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Application of Half Normal Distribution in Hybrid Group Adoption Sampling Plan for Life Tests

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Abstract
This article deals with the discussion of a hybrid group adoption sampling plan depending upon truncated lifetimes of an object whose lifetime accompanies half normal distribution. By considering a size of a group of objects, the least quantity of testers and the value of acceptance number needed are calculated for identified customer's risk and closing time of the test. The numeric value of the operating characteristic function to different standard levels are evaluated, also minimum ratios for real mean life period to an identified life period for specified producer's risk are acquired. Obtained outputs are elucidated with some illustrations.

Keywords: Operating characteristic (OC) function, half normal distribution (HND), producer's risk, customer's risk, truncated life test, hybrid group adoption sampling plans.

1. Introduction
A decision making of selection of a product depends on the fitness of the product for its usage. In quality control, the process of quality check is of many types. One among such processes is acceptance sampling plans. Acceptance sampling is one of the oldest important techniques in quality control involved with inspection and decision making with respect to lots of product. If the quality characteristic of interest is the lifetime of the product then the acceptance sampling is that a sample is considered from the lot and the related quality characteristic of the units in the sample is tested. A decision is built with regard to the lot based on the information of the sample. Generally, the lot of products is accepted when the life test reveals that the mean life of products exceeds the specified one, otherwise it is rejected. Accepted lots are put into production. For the purpose of reducing the test time and cost, a truncated life test may be organized to determine the sample size to ensure a certain mean life of products when the life test is terminated at a time t_0 and the number of failures does not exceed a given acceptance number 'c'.This design provides least number of items in the sample (sample size) to be used in the testing process.Frequently, a single object is used in a tester while making a sampling plan.

But, in practical testers lodging much number of objects at one time are used to minimize the cost and testing time by testing objects at the same time. The objects of tester may treat as one group, the amount of objects within the group named as size of group or group size. Adoption sampling plan depending upon such a group of objects is named as group adoption sampling plan (GASP).

When developing a sampling strategy, it is often assumed that only one object is placed in a tester. In practice, the testers can handle a large number of items at once are used because testing time and money can be saved by testing the items at the same time. Together with truncated life tests, if HGASP is applied then the method is named as HGASP depending on truncated life tests accepting that the objects lifetime accompanies particular probability distribution.

Further literature regarding HGASP of shorten life tests, group adoption sampling plans (GASP) and adoption sampling plans can be viewed in Aslam (2007), Balakrishnan et al. (2007), Aslam and Kantam (2008), Srinivasa Rao et al. (2008), Srinivasa Rao et al. (2009), Srinivasa Rao (2009), Aslam et al. (2009), Lio et al. (2010), Srinivasa Rao and Kantam (2010), Srinivasa Rao (2011) Aslam et al. (2011), Ramaswamy and Anburajan (2012), Subba Rao et al. (2014), Rajagopal and Vijayadevi (2018), Aldossary et al. (2021), Almarashi et al. (2021), Lakshmi and Srinivasa Rao (2022), Varaprasad Rao et al. (2021), Algarni (2022), Fayomi and Khan (2022), Srinivasa Rao and Bala Suseela (2022), Srinivasa Rao and Anil (2022), Naz et al. (2023).

In this article, we narrate the suggested HGASP depending on truncated life tests accepting that the objects lifetime accom-panies half normal distribution in second section. The producer's risk and operating characteristic (OC) are given in fourth and third sections. The obtained outcomes are illustrated with suitable illustrations in fifth section. Lastly the conclusions and summary are specified in conclusion section.

2. The Hybrid Group Adoption Sampling Plans (HGASP)

The methods of statistics handling with the applications and properties of half normal distribution have been highly used in applications of multiple areas particularly if the data is left / right truncated. Half normal distribution comes into picture when the life time of a commodity spans in $(0, \infty)$. Generally in study of reliability, the lifetime of a product ranges in $(0, \infty)$, this study proceeds from the observation that if we have a variable which follows half-normal distribution, then the probability density function (pdf) of half normal distribution is given by

$$p(t) = \frac{2\theta}{\pi} e^{-t^2\theta^2/\pi}, \quad t \geq 0. \tag{1}$$

The (cdf) cumulative distribution function is

$$P(t) = \operatorname{erf}\left(\frac{\theta t}{\sqrt{\pi}}\right), \quad t \geq 0. \tag{2}$$

In the field of reliability, the increasing failure rate (IFR) model is very much handy and the half normal distribution is one of those IFR models. Due to this IFR nature we are influenced to work with half normal distribution. Suppose the lifetime of an object accompanies half normal distribution accompanied by the scale variable σ, the cdf is

$$F(t) = \operatorname{erf}\left(\frac{\theta t/\sigma}{\sqrt{\pi}}\right), \quad t \geq 0, \sigma > 0. \tag{3}$$

For q between 0 and 1, the 100^{th} percentile is given by

$$t_q = \sigma \frac{\sqrt{\pi}}{\theta} \operatorname{erf}^{-1}(q). \tag{4}$$

Substitute σ in Equation (3) we obtain

$$F(t) = \operatorname{erf}\left(\frac{(\frac{\theta t}{t_q})\frac{\sqrt{\pi}}{\theta}\operatorname{erf}^{-1}(q)}{\sqrt{\pi}}\right), \tag{5}$$

$$F(t) = \text{erf}(\delta\, \text{erf}^{-1}(q)), \tag{6}$$

where $\delta = t/t_q$ and erf means error function, and erf^{-1} means inverse error function in Equations (2)-(6). Generally mean, median are equal if the probability distribution is symmetric. But if the distribution is skewed, then more data points of the population spread in one side of the distribution. While raising the quantity of the skewness the mean become larger so that excessive percentage of the population is below the mean. These reflect that the mean is not the center point of the probability distribution and greater than eighty percent of the entire population appears under the mean. Suppose median is taken, then half of the population is lower than the median and hence the population median depended sampling plan of half normal distribution scheme is low-price compare with depended on population mean regarding size of sample. Particularly take $q = 0.5$ for skewed population.

Assuming that the data of life of particular object stick to half normal distribution, lets μ denote the accurate value of the median, μ_0 represent identified median. Depending on the quantity of failure data, we are interest to check the hypothesis $H_0 : \mu \geq \mu_0$ versus $H_1 : \mu < \mu_0$. A consignment of objects are taken as good and received by the customers for the usage if the sample data bear the hypothesis $\mu \geq \mu_0$. On the far side, the consignment of the objects is refused if $\mu < \mu_0$. Among the acceptance sampling plans, the above hypothesis is checked depending on quantity of failures in a sample at pre-fixed time. If the quantity of failures is greater than action limit c, then the consignment of the objects is rejected. If there is an authentication such that $\mu \geq \mu_0$ at somewhat customer's risk, then we accept the consignment of objects. Otherwise the consignment is rejected. Consider the following suggested HGASP depending on truncated lifetimes as follows:

1. Find the quantity n of testers and allot r objects to every pre-defined group g, the needed observations in the consignment is $n = g \times r$.
2. Affix adoption parameter c to every group as well as time of experiment t_0.
3. Receive consignment when the maximum number of non-success occurs is c in every group.
4. Cease the experiment if the quantity of failures occurs is greater than the adoption parameter c in any one of the groups and reject the consignment.

By assuming particular numerics to termination time t_0, we focused on finding the quantity of testers r desired to half normal distribution and several numerics for adoption number c. We consider ending time t_0 as the product of median and termination ratio, i.e $t_0 = \delta\mu_0$. Probability (β) of receiving a bad consignment is named as customer's risk. On the other hand the probability (α) of refusing good consignment is named as producer's risk. Frequently customer's risk β is indicated by customer's belief level. Let, customer's belief level be p^*, hence the customer's risk is $\beta = 1 - p^*$. We evaluate the quantity of groups g in the suggested sampling plan such that the customer's risk is not greater than a taken value β. Suppose bulk of the consignment is much large, we make use of binomial distribution to establish HGASP. In accordance with HGASP, the consignment of objects is received only when the number of non-successes is at most c in every group. Hence the consignment adoption probability is

$$\left(\sum_{i=0}^{c} \binom{r}{i} p_0^i (1-p_0)^{r-i}\right)^g \leq \beta \tag{7}$$

where $p_0 = F_t(\delta_0)$ which represents probability that a non-success occur during the time $t = \delta t_q^0$. For small sample sizes the results corresponding to for $\beta = 0.25$, 0.10, 0.05, 0.01; $c = 0$, 1, 2, 3, 4, 5, 6, 7, 8; $g = 2$, 3, 4, 5, 6, 7, 8, 9, 10 and $\delta = 0.7$, 0.8, 1.0, 1.2, 1.5, 2.0 are given in Table 1.

Table 1 Minimum number of testers (r) needed for the offered plan in case of HND

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

3. Operating Characteristic (OC) of Sampling Plan

For a sampling plan, operating characteristic (OC) function is defined as a function of deflection of particular value of median μ_0 from its actual value μ. The probability of receiving a consignment can be treated as OC function. After finding the least number of testers r, we can find the probability of receiving a consignment when the consignment is in good quality if $\mu \geq \mu_0$. The operating characteristic (OC) is

$$L(p) = \left(\sum_{i=0}^{c} \binom{r}{i} p^i (1-p)^{r-i} \right)^g . \tag{8}$$

Employing Equation (8) the OC values corresponding to $\beta = 0.25, 010, 0.05, 0.01$; $\mu/\mu_0 =$

$2, 4, 6, 8, 10, 12$; and $\delta = 0.7, 0.8, 1.0, 1.2, 1.5, 2.0$; are exhibited in Table 2.

Table 2 OC values of HGASP for HND with $c = 2$ and $g = 4$

β	r	δ	μ/μ_0					
			2	4	6	8	10	12
0.25	6	0.7	0.8822	0.9834	0.9949	0.9978	0.9989	0.9994
	5	0.8	0.8580	0.9796	0.9937	0.9973	0.9986	0.9996
	4	1.0	0.8118	0.9720	0.9913	0.9963	0.9981	0.9989
	4	1.2	0.7261	0.9569	0.9866	0.9942	0.9970	0.9982
	3	1.5	0.6792	0.9477	0.9835	0.9929	0.9963	0.9978
	3	2.0	0.5266	0.9143	0.9725	0.9880	0.9937	0.9963
0.10	7	0.7	0.5684	0.9182	0.9733	0.9883	0.9938	0.9964
	6	0.8	0.5027	0.8993	0.9666	0.9852	0.9922	0.9954
	5	1.0	0.3952	0.8626	0.9532	0.9790	0.9889	0.9934
	4	1.2	0.3357	0.8366	0.9431	0.9743	0.9863	0.9919
	4	1.5	0.1884	0.7557	0.9108	0.9589	0.9779	0.9868
	3	2.0	0.1413	0.7146	0.8922	0.9495	0.9726	0.9836
0.05	8	0.7	0.3669	0.8522	0.9496	0.9774	0.9881	0.9929
	7	0.8	0.2922	0.8177	0.9362	0.9712	0.9847	0.9909
	6	1.0	0.1873	0.7524	0.9096	0.9584	0.9777	0.9867
	5	1.2	0.1329	0.7024	0.8873	0.9473	0.9715	0.9829
	4	1.5	0.0887	0.6459	0.8600	0.9333	0.9635	0.9780
	3	2.0	0.0619	0.5972	0.8339	0.9192	0.9553	0.9728
0.01	9	0.7	0.1141	0.6836	0.8799	0.9440	0.9697	0.9819
	8	0.8	0.0708	0.6194	0.8490	0.9283	0.9609	0.9765
	7	1.0	0.0282	0.5093	0.7898	0.8970	0.9429	0.9653
	6	1.2	0.0134	0.4302	0.7400	0.8690	0.9263	0.9549
	5	1.5	0.0053	0.3463	0.6787	0.8324	0.9040	0.9405
	4	2.0	0.0020	0.2735	0.6150	0.7913	0.8778	0.9232

4. Producer's Risk

Any producer is intended in magnifying quality grade level of the object such that the probability of receiving the object is greater than given level. For specified value of producer's risk α, the minimum ratio is acquired which satisfies the inequality

$$\left(\sum_{i=0}^{c}\binom{r}{i}p^i(1-p)^{r-i}\right)^g \geq 1-\alpha \qquad (9)$$

In the event of HND depending on the values shown in Table 1 for receiving of a consignment at producer's risk $\alpha = 0.05$, the least numerics of the ratio $\mu/\mu_0 = 2$ are given in Table 3.

Table 3 Minimum ratio values of true median to the specified median for the producer's risk of $\alpha = 0.05$ in HND

β	c	g	δ					
			0.7	0.8	1.0	1.2	1.5	2.0
0.25	0	2	29.5580	33.7805	21.2456	25.4947	31.8683	42.4911
	1	3	6.8201	7.7944	6.9600	8.3520	6.1709	8.2279
	2	4	4.0661	3.7262	3.4892	4.1870	3.4053	4.5404
	3	5	3.0842	2.9923	3.0669	2.8535	3.5668	3.2933
	4	6	2.5844	2.5937	2.3266	2.7919	2.7766	2.6778
	5	7	2.2807	2.0727	2.2519	2.2872	2.3206	2.3113
	6	8	2.0755	1.9549	1.9112	1.9638	2.0247	2.0672
	7	9	1.9269	1.8630	1.8974	2.0118	1.8170	1.8922
	8	10	1.8139	1.7891	1.6926	1.8065	1.6630	1.7600
0.10	0	2	44.2435	50.5640	42.2257	50.6708	31.8683	42.4911
	1	3	8.7541	7.7944	9.7430	8.3520	10.4400	8.2279
	2	4	4.8659	4.6469	4.6577	4.1870	5.2338	4.5403
	3	5	3.5470	3.5248	3.7403	3.6803	3.5668	3.2933
	4	6	2.8897	2.9536	2.7880	2.7919	2.7766	2.6778
	5	7	2.5119	2.6065	2.5909	2.7022	2.3206	2.3113
	6	8	2.2564	2.1642	2.1794	2.2934	2.4547	2.0672
	7	9	2.0741	2.0332	2.1144	2.0118	2.1743	2.4226
	8	10	1.9371	1.9314	1.8761	2.0310	1.9683	2.2168
0.05	0	2	58.9289	50.5640	63.2050	50.6708	63.3385	42.4911
	1	3	10.6817	10.0046	9.7430	11.6915	10.4400	8.2279
	2	4	5.6625	5.5610	5.8087	5.5893	5.2338	4.5404
	3	5	4.0079	4.0537	3.7403	3.6803	3.5668	3.2933
	4	6	3.2090	2.9536	3.2421	3.3456	2.7766	3.7021
	5	7	2.7422	2.6065	2.5909	2.7022	2.8589	3.0940
	6	8	2.4366	2.3720	2.4436	2.2934	2.4547	2.6995
	7	9	2.2207	2.2022	2.1144	2.2768	2.1743	2.4226
	8	10	2.0599	2.0730	2.0571	2.0311	1.9685	2.2173
0.01	0	2	88.2995	84.1305	84.1841	75.8460	63.3385	84.4513
	1	3	12.6061	14.4069	12.5058	11.6915	14.6144	13.9200
	2	4	6.4571	6.4714	6.9513	6.9704	6.9866	6.9784
	3	5	4.4675	4.5805	4.4060	4.4884	4.6003	4.7558
	4	6	3.5197	3.6675	3.6920	3.3456	3.4899	3.7021
	5	7	3.2009	3.1340	2.9258	3.1091	2.8590	3.0942
	6	8	2.7954	2.7847	2.7052	2.6152	2.8667	2.6993
	7	9	2.5128	2.5380	2.5414	2.5372	2.5148	2.4226
	8	10	2.3046	2.3542	2.2364	2.2513	2.2581	2.2173

5. Tables and Examples

For different values of test termination time multiplier and customer's risk, the numerics of design variables of HGASP are given in Table 1. It is observed that the least sample size may be evaluated using n = $r \times g$. It is noticed in first Table that the quantity of testers r reduced as the value of test termination time multiplier δ raises. In Table 1, for the sake of example if c = 2, g = 4, β = 0.10 and δ varies from 0.7 to 0.8, then values of the parameter r of HGASP changes from 7 to 6. But this movement is not monotonic for the reason that it is based on the adoption number also. The probability of receiving a consignment relating to the producer's risk is shown in Table 2. Lastly, the minimum ratios to receive a consignment with producer's risk α = 0.05 are given in Table 3.

Assuming that the data of lifetime of an object follows half normal distribution, we are interested to develop HGASP to examine if the testing time is 700 hours and the median is more than 1000 hours using 4 groups. If $\beta = 0.10$ and $c = 2$, then the value of the termination multiplier δ is 0.7. In Table 1 it is shown that the least number of testers r needed is found as 7. Therefore take a random sample with size $n = 28$ objects and 4 groups are formed each one with 7 objects to place on test for testing time of 700 hours. The consignment is received if the quantity of failures is not more than 2 before the testing time of 700 hours in every one of four groups. The experiment is trimmed when the third failure take place prior to 700 hours. In this suggested sampling plan design, probability of receiving the consignment is 0.9182 if the actual value of the median is 4000 hours. It exhibits that, when even the actual value of the median is equal to four times of the needed value 1000 hours, producer's risk is 0.0818. From Table 3, we can find the value of ratio $\frac{\mu}{\mu_0}$ to guarantee the producer's risk of 0.05. If r = 6, $\beta = 0.10$, $g = 4$, $\delta = 0.7$ and $c = 2$, then the needed ratio is 4.8659.

We consider a data set which consists of a sample of 50 observed values of breaking stress of carbon fibers given by Nicholas and Padgett(2006) Nichols and Padgett (2006). The data set is given by,

1.12, 0.17, 0.64, 4.32, 1.22, 0.37, 1.16, 1.42, 0.09, 1.67, 0.13, 0.25, 0.08, 0.04, 2.35, 0.20, 0.78, 0.34, 1.02, 0.17, 1.76, 2.39, 0.50, 1.35, 3.36, 0.45, 0.90, 2.92, 6.53, 1.62, 7.46, 3.19, 2.49, 1.40, 7.49, 0.57, 0.14, 0.63, 5.23, 0.71, 0.68, 0.12, 0.09, 3.47, 5.93, 1.82, 4.20, 7.29, 3.13, 3.41.

The p-value is 0.9635 according to Kolmogorov-Smirnov (K-S) test. As an example The OC values of HGASP for HND with $c = 2$ and $g = 4$ with $\delta = 1.2$ are:

β	r	δ	μ/μ_0					
			2	4	6	8	10	12
0.25	4	1.2	0.6261	0.9369	0.9466	0.9568	0.9796	0.9912
0.10	4	1.2	0.3049	0.8212	0.9320	0.9472	0.9821	0.9895
0.05	4	1.2	0.2329	0.7824	0.8163	0.9324	0.9612	0.9542
0.01	4	1.2	0.1134	0.5314	0.7567	0.8890	0.9456	0.9498

6. Conclusions

In this article, by considering the HND a HGASP from truncated life test is suggested. If values of customer's risk (β) and remaining parameters of the plan are specified, then the quantity of the groups and the adoption number value are calculated. It is noticed that the raise in the value of test termination time multiplier leads to fall down in the value of least number of groups needed. Furthermore it is observed that the operating characteristics function rises immensely as the quality of the object enhances. The suggested HGASP can be applied for much number of objects to test concurrently. Distinctly with reference to test cost and test time, the proposed tester would be fruitful.

Conflict of Interest Statement

We have no conflict of interest and we undertake that the work in the manuscript is original work and is not reviewed by any other journal.

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References

Aldossary F, Hamed MS, Mohamed SM. A group acceptance sampling plan for truncated life test having the (P-A-L) extended Weibull distribution. Adv Appl Stat. 2021; 68(2): 201-211.

Algarni A. Group acceptance sampling based on new compounded three-parameter Weibull model. Axioms. 2022; 11(9): 431.

Almarashi AM, Khan K, Chesneau C, Jamal F. Group acceptance sampling using Marshall-Olkin Kumaraswamy exponential distribution. Processes. 2021; 9: 1066.

Aslam M. Double acceptance sampling based on truncated life tests in Rayleigh distribution. Eur J Sci Res. 2007; 17(4): 605-610.

Aslam M, Kantam RRL. Economic reliability acceptance sampling plan based on truncated life tests in Birnbaum-Saunders distribution. Pak J Stat. 2008; 24(4): 269-276.

Aslam M, Jun CH, Ahmad M. A group sampling plan based on truncated life tests for gamma distributed items. Pak J Stat. 2009; 25(3): 333-340.

Aslam M, Kundu D, Jun CH, Ahmad M. Time truncated group acceptance sampling plans for generalized exponential distribution. J Test Eval. 2011; 39(4): 671-677.

Balakrishnan N, Leiva V, Lpez J. Acceptance sampling plans from truncated life tests based on generalized Birnbaum-Saunders distribution. Commun Stat Simul Comput. 2007; 36(3): 643-656.

Fayomi A, Khan K. A group acceptance sampling plan for Another Generalized Transmuted-Exponential Distribution based on truncated lifetimes. Qual Reliab Eng Int. 2022; 40(1): 145-153.

Lakshmi KNVR, Srinivasa Rao B. Group acceptance sampling for life tests based on new Weibull Pareto distribution. Int J Res Eng Appl Manag. 2022; 22(1): 76-86.

Lio YL, Tsai TR, Wu SJ. Acceptance sampling plans from truncated life tests based on Birnbaum-Saunders distribution for percentiles. Commun Stat Simul Comput. 2010; 39(1): 119-136.

Naz S, Tahir MH, Jamal F, Ameeq M, Shafiq S, Mendy JT. A group acceptance sampling plan based on flexible new Kumaraswamy exponential distribution: an application to quality control reliability. Cogent Eng. 2023; 10(2): 2257945.

Nichols MD, Padgett WJ. A bootstrap control chart for Weibull percentiles. Qual Reliab Eng Int. 2006; 22(2): 141-151.

Rajagopal S, Vijayadevi K. A hybrid group acceptance sampling plan for lifetimes based on transmuted exponential distribution. Int J Stat Appl Math. 2018; 3(2): 268-273.

Ramaswamy AS, Anburajan P. Group acceptance sampling plan using weighted binomial on truncated life tests for inverse Rayleigh and Log-logistic distributions. IOSR J Math. 2012; 2(3): 33-38.

Srinivasa Rao G, Ghitany ME, Kantam RRL. Acceptance sampling plans for Marshall-Olkin extended Lomax distribution. Int J Appl Math. 2008; 21(2): 315-325.

Srinivasa Rao G, Ghitany ME, Kantam RRL. Reliability test plans for Marshall-Olkin extended exponential distribution. Appl Math Sci. 2009; 3(55): 2745-2755.

Srinivasa Rao G. A group acceptance sampling plans for truncated life tests for Marshall-Olkin extended Lomax distribution. Electron J Appl Stat Anal. 2009; 3(1): 18-27.

Srinivasa Rao G. A hybrid group acceptance sampling plans for lifetimes based on log-logistic distribution. J Reliab Stat Stud. 2011; 4(1): 31-40.

Srinivasa Rao B, Bala Suseela VR. A hybrid group acceptance sampling plans for life tests based on exponentiated inverted Weibull distribution. Adv Appl Math Sci. 2022; 21(5): 2545-2558.

Srinivasa Rao B, Anil A. A hybrid group acceptance sampling plans for life tests based on the new weighted exponential distribution. Int J Appl Math Stat. 2022; 61(2): 50-59.

Srinivasa Rao G, Kantam RRL. Acceptance sampling plans from truncated life tests based on the log-logistic distribution for percentiles. Econ Qual Control. 2010; 25(2): 153-167.

Subba Rao R, Durgamamba NA, Kantam RRL. Hybrid group acceptance sampling plan based on size biased Lomax model. Math Stat. 2014; 2(3): 137-141.

Varaprasad Rao B, Srinivasa Rao K, Ramesh E, Kiran Kumar N. A hybrid group acceptance sampling plans for life tests based on half logistic distribution. Turk Online J Qual Inq. 2021; 12(7): 1293-1301.