STATISTICAL DESIGN OF CONDITIONAL REPETITIVE GROUP SAMPLING PLAN BASED ON TRUNCATED LIFE TEST FOR PERCENTILE LIFETIME USING EXPONENTIATED GENERALIZED FRECHET DISTRIBUTION

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Abstract

Reliability Acceptance sampling plan is used to assess whether to accept or reject a product depending on its lifetime. An inspection carried out for the purpose of determining if lifetime inspections are performing properly can be tested by submitting a truncated lifetime test. In this paper describes a new approach on Conditional Repetitive Group Sampling Plan based on Truncated life test is proposed and the lifetime follows an Exponentiated Generalized Frechet Distribution. For each consumer risk, it is determined whether minimum sample sizes are required to assert a percentile life. It is calculated that the operating characteristic function values of the sampling plans as well as the producer's risk ratio corresponding to the sampling plans. The results are illustrated with numerical examples and a real-world data set is used to demonstrate the impact and performance of the suggested acceptance sampling plans.

Keywords: Conditional Repetitive Group Sampling Plan, Exponentiated Generalized Frechet Distribution, Producer's risk, percentile life.

1. Introduction

Quality items always need greater attention and must maintain the manufacturers' standards in the highly competitive worldwide market. In order to monitor the product quality, which is among the most important operations in industries, outgoing or incoming products are checked thoroughly. A method of quality control which uses statistical methods is known as statistical quality control. It may be categorized into process control and product control. Acceptance sampling is one of the statistical methods of statistical quality control. It is used to determine whether to accept or reject a decision based on the inspection of a sample of items from the lot. Reliability Acceptance sampling plan is used to determine to accept or reject based on lifetime of product. Truncated life test is adopted at which the test will terminated at a certain point of time in the sense that observing the lifetime of the products until it fails is not possible. It helps to minimize the inspection of time and cost. In acceptance sampling based on truncated life tests have the following assumptions: (i) the units are destructible or are degraded after the life test, and (ii) there are several distributions that model the product life reasonably well. The purpose of truncated life test used to save the inspection time and cost. A truncated life test may be conducted to determine the smallest sample size to ensure a certain percentile life of products when the life test is terminated at a preassigned time t_0, and the number of failures observed does not exceed a given acceptance number. For example, some production companies that routinely inspect and sample their products based on their production stages before they are released to market. Accepted lots are sent on for further processing, while rejected lots are either reworked or scrapped. The sampling plan process are carried out throughout the production process to ensure that the product meets the desired specifications. Regular audits are also conducted to make sure all quality standards are consistently met. Finally, customer feedback is used to improve the production process.

An Exponentiated Generalized Frechet Distribution is used in this paper to calculate a Conditional Repetitive Group Sampling plan based on a truncated life test. As part of acceptance sampling plans, it is important to find the minimum sample size, operating characteristics function, and producer's risk that exceeds the specified life of the product. Using the reliable life criterion as a basis for selecting the parameters of the plan, a methodological procedure is proposed for selecting the parameters of the plan with the desired discrimination protecting the interests of the producer and the consumer in terms of the acceptable reliable life and the unacceptable reliable life. As a measure of discrimination, the operating ratio is used to design the proposed reliability sampling plan.

In Reliability Acceptance Sampling Plan based on truncated life test using various distribution of review of literature given below: Epstein [5] has developed truncate life test in the Exponential cases. Goode and kao [6] have developed Sampling Plans Based on the Weibull Distribution. Gupta [7]has designed the life test sampling plans for Normal and Lognormal Distributions. Rosaiah and kantam [11] have progressed an acceptance sampling based on the Inverse Rayleigh Distribution. Rosaiah.et.al [12] have described the source of reliability of test plans for Exponentiated Log-Logistic Distribution. Balakrishnan et.al [4] have designed an acceptance sampling plan from truncated life tests based on the Generalized Birnbaum-Saunders Distribution. Aslam.et.al [3] have designed acceptance sampling plan using generalized exponential Distribution. Pradeepa Veerakumari.et.al [10] have developed for Exponentiated Rayleigh Distribution. Kaviyarasu et.al[9] have developed for Weibull-Poisson Distribution.

Robert Sherman [14] has introduced an inspection procedure and developed Repetitive Group Sampling (RGS) plans. Shankar and Mohapatra [13] have introduced the GERT Analysis of Conditional Repetitive Group Sampling Plan. Anburajan and Ramaswamy[2] have developed a Conditional Repetitive Group Sampling plan based on Truncated life test using Various distributions. Jayalakshmi and Kavyamani [8] have designed the Quick Switching conditional Repetitive Group Sampling Plan through quality decision Region.

Abd-Elfattah et.al [1] have developed a statistical distribution of Exponentiated Generalized Frechet Distribution. The real time application of Exponentiated Generalized Frechet Distributions are reliability studies, hydrology, finance and so on.

2. Exponentiated Generalized Frechet Distribution

The Cumulative Distribution Function of Exponentiated Generalized Frechet distribution is

$$F(x) = \left[1 - \left(1 - \exp - \left\{ \left(\frac{\sigma}{x}\right)^{\lambda} \right\}\right)^{\alpha}\right]^{\beta} \tag{1}$$

The Probability density function of Exponentiated Generalized Frechet distribution is

$$f(x) = \alpha\beta\lambda\sigma^{\lambda}x^{-(\lambda-1)} \exp\left[-\left(\frac{\sigma}{x}\right)^{\lambda}\right] \left\{1 - \exp\left[-\left(\frac{\sigma}{x}\right)^{\lambda}\right]\right\}^{\alpha-1} \left\{1 - \left[1 - \exp\left(-\left(\frac{\sigma}{x}\right)^{\lambda}\right)\right]^{\alpha}\right\}^{\beta-1} \tag{2}$$

Where, α, β, λ are Shape parameters and σ be a Scale parameter.
$Pr(T \leq t_q) = q$

$$t_q = \sigma \left[-\ln \left(1 - \left(1 - (1-u)^{\frac{1}{\beta}} \right)^{\frac{1}{\alpha}} \right) \right]^{-\frac{1}{\lambda}}$$
$$\varphi_q = \left[-\ln \left(1 - \left(1 - (1-u)^{\frac{1}{\beta}} \right)^{\frac{1}{\alpha}} \right) \right]^{-\frac{1}{\lambda}} \tag{3}$$

Replacing the scale parameter σ in equation (1) then we get Cumulative Distribution function for Exponentiated Generalized Frechet distribution is

$$F(x) = \left[1 - \left(1 - \exp - \left\{ \left(\frac{\sigma}{\varphi_q \delta_q} \right)^{\lambda} \right\} \right)^{\alpha} \right]^{\beta} \tag{4}$$

Taking a first derivative of partial differentiation with respect to δ_q, we get

$$\frac{\partial F(t,\delta_q)}{\partial \delta_q} = \frac{\mathrm{e}^{-\frac{1}{\varphi_q \delta_q}}}{\varphi_q \delta_q^2} \beta \left[1 - \left(1 - \exp \left\{ - \left(\frac{1}{\varphi_q \delta_q} \right)^{\lambda} \right\} \right)^{\alpha} \right]^{\beta - 1}$$
$$-\alpha \left[1 - \exp \left\{ - \left(\frac{1}{\varphi_q \delta_q} \right)^{\lambda} \right) \right]^{\alpha - 1} \cdot -\lambda \exp \left\{ - \left(\frac{1}{\varphi_q \delta_q} \right)^{\lambda - 1} \right\} \tag{5}$$

$\frac{\partial F(t,\delta_q)}{\partial \delta_q} > 0$.The cumulative distribution function $F(t, \delta_q)$ is a non- decreasing function of δ_q.

3. Conditional Repetitive Group Sampling Plan (CRGS) Based on Truncated Life Test

Conditional Repetitive Group sampling plan is the extension of Repetitive Group Sampling plan. The following notations similar to those of Sherman (1965), the proposed conditional RGS plan is carried out through the following steps:

3.1. Conditions for the application of CRGS

- The production is steady, so the results of previous, present, and future lots can be used as broad indicators of a process that will continue into the future.
- It is possible to submit isolated lots or a series of lots.
- Inspection is by attributes, when lot quality is defined as the proportion of defective.
- Variation in lot quality may exist.
- Lot has at least one defective unit.
- Lots submitted for inspection may be of low quality.

3.2. Operating procedure of Conditional Repetitive Group Sampling plan

- Step 1: Draw a random sample of size n and determine the number of defectives d found therein.
- Step 2: Accept the lot, if $d \leq c_1$. Reject the lot, if $d > c_2$.

- Step 3: If $c_1 < d \leq c_2$, repeat the steps (1), (2) and (3) provided previous 'i' lots are accepted (i.e. in each of the previous 'i' lots $d \leq c_1$); otherwise reject the lot.

The proposed plan parameters are $(n, c_1, c_2, i, \frac{t}{t_q})$ Where, i=acceptance criterion, Figure 1 repre-

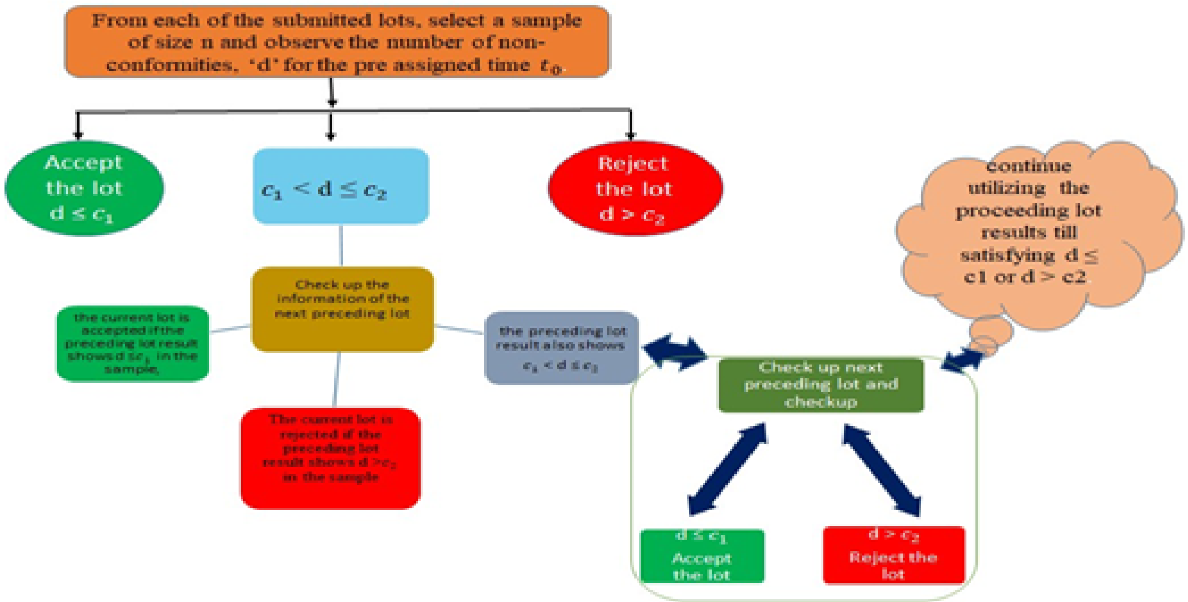

Figure 1: *Flow Chart of operating procedure of Conditional Repetitive Group Sampling Plan based on Truncated Life Test*

sents the Operating Procedure of Conditional Repetitive Group Sampling Plan based on Truncated Life test.We have used binomial models to determine the number of samples. The Operating Characteristics function of Conditional Repetitive Group Sampling Plan is,

$$L(P) = \frac{P_1}{1 - P_3 P_1^i} \tag{6}$$

$$\boldsymbol{L(P)} = \frac{\sum_{i=0}^{c_1} \binom{n}{i} p^i (1-p)^i}{\mathbf{1} - \left[\sum_{i=0}^{c_2} \binom{n}{i} p^i (1-p)^i - \sum_{i=0}^{c_1} \binom{n}{i} p^i (1-p)^i \right] \left[\sum_{i=0}^{c_1} \left(\begin{array}{c} n_i \end{array} \right) p^i (1-p)^i \right]^i} \tag{7}$$

Where,

$$\begin{gathered} P_1 = \sum_{i=0}^{c_1} \binom{n}{i} p^i (1-p)^i \\ P_2 = 1 - \sum_{i=0}^{c_2} \binom{n}{i} p^i (1-p)^i \\ P_3 = 1 - P_1 - P_2 \end{gathered} \tag{8}$$

The failure probability is expressed as 'p'. As a result of the cumulative distribution function of the lifetime distributions, these failure probabilities can be determined. These probabilities can then be used to estimate the percentile lifetime of a product. They can also be used to assess the reliability of a product, as well as the risk of failure.

3.3. Minimum Sample Size

Our sampling plan parameters are $(n, c_1, c_2, i, \frac{t}{t_q})$ for a given Probability of acceptance P*. We determine that acceptable exhaust sized lots are possible, as well as that the binomial distribution may be used. The study is designed to determine the minimum sample size 'n' necessary to ensure that $t_q < t_q^0$.

$$\boldsymbol{L(P)} = \frac{\sum_{i=0}^{c_1} \binom{n}{i} p^i (1-p)^i}{\boldsymbol{1} - \left[\sum_{i=0}^{c_2} \binom{n}{i} p^i (1-p)^i - \sum_{i=0}^{c_1} \binom{n}{i} p^i (1-p)^i\right] \left[\sum_{i=0}^{c_1} \binom{n}{i} p^i (1-p)^i\right]^i} \leq \boldsymbol{1} - \boldsymbol{P}^* \tag{9}$$

Where, P* is the Probability of acceptance.

The minimum sample size n is determined by calculating the binomial distribution, where n is the number of samples, c_1 is the number of successes in n trials, c_2 is the number of failures in n trials, i is the acceptance criterion and $\frac{t}{t_q}$ is the number of successes that are expected in n trials.

As shown in Table 1, the Exponentiated Generalized Frechet Distribution requires a minimum sample size n to exceed the actual 50^{th} percentile value.

Table 1: *The minimum sample size n for the specified 50^{th} percentile value of the Exponentiated Generalized Frechet Distribution exceeding the actual 50^{th} percentile value , with probability p^* and acceptance number c using binomial approximation.*

P^*	i	c_1	c_2	$\frac{t}{t_q}$				
				0.9	1	1.1	1.2	1.3
0.75	1	0	1	19	3	1	1	1
	1	0	2	20	3	2	2	2
	1	1	1	36	5	3	2	2
	1	1	2	37	5	3	2	2
	1	1	3	38	5	3	3	3
	3	0	1	20	2	1	1	1
	3	0	2	21	3	2	2	2
	3	1	1	37	5	3	2	2
	3	1	2	38	6	3	2	2
	3	1	3	40	7	5	3	3
0.90	1	0	1	30	4	2	1	1
	1	0	2	32	6	4	2	2
	1	1	1	51	7	4	2	2
	1	1	2	53	7	5	2	2
	1	1	3	54	7	3	3	3
	3	0	1	30	4	2	1	1
	3	0	2	32	5	2	2	2
	3	1	1	52	7	3	2	2
	3	1	2	53	8	6	2	2
	3	1	3	54	9	7	3	3
0.95	1	0	1	39	5	3	1	1
	1	0	2	40	6	4	2	2
	1	1	1	63	8	4	3	3
	1	1	2	64	9	5	4	3
	1	1	3	65	10	7	4	3
	3	0	1	41	6	3	2	2
	3	0	2	42	7	3	2	2
	3	1	1	64	9	4	3	2
	3	1	2	65	10	6	4	3
	3	1	3	66	12	7	4	3
0.99	1	0	1	60	7	3	2	2
	1	0	2	62	8	4	2	2
	1	1	1	88	11	5	3	3
	1	1	2	89	12	6	4	3
	1	1	3	90	13	7	5	4
	3	0	1	62	8	3	2	2
	3	0	2	65	10	6	2	2
	3	1	1	89	12	5	3	3
	3	1	2	90	13	6	4	3
	3	1	3	92	15	7	4	3

3.4. Operating Characteristic Function

The operating characteristic curve plots the relationship between the probability of acceptance of a product and the specified lifetime of that product. It is required that the operating characteristic function of the Conditional Repetitive Group sampling plan satisfy the following equation,

$$\boldsymbol{L(P)} = \frac{\sum_{i=0}^{c_1} \binom{n}{i} p^i (1-p)^i}{\mathbf{1} - \left[\sum_{i=0}^{c_2} \binom{n}{i} p^i (1-p)^i - \sum_{i=0}^{c_1} \binom{n}{i} p^i (1-p)^i\right] \left[\sum_{i=0}^{c_1} \binom{n}{i} p^i (1-p)^i\right]^i} \tag{10}$$

Where, $p = F(t, \delta)$ and δ can be indicated as a function of $\delta = \frac{t}{t_q}$

$$\therefore p = F\left(\frac{t}{t_q} \cdot \frac{1}{d_q}\right) \tag{11}$$

Where $d_q = \frac{t_q}{t_q^0}$.

The operating characteristic curve helps to identify the optimal sample size for a sampling plan. It can also be used to compare different sampling plans and determine which one is more efficient. Table 2 represents the values of operating Characteristic function for using the acceptance numbers $c_1 = 0, c_2 = 2$ and i=1,3 .

3.5. Producer's Risk Ratio

A producer's risk is explained as the probability of rejecting a lot when a lot has a rejection rate $t_q > t_q^0$. Consider the case of a given producer's risk, say α . Table 3 represents the minimum ratio of true lifetime to specified lifetime for the acceptability of a lot with producer's risk of 0.05. Producer's risk ratio, which is based on the Conditional Repetitive Group Sampling plan in the ratio of the specified lifetime to the actual lifetime. It must meet the following conditions:

$$\boldsymbol{L(P)} = \frac{\sum_{i=0}^{c_1} \binom{n}{i} p^i (1-p)^i}{\mathbf{1} - \left[\sum_{i=0}^{c_2} \binom{n}{i} p^i (1-p)^i - \sum_{i=0}^{c_1} \binom{n}{i} p^i (1-p)^i\right] \left[\sum_{i=0}^{c_1} \binom{n}{i} p^i (1-p)^i\right]^i} > \mathbf{1} - \boldsymbol{\alpha} \tag{12}$$

Where, $p = F(\frac{t}{t_q} \cdot \frac{1}{d_q})$

4. Applications

4.1. Numerical Illustration

We consider the inspector wants to conduct the inspection for lifetime of battery in Laptop and he suggests to use the Exponentiated Generalized Frechet distribution with pre-determined known shape parameters are $\alpha = 3$, $\beta = 6$ and $\lambda = 6$. Figure 2 represents the images of battery for Laptop. The investigator wants to run the experiment for 2700 hours, but the laboratory has testers to true percentile life time $t_{0.50} = 3000$ hours, $c_1 = 0, c_2 = 2$, i=3 $\alpha = 0.05$,$\beta = 0.10$,then,$\phi = 1.7045$ is computed from the equation get under the percentile estimator and the minimum ratio and the minimum sample size is n=3 get the information from the Table 1.
The probability of acceptance is given by $(n, c_1, c_2, i, t/t_{0.50}) = (3, 0, 2, 31.1)$ with p^* = 0.95 under the Exponentiated Generalized Frechet distribution.

Table 4 represents the Operating Characteristic values with p* = 0.95 under Exponentiated Generalized Frechet Distribution. Figure 3 represents the Operating Characteristic curve for

Table 2: *Operating Characteristic values for Conditional Repetitive Group sampling Plan $(n, c_1 = 0, c_2 = 2, t/t_{0.50})$ for a given p^* under Exponentiated Generalized Frechet distribution.*

P^*	i	n	$\frac{t}{t_q}$	t_q/t_q^0					
				1	1.1	1.2	1.25	1.3	1.4
0.75	1	20	0.9	0.2498	0.9997	1.0000	1.0000	1.0000	1.0000
	1	3	1	0.1399	0.9112	1.0000	1.0000	1.0000	1.0000
	1	2	1.1	0.0271	0.3108	0.9950	0.9998	1.0000	1.0000
	1	2	1.2	0.0019	0.0342	0.6472	0.9113	0.9994	1.0000
	1	2	1.3	0.0001	0.0031	0.1227	0.3108	0.8845	0.9985
	1	21	0.9	0.2020	0.9991	0.1000	0.1000	0.1000	0.1000
	3	3	1	0.1268	0.8199	0.9999	1.0000	1.0000	1.0000
	3	2	1.1	0.0264	0.2552	0.9862	0.9995	1.0000	1.0000
	3	2	1.2	0.0019	0.0342	0.6472	0.9113	0.9994	1.0000
	3	2	1.3	0.0001	0.0031	0.1227	0.3108	0.8845	0.9985
0.90	1	32	0.9	0.0906	0.9993	1.0000	1.0000	1.0000	1.0000
	1	6	1	0.0161	0.7092	0.9999	1.0000	1.0000	1.0000
	1	4	1.1	0.0006	0.0662	0.9802	0.9994	1.0000	1.0000
	1	2	1.2	0.0019	0.0342	0.6472	0.9113	0.9994	1.0000
	1	2	1.3	0.0001	0.0031	0.1227	0.3108	0.8845	0.9985
	3	34	0.9	0.0868	0.9981	0.1000	0.1000	0.1000	0.1000
	3	5	1	0.0319	0.6520	0.9999	1.0000	1.0000	1.0000
	3	2	1.1	0.0264	0.2552	0.9862	0.9995	1.0000	1.0000
	3	2	1.2	0.0019	0.0331	0.5159	0.8191	0.9984	1.0000
	3	2	1.3	0.0001	0.0031	0.1108	0.2552	0.7781	0.9958
0.95	1	40	0.9	0.0479	0.9989	1.0000	1.0000	1.0000	1.0000
	1	6	1	0.0161	0.7092	0.9999	1.0000	1.0000	1.0000
	1	4	1.1	0.0006	0.0662	0.9802	0.9994	1.0000	1.0000
	1	2	1.2	0.0019	0.0342	0.6472	0.9113	0.9994	1.0000
	1	2	1.3	0.0001	0.0031	0.1227	0.3108	0.8845	0.9985
	3	42	0.9	0.0404	0.9967	0.1000	0.1000	0.1000	0.1000
	3	7	1	0.0080	0.5148	0.9999	1.0000	1.0000	1.0000
	3	3	1.1	0.0043	0.1268	0.8704	0.9990	1.0000	1.0000
	3	2	1.2	0.0019	0.0331	0.5159	0.8191	0.9984	1.0000
	3	2	1.3	0.0001	0.0031	0.1108	0.2552	0.7781	0.9985
0.99	1	62	0.9	0.0087	0.9975	1.0000	1.0000	1.0000	1.0000
	1	8	1	0.0040	0.5695	0.9999	1.0000	1.0000	1.0000
	1	4	1.1	0.0006	0.0662	0.9802	0.9994	1.0000	1.0000
	1	2	1.2	0.0019	0.0342	0.6472	0.9113	0.9994	1.0000
	1	2	1.3	0.0001	0.0031	0.1227	0.3108	0.8845	0.9985
	3	89	0.9	0.9985	0.9999	0.1000	0.1000	0.1000	0.1000
	3	12	1	0.0090	0.7167	1.0000	1.0000	1.0000	1.0000
	3	6	1.1	0.0033	0.1114	0.9984	0.9999	1.0000	1.0000
	3	4	1.2	0.0005	0.0208	0.6963	0.9618	0.9999	1.0000
	3	3	1.3	0.0003	0.0091	0.2604	0.5284	0.9808	0.9999

Table 3: *Minimum ratio of true lifetime to specified lifetime for the acceptability of a lot with producer's risk of 0.05*

P^*	i	c_1	c_2	$\frac{t}{t_q}$				
				0.9	1	1.1	1.2	1.3
0.75	1	0	1	1.0307	1.0792	1.1147	1.2160	1.3175
	1	0	2	1.0290	1.0747	1.1600	1.2655	1.3710
	1	1	1	1.0297	1.0684	1.1401	1.1995	1.2992
	1	1	2	1.0232	1.0531	1.1161	1.1563	1.2528
	1	1	3	1.0211	1.0477	1.1098	1.2105	1.3115
	3	0	1	1.0388	1.0741	1.1406	1.2443	1.3478
	3	0	2	1.0390	1.0905	1.1801	1.2874	1.3946
	3	1	1	1.0304	1.0686	1.1399	1.1993	1.2994
	3	1	2	1.0275	1.0711	1.1290	1.1811	1.2796
	3	1	3	1.0278	1.0772	1.1652	1.2295	1.3320
0.90	1	0	1	1.0546	1.1130	1.1929	1.2560	1.3606
	1	0	2	1.0529	1.1224	1.2192	1.2966	1.4047
	1	1	1	1.0521	1.1085	1.1922	1.2817	1.3885
	1	1	2	1.0421	1.0888	1.1788	1.1913	1.2907
	1	1	3	1.0381	1.1071	1.1343	1.2375	1.3406
	3	0	1	1.0618	1.1251	1.2101	1.2832	1.3901
	3	0	2	1.0620	1.1309	1.2087	1.3187	1.4286
	3	1	1	1.0526	1.1086	1.1747	1.2465	1.3503
	3	1	2	1.0457	1.1015	1.1976	1.2156	1.3166
	3	1	3	1.0446	1.1038	1.2026	1.2562	1.3611
0.95	1	0	1	1.0678	1.1330	1.2271	1.2788	1.3854
	1	0	2	1.0651	1.1343	1.2332	1.3146	1.4244
	1	1	1	1.0650	1.1271	1.2101	1.3031	1.4117
	1	1	2	1.0524	1.1092	1.1913	1.2846	1.3664
	1	1	3	1.0486	1.1071	1.2014	1.2759	1.3575
	3	0	1	1.0760	1.1496	1.2416	1.3379	1.4493
	3	0	2	1.0751	1.1520	1.2403	1.3364	1.4477
	3	1	1	1.0654	1.1311	1.2104	1.3031	1.3790
	3	1	2	1.0560	1.1192	1.2088	1.2951	1.3807
	3	1	3	1.0544	1.1232	1.2127	1.2916	1.3773
0.99	1	0	1	1.0912	1.1652	1.2550	1.3542	1.4675
	1	0	2	1.0890	1.1642	1.2603	1.3513	1.4624
	1	1	1	1.0883	1.1624	1.2525	1.3416	1.4538
	1	1	2	1.0710	1.1377	1.2232	1.3130	1.3994
	1	1	3	1.0653	1.1328	1.2222	1.3036	1.3910
	3	0	1	1.0978	1.1757	1.2679	1.3695	1.4850
	3	0	2	1.0974	1.1768	1.2885	1.3690	1.4838
	3	1	1	1.0876	1.1636	1.2506	1.3412	1.4534
	3	1	2	1.0729	1.1439	1.2307	1.3196	1.4107
	3	3	3	1.0714	1.1455	1.2327	1.3162	1.4069

Figure 2: *Image of laptop battery*

Table 4: $(n, c_1, c_2, i, \frac{t}{t_{0.50}}) = (3, 0, 2, 3, 1.1)$ *with* $p^* = 0.95$ *under Exponentiated Generalized Frechet Distribution*

$\frac{t_{0.50}}{t^0_{0.50}}$	1	1.1	1.2	1.25	1.3	1.4
L(p)	0.0043	0.1268	0.8904	0.9790	1.0000	1.0000

truncated lifetest using Exponentiated Generalized Frechet distribution.
It reveals that if the true 50th percentile is almost equal to the true 50th percentile ($t_{0.50}/t^0_{0.50} = 1.2$) the producer's risk nearly 0.9957 (1-0.0043). The producer's risk is an almost nearly equal to Zero whenever the actual 50^{th} percentile is greater than or equal to 1.2 times the specified 50^{th} percentile.

4.2. Real Data Study

According to Lawless (2012), consider the real data study for lifetime for brake pads to predetermine the minimum of thickness of product. In this study follows lifetime distribution of Exponentiated Generalized Frechet Distribution with known shape Parameters. The values of data as follows:

First, we check the goodness of fit for given data. The Kolmogorov-Smirnov test, Anderson-Darling test, Shapiro-Wilk's normality test, Histogram, box-plot and the Q-Q plot are all considered for goodness of fit.

Figure 7 graphically represents the Histogram satisfies the Normality of the given data. We get the result of Kolmogorov Smirnov test statistic is 0.999, Anderson Darling test is 0.94590 and the Shapiro-Wilk test is 0.95462. Figure 6 represents the graphically satisfies the Q-Q plot and

38.7,	49.2,	42.4,	73.8,	46.7	,44.1,	61.9,	39.3,	49.8,	46.3,	56.2,
50.5,	54.9,	54,	49.2,	44.8,	72.2,	107.8,	81.6,	45.2,	124.6,	64,
83,	143.6,	43.4,	69.6,	74.8,	32.9,	51.5,	31.8,	77.6,	63.7,	83,
24.8,	68.8,	68.8,	89.1,	65,	65.1,	59.3,	53.9,	79.4,	47.4,	61.4,
72.8,	61.4,	72.8,	54,	37.2,	44.2,	50.8,	65.5,	86.7,	43.8,	100.6,
67.6,	89.5,	60.3,	103.6,	82.6,	88,	42.4,	68.9,	95.7,	78.1,	83.6,
18.6,	92.6,	42.4,	34.3,	105.6,	68.9,	78.7,	165.5,	79.5,	55,	46.8,
124.5,	92.5,	110,	101.2,	59.4,	27.8,	33.6,	69,	75.2,	58.4,	105.6,
56.2,	55.9,	83.8,	123.5,	69,	101.9,	87.6,	38.8,	74.7		

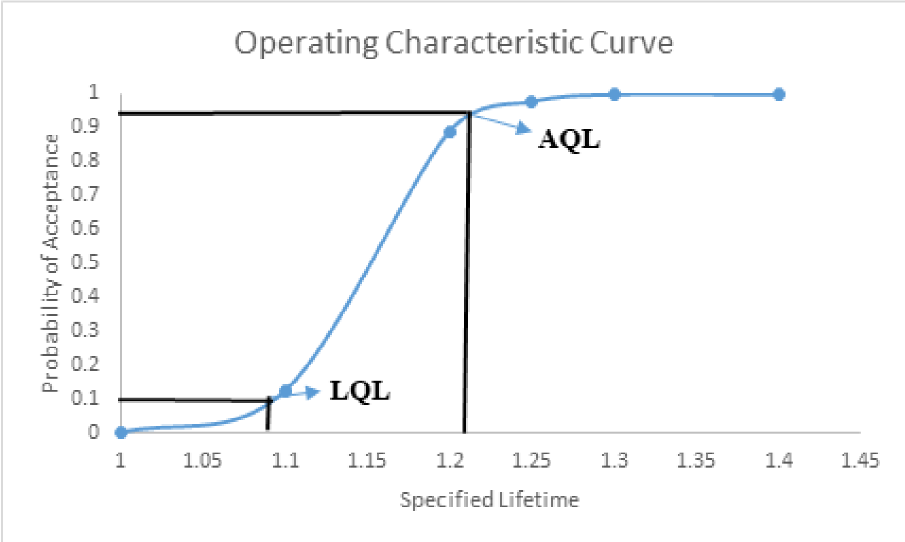

Figure 3: *Operating Characteristic Curve for Exponentiated Generalized Frechet Distribution*

Figure 5 represents the box plot of the given data. Hence, the data provides reasonable goodness of fits for data set.

Assume that the inspector wants to inspect the lifetime of brake pad and he interested to using Double Sampling plan follows lifetime as Exponentiated Generalized Frechet Distribution. He wants to conduct the runtime of experiment is 2600hrs but the laboratory has the testers to true percentile life time $t_{0.10} = 2450$ hrs. $c_1 = 0, c_2 = 2$, Producer's Risk $(\alpha) = 0.05$, Consumer's Risk $(\beta) = 0.10$, i=1 then, $\phi = 1.704$ is computed from the equation get under the percentile estimator and the minimum ratio, $t/t_q = 1$ and minimum sample size is n =7 get the information from the Table 1. The probability of acceptance is characterized by $((n, c_1, c_2, i, t/t_0.50) = (7, 0, 2, 3, 1)$ with $P^* = 0.95$ under Exponentiated Generalized Frechet the values of tables are given. Since there were no items with a failure time less than or equal to 2600 hours in the given sample of n= 7 observations, the experimenter would accept the lot, assuming the 50^{th} percentile lifetime $t_{0.50}$ of at least 2450 hours with a confidence level of $P^{\bar{}} = 0.95$.

5. Construction of tables

Step 1: Find the value of ϕ for fixing the values of parameters are λ, β,α and q=0.50.Set the evaluated ϕ=1.0745, $c_1 = 0, 1, c_2 = 1, 2, 3$ and $\frac{t}{t_q}$= 0.9, 1,1.1, 1.2, 1.3 and 1.4.

Step 2: Find the minimum value of n satisfying

$$\boldsymbol{L(P)} = \frac{\sum_{i=0}^{c_1} \begin{pmatrix} n \\ i \end{pmatrix} p^i (1-p)^i}{\boldsymbol{1} - \left[\sum_{i=0}^{c_2} \begin{pmatrix} n \\ i \end{pmatrix} p^i (1-p)^i - \sum_{i=0}^{c_1} \begin{pmatrix} n \\ i \end{pmatrix} p^i (1-p)^i\right] \left[\sum_{i=0}^{c_1} \begin{pmatrix} n \\ i \end{pmatrix} p^i (1-p)^i\right]^i} \leq \boldsymbol{1 - P^*}$$

Step 3: Find the operating characteristic function of the Conditional Repetitive Group sampling plan must satisfy,

$$\boldsymbol{L(P)} = \frac{\sum_{i=0}^{c_1} \begin{pmatrix} n \\ i \end{pmatrix} p^i (1-p)^i}{\boldsymbol{1} - \left[\sum_{i=0}^{c_2} \begin{pmatrix} n \\ i \end{pmatrix} p^i (1-p)^i - \sum_{i=0}^{c_1} \begin{pmatrix} n \\ i \end{pmatrix} p^i (1-p)^i\right] \left[\sum_{i=0}^{c_1} \begin{pmatrix} n \\ i \end{pmatrix} p^i (1-p)^i\right]^i}$$

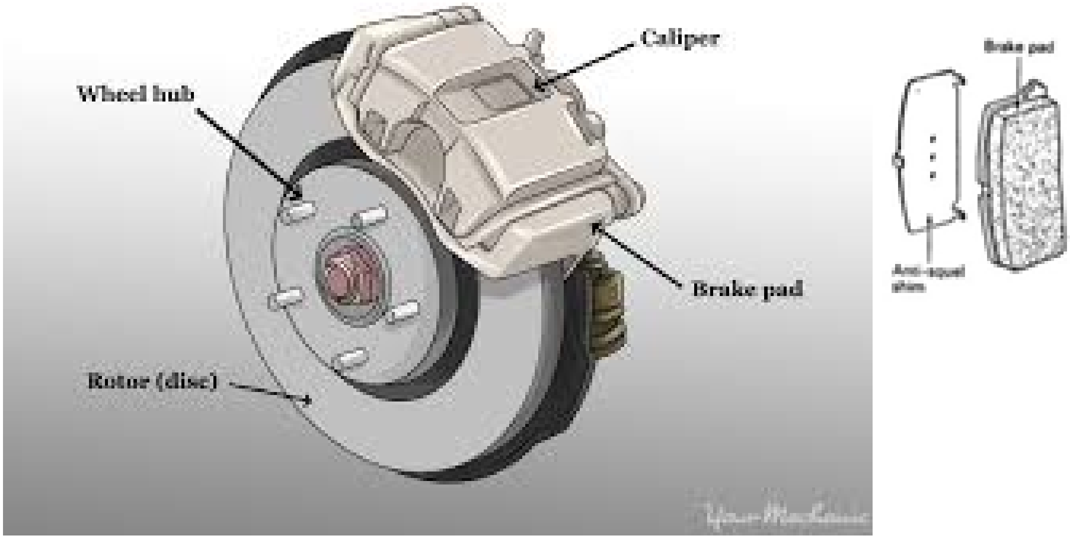

Figure 4: *Image of brakepads*

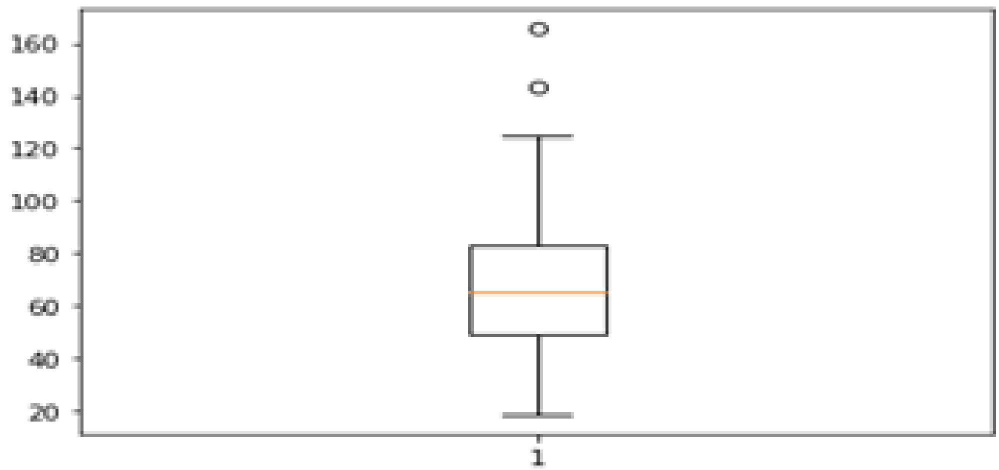

Figure 5: *Box Plot*

Where $d_q = \frac{t_q}{t_q^0}$. Set the evaluated $\frac{t_q}{t_q^0}$=1,1.1, 1.2, 1.25, 1.3 and 1.4.

Step 4: Find the minimum ratio for the acceptability of a lot with producer's risk must satisfy the condition is,

$$\boldsymbol{L(P)} = \frac{\sum_{i=0}^{c_1}\begin{pmatrix} n \\ i \end{pmatrix} p^i(1-p)^i}{\mathbf{1} - \left[\sum_{i=0}^{c_2}\begin{pmatrix} n \\ i \end{pmatrix} p^i(1-p)^i - \sum_{i=0}^{c_1}\begin{pmatrix} n \\ i \end{pmatrix} p^i(1-p)^i\right]\left[\sum_{i=0}^{c_1}\begin{pmatrix} n \\ i \end{pmatrix} p^i(1-p)^i\right]^i} > \mathbf{1} - \boldsymbol{\alpha}$$

Where, $p = F(\frac{t}{t_q} \cdot \frac{1}{d_q})$

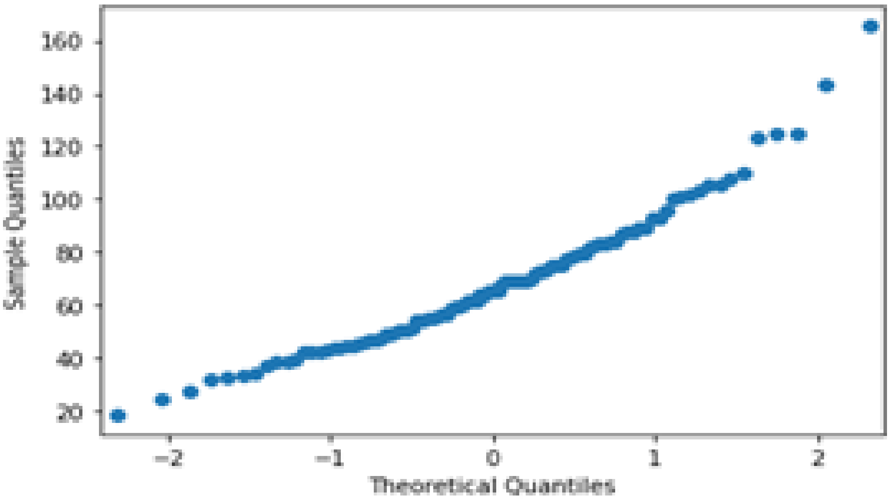

Figure 6: *Q-Q plot*

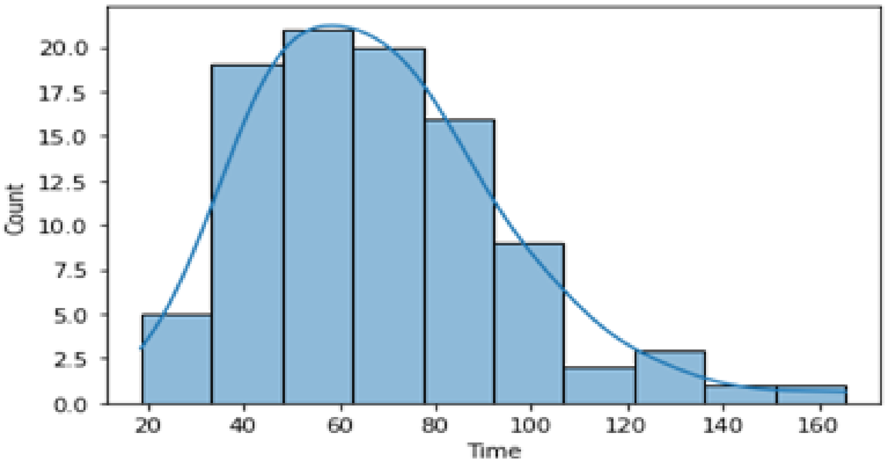

Figure 7: *Histogram*

6. Conclusion

In this article deals with Conditional Repetitive Group Sampling plan are designed when the lifetimes of the items follow Exponentiated Generalized Frechet Distribution. Conditional Repetitive group sampling plan is quite flexible and reliable.This sampling plan can also be used to increase the accuracy of the life tests. It can also help to reduce the sample size, which in turn can help reduce the costs associated with the life tests. According to the results of this study, as the time termination ratio increase, the sample size decreases. Further, it has been shown that there is an increase in the operating characteristic values when the quality is improved. So, it is strongly suggested that industrial practitioners test electrical components using the proposed plan. This plan is also cost-effective and efficient, making it an ideal choice for industrial practitioners. It can be easily adjusted to fit different production requirements. The study will also concentrate the effectiveness of the sampling plan in terms of accuracy and precision. Finally, the study will provide recommendations for future research.

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