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RESEARCH ORGANISATION|

Volume 2, Issue 1
February 28, 2015|

Journal of Progressive Research in Mathematics
www.scitecresearch.com

A Hybrid Group Acceptance Sampling Plan for Lifetimes Based on Gamma, Exponentiated Log – Logistic and Marshall – Olkin extended exponential Distributions

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Abstract

In this paper we have developed a hybrid group acceptance sampling plan for a truncated life test when the lifetime of an item follows gamma distribution, exponentiated log – logistic distribution and Marshall – Olkin extended exponential distribution. The minimum number of testers and acceptance number are determined when the consumer's risk and the test termination time and group size are specified. The operating characteristic values according to various quality levels are also obtained.

Keywords Gamma distribution; exponentiated log – logistic distribution and Marshall – Olkin extended exponential distribution; hybrid group acceptance sampling plan; consumer's risk; producer's risk; operating characteristic; truncated life tests.

1. Introduction

In most acceptance sampling plans for a truncated life test, the major issue is to determine the sample size from a lot under consideration. It is implicitly assumed in the usual sampling plan that only a single item is put in a tester. However, testers accommodating a multiple number of items at a time are used in practice because testing time and cost can be saved by testing those items simultaneously. Sudden death testing is frequently adopted by using this type of testers (Pascual and Meeker, 1998; Vlcek et al. 2003; Jun et al. 2006). For this type of testers the number of items to be equipped in a tester is given by the specification. The acceptance sampling plan under this type of testers will be called a group acceptance sampling plan. When designing a group sampling plan, determining the sample size is equivalent to determining the number of groups as the group size is already given. The items in a group are tested independently, identically and simultaneously on the different testers for a pre-assigned time. The experiment is truncated if more than the acceptable number of failures occurred in any group during the experiment time. The method of determining the minimum number of testers for a predetermined number of groups is called as Hybrid Group Acceptance Sampling Plan (HGASP). If the HGASP is used in conjunction with truncated life tests, it is called a HGASP based on truncated life test assuming that the lifetime of product follows a certain probability distribution.

Many authors discussed acceptance sampling based on truncated life tests. Aslam, M. and C.H., have studied, a group acceptance sampling plans for truncated life tests based on the inverse Rayleigh and log-logistic distributions. Gupta, S. S. and Groll, P.A., in 1961 have studied Gamma distribution in acceptance sampling based on life tests. Baklizi, A. and El Masri, A.E.K. in 2004 have studied acceptance sampling plans based on truncated life tests in the Birnbaum Saunders model. Rosaiah K., Kantam R.R.L. and Santosh Kumar, 2007 have studied exponentiated Log – Logistic distribution – An economic reliability test plan. Muhammad Aslam, Chi-Hyuck Jun, Munir Ahmad in 2009 have studied a group acceptance plan based on truncated life test for Gamma distribution. Again Muhammad Aslam, Chi-Hyuck Jun, Munir Ahmad along with Mujahid Rasool in 2011 have studied improved group sampling plans based on time – truncated life tests. Srinivasa Rao, in 2009, has studied a group acceptance sampling plans for lifetimes following a generalized exponential distribution. Srinivasa Rao, G., in 2010 have studied a group acceptance sampling plans for truncated life tests for Marshall-Olkin extended Lomax distribution. Also Srinivasa Rao, G., in 2011 have studied a hybrid group acceptance sampling plans for lifetimes based on generalized exponential distribution.

The purpose of this study is to propose a HGASP based on truncated life tests when the lifetime of a product follows the Gamma distribution.

2 Lifetime Distributions

Gamma Distribution:

The cumulative distribution function (cdf) of the Gamma distribution is given by

$$F(t,\sigma) = 1 - e^{-\frac{t}{\sigma}} \sum_{j=0}^{\gamma-1} \left(\frac{t}{\sigma}\right)^{j} / j! \text{, } t > 0 \qquad (1)$$

where σ is a scale parameter.

Exponentiated Log – Logistic Distribution:

The cumulative distribution function (cdf) of the exponentiated Log – Logistic distribution is given by

$$F(t,\sigma,b,\theta) = \left[\frac{\left(t/\sigma\right)}{1+\left(t/\sigma\right)}\right]^{\theta} \text{, } t > 0 \qquad (2)$$

where σ is a scale parameter.

Marshall – Olkin Extended Exponential Distribution:

The cumulative distribution function (cdf) of the Marshall – Olkin extended exponential distribution is given by

$$F(t,\sigma) = \frac{1-e^{-t/\sigma}}{1-\bar{\gamma}e^{-t/\sigma}}, \bar{\gamma} = 1-\gamma \text{ , } t > 0 \qquad (3)$$

where σ is a scale parameter.

If some other parameters are involved, then they are assumed to be known, for an example, if shape parameter of a distribution is unknown it is very difficult to design the acceptance sampling plan. In quality control analysis, the scale parameter is often called the quality parameter or characteristics parameter. Therefore it is assumed that the distribution function depends on time only through the ratio of t/ σ.

The failure probability of an item by time t0 is given by

$$p = F(t_0 : \sigma) \qquad (4)$$

The quality of an item is usually represented by its true mean lifetime although some other options such as median lifetime or B10 life are sometimes used. Let us assume that the true mean μ can be represented by the scale parameter. Also, it is convenient to specify the test time as a multiple of the specified life so thataμ0 and the quality of an item as a ratio of the true mean to the specified life (μ/ μ0).

Then we can rewrite (4) as a function of 'a' (termination time) and the ratio μ/μ0

$$p = F(a\,\mu_0 : \mu/\,\mu0) \qquad (5)$$

When the underlying distributions are the Gamma, exponentiated log – logistic and Marshall – Olkin extended exponential distributions having known shape parameter γ and unknown scale parameter σ. Then the true mean life of a product under the above distributions is given by

$$\mu = \gamma\sigma \tag{6}$$

and the failure probability of gamma distribution is

$$p = 1 - e^{-\frac{a\gamma}{\mu/\mu_0}} \sum_{j=0}^{\gamma-1} \left(\frac{a\gamma}{\mu/\mu_0} \right)^j / j! \tag{7}$$

and the failure probability of exponentiated log – logistic distribution is

$$p = \left[\frac{(1.5708a)^2}{(\mu/\mu_0)^2 + (1.5708a)^2} \right]^2 \tag{8}$$

and the failure probability of Marshall – Olkin extended exponential distribution is

$$p = \frac{1 - e^{-\frac{1.5708a}{\mu/\mu_0}}}{1 - \bar{\gamma} e^{-\frac{1.5708a}{\mu/\mu_0}}}, \bar{\gamma} = 1 - \gamma \tag{9}$$

3 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 μ0, say under the assumption that the life time of an item follows gamma, exponentiated log – logistic and Marshall – Olkin extended exponential distributions 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 μ0. We will accept the lot if μ ≥ μ0 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:

1) Select the number of testers, r and assign the r items to each predefined groups g so that the sample size for a lot will be n = gr .

2) Pre-fix the acceptance number, c for each group and the experiment time t0

3) Accept the lot if at most c failures occur in each of all groups

4) Terminate the experiment if more than c failures occur in any group and reject the lot

The proposed sampling plan is an extension of the ordinary sampling plan available in literature such as in Kantam et al. (2001) and Rosaiah and Kantam (2005), for which r =1. We are interested in determining the number of groups g required for each of two distributions under study, whereas the various values of acceptance number c and the termination time t0 are assumed to be specified. Since it is convenient to set the termination time as a multiple of the specified life μ0, we will consider t0 = aμ0 for a specified constant a (termination ratio).

The probability of rejecting a good lot is called the producer’s risk, whereas theprobability 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 β =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 at most c failures observed in each of the g groups.

The HGASP is characterized by the three parameters. So, the lot acceptance probability will be

$$L(p) = \left(\sum_{i=0}^{c} \binom{r}{i} p^i (1-p)^{r-1} \right)^g \tag{10}$$

where p is the probability that an item in a group fails before the termination time t0 = aμ0.

The minimum number of testers required can be determined by considering equations (7), (8) and (9) and the consumer's risk when the true median life equals the specified median life (μ = μ0) (worst case) by means of the following inequality:

$$L(p_0) \leq \beta \tag{11}$$

where p_0 is the failure probability at $\mu = \mu_0$.

4 Operation Characteristic Functions

The probability of acceptance can be regarded as a function of the deviation of the specified value μ0 of the median from its true value μ. This function is called Operating Charateristic (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 μ ≥ μ0. For γ = 2 the probabilities of acceptance are displayed in Table 4, 5 and 6 for various values of the median ratios μ/μ0, producer's risks β and time multiplier a.

5 Notations

g	-	Number of groups
r	-	Number of items in a group
n	-	Sample size
d	-	Number of defectives
c	-	Acceptance number
t0	-	Termination time
a	-	Test termination time multiplier
γ	-	Shape parameter
σ	-	Scale parameter
β	-	Consumer's risk
p	-	Failure probability
L(p)	-	Probability of acceptance
p*	-	Minimum probability
μ	-	Mean life
μ0	-	Specified life

6 Description of tables and examples

6.1 Example 1

Assume that an experimenter wants to establish that the lifetime of the electric bulbs produced in the factory ensures that the true unknown mean life is at least 1000 hours. It is desired to design a HGASP to test if the mean life is greater than 1,000 hrs based on a testing time of 700 hrs and using 4 groups. Following are the results obtained when the lifetime of an item follows different lifetime distributions namely Marshall – Olkin extended exponential distribution, Gamma distribution and exponentiated log – logistic distribution.

Gamma distribution

Suppose that the lifetime of a product follows the gamma distribution with γ = 2. For the above example, from Table 1, the minimum number of testers required is r = 6. Thus, we will draw a random sample of size 24 items and allocate 6 items to each of 4 groups to put on test for 700 hrs. The lot will be accepted if no more than 2 failures occur before 700 hrs in each of 4 groups. The experiment is truncated as soon as the 3rd failure occurs before the 700th hr. From Table 4, the probability of acceptance is 0.881039 when the true mean is 4,000 hrs. This shows that, if the true mean life is 4 times of 1000 hrs, the producer's risk is 0.118961.

Exponentiated log - logistic distribution

Suppose that the lifetime of a product follows the exponentiated log - logistic distribution. For the above example, from Table 2, 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 700 hrs. The lot will be accepted if no more than 2 failures occur before 700 hrs in each of 4 groups. The experiment is truncated as soon as the 3rd failure occurs before the 700th hr. From Table 5, the probability of acceptance is 0.999974 when the true mean is 4,000 hrs. This shows that, if the true mean life is 4 times of 1000 hrs, the producer's risk is 0.000026.

Marshall – Olkin extended exponential distribution

Suppose that the lifetime of a product follows the Marshall – Olkin extended exponential distribution. For the above example, from Table 3, the minimum number of testers required is r = 5. Thus, we will draw a random sample of size 20 items and allocate 5 items to each of 4 groups to put on test for 700 hrs. The lot will be accepted if no more than 2 failures occur before 700 hrs in each of 4 groups. The experiment is truncated as soon as the 3rd failure occurs before the 700th hrs. From Table 6, the probability of acceptance is 0.920315 when the true mean is 4,000 hrs. This shows that, if the true mean life is 4 times of 1000 hrs, the producer's risk is 0.079685.

On comparing the three distributions used exponentiated log-logistic distribution has high probability and thus can be declared as the comparatively better distribution. It is clearly seen in the following figure

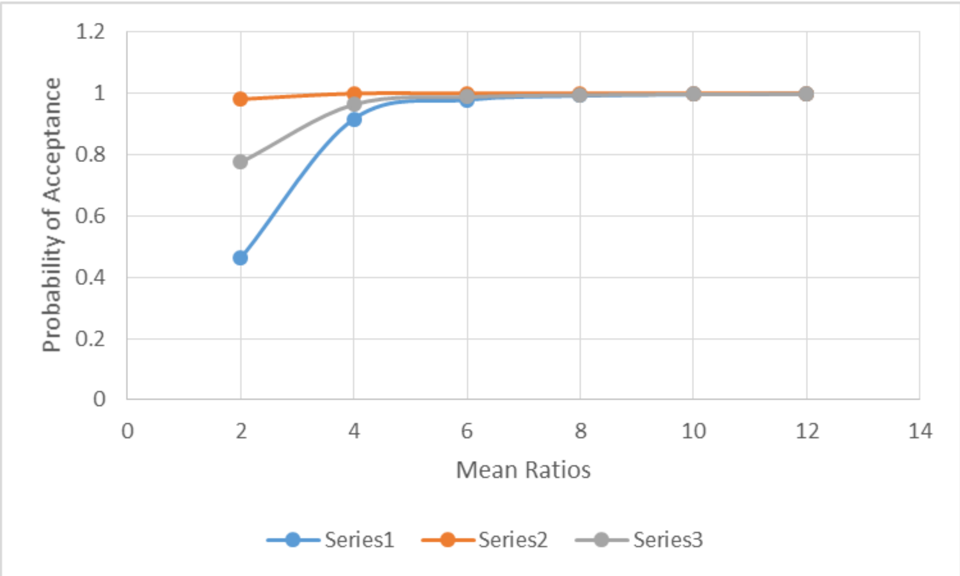

Figure 1: Operating characteristic curve for the hybrid group sampling plan with a = 0.7, β = 0.10 and c = 2 when the lifetime of the items follows different lifetime distributions

Table 1: Minimum number of testers (*r*) for the hybrid group sampling plan when the lifetime of the items follows the Gamma distribution

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

Table 2: Minimum number of testers (r) for the hybrid group sampling plan when the lifetime of the items follows the exponentiated Log – Logistic distribution

β	g	c	a					
			0.7	0.8	1.0	1.2	1.5	2.0
0.25	2	0	2	2	1	1	1	1
	3	1	5	4	3	2	2	2
	4	2	7	6	4	4	3	3
	5	3	9	7	6	5	4	4
	6	4	11	9	7	6	6	5
	7	5	14	11	9	8	7	6
	8	6	16	13	10	9	8	7
	9	7	19	15	12	10	9	8
	10	8	21	17	13	11	10	9
0.10	2	0	4	3	2	2	1	1
	3	1	6	5	4	3	3	2
	4	2	8	7	5	4	4	3
	5	3	11	9	7	6	5	4
	6	4	13	11	8	7	6	5
	7	5	16	13	10	8	7	6
	8	6	18	15	11	10	8	7
	9	7	20	17	13	11	9	9
	10	8	23	19	14	12	11	10
0.05	2	0	5	4	3	2	2	1
	3	1	7	6	4	3	3	2
	4	2	9	8	6	5	4	3
	5	3	12	9	7	6	5	4
	6	4	14	11	9	7	6	6
	7	5	17	13	10	9	7	7
	8	6	19	15	12	10	9	8
	9	7	22	18	13	11	10	9
	10	8	24	20	15	13	11	10
0.01	2	0	7	5	4	3	2	2
	3	1	9	7	5	4	3	2
	4	2	11	9	7	5	5	4
	5	3	14	11	8	7	6	5
	6	4	16	13	10	8	7	6
	7	5	19	15	11	9	8	7
	8	6	21	17	13	11	9	8
	9	7	24	19	14	12	10	9
	10	8	26	21	16	13	12	10

Table 3: Minimum number of testers (*r*) for the hybrid group sampling plan when the lifetime of the items follows the Marshall–Olkin extended exponential distribution

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

Table 4: Probability of acceptance for the hybrid group sampling plan with g = 4 and c = 2 when the lifetime of the items follows the gamma distribution

β	r	a	μ/μ₀					
			2	4	6	8	10	12
0.25	5	0.7	0.461949	0.916862	0.979377	0.992781	0.996869	0.998434
	5	0.8	0.325240	0.872822	0.966915	0.988195	0.994829	0.997397
	4	1.0	0.259944	0.838263	0.955756	0.983836	0.992821	0.996353
	3	1.2	0.292381	0.845965	0.957110	0.984127	0.992887	0.996363
	3	1.5	0.118204	0.717204	0.911341	0.965515	0.984127	0.991748
	3	2.0	0.016921	0.468733	0.792571	0.911341	0.957110	0.977015
0.10	6	0.7	0.338520	0.881039	0.969657	0.989283	0.995335	0.997661
	5	0.8	0.325240	0.872822	0.966915	0.988995	0.994829	0.997397
	4	1.0	0.259944	0.838263	0.955756	0.983836	0.992821	0.996353
	4	1.2	0.117448	0.731048	0.918950	0.969209	0.986043	0.992821
	3	1.5	0.118204	0.717204	0.911341	0.965515	0.984127	0.991748
	3	2.0	0.016921	0.468733	0.792571	0.911341	0.957110	0.977015
0.05	7	0.7	0.240546	0.841439	0.958358	0.985156	0.993512	0.996741
	6	0.8	0.210014	0.820950	0.951638	0.982536	0.992310	0.996119
	5	1.0	0.132031	0.755617	0.929181	0.973636	0.988195	0.993978
	4	1.2	0.117448	0.731048	0.918950	0.969209	0.986043	0.992821
	4	1.5	0.026596	0.543584	0.838263	0.934349	0.969209	0.983836
	3	2.0	0.016921	0.468733	0.792571	0.911341	0.957110	0.977015
0.01	8	0.7	0.166537	0.799066	0.945604	0.980422	0.991407	0.995674
	7	0.8	0.130501	0.765341	0.934082	0.975896	0.989328	0.994598
	6	1.0	0.062743	0.669228	0.898175	0.961332	0.982536	0.991052
	5	1.2	0.042092	0.611848	0.872822	0.950303	0.977194	0.983836
	4	1.5	0.026596	0.543584	0.838263	0.934349	0.969209	0.977015
	3	2.0	0.016921	0.468733	0.792571	0.911341	0.957110	0.977015

Table 5: Probability of acceptance for the hybrid group sampling plan with g = 4 and c = 2 when the lifetime of the items follows the exponentiated Log – Logistic distribution

1)

2)

β	r	a	μ/μ$_0$					
			2	**4**	**6**	**8**	**10**	**12**
0.25	**7**	**0.7**	0.981556	0.999983	1.000000	1.000000	1.000000	1.000000
	6	**0.8**	0.966251	0.999959	1.000000	1.000000	1.000000	1.000000
	4	**1.0**	0.956767	0.999910	0.999999	1.000000	1.000000	1.000000
	4	**1.2**	0.863048	0.999438	0.999992	1.000000	1.000000	1.000000
	3	**1.5**	0.854476	0.998832	0.999977	0.999999	1.000000	1.000000
	3	**2.0**	0.573312	0.987722	0.999603	0.999977	0.999998	1.000000
0.10	**8**	**0.7**	0.971774	0.999974	1.000000	1.000000	1.000000	1.000000
	7	**0.8**	0.944901	0.999928	0.999999	1.000000	1.000000	1.000000
	5	**1.0**	0.905558	0.999779	0.999997	1.000000	1.000000	1.000000
	4	**1.2**	0.863048	0.999438	0.999992	1.000000	1.000000	1.000000
	4	**1.5**	0.613047	0.995565	0.999910	0.999996	1.000000	1.000000
	3	**2.0**	0.573312	0.987722	0.999603	0.999977	0.999998	1.000000
0.05	**9**	**0.7**	0.959539	0.999960	1.000000	1.000000	1.000000	1.000000
	8	**0.8**	0.917929	0.999886	0.999999	1.000000	1.000000	1.000000
	6	**1.0**	0.836215	0.999563	0.999994	1.000000	1.000000	1.000000
	5	**1.2**	0.730267	0.998631	0.999979	0.999999	1.000000	1.000000
	4	**1.5**	0.613047	0.995565	0.999910	0.999996	1.000000	1.000000
	3	**2.0**	0.573312	0.987722	0.999603	0.999977	0.999998	1.000000
0.01	**11**	**0.7**	0.927613	0.999923	0.999999	1.000000	1.000000	1.000000
	9	**0.8**	0.885640	0.999830	0.999998	1.000000	1.000000	1.000000
	7	**1.0**	0.753255	0.999246	0.999990	1.000000	1.000000	1.000000
	5	**1.2**	0.730267	0.998631	0.999979	0.999999	1.000000	1.000000
	5	**1.5**	0.376700	0.989487	0.999779	0.999990	0.999999	1.000000
	4	**2.0**	0.211156	0.956767	0.998468	0.999910	0.999992	0.999999

Table 6: Probability of acceptance for the hybrid group sampling plan with g = 4 and c = 2 when the lifetime of the items follows the Marshall – Olkin extended exponential distribution

β	**r**	**a**	**μ/μ₀**					
			2	**4**	**6**	**8**	**10**	**12**
0.25	**4**	**0.7**	0.775361	0.963906	0.988678	0.995106	0.997461	0.998518
	4	**0.8**	0.695071	0.947622	0.983353	0.992769	0.996238	0.997801
	4	**1.0**	0.521445	0.904033	0.968542	0.986178	0.992769	0.995759
	3	**1.2**	0.701802	0.951380	0.984958	0.993565	0.996685	0.998075
	3	**1.5**	0.526408	0.909389	0.971172	0.987557	0.993565	0.996257
	3	**2.0**	0.265711	0.807050	0.934577	0.971172	0.984958	0.991209
0.10	**5**	**0.7**	0.589946	0.920315	0.973775	0.988423	0.993921	0.996425
	5	**0.8**	0.477555	0.887005	0.961934	0.983042	0.991054	0.994724
	4	**1.0**	0.521445	0.904033	0.968542	0.986178	0.992769	0.995759
	4	**1.2**	0.356571	0.846031	0.947622	0.976674	0.987716	0.992769
	3	**1.5**	0.526408	0.909389	0.971172	0.987557	0.993565	0.996257
	3	**2.0**	0.265711	0.807050	0.934577	0.971172	0.984958	0.991209
0.05	**6**	**0.7**	0.411267	0.860203	0.951528	0.978114	0.988364	0.993103
	5	**0.8**	0.477555	0.887005	0.961934	0.983042	0.991054	0.994724
	4	**1.0**	0.521445	0.904033	0.968542	0.986178	0.992769	0.995759
	4	**1.2**	0.356571	0.846031	0.947622	0.976674	0.987716	0.992769
	3	**1.5**	0.526408	0.909389	0.971172	0.987557	0.993565	0.996257
	3	**2.0**	0.265711	0.807050	0.934577	0.971172	0.984958	0.991209
0.01	**7**	**0.7**	0.265521	0.786785	0.921823	0.963848	0.980527	0.988363
	6	**0.8**	0.294170	0.806700	0.930615	0.968242	0.982997	0.989879
	5	**1.0**	0.279275	0.803191	0.930038	0.968187	0.983042	0.989937
	4	**1.2**	0.356571	0.846031	0.947622	0.976674	0.987716	0.992769
	4	**1.5**	0.170360	0.736189	0.904033	0.956215	0.976674	0.986178
	3	**2.0**	0.265711	0.807050	0.934577	0.971172	0.984958	0.991209

7. Conclusion

We here proposed a hybrid group acceptance sampling plan from the truncated life test, the number of testers and the acceptance number was determined for gamma, exponentiated log – logistic and Marshall – Olkin extended exponential distributions when the consumer's risk (β) and the other plan parameters are specified. It can be observed that the minimum number of testers required decreases as test termination time multiplier increases and also the operating characteristics values increases more rapidly as the quality improves. This HGASP can be used when a multiple number of items at a time are adopted for a life test and it would be beneficial in terms of test time and cost because a group of items will be tested simultaneously.

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