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Original Article

On an isolated truncated chain deferred sampling plan for Lomax product life distribution

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ABSTRACT

This research work presents a developed new sampling plan that utilizes information from the past and current lots for lot disposition assuming the life time of a product follows a Lomax distribution. An isolated truncated chain deferred sampling plan for Lomax product life distribution is proposed when the testing is truncated at a specified time. The optimal sample sizes obtained under a given maximum allowable percent defective, test termination ratios, and acceptance numbers. The operating characteristics formula of the proposed plan was developed. The operating characteristics and mean ratio were used to assess the performance of the plan. The study revealed that Lomax distribution has an increasing failure rate; also, as mean life ratio increases, the failure rate reduces and the minimum sample size increases as the acceptance number, maximum allowable percent defective, and experiment time ratio increase. The study concludes that the modified required minimum sample sizes were smaller making it a more economical plan to be adopted when time and cost of production is expensive and the testing is destructive.

Keywords: Mean life, minimum sample size, operating characteristics, producers consumers and risk

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INTRODUCTION

Acceptance sampling inspection is a vital field in statistical quality assurance used to reject or accept products submitted for inspection. This field was popularized by Amal and Amani.[1] Acceptance sampling inspection is the process of examining samples or fraction of lot to verify whether it meets certain minimum quality specification so that the lot can be rejected or accepted if otherwise. Dodge and Roming summarized the procedure of inspecting sampling plan as follows: “A sample is randomly selected from the lot and the probability of the products being rejected or accepted depends on the information gotten from this sample.” This process is referred to as acceptance sampling. Therefore, acceptance sampling inspection is all about assessment and decision-making regarding products in quality assurance. Acceptance inspection sampling is one of the key components in the field of quality control and is mainly used for incoming inspection.

In acceptance sampling plans, such as those developed by Balakrishnan *et al*., in 2007.[2] In Aslam *et al*.[1] and Srinivasa,[3] a lot under inspection is accepted if the number of failures is less or equal to the acceptance number. There are, however, different distributions that model these life products. To minimize both the producer and consumer’s risks, the selection of sample size (n) and other parameters $(c, t, \frac{t}{\mu_o}, \frac{\mu}{\mu_o}, P^*)$ is done in a systematic way, through “trial and error” method adopted by different authors such as Balakrishnan *et al*.,[2] Aslam and Shabaz,[4] Aslam *et al*.,[5] and Srinivasa.[6] These authors did not consider the two types of risks in their developed plans but considered either the producer’s or consumer’s risk. More so, the failure rate of these life distributions has not been put into consideration to know the different failure patterns of products that assume these distributions and how to reduce the failure rate. These are the motivations behind this study.

Statistical quality control is important to all human endeavors. It makes use of available data to elicit the required best decision for utmost profit. The theory and methods of statistical process control have been developed from industrial statistics roots,

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such as quality specifications. In modern times, while quality enhancement still remains a major field of applications such as in health-care monitoring,[7] detecting of genetic mutation,[8] and credit and financial fraud detecting to mention but a few.[9] However, in acceptance sampling lot, this becomes an issue for optimal determination in management process. Existing literature on the acceptance number, acceptance maximum allowable percent defectives, and test ratio are conventionally set, such as in Amal and Amani,[1] Aslam and Shabaz,[4] and Steiner *et al*.[7]

Considering the works of Lio *et al*. in 2010[10] on acceptance sampling plans from truncated life tests based on the Birnbaum-Saunders distribution for percentiles, Ramaswamy and Priyah in 2012 on Hybrid Group Acceptance Sampling Plans for Lifetimes Based on Exponential Weibull Distribution.[11] Muhammad *et al*. in 2010 work on group acceptance sampling plan for lifetime data using generalized Pareto distribution.[12]

An isolated truncated chain deferred sampling plan for Lomax product life distribution is will be used when the testing is truncated at a specified time following Lemonte and Cordeiro work in 2013[13] and in the works of Oguntunde *et al*. in 2017.[14] The optimal sample sizes obtained under a given maximum allowable percent defective, test termination ratios, and acceptance numbers. The operating characteristics formula of the proposed plan was developed. The operating characteristics and mean ratio following Lomonte and Cordeiro idea will be used to assess the performance of the plan. The study revealed that Lomax distribution has an increasing failure rate; also, as mean life ratio increases, the failure rate reduces, and the minimum sample size increases as the acceptance number, maximum allowable percent defective, and experiment time ratio increase.

There is failure rate according to Lemonte and Cordeiro,[13] Aslam *et al*.,[15] Aslam *et al*.,[5] and Ramaswamy and Priyah.[11] This work has given an insight about the failure rate pattern and effect of mean life on the product that assumes Lomax distribution, thereby affecting the producers and the users of this distribution on information that will enhance decision-making when using these distributions.

METHODOLOGY

The Lomax Distribution

Lomax distribution was first proposed as a second kind of the Pareto distribution by Lomax in 1954.[1] The distribution provides a good model in biomedical problems. It is considered a significant model of lifetime models. It has also been used in relation with studies of income and reliability engineering modeling. It is being extensively used for stochastic modeling of decreasing failure rate life components. It has also serve as a handy model in the study of queuing theory and biological analysis.

The probability density function (p.d.f) and cumulative distribution function (cdf) of a product that has the Lomax distribution are given by:

$$f(t,\mu_0)=\frac{\left(1+\frac{t}{\mu_0}\right)^{\alpha}}{\left(1+\frac{t}{\mu_0}\right)^{\alpha+1}} \tag{1}$$

$$F(x;\alpha,\mu_0)=1-\left(1+\frac{t}{\mu_0}\right)^{-\alpha} \tag{2}$$

Where, α >0 and μ >0 are the shape and scale parameters, respectively.

Failure Rate Function of Lomax Products' Distribution

Although the pdf describes the time till an item will fail completely, it does not directly specify either the probability of the item continuing to work for a given period of time or how the probability of failure depends on the quality of the part. Therefore, reliability is defined mathematically as:

$$R(t)=Pr(T>t)=\int_t^{\infty} f(x)\,dx \tag{3}$$

= 1-F(t)=Probability of an item meeting specification for at least till age (time t), where, F(t) is the cdf.

Therefore, a useful function used in life time analysis is the failure rate. It is defined as:

$$h(t)=\frac{f(t)}{1-F(t)} \tag{4}$$

Equation (4) is the rate of failure given a testing till age t, where f(t) is the pdf and F(t) is the cdf, respectively.

Minimum Sample Size (n)

Suppose the probability of accepting a poor quality lot is fixed and the lot size is large enough, the binomial distribution can be used by Ramaswamy and Priyah.[11] Thus, the acceptance and non-acceptance criteria for the lot are equivalent to the decisions of accepting or rejecting the hypothesis. Suppose we want to find the minimum sample size such that:

$$\sum_{i=0}^{c}\binom{n}{i}p^i(1-p)^{n-i}\le 1-p^* \tag{5}$$

If p=F(t,μ) which is an increasing function of, it is always sufficient to specify this ratio.

Aslam *et al*.[5] assumed that if the lot is very large and is not very small; therefore, Equation (4) can be rewritten as:

$$\sum_{i=0}^{c} \frac{e^{-\mu} 1/4^{i}}{i!} \leq 1-p^{*} \quad (6)$$

Where μ=*np*=*nF*(*t;* μ).

We, therefore, have $\sum_{i=0}^{c} \frac{e^{-\mu}\mu^{i}}{i!} = 1-G_{c+1}(\mu,1)$ (7)

Where, G_k (α, μ) denotes the cdf of a gamma distribution with the scale and shape parameters as α and , respectively. Gupta (1962) gave the minimum sample size formula as:

$$n = \left[\frac{\gamma_{c+1,p^{*}}}{\mathrm{P}}\right]+1 \quad (8)$$

Where, q = specified probability of failure, $\gamma_{(c+1,p^{*})}$ is the percentage point at a standardized gamma variable with shape parameter.

This approximation was later discussed in Muhammad *et al*.[12] Using the relationship between gamma and Chi-square random variable, Equation (8) becomes

$$n = \left[\frac{\chi^{2}_{2c+2,P^{*}}}{2P}\right]+1 \quad (9)$$

Where = Assumed failure probability, is then introduced in place of P* to take care of the consumers risk and assumed failure probability (P) with the failure probability of assumed product life distribution F(t;μ) or consumer's risk, that is, the cumulative life distribution function.

Assuming the Chi-square (χ^2) random variables, Equation (9) is modified as:

$$n = \left[\frac{\chi^{2}_{v,\beta}}{2F(t;\mu)}\right]+1 \quad (10)$$

Where takes care of the consumers risk, *F*(*t*; μ)= is the failure probability and can also be taken as the producer's risk $\chi^2_{v,\beta}$ denotes the β consumer's risk of a variable with v=2(c+1) degree of freedom. Since one of the objectives of this study is to arrive at a values of *n* that will results to a plan with reduced sample size needed to be selected from the lot for inspection and result to reduced inspection cost and time, the approximate value of *n* can then be reduce by introducing parameter (shape parameter of the failure rate (*F*(*t*;μ)).When ρ<1.5, the sample size values become very large and when ρ<2.5, the sample size becomes approximately one irrespective of the combination of the parameters.

On replacing *F*(*t*,μ) in (10) with ρ *F*(*t*,μ), the resulting equation becomes

$$n = \left[\frac{\chi^{2}_{v,\beta}}{\rho F(t;\mu)}\right]+1 \quad (11)$$

Therefore, Equation (11) is the approximate of the improved sample size *n*.

Development of the Operating Characteristics of Isolated Truncated Chain Deferred Sampling Plan

Let *A* be the event of having "0" defectives in a sample of size "*n*." Let *B* be the event of having "1" defectives in a sample of size "n."

Let P(A) be the probability of having "0" defectives in a lot with sample size "n."

Similarly, let P(B) be probability of having "1" defective in a lot with sample size "n" with the condition that there are zero defectives in the immediate preceding "i" lot and succeeding "j" lot.

That is, $P(B)=P_{0,n}+(P_0)^{i}P_{1,n}(P_0)^{j}$ (12)

Since A and B are mutually exclusive events, using the addition theorem of probability,

$P(P_0 \cup P_1)=P_{0,n}+(P_{0,n})^{i}P_{1,n}(P_{0,n})^{j}$ (13)

We, therefore, have the probability of acceptance of lot as:

$P_a(P)=P_{0,n}+(P_{0,n})^{i}P_{1,n}(P_{0,n})^{j}$ (14)

=*P*(*d*=0)+{*P*(*d*=1)/*d*=0 in the precedig i lot and succeeding j lot.}

Assuming Poisson distribution,

$$P_a(P) = \frac{e^{-np}(np)^0}{0!} + \frac{e^{-np}(np)^0}{0!}\frac{e^{-np}(np)^1}{1!}\frac{e^{-np}(np)^0}{0!}$$

$$P_a(P) = e^{-np} + e^{-np}e^{-np}(np)e^{-np}$$

$$P_a(P) = e^{-np} + e^{-np}(np)\left\{\left(e^{-np}.e^{-np}\right), i = j = 1\right\} \quad (15)$$

$$= e^{-np} + npe^{-(i+j)np} \quad (16)$$

$$= e^{(-np)} + npe^{(-2np)}, \text{ since i = j =1} \quad (17)$$

On factorizing, we have:

$$= e^{-np}\left(1+npe^{2}\right) \tag{18}$$

Now assuming a binomial distribution,

$$P_a(P)=\binom{n}{0}P^0(1-P)^n+\binom{n}{1}P^1(1-P)^{n-1}$$
$$\left(\binom{n}{0}P^0(1-P)^n.\binom{n}{0}P^0(1-P)^n\right) \tag{19}$$

$$=\binom{n}{0}P^0(1-P)^n+\binom{n}{1}P^1(1-P)^{n-1}\left(\binom{n}{0}P^0(1-P)^n\right)^{(i+j)}$$

(20)

Considering i = j = 1, we also have:

$$P_a(P)=\binom{n}{0}P^0(1-P)^n+\binom{n}{1}P^1(1-P)^{n-1}\left(\binom{n}{0}P^0(1-P)^n\right)^{2}$$

(21)

Product Mean Life Ratio

The product life ratio is the ratio of the true unknown life of a product to the specified mean life by the producer when designing his product.[4] These values enable the producer to design his products so that it can be accepted at a high probability. To calculate the product life ratio values, the producer's risk is been considered.

The value of $\frac{\mu}{\mu_0}$ is the smallest positive number for which the following inequality holds:

$$\sum\nolimits_{i=c+1}^{n}\binom{n}{i}p^i(1-p)^{n-i}\geq 0.95 \tag{22}$$

For a given value of the producer's risk, for example 0.05, one may be interested in knowing what value of that will ensure a producer's risk ≤0.05 if a sampling plan is adopted. For a given sampling plan $(n,c,\frac{t}{\mu_0})$ and specified confidence level, the

minimum values of are said to satisfy the equation below.

$$\sum\nolimits_{i=c+1}^{n}\binom{n}{i}p^i(1-p)^{n-i} \tag{23}$$

Table 1: Failure rates of life distributions at specified

$\frac{t}{\mu_0}$	Lomax
0.628	0.2422
0.942	0.4570
1.571	0.9597
2.356	1.6543
3.141	2.3835
3.972	3.1704
4.713	3.8922

Table 2: Effect of on failure rate for the studied life distribution

$\frac{t}{\mu_0}$	Lomax
0.628	0.0571
0.942	0.0210
1.571	0.0099
2.356	0.0057
3.141	0.0037
3.972	0.0027
4.713	0.0571

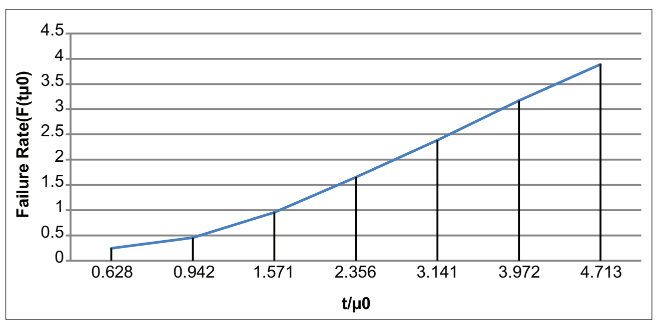

Figure 1: Failure rate plot for the underlined distribution for specified

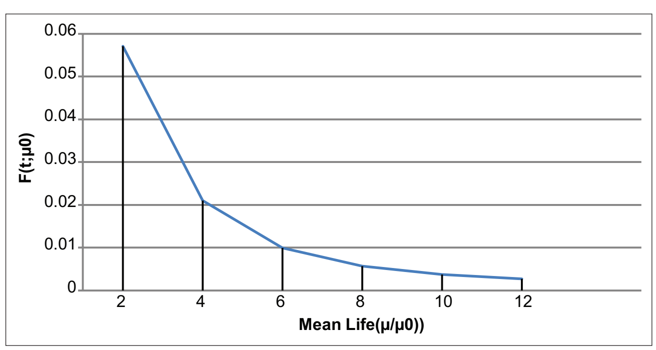

Figure 2: Effect of mean life on failure rate plot for studied distributions

RESULTS AND DISCUSSION

Product Failure Rate Analysis

The failure rate function h(t) was used to obtain the rate of failure of products that assume these distribution. This function can be used to characterize the performance of an item with time. The result for this analysis is shown in Tables 1 and 2 and Figures 1 and 2.

From Table 1 and Figure 1, Lomax distribution, the failure rate increases as the testing time increase.

Effect of Increasing Mean Ratio on Failure Rate of Life Distribution

Since the failure rate of the life distributions is known, the question is: How do we now reduce the failure rate of products that assume this distribution? Table 2 and Figure 2 show the effect of product's mean life on failure rate of the distribution.

From Table 2 and Figure 2, as the products' life ratio increases, the failure rate reduces. Weibull distribution had a sharp decrease in failure rate as the mean life increases.

Improved Minimum Sample Size

From existing literature, such as in Aslam and Shabaz,[4] Srinivasa,[2] and in Aslam *et al*.,[15] the acceptance number, acceptance maximum allowable percent defectives, and test ratio are conventionally set as follows: Acceptance number (c = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10), (= 0.75, 0.90, 0.95, and 0.990) and (t/μ_0 = 0.68, 0.942, 1.257, 1.571, 2.358, 3.141, and 3.972). A program written in R is used to generate the results.

Simulations for the Study

The minimum (optimal) sample size is obtained by first calculating the failure probability which is the probability that an item is classified as defective using the product life cdf (p) and there after substituting it into our modified minimum sample size formula with other parameters. A program was written in R to accomplish this task.

Table 3 displays the simulated values of the developed and modified sample sizes for the studied product life distribution under single truncated acceptance sampling plan.

From Table 3, the behavior of choice parameters from the sample size is as follows: The minimum sample sizes are smaller for lower acceptance number compared to a higher acceptance number for any combination of consumers' risk and experiment time ratio.

Operating Characteristics for Isolated Truncated Chain Deferred Sampling Plan

The generated design parameters for the proposed sampling plan are presented in Table 4.

From Table 4, the operating characteristics increase as the mean life ratio increases, which indicate that items with increased mean life will be accepted with higher probability compared with items with lower mean life ratio.

Product Mean Life Ratio

The product mean ratio values guide the producer at improving on product quality for acceptability with high probability and minimized producer's risk. For any given sampling plan and producer's risk, say α=0.05, the minimum value of $\frac{\mu}{\mu_O}$ is obtained. This is done by combining values of the sample size, acceptance number, maximum allowable percent defective, and experimental ratio in the simulation using developed program in R software.

From Table 5, as the experimental time ratio increases, the minimum ratio of true mean life to specified mean life increases. It decreases as the acceptance number increases with decrease in consumers' risk.

Table 3: Minimum sample size for Lomax distribution

β	***c***	$\frac{t}{\mu_0}$							
		0.628	**0.942**	**1.257**	**1.571**	**2.356**	**3.141**	**3.972**	**4.713**
0.25	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

(Contd...)

Table 3: *(Continued)*

β	c	$\frac{t}{\mu_0}$							
		0.628	0.942	1.257	1.571	2.356	3.141	3.972	4.713
0.10	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
0.05	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
0.01	0	4	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 4: Operating characteristics for ITDCSP for Lomax distribution

β	$\frac{t}{\mu_0}$	n	$\frac{t}{\mu_0}$					
			2	4	6	8	10	12
0.25	0.628	3	0.6343	0.650239	0.744285	0.798667	0.834031	0.858849
	0.912	3	0.574673	0.68239	0.79462	0.783044	0.812654	0.835165
	1.257	3	0.510403	0.634179	0.695012	0.737501	0.769485	0.794514
	1.571	3	0.449673	0.599518	0.661688	0.704637	0.737524	0.763752
	2.356	3	0.558911	0.623462	0.673669	0.712634	0.743497	0.768467
	3.141	3	0.540933	0.593036	0.637283	0.673683	0.703772	0.728935
	3.927	2	0.530185	0.572943	0.611738	0.64512	0.673658	0.698162
	4.712	2	0.523228	0.558911	0.593026	0.623462	0.650202	0.673669

(Contd...)

Table 4: ***(Continued)***

β	$\frac{t}{\mu_0}$	*n*	$\frac{t}{\mu_0}$					
			2	**4**	**6**	**8**	**10**	**12**
0.10	0.628	3	0.570349	0.569612	0.67807	0.743282	0.786649	0.817528
	0.912	3	0.574673	0.68239	0.751879	0.783044	0.812654	0.835165
	1.257	3	0.510403	0.634179	0.695012	0.737501	0.769485	0.794514
	1.571	3	0.449673	0.599518	0.661688	0.704637	0.737524	0.763752
	2.356	3	0.558911	0.623462	0.673669	0.712634	0.743497	0.768467
	3.141	3	0.540933	0.593036	0.637283	0.673683	0.703772	0.728935
	3.927	3	0.530185	0.572943	0.611738	0.64512	0.673658	0.698162
	4.712	2	0.523228	0.558911	0.593026	0.623462	0.650202	0.673669
0.05	0.628	4	0.496587	0.501878	0.619519	0.69292	0.742799	0.778822
	0.912	4	0.574673	0.68239	0.715912	0.783044	0.812654	0.835165
	1.257	4	0.510403	0.634179	0.695012	0.737501	0.769485	0.794514
	1.571	4	0.449673	0.599518	0.661688	0.704637	0.737524	0.763752
	2.356	4	0.558911	0.623462	0.673669	0.712634	0.743497	0.768467
	3.141	4	0.540933	0.593036	0.637283	0.673683	0.703772	0.728935
	3.927	3	0.530185	0.572943	0.611738	0.64512	0.673658	0.698162
	4.712	3	0.523228	0.558911	0.593026	0.623462	0.650202	0.673669
0.01	0.628	5	0.319894	0.395699	0.521256	0.605098	0.664429	0.708453
	0.912	5	0.474837	0.629594	0.656078	0.739198	0.771843	0.797172
	1.257	5	0.510403	0.634179	0.695012	0.737501	0.769485	0.794514
	1.571	4	0.449673	0.599518	0.661688	0.704637	0.737524	0.763752
	2.356	4	0.295886	0.525166	0.599552	0.644008	0.677491	0.704669
	3.141	4	0.540933	0.593036	0.637283	0.673683	0.703772	0.728935
	3.927	3	0.530185	0.572943	0.611738	0.64512	0.673658	0.698162
	4.712	3	0.523228	0.558911	0.593026	0.623462	0.650202	0.673669

Table 5: Minimum ratio of true mean life to specified mean life for Weibull distribution

β	*c*	$\frac{t}{\mu_0}$							
		0.628	**0.942**	**1.257**	**1.571**	**2.356**	**3.141**	**3.972**	**4.713**
0.25	0	26.518	2.3034	3.4555	4.159	5.1983	6.2402	7.2796	8.3188
	1	7.587	1.9268	2.5549	3.4072	3.6832	4.417	5.1706	5.9102
	2	4.690	1.7224	2.3261	2.8425	3.5537	3.6101	4.2123	4.8146
	3	3.654	1.6565	2.0623	2.4919	3.1153	3.7439	3.639	4.1736
	4	3.115	1.5706	2.0076	2.2457	2.8074	3.3693	3.2605	3.7286
	5	2.799	1.5106	1.8598	2.3026	2.5767	3.0941	3.6101	4.1356
	6	2.548	1.4643	1.8484	2.1501	2.3998	2.8785	3.3568	3.8388
	7	2.394	1.4276	1.7489	2.021	2.2512	2.6991	3.1586	3.6101
	8	2.257	1.4253	1.6625	1.9146	2.3935	2.5549	2.9824	3.4072
	9	2.150	1.399	1.6748	1.9857	2.2852	2.4319	2.8337	3.2373
	10	2.081	1.3757	1.6067	1.9026	2.1863	2.3202	2.7071	3.0941
0.10	0	11.170	2.5093	3.4555	4.6081	5.758	6.2402	7.2796	8.3188
	1	10.593	2.0576	2.7563	3.4072	4.2517	5.1125	5.9488	6.8446
	2	6.365	1.8335	2.4716	3.1046	3.5537	4.2517	4.9727	5.6883
	3	4.789	1.7422	2.2022	2.748	3.1153	3.7439	4.3535	4.9727

(Contd...)

Table 5: ***(Continued)***

β	c	$\frac{t}{\mu_0}$							
		0.628	**0.942**	**1.257**	**1.571**	**2.356**	**3.141**	**3.972**	**4.713**
0.10	4	3.956	1.6474	2.12	2.4919	3.1153	3.3693	3.9386	4.5045
	5	3.459	1.6095	1.9685	2.4851	2.8785	3.0941	3.6101	4.1356
	6	3.126	1.5545	1.9391	2.3261	2.6831	3.2258	3.3568	3.8388
	7	2.897	1.5106	1.9106	2.1915	2.5265	3.0321	3.1586	3.6101
	8	2.699	1.4981	1.8225	2.2183	2.6062	2.8785	3.3568	3.8388
	9	2.569	1.4667	1.8116	2.12	2.4851	2.7397	3.1918	3.6536
	10	2.445	1.4388	1.7455	2.0346	2.381	2.6212	3.0628	3.499
0.05	0	16.529	2.5725	3.6381	4.6081	5.758	6.9089	8.0606	9.2123
	1	13.021	2.1053	2.8969	3.6684	4.2517	5.1125	5.9488	6.8446
	2	7.463	1.9146	2.4716	3.1046	3.888	4.2517	4.9727	5.6883
	3	5.516	1.7762	2.3143	2.9343	3.4329	3.7439	4.3535	4.9727
	4	9.518	1.7094	2.2129	2.6831	3.1153	3.7439	3.9386	4.5045
	5	7.587	1.6385	2.0623	2.4851	2.8785	3.459	4.0258	4.6189
	6	4.690	1.6038	2.0165	2.4649	2.9061	3.2258	3.7594	4.2918
	7	3.654	1.5571	1.9771	2.3321	2.7397	3.0321	3.5398	4.0437
	8	3.115	1.5387	1.8907	2.2183	2.6062	2.8785	3.3568	3.8388
	9	2.799	1.5056	1.8713	2.2346	2.4851	2.9824	3.1918	3.6536
	10	2.548	1.4762	1.8044	2.145	2.5407	2.8604	3.0628	3.499
0.01	0	2.394	2.6645	3.7646	4.8515	6.0654	6.9089	8.0606	9.2123
	1	2.257	2.2183	3.0021	3.8551	4.5956	5.5157	5.9488	6.8446
	2	2.150	2.0121	2.6752	3.296	3.888	4.6664	5.4496	6.2344
	3	2.081	1.8907	2.4851	3.0836	3.6684	4.1169	4.8146	5.5157
	4	4.170	1.7867	2.3563	2.8249	3.3445	4.0258	4.3745	5
	5	10.593	1.7289	2.2075	2.748	3.1046	3.7286	4.0258	4.6189
	6	6.365	1.6872	2.145	2.584	3.0836	3.4855	4.0617	4.6425
	7	4.789	1.6356	2.0956	2.5478	2.9155	3.296	3.8388	4.3956
	8	3.956	1.6095	2.0032	2.4319	2.7732	3.126	3.6536	4.1736
	9	3.459	1.587	1.9728	2.3321	2.7902	3.1807	3.4855	3.973
	10	3.126	1.5571	1.9474	2.3261	2.6831	3.0525	3.3322	3.8066

CONCLUSION

An isolated truncated chain deferred sampling plan for Lomax product life distribution is proposed when the testing is truncated at a specified time. The optimal sample sizes obtained under a given maximum allowable percent defective, test termination ratios, and acceptance numbers. The operating characteristics formula of the proposed plan was developed. The operating characteristics and mean ratio were used to assess the performance of the plan. The study revealed that Lomax distribution has an increasing failure rate; also, as mean life ratio increases, the failure rate reduces, and the minimum sample size increases as the acceptance number, maximum allowable percent defective, and experiment time ratio increase.

This work has given an insight about the failure rate pattern and effect of mean life on the product that assumes Lomax distribution, thereby enriching producers and users of this distribution on information that will enhance decision making when using these distributions. The developed plan is economically preferred when the test is destructive, thereby saving both cost and time of testing. The study concludes that the modified required minimum sample sizes were smaller making it a more economical plan to be adopted when time and cost of production is expensive and the testing is destructive.

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