A GENERALIZATION TO LAPLACE AND LOGISTIC DISTRIBUTIONS

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ABSTRACT

Half-logistic distribution is generalized by introducing a parameter. A new family of distribution that generalizes the Laplace and logistic distribution is introduced and studied. Symmetric Laplace and asymmetric Laplace distributions discussed in Kozubowski and Podgorski (2000) are included in this class as special cases. The logistic distribution is also a member of this family. The asymmetric logistic distribution is explored. Estimation of parameters of the family of distribution is done. This distribution is applied to model the share index of Bombay stock exchange (INDIA). It is shown that generalized asymmetric Laplace logistic distribution is suitable to model the share index of Bombay stock exchange (INDIA).

KEYWORDS

Asymmetric Laplace Distribution, Chi-Square Test, Kolmogrove Smirnove Two Sample Test, Laplace Distribution, Logistic Distribution Linnik Distribution, Marshall-Olkin Half-Logistic Distribution etc.

1. INTRODUCTION

Balakrishnan (1985) considered the folded form of standard logistic distribution and termed it as half-logistic distribution (logistic distribution truncated below at zero).

The density function is given by

$$f(x) \ = \ \frac{2e^{\frac{x}{\sigma}}}{\sigma\left(1 + e^{\frac{x}{\sigma}}\right)^2} ; \sigma > 0, x \geq 0$$

$$(1.1)$$

In addition, survival function is given by

$$\overline{F}(x) \ = \ \frac{2}{1 + e^{\frac{x}{\sigma}}} ; \sigma > 0, x \geq 0$$

$$(1.2)$$

Balakrishnan (1985), who has established several recurrence relations for the single and product moments of order statistics, has suggested use of this distribution as a possible lifetime model. Balakrishnan and Puthenpura (1986) derived the best linear unbiased estimators for the location and scale parameters for the two parameter half-logistic distribution. Balakrishnan and Wong (1991) derived approximate maximum likelihood estimators for the two parameters based on type II censored sample.

Torabi and Bagheri (2010) introduced an extended generalized half logistic distribution a special case takes the form.

$$\overline{F}(x) = \left(\frac{2}{1 + e^{\beta x}}\right)^{\gamma}, \qquad \beta, \gamma > 0, \quad x > 0$$

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The corresponding density is given by

$$f(x) = \frac{\beta \gamma 2^\gamma e^{\beta x}}{\left(1 + e^{\beta x}\right)^{\gamma+1}}, \qquad \beta, \gamma > 0, \quad x > 0$$

Recently, Kang and Seo (2011) discussed the estimation of the scale parameter and reliability function of the exponentiated half-logistic distribution (EHLD) based on progressively Type-II censored samples. The distribution function of the random variable *X* having the exponentiated half-logistic distribution is:

$$F(x) = \left(\frac{1 - e^{-\frac{x}{\sigma}}}{1 + e^{-\frac{x}{\sigma}}} \right)^\lambda, x > 0, \sigma, \lambda > 0$$

Krishnarani (2016) considered a power transformation of half-logistic distribution and arrived in the form.

$$\bar{F}(x) = \frac{2}{1 + e^{\beta x^\alpha}}, \quad \alpha > 0, 0 \le x < \infty$$

Due to the increasing need for modeling data in various areas, the existing distributions seem to be not sufficient. In this situation the need for more models or generalizations of existing models are long felt. This is the motivation of the present study.

Marshall and Olkin (1997) introduced a method of adding parameters to a distribution for expanding families of distributions. They have illustrated some situations where this method is very useful. Throughout this paper, we refer to this method as Marshall-Olkin method / scheme.

Starting with a survival function $\bar{F}$, the extended family of survival function is

$$\bar{G}_\alpha(x) = \left[\frac{\alpha \bar{F}(x)}{1 - \bar{\alpha} \bar{F}(x)} \right] \quad -\infty < x < \infty, 0 < \alpha < \infty, \bar{\alpha} = 1 - \alpha. \tag{1.3}$$

$\bar{G}_\alpha$ is called the M-O distribution generated from $\bar{F}$. Marshall and Olkin (1997) have applied this to exponential and Weibull case. Jayakumar and Thomas Mathew (2008) generalized this method by adding one more parameter.

2. THE NEW HALF-LOGISTIC DISTRIBUTION

Definition 2.1

Substituting (1.2) in (1.3) we get the Marshall-Olkin half logistic distribution $\text{MOHL}(\alpha, \sigma)$ with survival function

$$\bar{G}(x) = \frac{2\alpha}{e^{\frac{x}{\sigma}} - 1 + 2\alpha}; \alpha, \beta \ge 0, x \ge 0 \tag{2.1}$$

The density function is

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$$g(x) \quad = \quad \frac{2\alpha e^{\frac{x}{\sigma}}}{\sigma \left(e^{\frac{x}{\sigma}} - 1 + 2\alpha \right)^2} ; \alpha, \sigma \geq 0, x \geq 0.\qquad (2.2)$$

For $\alpha > \dfrac{1}{2}$, this is equivalent to shifting the logistic distribution to the new location $\sigma \ln(2\alpha - 1)$ and then truncating this distribution below at zero.

For $0 < \alpha < 1$,

$$E\left(X \right) \quad = \quad 2\alpha\sigma \sum_{j=0}^{\infty} \frac{(1-2\alpha)^j}{j+1}$$

$$E\left(X^s \right) \quad = \quad 2\alpha\sigma^s \Gamma(s+1) \sum_{j=0}^{\infty} \frac{(1-2\alpha)^j}{(j+1)^s}$$

$$E\left(e^{tX} \right) \quad = \quad 2\alpha \sum_{j=0}^{\infty} (1-2\alpha)^j \frac{j+1}{j+1-t\sigma}$$

$$Mode(X) = \begin{cases} \sigma \ln(2\alpha - 1) & If \quad \alpha > 1 \\ 0 & If \quad 0 < \alpha \leq 1 \end{cases}$$

$$Median\left(X \right) \quad = \quad \sigma \ln(2\alpha + 1)$$

Characterizations

It may be noted that

$$F(x)\bar{F}(x) \quad = \quad f(x) - \frac{\left(\bar{F}(x) \right)^2}{2\alpha}.$$

If U is standard uniform then

$$X \quad = \quad \sigma \ln\left(\frac{2\alpha U}{1-U} - 1 \right) \text{ is } MOHL(\alpha, \sigma)$$

Theorem 2.1

If $X_1, X_2, ..., X_n$ are N independent and identically distributed half-logistic random variables and N is a geometric random variable with distribution $\quad P(N = n) = p(1-p)^{n-1}; n = 1, 2, ...; \quad 0 < p < 1, q = 1 - p$ and let $U_N = \min(X_1, X_2, ...X_N)$. Then distribution of U_n is MOHL with $\alpha = p$.

Proof

We have, $\qquad P(U_N \geq x) \quad = \quad P\left(\min(X_1, X_2, ..., X_N) \geq x\right)$

$$= \quad \prod_{i=1}^{N} P(X_i \geq x)$$

$$= \quad \left(\overline{F}(x)\right)^{N}$$

$$= \quad \sum_{n=1}^{\infty} \left(\overline{F}(x)\right)^{n} q^{n-1} p$$

$$= \quad \frac{p\overline{F}(x)}{1 - q\overline{F}(x)}.$$

$$= \quad \frac{2p}{e^{\frac{x}{\sigma}} - 1 + 2p}.$$

Estimation

σ being a scale parameter without losing generality we may assume that $\sigma = 1$. The maximum likelihood estimate of α is obtained using the expression

$$\hat{\alpha} \quad = \quad \frac{n}{\displaystyle\sum_{i=1}^{n} \frac{2e^{x_i}}{e^{x_i} - 1 + 2\alpha}}$$

Suppose the first and third quartiles are P_{25} and P_{75} respectively. Then the estimate of α is

$$\alpha \quad = \quad \frac{3}{16}\left(e^{P_{75}} - e^{P_{25}}\right).$$

For convenience put $2\alpha = \beta$, Then (2.1) becomes

$$\overline{G}(x) \quad = \quad \frac{\beta}{e^{\frac{x}{\sigma}} - 1 + \beta}; \sigma, \beta \geq 0, x \geq 0$$

and density function

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$$g(x) \ = \ \frac{\beta e^{\frac{x}{\sigma}}}{\sigma \left(e^{\frac{x}{\sigma}} - 1 + \beta \right)^2} ; \beta, \sigma \geq 0, x \geq 0 . \tag{2.3}$$

3. THE LAPLACE LOGISTIC DISTRIBUTION

A real valued extension of the $\mathrm{MOHL}(\beta, \sigma)$ distribution is possible and corresponding probability density function is given by $g(x;\beta) = \frac{1}{2} f(|x|;\beta)$. The random variable X with this probability density function is termed as symmetric Laplace logistic (SLL) random variable and the corresponding probability density function is given by.

$$g(x;\beta) = \frac{\beta}{2\sigma} \frac{e^{\left|\frac{x}{\sigma}\right|}}{(e^{\left|\frac{x}{\sigma}\right|} - \bar{\beta})^2} ; -\infty < x < \infty; 0 < \beta \leq \infty, \sigma > 0 \text{ and } \bar{\beta} = 1 - \beta \tag{3.1}$$

In this case we write it as $X \underline{d} \mathrm{SLL}(\beta, \sigma)$.

The distribution function of $\mathrm{SLL}(\beta, \sigma)$ random variable is given by

$$F(x) = \begin{cases} \dfrac{\beta}{2} \dfrac{1}{(e^{-\frac{x}{\sigma}} - \bar{\beta})} & \text{if } x \leq 0 \\[3mm] 1 - \dfrac{\beta}{2} \dfrac{1}{(e^{\frac{x}{\sigma}} - \bar{\beta})} & \text{if } x \geq 0. \end{cases} \tag{3.2}$$

Remark 3.1

When $\beta = 2$, (3.2) reduces to the distribution function of logistic distribution

$$F(x) \ = \ \frac{1}{1 + e^{-\frac{x}{\sigma}}}, -\infty < x < \infty .$$

Remark 3.2

When $\beta = 1$, (3.2) reduces to the distribution function of Laplace distribution.

$$F(x) = \begin{cases} \dfrac{1}{2} e^{-\frac{|x|}{\sigma}} & \text{if } x \leq 0 \\[3mm] 1 - \dfrac{1}{2} e^{-\frac{|x|}{\sigma}} & \text{if } x \geq 0. \end{cases} .$$

The SLL family of distributions includes the Laplace as well as the logistic distribution.

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The probability density plots of $\text{SLL}(\beta, \sigma)$ for various values of β and $\sigma = 1$ is given in Figure 3.1.

Figure-3.1: Density Plots of SLL Distribution

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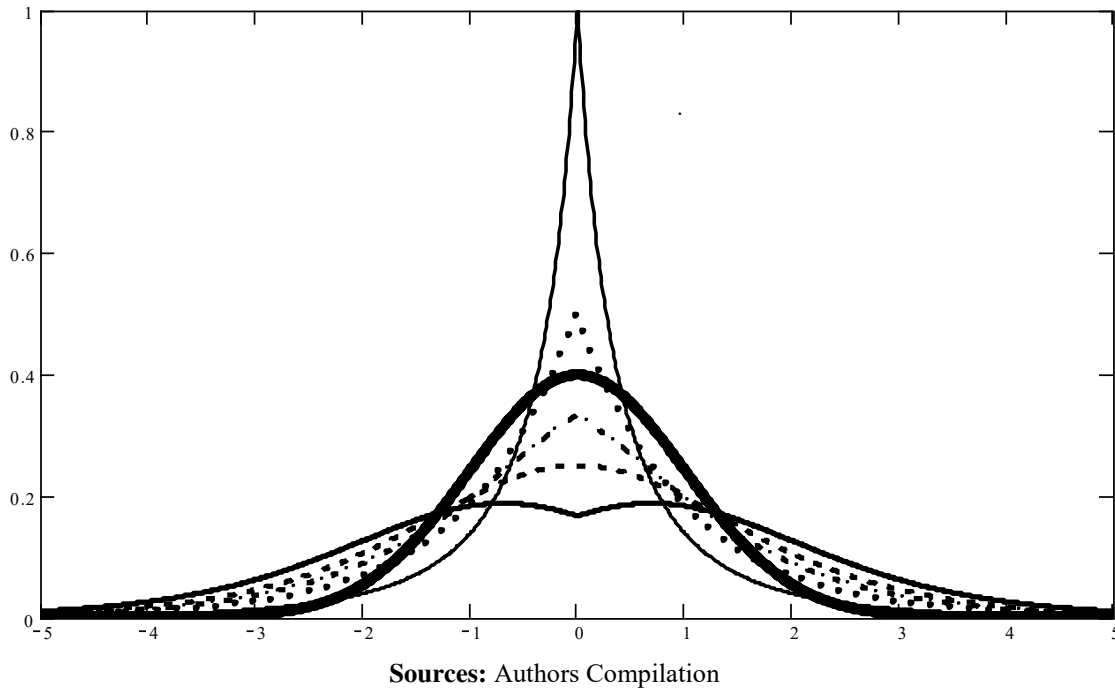
($\beta = 0.5, 1, 1.5, 2, 2.5$ is plotted from top to bottom, the thickest line is standard normal)

We can observe that when $\beta = 2.5$ the distribution become bimodal and as β increases beyond 2 the mode goes away from zero on either sides. By suitably adjusting the parameter β we can make the modes very near to zero. This property is very useful for modeling heavy tailed data having mode very near to zero on either sides but not zero.

The following table presents the cumulative probabilities for standard normal, Laplace, logistic and SLL distributions for $\sigma = 1$.

The characteristic function of SLL distribution is

$$\Phi(t) = \beta \sum_{j=1}^{\infty} \bar{\beta}^{j-1} \frac{j^2}{j^2 + \sigma^2 t^2} \qquad = \beta \sum_{j=1}^{\infty} \bar{\beta}^{j-1} \frac{1}{1 + \left(\frac{\sigma}{j}\right)^2 t^2}$$

The odd order moments of SLL distribution are equal to 0 and even order moments are given by

$$E(X^{2r}) = (2r)! \sigma^{2r} \beta \sum_{j=1}^{\infty} \frac{\bar{\beta}^{j-1}}{j^{2r}}.$$

Table-3.1: Cumulative Probability table of Standard Normal, SLL, Laplace and Logistic Distributions

X β	normal	0.5	1(Laplace)	1.5	2(logistic)	2.5	3
0	0.5	0.5	0.5	0.5	0.5	0.5	0.5
0.5	0.6915	0.7824	0.6967	0.651	0.6225	0.603	0.5889
1	0.8413	0.8873	0.8161	0.767	0.7311	0.7037	0.6821
1.5	0.9332	0.9372	0.8884	0.8494	0.8176	0.791	0.7686
2	0.9772	0.9637	0.9323	0.9049	0.8808	0.8594	0.8402
2.5	0.9938	0.9786	0.959	0.9409	0.9241	0.9086	0.8942
3	0.9987	0.9872	0.9751	0.9636	0.9526	0.9421	0.9321
3.5	0.9998	0.9923	0.9849	0.9777	0.9707	0.9639	0.9573
4	1	0.9954	0.9908	0.9864	0.982	0.9777	0.9735
4.5	1	0.9972	0.9944	0.9917	0.989	0.9863	0.9837
5	1	0.9983	0.9966	0.995	0.9933	0.9917	0.99
5.5	1	0.999	0.998	0.9969	0.9959	0.9949	0.9939
6	1	0.9994	0.9988	0.9981	0.9975	0.9969	0.9963
6.5	1	0.9996	0.9992	0.9989	0.9985	0.9981	0.9978
7	1	0.9998	0.9995	0.9993	0.9991	0.9989	0.9986
7.5	1	0.9999	0.9997	0.9996	0.9994	0.9993	0.9992
8	1	0.9999	0.9998	0.9997	0.9997	0.9996	0.9995
8.5	1	0.9999	0.9999	0.9998	0.9998	0.9997	0.9997
9	1	1	0.9999	0.9999	0.9999	0.9998	0.9998
9.5	1	1	1	0.9999	0.9999	0.9999	0.9999
10	1	1	1	1	1	0.9999	0.9999
10.5	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1

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In particular, the mean and variance are given by $E(X) = 0$ and $V(X) = 2\sigma^2\beta \sum_{j=1}^{\infty} \frac{\bar{\beta}^{j-1}}{j^2}$ respectively.

Since the third moment of $SLL(\beta, \sigma)$ distribution is equal to zero, the coefficient of skewness γ_1 of SLL distribution is equal to zero.

Now we give a method of estimating the parameters of the SLL distribution. To estimate the parameter β and σ we consider the method of maximum likelihood iteratively. The log likelihood function for a random sample $X_1, X_2, ..., X_n$ drawn from the SLL distribution is

$$\log L(x_1, x_2, ..., x_n; \beta, \sigma) = n\log(\frac{\beta}{2}) - n\ln(\sigma) - \sum_{i=1}^{n}\left|\frac{x_i}{\sigma}\right| - 2\sum_{i=1}^{n}\log(1 - \bar{\beta}e^{-\left|\frac{x_i}{\sigma}\right|}). \quad (3.3)$$

The first order derivative of (3.3) with respect to parameter β is

$$\frac{n}{\beta} - 2\sum_{i=1}^{n}\frac{1}{\exp\left(\left|\frac{x_i}{\sigma}\right|\right) - \bar{\beta}}.$$

With respect to σ is

$$\sum_{i=1}^{n}\left|\frac{x_i}{\sigma^2}\right| - \frac{n}{\sigma} - \frac{2\bar{\beta}}{\sigma^2}\sum_{i=1}^{n}\frac{x_i}{\exp\left(\left|\frac{x_i}{\sigma}\right|\right) - \bar{\beta}}.$$

Setting the above expressions to zero and solving by iterative method we will get the values of β and σ. If we introduce the location parameter, the density and distribution functions become

$$g(x;\beta) = \frac{\beta}{2\sigma}\frac{e^{\left|\frac{x-\mu}{\sigma}\right|}}{\left(e^{\left|\frac{x-\mu}{\sigma}\right|} - \bar{\beta}\right)^2}; -\infty < x < \infty; 0 < \beta \leq \infty, \sigma > 0, -\infty < \mu < \infty \text{ where } \bar{\beta} = 1 - \beta$$

and

$$F(x) = \begin{cases} \dfrac{\beta}{2}\dfrac{1}{\left(e^{-\frac{(x-\mu)}{\sigma}} - \bar{\beta}\right)} & \text{if } x \leq \mu \\ 1 - \dfrac{\beta}{2}\dfrac{1}{\left(e^{\frac{x-\mu}{\sigma}} - \bar{\beta}\right)} & \text{f } x \geq \mu. \end{cases}$$

Since the SLL distribution function has closed form, the inversion method can be applied to generate a SLL random variable. The method of generating SLL random variable is as follows.

- Generate a uniform (0, 1) random variable U
- $X = \mu - \sigma \ln\left(\frac{\beta}{2U} + 1 - \beta\right)$ If $U \leq 0.5$
- $X = \mu + \sigma \ln\left(\frac{\beta}{2(1-U)} + 1 - \beta\right)$ If $U > 0.5$.

Note that for $\beta = 2$, it generates logistic and for $\beta = 1$, it generates Laplace.

Alternatively, we can generate a SLL random variable using the representation $X \underset{=}{d} IW$ where W is a

MOHL random variable and $P(I = \pm 1) = \dfrac{1}{2}$. The method is described below.

- Generate Marshall-Olkin exponential random variable W

- $X = \begin{cases} W & \text{with probability } \frac{1}{2} \\ -W & \text{with probability } \frac{1}{2}. \end{cases}$

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4. ASYMMETRIC LAPLACE LOGISTIC DISTRIBUTION

In the last several decades different methods of introducing skewness into symmetric distributions has been proposed and studied by various authors. Fernandez and Steel (1998) defined probability density function of a skewed distribution generated by symmetric probability density function $f(.)$ as

$$f(x/\kappa) = \frac{2\kappa}{1+\kappa^2} \begin{cases} f(\kappa x) & \text{if } x \geq 0 \\ f(\kappa^{-1}x) & \text{f } x < 0 \end{cases} \quad (4.1)$$

Where $\kappa > 0.$

When $f(.)$ is the probability density function of $\text{SLL}(\beta, \sigma)$ defined in (3.1), then (4.1) leads to an asymmetric distribution with probability density function

$$f(x) = \begin{cases} \dfrac{\kappa}{1+\kappa^2} \dfrac{\beta}{\sigma} \dfrac{e^{-\frac{x}{\kappa\sigma}}}{(e^{-\frac{x}{\kappa\sigma}} - \bar\beta)^2} & \text{if } x < 0 \\[4mm] \dfrac{\kappa}{1+\kappa^2} \dfrac{1}{\sigma} \dfrac{\beta e^{\kappa\frac{x}{\sigma}}}{(e^{\kappa\frac{x}{\sigma}} - \bar\beta)^2} & \text{if } x \geq 0 \end{cases} \quad . (4.2)$$

The distribution function is

$$F(x) = \begin{cases} \dfrac{\kappa^2\beta}{1+\kappa^2} \dfrac{1}{\sigma} \dfrac{1}{e^{-\frac{x}{\kappa\sigma}} - \bar\beta} & x < 0 \\[4mm] 1 - \dfrac{\beta}{1+\kappa^2} \dfrac{1}{\sigma} \dfrac{1}{e^{\kappa\frac{x}{\sigma}} - \bar\beta} & x \geq 0 \end{cases}$$

It may be verified that $P(X < 0) = \dfrac{\kappa^2}{1+\kappa^2}$ and $P(X \geq 0) = \dfrac{1}{1+\kappa^2}$. Consequently, the parameter κ controls the probability assigned to each side of 0. Clearly, for $\kappa = 1$, the two probabilities are equal and the distribution is symmetric about 0.

A random variable with probability density function (4.2) is said to have asymmetric Laplace logistic (ALL) distribution with parameters $\beta \in (0, \infty]$ and $\kappa > 0$. We denote such random variable X as $X \underline{d} \, \text{ALL}(\beta, \sigma, \kappa)$. Note that for $\beta = 2$, (4.2) reduces to asymmetric logistic distribution with density function,
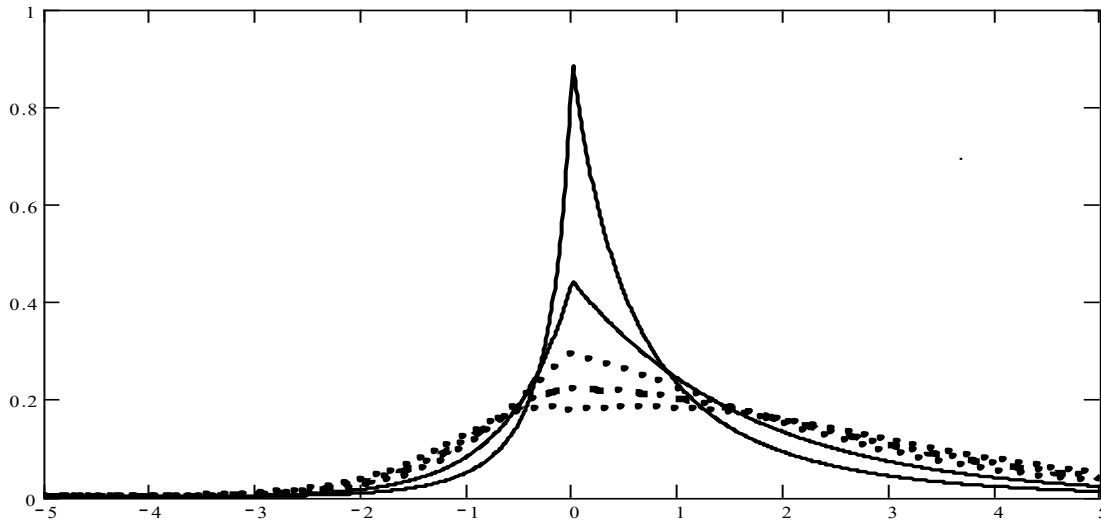
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$$f(x) = \begin{cases} \dfrac{\kappa}{1+\kappa^2} \dfrac{2}{\sigma} \dfrac{e^{-\frac{x}{\kappa\sigma}}}{(e^{-\frac{x}{\kappa\sigma}}-1)^2} & \text{if } x < 0 \\[4mm] \dfrac{\kappa}{1+\kappa^2} \dfrac{2}{\sigma} \dfrac{e^{\kappa\frac{x}{\sigma}}}{(e^{\kappa\frac{x}{\sigma}}-1)^2} & \text{if } x \ge 0 \end{cases} .$$

and distribution function,

$$F(x) = \begin{cases} \dfrac{\kappa^2}{1+\kappa^2} \dfrac{2}{\sigma} \dfrac{1}{e^{-\frac{x}{\kappa\sigma}}-1} & x < 0 \\[4mm] 1 - \dfrac{1}{1+\kappa^2} \dfrac{2}{\sigma} \dfrac{1}{e^{\kappa\frac{x}{\sigma}}-1} & x \ge 0 \end{cases}$$

For $\beta = 1$, (4.2) reduces to asymmetric Laplace distribution see Kozubowski and Podgorski (2000).

Figure-4.1: Probability Density Plots of ALL Distribution

Sources: Authors Compilation

The probability density plots of ALL distribution defined by (4.2) when β = 0.5, 1, 1.5, 2 and 2.5 (top to bottom) and σ = 1, κ = 0.6 is given in Figure 4.1.

The characteristic function of $\text{ALL}(\beta, \sigma, \kappa)$ is

$$\Phi(t) = \frac{\beta\kappa}{1+\kappa^2} \sum_{j=1}^{\infty} j\bar{\beta}^{j-1} \frac{1}{j\kappa - it\sigma} + \frac{\beta\kappa}{1+\kappa^2} \sum_{j=1}^{\infty} j\bar{\beta}^{j-1} \frac{1}{\frac{j}{\kappa} + it\sigma}$$

$$= \beta \sum_{j=1}^{\infty} \overline{\beta}^{j-1} \frac{1}{1+t^2 \left(\frac{\sigma}{j}\right)^2 - it\frac{1}{j}\mu} \ , \ \text{where} \ \frac{\mu}{\sigma} = \frac{1}{\kappa} - \kappa . \ (4.3)$$

It may be noted that when $\beta = 1$, the characteristic function (4.3) reduced to the form of characteristic function of asymmetric Laplace distribution defined by Kozubowski and Podgorski (2000).

The moments of $\text{ALL}(\beta, \sigma, \kappa)$ distribution are given by

$$E(X^r) = \beta \frac{\kappa}{1+\kappa^2} r! \sigma^r \left(\frac{1}{\kappa^{r+1}} + (-1)^r \kappa^{r+1}\right) \sum_{j=1}^{\infty} \overline{\beta}^{j-1}, \overline{\beta} = 1 - \beta .$$

If we introduce the location parameter also, then the density and distribution function become.

$$f(x) = \begin{cases} \dfrac{\kappa}{1+\kappa^2} \dfrac{\beta}{\sigma} \dfrac{e^{-\frac{x-\mu}{\kappa\sigma}}}{(e^{-\frac{x-\mu}{\kappa\sigma}} - \overline{\beta})^2} & \text{if } x < \mu \\[20pt] \dfrac{\kappa}{1+\kappa^2} \dfrac{1}{\sigma} \dfrac{\beta e^{\kappa\frac{x-\mu}{\sigma}}}{(e^{\kappa\frac{x-\mu}{\sigma}} - \overline{\beta})^2} & \text{if } x \geq \mu \end{cases} .$$

and

$$F(x) = \begin{cases} \dfrac{\kappa^2\beta}{1+\kappa^2} \dfrac{1}{e^{-\frac{x-\mu}{\kappa\sigma}} - \overline{\beta}} & x < \mu \\[20pt] 1 - \dfrac{\beta}{1+\kappa^2} \dfrac{1}{e^{\kappa\frac{x-\mu}{\sigma}} - \overline{\beta}} & x \geq \mu \end{cases}$$

The $\text{ALL}(\beta, \sigma, \kappa)$ random variables can be generated as follows

Generate a uniform random variable U

$$X = \begin{cases} \mu - \sigma\kappa \ln\left(\dfrac{\kappa^2\beta}{U(1+\kappa^2)} + \overline{\beta}\right) & \text{if} \quad U < \frac{\kappa^2}{1+\kappa^2} \\[15pt] \mu + \sigma\frac{1}{\kappa} \ln\left(\dfrac{\beta}{(1-U)(1+\kappa^2)} + \overline{\beta}\right) & \text{if} \quad U \geq \frac{\kappa^2}{1+\kappa^2} \end{cases}$$

Now we can represent a ALL random variable X using a MOHL random variable W as $X \underline{d} I W$, where the random variables I and W are independent and I is a discrete random variable with $P(I = -\kappa) = \dfrac{\kappa^2}{1+\kappa^2}$ and

$P(I = \dfrac{1}{\kappa}) = \dfrac{1}{1+\kappa^2}$. So the ALL distribution is a mixture of MOHL random variables.

Using this representation, we can generate a ALL random variable the method is described below.

- Generate Marshall-Olkin half logistic W

- $X = \begin{cases} -\kappa W & \text{w.p. } \frac{\kappa^2}{1+\kappa^2} \\ \frac{1}{\kappa} W & \text{w.p. } \frac{1}{1+\kappa^2}. \end{cases}$

Now we suggest a method of estimating the parameters of the ALL distribution using the method of maximum likelihood and iteration. To estimate the parameters β, σ and κ we consider the likelihood function for a random sample $X_1, X_2, ..., X_n$ drawn from the ALL distribution. It is given by

$$L(\beta, \sigma, \kappa; x_1, x_2, ..., x_n) = \left(\frac{\beta}{\sigma}\right)^n \frac{\kappa^n}{(1+\kappa^2)^n} \frac{\exp(-\frac{1}{\sigma}(\kappa \sum_{i=1}^{n} x_i^+ + \frac{1}{\kappa}\sum_{i=1}^{n} x_i^-))}{\prod_{i=1}^{n}(1-\bar{\beta}\exp(-\frac{1}{\sigma}(\kappa x_i^+ + \frac{1}{\kappa} x_i^-)))^2},$$

where $x_i^+ = \max(0, x_i)$ and $x_i^- = -\min(0, x_i)$.

The first order derivatives of log likelihood function with respect to two parameters β, σ and κ are

$$\frac{\partial LogL}{\partial \beta} = \frac{n}{\beta} - \frac{2\exp\left(-\frac{1}{\sigma}\left(\kappa x_i^+ + \frac{1}{\kappa} x_i^-\right)\right)}{1-\bar{\beta}\exp\left(-\frac{1}{\sigma}\left(\kappa x_i^+ + \frac{1}{\kappa} x_i^-\right)\right)},$$

$$\frac{\partial \log L}{\partial \sigma} = -\frac{n}{\sigma} + \frac{1}{\sigma^2}\left(\kappa x_i^+ + \frac{1}{\kappa} x_i^-\right) + \frac{2}{\sigma^2}\sum_{i=1}^{n}\left(\frac{\bar{\beta}\left(\kappa x_i^+ + \frac{1}{\kappa} x_i^-\right)\exp\left(-\frac{1}{\sigma}\left(\kappa x_i^+ + \frac{1}{\kappa} x_i^-\right)\right)}{1-\bar{\beta}\exp\left(-\frac{1}{\sigma}\left(\kappa x_i^+ + \frac{1}{\kappa} x_i^-\right)\right)}\right),$$

and

$$\frac{\partial \log L}{\partial \kappa} = \frac{n(1-\kappa^2)}{\kappa(1+\kappa^2)} - \left(y_i^+ - \frac{1}{\kappa^2} y_i^-\right) - 2\sum_{i=1}^{n}\frac{\left(y_i^+ - \frac{1}{\kappa^2} y_i^-\right)}{\frac{1}{\beta}\exp(\kappa x_i^+ + \frac{1}{\kappa} x_i^-)-1},$$

where $y_i^+ = \sum_{i=1}^{n} x_i^+$ and $y_i^- = \sum_{i=1}^{n} x_i^-$.

Setting these expressions to zero and solving them simultaneously for a given set of values $x_1, x_2, ..., x_n$ by numerical methods (iteratively) yields the maximum likelihood estimates of β, σ and κ.

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5. THE ASYMMETRIC LOGISTIC DISTRIBUTION

The asymmetric logistic distribution $\text{ALg}(\sigma, \kappa)$ can be obtained as a special case of asymmetric Laplace logistic distribution.

For $\beta = 2$, (4.2) reduces to asymmetric logistic distribution with density function,

$$f(x) = \begin{cases} \dfrac{\kappa}{1+\kappa^2} \dfrac{2}{\sigma} \dfrac{e^{-\frac{x}{\kappa\sigma}}}{(e^{-\frac{x}{\kappa\sigma}} - 1)^2} & \text{if } x < 0 \\[4mm] \dfrac{\kappa}{1+\kappa^2} \dfrac{2}{\sigma} \dfrac{e^{\kappa\frac{x}{\sigma}}}{(e^{\kappa\frac{x}{\sigma}} - 1)^2} & \text{if } x \geq 0 \end{cases} \quad . \text{ (5.1)}$$

and distribution function,

$$F(x) = \begin{cases} \dfrac{\kappa^2}{1+\kappa^2} \dfrac{2}{\sigma} \dfrac{1}{e^{-\frac{x}{\kappa\sigma}} - 1} & x < 0 \\[4mm] 1 - \dfrac{1}{1+\kappa^2} \dfrac{2}{\sigma} \dfrac{1}{e^{\kappa\frac{x}{\sigma}} - 1} & x \geq 0 \end{cases}$$

$$(5.2)$$

The Characteristic function is

$$\Phi(t) = \sum_{j=1}^{\infty} \dfrac{2}{1 + t^2 \left(\dfrac{\sigma}{j}\right)^2 - it\dfrac{1}{j}\mu} \ , \text{ where } \dfrac{\mu}{\sigma} = \dfrac{1}{\kappa} - \kappa \, . \text{ (5.3)}$$

The moments of $\text{ALg}(\sigma, \kappa)$ distribution are given by

$$E(X^r) = \dfrac{\kappa}{1+\kappa^2} 2r!\sigma^r \left(\dfrac{1}{\kappa^{r+1}} + (-1)^r \kappa^{r+1} \right).$$

$$E(X) = \dfrac{2\sigma(\kappa^2 - 1)}{\kappa}$$

$$V(X) = 4\sigma^2$$

Measure of skewness based on moments

$$\beta_1 = \dfrac{49(\kappa^2 - 1)^6}{\kappa^6} = 0 \text{ when } \kappa = 1 \quad .$$

Measure of Kurtosis

$$\beta_2 = -\frac{3\left(2\kappa^8 - 5\kappa^6 + 5\kappa^4 - 5\kappa^2 + 2\right)}{\kappa^4} = 3 \text{ when } \kappa = 1$$

If we introduce the location parameter also, then the density and distribution function become

$$f(x) = \begin{cases} \dfrac{\kappa}{1+\kappa^2} \dfrac{2}{\sigma} \dfrac{e^{-\frac{x-\theta}{\kappa\sigma}}}{(e^{-\frac{x-\theta}{\kappa\sigma}} - 1)^2} & \text{if } x < \mu \\[3em] \dfrac{\kappa}{1+\kappa^2} \dfrac{2}{\sigma} \dfrac{e^{\kappa\frac{x-\theta}{\sigma}}}{(e^{\kappa\frac{x-\theta}{\sigma}} - 1)^2} & \text{if } x \geq \mu \end{cases}.$$

and

$$F(x) = \begin{cases} \dfrac{\kappa^2}{1+\kappa^2} \dfrac{2}{e^{-\frac{x-\theta}{\kappa\sigma}} - 1} & x < \mu \\[3em] 1 - \dfrac{1}{1+\kappa^2} \dfrac{2}{e^{\kappa\frac{x-\theta}{\sigma}} - 1} & x \geq \mu \end{cases}$$

The $\mathrm{ALg}(\sigma, \kappa)$ random variables can be generated as follows

Generate a uniform random variable U

$$X = \begin{cases} \theta - \sigma\kappa \ln\left(\frac{2\kappa^2}{U(1+\kappa^2)} + 1\right) & \text{if } U < \frac{\kappa^2}{1+\kappa^2} \\[2em] \theta + \sigma\frac{1}{\kappa} \ln\left(\frac{2}{(1-U)(1+\kappa^2)} + 1\right) & \text{if } U \geq \frac{\kappa^2}{1+\kappa^2} \end{cases}$$

Now we suggest a method of estimating the parameters of the ALg distribution using the method of maximum likelihood and iteration. To estimate the parameters, σ and κ we consider the likelihood function for a random sample $X_1, X_2, ..., X_n$ drawn from the ALg distribution. It is given by

$$L(\kappa, \sigma; x_1, x_2, ..., x_n) = \left(\frac{2}{\sigma}\right)^n \frac{\kappa^n}{(1+\kappa^2)^n} \frac{\exp\left(-\frac{1}{\sigma}\left(\kappa\sum_{i=1}^n x_i^+ + \frac{1}{\kappa}\sum_{i=1}^n x_i^-\right)\right)}{\prod_{i=1}^n \left(1 - \exp\left(-\frac{1}{\sigma}\left(\kappa x_i^+ + \frac{1}{\kappa} x_i^-\right)\right)\right)^2},$$

where $x_i^+ = \max(0, x_i)$ and $x_i^- = -\min(0, x_i)$.

The first order derivatives of log likelihood function with respect to two parameters β, σ and κ are

$$\frac{\partial \log L}{\partial \sigma} = -\frac{n}{\sigma} + \frac{1}{\sigma^2}\left(\kappa x_i^+ + \frac{1}{\kappa} x_i^-\right) + \frac{2}{\sigma^2}\sum_{i=1}^{n}\left(\frac{\left(\kappa x_i^+ + \frac{1}{\kappa} x_i^-\right)\exp\left(-\frac{1}{\sigma}\left(\kappa x_i^+ + \frac{1}{\kappa} x_i^-\right)\right)}{1 - \exp\left(-\frac{1}{\sigma}\left(\kappa x_i^+ + \frac{1}{\kappa} x_i^-\right)\right)}\right),$$

and

$$\frac{\partial \log L}{\partial \kappa} = \frac{n(1-\kappa^2)}{\kappa(1+\kappa^2)} - \left(y_i^+ - \frac{1}{\kappa^2} y_i^-\right) - 2\sum_{i=1}^{n}\frac{\left(y_i^+ - \frac{1}{\kappa^2} y_i^-\right)}{\exp\left(\kappa x_i^+ + \frac{1}{\kappa} x_i^-\right) - 1},$$

where $y_i^+ = \sum_{i=1}^{n} x_i^+$ and $y_i^- = \sum_{i=1}^{n} x_i^-$. Setting these expressions to zero and solving them simultaneously for a given set of values $x_1, x_2, ..., x_n$ by numerical methods (iteratively) yields the maximum likelihood estimates of σ and κ.

Motivation of the Work

Financial data always fluctuate and there is no or very little possibility of a zero fluctuation. Very small positive as well as negative fluctuations exhibit bimodal situations with the two modes distributed identically on either side of zero. Fitting bimodal distributions for such data is more suitable than fitting a unimodal distribution especially with mode zero. This is the motivation of the present study. Here by suitably adjusting the parameter β we can make the modes of ALL distribution away from zero on either side of zero.

6. AN ILLUSTRATIVE APPLICATION

In this Section daily share index of Bombay stock exchange (INDIA) is considered. It is shown that the most suitable distribution for modeling it is the asymmetric Laplace logistic distribution. For modeling the data, we have considered standard normal distribution, logistic distribution, Laplace distribution, Asymmetric Laplace distribution, Asymmetric Linnik distribution, Cauchy distribution, symmetric Laplace logistic distribution and asymmetric Laplace logistic distribution.

The tools used for selecting the best model are the chi-square test for goodness of fit and Kolmogrov Smirnov two sample test. The procedure adopted is that calculate chi-square statistic for the suspected models and select those models having chi-square values lower than the critical value at 5% level. Among these models, select that one having least Kolmogrove distance.

The daily share index of Bombay stock exchange (INDIA) is considered. It consists of daily data from 1, July 1997 to 10, March 2008 (2649 observations). Logarithmic difference is taken and the resulting series is standardized and plotted in Figure 6.1.

Figure 6.1: Error Plot of the Daily Share Index (BSE) INDIA (standardized)
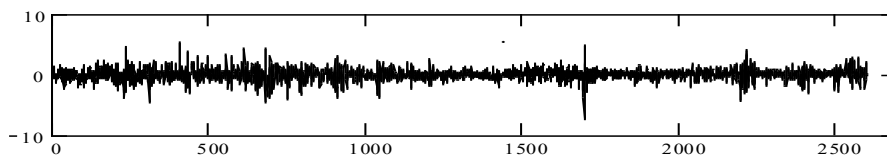
**Sources:** Authors Compilation

The data exhibit random nature and we are interested in modeling this random nature. The maximum of observation is 5.318, minimum is -7.399 median is 0.041. The histogram is plotted with 50 classes of equal width and it is given in Figure 6.2.

Figure-6.2: Histogram of the Standardized Error Distribution of Daily Share Index (BSE)

Sources: Authors Compilation
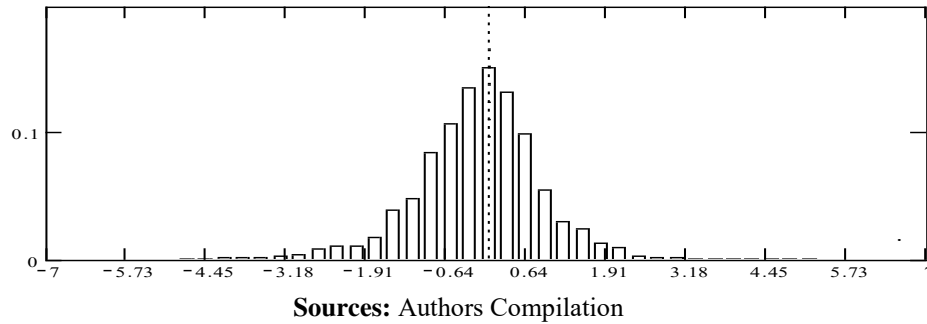
As an initial assumption a normal model is suspected, a standard normal curve is embedded in the frequency curve of the data and is shown In Figure 6.3. The dotted line represents standard normal and solid line for frequency curve of the given data. The QQ plot and PP plot are given in Figure 6.3 (see Chambers et al: (1983)).

Figure 6.3

Sources: Authors Compilation
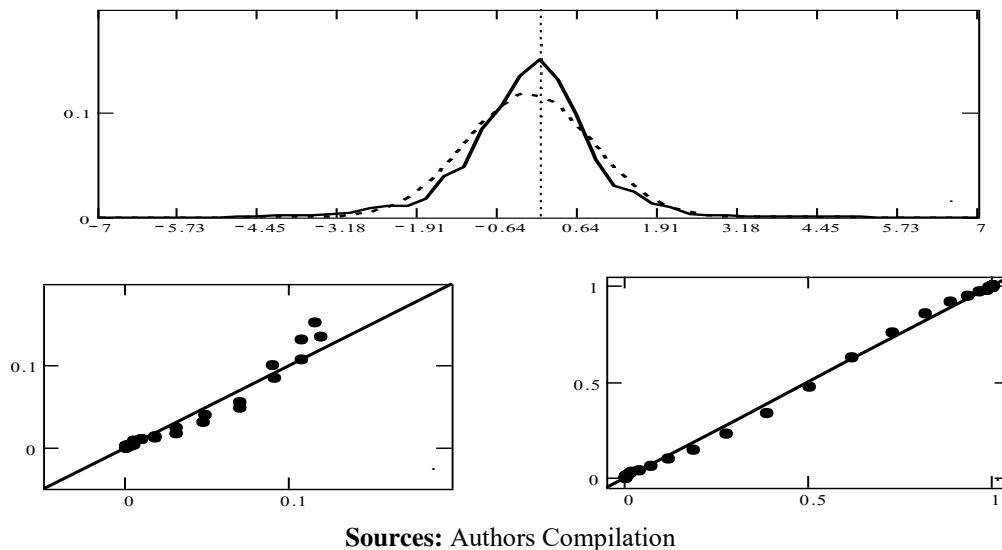
Empirical frequency curve with empirical standard normal curve embedded on it together with QQ plot and PP plot

From the Figure, it can be observed that the standard normal is not a good fit. The value of chi-square goodness of fit test is 294.18 while the critical value is 44 at 5% level of significance. The Kolmogrov Smirnov two sample statistic is 0.045. Therefore, we may reject our assumption of normality.

On analyzing the data, it is found that $P\left[|X| > 3\right] = 0.011$. Hence, a distribution with a heavier tail is suspected and a Laplace model is suggested.

The parameters are estimated as $\mu = 0.041$ and $\sigma = 0.73$. The QQ plot and PP plot are given in Figure 6.4.

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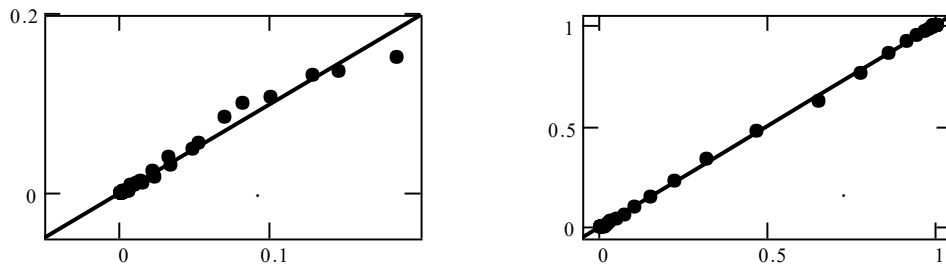**Figure-6.4: QQ plot and PP plot for Laplace Density**
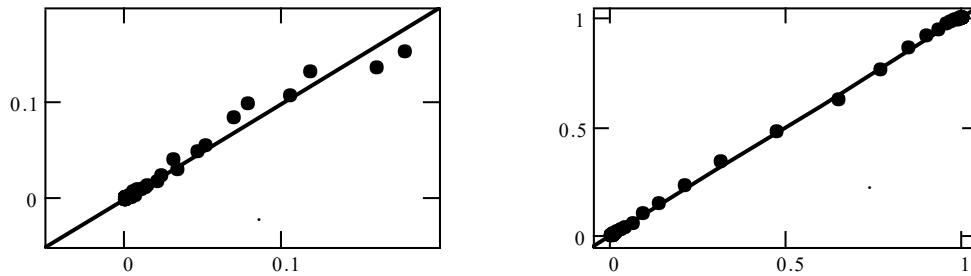
Sources: Authors Compilation

The value for chi-square goodness of fit test is 75.9 while the critical value is 44 at 5% level of significance. The Kolmogrov Smirnov two-sample statistic is 0.026. Therefore, we may reject our assumption of Laplace distribution.

Next, an asymmetric Laplace model is assumed. The estimated parameters are $\kappa = 1.09$, $\sigma = 0.73$ and $\mu = 0.041$. The QQ plot, PP plot are given in Figure 6.5.

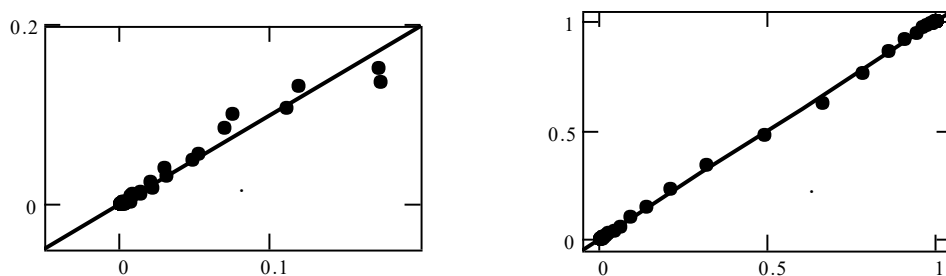**Figure-6.5: QQ Plot and PP Plot for Asymmetric Laplace Density**
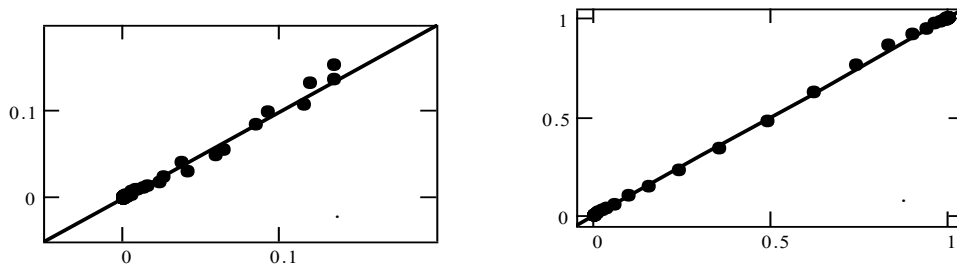

Sources: Authors Compilation

The value for chi-square goodness of fit test is 62.26 while the critical value is 44 at 5% level of significance. The Kolmogrov Smirnov two-sample statistic is 0.051. Therefore, we may reject our assumption of asymmetric Laplace distribution.

Next, an asymmetric Linnik model is assumed. The estimated parameters are $\tau = 0.02$, $\alpha = 1.99$ and $\sigma = 0.49$. The QQ plot, PP plot are given in Figure 6.6.

Figure-6.6: QQ Plot and PP Plot for Asymmetric Linnik Density

Sources: Authors Compilation

The value for chi-square goodness of fit test is 98.18 while the critical value is 44 at 5% level of significance. The Kolmogorov Smirnov two-sample statistic is 0.035. Therefore we may reject our assumption of asymmetric Linnik distribution.

Next, we may suspect a logistic model defined by the density function.

$$f(x) = \frac{1}{\sigma} \frac{e^{\frac{x-\mu}{\sigma}}}{\left(1+e^{\frac{x-\mu}{\sigma}}\right)^2}, -\infty < x < \infty, -\infty < \mu < \infty, \sigma > 0.$$

The parameters are estimated as μ = 0.041 and σ =0.54. The QQ plot, PP plot are given in Figure 6.7.

Figure 6.7: QQ Plot and PP Plot for Logistic Density
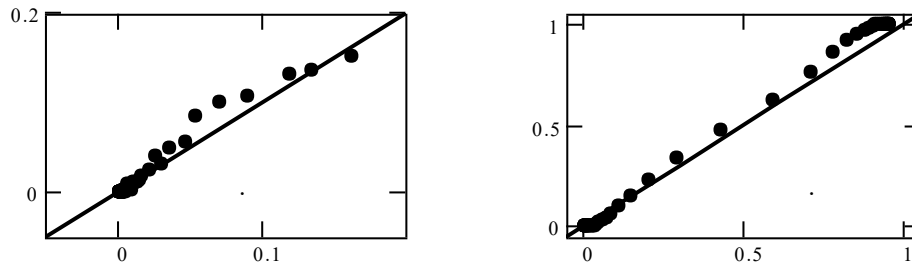

Sources: Authors Compilation

The value for chi-square goodness of fit test is 64 while the critical value is 44 at 0.5% level of significant. The Kolmogorov Smirnov two-sample statistic is 0.03. Therefore, we may reject our logistic assumption.

Next, a Cauchy model is assumed. The estimated parameters are μ = 0.041 and σ = 0.58. The QQ plot, PP plot are given in Figure 6.8.

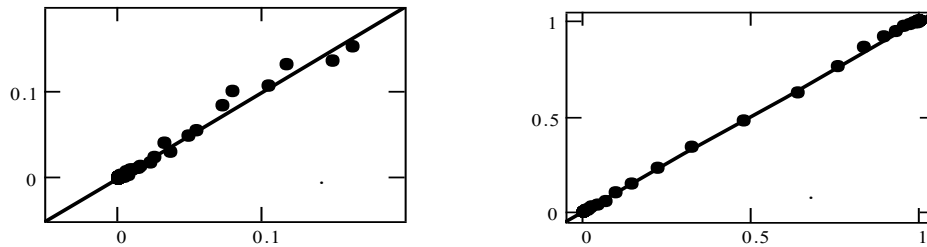**Figure-6.8: QQ Plot and PP Plot for Cauchy Density**

Sources: Authors Compilation

The value for Chi-square goodness of fit test is 278 while the critical value is 44 at 0.5% level of significance. The Kolmogorov Smirnov two-sample statistic is 0.096. Therefore, we may reject our assumption of Cauchy distribution.

Here we may note that the least value of chi-square is for Asymmetric Laplace (62.26) and logistic (64) and observed that a generalization to these models may be a suitable choice.

Next, the SLL model in Section 3 is assumed. The estimated parameters are μ = 0.041, β = 1.15, and σ = 0.71. The QQ plot, PP plot are given in Figure 6.9.

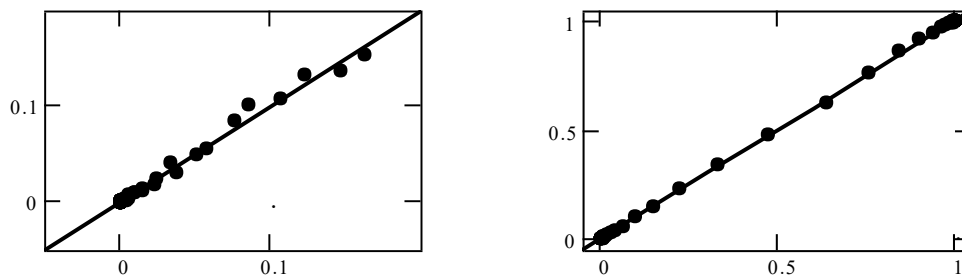**Figure-6.9: QQ plot and PP plot for SLL Density**

Sources: Authors Compilation

The value for chi-square goodness of fit test is 61.12 while the critical value is 44 at 5% level of significance. The Kolmogrov Smirnov two sample statistics is 0.024. Therefore, we may reject our assumption of symmetric Laplace logistic distribution.

Next, the ALL model in Section 4 is assumed. The estimated parameters are $\mu = 0.041$, $\kappa = 1.03$, $\beta = 1.32$, and $\sigma = 0.64$. The QQ plot, PP plot are given in Figure 6.10.

Figure-6.10: QQ Plot and PP Plot for ALL Density

Sources: Authors Compilation

The value for chi-square goodness of fit test is 43.59 while the critical value is 44 at 0.5% level of significance. The Kolmogorov Smirnov two-sample statistic is 0.023. Therefore, we may accept our assumption of ALL distribution.

A comparative study is presented in table 6.1.

Table-6.1: Values for Chi-Square and KS Test for Various Distributions

	Standard Normal	Asymmetric Linnik	Linnik	Laplace	General Asy Linnik	Logistic	Asy Laplace	Laplace Logistic	Asy Laplace Logistic	Table Value (5%)
Chi-Square Test	294.18	98.4	87	75.9	65.35	64	62.26	61.12	43.59	44
KS test	0.045	0.035	0.037	0.026	0.041	0.03	0.062	0.024	0.023	0.032

Sources: Authors Compilation

It can be observed that the parameter β bridges the gap between Laplace and logistic distribution. That is when β =1, it is Laplace and when $\beta = 2$ it is logistic. The estimated parameter $\beta = 1.32$ lies between 1 and 2. Hence, the ALL distribution is a suitable choice.

Therefore, it may be concluded that a variety of bimodal heavy tailed models are needed for modeling the financial data.

From the table and Figures, it may be noted that the ALL distribution is far better in modeling the data than many other distributions considered. Since Laplace distribution is a special case of ALL distribution and ALL distribution can be made heavier tailed than Laplace distribution by adjusting parameters we can infer that this distribution can be used for wider range of modeling heavy tailed data than Laplace distribution.

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PLASTIC WASTE MANAGEMENT: CRITICAL ANALYSIS

Dr. Archana Dadhe[2]

ABSTRACT

Plastics are user friendly but not eco-friendly as they are non-biodegradable. Generally, it is disposed by way of land filling or incineration of materials, which is extremely risky. An Indian consumes 11 kg plastic every year and an average American 109 kg. According to the latest report on the Implementation of Plastic Waste Management Rules published in 2016, the plastic waste generated across the country is close to 1.6 million tonnes a year, with almost half of it coming from Maharashtra and Gujarat. 43 per cent of India's plastics are used in packaging and are single-use plastic. Consumption has clearly outstripped India's capacity to recycle. The Rules were replaced with a stronger Plastic Waste Management Rules, 2016. The new rules gave emphasis on a complete ban on plastics below 50 microns, phasing out use of multi-layered packaging and introducing extended producer responsibility (EPR) for producers, importers and brand owners to ensure environmentally sound management of plastic products until the end of their lives.

KEYWORDS

Incineration, EPR, Recycled, Micro Plastics etc.

INTRODUCTION

In today's lifestyle, we see plastic in every spot. Plastic is used daily for packaging, protecting, serving, and even disposing of all kinds of consumer goods. India consumption of plastics will grow more than 15 million tons by 2015 and is set to be the third largest consumer of plastics in the world. Today the availability of the waste plastics is so much, as the plastic materials have become part and need of daily life. Only 60% of waste plastic recycled in India. If not recycled, either their present disposal is by land filling or by incineration but both the processes have certain impact on the environment. Finding proper solution for the disposed of plastics waste is the need of the hour on the other side, the road traffic is increasing, hence there is need to increase the load bearing capacities of the roads. Plastic waste like plastic bags, waste disposable cups, waste tires, and laminated pouches like chips, aluminum foil and packaging material used for biscuits, chocolates, milk etc., are used. Lack of proper disposal mechanism for plastic at railway station forces the passengers to throw them in the station premises or on tracks, and it finally ends up in drains leading to its choking.

Figure-1
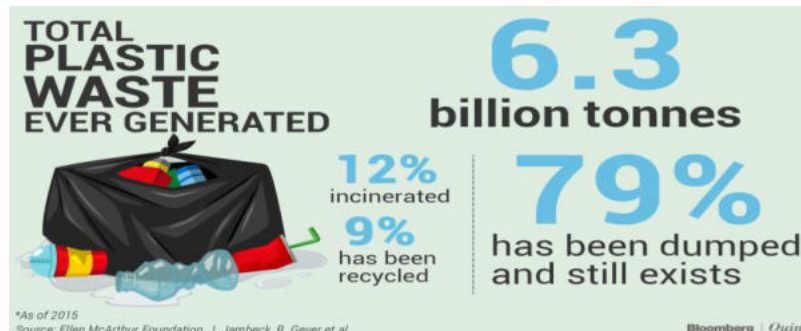
Sources: Authors Compilation

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Mismanaged Plastic Waste

Mismanaged waste is material, which is at high risk of entering the ocean via wind or tidal transport, or carried to coastlines from inland waterways. Mismanaged waste is the sum of material, which is either littered or inadequately disposed. Inadequately disposed waste is that which has the intention of being managed through waste collection or storage sites, but is ultimately not formally or sufficiently managed. This includes disposal in dumps or open, uncontrolled landfills; this means the material is not fully contained and can be lost to the surrounding environment. This makes it at risk of leakage and transport to the natural environment and oceans via waterways, winds and tides.

High-income countries, including most of Europe, North America, Australia, New Zealand, Japan and South Korea have very effective waste management infrastructure and systems; this means discarded plastic waste (even that which is not recycled or incinerated) is stored in secure, closed landfills. Across such countries, almost no plastic waste is considered inadequately managed. Note this does not mean there is no plastic at risk of entering the natural environment.

Across many low-to-middle-income countries, inadequately disposed waste can be high; across many countries in South Asia and Sub-Saharan Africa, between 80-90 percent of plastic waste is inadequately disposed of, and therefore at risk of polluting rivers and oceans. This is strongly reflected in the global distribution of mismanaged waste and inputs from river systems.

Figure-2

Sources: Authors Compilation

Plastic Use by Sector

To which industries and product uses is primary plastic production allocated? In the chart below, we see plastic production allocation by sector. Packaging was the dominant use of primary plastics, with 35.8 percent of plastics. Building and construction was the second largest sector utilizing 15.9 percent of the total.

Figure-3
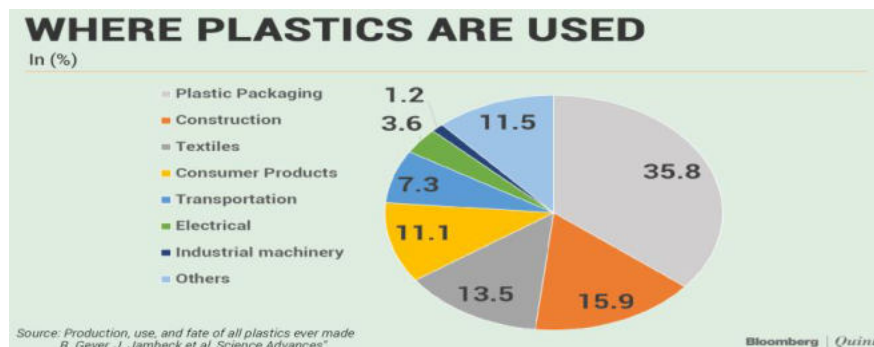
Sources: Authors Compilation

Impact of Micro Plastics on Humans

There is, currently, very little evidence of the impact of micro plastics in humans. Despite having no clear evidence of health impacts, research on potential exposure is ongoing.

For human health, it is the smallest particles-micro-and nano-particles, which are of greatest concern. Particles must be small enough to be ingested. There are several ways by which plastic particles can be ingested: orally through water, consumption of marine products which contain micro plastics, through the skin via cosmetics (identified as highly unlikely but possible), or inhalation of particles in the air.

It is possible for micro plastics to be passed up to higher levels in the food chain. This can occur when a species consumes organisms of a lower level in the food chain, which has micro plastics in the gut or tissue. The presence of micro plastics at higher levels of the food chain (in fish) has been documented.

One factor, which possibly limits the dietary uptake for humans, is that micro plastics in fish tend to be present in the gut and digestive tract - parts of the fish not typically eaten. Micro- and Nano plastics in bivalves (mussels and oysters) cultured for human consumption have also been identified. However, any human exposure and potential risk cannot yet be identified or quantified.

Figure-4

Sources: Authors Compilation

CONCLUSION

Plastic Waste Management Rules 2016 mandated the producers and brand owners to devise a plan in consultation with the local bodies to introduce a collect-back system. This system is known as the Extended Producers Responsibility (EPR).

Some plastics have fibers, which shorten with every time it is recycled. Thus, a plastic can be recycled 7-9 times before it is no longer recyclable.

Recycling is good - every ton of plastic waste recycled results in a saving of approximately 3.8 barrels of petroleum. Technologies are available in India that can convert 1 Kg of plastic to 750 ml of automotive grade gasoline.

Shredded plastic waste can be used in laying roads.

• Jambulingam Street in Chennai was one of India's first plastic roads built in 2002.
• In 2015-16, the National Rural Road Development Agency laid around 7,500 km of roads using plastic waste.

Co-processing of plastic in cement kilns offers a sound, environmentally viable mechanism to process non-recyclable, combustible plastic waste.

Develop bio-based and biodegradable plastic, which utilize starch, cellulose, poly lactic acid as raw materials for short-term use products.

- Need to promote the use of biodegradable plastic, and especially in high-end large-scale applications that can absorb the full cost of this kind of plastic. This will help in moving out bioplastics from labs to markets.
- India already has a market for bioplastics with several manufacturing plants at Bengaluru and Chennai.

The Railways is planning to install plastic bottle crushing machines in its major stations as the national transporter is grappling with the problem of mounting plastic waste generated by it.

With huge quantities of plastic used in stations, mostly water bottles and packaged drinks, the railways wanted to crush them at the station premises and give it to plastic manufacturers for recycling. Crushing units of refrigerator-size will be installed at the exit gates of railway stations and platforms so that passengers can dump empty bottles in it, said an official of the national transporter. Char formation of neat HDPE

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CHALLENGES AND PROBLEMS FACED BY HARDWARE BUSINESS IN KARNATAKA

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INTRODUCTION

Hardware shops/ store sell household hardware for home improvement including fasteners, building materials hand tools, power tools, keys, lock, chains, plumbing supplies, electrical supplies, cleaning products, house wares, tools, utensils paints and lawn and garden products directly to consumers for use at home or for business.

Many hardware shops have specialty departments unique to its owner's interests. These departments include separate paint department and pipe sections etc.

The five largest hardware retailers in the world are the home depot, Lowe's (both of United States), kingfisher of U. K, Obi of Germany and Leroy Merlin of France.

A hardware store requires a huge investment for a facility and an inventory of tools and materials. Like any new business, the best ways to start a hardware shop involves through research of your potential market to find out if there is a need as well as a lot of planning before you start leasing or buying space, purchasing inventory, hiring people and otherwise investing capital.

A good hardware purchasing strategy is vital for a business trying to keep up with larger and often better financial competitors. A wrong can seriously impair a company's operations and even change the course of its business. Hardware must be affordable, reliable, long- lasting and require little maintenance. It also must be incorporated into the overall business plan to provide flexibility for growth or to meet new opportunities or challenges. Hardware is a tool and must bit the task, like a wrench for a saw or a child.

Hardware stores sells building materials, hand tools locks, chain, plumbing supplies, cleaning products, tools, paint etc.

INDUSTRIAL PROFILE

Figure-1

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LIST OF PRODUCTS IN HARDWARE BUSINESS

Cement: A powdery substance made by calcining lime and clay, mixed with water to form mortar or mixed with sand, gravel, and water to make concrete. Cement is mixed with water and allowed to dry. A substance that is used to make things stick together.

Figure-2

Sources: Authors Compilation

Pipes: A tube used to convey water, gas, oil, or other fluid substances.

Figure-3
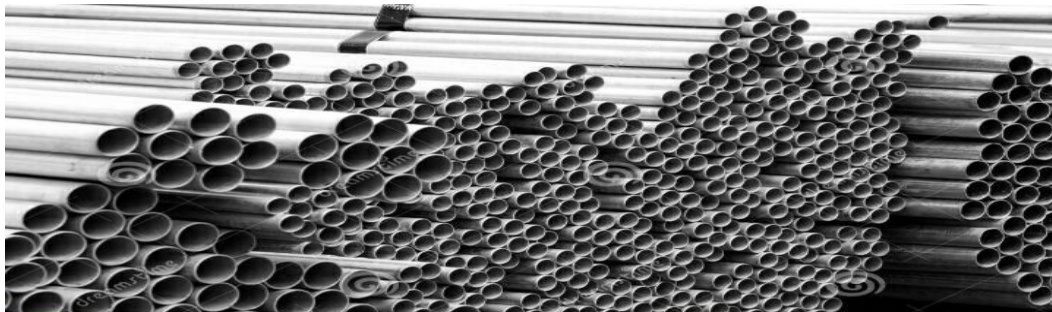
Sources: Authors Compilation

Spare Parts: A duplicate part to replace a lost or damaged part of machine. Replaceable component, sub assembly, and assembly identical to and inter changeable with the item it is intended to replace it is called spare parts.

Figure-4

Sources: Authors Compilation

Paints: A substance composed of solid coloring matter suspended in a liquid medium and applied as a protective or decorative coating to various surfaces, or to canvas or other materials introducing a work of art.

Figure-5

Sources: Authors Compilation

Building Materials: Any material, which is, used for construction purposes many naturally occurring substances such as clay, sand, rocks, and wood.

Figure-6

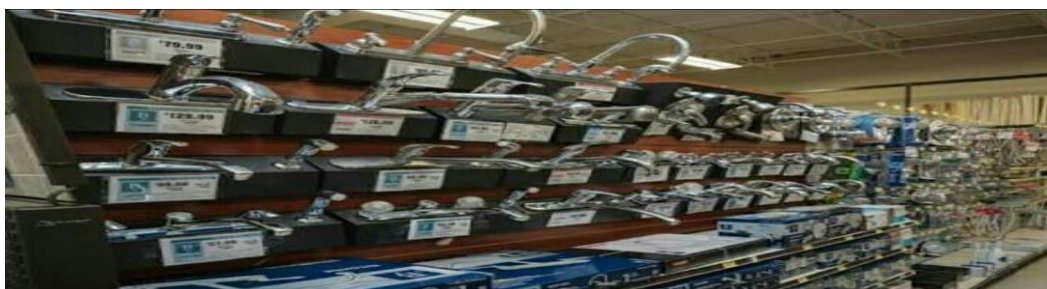**Sources**: Authors Compilation

Plumbing Supplies: Any system that conveys fluids for a wide range of applications heating and cooling waste removal, and potable water delivery.

Figure-7

Sources: Authors Compilation

Keys: Devise that used to operate a lock such as to lock or unlock it. A typical key is a small piece of small piece of metal consisting of two parts blade and bow.

Figure-8

Sources: Authors Compilation

Chains: series of connected links, which are typically made of metal. It may consist of two or more links.

Figure-9

Sources: Authors Compilation

STRATEGIES OF HARDWARE BUSINESS

Location: Usually the hardware stores are located in urban area where there is more scope for construction. While commencement of new hardware store's location plays an important role**.**

Seasonal Products: Each season has its own unique demand on a homeowner. Hardware will focus on this pattern and bring in local customers by marketing these items at competitive price.

Repair / Project Resource Area: The first section customer will find when they enter the store is a repair/project resource area that they can use to plan respires or projects. There will be a repair/project resource person there to answer their questions and direct them to the section of store where the needed products are available

In Store Expertise: Store employees will be knowledgeable in home repairs/projects. In addition, the resource area will be used to conduct short training and demonstrations in hardware business

Sales Strategy: Create a shopping environment that will create confidence in the customer that he or she will get the needed material, make the stores easy to navigate and know your customer seasonal hardware needs and offer it in attractive price

CHALLENGES FACED BY HARDWARE SHOPS

- Maintaining the stock,
- Heavy competition,
- Damages of goods in transit,

- ▪ Hardware business cannot start with less cost,
- ▪ Return is completely based on their risk management level.

RESEARCH DESIGN AND METHODOLOGY

Research is a systematic process, which will show the depth of the subject studying, and to understand the scientific body knowledge. Research process is a single entity, but it is multiphase work. Research methodology constitutes the base and structure through which data is collected and interpreted. The project quality depends upon method followed in collection of data. Methodology can be said as "The perfect way which is chosen to study the subject". An enquire would be either valid or reliable if it is not done along with certain methodological framework. Methodology includes depth of study, objective, sampling techniques, goals of data collection, research design, discussion, mock interview, limitation of study.

Sample Size

A sample is nothing but selecting small amount from the larger volume. We have randomly selected 50 people and distributed the questionnaire for them who are the shopkeepers and owners of hardware shops in and around the rural and urban area.

Sampling Technique

Technique followed was simple random technique.

Statistical Tools

In order to know the quantities in the data collection we have used the simple statistical tools such as average, percentage, tables and charts.

Sources of Data Collection

Research is based on two sources they are, Primary data and Secondary data. Primary data constitute the Questionnaire.

Questionnaire

A questionnaire is a written document, which is farmed when a company or organization wishes to conduct a research survey on the any market. Such a questionnaire consists of multiple questions, which are asked to get different point of view of a group or section of people on the same topic to evaluate the result and concluded. The question can be both types i.e. objective and subjective.

Sampling Plan

It consists of hardware shop owners and shopkeepers in and around Mangalore Moodbidri, B. C. Road, Vamanjoore, Karkala, Bellary and Bangalore.

OBJECTIVES OF STUDY

- • To know the challenges and risk faced by hardware vender.
- • To analyze the marketing strategies adopted by hardware vender.
- • To study the market forces which affect hardware business.
- • To study the mindset and difficulties faced by customers while constructing new house.

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LIMITATIONS OF STUDY

- There is limited time to conduct survey.
- Survey is conducted in limited areas Dakshina Kannada, Bellary, Bangalore.
- Respondent's opinion is true to our knowledge.
- The respondents do not reveal the marketing strategies used in hardware shops.

Table-1: Number of Years in Hardware Business

Years	Number of Respondents	Percentage
0-2 years	3	6%
2-5 years	13	26%
5-10 years	16	32%
10 and above	18	36%
Total	50	100%

Sources: Authors Compilation

Interpretation

From the above table it is clear that, the number of years in hardware business from 0 to 2 years is 6%, 2 to 5 years is 26%, 5 to 10 years is 32% and above 10 year is 36%. It clearly shows that before 10 years there is a boom in hardware business, now it is slowly reducing

Table-2: Shops Offer Value Added Services

Particulars	Number of Respondents	Percentage
No Service	12	24%
If Required	27	54%
Compulsory	11	22%
Total	50	100%

Sources: Authors Compilation

Interpretation

From the above table it is clear that, the hardware shops will not provide the value added service is 24%, if required is 54% and compulsory is 22%. Therefore, majority of hardware shops provide services only when the customers require it.

Table-3: Credit Facilities Offered by Hardware Vendors

Particulars	Respondents	Percentage
Yes	6	12%
No	17	34%
Only for Regular Customer	27	54%
Total	50	100%

Sources: Authors Compilation

Interpretation

We can understand that the % of shopkeepers who are giving credit facilities is 12% and who are not giving is 34%, and only for guaranteed customers is 54%. Hardware shop vendors think giving credit facilities is a riskier task, so they give credit facilities only to regular and guaranteed customers who are ready and capable of repaying the money.

Table-4: Percentage of Sellers Considering Purchase Return

Particulars	Number of Respondents	Percentage
yes	39	78
No	11	22
Total	50	100

Sources: Authors Compilation

Interpretation

Here % of sellers who are considering purchase return is 78% and who are not considering is 22%. Considering purchase return is good for shop vendors.

Table-5: Hardware Shop is a Seasonal Business

Particulars	Number of Respondents	Percentage
Yes	38	76
No	12	24
Total	50	100

Sources: Authors Compilation

Interpretation

The respondents who are saying hardware business is seasonal business is 76%, and who are saying not a seasonal business is 24%, so it clearly shows it is a seasonal business.

Table-6: Location Suitable for Hardware Shops

Particulars	Number of Respondents	Percentage
Rural	5	10
Urban	45	90
Total	50	100

Sources: Authors Compilation

Interpretation

In this table, hardware vendors like to setup hardware shops in rural areas is 10%, and where as in urban area is 90%. Because they think that establishing shops in urban area is more profitable compared to rural areas.

Table-7: Type of Discount Offered to Customers

Type of Discount	Respondents	Percentage
Trade Discount	16	32%
Cash Discount	12	24%
No Discount	22	44%
Total	50	100%

Sources: Authors Compilation

Interpretation

In the above table, 44% of the shopkeepers are not providing any discount, 32% are providing trade discounts and 24% are providing cash discounts. They are not providing discount to customer directly and they provide cash and trade discounts to large buyers or contractors.

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Table-8: Effect of Government Policies in Hardware Business

Particulars	Number of Respondents	Percentage
Yes	25	50
No	7	14
Proportionately	18	36
Total	50	100

Sources: Authors Compilation

Interpretation

From the above analysis, it is clear that, the influence of government policies is there 50%, not there 14% and proportionately there is 36% respectively. Government policies like rise in price of raw-material raise in excise duty, VAT etc.

Table-9: Mode of Advertisement

Type of Advertisement	Frequency	Percentage
Newspaper	25	50
Hoardings	13	26
Others	12	24
Total	50	100

Sources: Authors Compilation

Interpretation

From the above analysis it is clear that, advertisement through newspapers is 50%, hoardings is 26%, and others is 24%. Most of the stores like to give advertisement in newspaper because they assume it as cheaper compare to other mode of advertisement. Other mode of advertisement like pamphlets, sponsoring programmes etc.

Table-10: Showing Competition in the Business

Do You Have Competitors	Frequency	Percentage
Yes	43	86
No	7	14
Total	50	100

Sources: Authors Compilation

Interpretation

From the above analysis it is clear that, competitors in business is 86% and no competitors in business is of 14%. Therefore, competition is common in every field of business. If there is competition then only a business can grow. 14% of people say there is no competition because there is monopoly.

Table-11: Using Strategies Adopted for Big Contractors

Particulars	Frequency	Percentage
Yes	23	46
No	27	54
Total	50	100

Sources: Authors Compilation

Interpretation

From the above analysis it is clear that, the respondents use strategies to attract big contractors is 27 and for not implementing strategies is of 23. Strategies like giving discount to contractors etc.

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FINDINGS

From the Samples Collected

- Most of the hardware business / shops owned and managed by male.
- Government policies and regulation affects hardware business. Change in VAT, excise duty will influence hardware business, it also may lead to fluctuation in price, and they are not getting much benefit from the government.
- Hardware shop owners mainly gain profit from the material, which is required at the finished stage of construction like, interior decorators, paints, needles etc.
- We found that work pressure and risk is very high and high return.
- Maintaining stock is very difficult in hardware business, they prefer optimal level of stock.
- To succeed in hardware business they must go for training. We found in Rajasthan there are some training centers, which gives training in this hardware business.
- They gain more when they deal with big contractor.
- They restrict their transactions with government agencies or government tenders because of bribe.
- They provide value added service to customer in order to maintain good customer relationship.
- Hardware business requires huge capital.
- Majority of hardware shops go for advertising in newspaper, other modes used are pamphlets, sponsoring some events, and giving donations to fairs, festivals etc.
- From our survey, we found that most of the customers will purchase small products from nearby shops or from village shops and they will purchase bulk products from urban shops.

From the Customer Survey

- They purchase material from those shops, which they know very well about the stores.
- Customers find very difficult in the finishing stage of construction because required materials are costly at final stage.
- They would not get all the material in one store.
- Majority of the people give their house construction to the contract basis.

SUGGESTIONS

- Generally, there is a problem of seasonal demand in this business, to eliminate a problem they should sell the all season products required in hardware business.
- As the shop keepers now a days face tuff competition, they should compulsory provide value added services
- Many shopkeepers say giving credit facility is risky, so they should give credit facility to only regular customers and guaranteed customers.
- Risk in this business is very high; to reduce risk they should concentrate more on the availability of many products under one roof.
- To overcome from risk they can locate their shops in such area which growing and where no competitors are there.
- In order to retain customers, they should maintain good relationship with them by providing discounts, offers and other facilities.
- In order to find success in hardware business, before starting they should undergo training program.
- Pricing decisions can be made by considering quality and demand.
- If hardware shops focuses on modern and innovative design and materials they will get profit because even rural people prefer to have well designed house.
- There is a scope for opening up of training centers in Karnataka relating to hardware business.

CONCLUSION

This study is concerned to know about the "hardware business" at undivided Dakshina Kannada, Bellary and Bangalore. It is benefited to us as a student to learn several lessons relating to marketing strategies of hardware business.

As per our survey it is found, that hardware business has some limitation like requires huge capital, maintenance of stock, lag in payments. Apart from these limitations, hardware business is the profitable one and more opportunities available for new entrepreneurs, which help them to increase their standard of living. It is business, which required hard work, and one can earn more. Varieties of people are the customers of this hardware business irrespective of their income.

Hardware business will have good scope in this modern world. Because construction, interior decorations are most booming business of this era. Hardware business directly linked with industries. If hardware venders provide value added service, guarantee and warrantee etc., then there will be affective business.

Now-a-days at least in village usually find one hardware shop. Because there is high demand for this business but hardware, business is as difficult as software business, because in hardware business hard work is the essence of business. Finally, hardware is as important as software to develop particular country.

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A STUDY ON THE STATE OF FOOD PROCESSING UNITS IN CHITTOOR DISTRICT OF ANDHRA PRADESH

P. Sudhakara Rao[6] Sathish Babu Adipudi[7] Sripathi Kalvakolanu[8]

ABSTRACT

The essential requirements for human sustenance are air, water and food. Man has travelled distance destination in search of food and fodder. Human existence and survival depend on food and in fact, all living creatures require food for its survival. For a country like India with more than a billion populations, this food processing opens enormous opportunities. India is experiencing a great momentum in embracing the organic revolution. Though the Indian Organic Food industry is at its slow pace, the growth is significant in past few years. The Food processing industry is growing with a rapid rate and has a great-untapped potential to lead the economy to progress (Khan F M and Ahmad S, 2014). Not only being just another form of industry, but for India's development, food processing industry is very essential as it help to bridge the gap between two pillars of economy, namely industry and agriculture (Salman H and Bhargava P.K, 2016). Chittoor district in Andhra Pradesh is recognized for the presence of several agro-based units. Particularly the importance of various food-processing units is considerable. To understand the state of food processing units in Chittoor district and profile of various entrepreneurs who are running these units, a study is carried out. Chittoor district is a center for food processing units due to the availability of raw material abundantly. This paved the path for the development of food processing units in this area. An attempt has been made in this paper to discuss about the prospects and problems of these food-processing units.

KEYWORDS

Food Processing, Entrepreneurs, Entrepreneurial Motivation, Problems etc.

INTRODUCTION

Food Processing units occupy a significant position in the rural economy of Andhra Pradesh. This state is an agrarian state and vast majority of the population directly depends on agriculture. For a developing economy, both agriculture and industry are two wheels. When these two wheels are properly propelled then only it is said to be the development. Due to its soil, water availability, vegetables, and fruits are abundantly cultivated in and around Chittoor district. Farmers are not getting remunerative price and at the same time, cost of cultivation is growing without leaps and bounds. Most of the cultivators are unable to understand the opportunities available to them and due to their low income and education unable to grab the avenues available to them. Intermediaries have exploited this situation and neither the cultivator nor the customer is not benefitting. Only the middlemen are controlling the procurement costs and sometimes the farmers are not getting the input costs. Consequently, they are throwing their produce on the streets. Understanding this scenario some enthusiastic entrepreneurs has started their ventures in three forms such as individual units, small and medium units. Corporate units are also in vogue and slowly the entrepreneurial activity has been taken momentum.

Food processing industry is of great importance for India's development. They complement the agriculture production to reach the customers with varying needs. Food processing industries are very essential as they help bridge the gap between the two pillars of economy, namely industry and agriculture.

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Globally, India occupies 2nd position only next to China, in terms of overall food production. India's position is stable at the first slot in the global arena when it comes to production of milk. India also tops in producing fruits such as guavas, mangoes, papayas, and bananas. In producing other products like ginger, okra and buffalo meat also India occupies predominant position. In producing certain items such as green peas, potatoes, tea, tomato, and sesame, India stands at the 2nd position. Indian food processing sector is the first in terms of employment and tops in the number of factories being operated. Also, India ranks 3rd in terms of output.

India accounts to the production of nearly 450 million tons of raw food materials. These are from the plants and of animal origin. The raw forms of food are refined, stored and transformed into various usable products using conventional and modern postharvest and food processing technology. In food processing several activities are involved such as cleaning, grading, drying, storage, milling, packaging, transport, marketing and utilization.

In India, the post-harvest losses amount to nearly Rs. 76,000 Crores per annum, this is an indication of the bad stage through which the industry is passing. The basic purpose of food processing is aimed at preparing the food ready for consumption. Technically, any act involving conversion of raw ingredients into another consumable form is known as food processing. The simple process is that various vegetables and fruits will be converted for ready to use or eat. The food processing units does not require laborious manufacturing process. Simple processing is enough and the customer expects good storage life.

Highly processed foods are made from combinations of unprocessed food, minimally processed food and processed food ingredients. In recent times, health consciousness among the people has been growing and they are of the view that indiscriminate usage of pesticides is the cause of cancer and other dreaded diseases. Hence, they are giving utmost importance to organic fruits and vegetables or to the organic foods such Chips, Marmalades, Zellys, pickles and jams.

India is experiencing a great momentum in encouraging the organic revolution. Even though it is at its lowest ebb and slowing being ground gradually. The food processing basket consists of several verities and forms It covers fruits and vegetables, dairy, edible oils, meat and poultry, non-alcoholic beverages, grain-based products, marine products, sugar and sugar-based products, alcoholic beverages, pulses, aerated beverages, malted beverages, spices, and salt. Out of these segments, dairy (16%), grain-based Products (34%), bakery-based products (20%), and fish and meat products (14%) contribute to a major portion of industry revenues, apart from the manufacture of beverages.

LITERATURE REVIEW

Sriraman Parthasarathy, (2008) in his article "Indian Food Processing Industry – A Snapshot" stated that the India contributes to less than 1.5% of international food trade, indicating the scope of gains for the exporters as well as investors to tap fully from the Indian food processing industry.

FICCI (2010) in its report on "Bottlenecks in Indian Food Processing Industry" concluded that The Indian food industry presents a very huge opportunity to every stakeholder. FICCI survey initiated the first efforts in identifying the challenges. This also helped create a guideline framework to the interested parties and stakeholders to harness the potential of food processing industry.

Sitalakshmi S., (2010) in her article, "Towards Achieving a Second Green Revolution – The Role of radiation technology in food processing management" stated that there is an urgent need for developing economies like India to utilize the technological advances made by BRIT to revamp the food processing sector. Starting from deregulation of the sector to investing in Research and Development facilities, to providing post-harvest storage facilities and marketing infrastructure, to linking economic policies to investments in agricultural extension services, a lot of ground has been cleared for the successful implementation of radiation technology.

Sreenivasa Murthy, K., and Himachalam Dasaraju (2011) in their article "Problems of Fruit Processing Industry in Andhra Pradesh - A Case Study of Select Units in Chittoor" attempted to review the status of fruit processing industry and the problems encountered by the industry in Chittoor District of Andhra Pradesh. The Chittoor Fruit Processing Cluster (CFPC) is among the largest cluster of its kind in India. Factors such as lack of mutual trust,

intense inter-firm competition and a roller-coaster performance helped the cluster grow prior to the interventions in 1998.

Surendra P. Singh et. al., (2012) in their article "The Food Processing Industry in India: Challenges and Opportunities" revealed that while on one hand India's agricultural base is quite strong but very low processing of food products and very high amounts of wastage are witnessed.

Kakali Majumdar (2013) in his article "Export Performance of Processed Food in India" stated that the Indian food processing industry is primarily export oriented. With the export growth rate of around 15%, its share in the international market is only 1.7%. Again, only 2% of the total food produced in India is processed for further consumption. This is a matter of concern that despite massive potential, this sector remains grossly underutilized.

Khan, F. M., and Ahmad, S. (2014) in their article "Managerial issues for Green Marketing in Food Processing Industry of India" stated that the food processing industry is fast growing and has a tremendous potential to support the country's economy. Food processing units can also make use of the green marketing concept both in its domestic and global operations. Products, processes, packaging, delivery, and advertising areas of food processing can be brought under green marketing.

Sridhar Murthy T. M. and Yogesh M. S. (2014) in their article "An overview of Food Processing Industry in India- Challenges and Opportunities" opined positively about the vast opportunities Indian food industry offers to all the stakeholders. Consumer demand is the prime driver for the industry while other drivers include the changing nature of the Indian consumer, who is more informed and willing to try new products and the strong production base of the country.

Rajender Kumar et al (2016) in their article "Agro Processing Industries in Haryana: Status, Problems and Prospects" stated that the agro processing assumed vital importance particularly in a state like Haryana where agriculture production has reached on plateau. Its importance became more elevated when employment opportunities in rural areas are squeezed. This paper analyzed the growth of village level agro industries for different periods and prioritized the factors hindering agro industrialization in Haryana. It is evident from the results traditional processing of village oil ghani, and jaggery and khandsari not keeping pace with time whereas cereal and pulses processing industries and fruits preservation and processing gaining movement in recent period.

Salman Hyder and P. K. Bhargava (2016) in their article "Indian food processing industry - opportunities and challenges" stated that the significance of food processing industry is very high. Not only being just another form of industry, but for India's development, food processing industries are very essential as they help bridge the gap between two pillars of economy, namely industry and agriculture.

Rewa Singh and Ravindra Tripathi (2017) in their article "Food Processing Industries: An Engine for Growth in Uttar Pradesh" India is an agrarian economy where more than 70% of the population largely depends on agricultural and allied activities for its livelihood. Despite this, Indian farmers are in very poor socioeconomic condition. They are in low-income equilibrium trap.

Sannamelam Murali Mohan and Jayachandra K, (2018) in their article "Marketing Problems of Agro Based Industries in Andhra Pradesh: With Special Reference to Chittoor District" revealed that the agro based industries are seen as part of the sunrise sector of the Indian economy. They offer vast potential for growth. Besides, they also create employment thus ensuring socio-economic impact through income generation.

Chittoor district is recognized for the presence of several agro-based industries. Particularly the importance of various food-processing industries is considerable. They are playing significant role in contributing to the food processing business to the state as well as meeting the export requirements. In this context, a study on food processing industries in Chittoor district is taken up.

METHODOLOGY

The present study is aimed to understand the state of food processing units in Chittoor district. To understand the profile of various entrepreneurs who are running these units and the problems and prospects of these food-processing units, a well-structured questionnaire was developed. The questionnaire was administered to the entrepreneurs in this region who own different forms of food processing units. The questionnaire was revised after consultation with experts and after a simple pilot survey. Using simple random sampling method, the sample was chosen. The sample size is 230.

To get better understanding and interpret the results of the present study, secondary data from the records, articles and other documentary materials was collected from industry reports, newspapers, magazines, etc. and are included in the study.

Objectives of the study

The objectives of the study are:

- To study the profile of entrepreneurs of food processing units.
- To examine the factors of motivation in promotion of food processing units.
- To analyze the problems faced by the food processing units.

RESULTS AND DISCUSSION

Gender wise Distribution of Entrepreneurs

Table-1

	Frequency	Percent	Valid Percent	Cumulative Percent
Female	6	2.6	2.6	2.6
Male	224	97.4	97.4	100.0
Total	230	100.0	100.0	

Sources: Authors Compilation

The gender wise distribution of respondents is presented in table-1. The data shows that most of the entrepreneurs running food-processing units are male. Of the total respondents, 97.4 percent are male, while only 2.6 percent are female.

Educational Qualification of Entrepreneurs

Table-2

	Frequency	Percent	Valid Percent	Cumulative Percent
General	83	36.1	36.1	36.1
Technical	147	63.9	63.9	100.0
Total	230	100.0	100.0	

Sources: Authors Compilation

The distribution of respondents as per their educational qualification is presented in table-2. The data indicates that a majority of the entrepreneurs in food processing units are from a technical background amounting to 63.9 percent of the total respondents. The respondents with other general educational background were representing 36.1 percent of the total respondents.

Distribution of Respondents Based on Segment of Unit

Table-3

	Frequency	Percent	Valid Percent	Cumulative Percent
Bread & Bakery	23	10.0	10.0	10.0
Cereals Processing	6	2.6	2.6	12.6
Confectionary Consumer Products	23	10.0	10.0	22.6
Edible Oils	6	2.6	2.6	25.2
Fruits and Vegetable	37	16.1	16.1	41.3
Grain Processing	23	10.0	10.0	51.3
Meat, Poultry And Fishery	12	5.2	5.2	56.5
Milk And Milk Products	23	10.0	10.0	66.5
Mineral Water	17	7.4	7.4	73.9
Papad, Pickles, Chutany	11	4.8	4.8	78.7
Soft Drinks	35	15.2	15.2	93.9
Spices	14	6.1	6.1	100.0
Total	230	100.0	100.0	

Sources: Authors Compilation

Business Practice Experience of Entrepreneurs in Food Processing Units

Table-4

	Frequency	Percent	Valid Percent	Cumulative Percent
2 to 4 years	82	35.7	35.7	35.7
4 to 6 years	28	12.2	12.2	47.8
6 to 8 years	15	6.5	6.5	54.3
8 years	11	4.8	4.8	59.1
Up to 2 years	94	40.9	40.9	100
Total	230	100	100	

Sources: Authors Compilation

The data in table-4 presents that 40.9 percent of the respondents are having units with less than 2 years of business practice experience. 35.7 percent of respondents are having units with 2 to 4 years of business practice experience. While 4.8 percent of the respondents are having units with 8 years or above years of business practice experience others are in between the ranges.

Location of Food Processing Units

Table-5

	Frequency	Percent	Valid Percent	Cumulative Percent
Rural	80	34.8	34.8	34.8
Semi-urban	62	27.0	27.0	61.7
Urban	88	38.3	38.3	100.0
Total	230	100.0	100.0	

Sources: Authors Compilation

The data in table-5 indicates that 34.8 percent of units are present in rural areas and 27 percent of the units are located in semi-urban areas. The remaining 38.3 percent of units are located in urban areas.

Motivational Factors for Starting of Food Processing Unit

Table-6

	Frequency	Percent	Valid Percent	Cumulative Percent
Cooperative Society Managements	33	14.3	14.3	14.3
Family Business	64	27.8	27.8	42.2
Government Programmes	28	12.2	12.2	54.3
Self Help Groups	26	11.3	11.3	65.7
Self-motivation	79	34.3	34.3	100.0
Total	230	100.0	100.0	

Sources: Authors Compilation

The motivational factors that led to the starting of food processing units by the respondents are presented in Table 6. The data shows that 14.3 percent of the respondents cited cooperative society managements as the factor, while 27.8 percent of the respondents cited family business as the factor. It is observed that self-motivation is the factor that highest percent of respondents cited as motivation, representing 34.3 percent of the total respondents. On the other hand, 12.2 percent quoted government programmes and 11.3 percent quoted self-help groups as the factor of motivation for starting food-processing unit.

Mode through Which the Unit is Promoted

Table-7

	Frequency	Percent	Valid Percent	Cumulative Percent
Not Under Any Government Programme	119	51.7	51.7	51.7
P.M.R.Y.	58	25.2	25.2	77.0
S.H.G.	12	5.2	5.2	82.2
Swarnjayanti Gram Swarozgar Yojana	41	17.8	17.8	100.0
Total	230	100.0	100.0	

Sources: Authors Compilation

The government programme under which the respondents are operating business is presented in table 7. The data shows that 51.7 percent of the respondents' businesses are not under any government programme. 25.2 percent have indicated to be under the PMRY, 17.8 percent are under Swarnajayanti Gram Swarozgar Yojana, and 5.2 percent are under SHG.

Source of Business Finance

Table-8

	Frequency	Percent	Valid Percent	Cumulative Percent
Bank, Financial Institutions	96	41.7	41.7	41.7
Own Friends, Relatives	75	32.6	32.6	74.3
Private Finance.	49	21.3	21.3	95.7
Self Help Group	10	4.3	4.3	100.0
Total	230	100.0	100.0	

Sources: Authors Compilation

The source of business finance for the enterprises is presented in table 8. A majority of 41.7 percent of the enterprises received finance from banks and financial institutions. 32.6 percent of the enterprises have relied on own friends and relatives for the finance. 21.3 percent of the enterprises reported to have taken private finance. Another 4.3 percent of the enterprises have received finance from Self Help Groups.

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Completion of Training / Special Course for Food Processing Unit

Table-9

	N	**Percent**	**Percent of Cases**
Conferences Seminar Attended	47	14.8	20.43
Dic Training Completed	35	10.9	15.22
Food Processing Diploma Completed	148	46.1	64.35
No Training Obtained	91	28.3	39.57
Total	321	100	139.57

Sources: Authors Compilation

The data on whether any training/special course for food processing unit was completed is presented in table 9. The data reveals that 14.8 percent of respondents attended conferences/seminars, 10.9 percent respondents completed DIC training, 46.1 percent respondents completed diploma in food processing, whereas remaining 28.3 percent of respondents did not obtain any training.

Help from the Government Agencies in Obtaining Raw Materials

Table-10

	Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
May be	58	25.2	25.2	25.2
No	75	32.6	32.6	57.8
Yes	97	42.2	42.2	100.0
Total	230	100.0	100.0	

Sources: Authors Compilation

Data pertaining to whether any help is received from the government agencies in obtaining the raw materials is presented in table-10. The data shows that 32.6 percent of the respondents did not receive any help from government agencies in obtaining raw materials. 42.2 percent of the respondents received help from government agencies in obtaining raw materials. Whereas 25.2 percent of respondents could not say exactly whether they received help from government agencies in obtaining raw materials.

Technology Being Used in the Business Unit

Table 11

	Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Manual	48	20.9	20.9	20.9
Modern Technology & Machinery	89	38.7	38.7	59.6
Old Machinery and Techniques	28	12.2	12.2	71.7
Only Grading, Packaging and Distribution	20	8.7	8.7	80.4
Partially Using of Machinery	45	19.6	19.6	100.0
Total	230	100.0	100.0	

Sources: Authors Compilation

The technology being used in the business units under study is presented in table 11. The data shows that 20.9 percent of units under study are using manual methods. 38.7 percent of units are using modern technology and machinery. 12.2 percent of units are using old machinery and techniques. 8.7 percent of units are using technology for only grading, packaging, and distribution. 19.6 percent of units are using machinery partially only.

Marketing Problems Faced by the Food Processing Units

Table-12

	N	Percent	Percent of Cases
Channels	35	9.1	15.22
Competition	132	34.3	57.39
Improper Distribution	61	15.7	26.52
Inadequate Transport Facilities	62	16.1	26.96
Ineffective Salesmen	14	3.5	6.09
Lack of Storage Facilities	82	21.3	35.65
Total	386	100	167.83

Sources: Authors Compilation

The data about usual market problems faced by the unit is presented in table 12. The data shows that 9.1 percent of the units under study are facing channels related marketing problems. 34.3 percent of units are facing competition as a problem for marketing. 15.7 percent of units are facing marketing problems due to improper distribution. 16.1 percent of units are facing marketing problems due to inadequate transport facilities. 3.5 percent of the units are facing problems due to ineffective salesmen. Whereas, 21.3 percent of the units are facing marketing problems due to lack of storage facilities.

Food Safety Measures Adopted in Food Processing

Table-13

	N	Percent	Percent of Cases
Checking by Food Inspectors	55	17	23.91
Continuous Testing of Products at Laboratory	79	24.3	34.35
Internal Control	7	2.2	3.04
Obtained and Followed Standard Grade	23	7	10.00
Quality Manufacturing or Processing Practices	118	36.5	51.30
Strictly Followed Government Regulations	42	13	18.26
Total	324	100	140.87

Sources: Authors Compilation

The food safety measures adopted by the units under study for food processing are presented in table 13. Of the total units under study, 17 percent of the units are going through checking by food inspectors. 24.3 percent are using continuous testing of products at laboratory. While 2.2 percent units are using internal control, 7 percent have obtained and followed standard grade. 36.5 percent of units are using quality manufacturing or processing practices, whereas remaining 13 percent are strictly following government regulations.

Problems identified

- Marketing problems are more.
- Transportation is a problem.
- Availability of skilled manpower is low.
- Power problems are persistent.
- Government support is minimal.

CONCLUSION

The data analysis of the present study indicated that most of the entrepreneurs running food processing industries are male (97.4 percent). The entrepreneurs in food processing industries are from a technical background (63.9 percent).

40.9 percent of the entrepreneurs are having units with less than 2 years of business practice experience while 35.7 percent are having units with 2 to 4 years of business practice experience. While 27.8 percent of the entrepreneurs are motivated due to family business, 34.3 percent due to self-motivation and 12.2 percent due to government programmes. 46.1 percent of entrepreneurs completed diploma in food processing. 34.3 percent of units are facing competition as a problem for marketing. 21.3 percent of the units are facing marketing problems due to lack of storage facilities. 15.7 percent of units are facing marketing problems due to improper distribution whereas 16.1 percent of units are facing marketing problems due to inadequate transport facilities.

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SURVIVAL STRATEGY OF LOCAL ELECTRONIC REPAIR SHOPS:
A STUDY IN MANGALURU CITY

Poojari Nisha Gopal[9] Arjun Prakash[10] Shakin Raj[11]

ABSTRACT

Companies apply various strategies in order to compete with other. Some strategies help companies to earn huge profit, whereas others have to opt for some other strategies in order to survive. Similarly, due to advancement in the technology consumers are benefited with more economical and better quality electronic gadgets, due to which consumers prefer to buy new gadgets instead of getting it repaired if it is damaged. Now days the local repair shops of electronic gadgets are facing problem since there is no business for them. In addition, the showrooms of electronic gadgets render the after sale service which is one more threat to the local repair shops. Hence a study is made on how the local electronic repair shops are doing business and what are the challenges faced by them. For the study, 50 owners of the local electronic gadgets repairs shops from were chosen from Mangaluru to study the challenges faced by them and strategies applied by them in order to overcome from those challenges. From the study, it was clear that these shops are facing several problems and due to which the local repair shops have applied certain strategies such as collaborations, price reduction, etc.

KEYWORDS

Survival Strategies, Profits, Technology, Consumer, Electronic Gadgets, Collaborations etc.

INTRODUCTION

In almost every home, there are horde of appliances that practically remain in use throughout the day to provide us the comfort and easiness of life that we deserve. We are grateful to these appliances, which are necessity of every home. In addition, if we are grateful to such appliances then we must care for them too. The breakdown of electrical domestic devices is inevitable, as machines after long run tend to break down. At times, they break down early due to misuse or over use. The electrical appliances like mixer/ grinder, Geysers, water heater, fan; Iron, etc. are widely used in almost every household. The major manufacturers are Usha, Bajaj, Crompton, Onida, Videocon, LG etc. These electrical appliances do need periodic servicing, maintenance and repair actively. Though there are a number of authorized repair & servicing centers, provided by the authorized dealers network but still there is wide spread need of the repair & servicing centers to cater the need of repair and servicing activity for these appliances specially in semi urban and rural areas.

OBJECTIVES

- To analyse the current market trends in repair industry.
- To examine the factors limiting growth of local repair shops.
- To examine the various survival strategies applied by local repair shops.
- To know the various opportunities to increase the business.
- To analyse the competitive advantages and disadvantages of the repair shops.

NEED OF STUDY

Over the past decades, there has been an improvement in the science and technology due to which each day we can see new electronic gadgets take birth with unique features and due to these unique features people prefer it, thinking

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it is high technology goods and it may last long. In addition, due to these gadgets there is an effect on the repair business, since their growth is restricted by this. Hence, a study has to be made in order to study how the repair shops can still survive in the market with showroom standing in front of them as a tough competition.

METHODOLOGY

- **Primary Data:** For the primary data 50 respondents have been selected who are into the repair shop business in Mangaluru.
- **Secondary Data:** We have collected information from the secondary sources mainly to know the history, major companies in repair industry, etc.

LIMITATIONS

- The study has been conducted in Mangaluru and the survey is restricted to that place.
- Only a small sample is selected for the study.
- This research is time bound. The result of this study may not be applicable over period.
- Any advanced statistical tools were not applied while drawing conclusion and it depends on the respondent's views.

REPAIR SHOPS IN INDIA

Indian electronic industry dates back to early 1960. Electronic was one industry initially restricted to the development and maintenance of fundamental communication system including radiobroadcasting, telephonic and telegraphic communication. In 1980, due to the sweeping economic changes there was a growth in electronic industry. In addition, this gave a phase for the growth of repair industry in India.

MAJOR PLAYERS OF THE REPAIR SHOPS

Techmaster Electronics, ACS Industrial Services Industry, USA Industrial Control Repairs, Electronic Services Syma Technology Private Limited, Avalon Technology Private Limited, PSI Semicon Services Test Point Industry, Maxey Moverley, K+S Services, European Electronics, Audiolic Instruments, Autonum Controls, Electricity No Problem, Everest Point, Ken Flow, Micro Oven Clinic.

Problems Faced by the Repair Industry

The market segment of electronic equipment depends on the electronic products to which the services of repair are offered. A few of them includes consumer electronic repairs, computer, and office equipment repair. However, a major roadblock in the progress of repair industry is that due to constant innovation and technological advances, consumer is usually tempted to replace the gadgets with new one.

There is a huge competition among the start-ups in the line of business. The success ratio largely depends on the quality of work and technically skilled professionals with sound knowledge of production.

E-WASTE MANAGEMENT IN INDIA

The electronic industry is the world's largest and fastest growing manufacturing industry. The consequence of its consumer-oriented growth combined with rapid product obsolescence and technological advances are a new environmental challenge - the growing menace of "Electronics Waste" or "e waste" that consists of obsolete electronic devices. It is an emerging problem as well as a business opportunity of increasing significance, given the volumes of e-waste being generated and the content of both toxic and valuable materials in them.

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Effect on the Repair Shops

As this is one of the initiatives by the government, it would compel the entire e-waste generator to avoid the accumulation of the e-waste. Even the repair shops have certain amount of e-waste generated. There may be some waste parts of the electronic gadgets, which could not be used in any other gadgets for example burnt parts. In addition, this generates a huge waste.

DATA ANALYSIS AND INTERPRETATION

Table-1

Parameter	Respondents	
	In Numbers	**Percentage**
Gender		
Male	50	100
Female	0	0
Age		
<25	6	12
25-35	14	28
35-45	24	48
>45	6	12
Qualification		
Below SSLC	2	8
SSLC / Equivalent	3	12
PUC / Equivalent	6	24
Degree / Equivalent	14	56
Current Market Trend in Repair Industry.		
Increasing	22	44
Decreasing	4	8
Constant	8	16
Fluctuating	16	32
Views Regarding Whether High Tech Users Prefer Showroom Services.		
True	24	48
Partially True	8	16
False	10	20
Can't Say	8	16
Response Regarding Can Online Business Help to Improve the Business		
Favourable	10	20
Unfavourable	40	80
Effect of Showroom's After Sale Service on the Repair Industry.		
Majorly	6	12
Slightly	18	36
No Effect	26	52
Demand for the Repair Industry in Future Years as per Respondents.		
Increased	16	32
Decreased	14	28
Constant	12	24
No Demand	8	16
Strategies Applied by the Local Repair Shops to Increase the Business.		
Online Service	0	0
Reduction in Price	18	36

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Door to Door Service	28	56
Any Other	4	8
Main Barriers to the Local Repair Shops.		
High Tech Machines	2	4
Showrooms	14	28
Other Repair Shop	28	56
Online Service	6	12
Superiority of the Local Repair Shops Over the Showrooms.		
0-2.5	4	8
2.5-5	4	8
5-7.5	26	52
7.5-10	16	32
Whether the Local Repair Shop is a Profitable Undertaking or Not.		
Agree	44	88
Disagree	6	12
Views Regarding Collaboration with the Showrooms.		
Already Collaborated	0	0
No Need of Collaboration	50	100
Yet to Collaborate	0	0
Specialization in Which of the Gadget Gives More Profit.		
Household Gadget	44	88
High Tech Machinery	0	0
Industrial Gadgets	2	4
Office Equipment	4	8
Impact of Advertisement on the Customers.		
Majorly Impact	8	16
Slightly Impact	8	16
No Impact	34	68
Extra Services Provided by the Local Repairers in Order to Retain the Customers.		
Charge Less Price	18	36
Provide Exchange Offers	8	16
Installment Facilities	2	4
Door to Door Service	22	44
Convenient Place to Start a Repair Shops.		
Rural Market	2	4
Urban Market	26	52
Suburban	22	44
Reasons for Which Customers Prefer the Local Repair Shops.		
Convenient	32	64
Cost Effective	18	36
Credit Facilities	0	0
Number of Years of Operation of Local Repair Shops.		
0-2 Years	4	8
2-5 Years	6	12
5-10 Years	18	36
More Than 10 Years	22	44
Factors Restricting People from Opting Repair Shops as their Career.		
Insufficient Income	14	28
Lack of Scope	20	40
Seasonal Job	16	32
Ways Through Which Globalization has Affected the Local Repair Shops.		

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High Technology Goods	6	12
After Sale Service	26	52
Major Players in Repair Industry	0	0
Showrooms	18	36
Sources of Knowledge About the New Gadgets Repair.		
Online	18	36
Training	24	48
Workshops	6	12
Other Source	2	4
Segments in which there Are Less Number of Repair Shops.		
Household Gadgets	2	4
Office Gadgets	24	48
Factory Machinery	22	44
Restaurant Gadget	2	4
Views of Respondents Regarding Introduction of Innovative Electronic Gadgets.		
Opportunities	42	84
Threat	8	16
Whether There is Negative Impact of the High Tech Machineries on the Local Repair Shops or not.		
Strongly Agree	4	8
Agree	30	60
Disagree	14	28
Strongly Disagree	2	4

Sources: Primary Data

Table shows that they don't think online business can help them to increase their business, where only 20% of the respondents think that the strategy of online services would be favorable, whereas 80% think that it is not favorable.

Table interprets the strategies applied by the local repair shops in order to increase their business where it shows that 56% of them have opted for door to door services and 36% have gone for price reduction. But no one has gone for online business.

Table shows that 88% of the respondents think that the repairs shops are profitable undertaking whereas 12% disagree saying repair shops are not a profitable undertaking.

Table shows that all the respondent think that there is no need of collaboration with the showrooms.

Table shows that 88% of the respondents think that specialization in case of household gadgets is more profitable. And 8% of them think that specialization in office gadgets is more profitable and none of them think that specialization in the high tech machinery is beneficial.

Table shows that 52% of the respondent think that starting repair shops in the urban areas is convenient where as 44% of them think that setting up of repair shops in the suburban areas is convenient and small percentage (4%) think the rural areas are beneficial one.

Table shows the reason why people prefer local repair shops. 64% of the respondents think that customers find local repair shops more convenient while 36% of them think that since it is cost effective to get the electronic gadgets repaired by the local repairers, people prefer the local repair services.

Table shows the factors restricting people to opt this career option. Where 40% of them think that this career have lack of scope and 30% of them think that this business is seasonal in nature and 28% of them think that one of the factor is insufficient income.

Table shows that the respondent think (48%) repair shops for office gadgets is much required and 44% think that repair shops of factory machinery is required, on the other hand only 2% say that repair shops of the household and restaurant gadgets is required.

FINDINGS

- Most of the repairers have completed their diploma degree in electronics and communication.
- It has been observed that there is an increasing trend in repair business due to growth in electronic industries and increase in the users of electronic gadgets.
- It is regarded that majority of high tech users prefer showroom services.
- Local repairers don't consider online business as favourable for rendering their services.
- A majority of the local repairers have applied the strategy of door to door services to increase their services.
- The repairers consider other repair shops as a major competitor for their business.
- The local repairer considers that there is no need of collaboration with the showrooms.
- Specializations in the repair of the household gadgets are considered more profitable business.
- Local repairers consider that advertisement of their shops don't have any impact on their business because advertisement don't attract the customers.
- One of the reasons why the customers prefer the local repair shop is due to its convenience.
- The respondents have considered urban market is the best place to start up repair business.
- Due to the governments initiative of management of e-waste it has proved a burden on the local repair shops because there are restrictions on disposal of electronic waste.
- Some of the repairers get the knowledge about the repair of new gadgets through experience.
- The respondents think that there will be increase in demand for repair industry in the future because of the new government which has given more importance to this sector by encouraging start-ups in this sector.

SUGGESTIONS

- As it is observed that there has been increasing trend in repair industry it is better to continue the repair business since it may yield more profits in the future years.
- Since it is the view that majority of high tech machine users prefer showroom services the local repairers can give offers and discounts to the customers to attract the high tech users.
- Along with door to door services the local repairers can charge lesser price for regular customers so that they can maintain their market.
- As other local repairers are considered as major competitors each of the repairs shop can try to be unique either by charging lesser price or providing the services.
- Since advertisement don't have any impact on the repair business it is better for the repair shop not to advertise their shop.
- Even the suburban market can also prove out a convenient place to start repair business since now-a-days people living in suburban areas use more of electronic goods which would provide a better market.
- As there has been a rule set by government in case of disposal of the electronic waste, they can design a new product out of it and either sell it or gift it to the customers.
- Since the respondents think that the introduction of the innovative electronic gadgets provides an opportunity to them, they must update themselves regarding these innovative gadgets.
- Restaurant industry now a day is gaining momentum. And since there are only few numbers of repairers in this segment it would be suggested importance can be given to this sector also.

CONCLUSION

In order to survive in the market the repairers must keep updating themselves regarding the new gadgets and provide services in such a manner that customer prefer their services than others. They can even think of collaborating with the showrooms so that they don't lose the market all at once even though there is decline in demand for repair

services. They even think of tie ups with some of the electronic gadgets manufacturers in fixing the products where assembly line is followed. Through this way they can survive in the market.

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