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A Hybrid Group Acceptance Sampling Plan for Lifetimes Based on Transmuted Rayleigh Distribution

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Abstract: In this article, a hybrid group acceptance sampling plan (HGASP) is introduced for a truncated life test when the lifetime of an item follows transmuted rayleigh distribution. For specified consumer's risk, test termination time and group size, the minimum number of testers and acceptance number are determined. The operating characteristic values according to various quality levels are presented. The minimum ratios of the true average life to the specified life at the specified producer's risk are also found. The results are explained with examples. A comparative study of proposed hybrid group acceptance sampling plan based on transmuted rayleigh distribution with existing hybrid group acceptance sampling plan based on transmuted exponential distribution is also performed.

Key words: *Transmuted Rayleigh Distribution, Hybrid Group Acceptance Sampling Plan (HGASP), Consumer's risk, Operating characteristics (OC), Producer's risk, Truncated Life Test.*

I. INTRODUCTION

The acceptance sampling is a sampling inspection in which the consumer decides to accept or to reject a lot of products shipped by the producer, based on the results of a random sample selected from the lot. An acceptance sampling plan is a specified plan that establishes the minimum sample size to be used and the associated acceptance and non acceptance criteria for the lot. So, an acceptance sampling plan consists of the number of units on test (n) and the acceptance number (c) such that if there are atmost c failures out of n, the lot is accepted. The consumer's and producer's risks are then the probabilities that a bad lot is accepted and a good lot is rejected, respectively. An acceptance sampling plan is applied when the inspection of every item is not physically possible or if it is too expensive. It is an important point to choose a plausible distribution to represent the lifetime of an electronic item. The selection of an appropriate life test sampling scheme is a difficult decision because a good plan not only can help producers save testing time, cost, energy and labor, but it summers to purchase. There are various sampling plans available in literature, which may be used to decide the quality level of items. Actually, in an ordinary acceptance sampling plan only single items are inspected, but if several items are inspected simultaneously by a tester, the items put into the testers can be treated as a group. Any acceptance sampling plan that follows this type of pattern is called group acceptance sampling plan (GASP). The method of determining the minimum number of testers for a predetermined number of groups is called as Hybrid Group Acceptance Sampling Plan (HGASP). Hybrid group acceptance sampling plan is based on truncated life test assuming that the lifetime of a product follows a specific probability model. Some ordinary acceptance sampling plans are discussed by Baklizi (2003) [3], Epstein (1954) [4], Goode and Kao (1961) [6]. Srinivasa Rao (2009) for generalized exponential distribution [7], Srinivasa Rao (2010) for marshall-olkin extended lomax distribution are proposed the group acceptance sampling plan based on truncated life test [8]. Subba Rao, Naga durgamamba and kantam (2014) developed a hybrid group acceptance sampling plan for size biased lomax model [10].

The objective of this study is to develop a Hybrid Group Acceptance Sampling Plan (HGASP) based on truncated life test when the lifetime of an item follows the Transmuted Rayleigh Distribution introduced by Faton Merovci (2013) [5]. The Probability Density Function (p.d.f) and Cumulative Distribution Function (c.d.f) of Transmuted Rayleigh Distribution are given respectively

$$g(t;\sigma,\lambda)=\frac{t}{\sigma^2}\, e^{-\left(\frac{t^2}{2\sigma^2}\right)}\left(1-\lambda+2\lambda e^{-\left(\frac{t^2}{2\sigma^2}\right)}\right) \qquad \ldots\ldots\ldots\ldots\ldots(1)$$

$$G_T(t;\sigma,\lambda) = \left(1-e^{-\left(\frac{t^2}{2\sigma^2}\right)}\right)\left(1+\lambda e^{-\left(\frac{t^2}{2\sigma^2}\right)}\right) \quad \ldots\ldots\ldots\ldots\ldots(2)$$

where t>0, σ>0, | $\lambda \leq 1$|, σ and λ are scale and shape parameters, respectively. The mean of this distribution is given by $\mu = \frac{1}{2}\sigma\sqrt{\pi}\left[\lambda+\sqrt{2}\,(1-\lambda)\right]$. For λ=0.3, the mean is given by μ=1.1432 σ. For λ=0.5, the mean is given by μ=1.0698 σ. For λ=0.9, the mean is given by μ=0.9229 σ. For λ=1, the mean is given by μ=0.8862 σ. Construction of hybrid group acceptance sampling plan for transmuted rayleigh distribution is presented in section II. The operating characteristic values in section III. Producer's risk is given in section IV. The results are explained with some examples in some section V. The comparative study is presented in section VI. Concluding remarks are given in section VII.

II. DESIGN OF THE PROPOSED SAMPLING PLAN

We are interested in designing a group sampling plan in order to assure that the mean life of an item in a lot (μ, say) is greater than the specified life μ_0 with known shape parameter. A lot of products or items are considered to be "good" if the true average life μ is greater than the specified life μ_0. We will accept the lot if $\mu \geq \mu_0$ at a certain level of consumer's risk. Otherwise, we have to reject the lot. The following hybrid group acceptance sampling plan based on the truncated life test is proposed.

- Find the number of testers 'r' and allocate the 'r' items to each pre-specified 'g' groups. The required sample size for a lot in the truncated life test is n=gr.
- Specify the acceptance number 'c' for every group and the termination time t_0.
- Accept the lot if atmost c failures occur in each of all groups
- Terminate the experiment and reject the lot if more than 'c' failures are found in each group.

If r=1, the proposed HGASP convert to the ordinary acceptance sampling plan and we can say that the proposed HGASP is an extension of the ordinary plans available in the literature. Our concern is to find the number of testers 'r', required for transmuted rayleigh distribution and different values of acceptance number 'c' whereas the number of groups 'g' and the test termination time t_0 are considered to be pre-specified. For convenience, we will consider that the test termination time as a multiple of the specified value of μ_0 which is written as t_0 =a μ_0, for a given constant 'a' (truncated time).

The probability of rejecting a good lot is called producer's risk, whereas the probability of accepting a bad lot is known as the consumer's risk. When determining the parameters of the proposed sampling plan, we will use the consumer's risk. Often, the consumer's risk is expressed by the consumer's confidence level. If the confidence level is p^*, then the consumer's risk will be $\beta = 1 - p^*$. We will determine the number of groups in the proposed sampling plan so that the consumer's risk does not exceed β. According to the HGASP, the lot of products is accepted only if there are atmost c failures observed in each of the g groups.

Table 1: Consumer's risk (β), truncated time (a), group size (g) and acceptance number (c)

β	a	g	c
0.25	0.7	2	0
0.10	0.8	3	1
0.05	1.0	4	2
0.01	1.2	5	3
	1.5	6	4
	2.0	7	5
		8	6
		9	7
		10	8

The HGASP is characterized by the three parameters. The lot acceptance probability is:

$$L(P) = \left[\sum_{i=0}^{c}\binom{r}{i}p^i(1-p)^{r-i}\right]^g \quad \ldots\ldots\ldots(3)$$

where, p is the probability that an item in a tester fails before the termination time t_0 = a μ_0. The probability p for the transmuted rayleigh distribution with λ=0.3 is given by:

$$P = G_T(t_0)= \left[1-e^{-0.6534a^2/(\mu/\mu_0)^2}\right]\left[1+0.3\left(e^{-0.6534a^2/(\mu/\mu_0)^2}\right)\right] \text{ for } t>0 \ldots\ldots (4)$$

Since the probability p for λ=0.5 is given by:

$$P = G_T(t_0)= \left[1 - e^{-0.5722a^2/(\mu/\mu_0)^2}\right]\left[1 + 0.5\left(e^{-0.5722a^2/(\mu/\mu_0)^2}\right)\right] \text{ for } t>0 \quad \ldots\ldots (5)$$

Since the probability p for λ=0.9 is given by:

$$P = G_T(t_0)= \left[1 - e^{-0.4259a^2/(\mu/\mu_0)^2}\right]\left[1 + 0.9\left(e^{-0.4259a^2/(\mu/\mu_0)^2}\right)\right] \text{ for } t>0 \quad \ldots\ldots (6)$$

Since the probability p for λ=1 is given by:

$$P = G_T(t_0)= 1-\left[e^{-0.3926a^2/(\mu/\mu_0)^2}\right]^2 \quad \text{for } t > 0 \quad \ldots\ldots(7)$$

The minimum number of testers required can be determined by considering the consumer's risk when the true mean life equals the specified mean life ($\mu = \mu_0$) through the following inequality:

$$L(P_0) \leq \beta \quad \ldots\ldots(8)$$

where, P_0 is the failure probability at $\mu = \mu_0$ and it is given by:

$$\text{For } \lambda=0.3,\ P_0 = G_T(t_0) = \left[1 - e^{-0.6534a^2}\right]\left[1 + 0.3\left(e^{-0.6534a^2}\right)\right] \quad \ldots\ldots (9)$$

$$\text{For } \lambda=0.5,\ P_0 = G_T(t_0) = \left[1 - e^{-0.5722a^2}\right]\left[1 + 0.5\left(e^{-0.5722a^2}\right)\right] \quad \ldots\ldots (10)$$

$$\text{For } \lambda=0.9,\ P_0 = G_T(t_0) = \left[1 - e^{-0.4259a^2}\right]\left[1 + 0.9\left(e^{-0.4259a^2}\right)\right] \quad \ldots\ldots (11)$$

$$\text{For } \lambda=1,\ P_0 = G_T(t_0) = 1-\left[e^{-0.3926a^2}\right]^2 \quad \ldots\ldots (12)$$

Table 1 shows the selected values of the consumer's risk (β), number of groups (g), acceptance number (c) and truncation time (a) to obtain the minimum testers. The minimum number of testers required for the proposed sampling plan in case of the transmuted rayleigh distribution for the special case λ = 0.3, 0.5, 0.9 and 1 are given in tables 2, 3, 4 and 5, correspondingly the minimum sample size (n = rg) are also given in tables 2.1, 3.1, 4.1 and 5.1 for λ = 0.3, 0.5, 0.9 and 1 respectively. The used values of the consumer's risk, the group size, the acceptance number and the time multiplier are given in table 1.

III. OPERATING CHARACTERISTICS

The probability of acceptance can be regarded as a function of the ratio of the specified value μ_0 of the mean from its true value μ. This function is called operating characteristic (OC) function of the sampling plan. Once the minimum sample size is obtained, one may be interested to find the probability of acceptance of a lot when the quality (or reliability) of the product is sufficiently good. As mentioned earlier, the product is considered to be good if $\geq \mu_0$. For λ = 0.3, 0.5, 0.9 and 1 the probabilities of acceptance are displayed in tables 6, 7, 8, 9 and also the corresponding OC Curves are also displayed in figures 1, 2, 3, 4. For example from table 9, we see that L(P) values increase more quickly as the mean ratio increases. For example, when β=0.25, g=4,c=2 and a=0.7, the number of testers required is r=6. However, if the true mean lifetime is twice the specified mean lifetime (μ/μ_0=2) the producer's risk is approximately α=1−0.9510 = 0.0490.

Table 2: Minimum number of testers (r) required for the proposed plan for the transmuted rayleigh distribution with λ=0.3

			a					
β	g	c	0.7	0.8	1.0	1.2	1.5	2.0
0.25	2	0	2	2	1	1	1	1
0.25	3	1	4	3	3	2	2	2
0.25	4	2	6	5	4	3	3	3
0.25	5	3	8	7	5	5	4	4
0.25	6	4	10	9	7	6	5	5
0.25	7	5	12	10	8	7	6	6
0.25	8	6	15	12	10	8	7	7
0.25	9	7	17	14	11	9	8	8
0.25	10	8	19	16	12	11	9	9
0.10	2	0	3	2	2	1	1	1
0.10	3	1	5	4	3	3	2	2
0.10	4	2	7	6	5	4	3	3
0.10	5	3	10	8	6	5	4	4
0.10	6	4	12	10	7	6	5	5
0.10	7	5	14	12	9	7	6	6
0.10	8	6	16	13	10	9	7	7
0.10	9	7	18	15	12	10	8	8
0.10	10	8	20	17	13	11	10	9
0.05	2	0	4	3	2	2	1	1
0.05	3	1	6	5	4	3	2	2
0.05	4	2	8	7	5	4	3	3
0.05	5	3	10	9	6	5	4	4
0.05	6	4	13	10	8	7	5	5
0.05	7	5	15	12	9	8	7	6
0.05	8	6	17	14	11	9	8	7
0.05	9	7	19	16	12	10	9	8
0.05	10	8	22	18	14	11	10	9
0.01	2	0	6	4	3	2	2	1
0.01	3	1	8	6	4	3	3	2
0.01	4	2	10	8	6	5	4	3
0.01	5	3	12	10	7	6	5	4
0.01	6	4	14	12	9	7	6	5
0.01	7	5	16	13	10	8	7	6
0.01	8	6	19	15	11	9	8	7
0.01	9	7	21	17	13	11	9	8
0.01	10	8	23	19	14	12	10	9

From table 2 we have the following table 2.1, Minimum sample size n=gr (Minimum no. of testers=r, group size=g)

β	a	g	r	Sample size, n = gr
0.25	0.7	2	2	4
		3	4	12
		4	6	24
		5	8	40
		6	10	60
		7	12	84
		8	15	120
		9	17	153
		10	19	190

Table 3: Minimum number of testers (r) required for the proposed plan for the transmuted rayleigh distribution with λ=0.5

			a					
β	g	c	0.7	0.8	1.0	1.2	1.5	2.0
0.25	2	0	2	2	1	1	1	1
0.25	3	1	4	3	3	2	2	2
0.25	4	2	6	5	4	3	3	3
0.25	5	3	8	7	5	5	4	4
0.25	6	4	10	9	7	6	5	5
0.25	7	5	12	10	8	7	6	6
0.25	8	6	15	12	9	8	7	7
0.25	9	7	17	14	11	9	8	8
0.25	10	8	19	16	12	11	9	9
0.10	2	0	3	3	2	1	1	1
0.10	3	1	5	4	3	3	2	2
0.10	4	2	7	6	5	4	3	3
0.10	5	3	9	8	6	5	4	4
0.10	6	4	12	10	7	6	5	5
0.10	7	5	14	11	9	7	6	6
0.10	8	6	16	13	10	9	7	7
0.10	9	7	18	15	12	10	9	8
0.10	10	8	20	17	13	11	10	9
0.05	2	0	4	3	2	2	1	1
0.05	3	1	6	5	4	3	2	2
0.05	4	2	8	7	5	4	3	3
0.05	5	3	10	9	6	5	4	4
0.05	6	4	13	10	8	6	6	5
0.05	7	5	15	12	9	8	7	6
0.05	8	6	17	14	10	9	8	7
0.05	9	7	19	16	12	10	9	8
0.05	10	8	21	18	14	11	10	9
0.01	2	0	6	4	3	2	2	1
0.01	3	1	8	6	4	4	3	2
0.01	4	2	10	8	6	5	4	3
0.01	5	3	12	10	7	6	5	4
0.01	6	4	14	11	9	7	6	5
0.01	7	5	16	13	10	8	7	6
0.01	8	6	18	15	11	10	8	7
0.01	9	7	21	17	13	11	10	8
0.01	10	8	22	19	14	12	11	9

From table 3 we have the following table 3.1, Minimum sample size n=gr (Minimum no. of testers=r, group size=g)

β	a	g	r	Sample size, n = gr
0.25	0.7	2	2	4
		3	4	12
		4	6	24
		5	8	40
		6	10	60
		7	12	84
		8	15	120
		9	17	153
		10	19	190

Table 4: Minimum number of testers (r) required for the proposed plan for the transmuted rayleigh distribution with λ=0.9

			a					
β	g	c	0.7	0.8	1.0	1.2	1.5	2.0
0.25	2	0	2	2	1	1	1	1
0.25	3	1	4	4	3	2	2	2
0.25	4	2	6	5	4	3	3	3
0.25	5	3	8	7	5	5	4	4
0.25	6	4	11	9	7	6	5	5
0.25	7	5	13	11	8	7	6	6
0.25	8	6	15	12	10	8	7	7
0.25	9	7	17	14	11	9	8	8
0.25	10	8	19	16	12	11	9	9
0.10	2	0	3	3	2	1	1	1
0.10	3	1	5	4	3	3	2	2
0.10	4	2	8	6	5	4	3	3
0.10	5	3	10	8	6	5	4	4
0.10	6	4	12	10	7	6	5	5
0.10	7	5	14	12	9	7	6	6
0.10	8	6	16	14	10	9	7	7
0.10	9	7	19	16	12	10	8	8
0.10	10	8	21	17	13	11	10	9
0.05	2	0	4	3	2	2	1	1
0.05	3	1	6	5	4	3	2	2
0.05	4	2	9	6	6	4	3	3
0.05	5	3	11	9	6	5	4	4
0.05	6	4	13	11	8	6	5	5
0.05	7	5	15	12	9	8	7	6
0.05	8	6	18	14	11	9	8	7
0.05	9	7	20	16	12	10	9	8
0.05	10	8	22	18	14	11	10	9
0.01	2	0	6	5	3	2	2	1
0.01	3	1	8	6	5	4	3	2
0.01	4	2	10	7	6	5	4	3
0.01	5	3	12	10	7	6	5	4
0.01	6	4	14	12	9	7	6	5
0.01	7	5	17	13	10	8	7	6
0.01	8	6	19	16	12	9	8	7
0.01	9	7	21	18	13	11	9	8
0.01	10	8	24	19	14	12	10	9

From table 4 we have the following table 4.1, Minimum sample size n=gr. (Minimum no. of testers=r, group size=g)

β	a	g	r	Sample size, n = gr
0.25	0.7	2	2	4
		3	4	12
		4	6	24
		5	8	40
		6	11	66
		7	13	91
		8	15	120
		9	17	153
		10	19	190

Table 5: Minimum number of testers (r) required for the proposed plan for the transmuted rayleigh distribution with λ=1

			a					
β	g	c	0.7	0.8	1.0	1.2	1.5	2.0
0.25	2	0	2	2	1	1	1	1
0.25	3	1	4	4	3	2	2	2
0.25	4	2	6	5	4	3	3	3
0.25	5	3	9	7	5	5	4	4
0.25	6	4	11	9	7	6	5	5
0.25	7	5	13	11	8	7	6	6
0.25	8	6	15	13	10	8	7	7
0.25	9	7	17	14	11	9	8	8
0.25	10	8	20	16	13	11	9	9
0.10	2	0	3	3	2	1	1	1
0.10	3	1	6	4	3	3	2	2
0.10	4	2	8	6	4	4	3	3
0.10	5	3	10	8	5	5	4	4
0.10	6	4	12	10	7	6	5	5
0.10	7	5	14	12	9	7	6	6
0.10	8	6	17	14	10	9	7	7
0.10	9	7	19	15	11	10	8	8
0.10	10	8	21	17	13	11	9	9
0.05	2	0	4	3	2	2	1	1
0.05	3	1	7	5	4	3	2	2
0.05	4	2	9	7	5	4	3	3
0.05	5	3	11	9	6	5	4	4
0.05	6	4	13	11	8	6	5	5
0.05	7	5	16	13	9	7	7	6
0.05	8	6	18	15	11	9	8	7
0.05	9	7	20	17	12	10	9	8
0.05	10	8	23	19	14	11	10	9
0.01	2	0	6	5	3	2	2	1
0.01	3	1	8	6	4	4	3	2
0.01	4	2	10	8	6	5	4	3
0.01	5	3	12	10	6	6	5	4
0.01	6	4	15	12	9	7	6	5
0.01	7	5	17	14	10	8	7	6
0.01	8	6	19	15	12	10	8	7
0.01	9	7	22	17	13	11	9	8
0.01	10	8	24	20	15	12	10	9

From table 5 we have the following table 5.1, Minimum sample size n=gr (Minimum no. of testers=r, group size=g)

β	a	g	r	Sample size, n = gr
0.25	0.7	2	2	4
		3	4	12
		4	6	24
		5	9	45
		6	11	66
		7	13	91
		8	15	120
		9	17	153
		10	20	200

Table 6: Operating characteristics values of the hybrid group sampling plan with g=4 and c=2 for transmuted rayleigh distribution with λ=0.3

β	r	a	μ/μ_0					
			2	4	6	8	10	12
0.25	6	0.7	0.9410	0.9987	0.9999	1.0000	1.0000	1.0000
0.25	5	0.8	0.9358	0.9986	0.9999	1.0000	1.0000	1.0000
0.25	4	1.0	0.9103	0.9979	0.9998	1.0000	1.0000	1.0000
0.25	3	1.2	0.9320	0.9984	0.9998	1.0000	1.0000	1.0000
0.25	3	1.5	0.8102	0.9944	0.9994	0.9999	1.0000	1.0000
0.25	3	2.0	0.4732	0.9732	0.9971	0.9994	0.9998	0.9999
0.10	7	0.7	0.9056	0.9978	0.9998	1.0000	1.0000	1.0000
0.10	6	0.8	0.8859	0.9972	0.9997	1.0000	1.0000	1.0000
0.10	5	1.0	0.8149	0.9949	0.9995	0.9999	1.0000	1.0000
0.10	4	1.2	0.7935	0.9941	0.9994	0.9999	1.0000	1.0000
0.10	3	1.5	0.8102	0.9944	0.9994	0.9999	1.0000	1.0000
0.10	3	2.0	0.4732	0.9732	0.9971	0.9994	0.9998	0.9999
0.05	8	0.7	0.8623	0.9966	0.9997	0.9999	1.0000	1.0000
0.05	7	0.8	0.8236	0.9953	0.9995	0.9999	1.0000	1.0000
0.05	5	1.0	0.8149	0.9949	0.9995	0.9999	1.0000	1.0000
0.05	4	1.2	0.7935	0.9941	0.9994	0.9999	1.0000	1.0000
0.05	3	1.5	0.8102	0.9944	0.9994	0.9999	1.0000	1.0000
0.05	3	2.0	0.4732	0.9732	0.9971	0.9994	0.9998	0.9999
0.01	10	0.7	0.7572	0.9929	0.9993	0.9999	1.0000	1.0000
0.01	8	0.8	0.7518	0.9927	0.9993	0.9999	1.0000	1.0000
0.01	6	1.0	0.6980	0.9903	0.9990	0.9998	0.9999	1.0000
0.01	5	1.2	0.6174	0.9860	0.9986	0.9997	0.9999	1.0000
0.01	4	1.5	0.5272	0.9797	0.9979	0.9996	0.9999	1.0000
0.01	3	2.0	0.4732	0.9732	0.9971	0.9994	0.9998	0.9999

From table 6 we have to select (p, L(P)) and draw the OC Curve as follows in figure 1.

P	L(P)
0.0982	0.9410
0.0256	0.9987
0.0115	0.9999
0.0065	1.0000
0.0041	1.0000
0.0029	1.0000

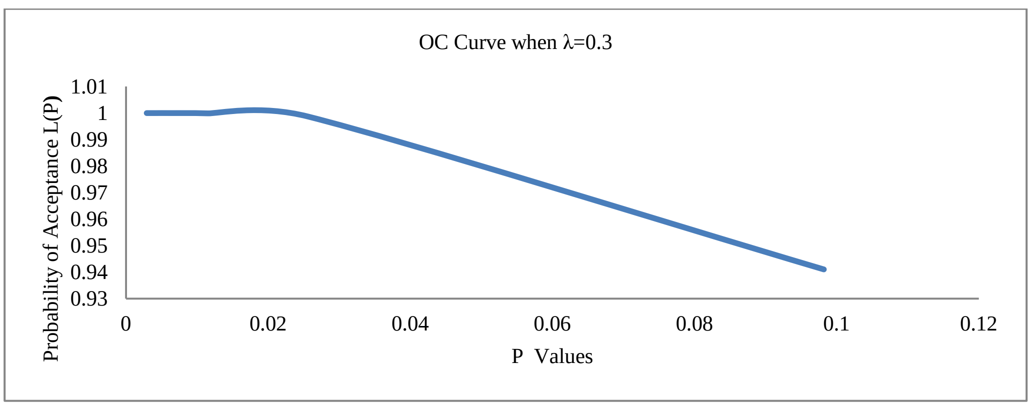

Figure 1 Operating Characteristic (OC) Curve when λ=0.3

Table 7: Operating characteristics values of the hybrid group sampling plan with g=4 and c=2 for transmuted rayleigh distribution with λ=0.5

β	r	a	μ/μ_0					
			2	4	6	8	10	12
0.25	6	0.7	0.9393	0.9981	0.9998	1.0000	1.0000	1.0000
0.25	5	0.8	0.9340	0.9985	0.9999	1.0000	1.0000	1.0000
0.25	4	1.0	0.9077	0.9978	0.9998	1.0000	1.0000	1.0000
0.25	3	1.2	0.9300	0.9984	0.9998	1.0000	1.0000	1.0000
0.25	3	1.5	0.8053	0.9942	0.9994	0.9999	1.0000	1.0000
0.25	3	2.0	0.4647	0.9724	0.9970	0.9994	0.9998	0.9999
0.10	7	0.7	0.9030	0.9977	0.9998	1.0000	1.0000	1.0000
0.10	6	0.8	0.8828	0.9971	0.9997	0.9999	1.0000	1.0000
0.10	5	1.0	0.8101	0.9948	0.9995	0.9999	1.0000	1.0000
0.10	4	1.2	0.7882	0.9939	0.9994	0.9999	1.0000	1.0000
0.10	3	1.5	0.8053	0.9942	0.9994	0.9999	1.0000	1.0000
0.10	3	2.0	0.4647	0.9724	0.9970	0.9994	0.9998	0.9999
0.05	8	0.7	0.8587	0.9965	0.9997	0.9999	1.0000	1.0000
0.05	7	0.8	0.8191	0.9951	0.9995	0.9999	1.0000	1.0000
0.05	5	1.0	0.8101	0.9948	0.9995	0.9999	1.0000	1.0000
0.05	4	1.2	0.7882	0.9939	0.9994	0.9999	1.0000	1.0000
0.05	3	1.5	0.8053	0.9942	0.9994	0.9999	1.0000	1.0000
0.05	3	2.0	0.4647	0.9724	0.9970	0.9994	0.9998	0.9999
0.01	10	0.7	0.7516	0.9927	0.9993	0.9999	1.0000	1.0000
0.01	8	0.8	0.7460	0.9925	0.9993	0.9999	1.0000	1.0000
0.01	6	1.0	0.6912	0.9900	0.9990	0.9998	0.9999	1.0000
0.01	5	1.2	0.6093	0.9856	0.9985	0.9997	0.9999	1.0000
0.01	4	1.5	0.5182	0.9790	0.9978	0.9996	0.9999	1.0000
0.01	4	2.0	0.4252	0.9078	0.9990	0.9978	0.9994	0.9998

From table 7 we have to select (p, L(P)) and draw the OC Curve as follows in figure 2.

P	L(P)
0.0992	0.9393
0.0259	0.9981
0.0116	0.9998
0.0066	1.0000
0.0042	1.0000
0.0029	1.0000

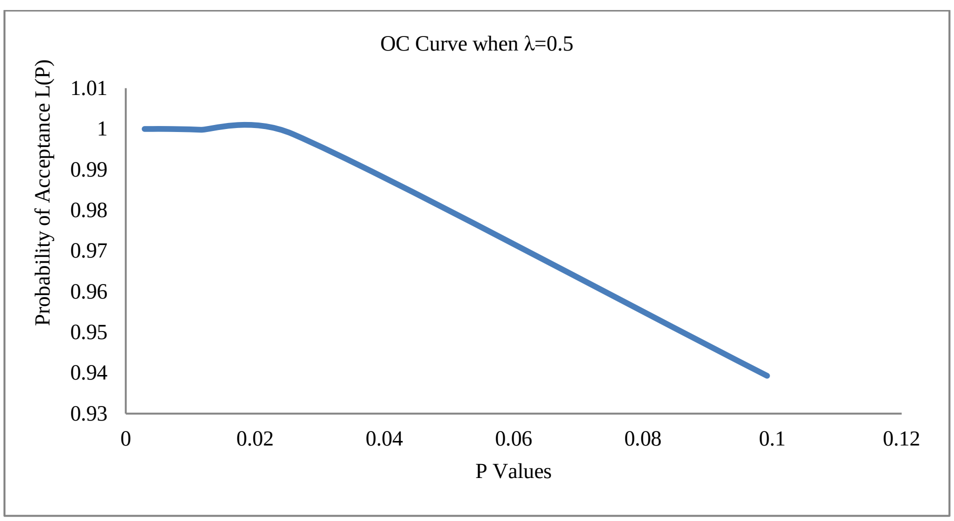

Figure 2 Operating Characteristic (OC) Curve when λ=0.5

Table 8: Operating characteristics values of the hybrid group sampling plan with g=4 and c=2 for transmuted rayleigh distribution with λ=0.9

β	r	a	μ/μ_0					
			2	4	6	8	10	12
0.25	6	0.7	0.9472	0.9989	0.9999	1.0000	1.0000	1.0000
0.25	5	0.8	0.9423	0.9988	0.9999	1.0000	1.0000	1.0000
0.25	4	1.0	0.9184	0.9981	0.9998	1.0000	1.0000	1.0000
0.25	3	1.2	0.9376	0.9986	0.9999	1.0000	1.0000	1.0000
0.25	3	1.5	0.8207	0.9950	0.9995	0.9999	1.0000	1.0000
0.25	3	2.0	0.4814	0.9758	0.9975	0.9995	0.9999	1.0000
0.10	8	0.7	0.8757	0.9970	0.9997	0.9999	1.0000	1.0000
0.10	6	0.8	0.8969	0.9976	0.9998	0.9999	1.0000	1.0000
0.10	5	1.0	0.8300	0.9956	0.9996	0.9999	1.0000	1.0000
0.10	4	1.2	0.8082	0.9948	0.9995	0.9999	1.0000	1.0000
0.10	3	1.5	0.8207	0.9950	0.9995	0.9999	1.0000	1.0000
0.10	3	2.0	0.4814	0.9758	0.9975	0.9995	0.9999	1.0000
0.05	9	0.7	0.8298	0.9956	0.9996	0.9999	1.0000	1.0000
0.05	6	0.8	0.8969	0.9976	0.9998	0.9999	1.0000	1.0000
0.05	6	1.0	0.7201	0.9915	0.9992	0.9999	1.0000	1.0000
0.05	4	1.2	0.8082	0.9948	0.9995	0.9999	1.0000	1.0000
0.05	3	1.5	0.8207	0.9950	0.9995	0.9999	1.0000	1.0000
0.05	3	2.0	0.4814	0.9758	0.9975	0.9995	0.9999	1.0000
0.01	10	0.7	0.7786	0.9938	0.9994	0.9999	1.0000	1.0000
0.01	7	0.8	0.8395	0.9959	0.9996	0.9999	1.0000	1.0000
0.01	6	1.0	0.7201	0.9915	0.9992	0.9998	1.0000	1.0000
0.01	5	1.2	0.6401	0.9876	0.9988	0.9998	0.9999	1.0000
0.01	4	1.5	0.5466	0.9819	0.9981	0.9996	0.9999	1.0000
0.01	3	2.0	0.4814	0.9758	0.9975	0.9995	0.9999	1.0000

From table 8 we have to select (p, L(P)) and draw the OC Curve as follows in figure 3.

P	L(P)
0.0942	0.9472
0.0245	0.9989
0.0109	0.9999
0.0062	1.0000
0.0039	1.0000
0.0027	1.0000

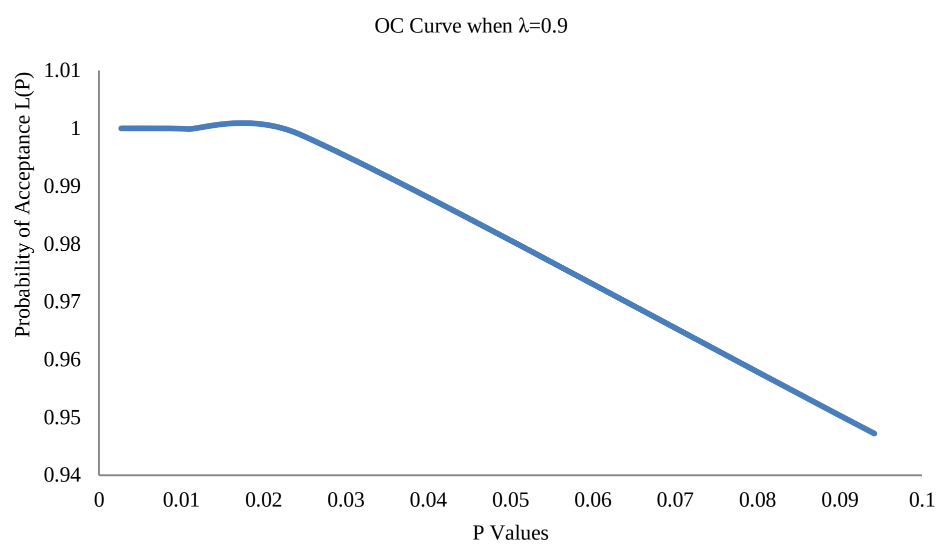

Figure 3 Operating Characteristic (OC) Curve when λ=0.9

Table 9: Operating characteristics values of the hybrid group sampling plan with g=4 and c=2 for transmuted rayleigh distribution with λ=1

β	r	a	μ/μ_0					
			2	4	6	8	10	12
0.25	6	0.7	0.9510	0.9989	0.9999	1.0000	1.0000	1.0000
0.25	5	0.8	0.9463	0.9988	0.9999	1.0000	1.0000	1.0000
0.25	4	1.0	0.9238	0.9983	0.9998	1.0000	1.0000	1.0000
0.25	3	1.2	0.9416	0.9987	1.0000	1.0000	1.0000	1.0000
0.25	3	1.5	0.8299	0.9954	0.9996	0.9999	1.0000	1.0000
0.25	3	2.0	0.4956	0.9775	0.9977	0.9995	0.9999	1.0000
0.10	8	0.7	0.8840	0.9972	0.9997	0.9999	1.0000	1.0000
0.10	6	0.8	0.9038	0.9978	0.9998	1.0000	1.0000	1.0000
0.10	4	1.0	0.9238	0.9983	0.9998	1.0000	1.0000	1.0000
0.10	4	1.2	0.8190	0.9952	0.9995	0.9999	1.0000	1.0000
0.10	3	1.5	0.8299	0.9954	0.9996	0.9999	1.0000	1.0000
0.10	3	2.0	0.4956	0.9775	0.9977	0.9995	0.9999	1.0000
0.05	9	0.7	0.8406	0.9959	0.9996	0.9999	1.0000	1.0000
0.05	7	0.8	0.8497	0.9962	0.9996	0.9999	1.0000	1.0000
0.05	5	1.0	0.8403	0.9959	0.9996	0.9999	1.0000	1.0000
0.05	4	1.2	0.8190	0.9952	0.9995	0.9999	1.0000	1.0000
0.05	3	1.5	0.8299	0.9954	0.9996	0.9999	1.0000	1.0000
0.05	3	2.0	0.4956	0.9775	0.9977	0.9995	0.9999	1.0000
0.01	10	0.7	0.7919	0.9943	0.9994	0.9999	1.0000	1.0000
0.01	8	0.8	0.7863	0.9941	0.9994	0.9999	1.0000	1.0000
0.01	6	1.0	0.7353	0.9921	0.9992	0.9998	1.0000	1.0000
0.01	5	1.2	0.6573	0.9886	0.9998	0.9998	0.9999	1.0000
0.01	4	1.5	0.5642	0.9832	0.9983	0.9996	0.9999	1.0000
0.01	3	2.0	0.4956	0.9775	0.9977	0.9995	0.9999	1.0000

From table 9 we have to select (p, L(P)) and draw the OC Curve as follows in figure 4.

P	L(P)
0.0917	0.9510
0.0238	0.9989
0.0106	0.9999
0.0060	1.0000
0.0038	1.0000
0.0027	1.0000

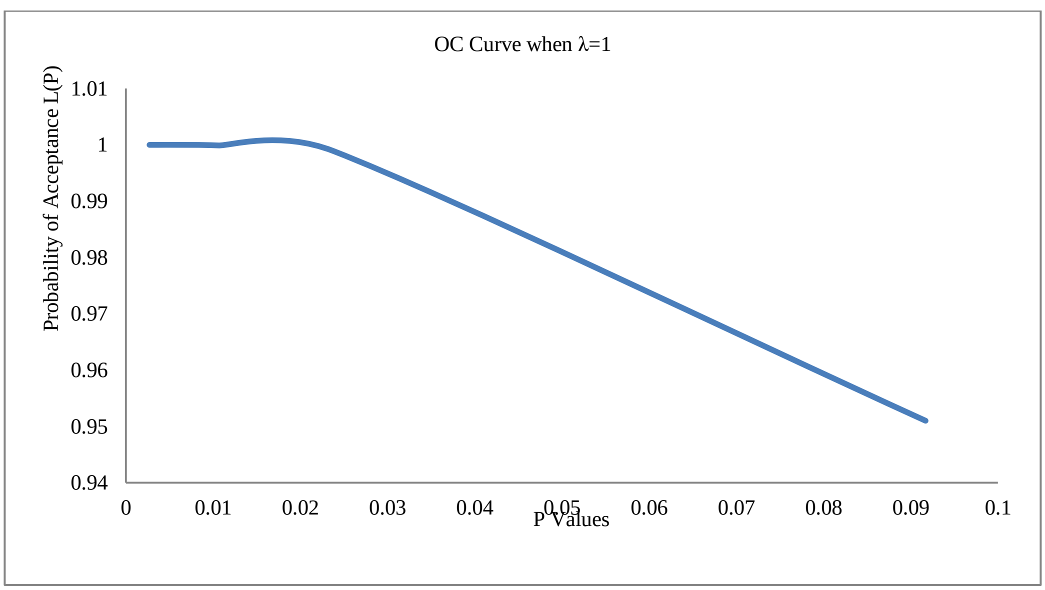

Figure 4 Operating Characteristic (OC) Curve when λ=1

IV. PRODUCER'S RISK

The producer may be interested in enhancing the quality level of the product so that the acceptance probability should be greater than a specified level. When the producer's risk is given, the minimum ratio (μ/μ_0) can be found by solving the following inequality:

$$\left[\sum_{i=0}^{c}\binom{r}{i}p^i(1-p)^{r-i}\right]^g \geq 1-\alpha \;\ldots\ldots\ldots\ldots\ldots(13)$$

Where, p is given by equation (4), r is chosen from the table (2.1 – 2.4) for different values of . From the tables 10, 11, 12 and 13 shows the minimum ratio for transmuted rayleigh distribution with λ = 0.3, 0.5, 0.9 and 1 at the producer's risk of α=0.05 under the plan parameters given in table 1.

For example from Table 13, when λ = 1, $\beta = 0.25$, r=6, c=2 and a=0.7, we obtain the minimum ratio value 1.99. In order that, the lot is accepted with L(P) is greater than or equal to 1-α=0.95. Similarly we can locate the producer's risk value from other tables (10, 11 and 12)

Table 10: Minimum ratio of true average life to specified life for the producer's risk of α = 0.05 in the case of transmuted exponential distribution with λ=0.3

β	g	c	a					
			0.7	0.8	1.0	1.2	1.5	2.0
0.25	2	0	5.02	5.73	5.07	6.07	7.58	10.10
0.25	3	1	2.43	2.33	2.88	2.63	3.26	4.34
0.25	4	2	1.88	1.91	2.03	1.92	2.37	3.14
0.25	5	3	1.64	1.71	1.66	1.97	1.99	2.62
0.25	6	4	1.51	1.59	1.65	1.72	1.77	2.33
0.25	7	5	1.42	1.43	1.48	1.56	1.62	2.13
0.25	8	6	1.41	1.39	1.49	1.45	1.52	1.99
0.25	9	7	1.36	1.35	1.39	1.37	1.45	1.89
0.25	10	8	1.31	1.33	1.31	1.43	1.15	1.81
0.10	2	0	6.14	5.73	7.15	6.07	7.58	10.10
0.10	3	1	2.74	2.76	2.88	3.45	3.26	4.34
0.10	4	2	2.05	2.13	2.35	2.41	2.37	3.14
0.10	5	3	1.87	1.86	1.90	1.97	1.99	2.62
0.10	6	4	1.67	1.70	1.65	1.72	1.77	2.33
0.10	7	5	1.55	1.60	1.62	1.56	1.62	2.13
0.10	8	6	1.47	1.46	1.49	1.61	1.52	1.99
0.10	9	7	1.40	1.41	1.48	1.51	1.45	1.89
0.10	10	8	1.35	1.38	1.40	1.43	1.30	1.81
0.05	2	0	7.09	7.01	7.15	8.58	7.58	10.10
0.05	3	1	3.03	3.12	3.42	3.45	3.26	4.34
0.05	4	2	2.21	2.33	2.35	2.41	2.37	3.14
0.05	5	3	1.87	1.99	1.90	1.97	1.99	2.62
0.05	6	4	1.75	1.70	1.81	1.95	1.77	2.33
0.05	7	5	1.61	1.60	1.62	1.56	1.92	2.13
0.05	8	6	1.52	1.52	1.59	1.61	1.78	1.99
0.05	9	7	1.45	1.47	1.48	1.51	1.67	1.89
0.05	10	8	1.43	1.43	1.47	1.43	1.30	1.81
0.01	2	0	8.67	8.09	8.76	8.58	10.72	10.10
0.01	3	1	3.53	3.45	3.42	3.45	4.29	4.34
0.01	4	2	2.50	2.51	2.63	2.80	2.99	3.14
0.01	5	3	2.07	2.11	2.10	2.25	2.43	2.62
0.01	6	4	1.83	1.89	1.95	2.14	2.12	2.33
0.01	7	5	1.67	1.68	1.74	1.75	1.92	2.13
0.01	8	6	1.61	1.59	1.59	1.61	1.78	1.99
0.01	9	7	1.53	1.52	1.57	1.63	1.67	1.89
0.01	10	8	1.46	1.47	1.47	1.54	1.30	1.81

β**:**Consumer's risk, g:Group size, c: Acceptance No. and a: Truncated time

Table 11: Minimum ratio of true average life to specified life for the producer's risk of α = 0.05 in the case of transmuted exponential distribution with λ=0.5

β	g	c	a					
			0.7	0.8	1.0	1.2	1.5	2.0
0.25	2	0	4.72	5.38	4.76	5.69	7.10	9.45
0.25	3	1	2.31	2.22	2.73	2.48	3.07	4.06
0.25	4	2	1.81	1.83	1.93	1.83	2.24	2.95
0.25	5	3	1.59	1.65	1.60	1.87	1.88	2.46
0.25	6	4	1.47	1.54	1.58	1.65	1.68	2.19
0.25	7	5	1.39	1.39	1.44	1.50	1.55	2.01
0.25	8	6	1.38	1.35	1.34	1.40	1.46	1.88
0.25	9	7	1.33	1.32	1.35	1.33	1.39	1.78
0.25	10	8	1.29	1.30	1.28	1.38	1.34	1.71
0.10	2	0	5.76	6.58	6.71	5.69	7.10	9.45
0.10	3	1	2.60	2.61	2.73	3.24	3.07	4.06
0.10	4	2	1.97	2.03	2.23	2.28	2.24	2.95
0.10	5	3	1.70	1.78	1.82	1.87	1.88	2.46
0.10	6	4	1.62	1.64	1.58	1.65	1.68	2.19
0.10	7	5	1.51	1.47	1.56	1.50	1.55	2.01
0.10	8	6	1.43	1.42	1.44	1.55	1.46	1.88
0.10	9	7	1.37	1.38	1.44	1.45	1.59	1.78
0.10	10	8	1.32	1.35	1.36	1.38	1.52	1.71
0.05	2	0	6.65	6.58	6.71	8.03	7.10	9.45
0.05	3	1	2.87	2.95	3.22	3.24	3.07	4.06
0.05	4	2	2.11	2.22	2.23	2.28	2.24	2.95
0.05	5	3	1.79	1.90	1.82	1.87	1.88	2.46
0.05	6	4	1.69	1.64	1.73	1.65	2.01	2.19
0.05	7	5	1.56	1.55	1.56	1.67	1.82	2.01
0.05	8	6	1.47	1.48	1.44	1.55	1.69	1.88
0.05	9	7	1.41	1.43	1.44	1.45	1.59	1.78
0.05	10	8	1.36	1.39	1.43	1.38	1.52	1.71
0.01	2	0	8.13	7.59	8.20	8.03	10.03	9.45
0.01	3	1	3.33	3.25	3.22	3.84	4.03	4.06
0.01	4	2	2.38	2.39	2.49	2.64	2.81	2.95
0.01	5	3	1.98	2.02	2.00	2.14	2.30	2.46
0.01	6	4	1.76	1.73	1.87	1.85	2.01	2.19
0.01	7	5	1.62	1.62	1.67	1.67	1.82	2.01
0.01	8	6	1.52	1.54	1.53	1.68	1.69	1.88
0.01	9	7	1.48	1.48	1.51	1.57	1.76	1.78
0.01	10	8	1.39	1.43	1.43	1.48	1.66	1.71

β**:**Consumer's risk, g:Group size, c: Acceptance No. and a: Truncated time

Table 12: Minimum ratio of true average life to specified life for the producer's risk of α = 0.05 in the case of transmuted exponential distribution with λ=0.9

β	g	c	a					
			0.7	0.8	1.0	1.2	1.5	2.0
0.25	2	0	4.13	4.69	4.15	4.94	6.15	8.17
0.25	3	1	2.08	2.33	2.42	2.21	2.69	3.52
0.25	4	2	1.66	1.68	1.76	1.67	2.00	2.57
0.25	5	3	1.48	1.53	1.49	1.71	1.70	2.64
0.25	6	4	1.45	1.44	1.47	1.52	1.53	1.93
0.25	7	5	1.36	1.38	1.35	1.40	1.43	1.78
0.25	8	6	1.31	1.28	1.35	1.32	1.36	1.67
0.25	9	7	1.26	1.26	1.28	1.26	1.30	1.59
0.25	10	8	1.23	1.24	1.23	1.30	1.26	1.53
0.10	2	0	5.02	5.71	5.82	4.94	6.15	8.17
0.10	3	1	2.33	2.33	2.42	2.85	2.69	3.52

0.10	4	2	1.92	1.85	2.01	2.04	2.00	2.57
0.10	5	3	1.65	1.64	1.66	1.71	1.70	2.64
0.10	6	4	1.57	1.52	1.47	1.52	1.53	1.93
0.10	7	5	1.41	1.44	1.45	1.40	1.43	1.78
0.10	8	6	1.35	1.39	1.35	1.44	1.36	1.67
0.10	9	7	1.33	1.35	1.35	1.36	1.30	1.59
0.10	10	8	1.29	1.28	1.29	1.30	1.40	1.53
0.05	2	0	5.77	5.71	5.82	6.96	6.15	8.17
0.05	3	1	2.55	2.62	2.85	2.85	2.69	3.52
0.05	4	2	2.03	1.85	2.26	2.04	2.00	2.57
0.05	5	3	1.73	1.74	1.66	1.71	1.70	2.64
0.05	6	4	1.57	1.60	1.59	1.52	1.53	1.93
0.05	7	5	1.46	1.44	1.45	1.54	1.65	1.78
0.05	8	6	1.42	1.39	1.43	1.44	1.54	1.67
0.05	9	7	1.36	1.35	1.35	1.36	1.46	1.59
0.05	10	8	1.32	1.32	1.34	1.30	1.40	1.53
0.01	2	0	7.04	7.34	7.10	6.96	8.67	8.17
0.01	3	1	2.94	2.88	3.21	3.36	3.51	3.52
0.01	4	2	2.10	2.00	2.23	2.35	2.48	2.57
0.01	5	3	1.81	1.84	1.82	1.92	2.04	2.64
0.01	6	4	1.62	1.67	1.71	1.69	1.80	1.93
0.01	7	5	1.55	1.50	1.54	1.54	1.65	1.78
0.01	8	6	1.46	1.49	1.51	1.44	1.54	1.67
0.01	9	7	1.40	1.43	1.41	1.45	1.46	1.59
0.01	10	8	1.37	1.35	1.34	1.38	1.40	1.53

β**:**Consumer's risk, g:Group size, c: Acceptance No. and a: Truncated time

Table 13: Minimum ratio of true average life to specified life for the producer's risk of α = 0.05 in the case of transmuted exponential distribution with λ=1

β	g	c	a					
			0.7	0.8	1.0	1.2	1.5	2.0
0.25	2	0	5.48	6.27	5.54	6.64	8.30	11.07
0.25	3	1	2.61	2.98	3.13	2.85	3.56	4.75
0.25	4	2	1.99	2.03	2.18	2.07	2.58	3.44
0.25	5	3	1.86	1.81	1.77	2.12	2.15	2.87
0.25	6	4	1.67	1.68	1.75	1.84	1.91	2.54
0.25	7	5	1.55	1.59	1.56	1.66	1.75	2.33
0.25	8	6	1.46	1.52	1.56	1.54	1.63	2.18
0.25	9	7	1.40	1.40	1.45	1.44	1.55	2.06
0.25	10	8	1.12	1.09	1.14	1.16	1.13	1.50
0.10	2	0	6.71	7.67	7.83	6.64	8.30	11.07
0.10	3	1	3.28	2.98	3.13	3.76	3.56	4.75
0.10	4	2	2.37	2.28	2.18	2.61	2.58	3.44
0.10	5	3	1.98	1.91	1.77	2.12	2.15	2.87
0.10	6	4	1.76	1.80	1.75	1.84	1.91	2.54
0.10	7	5	1.62	1.68	1.72	1.66	1.75	2.33
0.10	8	6	1.58	1.60	1.56	1.72	1.63	2.18
0.10	9	7	1.50	1.47	1.45	1.62	1.55	2.06
0.10	10	8	1.16	1.14	1.14	1.16	1.13	1.50
0.05	2	0	7.75	7.67	7.83	9.40	8.30	11.07
0.05	3	1	3.57	3.39	3.72	3.76	3.56	4.75
0.05	4	2	2.54	2.50	2.54	2.61	2.58	3.44
0.05	5	3	2.10	2.12	2.63	2.12	2.15	2.87
0.05	6	4	1.85	1.91	1.93	1.84	1.91	2.54
0.05	7	5	1.69	1.77	1.72	1.66	2.08	2.33
0.05	8	6	1.64	1.67	1.68	1.72	1.63	2.18
0.05	9	7	1.55	1.60	1.56	1.62	1.80	2.06

0.05	10	8	1.23	1.23	1.22	1.16	1.30	1.50
0.01	2	0	9.41	9.90	9.59	9.40	8.30	11.07
0.01	3	1	3.83	3.75	3.72	4.47	4.69	4.75
0.01	4	2	2.69	2.71	2.85	3.05	3.26	3.44
0.01	5	3	2.21	2.26	2.63	2.44	2.65	2.87
0.01	6	4	2.02	2.02	2.09	2.10	2.30	2.54
0.01	7	5	1.83	1.85	1.85	1.87	2.08	2.33
0.01	8	6	1.69	1.67	1.79	1.88	1.92	2.18
0.01	9	7	1.64	1.60	1.66	1.74	1.80	2.06
0.01	10	8	1.26	1.28	1.29	1.27	1.30	1.50

β**:**Consumer's risk, g:Group size, c: Acceptance No. and a: Truncated time

V. DESCRIPTION OF TABLES AND EXAMPLES

The required parameters of HGASP are evaluated at various values of the consumer's risk (β) and the termination time (t_0) in tables 2, 3, 4 and 5. The minimum sample size is calculated by using the relation n=rg.

Tables 2, 3, 4 and 5 indicates that, as the test termination time multiplier 'a' increases, the number of testers 'r' decrease, i.e., a smaller number of testers is needed, if the test termination time multiplier increases at a fixed number of groups. For example, from table 5, if β=0.10, g=4, c=2 and 'a' changes from 0.7 to 0.8, the required parameters of HGASP have been changed from r = 8 to r = 6. The probability of acceptance for the lot at the mean ratio corresponding to the producer's risk is also given in table 6, 7, 8 and 9. Finally, table 10, 11, 12 and 13 presents the minimum ratios of true mean (μ) to the specified mean (μ_0) for the acceptance of a lot with producer's risk α=0.05 for given parameter values.

Suppose that the lifetime of a product follows the transmuted rayleigh distribution with λ=1. It is desired to design a HGASP to test if the mean lifetime is greater than 1,000h based on a testing time (t_0) 700h and using 4 groups. It is assumed that c=2 and β=0.10. This leads to the termination multiplier a=0.7. From table 5, the minimum number of testers required is r=8. Thus, we will draw a random sample of size 32 items and allocate 8 items to each of 4 groups to put on test for 700h. This indicates that a total of 32 products are needed and that 8 items are allocated to each of 4 groups. We will accept the lot if no more than 2 failure occurs before 700h in each of 4 groups. We truncate the experiment as soon as the 3^{rd} failure occurs before the 700^{th}h.

For this proposed sampling plan, from table 3.4 the probability of acceptance is 0.9510 at λ=1, ${}^{\mu}/_{\mu_0} = 2$, β=0.25, a=0.7, r=6, g=4 and c=2. So, a lot of submitted items shall be accepted with probability 0.9510 if the true mean life is 2 times the specified mean life. If we need the mean ratio corresponding to the producer's risk of 0.05, we can obtain it from tables 10, 11, 12 and 13. For example, when λ=1, β=0.10, a=0.7, r=6, g=4 and c=2, the mean ratio is 2.37 respectively.

VI. COMPARATIVE STUDY

In this study, a HGASP is proposed for the Transmuted Rayleigh Distribution based on truncated life test. From Tables 14, 15, and 16 it can be easily observed that the proposed HGASP based on Transmuted Rayleigh Distribution perform better than the existing HGASP based on Transmuted Exponential Distribution. The table 16 shows the comparative study of L(P) values corresponding mean ratio (μ/μ_0) for the two types of distributions and it shows that L(P) values in transmuted rayleigh distribution is more stronger than the transmuted exponential distribution.

Table 14: OC values of proposed HGASP based on transmuted rayleigh distribution with a=0.7, β=0.25, g=4, c=2 and λ=1

P	L(P)
0.0917	0.9510
0.0238	0.9989
0.0106	0.9999
0.0060	1.0000
0.0038	1.0000
0.0027	1.0000

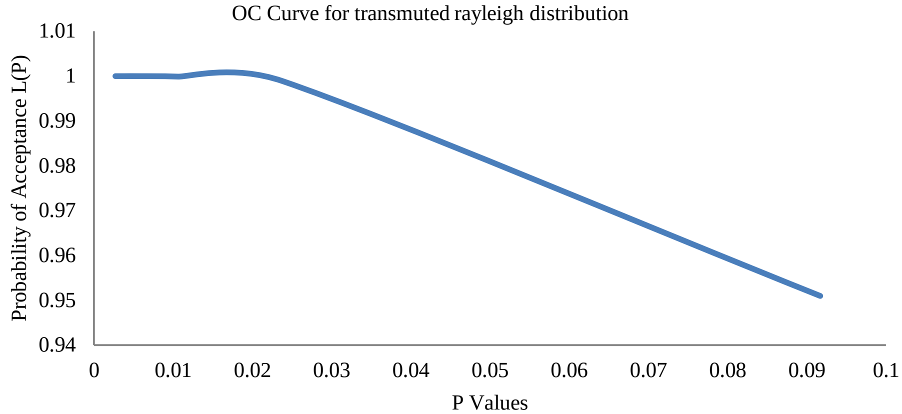

Figure 5: Operating Characteristic (OC) Curve for transmuted rayleigh distribution

Table 15: OC values of existing HGASP based on transmuted exponential distribution with a=0.7, β=0.25, g=4, c=2 and λ=1

P	L(P)
0.2953	0.7158
0.1605	0.9430
0.1101	0.9805
0.0838	0.9912
0.0676	0.9953
0.0567	0.9972

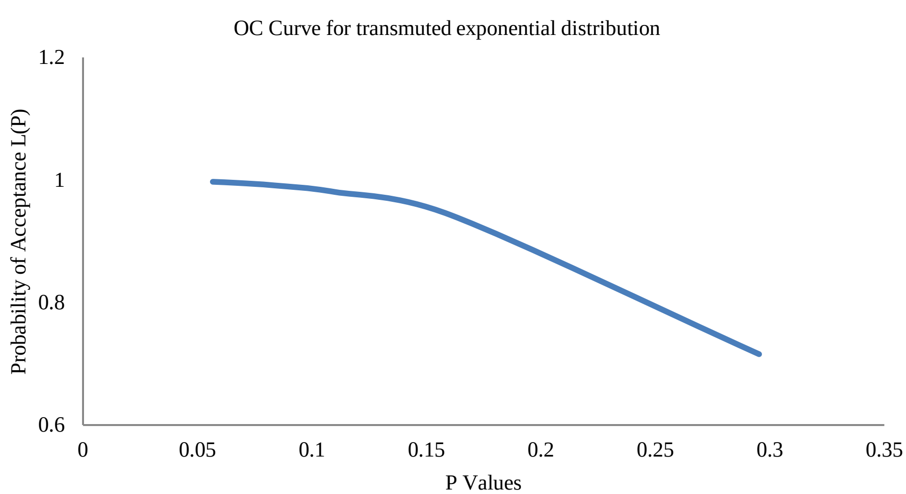

Figure 6: Operating Characteristic (OC) Curve for transmuted exponential distribution

Table 16: L(P) values of the HGASP against mean ratio μ/μ_0 with a=0.7, β=0.25, g=4, c=2 and λ=1

μ/μ_0	2	4	6	8	10	12
L(P) values of proposed HGASP based on transmuted rayleigh distribution	0.9510	0.9989	0.9999	1.0000	1.0000	1.0000
L(P) values of existing HGASP based on transmuted exponential distribution	0.7158	0.9430	0.9805	0.9912	0.9953	0.9972

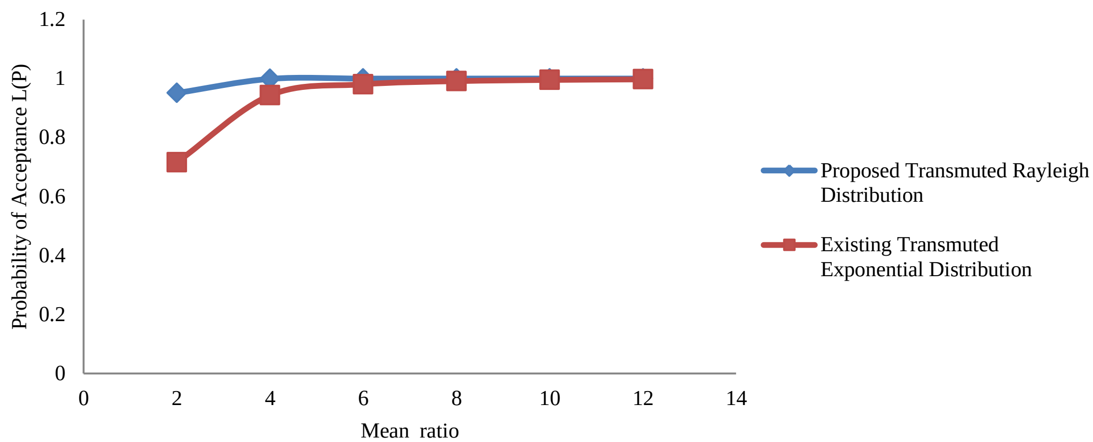

Figure 7 Comparison of two distributions

Here the number of testers used is minimum and more positively the probability of acceptance for proposed HGASP based on transmuted rayleigh distribution is higher than the probability of acceptance for existing HGASP based on transmuted exponential distribution. Also the producer risk remains zero for most of the values. This shows that in case of hybrid group acceptance sampling plan using transmuted rayleigh distribution will be profitable and provides more satisfaction for the producer.

VII. CONCLUSION

In this study, a hybrid group acceptance sampling plan from the truncated life test based on transmuted rayleigh distribution was proposed. The minimum number of testers, operating characteristic values and the minimum ratio of the true mean life to the specified mean life are found for transmuted rayleigh distribution when the other designed parameters are pre-assumed. It can be observed that the minimum number of testers required is decreases as test termination time multiplier increases and also the operating characteristic values increases more rapidly as the quality improves. This hybrid group acceptance sampling plan can be used when a multiple number of items at a time are adopted for a life test. Finally, on comparing the two lifetime distributions, one can find that the proposed hybrid group acceptance sampling plan based on transmuted rayleigh distribution is comparatively the best among the existing hybrid group acceptance sampling plan based on transmuted exponential distribution. Hence we conclude that the proposed hybrid group acceptance sampling plan is more economical in the sense of saving testing time, cost, energy and labor.

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