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GROUP ACCEPTANCE SAMPLING PLANS FOR LIFETIMES FOLLOWING EXPONENTIATED WEIBULL DISTRIBUTION

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Abstract:
A group acceptance sampling plan was created for the Exponentiated Weibull distribution, focusing on truncated lifetimes with a predetermined shape parameter. We determined the minimum number of groups needed for a specified group size and acceptance number, considering a set consumer risk and test termination time. The operating characteristic function values were computed for different quality levels, and we found the minimum ratios of actual average life to specified life at a given producer's risk. Tables illustrate these findings.
Key words: Exponentiated Weibull distribution, truncated lifetimes, group acceptance sampling plan, operating characteristic function, producer’s risk.

1. INTRODUCTION

Quality control involves inspecting products or services to ensure they meet standards. When inspecting every single item isn't practical, sampling becomes necessary. This raises questions about the optimal sample size or whether sampling is even needed. By analyzing sample data, decisions can be made about accepting or rejecting an entire batch. Statistical quality control relies heavily on acceptance sampling, a methodology popularized by Dodge and Romig during World War II, when the US military used it to test ammunition. This approach enables informed decisions about product lots based on sample inspections.
Acceptance sampling often involves truncated life tests to determine the required sample size for a given lot, ensuring reliable quality control decisions. Traditional sampling plans typically involve testing individual items. However, to optimize time and resources, testers that can handle multiple items simultaneously are employed. The number of items per tester is usually predetermined by specifications. When sampling plans are designed for such multi-item testers, they're referred to as group acceptance sampling plans (GASPs). When GASPs are combined with truncated life tests, the lifetime of the product is assumed to follow a specific probability distribution. In this context, determining the sample size is equivalent to determining the number of groups required, where the sample size n=rg is calculated as the product of the group size and the number of groups.
Group acceptance sampling plans (GASP) have received considerable attention in reliability testing due to their efficiency in simultaneously testing multiple items. Various lifetime distributions have been explored in the context of GASP, each providing different levels of flexibility and modeling capabilities. Aslam and Jun [4], [6], [7], [8] laid foundational work in the development of group acceptance sampling plans under truncated life tests by utilizing distributions like the inverse Rayleigh, log-logistic, Weibull, and generalized exponential. Their contributions emphasized the practical utility of GASP in quality control settings. Subsequent works extended these frameworks to more flexible lifetime distributions. For instance, Almarashi et al. [3] introduced GASP based on the Marshall-Olkin Kumaraswamy exponential distribution, highlighting its increased flexibility over traditional models. Likewise, Fayomi and Khan [13] developed GASP for the generalized transmuted lifetime distribution, showcasing improvements in modeling skewed data. Rao and colleagues [28], [29], [30], [31] contributed significantly by formulating GASP under distributions like Half Normal, Weibull, Gompertz, and via Bayesian approaches. These models addressed varying shapes of hazard functions and incorporated prior knowledge, enhancing the robustness of acceptance decisions. The Weibull distribution, known for its adaptability, has been widely used in GASP studies. Rao [28], and Kantam and Rosaiah [19] demonstrated its utility in truncated life tests. Meanwhile, Jun et al. [14], [15] developed variable sampling plans for Weibull-distributed lifetimes under sudden death testing, optimizing test efficiency when test positions are limited. More recently, Algarni [1] proposed a GASP based on a compounded three-parameter Weibull model, advancing the existing Weibull-based models by allowing for increased shape

flexibility. Similarly, Alghamdi et al. [2] introduced a more flexible Lomax distribution for GASP, enhancing reliability assessment under skewed lifetime data. Distributions such as the inverse log-logistic [22], finite mixture models [23], [41], and exponentiated forms [36], [42] have also been explored in GASP frameworks to better fit real-life reliability data. The use of exponentiated distributions, like the exponentiated inverted Weibull [42] and exponentiated log-logistic [36], closely aligns with the motivation for using the exponentiated Weibull distribution in this study. Additional studies have expanded GASP to include double sampling [22], [39], [40], two-stage plans [37], and hybrid strategies [35], enhancing decision-making efficiency. Monte Carlo simulations and sudden death testing strategies have also been used to assess the performance of sampling plans under restricted conditions [24], [25], [43], [45].

This study focuses on designing a group acceptance sampling plan (GASP) for truncated life tests, assuming that product lifetimes follow a Type II Exponentiated Weibull Distribution (EWD). The paper is organized as follows: Section 2 introduces the Type II EWD, while Section 3 outlines the proposed GASP. Section 4 illustrates the methodology using real-world data, and Section 5 summarizes the key findings and conclusions

2. Exponentiated Weibull Distribution

The Exponentiated Weibull Distribution (EWD) was indeed introduced by Mudholkar and Srivastava as an extension of the traditional Weibull distribution, adding more flexibility to model various types of data. The applications of this distribution in reliability and survival studies were illustrated by Mudholkar et al. The exponentiated exponential distribution and the Weibull distribution, examined by Gupta et al, are the special cases of EWD. Mudholkar and Hutson demonstrated that the EWD has bathtub shaped and unimodal failure rates.

The probability density function (pdf) and cumulative distribution function (cdf) of EWD are defined as follows.

$$f(\mathrm{t};\sigma,\lambda,\theta)=\lambda\theta\left(t\right)^{\lambda-1}e^{-(t)^{\lambda}}\left[1\text{-}e^{-(t)^{\lambda}}\right]^{\theta\text{-}1};\qquad t>0\ and\ \lambda,\theta>0\ . \tag{1}$$

and $F(\mathrm{t};\lambda,\theta)=\left[1-e^{-(t)^{\lambda}}\right]^{\theta};\quad t>0\ and\ \theta>0$ (2)

to discuss the three-parameter Exponentiated Weibull Distribution(EWD), Which includes a scale parameter σ in addition to two scale parameters denoted by λ (lambda) and θ (theta). The modified three-parameter Exponentiated Weibull Distribution (EWD) allowing for greater flexibility in modeling real-world data, whose pdf and cdf are respectively given by

$$f(\mathrm{t};\sigma,\lambda,\theta)=\frac{\lambda\theta}{\sigma}\left(\frac{t}{\sigma}\right)^{\lambda-1}e^{-(t/\sigma)^{\lambda}}\left[1\text{-}e^{-(t/\sigma)^{\lambda}}\right]^{\theta\text{-}1};\qquad t>0\ and\ \sigma,\lambda,\theta>0\ . \tag{3}$$

and $F(\mathrm{t};\sigma,\lambda,\theta)=\left[1-e^{-(t/\sigma)^{\lambda}}\right]^{\theta};\quad t>0\ and\ \theta>0$ (4)

where σ (sigma) is a scale parameter, and λ (lambda) and θ (theta) are the shape parameters. The exponentiated Weibull distribution is a special case of (1) for λ =1 and the Weibull distribution is a special case of (1) for θ =1.

For 0<q<1, the 100q-th percentile or qth quantile of the EWD, denoted by t_q, is given by

$$F(t_q)=q\Rightarrow t_q=F^{-1}(q)=\sigma\eta_q,\quad \text{where } \eta_q=\left[-\ln(1-q^{1/\theta})\right]^{1/\lambda} \tag{5}$$

From this equation, it's evident that for fixed values of $\lambda=\lambda_0$ and $\theta=\theta_0$, the quantile t_q is dependent on the scale parameter σ and by setting a specific value for the quantile t_q say t_q^0, we can solve for the corresponding value of the scale parameter σ, say σ_0, denoted as

$$\sigma_0=t_q^0\Big/\left[-\ln(1-q^{1/\theta_0})\right]^{1/\lambda_0}$$

Clearly, $t_q\geq t_q^0\Leftrightarrow\sigma\geq\sigma_0$ and we may also note that σ_0 are influenced by λ_0 and θ_0. Notably, the relationship between these parameters and the variables they depend on is crucial in developing acceptance sampling plans for the Exponentiated Weibull Distribution.

A key consideration is ensuring that t_q exceeds t_q^0 equivalently σ exceeds σ_0 surpassing its corresponding threshold.

3. The Group Acceptance Sampling Plan (GASP)

This discussion focuses on group acceptance sampling plans (GASPs) for products with lifetimes following an Exponentiated Weibull Distribution (EWD). Specifically, we explore GASPs under truncated life testing, where the decision criterion is based on the cumulative number of failures across all groups. The step-by-step procedure for implementing this plan is outlined below, drawing on the work of Aslam et al. (2011).

The proposed plan involves the following steps:

1. Randomly select a sample of n products and divide them into g groups, each containing r items (n = r × g).
2. Determine an acceptance number c and a predetermined test termination time (t_0).
3. Accept the lot if the total number of failures across all groups does not exceed c.
4. If more than c failures occur before the test termination time (t_0), terminate the experiment and reject the lot.

That's a crucial step in evaluating the effectiveness of a group acceptance sampling plan.

The lot acceptance probability calculation typically involves considering the number of failures across all groups within the truncated life test before the prefixed time (t_0). To delve deeper into the calculation specifics or discuss the implications of this approach as follows

$$\mathrm{P}(p)=\sum_{i=0}^{c}\binom{rg}{i}p^{i}\left(1-p\right)^{rg-i} \tag{6}$$

In this context, the key parameters are: g (number of groups), c (acceptance number), r (group size), and p (probability of failure within the test termination time). Assuming the product's lifetime 't' follows an Exponentiated Weibull Distribution (EWD) then $p=F(\mathrm{t};\sigma,\lambda,\theta)$. Usually, it would be convenient to determine the experiment termination time t_0 , as $t_0=\delta_q^0 t_q^0$ for a constant δ_q^0 and the targeted 100q-th lifetime percentile, t_q^0 . Let t_q be the true 100q-th lifetime percentile. Then, p can be rewritten as

$$p=1-\left(\exp\left(-\left(\frac{t_0}{\sigma}\right)^{\lambda}\right)\right)^{\theta}=1-\left(\exp\left(-\left(\frac{\eta_q\delta_q^0}{\left(t_q/t_q^0\right)}\right)^{\lambda}\right)\right)^{\theta} \tag{7}$$

To determine the design parameters of the proposed group acceptance sampling plan, a two-point approach on the operating characteristic (OC) curve is employed, taking into account both producer's and consumer's risks. This approach evaluates quality levels based on the ratio of percentile lifetime to its specified lifetime; t_q/t_q^0 . From the producer's perspective, the probability of lot acceptance should be at least a certain threshold should be at $1-\alpha$ when the product meets the acceptable reliability level (ARL), ensuring a high likelihood of acceptance for products that meet quality standards at p_1. The producer requires a high acceptance probability for lots meeting certain reliability standards, say t_q/t_q^0 =2, 4, 6, 8. as outlined in equation (7). Conversely, the consumer prioritizes lot rejection probability should be at most β at the lot tolerance reliability level (LTRL), p_2. In this way, the consumer consider that a lot should be rejected when t_q/t_q^0 =1, in equation (7). Now, let us consider

$$P_a(p_1)=\sum_{i=0}^{c}\binom{rg}{i}p_1^i(1-p_1)^{rg-i}\geq 1-\alpha \tag{8}$$

$$P_a(p_2)=\sum_{i=0}^{c}\binom{rg}{i}p_2^i(1-p_2)^{rg-i}\leq \beta \tag{9}$$

Where p_1 and p_2 are given by

$$p_1=\left(1-\exp\left[-\left(\frac{\eta_q\delta_q^0}{\left(t_q/t_q^0\right)}\right)^{\lambda}\right]\right)^{\theta}\text{ and }p_2=\left(1-\exp\left[-\left(\eta_q\delta_q^0\right)^{\lambda}\right]\right)^{\theta} \tag{10}$$

The plan parametric quantities for distinct values of parameters are constructed. For a specified producer's risk $\alpha=0.05$ and termination time schedule $t_0=\delta_q\, t_q^0$ with $\delta_q^0=0.5\,\text{and}\,1.0,$ the parameter of the proposed group acceptance sampling plan are estimated for 50th percentiles at different confidence levels $\beta=0.25,0.10,0.05,0.01.$ The plan parameters are presented in Tables 1, 2 and 3 for λ=1.5 and θ=1.5, λ=2.5 and θ=1.5 and λ=2.5 and θ=2.5 at 50th percentile. Table 4 is constructed using ML estimates $\hat{\lambda}=0.689438941329603,\ \hat{\theta}=1.77779793377646$ at 50th percentile. We noticed from Table 1 to 4, we observe that the percentile ratio increases when the number of groups g reduces. Similarly, as r increases from 5 to 10, the number of groups reduces.

4. Description of the Proposed Methodology with Real Lifetime Data

A dataset of remission times (in months) for 128 bladder cancer patients, originally presented by E.T. Lee (2003) [21], is analyzed below:
0.08, 2.09, 3.48, 4.87, 6.94, 8.66, 13.11, 23.63, 0.2, 2.23, 0.52, 4.98, 6.97, 9.02, 13.29, 0.4, 2.26, 3.57, 5.06, 7.09, 0.22, 13.8, 25.74, 0.5, 2.46, 3.46, 5.09, 7.26, 9.47, 14.24, 0.82, 0.51, 2.54, 3.7, 5.17, 7.28, 9.74, 14.76, 26.31, 0.81, 0.62, 3.28, 5.32, 7.32, 10.06, 14.77, 32.15, 2.64, 3.88, 5.32, 0.39, 10.34, 14.38, 34.26, 0.9, 2.69, 4.18, 5.34, 7.59, 10.66, 0.96, 36.66, 1.05, 2.69, 4.23, 5.41, 7.62, 10.75, 16.62, 43.01, 0.19, 2.75, 4.26, 5.41, 7.63, 17.12, 46.12, 1.26, 2.83, 4.33, 0.66, 11.25, 17.14, 79.05, 1.35, 2.87, 5.62, 7.87, 11.64, 17.36, 0.4, 3.02, 4.34, 5.71, 7.93, 11.79, 18.1, 1.46, 4.4, 5.85, 0.26, 11.98, 19.13, 1.76, 3.25, 4.5, 6.25, 8.37, 12.02, 2.02, 0.31, 4.51, 6.54, 8.53, 12.03, 20.28, 2.02, 3.36, 6.76, 12.07, 0.73, 2.07, 3.36, 6.39, 8.65, 12.63, 22.69, 5.49.
The above data set is assumed to follow $\mathrm{EWD}(\lambda,\theta)$. We obtain the MLEs of the parameters as $\hat{\lambda}=0.6894,\ \hat{\theta}=1.777$. To validate the model's fit, we conducted a Kolmogorov-Smirnov test on the dataset. The results showed a Kolmogorov-Smirnov statistic of 0.0514 with a p-value of 0.8883, indicating that the Exponentiated Weibull Distribution (EWD) provides a reasonable fit to the data
Thus the data sets are reasonably fitted for EWD distribution.

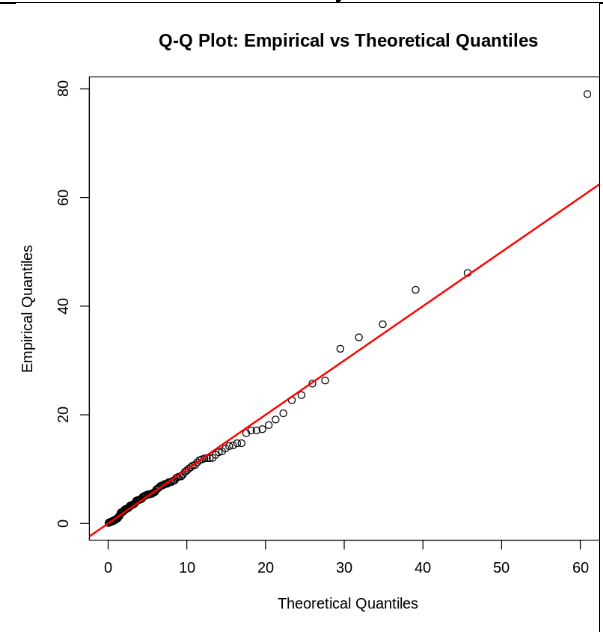

Figure 1: Exponentiated Weibull Distribution: Estimated Density and Q-Q Plot

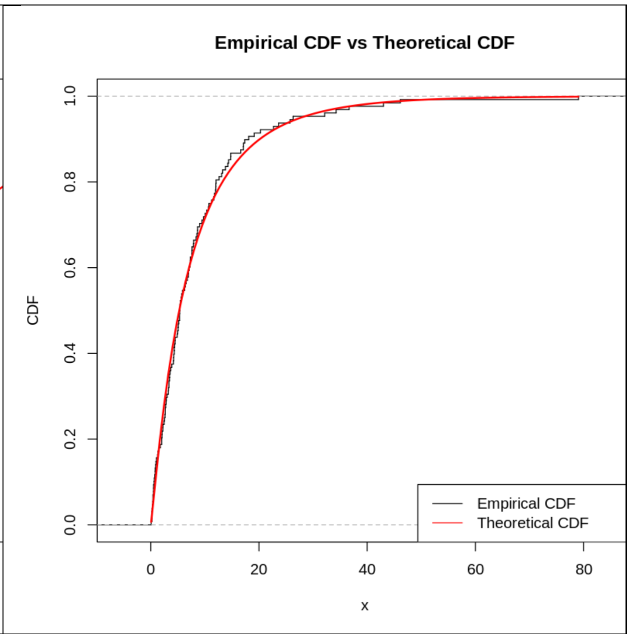

Figure 2: Empirical and Theoretical CDF's

Consider a product with a lifetime following an Exponentiated Weibull Distribution (EWD) with known index parameters $\hat{\lambda}=0.6894,\ \hat{\theta}=1.777$. The goal is to design a group acceptance sampling plan that ensures the 50th percentile of the lifetime distribution exceeds the remission time of bladder cancer patients. The producer's risk is 5%. For $\hat{\lambda}=0.6894,\ \hat{\theta}=1.777,$ and the consumer's risk is 25%, with r=5, $\delta_q^0=1.0$ and t_q/t_q^0=4, the minimum number of groups acceptance number given by g=5 and c =4 from Table 4, the plan's implementation involves selecting 20 products, divided into two groups of 10 items each. We can accept the lot when no more than 5 failures occur before 1 month from each of two groups. Based on this plan, the remission times have been accepted since there were only 5 failures before the 1-month termination time.

5. CONCLUSIONS

This study introduces a group acceptance sampling plan for products with lifetimes following an Exponentiated Weibull Distribution (EWD). The design parameters, c and g, are determined using a two-point approach. Our results show that as the percentile ratio increases, the required number of groups (g) decreases. Additionally, for certain parametric combinations, increasing the group size (r) also leads to a reduction in the number of groups. The effectiveness of the proposed plan is demonstrated using real-world lifetime data, highlighting its practical applicability in industrial settings.

1. REFERENCES

[1] F. Algarni, "Group acceptance sampling plan based on new compounded three-parameter Weibull model," Reliability Engineering & System Safety, vol. 225, p. 108580, 2022.

[2] S. A. Alghamdi, H. Tripathi, and M. Aslam, "More flexible Lomax distribution: characterization, estimation, group acceptance sampling plan applications," J. Appl. Probab. Stat., vol. 39, no. 1, pp. 75–90, 2024.
[3] M. Almarashi, M. Aslam, and C.-H. Jun, "Group acceptance sampling plan using Marshall-Olkin Kumaraswamy exponential distribution," Commun. Stat. Theory Methods, vol. 50, no. 17, pp. 4009–4023, 2021.
[4] M. Aslam, D. Kundu, C.-H. Jun, and M. Ahmad, "Time truncated group acceptance sampling plans for generalized exponential distribution," J. Test. Eval., vol. 39, no. 4, pp. 968–976, 2011.
[5] M. Aslam, C.-H. Jun, and M. Ahmad, "A group acceptance sampling plan for truncated life tests based on the generalized Rayleigh distribution," J. Stat. Comput. Simul., vol. 81, no. 12, pp. 1571–1580, 2011.
[6] M. Aslam, C.-H. Jun, and M. Ahmad, "A variables sampling plan for truncated life tests based on the Birnbaum-Saunders distribution," Commun. Stat. Simul. Comput., vol. 40, no. 10, pp. 1525–1535, 2011.
[7] M. Aslam, C.-H. Jun, M. Ahmad, and M. Rasool, "Group acceptance sampling plans for resubmitted lots under Burr-type XII distributions," Chin. Inst. Ind. Eng., vol. 28, no. 8, pp. 606–615, 2011.
[8] M. Aslam and C.-H. Jun, "Group acceptance sampling plan for truncated life tests based on the Burr-type XII distribution," J. Stat. Comput. Simul., vol. 79, no. 12, pp. 1401–1413, 2009.
[9] M. Aslam and C.-H. Jun, "Group acceptance sampling plans for truncated life tests based on the inverse Rayleigh distribution and log-logistic distribution," Pak. J. Stat., vol. 25, pp. 107–119, 2009.
[10] M. Aslam and C.-H. Jun, "A group acceptance sampling plan for truncated life test having Weibull distribution," J. Appl. Stat., vol. 39, pp. 1021–1027, 2009.
[11] M. Aslam and C.-H. Jun, "A group sampling plan for truncated life tests based on the generalized exponential distribution," J. Appl. Stat., vol. 36, no. 9, pp. 1021–1029, 2009.
[12] M. Aslam and C.-H. Jun, "A group acceptance sampling plans for truncated life tests based on the inverse Rayleigh and log-logistic distributions," Pak. J. Stat., vol. 25, no. 2, pp. 1–13, 2009.
[13] A. Fayomi and M. Khan, "Group acceptance sampling plan for another generalized transmuted lifetime distribution," Qual. Reliab. Eng. Int., vol. 38, no. 6, pp. 3215–3228, 2022.
[14] C.-H. Jun, N. Balakrishnan, and D. Kundu, "Variable sampling plans for sudden death testing for the Weibull distribution," IEEE Trans. Reliab., vol. 55, no. 1, pp. 16–22, 2006.
[15] C.-H. Jun, S. Balamurali, and S.-H. Lee, "Variables sampling plans for Weibull distributed lifetimes under sudden death testing," IEEE Trans. Reliab., vol. 55, pp. 53–58, 2006.
[16] R. R. L. Kantam, V. Ramakrishna, and M. S. Ravikumar, "Estimation and testing in type 1 generalized half logistic distribution," Mod. Appl. Stat. Methods, vol. 12, no. 1, pp. 198–206, 2014.
[17] R. R. L. Kantam and K. Rosaiah, "Acceptance sampling based on truncated life tests using the Weibull distribution," J. Appl. Stat., vol. 25, no. 4, pp. 415–420, 1998.
[18] R. R. L. Kantam and K. Rosaiah, "Half–logistic distribution in acceptance sampling based on life tests," IAPQR Trans., vol. 23, no. 2, pp. 117–125, 1998.
[19] R. R. L. Kantam, K. Rosaiah, and G. S. Rao, "Acceptance sampling based on life tests: Log-logistic model," J. Appl. Stat., vol. 28, pp. 121–128, 2001.
[20] R. R. L. Kantam, K. Rosaiah, and G. Sudhakar, "Reliability test plans for the log-logistic distribution," J. Stat. Plan. Inference, vol. 97, no. 1, pp. 171–180, 2001.
[21] E. T. Lee and J. W. Wang, Statistical Methods for Survival Data Analysis, 3rd ed. New York: Wiley, 2003.
[22] S. Mahendra and P. Kumar, "Double and group acceptance sampling plan for truncated life test based on inverse log-logistic distribution," Commun. Stat. Simul. Comput., vol. 49, no. 8, pp. 2110–2123, 2020.
[23] S. Mahendra and P. Kumar, "Group acceptance sampling inspection plan for truncated life test based on some finite mixture distributions," Stat. Pap., vol. 66, no. 3, pp. 1487–1502, 2025.
[24] F. G. Pascual and W. Q. Meeker, "The modified sudden death test: Application to reliability analysis," Technometrics, vol. 40, no. 3, pp. 277–286, 1998.
[25] F. G. Pascual and W. Q. Meeker, "The modified sudden death test: Planning life tests with a limited number of test positions," J. Test. Eval., vol. 26, no. 5, pp. 434–443, 1998.
[26] A. R. S. Ramaswamy and P. Anburajan, "Group acceptance sampling plans using weighted binomial on truncated life tests for inverse Rayleigh and log-logistic distributions," IOSR J. Math., vol. 2, no. 3, pp. 33–28, 2012.
[27] P. Ramaswamy and M. Anburajan, "Group acceptance sampling plans for truncated life tests based on the exponential distribution," Stat. Pap., vol. 53, no. 2, pp. 431–444, 2012.
[28] B. Rao, C. H. Srinivas Kumar, and K. Rosaiah, "Group acceptance sampling plans for life tests based on Half Normal distribution," Sri Lankan J. Appl. Stat., vol. 15, no. 3, pp. 221–231, 2014.
[29] B. S. Rao, "Group acceptance sampling plans for truncated life tests under the Weibull distribution," J. Indian Stat. Assoc., vol. 47, no. 1, pp. 67–79, 2009.
[30] B. S. Rao, "A study on group acceptance sampling plans for truncated life tests using the Gompertz distribution," J. Stat. Res., vol. 44, no. 2, pp. 101–114, 2010.
[31] B. S. Rao, "Bayesian approach to group acceptance sampling plans for truncated life tests," Commun. Stat. Theory Methods, vol. 40, no. 6, pp. 1100–1113, 2011.
[32] G. S. Rao, "A group acceptance sampling plans for lifetimes following a generalized exponential distribution," Econ. Qual. Control, vol. 24, no. 1, pp. 75–85, 2009.
[33] G. S. Rao, "A group acceptance sampling plans for truncated life tests for Marshall-Olkin extended Lomax distribution," Electron. J. Appl. Stat. Anal., vol. 3, pp. 18–27, 2010.

[34] G. S. Rao, “A hybrid group acceptance sampling plans for lifetimes based on log-logistic distribution,” J. Reliab. Stat. Stud., vol. 4, no. 1, pp. 31–40, 2011.
[35] D. Ratna Babu, “Some best proximity theorems for generalized proximal contraction maps in metric spaces with applications,” Sahand Commun. Math. Anal., vol. 22, no. 2, pp. 201–222, 2025, doi: 10.22130/scma.2024.2042087.1910.
[36] K. Rosaiah, R. R. L. Kantam, and C. H. Santosh Kumar, “Reliability test plans for exponentiated log-logistic distribution,” Econ. Qual. Control, vol. 21, no. 2, pp. 165–175, 2006.
[37] K. Rosaiah, G. S. Rao, and R. R. L. Kantam, “A two-stage group acceptance sampling plan based on life tests for the half logistic distribution,” J. Stat. Comput. Simul., vol. 86, no. 17, pp. 3442–3456, 2016.
[38] K. Rosaiah, G. S. Rao, K. Kalyani, and D. C. U. Sivakumar, “Group acceptance sampling plans for lifetimes following an odds exponential log logistic distribution,” Sri Lankan J. Appl. Stat., vol. 17, no. 3, pp. 201–216, 2016.
[39] M. Saha and P. Kumar, “Double and group acceptance sampling inspection plans based on truncated life test,” J. Stat. Comput. Simul., vol. 95, no. 4, pp. 781–798, 2025.
[40] S. Sen and A. Ghosh, “Double and group acceptance sampling inspection plans based on truncated life test,” Stat. Methodol., vol. 52, no. 1, pp. 45–63, 2025.
[41] S. Subhradev, “Group acceptance sampling inspection plan for truncated life test based on some finite mixture distributions,” J. Stat. Theory Appl., vol. 22, no. 2, pp. 198–215, 2025.
[42] M. Suseela and S. Rani, “Group acceptance sampling plan for life tests based on exponentiated inverted Weibull distribution,” Stat. Pap., vol. 62, no. 3, pp. 925–944, 2021.
[43] B. L. Vlcek, R. C. Hendricks, and E. V. Zaretsky, “Monte Carlo simulation of sudden death bearing testing,” Tribol. Trans., pp. 188–199, 2004.
[44] C. Vlcek and T. W. Anderson, “Statistical methods for sudden death testing,” IEEE Trans. Reliab., vol. 53, no. 4, pp. 519–525, 2004.
[45] Z. P. Xia, J. Y. Yu, L. D. Cheng, et al., “Study on the breaking strength of jute fibres using modified Weibull distribution,” J. Compos. Part A Appl. Sci. Manuf., vol. 40, no. 1, pp. 54–59, 2009.

Table-1: GASP for EWD λ=1.5, θ=1.5 for 50th percentile.

β	t_q/t_q^0	r=5						r=10					
		$\delta_q^0=0.5$			$\delta_q^0=1.0$			$\delta_q^0=0.5$			$\delta_q^0=1.0$		
		c	G	pa	c	g	pa	c	g	pa	C	G	pa
0.25	2	4	171	0.973074	-	0	0.000000	5	10	0.969732	7	4	0.964913
	4	2	5	0.984495	2	1	0.960097	2	1	0.971320	4	1	0.981468
	6	1	2	0.970622	2	1	0.990563	2	1	0.993762	3	1	0.985579
	8	1	2	0.986611	1	1	0.957148	1	1	0.972334	2	1	0.971320
0.10	2	4	283	0.955832	-	0	0.000000	5	16	0.952013	8	18	0.979846
	4	2	7	0.978360	3	4	0.984304	3	3	0.989133	4	1	0.981468
	6	1	3	0.956258	2	2	0.981216	2	2	0.987562	3	1	0.985579
	8	1	3	0.979984	1	1	0.957148	1	1	0.972334	2	1	0.971320
0.05	2	-	0	0.000000	-	0	0.000000	6	70	0.975526	8	23	0.974321
	4	2	9	0.972264	3	5	0.980418	3	4	0.985536	4	2	0.963280
	6	2	9	0.994570	2	2	0.981216	2	2	0.987562	3	1	0.985579
	8	1	4	0.973401	1	1	0.957148	2	2	0.996070	2	1	0.971320
0.01	2	-	0	0.000000	-	0	0.000000	6	107	0.962832	8	35	0.961186
	4	2	14	0.957188	3	7	0.972693	3	6	0.978383	4	2	0.963280

	6	2	14	0.991567	2	3	0.971957	2	3	0.981401	3	2	0.971366
	8	1	5	0.966863	2	3	0.990668	2	3	0.994111	2	1	0.971320

Table-2: GASP for EWD λ=2.5, θ=1.5 for 50th percentile.

M	t_q/t_q^0	r=5						r=10					
		$\delta_q^0=0.5$			$\delta_q^0=1.0$			$\delta_q^0=0.5$			$\delta_q^0=1.0$		
		c	G	pa	c	g	pa	c	g	pa	C	G	Pa
0.25	2	-	0	0.000000	-	0	0.000000	6	3	0.957403	9	5	0.969327
	4	2	2	0.957646	3	1	0.962740	3	1	0.961308	6	1	0.985595
	6	2	2	0.990544	3	1	0.993488	2	1	0.958237	4	1	0.968282
	8	1	1	0.973092	2	1	0.978594	2	1	0.985213	3	1	0.961308
0.10	2	-	0	0.000000	-	0	0.000000	7	13	0.970269	9	8	0.951377
	4	2	2	0.957646	4	4	0.987452	3	1	0.961308	6	1	0.985595
	6	2	2	0.990544	3	2	0.987019	2	1	0.958237	4	1	0.968282
	8	1	1	0.973092	2	1	0.978594	2	1	0.985213	3	1	0.961308
0.05	2	-	0	0.000000	-	0	0.000000	7	17	0.961300	-	0	0.000000
	4	3	8	0.986943	4	5	0.984340	4	2	0.986015	1	1	0.985595
	6	2	3	0.985849	3	2	0.987019	2	1	0.958237	1	1	0.968282
	8	2	3	0.995458	2	1	0.978594	2	1	0.985213	1	1	0.961308
0.01	2	0	0	0.000000	-	0	0.000000	8	95	0.978855	-	0	0.000000
	4	3	12	0.980478	4	7	0.978145	4	3	0.979095	6	2	0.971397
	6	2	4	0.981177	3	3	0.980592	3	2	0.987744	4	1	0.968282
	8	2	4	0.993948	2	2	0.957646	2	2	0.970644	3	1	0.961308

Table-3: GASP for EWD λ=2.5, θ=2.5 for 50th percentile.

β	t_q/t_q^0	r=5						r=10					
		$\delta_q^0=0.5$			$\delta_q^0=1.0$			$\delta_q^0=0.5$			$\delta_q^0=1.0$		
		c	g	pa	c	g	pa	c	g	pa	C	G	Pa
0.25	2	3	7	0.963322	-	0	0.000000	3	3	0.986163	8	2	0.975823
	4	1	1	0.977344	2	1	0.950769	1	1	0.988450	4	1	0.974406
	6	1	1	0.995792	2	1	0.993774	1	1	0.982339	3	1	0.991364
	8	1	1	0.998823	1	1	0.977344	1	1	0.994892	2	1	0.988450
0.10	2	4	68	0.984088	-	0	0.000000	5	5	0.977046	8	3	0.963954

	4	1	2	0.955201	2	1	0.950769	2	1	0.988450	4	1	0.974406
	6	1	2	0.991602	2	1	0.993774	1	1	0.982339	3	1	0.991364
	8	1	2	0.997647	1	1	0.977344	1	1	0.994892	2	1	0.988450
0.05	2	4	88	0979456	-	0	0.000000	5	6	0.972518	8	4	0.952230
	4	1	2	0.955201	2	1	0.950769	2	1	0.988450	4	1	0.974406
	6	1	2	0.991602	2	1	0.993774	1	1	0.982339	3	1	0.991364
	8	1	2	0.997647	1	1	0.977344	1	1	0.994892	2	1	0.988450
0.01	2	4	135	0.968657	-	0	0.000000	5	10	0.954618	9	18	0.979733
	4	2	7	0..991886	3	3	0.984113	2	2	0.977033	4	1	0.974406
	6	1	3	0.987429	2	2	0.987586	1	1	0.982339	3	1	0.991364
	8	1	3	0.996472	1	1	0.977344	1	1	0.994892	2	1	0.988450

Table-4: GASP for EWD with $\hat{\lambda}=1.109,\ \hat{\theta}=0.8408$ for 50th percentile.

β	t_q/t_q^0	r=5						r=10					
		$\delta_q^0=0.5$			$\delta_q^0=1.0$			$\delta_q^0=0.5$			$\delta_q^0=1.0$		
		c	g	pa	c	G	pa	c	g	Pa	C	g	Pa
0.25	2	-	0	0.000000	-	0	0.000000	9	431	0.971357	-	0	0.000000
	4	4	24	0.977342	4	5	0.959612	5	2	0.96798	6	1	0.957005
	6	3	5	0.972006	4	5	0.988177	4	1	0.972662	5	1	0.953636
	8	3	5	0986432	3	2	0.969518	4	1	0.987636	5	1	0.980713
0.10	2	-	0	0.000000	-	0	0.000000	9	715	0.952933	-	0	0.000000
	4	4	40	0.962523	-	0	0.000000	6	7	0.976386	7	3	0.973102
	6	3	8	0.955588	4	8	0.981151	5	3	0.984951	5	1	0.953636
	8	3	8	0.978380	3	3	0.954627	4	2	0.975426	5	1	0.980713
0.05	2	-	0	0.000000	-	0	0.000000	-	0	0.000000	-	0	0.000000
	4	4	52	0..951556	-	0	0.000000	6	9	0.969742	7	4	0.964297
	6	4	52	0.986792	4	10	0.976494	5	4	0.979985	6	2	0.979483
	8	3	10	0.973049	3	3	0.954627	4	3	0.963366	5	2	0.961798
0.01	2	-	0	0.000000	-	0	0.000000	-	0	0.000000	-	0	0.000000
	4	-	0	0.000000	-	0	0.000000	6	14	0.953329	8	14	0.983952
	6	4	79	0.980002	4	15	0.964949	5	6	0.970128	6	3	0.969383

	8	3	15	0.959847	4	15	0.985778	4	4	0.951455	5	2	0.961798