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Research Article

Designing of Acceptance Sampling Plan for life tests based on Percentiles of Exponentiated Rayleigh Distribution

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Abstract

The principal objective of this paper is to obtain attribute characteristic parameter of Acceptance Single Sampling Plans through percentiles of Exponentiated Rayleigh distribution. The life distribution is assumed to follow Exponentiated Rayleigh distribution. The hazard function and the percentile estimator is derived and the Acceptance Single Sampling Plan is developed. The operating characteristic values are obtained and this work extends by finding the ratio which fixes the producer's risk at 5%. An example is given for the effective use of the developed plan.

Keywords: *Acceptance Sampling Plan; Attribute characteristic parameters; Exponentiated Rayleigh distribution; percentiles.*

1. Introduction

Acceptance Sampling first given by Dodge and Romig (1929) is a process of making decision whether to accept or reject a lot based on the information gained from the sample inspected. This type of sampling is also called attribute sampling, based on the item sampled is classified as acceptable or unacceptable, defective or non-defective, conforming or non-conforming, pass or fail, good or bad etc. The key objective of Attribute Acceptance Sampling Plan is not to assess the quality of lots but to take decision on lots. The literature evidently show the existence of several Acceptance Sampling Plans and in this paper Acceptance Single Sampling Plan (sentencing a lot using single sample) is used in the context of life testing.

In present situations, products are manufactured and guaranteed with high reliability. In order to know the lifetime information of a particular product, a destructive experiment is made on it. Since the process is long and time consuming, the life time is truncated for a pre-specified time. The life distribution is assumed to follow Exponentiated Rayleigh Distribution. This experiment is terminated in two cases, when the number of failure item exceeds the expected number of failures or when the pre-specified time is attained. While designing the Acceptance Sampling Plan for the truncated life test we consider both producer and consumer and so their respective risks are optimized. Epstein (1954), Sobel and Tischendrof (1959), Goode and Kao (1961), Gupta and Groll (1961), Gupta (1962), Fertig and Mann (1980), Kantam and Rosaiah (1998), Kantam *et al*. (2001), Baklizi (2003), Wu and Tsai (2005), Rosaiah and Kantam (2005) and Tsai and Wu (2006) developed acceptance sampling plans based on the population mean under truncated life test.

Balakrishnan *et al*. (2007), Lio *et al*. (2009), Rao and Kantam (2010), Roa *et al*. (2012), Rao(2014) developed the Acceptance Sampling plans based on percentiles for truncated life tests. Percentiles are taken into account because lesser percentiles provide more information than mean life regarding the life distribution. The 50th percentile is the median which is equivalent to the mean life. So, literatures prove this as the generalization of Acceptance Sampling Plans based on the mean life of products.

2. Rayleigh Distribution

The Rayleigh distribution (RD) was originally derived by Rayleigh (1880) in physical sciences for understanding the intensity of sound. Further Dyer (1973) estimated BLUE for RD using order statistics in a type II censored sample. Tsai and Wu (2006) developed an ASP for a truncated life test when the life time follows the generalized Rayleigh distribution. The probability density function and cumulative distribution function of Rayleigh Distribution is given by,

$$f(t;\tau)=\frac{t}{\tau^2}e^{-\frac{1}{2}(t/\tau)^2};t>0,\tau>0 \tag{1}$$

and

$$F(t;\tau)=1-e^{-\frac{1}{2}(t/\tau)^2};t>0,\tau>0 \tag{2}$$

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respectively. The characteristic of Rayleigh distribution is that its failure rate is an increasing linear function of time. This property makes it a suitable model for components that possibly have no manufacturing defects but age rapidly with time.

3. Exponentiated Distribution

Gupta *et al* (1998) proposed a model to failure time data by $F^*(t)=[F(t)]^{\theta}$ where $F(t)$ is a baseline distribution function and θ is a positive real number which is derived from Lehman alternatives and called exponentiated distribution. SrinivasaRao and Ramesh(2014) developed acceptance sampling plans for the exponentiated half log logistic distribution based on percentiles when the life test is truncated for the pre-specified time. Abdallah *et al* (2015) states, adding a parameter α (a positive real number) to a cumulative distribution function (cdf), $F(.)$ by exponentiation produces a cdf of the so calledexponetiated distribution(ED). The cdf of ED can be written as follows,

$$G(x)=G(X;\theta)=[F(X;\beta)]^{\alpha}\equiv[F(X)]^{\alpha}. \tag{3}$$

4. Exponentiated Rayleigh distribution

Kundu and Raqab (2005) estimated different estimators for ERD. The distribution function of RD is given by,

$$F(t,\tau)=1-e^{-1/2(t/\tau)^2},t>0;1/\tau>0 \tag{4}$$

So, the cumulative distribution function of ERD is given by,

$$F(t;\tau,\theta)=\left[1-e^{-1/2(t/\tau)^2}\right]^{\theta},t>0;1/\tau>0,\theta>0 \tag{5}$$

Where τ and θ are the scale and shape parameter respectively. The first derivative of any cumulative distribution function is its probability density function. Hence the probability density function of ERD can be written as,

$$f(t;\tau,\theta)=\frac{d}{dt}[F(t,\tau,\theta)]=\frac{d}{dt}\left[1-e^{-1/2(t/\tau)^2}\right]^{\theta} t>0;1/\tau>0,\theta>0 \tag{6}$$

$$f(t;\tau,\theta)=\theta\left[1-e^{-1/2(t/\tau)^2}\right]^{\theta-1}\left[\frac{t}{\tau^2}e^{-1/2(t/\tau)^2}\right]. \tag{7}$$

4.1 Hazard function

The hazard function specifies the instantaneous rate of failure at time*t*, given that the item does not fail up to *t*. And it is defined as,

$$h(t)=\frac{f(t)}{1-F(t)}$$

Thus for ERD the hazard function is,

$$h(t)=\frac{\theta\left[1-e^{-1/2(t/\tau)^2}\right]^{\theta-1}\left[\frac{t}{\tau^2}e^{-1/2(t/\tau)^2}\right]}{1-\left[1-e^{-1/2(t/\tau)^2}\right]^{\theta}}.$$

4.2. Percentile Estimator

The percentile or the quantile of any distribution is given by,

Pr (T ≤ tq) = q

$$\Rightarrow t_q=\tau\sqrt{-2\ln(1-q^{\frac{1}{\theta}})}$$

t_q and q are directly proportional. Let,

$$\eta=\sqrt{-2\ln(1-q^{\frac{1}{\theta}})} \tag{8}$$

Replacing the scale parameter τ by $\tau=t_q/\eta$, we get the cumulative distribution function of ERD as,

$$F(t)=\left[1-e^{-1/2\eta^2(t/t_q)^2}\right]^{\theta};t>0,\theta>0 \tag{9}$$

Letting $\delta=t/t_q$

$$F(t;\tau,\theta)=\left[1-e^{-1/2(\eta\delta)^2}\right]^{\theta}. \tag{10}$$

Taking partial derivative with respect to δ , we have

$$\frac{\partial F(t;\delta)}{\partial\delta}=\theta\eta\left[1-e^{-1/2(\eta\delta)^2}\right]^{\theta-1}\left[e^{-1/2(\eta\delta)^2}\right] \tag{11}$$

Since $\frac{\partial F(t;\delta)}{\partial\delta}>0$, $F(t;\delta)$ is a non-decreasing function of δ.

5. ASSP through percentiles of ERD for life testing

ASSP is an inspection procedure used to determine whether to accept or reject a specific lot. Since the success and failure are experienced in frequent mode and also larger sized lots are taken, the parameter is said to follow binomial distribution with parameter (n,c,p). Assumptions for the construction of ASP through ERD percentiles are,

(1) Let the proposed single sampling plan procedure is said to follow binomial distribution with parameter (n,c,p).

(2) Let p be the failure probability observed during specified time *t* is obtained through $p=F(t;\delta_0)$,

(3) Let c be the acceptance number that is, if the number of failures is less than c at the specified time t we accept the lot and also we have,

$$F(t;\delta) \le F(t;\delta_0) \Leftrightarrow t_q \ge t_{q_0} \qquad (12)$$

6. Designing of ASSP through ERD percentiles for life testing

SSP is the basic for all acceptance sampling. For an SSP, one sample of items is selected at random from a lot and the disposition of the lot is determined from the resulting information. These plans are also denoted as (n, c) plans since there are n observations and the lot is rejected if there are more than c defectives. Since the output is conforming or non-conforming, SSP follows BD denoted by B(n, c, p).

The procedure is to develop single sampling plan whose parameter p is assumed to follow ERD with parameter $\delta_0 = t/t_q^{\,0}$. Where, t and $t_q^{\,0}$ are the specified test duration and specified 100qth percentile of the ERD respectively.

According to Cameron (1952), the smallest size n can be obtained by satisfying,

$$\sum_{i=0}^{c}\binom{n}{i}p^i(1-p)^{n-i} \le 1-p^* \qquad (13)$$

where $p*$ is the probability of rejecting a bad lot and $(1-p*)$ is the consumer's risk.

Since $p = F(t,\delta_0)$ depends on δ_0, it is sufficient to specify δ_0.

7. Operating Procedure for ASSP through ERD percentiles for life testing

The operating procedure of the proposed plan is listed as follows:

1. Draw a sample of size n and put on test for time t_0.
2. Find the number of defectives d and compare it with the acceptance number c.

i. If, $d > c$ reject the lot.
ii. If, $d \le c$ accept the lot.

3. If, $d > c$ is obtained before time t_0, terminate the test and ask the production management to produce a better quality product.

8. Operating Characteristic Function

The operating characteristic function of the sampling plan gives the probability of accepting the lot $L(p)$ with,

$$L(p) = \sum_{i=0}^{c}\binom{n}{i}p^i(1-p)^{n-i}. \qquad (14)$$

The producer's risk (α) is the probability of rejecting a lot when $t_q > t_q^{\,0}$. And for the given producer's risk (α), p as a function of d_q should be simulated satisfying the condition given by Cameron (1952) as

$$\sum_{i=0}^{c}\binom{n}{i}p^i(1-p)^{n-i} \ge 1-\alpha \qquad (15)$$

where $p = F(t,\delta_0)$ and $F(.)$ can be obtained as a function of d_q. For the sampling plan developed, the $d_{0.1}$ values are obtained at the producer's risk α=0.05.

9. Construction of the Table

Step 1: Find the value of η for θ=2 and q=0.1.
Step 2: Set the evaluated η, c=0 and t/t_q = 0.7, 0.9, 1, 1.5, 2, 2.5, 3, 3.5 and 4.
Step 3: Find the smallest value of n satisfying $\sum_{i=0}^{c}\binom{n}{i}p^i(1-p)^{n-1} \le 1-p^*$ where, p^* is probability of rejecting the bad lot.
Step 4: For the n value obtained find the ratio $d_{0.1}$ such that $\sum_{i=0}^{c}\binom{n}{i}p^i(1-p)^{n-1} \ge 1-\alpha$ where, α=0.05, $p = F(\frac{t}{t_{q_0}}.\frac{1}{d_q})$ and $d_q = t_{q_0}/t_q$.

10. Example

Suppose θ=2, $t = 40hrs$, $t_{0.1} = 20hrs$, c=2, α = 0.05, β=0.01, then, η = 0.871929 is calculated from the equation (8) and the ratio, $t/t_{0.1} = 2.00$ and from Table 2 the minimum sample size suitable for the given information is found to be as $n = 11$. And the respective operating characteristic values $L(p)$ for the Acceptance sampling plan $(n, c, t/t_{0.1}) = (11,2,2)$ with $p*$= 0.75 under ERD from Table 4 are,

$t_{0.1}^{\,0}$	$t_{0.1}/t_{0.1}^{\,0}$	$L(p)$
7.3	2.75	0.983
8	2.5	0.9596
8.9	2.25	0.9038
10	2	0.7786
11.4	1.75	0.5398
13.3	1.5	0.2238
16	1.25	0.0278
20	1	0.0002
26.7	0.75	0

This shows that if the actual 10th percentile is equal to the required 10th percentile $(t_{0.1}/t_{0.1}^{\,0} = 1.00)$ the producer's risk is approximately 0.9998 (1 - 0.0002). The producer's risk is almost equal to 0.05 or less when the actual 10th percentile is greater than or equal to 2.50 times the specified 10th percentile.

From Table 3, we get the values of $d_{0.1}$ for different choices of c and $t/t_{0.1}^{\,0}$ in order to assert that the producer's risk is less than or equals 0.05. In this example, the value of $d_{0.1}$ should be 2.013 for c = 2, $t/t_{0.1} = 2.00$ and $p* = 0.95$. This means the product can have a 10th percentile life of 2.013 times the required 10th percentile lifetime in order that under the above ASP the product is accepted with probability of at least

0.95. And its operating characteristic curve is shown below.

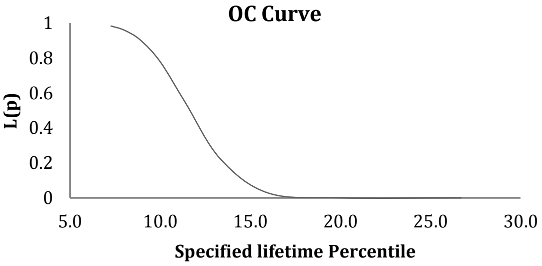

Fig.1OC Curve for life tests based on ERD percentiles

11. Results and Discussion

The hazard function of the ERD is derived. The percentile estimator of the ERD is found and for any known values of scleparameter τ , the shape parameter θ and specified quantile q , the lifetime of the $100q^{th}$ percentile t_q can be simulated.

In table 1, the sample size n is simulated for the expected failure probability p at various consumers' risk and time period t/t_q. In table 2 the respective ratio d_q values is estimated by fixing the producer's risk at 5%. The OC values for the developed plan are calculated and tabulated in table 3.

Conclusion

This article establishes the Acceptance Sampling Plans based on percentiles of Exponentiated Rayleigh Distribution when the life test is truncated for a pre-specified time. The proposed plan is constructed with the shape parameter $\theta = 2$. This plan ensures the life time quality at the specified life percentile. The tables are provided for the effective use of the plan. This research work can be extended to all existing ASP.

Table 1: Gives the minimum sample size nfor the specified 10th percentile value $t_{0.1}{}^{0}$ of ERD to exceed the actual 10th percentile value $t_{0.1}$, with probability $p*$ and acceptance number c using binomial approximation

$p*$	c	$t/t_{0.1}$								
		0.7	0.9	1	1.5	2	2.5	3	3.5	4
0.75	0	48	20	14	4	2	1	1	1	1
0.75	1	93	38	27	8	4	3	2	2	2
0.75	2	135	55	39	11	6	4	3	3	3
0.75	3	176	72	51	15	8	5	4	4	4
0.75	4	217	89	62	18	9	7	6	5	5
0.75	5	256	105	73	22	11	8	7	6	6
0.75	6	296	121	85	25	13	9	9	7	7
0.75	7	334	137	96	28	15	11	9	8	8
0.75	8	373	153	107	32	17	12	10	9	9
0.75	9	412	169	118	35	18	13	11	10	10
0.75	10	450	184	129	38	20	14	12	11	11
0.9	0	79	32	22	6	3	2	1	1	1
0.9	1	134	54	38	11	5	3	3	2	2
0.9	2	183	75	52	15	7	5	4	3	3
0.9	3	230	94	65	19	9	6	5	4	4
0.9	4	275	112	78	23	11	8	6	5	5
0.9	5	319	130	91	26	13	9	7	7	6
0.9	6	170	148	107	30	15	10	8	8	7
0.9	7	408	166	116	34	17	12	10	9	8
0.9	8	449	183	128	37	19	13	11	10	9
0.9	9	490	200	140	41	21	14	12	11	10
0.9	10	532	217	152	44	23	16	13	12	11
0.95	0	103	42	29	8	4	2	2	1	1
0.95	1	164	66	46	13	6	4	3	2	2
0.95	2	216	88	61	17	8	5	4	4	3
0.95	3	267	108	76	21	10	7	5	5	4
0.95	4	315	128	89	25	12	8	7	6	5
0.95	5	362	147	104	29	14	10	8	7	6
0.95	6	408	166	116	33	16	11	9	8	7
0.95	7	453	185	129	37	18	12	10	9	8
0.95	8	498	203	142	41	20	14	11	10	9

0.95	9	541	221	154	44	22	15	12	11	10
0.95	10	584	238	167	48	24	16	13	12	11
0.99	0	158	64	44	12	5	3	2	2	1
0.99	1	228	92	64	18	8	5	4	3	2
0.99	2	288	117	81	23	11	7	5	4	3
0.99	3	349	140	97	27	13	8	6	5	4
0.99	4	398	162	113	32	15	10	7	6	6
0.99	5	450	183	127	36	17	11	9	7	7
0.99	6	501	204	142	40	19	13	10	8	8
0.99	7	550	224	156	44	21	14	11	10	9
0.99	8	598	244	170	48	23	15	12	11	10
0.99	9	646	263	183	52	25	17	13	12	11
0.99	10	693	282	197	56	27	18	15	13	12

Table 2: Gives the ratio $d_{0.1}$ for accepting the lot with the producer's risk of 0.05 when $\theta = 2$

$p*$	c	$t/t_{0.1}$								
		0.7	0.9	1	1.5	2	2.5	3	3.5	4
0.75	0	2.4	2.45	2.47	2.68	2.97	3.1	3.7	4.3	5
0.75	1	1.71	1.74	1.77	1.88	2.02	2.28	2.32	2.7	3.09
0.75	2	1.52	1.54	1.56	1.62	1.75	1.86	1.92	2.24	2.56
0.75	3	1.42	1.44	1.46	1.52	1.63	1.65	1.72	2.01	2.29
0.75	4	1.37	1.38	1.39	1.44	1.48	1.65	1.82	1.86	2.13
0.75	5	1.33	1.34	1.35	1.4	1.44	1.55	1.71	1.76	2.01
0.75	6	1.3	1.31	1.32	1.36	1.41	1.47	1.76	1.7	1.93
0.75	7	1.27	1.28	1.29	1.32	1.39	1.49	1.56	1.63	1.86
0.75	8	1.25	1.261	1.267	1.31	1.366	1.43	1.51	1.576	1.81
0.75	9	1.235	1.246	1.25	1.284	1.318	1.384	1.465	1.537	1.756
0.75	10	1.222	1.231	1.236	1.265	1.308	1.325	1.428	1.504	1.718
0.9	0	2.687	2.746	2.773	2.973	3.31	3.703	3.677	4.29	4.903
0.9	1	1.876	1.905	1.929	2.0601	2.168	2.276	2.731	2.697	3.082
0.9	2	1.64	1.668	1.68	1.773	1.85	2.043	2.23	2.235	2.554
0.9	3	1.523	1.545	1.553	1.634	1.696	1.798	1.972	2.002	2.287
0.9	4	1.45	1.468	1.477	1.55	1.603	1.755	1.814	1.857	2.122
0.9	5	1.4	1.416	1.426	1.476	1.5403	1.639	1.704	1.989	2.01
0.9	6	1.1135	1.3781	1.4	1.438	1.496	1.552	1.623	1.893	1.923
0.9	7	1.337	1.35	1.3573	1.408	1.46	1.556	1.682	1.82	1.855
0.9	8	1.313	1.325	1.333	1.373	1.433	1.498	1.622	1.759	1.803
0.9	9	1.294	1.306	1.313	1.355	1.411	1.448	1.573	1.709	1.758
0.9	10	1.278	1.289	1.296	1.331	1.392	1.4598	1.5305	1.668	1.72
0.95	0	2.874	2.943	2.976	3.204	3.564	3.703	4.443	4.29	4.903
0.95	1	1.976	2.008	2.03	2.161	2.3	2.52	2.732	2.699	3.086
0.95	2	1.712	1.742	1.755	1.843	1.94	2.044	2.23	2.599	2.553
0.95	3	1.584	1.6032	1.621	1.684	1.764	1.922	1.974	2.304	2.29
0.95	4	1.503	1.523	1.532	1.592	1.6564	1.757	1.978	2.118	2.123
0.95	5	1.4472	1.465	1.48	1.528	1.586	1.725	1.85	1.99	2.01
0.95	6	1.407	1.422	1.432	1.483	1.534	1.631	1.755	1.895	1.923
0.95	7	1.375	1.391	1.399	1.448	1.495	1.557	1.681	1.82	1.857
0.95	8	1.35	1.364	1.373	1.42	1.464	1.557	1.622	1.76	1.801
0.95	9	1.328	1.342	1.349	1.388	1.438	1.505	1.573	1.71	1.757
0.95	10	1.31	1.322	1.331	1.37	1.417	1.461	1.531	1.6675	1.72
0.99	0	3.201	3.276	3.31	3.56	3.779	4.127	4.445	5.186	4.903
0.99	1	2.15	2.189	2.213	2.365	2.504	2.71	3.023	3.187	3.083
0.99	2	1.844	1.876	1.892	2.009	2.013	2.313	2.448	2.598	2.553
0.99	3	1.697	1.718	1.731	1.816	1.929	2.027	2.157	2.301	2.287
0.99	4	1.597	1.621	1.635	1.716	1.795	1.93	1.975	2.116	2.418
0.99	5	1.532	1.553	1.563	1.634	1.704	1.798	1.967	1.988	2.272
0.99	6	1.485	1.504	1.514	1.575	1.637	1.76	1.863	1.893	2.163
0.99	7	1.447	1.465	1.474	1.53	1.587	1.678	1.781	1.961	2.078
0.99	8	1.416	1.434	1.443	1.494	1.546	1.612	1.715	1.892	2.01
0.99	9	1.392	1.407	1.415	1.465	1.513	1.603	1.661	1.834	1.953
0.99	10	1.37	1.385	1.394	1.44	1.486	1.554	1.687	1.786	1.904

Table 3: Gives the OC values for Sampling Plan $(n, c = 2, t / t_{0.1})$ for a given $p*$ under ERD when $\theta = 2$

$p*$	n	$t/t_q{}^0$	$t_q/t_q{}^0$								
			2.75	2.5	2.25	2	1.75	1.5	1.25	1	0.75
0.75	135	0.70	0.9569	0.9378	0.9072	0.8565	0.7698	0.6204	0.3808	0.1048	0.0015
0.75	55	0.90	1.0000	0.9999	0.9998	0.9993	0.9971	0.9854	0.9191	0.5990	0.0482
0.75	39	1.00	1.0000	0.9999	0.9998	0.9992	0.9966	0.9834	0.9112	0.5816	0.0467
0.75	11	1.50	1.0000	0.9999	0.9996	0.9986	0.9943	0.9751	0.8858	0.5517	0.0603
0.75	6	2.00	0.9999	0.9996	0.9989	0.9962	0.9864	0.9486	0.8088	0.4292	0.0389
0.75	4	2.50	0.9997	0.9992	0.9976	0.9927	0.9762	0.9208	0.7503	0.3750	0.0394
0.9	183	0.70	0.9997	0.9992	0.9973	0.9906	0.9636	0.8567	0.5165	0.0622	0.0000
0.9	75	0.90	0.9996	0.9990	0.9967	0.9885	0.9571	0.8396	0.4930	0.0608	0.0000
0.9	52	1.00	0.9996	0.9988	0.9963	0.9874	0.9542	0.8328	0.4863	0.0623	0.0000
0.9	15	1.5000	0.9991	0.9976	0.9929	0.9776	0.9274	0.7725	0.4160	0.0549	0.0001
0.9	7	2.0000	0.9984	0.9958	0.9883	0.9662	0.9013	0.7281	0.3844	0.0601	0.0003
0.9	5	2.5000	0.9953	0.9885	0.9710	0.9257	0.8147	0.5819	0.2456	0.0280	0.0001
0.95	216	0.7000	0.9992	0.9976	0.9924	0.9746	0.9111	0.7059	0.2727	0.0084	0.0000
0.95	88	0.9000	0.9989	0.9970	0.9908	0.9699	0.8988	0.6826	0.2579	0.0088	0.0000
0.95	61	1.0000	0.9988	0.9967	0.9899	0.9675	0.8929	0.6727	0.2534	0.0094	0.0000
0.95	17	1.5000	0.9977	0.9939	0.9827	0.9491	0.8513	0.6071	0.2188	0.0107	0.0000
0.95	8	2.0000	0.9957	0.9890	0.9712	0.9230	0.8006	0.5408	0.1887	0.0117	0.0000
0.95	5	2.5000	0.9922	0.9814	0.9547	0.8901	0.7456	0.4803	0.1656	0.0129	0.0000
0.99	288	0.7000	0.9970	0.9916	0.9752	0.9241	0.7738	0.4332	0.0674	0.0002	0.0000
0.99	117	0.9000	0.9963	0.9898	0.9704	0.9122	0.7501	0.4067	0.0624	0.0002	0.0000
0.99	81	1.0000	0.9959	0.9887	0.9678	0.9062	0.7390	0.3959	0.0612	0.0002	0.0000
0.99	23	1.5000	0.9916	0.9786	0.9438	0.8538	0.6478	0.3076	0.0430	0.0002	0.0000
0.99	11	2.0000	0.9830	0.9596	0.9038	0.7786	0.5398	0.2238	0.0278	0.0002	0.0000
0.99	7	2.5000	0.9662	0.9261	0.8414	0.6781	0.4207	0.1490	0.0158	0.0001	0.0000

References

Abdullah, A. Abdel Ghaly, Hanan M. Aly and Rana N. Salah. (2015). Different Estimation Methods for constant stress Accelerated life test under the Family of the Exponentiated Distributions.*Quality and Reliability Engineering International.*

Baklizi, A. (2003). Acceptance sampling based on truncated life tests in the pareto distribution of the second kind. *Advances and Applications in Statistics*, Vol. 3, Issue 1, 33-48.

Balakrishnan, N., Leiva, V. and Lopez, J. (2007). Acceptance sampling plans from truncated life tests based on the generalized Birnbaum-Saunders distribution. *Communications in statistics – Simulation and Computation*, Vol. 36, pp. 643-656.

Cameron.J.M. (1952).Tables for constructing and computing the Operating Characteristics of Single Sampling Plans.*Industrial Quality Control* Vol. 11, pp. 37-39.

DebasisKundu and Mohammed Z. Raqab. (2005). Generalized Rayleigh distribution: different methods and estimations. *Computational Statistics and Data Analysis.*

Dyer, D.D, and Whisenand C.W. (1973) Best Linear Unbiased Estimator of the parameter of the Rayleigh Distribution.*IEEE Transactions on Reliability R*-22:27-34, pp. 455-466.

E.G. Schilling, (1982). Acceptance sampling in quality control, *Statistics: Textbooks and Monographs,* Vol. 42.

Epstein, B. (1954). Truncated life tests in the exponential case. *Annals of Mathematical Statistics* Vol. 25, pp. 555-564.

Fertig, F.W. and Mann, N.R. (1980) Life-test sampling plans for two-parameter Weibull populations. *Technometrics*Vol. 22, Issue 2, pp. 165-177.

Goode, H.P. and Kao, J.H.K. (1961) Sampling plans based on the Weibull distribution.*Proceedings of Seventh National Symposium on Reliability and Quality Control,* Philadelphia pp. 24-40.

Gupta, S.S. and Groll, P. A. (1961) Gamma distribution in acceptance sampling based on life tests.*Journal of the American Statistical Association* Vol. 56, pp. 942-970.

Gupta, S.S. (1962). Life test sampling plans for normal and lognormal distribution. *Technometrics,* Vol. 4, pp. 151-175.

Kantam, R.R.L. and Rosaiah, K. and Rao, G.S. (1998).Halflogistic distribution in acceptance sampling based on life tests.*IAPQR Transaction,* Vol. 23, pp. 117-125.

Kantam, R.R.L. and Rosaiah, K. and Rao, G.S. (2001) Acceptance sampling based on life tests: Log-Logistic model. *Journal of Applied Statistics,* Vol. 28, pp. 121-128.

Lio, Y.L., Tsai, T.-R.and Wu, S.-J. (2009), Acceptance sampling plans from truncated life tests based on the Birnbaum-Saunders distribution for percentiles.*Communications in Statistics - Simulation and Computation* Vol. 39, Issue 1, pp. 119-136.

Lord Rayleigh. (1880) On the resultant of a large number of vibrations of the same pitch and of arbitrary Phase. *The London, Edinburg and Dublin philosophical magazine and Journal of Science*Vol 10,pp. 73-78.

Polovko.(1968) Fundamentals of Reliability Theory.*Technology and Engineering.*

Ramesh, C. Gupta, Pushpa, L. Gupta and Rameshwar, D. Gupta. (1998), Modeling failure time data by Lehman alternatives. *Communication in statistics – Theory and Methods* Vol. 27, Issue 4, pp. 887-904.

Rao, G. S, and Naidu, Ch. R. (2014), Acceptance Sampling Plans for Percentiles based on the Exponentiated half log logistic distribution. *Applications and Applied Mathematics: An International Journal* Vol. 9, Issue 1, pp. 39-53.

Rao, G.S. and Kantam, R.R.L. (2010), Acceptance sampling plans from truncated life tests based on the log-logistic distribution for percentiles. *Economic Quality Control* Vol. 25, Issu 2, pp. 153- 167.

Rao, G.S., Kantam, R.R.L., Rosaiah, K. and Reddy, J.P. (2012), Acceptance sampling plans for percentiles based on the Inverse Rayleigh Distribution. *Electronic Journal of Applied Statistical Analysis* Vol.5, Issue 2, pp. 164-177.

Rosaiah, K. and Kantam, R. R. L. (2005), Acceptance sampling based on the inverse Rayleigh distribution. *Economic Quality Control* Vol. 20, pp. 277-286.

Sobel, M. and Tischendrof, J. A. (1959), Acceptance sampling with sew life test objective. *Proceedings of Fifth National Symposium on Reliability and Quality Control,* Philadelphia, pp. 108-118.

Tsai, T.-R.and Wu, S.-J. (2006), Acceptance sampling based on truncated life tests for generalized Rayleigh distribution. *Journal of Applied Statistics* Vol. 33, pp. 595-600.

Wu, C.-J.and Tsai, T.-R. (2005), Acceptance sampling plans for Birnbaum-Saunders distribution under truncated life tests.*International Journal of Reliability, Quality and Safety Engineering* Vol. 12, pp. 507-519.