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IMPROVED SINGLE TRUNCATED ACCEPTANCE SAMPLING PLANS FOR PRODUCT LIFE DISTRIBUTIONS

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ABSTRACT

In this study, improved acceptance sampling (reliability) plans are developed assuming the life time of a product follows Weibull, Rayleigh, Generalized Exponential and Marshall Olkin Generalized Exponential distribution and the life test is truncated at a prefixed time. This type of sampling plan is used to save the testing time in real life situations. The minimum sample size required for testing product quality to ascertain a true mean life is obtained under a given confidence level (P*), test termination ratios and acceptance numbers. The operating characteristic values and curves of the plan are examined with varying ratio of the true mean life to the specified life. The minimum mean life ratios are also obtained to minimize the producer's risk. Adoption of this sampling plan will result to better economic reliability product quality testing that will protect both the producers from rejecting semi-finished good lots from vendors for production and consumer from accepting bad lots of finished products. It will also guide the producer to improve his product's quality. For illustrative purpose, numerical examples were discussed.

Keywords: Acceptance sampling, Reliability, Producer's risk, Consumer's risk, Quality control.

INTRODUCTION

The purpose of acceptance sampling is as follows: Suppose a company receives a delivery of product from a merchant. This product is always a component or raw material used in the company's manufacturing process. A sample is taken from the lot and the relevant quality characteristic of the units in the sample is inspected. Base on the information in this sample, a decision is made regarding lot outlook. Usually, when the life test indicates that the mean life (μ) of products exceeds the specified (μ_o) one, the lot of products is accepted, otherwise it is rejected. Accepted lots are put into production, while rejected lots may be returned to the merchant or may be subjected to some other lot disposition action. While it is usual to think of acceptance sampling as a receiving inspection activity, there are also other uses. Frequently, a manufacturer samples and inspects its own product at various stages of production. Lots that are accepted are sent forward for further processing, while rejected lots may be reworked or scrapped. For the purpose of reducing the test time and cost, a truncated life test may be conducted to determine the smallest sample size to ensure a certain mean life of products when the life test is terminated at a pre-assigned time t and the number of failures observed does not exceed a given acceptance number c.

Acceptance sampling is concerned with inspection and decision making regarding lots of product and constitutes one of the oldest techniques in quality assurance. Sampling plans is used to determine the acceptability of lots of items (Priyah and Ramaswamy, 2015). Life test refers to measurements of product life; product life can be measured in hours, miles, cycles or any other metric that applies to the period of successful operation of a particular product. Since time is a common measure of life, life data points are often called ***times-to-failure.*** There are different types of life products. Statistical distributions have been assumed by various authors (statisticians, mathematicians and engineers) to mathematically model or represent certain behaviour of products. The probability density function (pdf) and cumulative distribution function (cdf) are mathematical functions that explain the distribution of life of an item.

Epstein (1954) and Sobel and Tischendrof (1959) were first to discussed Acceptance sampling based on truncated life tests for an exponential model. An extension of their work was carried out by Goode and Kao (1961) by considering the Weibull model which includes the exponential distribution. Gupta and Groll (1961) and Gupta (1962) also considered the gamma and log-normal distributions respectively. Recently cited in Balakrishnan *et al* (2007) discussed Acceptance Sampling Based on the Inverse Rayleigh Distribution, Muhammad *et al* (2010) discussed Time Truncated Acceptance Sampling Plans for Generalized Exponential Distribution, Sudamani and Jayasri (2012) discussed Time Truncated Chain Sampling Plans for Generalized Exponential Distribution, Sudamani and Priyah (2012) discussed Acceptance Sampling Plan for Truncated Life Tests at Maximum Allowable Percent Defective. Lastly, Sudamani and Jayasri (2013) Time Truncated Chain Sampling Plans for Marshall-Olkin Extended Exponential Distributions have all developed acceptance sampling plans for a various distributions.

Operating Procedure of Single Acceptance Sampling Plan for Truncated Life Tests

i. A random sample is selected and put on the tests.
ii. An experimenter runs this test for a pre-decided experiment time t.

iii. An acceptance number (c) is fixed for the experiment and the test is then truncated if more than c defectives (d) are recorded before the end of the experimental time t, otherwise accept the lot (i.e if $c \leq d$).

This study is aimed at developing an improved minimum sample size needed to be selected and put to test, thereby leading to reduced sample size that will protect both the producers and consumer's risk (i.e, save testing time and cost), determine the Operating Characteristics (OC) values under these plans and distributions and obtain the mean life ratio values that will guide the producer.

Definition of Terms

Notation	**Definition**	**Notation**	**Definition**
t	Termination time/Maximum test duration	$\frac{t}{\mu_0}$	Test termination ratio
P	Failure probability	α	Producer's risk
P^*	Confidence level	β	Consumer's risk,
μ	True Mean life	N	Sample size
μ_0	Specified Mean life	C	Acceptance number
Pa	Probability of Acceptance	D	Number of defectives

Studied Distributions

The Cumulative Distribution Function (CDF) gives the probability that a unit (item) will fail before time *t* or alternatively the proportion of units in the population that will fail before time *t*. Various distributions have been formulated by statisticians, mathematicians and engineers to mathematically model or represent certain behavior. Some distributions tend to better represent life data and are usually called *lifetime distributions*. Some of the most commonly used product life distributions in real life situation and their properties are shown in the table below:

S/No.	Distribution	Peculiarity	Proposed by	PDF (f) and CDF (F)
1	Weibill	i. It provides reasonably accurate failure analysis and failure forecast with extremely small samples. ii. It provides a simple and useful graphical plot of failure data. The distribution is extremely important and widely used in engineering, e.g machine parts, ball bearings, tools, e.t.c	Waloddi Weibull (1939)	$f(\alpha,\mu,x) = \frac{\mu}{\alpha}\left(\frac{x}{\alpha}\right)^{\mu-1} \exp\left[-\left(\frac{x}{\alpha}\right)^{\mu}\right]$ $F(t,\mu) = 1 - e^{-(\frac{t}{\mu_0})^{\alpha}}$
2.	Rayleigh	i. It is appropriate for components which might not have manufacturing defects but age rapidly with time. ii. It is widely applied engineering and communication technology, e.g CD ROM, Hard Drives, Compact Discs, e.t.c iii. It is also widely used in modelling of electronic components. For example, electric bulb manufacturing industries.	Rayleigh (1880)	$f(t,\mu) = 2\mu t e^{-\mu t^2}$ $F(t,\mu) = 1 - e^{-\frac{1}{2}(\frac{t}{\mu_0})^{\alpha}}$
3.	Generalized Exponential	i. This distribution can be used quite effectively to analyze lifetime items in place of gamma, Weibull and log-normal distributions. ii. It is also widely used in software manufacturing industries. iii. It is also used in automobile manufacturing industries and assembling industries for testing parts like brakes, tires, gears e.t.c	Mudholkar and Srivastava (1993)	$f(x;\alpha,\mu) = \frac{\alpha}{\mu} e^{\frac{-x}{\mu}} (1 - e^{\frac{-x}{\mu}})^{\alpha-1}$ $F(x;\alpha,\mu) = (1 - e^{-\frac{t}{\mu_0}})^{\alpha}$
4.	Marshall Olkin's Generalized Exponential	Same as 3 above	Li and Pellerey (2011)	$f(t,v,\mu) = \frac{ve^{-t/\mu}}{\mu(1-\bar{v}e^{-t/\mu})^2}$ $F(t,v,\mu_o) = \frac{1-e^{-1.3863\frac{t}{\mu_o}}}{1-\bar{v}e^{-1.3863\frac{t}{\mu_o}}}$

where μ_o is the scale parameter (quality parameter or characteristics parameter) and α is the shape parameter.

MATERIALS AND METHODS

Development of Improved Minimum Sample Size (n)

Suppose we fix the probability of accepting a bad lot (consumer's risk), that is, the one for which the true mean life μ is below the specified mean life say μ_0, not to exceed $1 - p^*$, Balakrishnan, et al, (2007), assuming the lot size (N) is large enough to be considered infinite, the binomial distribution can be used.

Thus, the acceptance and non acceptance criteria for the lot are equivalent to the decisions of accepting or rejecting the hypothesis: $H_o = \mu \geq \mu_0$ Versus $H_1 = \mu < \mu_0$.We want to find the minimum sample size (n) such that:

$$\sum_{i=0}^{c}\binom{n}{i}p^i (1-p)^{n-i} \leq 1 - p^* \qquad \textbf{(1)}$$

where $p = F(t,\mu)$ is monotonically increasing on $\frac{t}{\mu_0}$ and decreasing on μ, for fixed t, which is easy to establish for any distribution. Thus, $p = F(t,\mu)$ depends only on the ratio $\frac{t}{\mu_0}$. Hence, it is always sufficient to specify this ratio. According to Bhupendra *et al* (2013) and Gupta (1962), when p is very small, and n is large, then binomial distribution is approximated to Poisson distribution with $\mu = \lambda = np$. Therefore, (1) can be rewritten as:

$$\sum_{i=0}^{c} \frac{e^{-\lambda}\lambda^i}{i!} \leq 1 - p^* \qquad \textbf{(2)}$$

where $\lambda = np = nF(t;\ \mu)$.

Suppose $\sum_{i=0}^{c} \frac{e^{-\lambda}\lambda^i}{i!} = 1 - G_{c+1}(\lambda, 1)$

If $G_k(x,\mu)$ denotes the cumulative distribution function of a gamma distribution with the scale and shape parameters as k and μ respectively, i.e.

$$G_k(x,\mu) = \frac{\mu^k}{\Gamma(k)} \int_0^x t^k e^{-\mu t} dt \qquad \textbf{(3)}$$

Therefore, Gupta (1962) stated that if $\gamma_{c+1,}p^*$ denotes the p^* percentage point of a standardized gamma variable with the shape parameter $c+1$, then

$$n \approx \left[\frac{\gamma_{c+1,p^*}}{1-(1-q)^{\lambda}}\right] + 1 \qquad \textbf{(4)}$$

Where q = specified probability of failure, γ_{c+1,p^*} is the P^* percentage point at a standardized gamma variable with shape parameter $r = c + 1$ or one-half time the P^*percentage of a χ^2 with $2c + 2$ degree of freedom.

This approximation was discussed and modified by Muhammad *et al* (2012) as shown below.

$$n \approx \left[\frac{\chi^2{}_{2c+2,P^*}}{2(1-P)}\right] + 1 \qquad \textbf{(5)}$$

Where P = Acceptance Probability (assuming either Binomial or Poisson distribution) using trial and error method.

Now using the relationship between the gamma and χ^2 random variables, we modified the minimum sample size formula as:

$$\boldsymbol{n \approx \left[\frac{\chi^2{}_{2c+2,\,P^*}}{2F(t;\mu)}\right] + 1} \qquad \textbf{(6)}$$

Where $F(t;\ \mu)$ is the failure probability or cumulative distribution function (cdf) of the assumed distribution. $\chi^2{}_{2c+1,\ P^*}$ denotes the P^* percentage point of a χ^2 variable with $2c + 2$ degree of freedom.

Our main target is that ***n*** should have smaller values in order to have a better plan that will reduce the required sample size needed to be selected from the lot for inspection and will lead to reduced cost of inspection and also protect the producer's confidence.

To do this, we try to shrink the approximate value of ***n*** by introducing a new parameter ***b***, where ***b* is non-negative** (i.e $\boldsymbol{[1.5, 2.5]\, is\, \mathbb{R}}$**)** and ***b*** is known as ***shrinking value***.

Since the cumulative distribution function (cdf) is an integral function of the probability density function (pdf).

That is $F(t) = \int f(t)dt$ **(7)**

Multiplying this ***shrinking value*** with F(t),

$$\boldsymbol{b}F(t) = \boldsymbol{b} \int f(t)dt \qquad \textbf{(8)}$$

$$= \boldsymbol{b}F(t,u) \qquad \textbf{(9)}$$

We next replace F(t,μ) in (8) with bF(t, μ). Then, (6) becomes:

$$\boldsymbol{n} \approx \left[\frac{\chi^2{}_{2c+2,\,P^*}}{2\mathbf{b}F(t;\mu)}\right] + \mathbf{1} \qquad \textbf{(10)}$$

Therefore, equation (10) is the approximate of the modified sample size $\boldsymbol{n}$.

In order to ensure accuracy in our computation, a recent statistical software (R) is used to obtain the chi-square values.

Operating Characteristics

An acceptance sampling plan is best described in graphical terms on an operating characteristic curve (OC curve). An OC curve is a plot of the actual number of nonconforming units in a lot (expressed as a percentage) against the probability that the lot will be accepted when sampled according to the plan. The shape of an OC curve is determined primarily by sample size, n, and acceptance number, c, although there is a small effect of lot size, N. The OC function of the sampling plan $(n, c, \frac{t}{\mu_0})$ is the probability of accepting a lot and is given by

$$\boldsymbol{L(P)} = \sum_{i=0}^{c}\binom{n}{i}\boldsymbol{p^i}\,(\mathbf{1}-\boldsymbol{p})^{\boldsymbol{n-1}} \qquad \textbf{(11)}$$

Where $p = F(t, \mu)$ is considered as a function of μ, i.e., the lot quality parameter

Mean Life Ratio Value

In order to calculate the minimum required ratio values, the producer's risk is been considered. The producer's risk is the probability of rejection of the lot when $\mu \geq \mu_0$, it can be computed as follows;

$Pr(R)$ = P(Rejecting a lot) $= 1 - P(Acceting\ the\ Lot/\mu \geq \mu_0)$

$$= \sum_{i=c+1}^{n}\binom{n}{i}p^i\,(1-p)^{n-1} \qquad \textbf{(12)}$$

For the given sampling plan and for a given value of the producer's risk, say γ, one may be interested in knowing the minimum value of $\frac{\mu}{\mu_0}$, that will ensure the producer's risk to be at most γ. The $\frac{\mu}{\mu_0}$, is the smallest quantity for which P satisfies the inequality:

RESULTS AND ANALYSIS

Assuming that the lifetime of the testing items follow the underlined plans and distribution with known shape parameter, the numerical values that will serve as guide to the tester is presented in the appendix in tables 1 to 12. Table 1 to 4 provides the minimum sample size needed to be selected and put to test if the true mean life (μ) is to exceed assumed mean life (μ_0) of an item at a specified value with consumer's confidence level P* and corresponding acceptance number c.

Table 5 to 8 presents the Operating Characteristics (OC) values for different combinations of the values of probability P*, mean life ratio (μ/μ_0) and testing time ratio (t/μ_o) for c = 2. The values of the probability of acceptance for the sampling plan corresponding to the underlined distributions have also been computed for varying values of P*, (t/μ_0), and (μ/μ_0). Figures 1, 3, 5 and 7 are OC plots of probability of acceptance (Pa) against mean ratio (μ/μ_0) for (fixed t/μ_0 = 0.942 and varying P*=0.75, 0.90, 0.95, 0.99) and for (fixed P*=0.90 and varying t/μ_0 = 0.68, 0.942, 1.257, 1.571, 2.358, 3.141 and 3.972) respectively. Figure 2, 4, 6 and 8 depicts the OC curves for varying mean ratio (μ/μ_0) and with fixed P*=0.90 and $\frac{t}{\mu_o}$ =

0.942 corresponding to distributions Figure 9 depicts the OC cure comparing the performance of the studied underlined distributions.

In order to compare our results with existing researches, we used existing combined values to simulate our results using ***R*** Software and the results and graphs are shown in the appendix.

Sensitivity Analysis

In statistical quality control, Operating Characteristic (OC) Curves plays an important role in determining the probability of accepting manufactured lots when using different sampling plans. It shows the relationship between a designed parameter and lot acceptance when we conduct a lifetime experiment. The OC curves helps in the selection of acceptance sampling plans and also help in reducing risks. The different behavior of OC values and combined parameters are presented in figure 1 to 9. Thus, after analyzing the trends of the results given in Tables 1-9, one can make the trade-off between the required minimum sample size, confidence level, acceptance number and experimental time ratio to achieve the best sampling plan.

Real Life Example

The data used in this study were collected from the Quality Assurance and Assembly Plant of Machine and Tool department, Udofe Metal Industries, KM 3, Igarra, Okpe Road, Edo State, Nigeria. The data are the approximate number of revolutions (millions) of Oil Palm Milling Machine Ball-Bearings before failure. The data as retrieved from the record file of the Quality Assurance Department of the Industry are: 28.44, 28.16, 29.22, 32.56, 30.83, 27.44, 26.64, 34.88, 29.02, 30.42, 29.61, 30.02, 28.94, 31.94, 30.04, 29.79, 27.20, 33.54, 31.45 and 29.23.

Suppose a manufacturer want to develop a Sampling Plan and know whether the life of his products(ball bearing) are above the specified mean life revolution of 30 million revolutions per hour with confidence of P*=0.90 and the life test would be ended at 25 million revolutions, which should have led to the ratio $\frac{t}{\mu_o} = 0.83$. Consider that the lifetime of products follows a Weibull distribution. Thus, for an acceptance number C=2, the designed parameters of the Sampling Plan are $\left(n, C, \frac{t}{\mu_o}\right) = 4, 2 \; and \; 0.83$ for P*=0.90. That is from table 1, the manufacturer needs to select a sample of 4 products and put on test, the lot is rejected if more than 2 failures occur during 25 million revolution test per hour, otherwise accept it.

For Rayleigh, Generalized Exponential and Marshall Olkin's Generalized Exponential distribution, the minimum required sample sizes needed to be selected and be put to test is 6, 6 and 4 from table 2, 3 and 4 respectively.

Based on the ball bearings testing, the lot should be accepted only if the number of items of which lifetimes were less than or equal to the scheduled test lifetime (25 million revolutions) was at most 2 among the first 4, 6, 6 and 4 observations for the four underlined distributions.

The OC values for the acceptance sampling plan $\left(n, C, \frac{t}{\mu_o}\right) = 4, 2 \ and \ 0.83$ for P*=0.83 under Weibull distribution with $\frac{\mu}{\mu_0} = 2$ from Table 5 is as follows.

$\frac{\mu}{\mu_0}$	**2**	**4**	**6**	**8**	**10**	**12**
0.628	0.658	0.975	0.997	0.999	1.000	1.000

It can deduce from the above table that if the true mean life is twice the required mean life ($\frac{\mu}{\mu_0} = 2$), the producer's risk is approximately 1-0.658=0.342.

From table 9, the experimenter can get the values of mean life ratio for different choices of c and $\frac{t}{\mu_o}$ in order to assert that the producer's risk was less than 0.05. In this example, the mean life ratio value of his product should be 3.049 for c = 2, $\frac{t}{\mu_0} = 0.942$ and $P*$ =0.90. This means the product can have a mean life of 3.049 times the required mean lifetime in order that under the above acceptance sampling plan the product is accepted with probability of at least 0.90.

DISCUSSION OF RESULTS

Interpretation of required sample size

Refer to table 1to 4 in the appendix, the following can be deduced:

i. The minimum sample size for lower acceptance sampling number need to be very low as compare to a higher acceptance number for any combination of confidence level (P^*) and experiment time ratio ($\frac{t}{\mu_0}$).
ii. As we fixed the confidence level and acceptance number, as we try to increase experiment time ratio, the minimum sample size required to reach the decision tend to low.
iii. As we fixed the acceptance number and varying experiment time ratio, the minimum sample size required to reach a decision tend to increase as we increase the confidence level.

Probability of Acceptance (Pa)

Refer to table 5 to 8 in the appendix, the probability of acceptance (Pa) were obtained for different combination of the values of probability P*, mean ratio $\frac{\mu}{\mu_0}$ and experiment time ratio $\frac{t}{\mu_0}$ and c =2. Refer to table 5to 8, the following can be deduced:

Interpretation of the behaviour of Operating Characteristics (OC)

i. On fixing the experiment time ratio and varying mean ratio, the probability of acceptance is decreasing with an increase in the confidence level. We also observed the same trend in respect of experiment time ratio for a fixed confidence level.
ii. On fixing the confidence level and experiment time ratio, the probability of acceptance increases as we also increase the mean ratio.

Interpretation for the minimum required mean ratio at fixed producer's risk

Refer to table 9 to 12 in the appendix, the following can be deduced:

i. It was observed that the minimum mean ratios required for smaller acceptance number in order that the lot will be accepted with the probability $(1-\alpha)$ are very high as compared to higher acceptance number for any combination of confidence level and experiment time ratio.

ii. On fixing the acceptance number, the required minimum means ratio increases as we increase the confidence level.

Interpretation of Operating Characteristics (OC) Curves

i. From figure 9, when we compare the OC curve of the four underlined product life distributions, it is observed that for any fixed value of consumer's confidence level and experiment time ratio, the OC values of Weibill and Rayleigh life distribution were higher compare to Generalized Exponential and Marshal Olkin's Generalized lifetime distributions.

ii. This implies that for Weibill and Rayleigh life distribution, the probabilities of acceptance of lot are higher as compared to Generalized Exponential and Marshal Olkin's Generalized lifetime distributions. This may happen due to the incorporation of the past parametric fluctuations with the experimental data.

CONCLUSIONS

In this study, time truncated acceptance sampling plan for the Weibull, Rayleigh, Generalized Exponential and Marshal Olkin's generalized exponential product life distribution was carried out. It is assumed that the shape parameter is known and we have presented the results in tables for the developed and improved minimum sample size required to guarantee a certain mean life of the test units. On comparing our generated minimum sample size number needed to be selected and put to test with those obtained by Muhammed et al. (2012) on Generalized Exponential Distribution and Srinvasa (2012) on Marshal Olkin's Generalized Exponential, our plan resulted to smaller sample sizes which will save both testing cost and time. We have also presented the operating characteristic function values and mean life ratio values. We have provided an example to illustrate the tables.

Finally, it should be noted that our results can be used for other product life distributions that belongs to the families of the underlined studied distributions. Therefore, our tables can be used to develop the acceptance sampling plan for these product life distributions that will reduce testing cost, protect the producer and consumer and guide the producer in improving his product life.

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APPENDIX

Table 1: Developed minimum sample size for Weibull distribution with probability P*=0.75, 0.90, 0.95, 0.99 and the corresponding acceptance number c when the shape parameter α = 2.

		$\frac{t}{\mu_0}$							
(P*)	***c***	**0.628**	**0.942**	**1.257**	**1.571**	**2.356**	**3.141**	**3.972**	**4.713**
0.75	**0**	2	2	2	2	2	2	1	1
	1	3	3	3	2	2	2	2	2
	2	4	4	3	3	3	3	3	2
	3	5	5	4	4	3	3	3	3
	4	6	6	4	4	4	4	4	4
	5	7	7	5	5	4	4	4	4
	6	8	8	5	5	5	5	5	5
	7	8	8	6	6	5	5	5	5
	8	9	9	7	7	6	6	6	6
	9	10	10	7	7	6	6	6	6
	10	11	11	8	8	7	7	7	7
0.90	**0**	2	2	2	2	2	2	2	1
	1	3	3	3	3	2	2	3	3
	2	4	4	3	3	3	3	3	3
	3	5	5	5	4	4	4	4	4
	4	6	6	5	4	4	4	4	4
	5	7	7	5	5	4	4	4	4
	6	8	8	5	5	5	5	5	5
	7	8	8	6	6	5	5	5	5
	8	9	9	8	7	6	6	6	6
	9	11	10	9	7	6	6	6	6
	10	11	11	9	8	7	6	6	6
0.95	**0**	3	3	3	3	3	3	2	2
	1	5	5	5	5	4	4	4	3
	2	5	5	5	5	5	5	4	4
	3	7	7	6	6	6	6	6	4
	4	7	7	7	6	6	6	6	4
	5	7	7	7	7	6	6	6	5
	6	7	7	7	7	6	6	6	6
	7	8	8	8	7	6	6	6	6
	8	8	8	8	7	7	7	7	7
	9	9	8	8	7	7	7	7	7
	10	9	8	8	8	8	7	7	8
0.99	**0**	c	4	4	3	3	3	3	2
	1	4	4	4	4	4	3	3	3
	2	5	5	5	5	4	4	3	3
	3	5	5	4	4	4	4	4	4
	4	6	6	4	4	4	4	4	4
	5	7	7	5	5	5	5	5	5
	6	8	8	5	5	5	5	5	5
	7	8	8	6	6	5	5	5	5
	8	9	9	7	7	6	6	6	6
	9	10	10	7	7	6	6	6	6
	10	11	11	8	8	6	6	7	7

Table 2: Developed minimum sample size for Rayleigh distribution with probability P*=0.75, 0.90, 0.95, 0.99and the corresponding acceptance number c when the shape parameter α = 2.

		$\frac{t}{\mu_0}$							
(P*)	***c***	**0.628**	**0.942**	**1.257**	**1.571**	**2.356**	**3.141**	**3.972**	**4.713**
0.75	**0**	3	3	3	3	2	2	2	2
	1	4	5	4	4	3	3	3	3
	2	5	5	5	5	4	4	4	3
	3	6	6	6	6	5	5	5	5
	4	6	8	7	7	5	4	5	5
	5	7	7	7	7	6	6	6	6
	6	8	8	8	8	6	6	6	6
	7	8	8	9	9	7	7	7	7
	8	9	9	9	9	8	6	7	7
	9	10	9	9	9	8	8	8	8
	10	11	10	10	10	9	9	8	8
0.90	**0**	4	3	3	3	3	2	2	2
	1	5	5	4	4	3	3	3	3
	2	7	6	4	4	4	4	4	3
	3	7	7	6	6	6	5	5	5
	4	7	7	7	7	5	5	5	5
	5	8	8	7	7	6	6	6	6
	6	8	8	7	7	6	6	6	6
	7	8	8	8	8	7	7	7	7
	8	9	9	9	8	8	8	7	7
	9	11	11	10	10	8	6	8	8
	10	12	12	12	12	9	9	8	8
0.95	**0**	5	5	5	4	4	4	3	3
	1	5	5	5	4	3	3	3	3
	2	5	5	5	5	4	4	4	4
	3	5	5	5	5	5	5	5	5
	4	6	6	6	6	5	5	5	5
	5	8	8	7	7	6	6	6	6
	6	8	8	8	8	6	5	6	6
	7	8	8	9	9	7	7	7	7
	8	10	10	10	10	8	8	7	7
	9	11	11	11	11	8	8	8	8
	10	12	12	12	12	9	9	8	8
0.99	**0**	5	5	5	5	4	4	3	3
	1	5	5	4	4	3	3	3	3
	2	6	6	5	5	4	4	4	4
	3	6	6	6	6	5	3	5	5
	4	7	7	7	7	5	5	5	5
	5	7	7	7	7	6	6	6	6
	6	8	8	8	8	6	6	6	6
	7	10	9	9	9	8	7	7	7
	8	11	11	10	10	8	8	7	7
	9	12	12	11	11	8	8	8	8
	10	12	12	12	12	9	9	8	8

Table 3: Developed minimum sample size for Generalized Exponential distribution with probability P*=0.75, 0.90, 0.95, 0.99 and the corresponding acceptance number c when the shape parameter α= 2.

		$\frac{t}{\mu_0}$							
(P*)	***c***	**0.628**	**0.942**	**1.257**	**1.571**	**2.356**	**3.141**	**3.972**	**4.713**
0.75	**0**	3	3	3	3	2	2	2	2
	1	4	4	4	4	3	3	3	3
	2	6	6	5	5	4	4	4	4
	3	7	7	5	5	5	5	5	5
	4	8	8	6	6	5	5	6	6
	5	10	10	7	7	6	6	6	6
	6	11	11	8	8	7	7	7	7
	7	12	12	9	9	7	7	7	7
	8	13	13	10	10	8	8	8	8
	9	15	15	11	11	9	9	8	8
	10	16	16	11	11	9	9	9	9
0.90	**0**	3	3	3	3	3	2	2	2
	1	4	4	3	4	3	3	3	3
	2	7	6	4	4	4	4	4	4
	3	7	7	5	5	5	5	5	5
	4	8	8	5	6	5	5	6	6
	5	10	10	6	7	6	6	6	6
	6	11	11	7	8	7	7	7	7
	7	12	12	8	9	7	7	7	7
	8	13	13	9	10	8	8	8	8
	9	15	15	10	11	9	9	8	8
	10	16	16	11	11	9	9	9	9
0.95	**0**	3	3	11	3	3	3	3	3
	1	4	4	4	4	3	3	3	3
	2	6	6	4	4	4	4	4	4
	3	7	7	5	5	5	5	5	5
	4	8	8	6	6	5	5	6	6
	5	10	10	7	7	6	6	6	6
	6	11	11	8	8	7	7	7	7
	7	12	12	9	9	7	7	7	7
	8	13	13	10	10	8	8	8	8
	9	15	15	11	11	9	9	8	8
	10	16	16	11	11	9	9	9	9
0.99	**0**	3	3	3	3	3	3	2	2
	1	4	4	4	4	4	4	4	4
	2	6	6	5	5	4	4	4	4
	3	7	7	5	5	5	5	5	5
	4	9	8	6	6	5	5	5	5
	5	10	10	7	7	6	6	6	6
	6	11	11	8	8	7	7	7	7
	7	12	12	9	9	7	7	7	7
	8	13	13	10	10	8	8	8	8
	9	15	15	11	11	9	9	8	8
	10	16	16	11	11	9	9	9	9

Table 4: Developed minimum sample size for Marshall-Olkins Extended Exponential distribution with probability P*=0.75, 0.90, 0.95, 0.99and acceptance number c with indexed parameter $v = 2$.

		$\frac{t}{\mu_0}$							
(P*)	***c***	**0.628**	**0.942**	**1.257**	**1.571**	**2.356**	**3.141**	**3.972**	**4.713**
0.75	**0**	2	2	2	2	2	2	2	1
	1	3	3	3	3	3	2	2	2
	2	4	4	4	4	4	3	3	3
	3	5	5	5	5	5	5	5	5
	4	6	6	6	6	5	5	5	5
	5	7	7	6	6	6	6	6	6
	6	8	8	7	7	7	7	6	5
	7	9	9	8	8	7	7	7	7
	8	10	10	8	8	7	7	8	8
	9	11	11	9	9	8	8	8	8
	10	12	12	10	10	9	9	9	9
0.90	**0**	2	2	2	2	2	2	2	2
	1	3	3	3	3	3	3	2	2
	2	4	4	4	4	4	4	3	3
	3	5	5	4	5	5	5	4	4
	4	6	6	6	6	5	5	5	5
	5	7	7	6	6	6	6	6	6
	6	8	8	7	7	6	6	6	6
	7	9	9	7	8	7	7	7	7
	8	10	10	8	8	7	7	7	7
	9	11	11	8	9	8	8	8	8
	10	12	12	9	10	9	9	9	9
0.95	**0**	2	2	2	2	2	2	1	1
	1	3	3	2	3	3	3	4	4
	2	4	4	4	4	4	4	4	3
	3	5	5	5	5	4	4	4	4
	4	6	6	6	6	5	5	5	5
	5	7	7	6	6	6	6	6	6
	6	8	8	7	7	6	6	7	7
	7	9	9	8	8	7	7	7	7
	8	10	10	8	8	8	8	8	8
	9	11	11	9	9	8	8	8	8
	10	12	12	10	10	9	9	9	9
0.99	**0**	2	2	2	2	2	2	1	1
	1	3	3	3	3	3	3	2	1
	2	4	4	4	4	4	4	3	2
	3	5	5	5	5	4	4	5	5
	4	6	6	6	6	5	5	5	5
	5	7	7	6	6	6	6	6	6
	6	8	8	7	7	6	6	7	7
	7	9	9	8	8	7	7	7	7
	8	10	10	8	8	8	8	8	8
	9	11	11	9	9	8	8	8	8
	10	12	12	10	10	9	9	9	9

Table 5: Operating Characteristics (OC) values for sampling plan $\left(n, c, \frac{t}{\mu_0}\right)$ for a given P*=0.75, 0.90, 0.95, 0.99when $c = 2, \alpha = 2$ when the life time of a product follows a Weibull distribution.

			$\frac{\mu}{\mu_0}$					
(P*)	n	$\frac{t}{\mu_0}$	**2**	**4**	**6**	**8**	**10**	**12**
0.75	**4**	**0.628**	0.815	0.990	0.999	1.000	1.000	1.000
	4	**0.942**	0.709	0.973	0.996	0.999	1.000	1.000
	3	**1.257**	0.688	0.962	0.994	0.999	1.000	1.000
	3	**1.571**	0.667	0.951	0.990	0.998	0.999	1.000
	3	**2.356**	0.589	0.910	0.977	0.993	0.997	0.999
	3	**3.141**	0.409	0.810	0.937	0.977	0.991	0.996
	3	**3.972**	0.279	0.696	0.878	0.949	0.977	0.989
	3	**4.712**	0.505	0.823	0.932	0.971	0.987	0.993
0.90	**4**	**0.628**	0.658	0.975	0.997	0.999	1.000	1.000
	4	**0.942**	0.562	0.949	0.992	0.998	1.000	1.000
	3	**1.257**	0.478	0.914	0.984	0.996	0.999	1.000
	3	**1.571**	0.400	0.871	0.971	0.992	0.997	0.999
	3	**2.356**	0.385	0.827	0.951	0.984	0.994	0.998
	3	**3.141**	0.409	0.810	0.937	0.977	0.991	0.996
	3	**3.972**	0.279	0.696	0.878	0.949	0.977	0.989
	3	**4.712**	0.194	0.589	0.810	0.910	0.956	0.977
0.95	**4**	**0.628**	0.579	0.965	0.996	0.999	1.000	1.000
	4	**0.942**	0.493	0.934	0.990	0.998	0.999	1.000
	3	**1.257**	0.387	0.884	0.977	0.994	0.998	0.999
	3	**1.571**	0.400	0.871	0.971	0.992	0.997	0.999
	3	**2.356**	0.236	0.730	0.915	0.971	0.989	0.995
	3	**3.141**	0.211	0.667	0.875	0.951	0.979	0.990
	3	**3.972**	0.114	0.510	0.773	0.895	0.950	0.975
	3	**4.712**	0.194	0.589	0.810	0.910	0.956	0.977
0.99	**4**	**0.628**	0.368	0.924	0.990	0.998	1.000	1.000
	4	**0.942**	0.271	0.860	0.975	0.994	0.998	0.999
	3	**1.257**	0.242	0.815	0.960	0.990	0.997	0.999
	3	**1.571**	0.215	0.768	0.941	0.983	0.994	0.998
	3	**2.356**	0.138	0.630	0.871	0.954	0.982	0.992
	3	**3.141**	0.101	0.526	0.798	0.915	0.962	0.982
	3	**3.972**	0.001	0.007	0.014	0.024	0.035	0.047
	3	**4.712**	0.065	0.385	0.667	0.827	0.909	0.951

Table 6: Operating Characteristics (OC) values for sampling plan $\left(n, c, \frac{t}{\mu}\right)$ for a given P*=0.75, 0.90, 0.95, 0.99when $c = 2$ when the life time of a product follows a Rayleigh distribution.

			$\frac{\mu}{\mu_0}$					
(P*)	n	$\frac{t}{\mu_0}$	**2**	**4**	**6**	**8**	**10**	**12**
0.75	**5**	**0.628**	0.999	1.000	1.000	1.000	1.000	1.000
	5	**0.942**	0.987	1.000	1.000	1.000	1.000	1.000
	5	**1.257**	0.963	1.000	1.000	1.000	1.000	1.000
	5	**1.571**	0.873	1.000	1.000	1.000	1.000	1.000
	4	**2.356**	0.856	1.000	1.000	1.000	1.000	1.000
	4	**3.141**	0.753	1.000	1.000	1.000	1.000	1.000
	4	**3.972**	0.645	0.998	1.000	1.000	1.000	1.000
	4	**4.712**	0.453	0.983	1.000	1.000	1.000	1.000
0.90	**5**	**0.628**	0.998	1.000	1.000	1.000	1.000	1.000
	5	**0.942**	0.973	1.000	1.000	1.000	1.000	1.000
	5	**1.257**	0.901	1.000	1.000	1.000	1.000	1.000
	5	**1.571**	0.796	1.000	1.000	1.000	1.000	1.000
	4	**2.356**	0.736	1.000	1.000	1.000	1.000	1.000
	4	**3.141**	0.586	0.999	1.000	1.000	1.000	1.000
	4	**3.972**	0.449	0.996	1.000	1.000	1.000	1.000
	4	**4.712**	0.453	0.983	1.000	1.000	1.000	1.000
0.95	**5**	**0.628**	0.998	1.000	1.000	1.000	1.000	1.000
	5	**0.942**	0.963	1.000	1.000	1.000	1.000	1.000
	5	**1.257**	0.861	1.000	1.000	1.000	1.000	1.000
	5	**1.571**	0.712	1.000	1.000	1.000	1.000	1.000
	4	**2.356**	0.611	1.000	1.000	1.000	1.000	1.000
	4	**3.141**	0.586	0.999	1.000	1.000	1.000	1.000
	4	**3.972**	0.449	0.996	1.000	1.000	1.000	1.000
	4	**4.712**	0.249	0.963	1.000	1.000	1.000	1.000
0.99	**5**	**0.628**	0.994	1.000	1.000	1.000	1.000	1.000
	5	**0.942**	0.926	1.000	1.000	1.000	1.000	1.000
	5	**1.257**	0.769	1.000	1.000	1.000	1.000	1.000
	5	**1.571**	0.626	1.000	1.000	1.000	1.000	1.000
	4	**2.356**	0.491	1.000	1.000	1.000	1.000	1.000
	4	**3.141**	0.309	0.998	1.000	1.000	1.000	1.000
	4	**3.972**	0.294	0.992	1.000	1.000	1.000	1.000
	4	**4.712**	0.249	0.963	1.000	1.000	1.000	1.000

Table 7: Operating Characteristics (OC) values for sampling plan $\left(n, c, \frac{t}{\mu}\right)$ for a given P*=0.75, 0.90, 0.95, 0.99 when $c = 2, \alpha = 2$ when the life time of a product follows a Generalized Exponential distribution.

			$\frac{\mu}{\mu_0}$					
(P*)	$\boldsymbol{n}$	$\frac{t}{\mu_0}$	**2**	**4**	**6**	**8**	**10**	**12**
0.75	**6**	**0.628**	0.754	0.836	0.889	0.924	0.947	0.970
	6	**0.942**	0.752	0.835	0.888	0.924	0.947	0.970
	5	**1.257**	0.760	0.841	0.893	0.927	0.950	0.970
	5	**1.571**	0.759	0.840	0.893	0.928	0.950	0.960
	4	**2.356**	0.757	0.840	0.894	0.928	0.951	0.951
	4	**3.141**	0.776	0.855	0.905	0.936	0.957	0.958
	4	**3.972**	0.815	0.883	0.925	0.951	0.967	0.947
	4	**4.712**	0.777	0.856	0.907	0.938	0.958	0.968
0.90	**6**	**0.628**	0.571	0.687	0.774	0.836	0.880	0.890
	6	**0.942**	0.579	0.695	0.780	0.841	0.885	0.894
	5	**1.257**	0.578	0.694	0.780	0.841	0.884	0.894
	5	**1.571**	0.589	0.705	0.790	0.849	0.891	0.895
	4	**2.356**	0.591	0.708	0.792	0.852	0.893	0.896
	4	**3.141**	0.593	0.711	0.795	0.855	0.896	0.894
	4	**3.972**	0.595	0.714	0.799	0.858	0.899	0.894
	4	**4.712**	0.588	0.709	0.795	0.855	0.897	0.942
0.95	**6**	**0.628**	0.453	0.581	0.684	0.762	0.821	0.941
	6	**0.942**	0.462	0.590	0.692	0.769	0.827	0.933
	5	**1.257**	0.458	0.587	0.689	0.767	0.825	0.923
	5	**1.571**	0.467	0.596	0.699	0.776	0.833	0.894
	4	**2.356**	0.466	0.598	0.701	0.778	0.835	0.893
	4	**3.141**	0.487	0.618	0.719	0.794	0.848	0.884
	4	**3.972**	0.468	0.601	0.706	0.783	0.840	0.873
	4	**4.712**	0.474	0.609	0.713	0.790	0.846	0.878
0.99	**6**	**0.628**	0.254	0.376	0.491	0.591	0.674	0.732
	6	**0.942**	0.255	0.378	0.493	0.593	0.676	0.696
	5	**1.257**	0.259	0.384	0.499	0.599	0.682	0.697
	5	**1.571**	0.263	0.390	0.507	0.607	0.689	0.695
	4	**2.356**	0.275	0.404	0.522	0.622	0.703	0.823
	4	**3.141**	0.266	0.395	0.515	0.616	0.699	0.790
	4	**3.972**	0.279	0.412	0.532	0.633	0.714	0.745
	4	**4.712**	0.282	0.416	0.537	0.638	0.719	0.728

Table 8: Operating Characteristics (OC) values for sampling plan $\left(n, c, \frac{t}{\mu}\right)$ for a given P*=0.75, 0.90, 0.95, 0.90 when $c \; and \; \bar{v} = 2$ when the life time of a product follows Marshall-Olkin Extended Exponential Distribution.

			$\frac{\mu}{\mu_0}$					
(P*)	n	$\frac{t}{\mu_0}$	**2**	**4**	**6**	**8**	**10**	**12**
0.75	**4**	**0.628**	0.801	0.980	0.996	0.999	0.999	1.000
	4	**0.942**	0.773	0.977	0.995	0.998	0.999	1.000
	4	**1.257**	0.822	0.983	0.996	0.999	1.000	1.000
	4	**1.571**	0.674	0.962	0.992	0.997	0.999	0.999
	4	**2.356**	0.296	0.853	0.962	0.987	0.994	0.997
	4	**3.141**	0.091	0.674	0.899	0.962	0.983	0.992
	3	**3.972**	0.022	0.471	0.800	0.918	0.962	0.980
	3	**4.712**	0.004	0.296	0.674	0.853	0.929	0.962
0.90	**4**	**0.628**	0.659	0.959	0.991	0.997	0.999	0.999
	4	**0.942**	0.615	0.951	0.989	0.996	0.998	0.999
	4	**1.257**	0.544	0.936	0.985	0.995	0.998	0.999
	4	**1.571**	0.674	0.962	0.992	0.997	0.999	0.999
	4	**2.356**	0.296	0.853	0.962	0.987	0.994	0.999
	4	**3.141**	0.092	0.674	0.899	0.963	0.983	0.997
	3	**3.972**	0.022	0.471	0.800	0.918	0.962	0.992
	3	**4.712**	0.004	0.296	0.674	0.004	0.853	0.980
0.95	**4**	**0.628**	0.532	0.932	0.984	0.995	0.998	0.999
	4	**0.942**	0.481	0.918	0.983	0.993	0.997	0.999
	4	**1.257**	0.544	0.936	0.985	0.995	0.998	0.999
	4	**1.571**	0.333	0.867	0.966	0.988	0.995	0.998
	4	**2.356**	0.296	0.853	0.962	0.987	0.994	0.998
	4	**3.141**	0.091	0.674	0.899	0.962	0.983	0.997
	3	**3.972**	0.022	0.471	0.800	0.918	0.962	0.992
	3	**4.712**	0.004	0.296	0.674	0.853	0.929	0.980
0.99	**4**	**0.628**	0.342	0.867	0.966	0.988	0.995	0.998
	4	**0.942**	0.292	0.843	0.959	0.985	0.994	0.997
	4	**1.257**	0.347	0.872	0.967	0.989	0.995	0.998
	4	**1.571**	0.333	0.867	0.966	0.988	0.995	0.998
	4	**2.356**	0.296	0.853	0.962	0.987	0.994	0.997
	4	**3.141**	0.092	0.674	0.899	0.962	0.983	0.992
	3	**3.972**	0.022	0.471	0.800	0.918	0.962	0.980
	3	**4.712**	0.004	0.296	0.674	0.907	0.929	0.962

Table 9: Minimum ratio of true mean life to specified mean life for acceptance of lot of 0.05 when the life time of a product follows a Weibull distribution with P*=0.75, 0.90, 0.95, 0.90

		$\frac{t}{\mu_0}$							
(P*)	***c***	**0.628**	**0.942**	**1.257**	**1.571**	**2.356**	**3.141**	**3.972**	**4.713**
0.75	**0**	6.188	7.177	7.797	9.746	10.271	13.694	17.118	20.541
	1	3.038	3.276	3.821	3.971	5.956	5.854	7.318	8.781
	2	2.363	2.666	2.955	3.252	4.097	5.462	5.142	6.171
	3	2.067	2.244	2.571	2.575	3.264	4.352	4.147	4.976
	4	1.898	2.116	2.169	2.463	2.780	3.706	4.632	4.269
	5	1.787	1.941	2.060	2.165	2.884	3.275	4.094	3.793
	6	1.709	1.818	1.981	2.142	2.603	2.963	3.704	4.444
	7	2.394	2.381	2.362	2.338	2.350	2.291	2.314	2.644
	8	2.257	2.251	2.218	2.229	2.197	2.186	2.171	2.478
	9	2.150	2.150	2.140	2.110	2.076	2.100	2.058	2.356
	10	2.081	2.067	2.048	2.044	2.026	1.986	1.969	2.251
0.90	**0**	7.327	8.297	9.570	9.746	14.619	13.694	17.118	20.541
	1	3.699	3.970	4.368	4.777	5.956	7.941	9.926	8.781
	2	2.829	3.049	3.269	3.694	4.877	5.462	6.828	8.193
	3	2.391	2.645	2.790	3.214	3.862	4.352	5.440	6.528
	4	2.192	2.320	2.517	2.711	3.274	3.706	4.632	5.559
	5	2.026	2.190	2.340	2.575	3.247	3.846	4.094	4.912
	6	1.909	2.031	2.214	2.476	2.926	3.471	3.704	4.444
	7	1.750	1.850	1.950	1.970	2.400	2.740	2.730	3.280
	8	1.670	1.760	1.800	1.970	2.230	2.560	2.580	3.100
	9	1.630	1.690	1.770	1.840	2.090	2.420	2.450	2.940
	10	1.600	1.680	1.740	1.731	1.980	2.300	2.340	2.810
0.95	**0**	8.762	9.282	11.062	11.962	14.619	19.492	24.365	20.541
	1	3.988	4.557	4.853	5.460	7.165	7.941	9.926	11.911
	2	2.995	3.222	3.555	4.087	4.877	5.462	6.828	8.193
	3	2.567	2.766	2.992	3.214	3.862	5.149	5.440	6.528
	4	6.188	7.177	7.797	9.746	10.271	13.694	17.118	20.541
	5	3.038	3.276	3.821	3.971	5.956	5.854	7.318	8.781
	6	2.363	2.666	2.955	3.252	4.097	5.462	5.142	6.171
	7	2.067	2.244	2.571	2.575	3.264	4.352	4.147	4.976
	8	1.898	2.116	2.169	2.463	2.780	3.706	4.632	4.269
	9	1.787	1.941	2.060	2.165	2.884	3.275	4.094	3.793
	10	1.709	1.818	1.981	2.142	2.603	2.963	3.704	4.444
0.99	**0**	2.394	2.381	2.362	2.338	2.350	2.291	2.314	2.644
	1	2.257	2.251	2.218	2.229	2.197	2.186	2.171	2.478
	2	2.150	2.150	2.140	2.110	2.076	2.100	2.058	2.356
	3	2.081	2.067	2.048	2.044	2.026	1.986	1.969	2.251
	4	7.327	8.297	9.570	9.746	14.619	13.694	17.118	20.541
	5	3.699	3.970	4.368	4.777	5.956	7.941	9.926	8.781
	6	2.829	3.049	3.269	3.694	4.877	5.462	6.828	8.193
	7	2.391	2.645	2.790	3.214	3.862	4.352	5.440	6.528
	8	2.192	2.320	2.517	2.711	3.274	3.706	4.632	5.559
	9	2.026	2.190	2.340	2.575	3.247	3.846	4.094	4.912
	10	1.909	2.031	2.214	2.476	2.926	3.471	3.704	4.444

Table 10: Minimum ratio of true mean life to specified mean life for acceptance of lot of 0.05 when the life time of a product follows a Rayleigh distribution with P*=0.75, 0.90, 0.95, 0.90.

		$\frac{t}{\mu_0}$							
(P*)	***c***	**0.628**	**0.942**	**1.257**	**1.571**	**2.356**	**3.141**	**3.972**	**4.713**
0.75	**0**	7.420	9.699	10.603	13.252	13.878	18.502	23.398	27.756
	1	3.855	4.353	5.006	6.257	7.591	10.121	8.863	10.515
	2	2.850	3.457	3.720	3.989	4.822	6.429	8.130	6.710
	3	2.517	2.828	3.146	3.485	4.476	4.813	6.085	7.219
	4	2.236	2.472	2.817	3.186	3.623	3.903	4.935	5.854
	5	2.122	2.376	2.602	2.700	3.073	4.096	4.195	4.976
	6	1.983	2.193	2.449	2.607	3.131	3.581	3.676	4.361
	7	1.878	2.057	2.183	2.325	2.794	3.199	3.292	3.906
	8	1.841	2.035	2.114	2.293	2.532	2.903	3.671	3.553
	9	1.77	1.942	2.056	2.265	2.618	2.667	3.372	3.272
	10	1.714	1.866	2.008	2.094	2.424	2.869	3.128	3.042
0.90	**0**	8.967	11.130	12.942	16.175	19.874	26.495	23.397	27.757
	1	4.600	5.351	5.809	7.260	9.384	10.121	12.798	15.183
	2	3.444	4.020	4.613	5.235	5.982	6.429	8.130	9.644
	3	2.928	3.238	3.774	3.932	5.226	5.967	6.085	7.219
	4	2.634	2.943	3.299	3.521	4.231	4.831	6.108	5.855
	5	2.381	2.748	2.991	3.251	3.585	4.096	5.180	4.976
	6	2.255	2.510	2.775	3.060	3.536	4.175	4.529	5.372
	7	2.159	2.333	2.614	2.730	3.153	3.724	4.045	4.798
	8	2.046	2.272	2.489	2.642	3.157	3.376	3.671	4.355
	9	1.990	2.156	2.388	2.570	2.893	3.097	3.916	4.000
	10	1.912	2.121	2.306	2.377	2.677	3.231	3.628	3.710
0.95	**0**	10.229	12.360	14.851	16.175	19.874	26.496	33.506	39.748
	1	5.027	5.782	6.511	7.260	9.384	12.511	12.798	15.182
	2	3.704	4.274	5.002	5.235	6.972	7.974	10.084	9.644
	3	3.113	3.605	4.056	4.340	5.226	5.967	7.546	7.219
	4	2.846	3.222	3.518	3.831	4.778	5.640	6.109	7247
	5	2.558	2.862	3.171	3.502	4.050	4.780	5.180	6.145
	6	2.403	2.704	2.927	3.268	3.910	4.174	5.279	5.372
	7	2.287	2.585	2.745	3.095	3.486	4.203	4.710	4.798
	8	2.197	2.421	2.604	2.804	3.439	3.807	4.268	4.355
	9	2.125	2.354	2.492	2.713	3.152	3.490	3.916	4.646
	10	2.036	2.241	2.400	2.638	2.915	3.231	3.628	4.304
0.99	**0**	12.275	15.344	17.949	20.613	24.257	32.340	33.505	39.748
	1	5.945	6.899	8.247	8.925	10.888	12.511	15.821	18.769
	2	4.383	5.166	5.704	6.252	7.850	9.295	10.084	11.963
	3	3.610	4.246	4.810	5.069	6.507	6.966	8.810	8.952
	4	3.229	3.723	4.117	4.398	6.508	6.370	7.133	8.461
	5	2.931	3.284	3.667	3.963	4.876	5.398	6.044	7.170
	6	2.721	3.059	3.349	3.657	4.259	5.213	5.961	6.263
	7	2.564	2.891	3.229	3.430	4.093	4.648	5.316	5.587
	8	2.442	2.761	3.033	3.255	3.707	4.209	4.814	5.064
	9	2.343	2.598	2.877	3.114	3.630	4.202	4.414	5.236
	10	2.263	2.518	2.749	2.999	3.359	3.887	4.512	4.847

Table 11: Minimum ratio of true mean life to specified mean life for acceptance of lot of 0.05 when the life time of a product follows a Generalized Exponential distribution with P*=0.75, 0.90, 0.95, 0.90.

		$\frac{t}{\mu_0}$							
(P*)	***c***	**0.628**	**0.942**	**1.257**	**1.571**	**2.356**	**3.141**	**3.972**	**4.713**
0.75	**0**	7.300	8.300	9.000	11.200	11.500	15.300	19.100	23.000
	1	3.410	3.590	4.120	4.210	4.520	6.030	7.550	9.040
	2	2.600	2.860	3.110	3.400	4.200	4.140	5.200	6.200
	3	2.250	2.370	2.670	2.630	3.300	3.320	4.150	5.000
	4	2.050	2.220	2.220	2.500	2.790	2.860	3.570	4.300
	5	1.920	2.020	2.100	2.200	2.460	2.560	3.200	3.840
	6	1.820	1.880	2.020	2.160	2.230	2.970	2.930	3.520
	7	1.750	1.850	1.950	1.970	2.400	2.740	2.730	3.280
	8	1.670	1.760	1.800	1.970	2.230	2.560	2.580	3.100
	9	1.630	1.690	1.770	1.840	2.090	2.420	2.450	2.940
	10	1.600	1.680	1.740	1.731	1.980	2.300	2.340	2.810
0.90	**0**	8.700	8.300	9.000	11.200	16.700	15.030	19.100	23.000
	1	4.020	4.410	4.800	5.150	6.310	6.030	7.530	9.040
	2	3.050	3.310	3.500	3.900	4.200	5.600	5.170	6.200
	3	2.630	2.830	2.920	3.000	3.300	4.400	4.160	5.000
	4	2.340	2.450	2.610	2.780	3.300	3.710	3.570	4.300
	5	2.150	2.300	2.410	2.630	2.900	3.280	3.200	3.840
	6	2.060	2.120	2.270	2.340	2.610	2.970	3.710	3.520
	7	1.960	2.050	2.170	2.290	2.390	2.740	3.430	3.300
	8	1.880	1.940	2.090	2.110	2.490	2.560	3.210	3.100
	9	1.820	1.900	1.940	2.090	2.340	2.420	3.030	2.940
	10	1.760	1.830	1.900	1.970	2.210	2.300	2.880	2.810
0.95	**0**	9.840	10.900	13.000	14.000	16.800	15.300	19.010	23.010
	1	4.560	5.110	5.350	6.030	7.730	8.410	10.160	9.040
	2	3.360	3.710	3.810	3.890	5.100	5.590	5.200	6.200
	3	2.840	2.970	3.150	3.340	3.940	4.400	5.500	4.980
	4	7.300	8.300	9.000	11.200	11.500	15.300	19.100	23.000
	5	3.410	3.590	4.120	4.210	4.520	6.030	7.550	9.040
	6	2.600	2.860	3.110	3.400	4.200	4.140	5.200	6.200
	7	2.250	2.370	2.670	2.630	3.300	3.320	4.150	5.000
	8	2.050	2.220	2.220	2.500	2.790	2.860	3.570	4.300
	9	1.920	2.020	2.100	2.200	2.460	2.560	3.200	3.840
	10	1.820	1.880	2.020	2.160	2.230	2.970	2.930	3.520
0.99	**0**	1.750	1.850	1.950	1.970	2.400	2.740	2.730	3.280
	1	1.670	1.760	1.800	1.970	2.230	2.560	2.580	3.100
	2	1.630	1.690	1.770	1.840	2.090	2.420	2.450	2.940
	3	1.600	1.680	1.740	1.731	1.980	2.300	2.340	2.810
	4	8.700	8.300	9.000	11.200	16.700	15.030	19.100	23.000
	5	4.020	4.410	4.800	5.150	6.310	6.030	7.530	9.040
	6	3.050	3.310	3.500	3.900	4.200	5.600	5.170	6.200
	7	2.630	2.830	2.920	3.000	3.300	4.400	4.160	5.000
	8	2.340	2.450	2.610	2.780	3.300	3.710	3.570	4.300
	9	2.150	2.300	2.410	2.630	2.900	3.280	3.200	3.840
	10	2.060	2.120	2.270	2.340	2.610	2.970	3.710	3.520

Table 12: Minimum ratio of true mean life to specified mean life for acceptance of lot of 0.05 when the life time of a product follows a Marshall-Olkin Extended Exponential Distribution with P*=0.75, 0.90, 0.95, 0.90

		$\overline{\mu_0}$							
(P*)	***c***	**0.628**	**0.942**	**1.257**	**1.571**	**2.356**	**3.141**	**3.972**	**4.713**
0.75	**0**	26.518	27.480	26.518	27.563	24.582	29.533	27.563	31.586
	1	7.587	7.587	7.525	7.169	7.587	7.342	7.587	7.525
	2	4.690	4.715	4.690	4.527	4.417	4.573	4.460	5.084
	3	3.654	3.698	3.654	3.554	3.513	3.554	3.625	4.155
	4	3.115	3.105	3.053	3.053	3.042	3.042	3.012	3.433
	5	2.799	2.756	2.756	2.748	2.660	2.732	2.636	3.022
	6	2.548	2.555	2.499	2.478	2.485	2.425	2.394	2.740
	7	2.394	2.381	2.362	2.338	2.350	2.291	2.314	2.644
	8	2.257	2.251	2.218	2.229	2.197	2.186	2.171	2.478
	9	2.150	2.150	2.140	2.110	2.076	2.100	2.058	2.356
	10	2.081	2.067	2.048	2.044	2.026	1.986	1.969	2.251
0.90	**0**	44.170	43.122	44.170	43.328	44.170	41.357	41.357	47.148
	1	10.593	10.718	10.471	10.593	10.471	9.901	9.588	10.977
	2	6.365	6.321	6.150	6.234	5.949	6.028	5.760	10.977
	3	4.789	4.715	4.666	4.596	4.619	4.439	4.417	6.596
	4	3.956	3.922	3.905	3.872	3.823	3.807	3.729	5.028
	5	3.459	3.459	3.394	3.369	3.332	3.308	3.320	4.272
	6	3.126	3.137	3.105	3.032	3.022	2.982	2.934	3.791
	7	2.897	2.888	2.851	2.790	2.799	2.748	2.756	3.357
	8	2.699	2.699	2.675	2.660	2.629	2.577	2.548	3.159
	9	2.569	2.555	2.527	2.520	2.499	2.438	2.452	2.916
	10	2.445	2.445	2.419	2.375	2.399	2.384	2.224	2.807
0.95	**0**	56.529	56.883	55.835	55.157	54.171	53.220	55.157	63.211
	1	13.021	13.021	12.658	12.837	12.484	12.484	12.658	14.472
	2	7.463	7.323	7.283	7.225	7.225	7.169	7.057	8.058
	3	5.516	5.549	5.417	5.322	5.353	5.322	5.200	5.910
	4	26.518	27.480	26.518	27.563	24.582	29.533	27.563	31.586
	5	7.587	7.587	7.525	7.169	7.587	7.342	7.587	7.525
	6	4.690	4.715	4.690	4.527	4.417	4.573	4.460	5.084
	7	3.654	3.698	3.654	3.554	3.513	3.554	3.625	4.155
	8	3.115	3.105	3.053	3.053	3.042	3.042	3.012	3.433
	9	2.799	2.756	2.756	2.748	2.660	2.732	2.636	3.022
	10	2.548	2.555	2.499	2.478	2.485	2.425	2.394	2.740

0.99	0	2.394	2.381	2.362	2.338	2.350	2.291	2.314	2.644
	1	2.257	2.251	2.218	2.229	2.197	2.186	2.171	2.478
	2	2.150	2.150	2.140	2.110	2.076	2.100	2.058	2.356
	3	2.081	2.067	2.048	2.044	2.026	1.986	1.969	2.251
	4	44.170	43.122	44.170	43.328	44.170	41.357	41.357	47.148
	5	10.593	10.718	10.471	10.593	10.471	9.901	9.588	10.977
	6	6.365	6.321	6.150	6.234	5.949	6.028	5.760	10.977
	7	4.789	4.715	4.666	4.596	4.619	4.439	4.417	6.596
	8	3.956	3.922	3.905	3.872	3.823	3.807	3.729	5.028
	9	3.459	3.459	3.394	3.369	3.332	3.308	3.320	4.272
	10	3.126	3.137	3.105	3.032	3.022	2.982	2.934	3.791

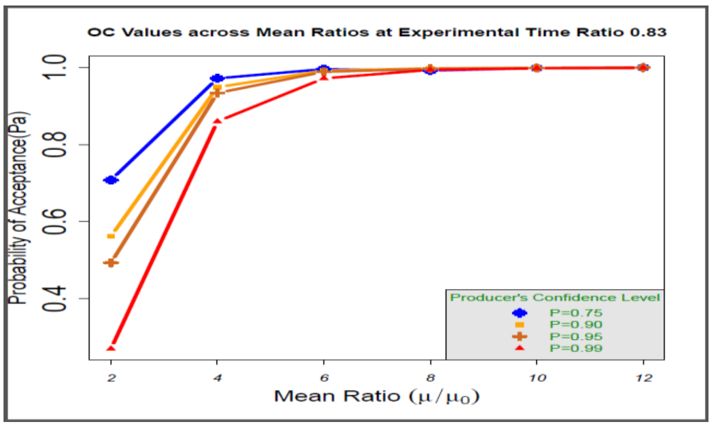

Fig. 1: Operating characteristics curve of probability of acceptance against mean life ratios at various confidence levels for Weibull distribution.

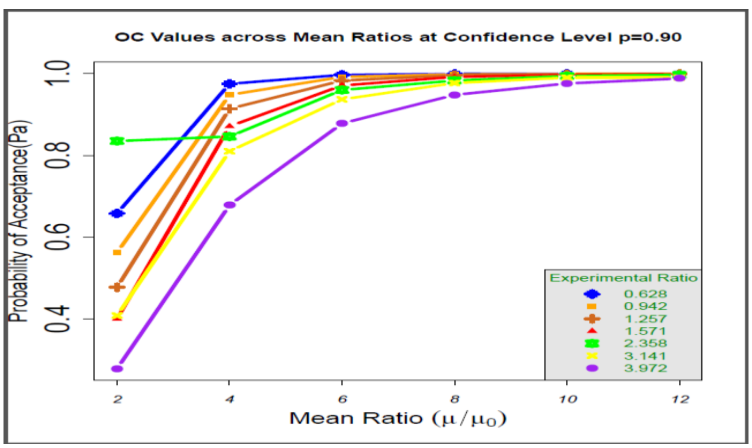

Fig. 2: Operating characteristics curve of probability of acceptance against experimental mean ratios at various experimental time ratios for Weibull distribution.

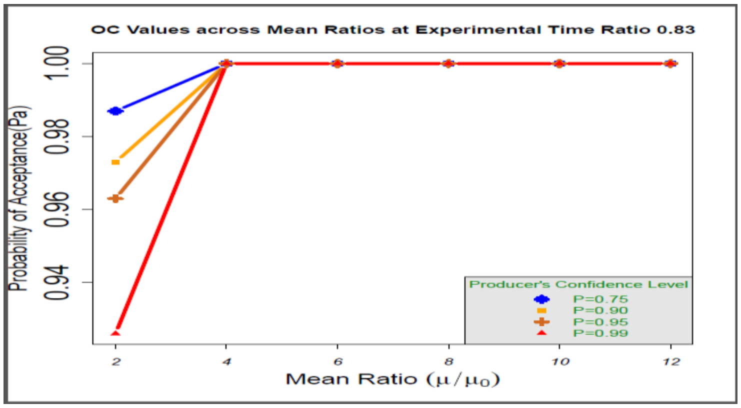

Fig. 3: Operating characteristics curve of probability of acceptance against mean life ratios at various probability of acceptance for Rayleigh distribution.

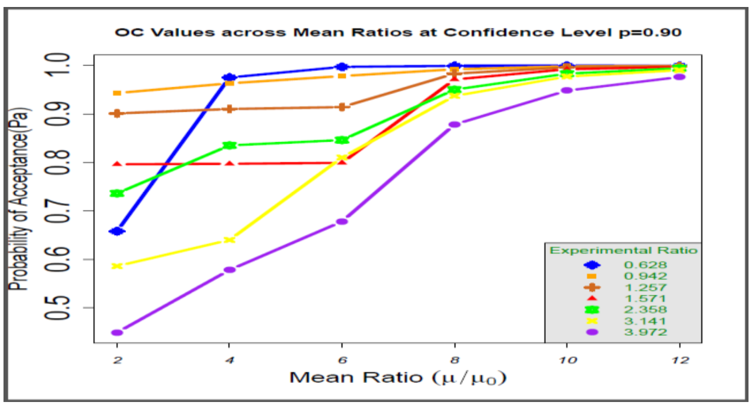

Fig. 4: Operating characteristics curve of probability of acceptance against experimental mean ratios at various experimental time ratios for Weibull distribution.

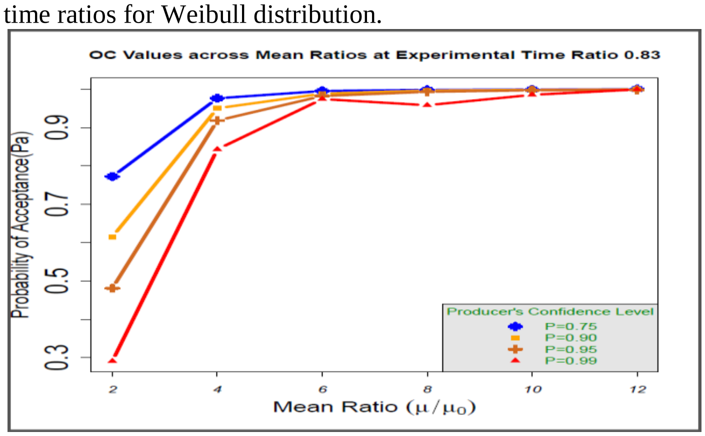

Fig. 5: Operating characteristics curve of probability of acceptance against producer's mean life ratios at various confidence levels for Generalized Exponential distribution.

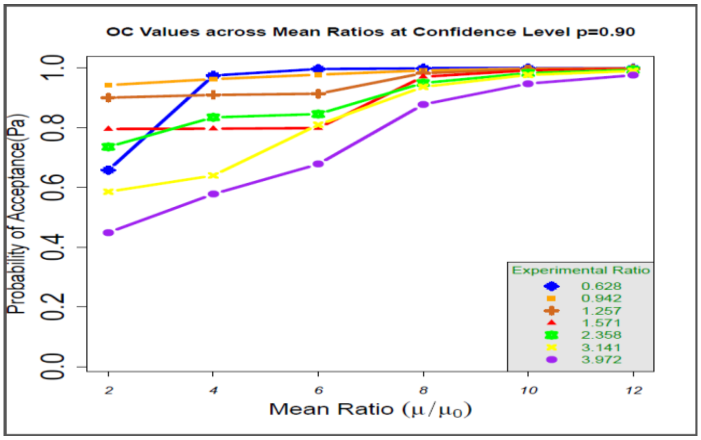

Fig. 6: Operating characteristics curve of probability of acceptance against experimental mean ratios at various experimental time ratios for Generalized Exponential distribution.

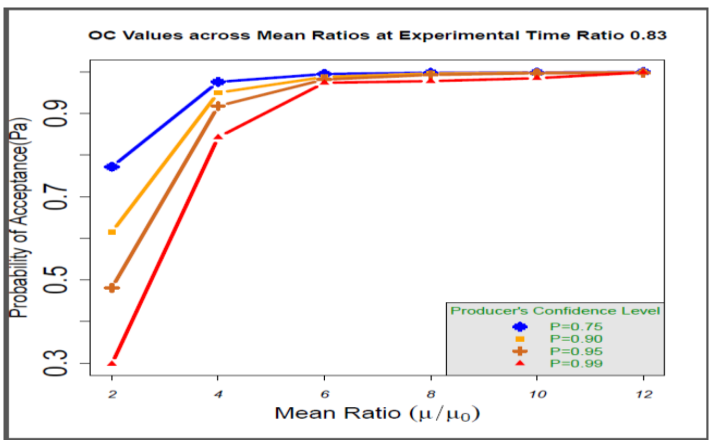

Fig. 7: Operating characteristics curve of probability of acceptance against mean life tatios at various producers' confidence level for Marshall Olkin's Generalized Exponential distribution.

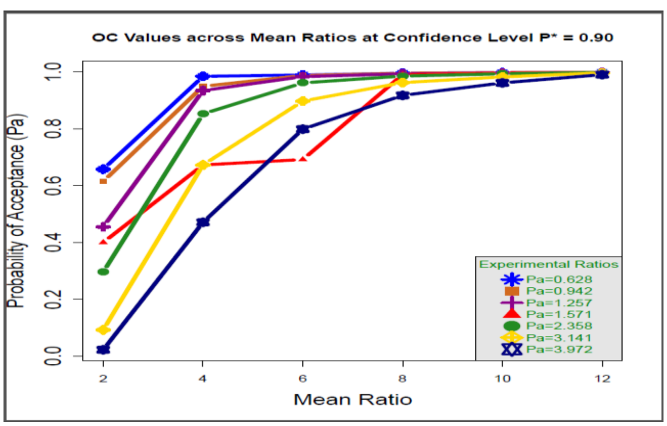

Fig. 8: Operating characteristics curve of probability of acceptance against experimental mean ratios at various experimental time ratios for Marshall Olkin's Generalized Exponential distribution.

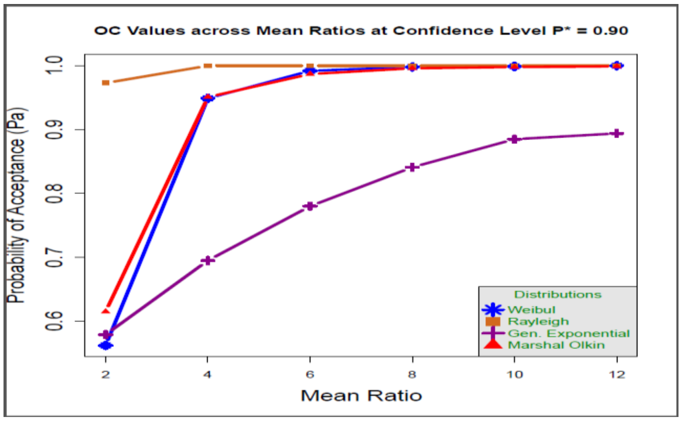

Fig. 9: Operating characteristics curve of probability of acceptance against experimental mean ratios for the four studied distributions.