Earthline Journal of Mathematical Sciences
E-ISSN: 2581-8147
Volume 13, Number 1, 2023, Pages 165-181
https://doi.org/10.34198/ejms.13123.165181

Single Acceptance Sampling Plan Based on Truncated Life Tests for Zubair-Exponential Distribution

Okechukwu J. Obulezi[1,*], Chinyere P. Igbokwe[2] and Ifeanyi C. Anabike[3]

[1] Department of Statistics, Faculty of Physical Sciences, Nnamdi Azikiwe University, Awka, Nigeria
e-mail: oj.obulezi@unizik.edu.ng

[2] Department of Statistics, Abia State Polytechnic, Aba, Nigeria

[3] Department of Statistics, Faculty of Physical Sciences, Nnamdi Azikiwe University, Awka, Nigeria

Abstract

In this paper, a single acceptance sampling plan based on a truncated life test is proposed for a lifetime that follows the Zubair-Exponential (ZE) distribution. For some acceptance numbers, confidence levels, values of the ratio of the fixed experiment time to the particular mean lifetime, and the minimum sample sizes required to assert the specified mean life are obtained. The operating characteristic function values of the proposed sampling plans, consumer's and the producer's risk are presented. Other useful tables are presented and the results are discussed.

1 Introduction

An acceptance sampling plan is a tool used to determine the acceptability of a product unit, in which case the consumer can accept or reject the lot, based on a random sample selected from the lot. The minimum sample size that is

Received: May 8, 2023; Revised & Accepted: May 29, 2023; Published: June 1, 2023
2020 Mathematics Subject Classification: 60-08.
Keywords and phrases: acceptance sampling plan, truncated life tests, Zubair-Exponential (ZE) distribution, operating characteristic curve (OCC), producer's risk, consumer's risk.
*Corresponding author

necessary to determine a certain average life when the life test is finished at a predetermined time is first calculated hence it is called a truncated lifetime test. It is useful in minimizing the variability of products. This study is motivated by the need to determine the various risks involved in choosing lots/samples based on Zubair-Exponential distribution. The choice of the distribution is based on the popularity of the exponential family of distributions and its tractability

Many authors have studied single acceptance sampling plan, double and group plans based on truncated lifetime tests for various distributions. Recent research in this area include Single acceptance sampling inspection plan based on transmuted Rayleigh distribution by Tripathi et al. [1], Reliability test plan based on logistic-exponential distribution and its application by Yadav et al. [2], Single and double acceptance sampling plans for truncated life tests based on transmuted Rayleigh distribution by Saha et al. [3], An application of time truncated single acceptance sampling inspection plan based on generalized half-normal distribution by Tripathi et al. [4], Double and group acceptance sampling plan for truncated life test based on inverse log-logistic distribution by Tripathi et al. [5] Anabike et al. [6] proposed the Zubair-Exponential (ZE) distribution, a two-parameter distribution having a flexibility advantage in modeling lifetime data. According to Lu et al. [7], an acceptance sampling plan is employed when the testing is destructive, the cost of 100% inspection is very high, and/or 100% inspection takes too long. Gui and Zhang [8] opined that since the lifetime of a product is expected to be very high and it might be time-consuming to wait until all the products fail, it is usual to terminate a life test by a preassigned time for saving money and time. The further argument is that the aim of these tests is to set a confidence limit on the mean life and to establish a specified mean life, t_0, with a probability of at least $P*$ which is the consumerâs confidence level.

As noted by Al-Omari [9], the process starts with obtaining the minimum sample size that is necessary to emphasize a certain average life when the life test is terminated at a predetermined time hence such tests are called truncated lifetime tests.

The literature is rich with articles on acceptance sampling plans based on truncated life tests for a variety of distributions. For instance, Aslam et al. [10] worked on repetitive acceptance sampling for Bur type XII distribution while Aslam et al. [11] worked on double acceptance sampling for Burr type XII distribution under truncated life test. Sobel and Tischendrof [12] proposed an acceptance sampling plan with a new life test objective. Generalized Rayleigh distribution by Tsai and Wu [13], Al-Omari [14] studied a three parameters kappa distribution, exponentiated Fréchet distribution by Al-Nasser and Al-Omari [15], transmuted inverse Rayleigh distribution by Al-Omari [16], generalized inverted exponential distribution by Al-Omari [17], generalized inversed Weibull by Al-Omari [18], Al-Omari [19] studied the improved acceptance sampling plan for Garima distribution. Al-Omari [20] studied the transmuted inverse Weibull distribution, Chris-Jerry distribution was proposed by Onyekwere and Obulezi [21], Sushila distribution by Al-Omari [22], extended exponential by Al-Omari [23], two-parameter quasi Lindley distribution by Al-Omari and Al-Nasser [24], Rama distribution by Al-Omari et al. [25], three-parameter Lindley distribution by Al-Omari [26], Marshall-Olkin Esscher transformed Laplace distribution by Al-Omari et al. [27], new Weibull-Pareto distribution by Al-Omari et al. [28], Akash distribution with application to Electric Carts data by Al-Omari [9], generalized Exponential distribution by Aslam et al. [29], Modification of Shanker distribution using quadratic rank transmutation map by Onyekwere et al. [30], Marshall-Olkin Chris-Jerry by Obulezi et al.([31], [32]), Power size biased Chris-Jerry by Innocent et al. [33] and Exponentiated Power Lindley-Logarithmic distribution by Musa et al. ([34], [35])

The rest of this article is organized as follows: Section 2 provides the Zubair-Exponential Distribution (ZE) distribution as and the plots of its pdf and cdf. In Section 3, we present the acceptance sampling design. Section 4, we derive the Operative Characteristic curve function. We derive the producer's risk in Section 5 and illustrate the single acceptance sampling plans based on the Zubair-Exponential Distribution (ZE) distribution and its properties namely the minimum sample size, the operating characteristic function, and the producerâs risk and consumer's risk. The important tables and examples are also shown and we conclude the paper in Section 6.

2 Zubair-Exponential Distribution

The Probability Density Function (PDF) of the Zubair-Exponential Distribution (ZE) distribution due to Anabike et al. [6] is given as

$$f(x) = 2\lambda\theta e^{-\theta x}(1 - e^{-\theta x})e^{\lambda(1-e^{-\theta x})^2}. \tag{1}$$

The cumulative distribution function(cdf) is given in equation (2) as

$$F(x) = \frac{e^{\lambda(1-e^{-\theta x})^2} - 1}{e^{\lambda} - 1}, \tag{2}$$

where λ is the shape parameter and θ is the scale parameter.

$$S(x; \lambda, \theta) = \frac{e^{\lambda} - e^{\lambda(1-e^{-\theta x})^2}}{e^{\lambda} - 1}, \tag{3}$$

$$h(x; \lambda, \theta) = \frac{2\lambda\theta e^{-\theta x}(1 - e^{-\theta x})e^{\lambda(1-e^{-\theta x})^2}}{e^{\lambda} - e^{\lambda(1-e^{-\theta x})^2}}. \tag{4}$$

The behaviour of the hazard rate function of Zubair-Exponential distribution is such that

- $h(\infty) = h(0) = 0$. hence, it is a monotone non-increasing function with a heavy tail. See figure below.

The plots of the probability density function (pdf) and cumulative distribution function (cdf) is a heavy-tailed and increasing functions respectively.

3 Design of the Acceptance Sampling Plan

Here, we propose a Single Acceptance Sampling Plan (SASP) for the lifetime of a product supposing it follows the Zubair-Exponential Distribution (ZE)

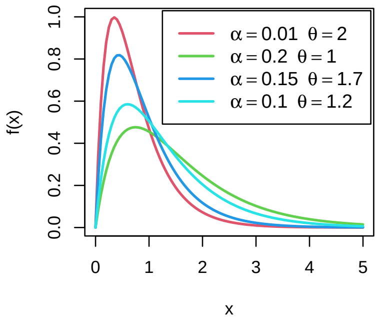

fig 1a: pdf of Zubair−Exponential distribution

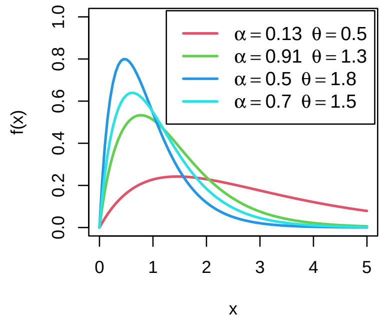

fig 1b: pdf of Zubair−Exponential distribution

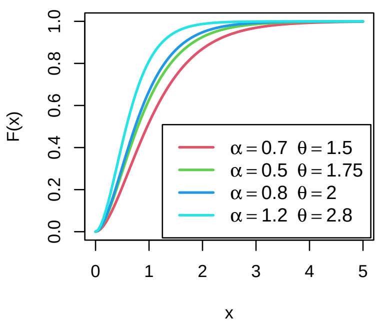

fig 1c: cdf of Zubair−Exponential distribution

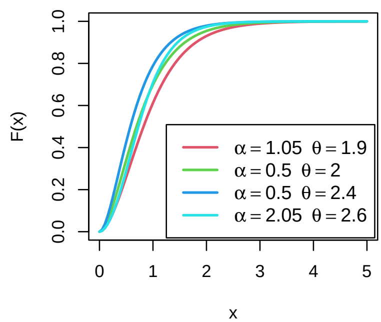

fig 1d: cdf of Zubair−Exponential distribution

distribution defined in Equation (1). If the life test terminates at a predetermined time t_0 and the number of failures within the interval $[0, t]$ are obtained. The lot is rejected if the number of failures at time t_0 exceeds the acceptance number c. A common assumption in the literature is that the lot size is infinitely large to allow the application of binomial distribution. Given that the probability of accepting a bad lot (consumer's risk) is at most $1 - \alpha^*$. Hence, the problem is one of determining the smallest sample size n necessary to satisfy the inequality

$$\sum_{i=0}^{c} \binom{n}{i} p_0^i (1 - p_0)^{n-i} \leq 1 - \alpha^*, \tag{5}$$

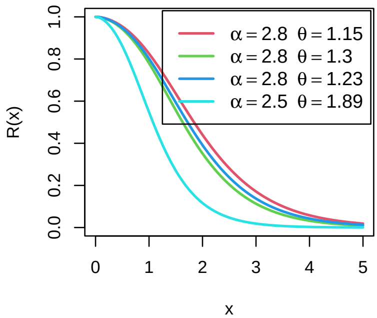

fig 2a: Reliability funct. of Zubair−Exponential dist

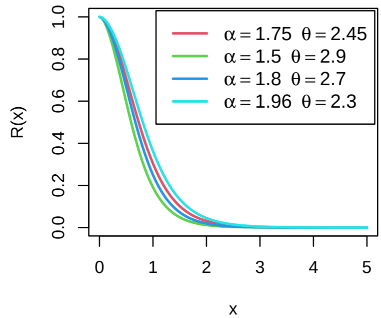

fig 2b: Reliability funct. of Zubair−Exponential dist

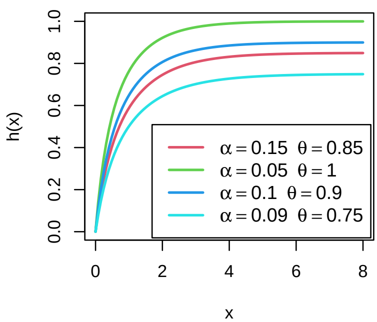

fig 2c: hazard function of Zubair−Exponential dist

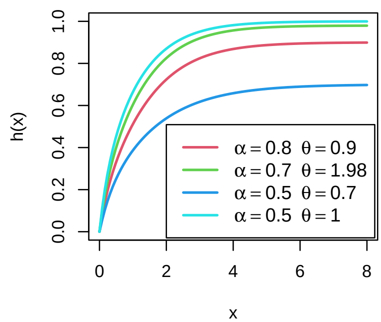

fig 2d: hazard function of Zubair−Exponential dist

where c is the acceptance number for the given values of $P^* \in (0,1)$ and $p = F(t,\mu_0)$ is the probability of failure observed within the time t which depends only on the ratio $\frac{t}{\mu_0}$.

Singh and Tripathi [36] documented the steps to accepting the proposed lot based on the evidence that $\mu \geq \mu_0$, given probability of at least α^* (consumerâs risk) using a single acceptance sampling plan. The steps are as follows:

1. Draw a random sample of n number of units from the proposed lot.

2. Conduct an experiment for t_0 units of time:

If during the experiment, c or less number of units (acceptance number) fail, then accept the whole lot, otherwise, the lot is rejected.

4 Operating Characteristic (OC) Function

The probability of accepting the lot based on the sampling plan $(n, c, \frac{t}{\mu_0})$ is obtained from the Operating Characteristic (OC) function given by

$$L(p) = \sum_{i=0}^{c} \binom{n}{i} p^i (1-p)^{n-i}, \quad i = 1, 2, \ldots, n, \tag{6}$$

where $p = F_{ZE}(t_0; \lambda, \theta)$, defined by equation (2). The function $L(p)$ is the operating characteristic function of the sampling plan, i.e. the acceptance probability of the lot as a function of the failure probability. Further using $t_0 = a\mu_0$, thus p_0 can be written as:

$$p_0 = F_{ZE}(t_0 = a\mu_0; \lambda, \theta) = \frac{e^{\lambda\left[1 - e^{-\frac{2a\mu_0}{\mu}\sum_{i,j=0}^{\infty}\frac{\lambda^{i+1}}{(e^{\lambda}-1)i!}\binom{2i+1}{j}\frac{1}{(j+1)^2}}\right]^2} - 1}{e^{\lambda} - 1}.$$

5 Producer's Risk

This is the probability of the consumer rejecting the lot $\mu_0 < \mu$ given by

$$Pr(p) = \sum_{i=c+1}^{n} \binom{n}{i} p^i (1-p)^{n-i}. \tag{8}$$

The ratio $\frac{\mu}{\mu_0}$ is the minimum positive number under the proposed SASP which ensures the maximum producer's risk Φ for which $p = F(\frac{t}{\mu_0}\frac{\mu_0}{\mu})$ satisfies the inequality

$$Pr(p) = \sum_{i=c+1}^{n} \binom{n}{i} p^i (1-p)^{n-i} \leq \Phi. \tag{9}$$

The operating characteristic probability and the minimal values of n satisfying the inequality are determined and shown in Table 1, Table 2, Table 3 and Table 4 for the following assumed parameters:

1. The consumerâs risk α^* is given as: $0.25, 0.75$, and 0.95.
2. The acceptance number c is given as: $0, 2, 4, 8$, and 10.
3. The constant a is assumed to be: $0.10, 0.2, 0.4, 0.8$ and 1. If $a = 1$, thus T_0 is the median life time $M_0 = 0.5 \quad \forall \quad (\lambda, \theta)$.
4. The parameters (λ, θ) of the ZE distribution are assumed as:

$$\lambda = (0.15, 0.25, 0.30, 0.50) \quad \& \quad \& \quad \theta = (0.15, 0.20)$$

Table 1: SASPs for ZE distribution with parameter: $\lambda = 0.15$ for different values of θ.

α^*	c	$a = 0.1$		$a = 0.2$		$a = 0.4$		$a = 0.8$		$a = 1$	
		n	$L(p_0)$	n	$L(p_0)$	n	$L(p_0)$	n	$L(p_0)$	n	$L(p_0)$
$\theta = 0.15$											
0.25	0	22	0.75534	6	0.78584	2	0.85050	1	1	1	1
	2	131	0.75099	37	0.76081	12	0.78034	5	0.83172	4	0.87500
	4	255	0.75030	72	0.75806	23	0.77596	10	0.75324	8	0.77344
	8	516	0.75129	146	0.75547	47	0.75737	19	0.76400	15	0.78802
	10	651	0.75022	184	0.75475	59	0.75716	23	0.79946	19	0.75966
0.75	0	104	0.25253	29	0.25934	9	0.27378	3	0.37166	2	0.50000
	2	295	0.25085	83	0.25252	26	0.25593	10	0.25035	7	0.34375
	4	472	0.25098	133	0.25110	41	0.26617	15	0.30473	12	0.27441
	8	813	0.25062	229	0.25064	71	0.26258	27	0.25679	21	0.25172
	10	980	0.25050	276	0.25061	86	0.25747	32	0.28116	25	0.27063
0.95	0	225	0.05014	63	0.05036	19	0.05422	7	0.05134	5	0.06250
	2	473	0.05010	132	0.05111	40	0.05562	14	0.06636	11	0.05469
	4	688	0.05003	192	0.05138	59	0.05295	21	0.06062	16	0.05923
	8	1085	0.05012	304	0.05060	94	0.05096	34	0.05585	26	0.05388
	10	1275	0.05016	357	0.05107	110	0.05338	40	0.05774	30	0.06802
$\theta = 0.20$											
0.25	0	22	0.75590	6	0.78644	2	0.85093	1	1	1	1
	2	131	0.75220	37	0.76222	12	0.78164	5	0.83212	4	0.87500
	4	255	0.75195	73	0.75116	23	0.77776	10	0.75397	8	0.77344
	8	518	0.75020	147	0.75212	47	0.76003	19	0.76499	15	0.78802
	10	652	0.75129	185	0.75241	59	0.76012	23	0.80046	19	0.75966
0.75	0	105	0.25010	29	0.26045	9	0.27489	3	0.37210	2	0.50000
	2	296	0.25040	83	0.25443	26	0.25782	10	0.25106	7	0.34375
	4	473	0.25138	133	0.25353	41	0.26862	15	0.30571	12	0.27441
	8	815	0.25080	229	0.25387	72	0.25036	27	0.25801	21	0.25172
	10	983	0.25003	277	0.25003	86	0.26100	32	0.28255	25	0.27063
0.95	0	225	0.05054	63	0.05084	19	0.05472	7	0.05152	5	0.06250
	2	474	0.05022	133	0.05006	41	0.05014	14	0.06670	11	0.05469
	4	689	0.05037	193	0.05078	59	0.05388	21	0.06101	16	0.05923
	8	1088	0.05007	305	0.05054	94	0.05212	34	0.05632	26	0.05388
	10	1278	0.05028	359	0.05007	111	0.05074	40	0.05827	30	0.06802

Table 2: SASPs for ZE distribution with parameter: $\lambda = 0.25$ for different values of θ.

α^*	c	$a=0.1$		$a=0.2$		$a=0.4$		$a=0.8$		$a=1$	
		n	$L(p_0)$	n	$L(p_0)$	n	$L(p_0)$	n	$L(p_0)$	n	$L(p_0)$
$\theta = 0.15$											
0.25	0	22	0.75653	7	0.75029	2	0.85139	1	1	1	1
	2	132	0.75003	38	0.75111	12	0.78302	5	0.83255	4	0.87500
	4	256	0.75133	73	0.75331	24	0.75038	10	0.75474	8	0.77344
	8	519	0.75109	147	0.75511	47	0.76285	19	0.76603	15	0.78802
	10	654	0.75117	186	0.75038	59	0.76327	23	0.80150	19	0.75966
0.75	0	105	0.25113	29	0.26167	9	0.27608	3	0.37256	3	0.25000
	2	297	0.25014	83	0.25652	26	0.25985	10	0.25181	7	0.34375
	4	475	0.25040	134	0.25032	42	0.25103	15	0.30674	12	0.27441
	8	818	0.25007	230	0.25287	72	0.25376	27	0.25929	21	0.25172
	10	985	0.25106	277	0.25391	87	0.25076	32	0.28401	25	0.27063
0.95	0	226	0.05032	63	0.05137	19	0.05525	7	0.05171	5	0.06250
	2	475	0.05042	133	0.05087	41	0.05092	14	0.06705	11	0.05469
	4	691	0.05039	194	0.05027	59	0.05489	21	0.06142	16	0.05923
	8	1091	0.05014	306	0.05060	94	0.05339	34	0.05682	26	0.05388
	10	1282	0.05021	360	0.05032	111	0.05209	40	0.05882	30	0.06802
$\theta = 0.20$											
0.25	0	22	0.75723	7	0.75111	2	0.85188	1	1	1	1
	2	132	0.75154	38	0.75283	12	0.78449	5	0.83299	4	0.87500
	4	257	0.75093	73	0.75563	24	0.75259	10	0.75553	8	0.77344
	8	521	0.75058	148	0.75231	47	0.76583	19	0.76711	15	0.78802
	10	656	0.75138	186	0.75402	59	0.76660	23	0.80258	19	0.75966
0.75	0	105	0.25228	30	0.25074	9	0.27735	3	0.37304	3	0.25000
	2	298	0.25009	84	0.25142	26	0.26201	10	0.25260	7	0.34375
	4	476	0.25131	134	0.25321	42	0.25376	15	0.30781	12	0.27441
	8	820	0.25092	231	0.25220	72	0.25739	27	0.26063	21	0.25172
	10	989	0.25020	278	0.25401	87	0.25474	32	0.28555	25	0.27063
0.95	0	227	0.05015	63	0.05195	19	0.05582	7	0.05191	5	0.06250
	2	477	0.05020	133	0.05175	41	0.05175	14	0.06742	11	0.05469
	4	694	0.05009	194	0.05135	60	0.05071	21	0.06185	16	0.05923
	8	1095	0.05001	307	0.05076	95	0.05054	34	0.05735	26	0.05388
	10	1286	0.05028	361	0.05070	111	0.05356	40	0.05941	30	0.06802

Table 3: SASPs for ZE distribution with parameter: $\lambda = 0.30$ for different values of θ.

α^*	c	$a = 0.1$		$a = 0.2$		$a = 0.4$		$a = 0.8$		$a = 1$	
		n	$L(p_0)$	n	$L(p_0)$	n	$L(p_0)$	n	$L(p_0)$	n	$L(p_0)$
$\theta = 0.15$											
0.25	0	22	0.75534	6	0.78583	2	0.85050	1	1	1	1
	2	131	0.75099	37	0.76081	12	0.78033	5	0.83172	4	0.87500
	4	255	0.75030	72	0.75805	23	0.77595	10	0.75324	8	0.77343
	8	516	0.75128	146	0.75546	47	0.75736	19	0.76399	15	0.78802
	10	651	0.75021	184	0.75474	59	0.75715	23	0.79946	19	0.75965
0.75	0	104	0.25253	29	0.25933	9	0.27378	3	0.37165	2	0.50000
	2	295	0.25084	83	0.25252	26	0.25593	10	0.25034	7	0.34374
	4	472	0.25097	133	0.25109	41	0.26616	15	0.30472	12	0.27441
	8	813	0.25061	229	0.25063	71	0.26257	27	0.25678	21	0.25171
	10	980	0.25049	276	0.25060	86	0.25745	32	0.28115	25	0.27062
0.95	0	225	0.05014	63	0.05036	19	0.05422	7	0.05134	5	0.06250
	2	473	0.05009	132	0.05110	40	0.05561	14	0.06636	11	0.05469
	4	688	0.05003	192	0.05138	59	0.05295	21	0.06061	16	0.05923
	8	1085	0.05011	304	0.05060	94	0.05096	34	0.05585	26	0.05387
	10	1275	0.05016	357	0.05106	110	0.05337	40	0.05774	30	0.06802
$\theta = 0.20$											
0.25	0	22	0.75590	6	0.78644	2	0.85093	1	1	1	1
	2	131	0.75220	37	0.76221	12	0.78163	5	0.83212	4	0.87500
	4	255	0.75194	73	0.75115	23	0.77775	10	0.75397	8	0.77343
	8	518	0.75019	147	0.75211	47	0.76002	19	0.76498	15	0.78802
	10	652	0.75128	185	0.75240	59	0.76011	23	0.80045	19	0.75965
0.75	0	105	0.25010	29	0.26044	9	0.27489	3	0.37209	2	0.50000
	2	296	0.25039	83	0.25443	26	0.25782	10	0.25106	7	0.34374
	4	473	0.25137	133	0.25353	41	0.26861	15	0.30570	12	0.27441
	8	815	0.25079	229	0.25386	72	0.25035	27	0.25800	21	0.25171
	10	983	0.25002	277	0.25002	86	0.26099	32	0.28254	25	0.27062
0.95	0	225	0.05054	63	0.05084	19	0.05471	7	0.05152	5	0.06250
	2	474	0.05022	133	0.05006	41	0.05014	14	0.06670	11	0.05469
	4	689	0.05037	193	0.05078	59	0.05388	21	0.06100	16	0.05923
	8	1088	0.05007	305	0.05054	94	0.05212	34	0.05632	26	0.05387
	10	1278	0.05027	359	0.05006	111	0.05074	40	0.05826	30	0.06802

Table 4: SASPs for ZE distribution with parameter: $\lambda = 0.50$ for different values of θ.

α^*	c	$a = 0.1$		$a = 0.2$		$a = 0.4$		$a = 0.8$		$a = 1$	
		n	$L(p_0)$	n	$L(p_0)$	n	$L(p_0)$	n	$L(p_0)$	n	$L(p_0)$
$\theta = 0.15$											
0.25	0	22	0.75653	7	0.75029	2	0.85139	1	1	1	1
	2	132	0.75003	38	0.75111	12	0.78302	5	0.83255	4	0.87500
	4	256	0.75133	73	0.75331	24	0.75038	10	0.75474	8	0.77344
	8	519	0.75109	147	0.75511	47	0.76285	19	0.76603	15	0.78803
	10	654	0.75117	186	0.75038	59	0.76327	23	0.80150	19	0.75966
0.75	0	105	0.25113	29	0.26167	9	0.27608	3	0.37256	3	0.25000
	2	297	0.25014	83	0.25652	26	0.25985	10	0.25181	7	0.34375
	4	475	0.25040	134	0.25032	42	0.25103	15	0.30674	12	0.27441
	8	818	0.25007	230	0.25287	72	0.25376	27	0.25929	21	0.25172
	10	985	0.25106	277	0.25391	87	0.25076	32	0.28402	25	0.27063
0.95	0	226	0.05032	63	0.05137	19	0.05525	7	0.05171	5	0.06250
	2	475	0.05042	133	0.05087	41	0.05092	14	0.06705	11	0.05469
	4	691	0.05039	194	0.05027	59	0.05489	21	0.06142	16	0.05923
	8	1091	0.05014	306	0.05060	94	0.05339	34	0.05682	26	0.05388
	10	1282	0.05021	360	0.05032	111	0.05209	40	0.05882	30	0.06802
$\theta = 0.20$											
0.25	0	22	0.75723	7	0.75111	2	0.85188	1	1	1	1
	2	132	0.75154	38	0.75283	12	0.78449	5	0.83299	4	0.87500
	4	257	0.75093	73	0.75563	24	0.75259	10	0.75553	8	0.77344
	8	521	0.75059	148	0.75231	47	0.76583	19	0.76711	15	0.78803
	10	656	0.75138	186	0.75402	59	0.76660	23	0.80258	19	0.75966
0.75	0	105	0.25228	30	0.25074	9	0.27735	3	0.37304	3	0.25000
	2	298	0.25009	84	0.25142	26	0.26201	10	0.25260	7	0.34375
	4	476	0.25131	134	0.25321	42	0.25376	15	0.30781	12	0.27441
	8	820	0.25092	231	0.25220	72	0.25739	27	0.26063	21	0.25172
	10	989	0.25020	278	0.25401	87	0.25474	32	0.28555	25	0.27063
0.95	0	227	0.05015	63	0.05195	19	0.05582	7	0.05191	5	0.06250
	2	477	0.05020	133	0.05175	41	0.05175	14	0.06742	11	0.05469
	4	694	0.05009	194	0.05135	60	0.05071	21	0.06185	16	0.05923
	8	1095	0.05001	307	0.05076	95	0.05054	34	0.05735	26	0.05388
	10	1286	0.05028	361	0.05070	111	0.05356	40	0.05941	30	0.06802

From the results obtained in Table 1 to Table 4, we notice that:

- The increasing in α^* and c, the required sample size n is increasing and $L(p_0)$ is decreasing.
- With increasing a, the required sample size n is decreasing and $L(p_0)$ is increasing.
- With increasing λ and fixed θ, the required sample size n is increasing and $L(p_0)$ is decreasing.

- With increasing θ and fixed λ, the required sample size n is increasing and $L(p_0)$ is decreasing.

Finally, for all results we have obtained, we checked that $L(p_0) \leq 1 - \alpha^*$. Also, when $a = 1$, we have $p_0 = 0.5$ as $T_0 = M_0$ and hence all results $(n, L(p_0))$ for any vector of parameter (λ, θ) are the same.

6 Conclusion

In this paper we have developed an acceptance sampling plan based on the truncated life tests when the life distribution of test items is Zubair-Exponential. Some tables were provided so that the plan can be effectively adopted.

Future Work

Further studies can investigate double acceptance sampling plan, group, two-stage and fuzzy acceptance sampling schemes base on truncated life test for Zubair-Exponential distribution.

References

[1] Harsh Tripathi, Mahendra Saha and Soumik Halder, Single acceptance sampling inspection plan based on transmuted Rayleigh distribution, *Life Cycle Reliability and Safety Engineering* (2023), 1-13. `https://doi.org/10.1007/s41872-023-00221-x`

[2] Abhimanyu Singh Yadav et al., Reliability test plan based on logistic-exponential distribution and its application, *Journal of Reliability and Statistical Studies* 14(02) (2021), 695-724. `https://doi.org/10.13052/10.13052/jrss0974-8024.14215`

[3] Mahendra Saha, Harsh Tripathi and Sanku Dey, Single and double acceptance sampling plans for truncated life tests based on transmuted Rayleigh distribution, *Journal of Industrial and Production Engineering* 38(5) (2021), 356-368. https://doi.org/10.1080/21681015.2021.1893843

[4] Harsh Tripathi, Mahendra Saha and Vishal Alha, An application of time truncated single acceptance sampling inspection plan based on generalized half-normal distribution, *Annals of Data Science* 9 (2022), 1243-1255. https://doi.org/10.1007/s40745-020-00267-z

[5] Harsh Tripathi, Sanku Dey and Mahendra Saha, Double and group acceptance sampling plan for truncated life test based on inverse log-logistic distribution, *Journal of Applied Statistics* 48(7) (2021), 1227-1242. https://doi.org/10.1080/02664763.2020.1759031

[6] Ifeanyi C. Anabike et al., Inference on the parameters of Zubair-Exponential distribution with application to survival times of Guinea Pigs, *Journal of Advances in Mathematics and Computer Science* 38(7) (2023), 12-35. https://doi.org/10.9734/jamcs/2023/v38i71769

[7] Xinman Lu, Wenhao Gui and Jianyuan Yan, Acceptance sampling plans for half-normal distribution under truncated life tests, *American Journal of Mathematical and Management Sciences* 32(2) (2013), 133-144. https://doi.org/10.1080/01966324.2013.846051

[8] Wenhao Gui and Shangli Zhang, Acceptance sampling plans based on truncated life tests for Gompertz distribution, *Journal of Industrial Mathematics* 2014 (2014), Article ID 391728, 7 pp. https://doi.org/10.1155/2014/391728

[9] Amer Ibrahim Falah Al-Omari, Nursel Koyuncu and Ayed Rheal A. Alanzi, New acceptance sampling plans based on truncated life tests for Akash distribution with an application to electric carts data, *IEEE Access* 8 (2020), 201393-201403. https://doi.org/10.1109/access.2020.3034834

[10] Muhammad Aslam, YL Lio and Chi-Hyuck Jun, Repetitive acceptance sampling plans for burr type XII percentiles, *The International Journal of Advanced Manufacturing Technology* 68(1) (2013), 495-507. https://doi.org/10.1007/s00170-013-4747-x

[11] Muhammad Aslam et al., Double acceptance sampling plans for Burr type XII distribution percentiles under the truncated life test, *Journal of the Operational Research Society* 63(7) (2012), 1010-1017. https://doi.org/10.1057/jors.2011.112

[12] Milton Sobel and J. A. Tischendrof, Acceptance sampling with new life test objectives, *Proceedings of Fifth National Symposium on Reliability and Quality Control*, Philadelphia Pennsylvania, 1959, pp. 108-118.

[13] Tzong-Ru Tsai and Shuo-Jye Wu, Acceptance sampling based on truncated life tests for generalized Rayleigh distribution, *Journal of Applied Statistics* 33(6) (2006), 595-600. https://doi.org/10.1080/02664760600679700

[14] Amer Ibrahim Al-Omari, Acceptance sampling plan based on truncated life tests for three parameter kappa distribution, *Economic Quality Control* 29(1) (2014), 53-62. https://doi.org/10.1515/eqc-2014-0006

[15] Amjad D. Al-Nasser and Amer I. Al-Omari, Acceptance sampling plan based on truncated life tests for exponentiated Frechet distribution, *Journal of Statistics and Management Systems* 16(1) (2013), 13-24. https://doi.org/10.1080/09720510.2013.777571

[16] Amer I Al-Omari, Acceptance sampling plans based on truncated lifetime tests for transmuted inverse Rayleigh distribution, *Economic Quality Control* 31(2) (2016), 85-91. https://doi.org/10.1515/eqc-2016-0011

[17] Amer Ibrahim Al-Omari, Time truncated acceptance sampling plans for generalized inverted exponential distribution, *Electronic Journal of Applied Statistical Analysis* 8(1) (2015), 1-12.

[18] Amer Ibrahim Al-Omari, Time truncated acceptance sampling plans for Generalized Inverse Weibull Distribution, *Journal of Statistics and Management Systems* 19(1) (2016), 1-19. https://doi.org/10.1080/09720510.2013.867703

[19] Amer Al-Omari, Improved acceptance sampling plans based on truncated life tests for Garima distribution, *International Journal of System Assurance Engineering and Management* 9(6) (2018), 1287-1293. https://doi.org/10.1007/s13198-018-0719-8

[20] Amer Ibrahim Al-Omari, The transmuted generalized inverse Weibull distribution in acceptance sampling plans based on life tests, *Transactions of the Institute of Measurement and Control* 40(16) (2018), 4432-4443. https://doi.org/10.1177/0142331217749695

[21] Chrisogonus K. Onyekwere and Okechukwu J. Obulezi, Chris-Jerry distribution and its applications, *Asian Journal of Probability and Statistics* 20(1) (2022), 16-30. https://doi.org/10.9734/ajpas/2022/v20i130480

[22] Amer Ibrahim Al-Omari, Acceptance sampling plans based on truncated life tests for Sushila distribution, *Journal of Mathematical and Fundamental Sciences* 50(1) (2018), 72-83. https://doi.org/10.5614/j.math.fund.sci.2018.50.1.6

[23] Amer Al-Omari and Said Al-Hadhrami, Acceptance sampling plans based on truncated life tests for Extended Exponential distribution, *Kuwait Journal of Science* 45(2) (2018).

[24] Amer Ibrahim Al-Omari and Amjad Al-Nasser, A two-parameter quasi Lindley distribution in acceptance sampling plans from truncated life tests, *Pakistan Journal of Statistics and Operation Research* (2019), 39-47. https://doi.org/10.18187/pjsor.v15i1.1618

[25] Amer Al-Omari, Amjad Al-Nasser and Enrico Ciavolino, Acceptance sampling plans based on truncated life tests for Rama distribution, *International Journal of Quality Reliability Management* 36(7) (2019), 1181-1191. https://doi.org/10.1108/ijqrm-04-2018-0107

[26] Amer Ibrahim Al-Omari, Enrico Ciavolino, and Amjad D. Al-Nasser, Economic design of acceptance sampling plans for truncated life tests using three-parameter Lindley distribution, *Journal of Modern Applied Statistical Methods* 18(2) (2019), eP2746. https://doi.org/10.22237/jmasm/1604189220

[27] Amer I. Al-Omari, Muhammad Aslam and Amjad D. Al-Nasser, Acceptance sampling plans from truncated life tests using Marshall-Olkin Esscher transformed Laplace distribution, *Journal of Reliability and Statistical Studies* 11(01) (2018), 103-115.

[28] Amer Ibrahim Al-Omari et al., New Weibull-Pareto distribution in acceptance sampling plans based on truncated life tests, *Amer. J. Math. Statist.* 8(5) (2018), 144-150. https://doi.org/10.3390/pr9112041

[29] Muhammad Aslam, Debasis Kundu and Munir Ahmad, Time truncated acceptance sampling plans for generalized exponential distribution, *Journal of Applied Statistics* 37(4) (2010), 555-566. https://doi.org/10.1080/02664760902769787

[30] Chrisogonus K Onyekwere et al., Modification of Shanker distribution using quadratic rank transmutation map, *Journal of Xidian University* 16(8) (2022), 179-198.

[31] Okechukwu J Obulezi et al., Marshall-Olkin Chris-Jerry distribution and its applications, *International Journal of Innovative Science and Research Technology* 8(5) (2023), 522-533.

[32] Umeh Edith Uzoma and Obulezi Okechukwu Jeremiah, An alternative approach to AIC and Mallow's C_p statistic-based relative influence measures (RIMS) in regression variable selection, *Open Journal of Statistics* 6(1) (2016), 70-75. https://doi.org/10.4236/ojs.2016.61009

[33] Chidera F. Innocent et al., Estimation of the parameters of the power size biased Chris-Jerry distribution, *International Journal of Innovative Science and Research Technology* 8(5) (2023), 423-436.

[34] Abuh Musa, Sidney I. Onyeagu and Okechukwu J. Obulezi, Exponentiated Power Lindley-Logarithmic distribution and its applications, *Asian Research J. Math.* 19(8) (2023), 47-60. https://doi.org/10.9734/arjom/2023/v19i8686

[35] Abuh Musa, Sidney I. Onyeagu and Okechukwu J. Obulezi, Comparative study based on simulation of some methods of classical estimation of the parameters of Exponentiated Lindley-Logarithmic distribution, *Asian Journal of Probability and Statistics* 22(4) (2023), 14-30. https://doi.org/10.9734/ajpas/2023/v22i4489

[36] Sukhdev Singh and Yogesh Mani Tripathi, Acceptance sampling plans for inverse Weibull distribution based on truncated life test, *Life Cycle Reliability and Safety Engineering* 6(3) (2017), 169-178. https://doi.org/10.1007/s41872-017-0022-8