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Economic reliability design methods for Generalized Exponential - Poisson Distribution

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Abstract - This article presents, a new three parameter compound distribution named as Generalized Exponential-Poisson distribution is developed towards the performance measures of reliability sampling plan under minimum total cost analysis. Single Acceptance sampling plan is proposed for the truncated life test when the life time of the item follows the GEP distribution. The minimum sample size are obtained when the consumers risk and test termination time are specified. The Operating Characteristic values and sensitivity analysis of the cost parameters are also exhibited for the specified percentile accompanying with the economic designing of the plan. Minimum Total cost function values are given and the results are discussed with the help of table values and it reveals with the suitable real time example.

Keywords: Consumer's risk, Generalized Exponential –Poisson distribution, Minimum Total cost, Percentiles, Truncated life test plan.

INTRODUCTION

Acceptance sampling plan is an essential and inevitable techniques in Statistical Quality Control. Here, sampling plan are widely used in industry and government sector for controlling the quality of the shipments of products. Acceptance sampling plan retains accurate decision about the lot based on the sample inspection, it neither takes the chance with zero percent nor hundred percent inspection at arriving a good decision about the lot. Quality of the products will always vary even the product manufacturing under the same Man, Machine, Material and Method. Even though these 4 M's are perfect, sometimes the product lost its quality due to random fluctuations. Therefore, manufactured product are to be undergone to its inspection to check the product meets it significant or insignificant variations. The significant variation affects the quality of the product such as the life time of the product directly. Henceforth the necessary action must be taken before the product reach the customer. The probability that the device will function over a specified period of time or amount of usage at stated condition is termed as reliability sampling plan. In the truncated life test plan the units are randomly selected from a lot of products are subjected to a set of test procedures. The test may get terminated before the pre specified time or at the time or beyond the time. For such a truncated life test plan and the associated decision rule we are interested in obtaining the smallest sample size when the life time of an item follows the Generalized Exponential –Poisson distribution.

The main purpose of the sampling plan is to save the cost and time of the experiment and to reach a decision more precisely. The priority of any sampling plan is the reduction of cost and time which is to be more efficient method than the other methods which provides with the least sample size. The proposed sampling plans are essential needed if the product under inspection is destructive in nature. Here it is not possible to test all the items which are manufactured and to test the failure time of an item. So sampling plans are inevitable in such circumstances and acceptance sampling plan for life test are studied. In this case single sampling plan are widely used in industries or government organizations for the submitted products for its possible acceptance or rejection of the lot is taken on the basis of single sample.

DESCRIPTION OF THE PROBLEM

Quality control is an emerging field in every walk of our life. A proper quality control techniques aims to protect both the producer and consumer simultaneously. It tries to make fulfil the consumer needs by providing the quality of the item at the same time protecting the producer products are more acceptable in the market. Reliability is playing an important role in manufacturing industries. The term reliability means the constant performance of the electronic components with less repair within the stated conditions. The customer demands on high reliable products with the lowest cost in the market. Sampling inspection through this methodology is an important way in maintain the high reliable product. For instance if one is interested in testing the average failure time of electronic products. The acceptance sampling plan makes it more convenient to apply in such situation, a suitable sampling plan can be applied based on the statistical distribution under life testing experiments a random sample of items are selected and tested from a lot a decision is arrived either to accept or not to accept the lot.

Life tests are studied to check the life time of the products through the number of failure occurs during the test period. In life testing, it is not always possible to identify the life time of all the products due to time and cost. The truncated life test plans derives the solution for this problem to reduce the time as well as cost. To reduce the inspection cost and time, truncated life test plans are terminated at a pre-specified time have been introduced.

In life testing, number of failures observed at a pre-specified time. To arrive at a good decision, the appropriate measure to be needed to thoroughly study about the distribution. Symmetrical distribution reflects clearly by the Measures of central distribution such as mean, median and mode. In the case of asymmetrical distribution, a precise measure, percentile derives a better solution. It split the whole distribution into 100 equal parts. In this study, 25th percentile taken into account.

REVIEW OF LITERATURE

Many authors elicit their results from the various distribution under percentile lifetime such as Lio et al.(2009)[10]discussed that a small decrease in the mean life from a lot could be accepted after inspection. But the material strengths of products are deteriorated significantly and may not meet the consumer's expectation such problem will not occur in percentiles. Gupta, S.S. and Groll, P.A.(1961)[5] explain the life test in Gamma Distribution . Aslam et al.(2007)[2] proposed Economic reliability test plans using the generalized exponential distribution. Aslam.M., Kundu.D and Ahmad.M. (2010)[1] for Time truncated acceptance sampling plans for generalized exponential distribution. According to Rao and Kantam (2010)[13],Acceptance Sampling plans for truncated life tests based on the log-logistic distribution for percentiles. Rao *et al*. (2012)[12] also developed Acceptance Sampling plans for percentiles based on the Inverse Rayleigh Distribution. Tsai, T.R. and Wu, S.J. (2006)[14]for Acceptance sampling based on truncated life tests for generalized Rayleigh distribution. Kaviyarasu and Fawaz (2017)[7,8]developed Acceptance Sampling Plans for Percentiles Based on the Modified Weibull Distribution and Weibull-Poisson distribution.

The vital objective of this study is to find the optimal sample size which minimizes total cost of the inspection in Truncated Acceptance Sampling plan for the Generalized Exponential–Poisson Distribution through specified percentile lifetime. It is an economic design in Truncated Acceptance sampling plan and a kind of safeguard for both the consumer as well as producer. The total cost of the inspection per lot for the acceptance sampling plan includes appraisal cost, internal failure cost and external failure cost are considered.

GENERALIZED EXPONENTIAL-POISSON(GEP) DISTRIBUTION

Gupta and Kundu (1999)[4] introduced the generalized exponential (GE) distribution (also known as Exponentiated Exponential distribution). Kus (2007) [9]introduced a two parameter distribution known as Exponential-Poisson (EP) Distribution, which has a decreasing failure rate. Further Wagner Barreto-Souza and Francisco Cribari-

Neto (2009)[15] generalize the distribution known as Generalized Exponential-Poisson (GEP). Also interpreted as the GEP distribution can be used to model the maximum lifetimes of random EP samples. Moreover, This distribution is much suitable for physical interpretation if there are n components in a parallel system and the lifetime of the components follows identically and independently GEP distributed random variable, then the system lifetime also follows the GEP law.

The Cumulative Distribution Function of the GEP is given as

$$F(x;\theta) = \left(\frac{1-e^{-\lambda+\lambda\exp(-\beta x)}}{1-e^{-\lambda}}\right)^{\alpha} \quad (1)$$

The Probability density function of GEP is

$$f(x;\theta) = \frac{\alpha\lambda\beta}{(1-e^{-\lambda})^{\alpha}}\{1-e^{-\lambda+\lambda\exp(-\beta x)}\}^{\alpha-1}e^{-\lambda-\beta x+\lambda\exp(-\beta x)} \quad (2)$$

Where θ=(α, β, λ), α is the shape parameter , β is the scale parameter of the Exponential distribution and λ is the Poisson parameter.

The q^{th} percentile , t_q derived from the expression (1) is given by,

$$tq = -\beta^{-1}\ log\left(1+\lambda^{-1}\ log\left(1-q^{1/\alpha}(1-e^{-\lambda})\right)\right)$$

Since tq and q are directly proportional

$$\text{Let}\quad \phi = -\,log\left(1+\lambda^{-1}\ log\left(1-q^{1/\alpha}(1-e^{-\lambda})\right)\right) \quad (3)$$

$$\Rightarrow tq = \phi/\beta$$

$$\Rightarrow \beta = \phi/t_q \quad (4)$$

The cumulative distribution function becomes by replacing the scale parameter by (4)

$$F(t) = \left(1-\ e^{-\lambda+\lambda\ exp\left(t/t_q .\phi\right)}\right)^{\alpha}\left((1-e^{-\lambda})^{-1}\right)^{\alpha} \quad , \quad t > 0,\ \phi > 0$$

Let $\psi = t/t_q$

$$F(t;\psi) = \left(1-\ e^{-\lambda+\lambda\ exp(\psi .\phi)}\right)^{\alpha}\left((1-e^{-\lambda})^{-1}\right)^{\alpha} \quad , \ t > 0, \psi > 0 \quad (5)$$

PERCENTILE LIFETIME UNDER GEP LAW:

In the manufacturing industry, there is no contradiction in such a way that the Single sampling plan is the widely used one to identify the flaws in the product by the producer. Since the products are classified as either good or bad item, the lifetime of the product follows Binomial distribution with (n, c, p). As we know that n is the sample size, c is the acceptance criteria and here p follows GEP distribution with the parameter of t/t_q^0.

Where t = Pre-specified time, t_q^0 =specified percentile life time.

Hence the single acceptance truncated life test plan follows the triplet (n, c, t/t_q^0).

DESIGNING PLAN USING MINIMUM TOTAL COST

In this section, Minimum sample size of Single Acceptance Truncated Life Test plan which minimizes the total cost of the inspection process with satisfying the consumer's confidence level are obtained. The sensitivity of the costs parameters are also calculated for the given specified percentile.

The lot will be accepted when $t_q \geq t_q^0$, Otherwise it is rejected. That is, the product will attain the consumer's expectation if the true percentile lifetime of the product exceeds the specified one, the lot will be accepted without ignoring any product.

The sample size n can be obtained by testing the hypothesis $tq>t_q^0$ for the specified values of p* and c must satisfy the inequality,

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

The consumer's risk (Probability of accepting a bad lot) should not exceed $1 - p^*$.

Since the probability p* is the confidence level , the probability of rejecting a bad lot with $tq<t_q^0$ is at least equal to p*.

The probability of acceptance for single acceptance sampling truncated life test plan under Binomial model,

$$\sum_{i=0}^{c} \binom{n}{i} p^i (1-p)^{n-i} = L(p) \qquad (6)$$

Where p is the probability of finding a failure item before the specified time exist in terms of cumulative distribution function of GEP through percentile lifetime is given by

$$p = F(t, \psi_0)$$

The smallest positive integer n which is require to be satisfy,

$$L(p) \leq 1\text{-}p^* \qquad (7)$$

Multiple solutions exist for the smallest positive integer n, which is satisfying the inequality (7) for the L(p) values defined in (6). Here the concept of minimum total cost is incorporated with consumer's confidence level to derive at a unique solution of the minimum sample size.

MINIMUM TOTAL COST

Hsu(2009)[6] designed an economic model to determine the optimal sampling plan that minimizing the producer's total cost. . Malathi, D. and Muthulakshmi, S. (2016)[11] studied Truncated life test acceptance sampling plans assuring percentile life under Gompertz distribution with the minimum total cost. In the acceptance sampling inspection, let D_d denote the defective items detected and D_n denote the defective items that are not detected. Hence for any sampling inspection plan,

$D_d = ASN * p$ and $D_n = (N - ASN) * p * L(p)$

The producer's total cost of the inspection for any lot includes the appraisal cost C_a, internal failure cost C_o and external failure cost C_e. Hence the mathematical model of designing truncated acceptance sampling life test plan in the economic design of the plan is given by

$Minimize\ TC = C_a\ ASN + C_o D_d + C_e D_n$

Subject to $L(p) \leq 1\text{-}p^*$

(8)

Where p^* (= 0.75, 0.90,0.95,0.99)is the consumer's confidence level, $C_a = 1.0$,

C_o= 2.0 and C_e = 10 and N=500 as in Hsu (2009)

Under the inequality (7) and (8), one can reveals that the optimal sample size n is obtained which minimizes total cost of the inspection and the risk of consumer through the percentile lifetime.

OPERATING CHARACTERISTIC (OC) FUNCTION

The operating characteristic function strive to show the discrimination power of a sampling plan through the probability of acceptance. The OC function of Acceptance sampling truncated life test plan

(n, c , ψ_0) is given as

$$\sum_{i=0}^{c} \binom{n}{i} p^i (1-p)^{n-i} = L(p) \qquad (9)$$

Where p = F (t,ψ),

F (t, ψ) is a function of $\psi = {}^{t}/_{t_q}$.

Here, p = F (t, ψ) in (5) replaced as $p = F\left(\frac{t}{t_q^0}\frac{t_q}{t_q^0}\right)$ in (5), One can obtain the operating characteristic values by using the (9) for any given value p*.

Operating Characteristic values of (n, c = 2, ${}^{t}/_{t_q^0}$) are obtained here with the given values of α=2, λ=2 according to the minimum total cost tabulated in **Table(6)**

TABULATED VALUES:

Substitute α=2 , λ=2 and q = 0.25 in the equation (3) , ϕ value calculated as 0.33283.

Substitute $\beta = {}^{\phi}/_{t_q}$ in the equation (4), and then obtain p = F (t, ψ).

Obtain the optimal sample size ‘ n’ incorporate with the minimum total cost for the given value of p* by satisfying the inequality and presented in **Table (2)**

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

Obtain the OC values by using the following equation

$$\sum_{i=0}^{c} \binom{n}{i} p^i (1-p)^{n-i} = L(p)$$

REAL TIME EXAMPLE

This real life example extracts from the Guangbin Yang[3] p-270, such that the failure time of small electronic module are given. The type of a small electronic module at a use temperature of 35^0 C, three groups of modules were tested at 3 different temperatures 100^0, 120^0 and 150^0 C. Here an example consider at 120^0 C with 8 units whereas the test time -censored at 4500 hours as

120, 1121, 1572, 2329, 2573, 2702, 3702, 4277

This data set is assumed to follow GEP distribution. Suppose the experimenter wants to interprets that the unknown 25th percentile to be at least 3000 hours with a confidence level of p*= 0.75 and test terminates at 4500.

Hence with the ratio t/t_q^0 becomes $t/t_{0.25}^0 = \frac{4500}{3000} = 1.5$ and c=2

The proposed plan obtained as (n=8, c =2, $t/t_{0.25}^0 = 1.5$)with Minimum TC = 461.24.

Here one can reveals from the above example, for a given lifetime of the electronic module, out of the 8 modules 2 modules fails before 3000 hours accept the lot or else (that is more than 2 modules fails before 3000 hours) reject the lot.

Table 1: OC values under GEP for p*=0.75

t/t_q^0	1	1.5	2	2.5	3	3.5	4	4.5	5
L(p)	0.2388	0.6007	0.8125	0.9109	0.9556	0.9767	0.9871	0.9925	0.9955

This OC values shows that ,If the true 25th percentile is equal to the required 25th percentile.ie. $t/t_{0.25}^0$ =1 , The producer’s risk is approximately equal to 0.7612 which is 1-0.2388.

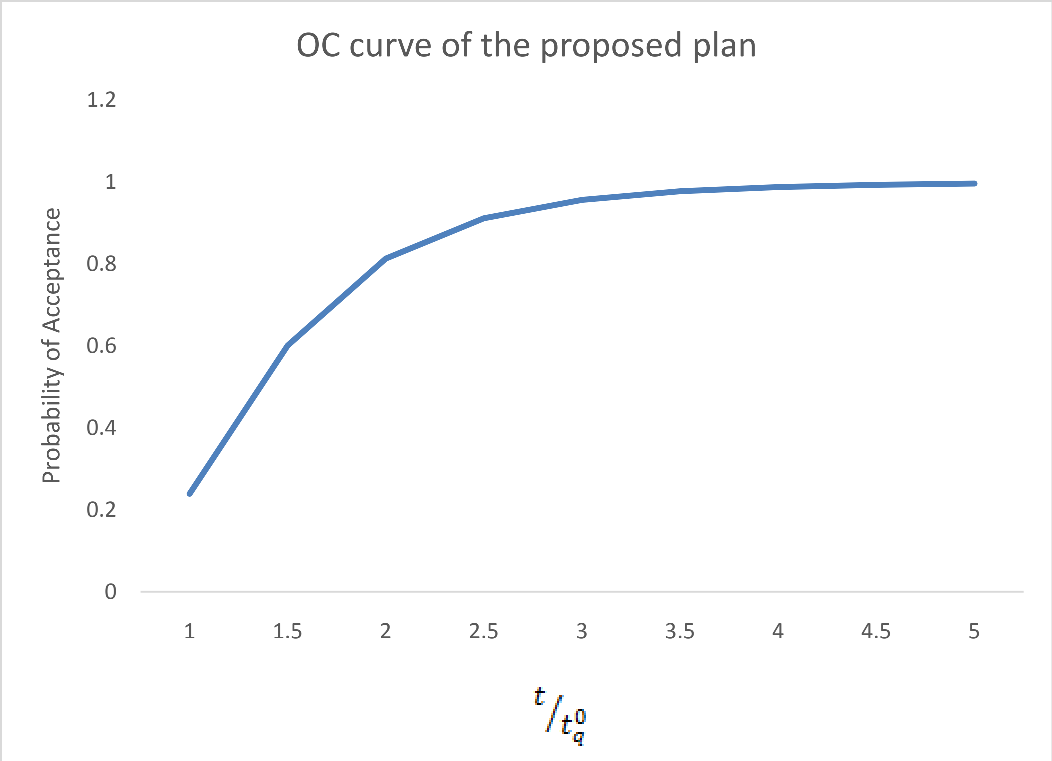

Fig. 1: OC curve for the sampling plan (n=8, c =2, $t/t_{0.25}^0$ = 1.5)**with** P*=0.75**.**

SENSITIVITY ANALYSIS

Sensitivity of the cost parameters C_a ,C_o and C_e are studied here to designing truncated life acceptance sampling plan. Table (3) shows the sensitivity analysis of the appraisal cost C_a whenC_o and C_e are keeping as constant. Table(4) shows the sensitivity of the internal failure cost C_o whenC_a and C_e are keeping as constant. Table (5) shows the sensitivity of the external failure cost C_e whenC_a and C_o are keeping as constant. These sensitivity analysis reveals that the cost parameters have no significant effect on the minimum sample sizes of the proposed life test sampling plan.

CONCLUSION

In this article , An economic based sampling plan is developed to obtain the Minimum Total cost have been designed for the Truncated Acceptance Life Test plan based on Generalized Exponential-Poisson Distribution. This paper elaborates with percentile lifetime which gives more precision than the average life time of the item. Here, the minimum sample size and OC values are obtained for the proposed plan with respect of reducing the risk of the consumers and inspection cost to the producer. The tables exhibited here are useful for the Industry's reference. The table values reveal that sample size increases for various levels of P* and decreases for increase in ψ_0 when other parameters are fixed. Sensitivity analysis carried over to explain more depth about cost analysis related with sample size. Real time example explains the selection of the plan.

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Table: 2: Optimal sample size for Single acceptance sampling truncated life test plan with Minimum Total Cost ensuring 25th percentile life time under GEP distribution for α=2 and λ=2.

P*	c	ψ_0									
		0.5		0.75		1.0		1.25		1.5	
		n	TC	n	TC	n	TC	n	TC	N	TC
0.75	0	15	132.32	8	199.00	6	301.77	4	340.24	4	439.26
	1	28	143.52	16	225.18	10	314.15	8	345.74	6	448.91
	2	42	156.54	22	233.24	15	309.06	12	417.67	8	461.24
	3	54	166.92	29	237.30	21	316.00	15	383.42	13	473.14
	4	67	176.33	36	239.54	24	329.66	20	355.64	15	582.04
	5	79	193.03	43	240.96	29	316.42	22	390.61	18	448.91
	6	92	201.88	50	256.61	33	337.72	26	421.55	22	475.27
	7	103	212.98	56	256.38	38	324.62	29	389.86	23	492.36
	8	115	224.35	62	268.61	43	341.75	32	413.97	26	511.88
	9	126	237.89	69	268.44	47	357	35	435.56	29	524.77
0.90	10	139	249.13	75	279.04	51	343.18	39	406.14	32	536.96
	0	23	74.09	13	90.58	8	135.29	7	113.08	5	166.65
	1	41	89.18	22	103.12	15	136.47	11	149.81	10	170.25
	2	56	106.55	30	115.42	20	139.76	15	164.36	13	191.47
	3	70	122.57	38	123.64	25	151.93	20	171.12	15	210.40
	4	84	139.76	46	137.39	30	160.39	23	172.94	18	222.80
	5	98	152.78	53	141.20	35	166.37	27	173.26	22	231.43
	6	111	167.30	59	157.64	40	170.92	30	191.98	25	236.91
	7	124	183.33	67	160.74	45	175.13	34	193.42	28	240.31
	8	137	196.50	74	175.43	50	178.27	38	198.78	31	242.87
	9	149	210.79	81	177.65	55	194.19	41	211.81	34	244.48
0.95	10	162	224.78	87	190.02	59	209.25	44	230.43	37	245.35
	0	31	59.68	16	63.18	11	85.05	8	81.61	8	49.02
	1	49	79.52	26	74.57	17	86.22	13	90.70	12	61.94
	2	66	98.02	35	90.35	23	93.50	18	107.78	15	82.86
	3	81	115.43	43	96.94	29	108.42	21	117.65	18	99.51
	4	96	133.14	52	107.26	35	108.85	26	125.82	21	113.25
	5	110	149.15	60	116.71	41	110.54	30	131.23	24	124.76
	6	124	165.08	68	125.78	46	118.95	34	135.01	27	134.35
	7	138	180.87	74	135.20	49	132.89	37	136.91	30	142.33
	8	152	196.68	82	145.92	55	140.61	41	140.25	33	149.43
0.99	9	165	211.89	90	153.81	59	145.78	45	142.91	37	155.98
	10	178	226.56	96	162.74	65	146.27	48	157.35	39	160.89
	0	48	61.13	25	41.64	17	36.03	12	40.36	10	37.87
	1	69	85.82	37	57.21	24	49.25	18	42.60	14	42.33
	2	86	106.60	46	69.48	31	58.34	23	50.84	18	50.04
	3	104	126.96	57	83.03	37	65.85	28	61.78	23	56.51
	4	120	146.44	64	93.86	43	76.30	32	66.21	25	64.70
	5	136	164.66	73	105.44	49	84.40	36	74.58	29	68.72
	6	152	183.41	81	116.10	54	91.71	41	82.46	33	77.35
	7	167	201.24	90	127.47	59	100.20	45	89.95	36	80.06
	8	182	219.00	97	137.58	66	108.72	48	95.14	39	87.29
	9	195	234.81	106	148.46	71	116.64	53	102.38	43	94.96
	10	210	252.44	112	157.76	75	123.77	57	109.57	46	101.36

Table 3: Sensitivity of appraisal cost c_a on minimum sample size of single acceptance sampling truncatedlife test plan for c =5 under GEP distribution for α=2 and λ=2.

Ca	P*	ψ_0									
		0.5		0.75		1		1.25		1.5	
		n	TC	n	TC	n	TC	n	TC	n	TC
1.5	0.75	80	229.77	43	262.70	29	331.15	23	402.46	18	458.22
	0.90	98	202.61	52	174.10	35	184.09	27	216.46	22	197.03
	0.95	110	203.91	60	146.42	41	130.82	30	145.65	25	138.22
	0.99	136	233.49	74	142.82	49	108.64	36	92.60	29	83.38
2.5	0.75	79	308.76	43	306.26	29	396.93	22	423.79	18	476.13
	0.90	98	300.22	54	221.99	35	219.43	27	243.46	22	264.33
	0.95	110	314.86	58	207.10	40	169.77	30	175.35	24	186.89
	0.99	135	367.01	73	214.28	48	155.64	37	129.98	29	117.53
7.5	0.75	78	701.05	43	533.18	29	506.92	22	535.10	18	671.70
	0.90	98	790.35	52	488.96	35	396.14	27	377.11	23	333.92
	0.95	110	865.26	59	500.56	40	375.75	30	323.85	25	287.26
	0.99	136	1047.10	72	572.46	48	395.64	37	313.13	29	258.00
10	0.75	80	905.72	43	639.61	29	580.13	22	590.64	18	612.45
	0.90	97	1026.40	53	620.14	35	484.50	27	443.94	22	426.54
	0.95	110	1141.40	59	649.16	40	474.75	30	398.10	24	342.93
	0.99	135	1378.90	72	752.46	48	515.64	36	398.01	29	331.75

Table 4: Sensitivity of Internal failure cost c_o on minimum sample size of single acceptance sampling truncatedlife test plan for c =5 under GEP distribution for α=2 and λ=2.

C_o	P*	ψ_0									
		0.5		0.75		1		1.25		1.5	
		n	TC	n	TC	n	TC	n	TC	n	TC
1.5	0.75	80	185.97	44	237.64	29	312.92	22	387.07	18	445.26
	0.90	98	149.68	53	143.97	35	162.00	27	168.67	22	227.34
	0.95	110	143.49	59	114.78	41	105.47	30	109.71	24	147.23
	0.99	135	157.61	73	98.65	48	77.64	36	68.14	29	68.77
2.5	0.75	79	193.28	43	260.11	29	320.24	22	394.32	18	452.47
	0.90	99	158.00	52	152.38	35	170.83	27	207.73	22	235.97
	0.95	110	153.75	58	124.27	40	123.30	30	135.64	24	156.65
	0.99	135	170.21	73	111.11	48	89.64	36	79.88	29	80.15
7.5	0.75	78	232.80	43	296.42	29	356.73	22	430.53	18	488.49
	0.90	97	203.37	52	197.14	35	215.01	27	251.30	22	279.13
	0.95	110	205.04	59	171.53	40	172.80	30	184.06	24	203.73
	0.99	135	233.16	73	173.37	48	149.64	36	138.57	29	137.05
10	0.75	80	249.04	43	314.58	29	375.14	22	448.64	18	506.50
	0.90	99	227.20	52	219.51	35	237.10	27	243.61	22	300.71
	0.95	110	230.69	58	199.00	41	191.66	30	193.30	24	227.28
	0.99	135	264.64	73	204.50	48	179.64	36	167.91	29	165.49

Table 5: Sensitivity of External failure cost c_e on minimum sample size of single acceptance sampling truncatedlife test plan for c =5 under GEP distribution for α=2 and λ=2.

Ce	P*	ψ_0									
		0.5		0.75		1		1.25		1.5	
		n	TC	n	TC	n	TC	n	TC	n	TC
5	0.75	80	142.04	44	149.98	29	180.19	22	213.70	18	240.66
	0.90	98	134.52	53	109.76	35	109.27	27	123.50	22	135.35
	0.95	111	140.67	58	98.814	40	88.88	30	89.93	24	97.27
	0.99	136	163.58	73	101.39	49	78.58	36	66.74	29	62.97
15	0.75	79	243.01	43	356.34	29	452.90	22	567.69	18	657.01
	0.90	98	170.57	52	186.67	35	250.56	27	282.97	22	327.96
	0.95	110	157.66	59	134.36	40	147.83	30	171.66	24	206.62
	0.99	137	167.45	73	108.37	48	89.46	36	81.30	29	76.98
50	0.75	79	592.23	44	972.62	29	1407.24	22	1806.67	18	2114.00
	0.90	98	296.77	53	458.28	35	620.01	27	840.20	22	1002.10
	0.95	111	221.90	59	283.45	40	354.15	30	457.71	24	450.29
	0.99	136	179.26	73	132.87	48	130.20	37	133.09	29	166.45
100	0.75	79	1091.00	42	2051.60	29	2770.42	22	3576.62	18	4195.40
	0.90	99	477.27	52	845.72	35	1187.01	27	1636.24	22	1965.16
	0.95	110	311.48	58	487.85	40	648.90	30	866.34	24	1136.08
	0.99	136	196.24	73	167.63	48	188.40	37	205.66	29	217.37

Table 6:Operating Characteristic values of single acceptance sampling truncated life test plan for c=2 with minimum sample size under GEP distribution for α=2 and λ=2.

P*	δ0	n	Single Acceptance sampling Plan (c=2)								
			t_q / t_q^0								
			1	1.5	2	2.5	3	3.5	4	4.5	5
0.75	0.5	42	0.2363	0.6723	0.8769	0.9513	0.9790	0.9902	0.9950	0.9973	0.9985
	0.75	22	0.2498	0.6622	0.8651	0.9439	0.9748	0.9878	0.9937	0.9965	0.9980
	1.0	15	0.2361	0.6297	0.8413	0.9303	0.9674	0.9837	0.9914	0.9952	0.9972
	1.25	12	0.1954	0.5683	0.7986	0.9058	0.9538	0.9761	0.9870	0.9925	0.9955
	1.5	8	0.2388	0.6007	0.8125	0.9109	0.9556	0.9767	0.9871	0.9925	0.9955
0.90	0.5	56	0.0959	0.4924	0.7767	0.9034	0.9561	0.9787	0.989	0.9940	0.9965
	0.75	30	0.0935	0.4606	0.7446	0.8826	0.944	0.9718	0.985	0.9916	0.9951
	1.0	20	0.0913	0.4337	0.7151	0.8622	0.9315	0.9644	0.981	0.9889	0.9934
	1.25	15	0.0882	0.4087	0.6866	0.8413	0.9182	0.9562	0.975	0.9857	0.9914
	1.5	13	0.0610	0.3326	0.6130	0.7897	0.8856	0.9362	0.9630	0.9780	0.9864
0.95	0.5	66	0.0476	0.3806	0.6979	0.8612	0.9344	0.9674	0.9828	0.9905	0.9945
	0.75	35	0.0479	0.3540	0.6633	0.8359	0.9188	0.9581	0.9773	0.9871	0.9924
	1.0	23	0.0492	0.3357	0.6357	0.8138	0.9042	0.9490	0.9717	0.9836	0.9901
	1.25	18	0.0374	0.2812	0.5735	0.7673	0.874	0.9302	0.9600	0.9763	0.9855
	1.5	15	0.0289	0.2361	0.5156	0.7201	0.8413	0.9088	0.9463	0.9674	0.9796
0.99	0.5	86	0.0107	0.2128	0.5405	0.7634	0.8799	0.9373	0.9659	0.9807	0.9886
	0.75	46	0.0099	0.1846	0.4905	0.7199	0.8501	0.9185	0.9542	0.9734	0.9839
	1.0	31	0.0084	0.1556	0.4378	0.6715	0.8151	0.8953	0.9393	0.9638	0.9777
	1.25	23	0.0082	0.1402	0.4035	0.6357	0.7869	0.8754	0.9259	0.9548	0.9717
	1.5	18	0.0089	0.1353	0.3855	0.6133	0.7673	0.8606	0.9153	0.9474	0.9666

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