribution.

### 3. MOMENTS AND GENERATING FUNCTIONS

Let  $y$  be a random variable having the Kw-DIE distribution. Using (6), it is easy to obtain the  $r$ th moment about origin is given as

$$\mu_r' = \frac{ab}{\delta} \sum_{i=0}^{b-1} \sum_{j=1}^{a(i+1)-1} \binom{a(i+1)-1}{j} \binom{b-1}{i} (-1)^{i+j} \Gamma(1-r) \begin{cases} \frac{1}{2^{a(i+1)}} \left(\frac{\delta}{(i+1)}\right)^{1-r} & (y < 0) \\ \sum_{k=1}^j \binom{j}{k} \frac{(-1)^k}{2^{(j+1)}} \left(\frac{\delta}{(k+1)}\right)^{1-r} & (y \geq 0) \end{cases} \quad (10)$$

Hence, (10) is the expression of  $r$ th moment about origin of Kumaraswamy-Double Inverse Exponential distribution.

Where  $0 < r < 1$ , so we cannot find the raw moments from (10). If we put the positive fractional values as  $(1/2, 1/3, 1/4, \dots)$  in (10) we will get the respective fractional moments.

#### 3.1 Generating function

First, the mgf  $MY(t)$  corresponding to a random variable  $Y$  with Kw-DIE distribution with parameters  $a, b$  and  $\delta$  is given by

$$M_y(t) = \frac{ab}{k! \delta} \sum_{i=0}^{b-1} \sum_{j=0}^{a(i+1)-1} \sum_{k=0}^{\infty} \binom{a(i+1)-1}{j} \binom{b-1}{i} (-1)^{i+j} \begin{cases} \frac{\Gamma(1-k)}{2^{a(i+1)}} \left(\frac{\delta}{(i+1)}\right)^{1-k} & (y < 0) \\ \sum_{l=1}^j \binom{j}{l} \frac{(-1)^l \Gamma(1-l)}{2^{(j+1)}} \left(\frac{\delta}{(l+1)}\right)^{1-l} & (y \geq 0) \end{cases} \quad (11)$$

In the same way, the characteristic function of the Kw-DIE distribution can be obtained from (10) by taking  $\phi_y(t) = My(it)$ , where  $i = \sqrt{-1}$  is the unit imaginary number.

### 4. QUANTILE FUNCTION

The  $q$ th quantile corresponding to (6) is

$$y = \frac{1}{\delta \log} \begin{cases} \left(1 - 2 \left(1 - (1-q)^{1/b}\right)^{1/a}\right)^{-1} & (y < 0) \\ - \left(1 + 2 \left\{1 - \left(1 - (1-q)^{1/b}\right)^{1/a}\right\}\right)^{-1} & (y \geq 0) \end{cases} \quad (12)$$

where  $G(y) = q$

**4.1 Median =  $Q_2 = D_5 = P_{50}$** 

The median of the Kumaraswamy Double Inverse Exponential distribution can be obtained by putting “ $q = 0.5$ ” in (12)

**4.2 Quartile Deviation**

The quartile deviation of the Kumaraswamy-double inverse exponential distribution is obtained by putting “ $q = 0.75$ ” for  $Q_3$  and “ $q = 0.25$ ” for  $Q_1$  in (12), then

$$Q.D = \frac{Q_3 - Q_1}{2}$$

**4.3 Coefficient of Quartile Deviation**

The coefficient of quartile deviation of the Kumaraswamy-double inverse exponential distribution can be obtained as:

$$\text{Coefficient of } Q.D = \frac{Q_3 - Q_1}{Q_3 + Q_1}$$

The Bowley’s skewness is based on quartiles, Kenney and Keeping (1962):

$$B = \frac{Q(3/4) - 2Q(1/2) + Q(1/4)}{Q(3/4) - Q(1/4)}$$

and the Moors’ kurtosis (Moors, 1998) is based on octiles:

$$M = \frac{Q(7/8) - Q(5/8) - Q(3/8) + Q(1/8)}{Q(6/8) - Q(2/8)}$$

where  $Q(\cdot)$  represents the quantile function defined in (11).

**5. RELIABILITY PROPERTIES**

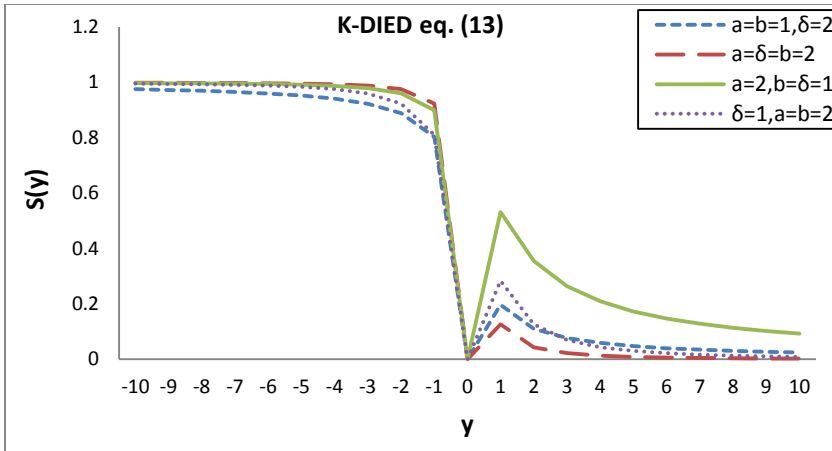
Reliability properties of Kumaraswamy-double inverse exponential distribution such as survival function also called (reliability function), hazard rate, cumulative hazard rate, reversed hazard rate and mean residual life are derived as

**5.1 Reliability function**

The reliability function  $R(y)$ , is defined as

$$R(y) = 1 - G(y) \tag{13}$$

where  $G(y)$  is the cdf of Kw-DIE given in eq. (5)

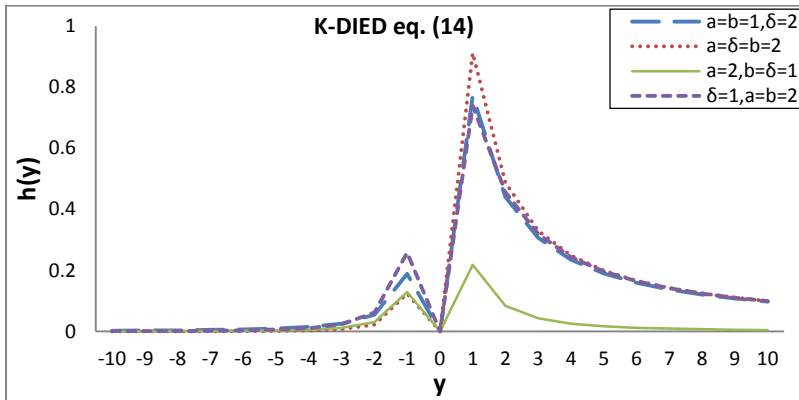


**Fig. 3: Plot of the reliability function/survival function of Kw-DIE (13) for the different values of parameters**

**5.2 Hazard Function**

By the definition of hazard function

$$h(y) = g(y) / R(y) \tag{14}$$

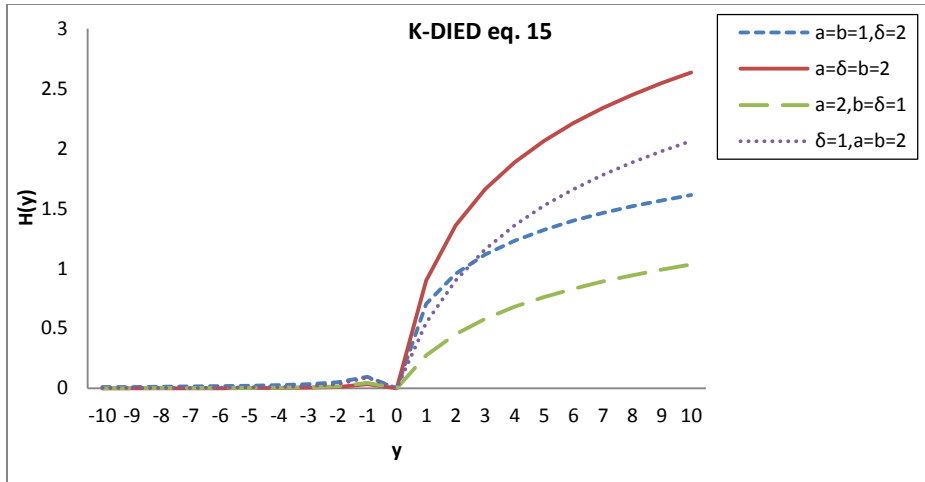


**Fig. 4: Plot of the hazard function of Kw-DIE (14) for the different values of parameters**

Where  $g(y)$  and  $R(y)$  are the pdf and reliability function of Kw-DIE distribution respectively.

We get the Cumulative hazard function as

$$H(y) = -\log\{R(y)\} \tag{15}$$



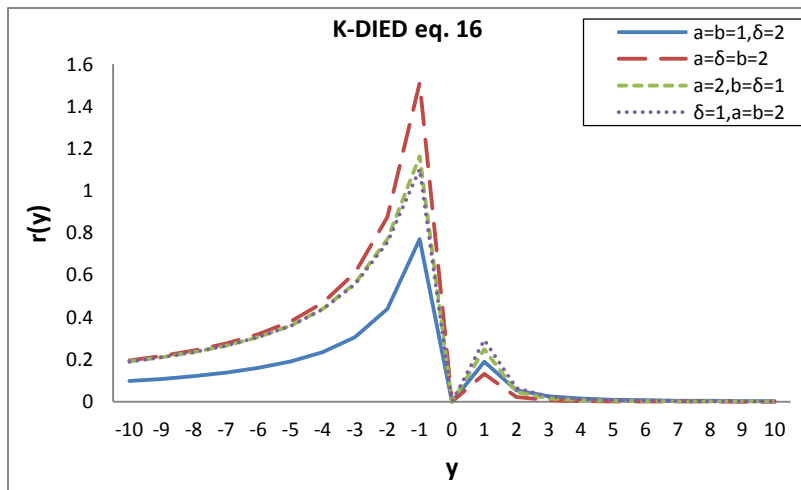
**Fig. 5: Plot of the Cumulative Hazard Function of Kw-DIE (15) for the Different Values of Parameters**

### 5.3 The Reversed Hazard Function

By the definition of reversed hazard function

$$r(y) = g(y)/G(y) \quad (16)$$

where  $g(y)$  and  $G(y)$  are the pdf and cdf of Kw-DIE distribution respectively given in eq's (5) and (6) respectively.



**Fig. 6: Plot of the Reversed hazard function of Kw-DIE (16) for the different values of parameters.**



## 6. ESTIMATION OF PARAMETERS (a, b, σ)

For the estimation of parameters we used method of Maximum Likelihood estimation.

### Maximum likelihood function

Let  $y_1, y_2, y_3, \dots, y_n$  be a random sample from probability distribution  $g(y; a, b, \delta)$ ; where  $a, b$ , and  $\delta$  are unknown parameters then the joint distribution for  $y_1, y_2, y_3, \dots, y_n$  is

$$g(y_1, y_2, y_3, \dots, y_n; a, b, \delta) = g(y_1; a, b, \delta) \cdot g(y_2; a, b, \delta) \dots g(y_n; a, b, \delta)$$

$$f(y_1, y_2, y_3, \dots, y_n; a, b, \delta) = \prod_{i=1}^n g(y_i; a, b, \delta)$$

As the observation in random sample are statistically independent this joint distribution  $g(y_1, y_2, y_3, \dots, y_n; a, b, \delta)$  regarded as a function of parameters  $a, b, \sigma$  is called the likelihood function of the sample and is usually denoted by  $L(y; a, b, \delta)$  i.e.

$$L(y; a, b, \delta) = \prod_{i=1}^n g(y_i; a, b, \delta)$$

Now we wish to estimate the unknown parameters by that value which minimizes the likelihood function  $L(y; a, b, \delta)$ . Such a value called the maximum Likelihood function (M.L.E).

### (1) The Log Likelihood Function for (6) when ( $y < 0$ )

$$\begin{aligned} \partial \log L(y) = \sum_{i=1}^n \left[ \log a + \log b - \log(2\delta) + \log\left(y^{-2} e^{1/\delta y}\right) + (a-1) \log\left(1/2 \left(1 - e^{\frac{1}{\delta y}}\right)\right) \right. \\ \left. + (b-1) \log\left\{1 - \left(\frac{1}{2} \left(1 - e^{\frac{1}{\delta y}}\right)\right)^a\right\} \right] \end{aligned} \quad (17)$$

The maximum likelihood estimates of  $a, b$  and  $\delta$  are obtained by setting the first partial derivatives of Eq. (12) to zero with respect to  $a, b$  and  $\delta$  respectively. These simultaneous equations are,

$$\frac{\partial \ln L}{\partial a} = \frac{n}{a} + \frac{1}{2} \sum_{i=1}^n \left(1 - e^{\frac{1}{\sigma y}}\right)^{a-1} \ln \frac{1}{2} \left(1 - e^{\frac{1}{\sigma y}}\right) - (b-1) \ln \frac{1}{2} \left(1 - e^{\frac{1}{\sigma y}}\right) \left[1 - \left\{\frac{1}{2} \left(1 - e^{\frac{1}{\sigma y}}\right)\right\}^a\right]^{b-1} \quad (18)$$

$$\frac{\partial \ln L}{\partial b} = \frac{n}{b} + \sum_{i=1}^n \left[ 1 - \left\{ \frac{1}{2} \left( 1 - e^{-\frac{1}{\sigma y}} \right) \right\}^a \right] \ln \left[ 1 - \left\{ \frac{1}{2} \left( 1 - e^{-\frac{1}{\sigma y}} \right) \right\}^a \right]^{-b-1} \quad (19)$$

$$\frac{\partial \ln L}{\partial \sigma} = -\frac{n}{a} + \sum \frac{ab}{\sigma^2 y} \quad (20)$$

By solving eq's (18) to (20) simultaneously we can obtain the estimate of  $a, b$  and  $\delta$ .

## (2) The log likelihood function When ( $y \geq 0$ )

$$\begin{aligned} \log L(y; a, b, \delta) = & \sum_{i=1}^n \left[ \log a + \log b - \log(2\delta) + \log \left( y^{-2} e^{-1/\delta y} \right) \right. \\ & \left. + (a-1) \log \left( 1 - 1/2 \left( 1 - e^{-1/\delta y} \right) \right) + (b-1) \log \left\{ 1 - \left( 1 - 1/2 \left( 1 - e^{-1/\delta y} \right) \right)^a \right\} \right] \quad (21) \end{aligned}$$

The maximum likelihood estimates of  $a, b$  and  $\delta$  are obtained by setting the first partial derivatives of Eq. (16) to zero with respect to  $a, b$  and  $\delta$  respectively. These simultaneous equations are,

$$\begin{aligned} \frac{\partial \ln L}{\partial a} = & \frac{n}{a} + \sum_{i=1}^n \left\{ 1 - \frac{1}{2} \left( 1 - e^{-\frac{1}{\sigma y}} \right) \right\}^{a-1} \ln \left[ 1 - \frac{1}{2} \left( 1 - e^{-\frac{1}{\sigma y}} \right) \right] \\ & + \left[ 1 - \left\{ 1 - \frac{1}{2} \left( 1 - e^{-\frac{1}{\sigma y}} \right) \right\}^a \right]^{b-1} \ln \left[ 1 - \left\{ 1 - \frac{1}{2} \left( 1 - e^{-\frac{1}{\sigma y}} \right) \right\}^a \right] \quad (22) \end{aligned}$$

$$\frac{\partial \ln L}{\partial b} = \frac{n}{b} + \left[ 1 - \left\{ 1 - \frac{1}{2} \left( 1 - e^{-\frac{1}{\sigma y}} \right) \right\}^a \right]^{b-1} \ln \left[ 1 - \left\{ 1 - \frac{1}{2} \left( 1 - e^{-\frac{1}{\sigma y}} \right) \right\}^a \right] \quad (23)$$

$$\frac{\partial \ln L}{\partial \sigma} = -\frac{n}{\sigma} + \sum_{i=1}^n \frac{a(2-b)}{\sigma^2 y} \quad (24)$$

By solving eq's (22) to (24) simultaneously we can obtain the estimate of  $a, b$  and  $\delta$ .

## 7. FISHER INFORMATION MATRIX

The asymptotic variance covariance matrix of the estimators of the parameters ( $a, b$  and  $\delta$ ) are obtained by inverting the Fisher information matrix in which elements

are negatives of expected values of the second partial derivatives of the logarithm of the likelihood function. Thus the invers dispersion matrix is given as

$$\begin{pmatrix} \hat{a} \\ \hat{b} \\ \hat{\delta} \end{pmatrix} \sim N \left[ \begin{pmatrix} a \\ b \\ \delta \end{pmatrix}, \begin{pmatrix} \hat{I}_{aa} & \hat{I}_{ab} & \hat{I}_{a\delta} \\ \hat{I}_{ba} & \hat{I}_{bb} & \hat{I}_{b\delta} \\ \hat{I}_{\delta a} & \hat{I}_{\delta b} & \hat{I}_{\delta\delta} \end{pmatrix} \right]$$

$$I^{-1}_{(a,b,\delta)} = -E \begin{bmatrix} I_{aa} & I_{ab} & I_{a\delta} \\ I_{ba} & I_{bb} & I_{b\delta} \\ I_{\delta a} & I_{\delta b} & I_{\delta\delta} \end{bmatrix}$$

$$I_{aa} = \frac{\partial^2 L}{\partial a^2}, I_{ab} = \frac{\partial^2 L}{\partial a \partial b}, I_{a\delta} = \frac{\partial^2 L}{\partial a \partial \delta}, I_{bb} = \frac{\partial^2 L}{\partial b^2}, I_{b\delta} = \frac{\partial^2 L}{\partial b \partial \delta}, I_{\delta\delta} = \frac{\partial^2 L}{\partial \delta^2}$$

The variances are on the main diagonal and covariances are on the off diagonal. The asymptotic distribution of MLE's of  $(\hat{a}, \hat{b}, \hat{\delta})$  is given as (see; Milla, (1981))

$$\hat{a}, \hat{b}, \hat{\delta} \sim N_3((a, b, \delta); \hat{I}^{-1})$$

Since  $I_{(a,b,\delta)}$  involve the parameters we will replace the parameters with the corresponding MLE's in order to obtain an estimate of  $I_{(a,b,\delta)}$ . The 100(1- $\alpha$ ) % C.I. for parameters a, b and  $\delta$  are as follows

$$\hat{a} \pm Z_{\alpha/2} S.E(\hat{a}), \quad \hat{b} \pm Z_{\alpha/2} S.E(\hat{b}) \quad \text{and} \quad \hat{\delta} \pm Z_{\alpha/2} S.E(\hat{\delta})$$

for both cases ( $y < 0$  and  $y \geq 0$ ).

### 8. CONCLUSION

In this study we introduce a new distribution, the so-called Kumaraswamy-double inverse exponential (Kum-DIE) distribution, which extends the double inverse exponential distribution, the double inverse exponential distribution is in absolute form so we are dealing with two cases when random variable ( $y < 0$ ) and ( $y \geq 0$ ) and study some of its general mathematical and statistical properties. We derived its probability density function. Cumulative distribution function, 1<sup>st</sup> four fractional moments by putting positive fractional values such as (1/2, 1/3, 1/4,...) in general expression of rth moment, moments generating function and characteristic function. We also derived its reliability properties for both cases. We use the method of maximum likelihood estimation for estimation of parameters discussed the fisher information matrix. In the graphical representation of the new distribution (Kw-DIED) shows increasing and decreasing probability density function.

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