DESINGING DSP (0, 1) ACCEPTANCE SAMPLING PLANS BASED ON TRUNCATED LIFE TESTS UNDER VARIOUS DISTRIBUTIONS USING MINIMUM ANGLE METHOD

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Abstract

In this paper DSP (0, 1) sampling plans for truncated life tests are developed using minimum angle method, when the life time of the items follows some selected distributions. The design parameters of the sampling plan are determined for pre-determined acceptance number by satisfying two risks at the specified quality levels simultaneously. The tables of design parameters are provided for various test termination time and mean ratio for some selected distributions. The operating characteristic values are also provided in the table. Some comparisons are made among the selected distributions. The results are explained with examples.

Keywords: *Probability of acceptance**,** Rayleigh distribution, generalized exponential distribution, Weibull distribution, Gamma distribution, Producer's risk, Consumer's risk, Minimum angle method.*

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1. INTRODUCTION

Acceptance sampling is a inspecting procedure applied in statistical quality control. Acceptance sampling is a part of operations management and service quality maintenance. It is important for industrial, but also for business purposes helping the decision - making process for the purpose of quality management. In a time- truncated sampling plan, a random sample is selected from a lot of products and put on the test where the number of failures is recorded until the pre – specified time. If the number of failures observed is not greater than the specified acceptance number, then the lot will be accepted. Two risks are always attached to an acceptance sampling. The probability of rejecting the good lot is known as the type – 1 error (producer's risk) and it is denoted by α. The probability of accepting the bad lot is known as the type – 2 error (consumer's risk) and it is denoted by β. An acceptance sampling plan should be designed so that both risks are smaller than the required values. An acceptance sampling plan involves quality contracting on product orders between the producer's risk and consumer's risk. In many practical situations, an important quality characteristic is the lifetime of the product that is, the time over which it fulfills its task. Sampling plans to determine acceptability of a product based on the number of failures recorded until the pre-specified time are called time-truncated sampling plans.

The life tests are discussed by many authors [1] Goode and Kao (1961). Gupta and Groll. [2] Balklizi (2003), [3] Balklizi and EI Masri (2004). [4] Rosaiah and Kantam (2005) and [5] Tsai, Tzong and Shuo (2006). Mohammad Aslam [6] have designed double acceptance sampling plan based on truncated life tests in various distribution. Srinivasa Rao [8] have designed double acceptance sampling plan based on truncated life tests for the Marshall – Olkin extended exponential distribution.

The intent of this paper is to design DSP (0,1) sampling plans for truncated life tests using minimum angle method, when life times of the items follows various distribution.

For designing any sampling inspection plan it is usual practice to select the plan parameters based on the operating characteristic (OC) curve with desired discrimination such that the operating characteristic curve passes through the points with acceptable quality level $\alpha \leq 0.05$ and limiting quality level $\beta \leq 0.10$. Cameron (1952) has used the operating ratio to design the single sampling plan and constructed tables for easy selection of the plan parameters with Poisson model, which is widely, used measure of discrimination to fix the OC curve.

From Cameron table one can observe a jump between the operating ratios of c = 0 and c = 1 and slow reduction of operating ratios for other values of c .It may also be seen that , in between the OC curves of c = 0, and c = 1 plans , there is vast gap to be filled which leads one to access the possibility of designing plans having OC curves lying between the OC curves of c = 0, and c = 1 plans . To overcome such situation, Craig (1981) has proposed double sampling plan with acceptance number 0 and 1 and rejection number 2. Dodge and Romig (1959) have studied the use of DSP – (0, 1) plan to product characteristics involving costly and destructive testing.

1.1. Operating Procedure of Double Sampling Plan of the Type DSP (0, 1)

According to Hald (1981), the operating procedure for DSP (0, 1) is as follows:

(i) From a lot, select a sample size n_1, and observe the number of defectives d_1.

(ii) If $d_1 = 0$, accept the lot.
If $d_1 > 1$, reject the lot.

(iii) If $d_1 = 1$, select a second sample of size n_2 and observe d_2.
If $d_2 = 0$, accept the lot. Otherwise reject the lot.

1.1.1 Operating Procedure of Double Sampling Plan of the Type DSP (0, 1) for Life Tests

(i) From a lot, select a sample size n_1 , and observe the number of defectives d_1 ,during the time t_0.

(ii) If $d_1 = 0$, accept the lot.
If $d_1 > 1$, reject the lot.

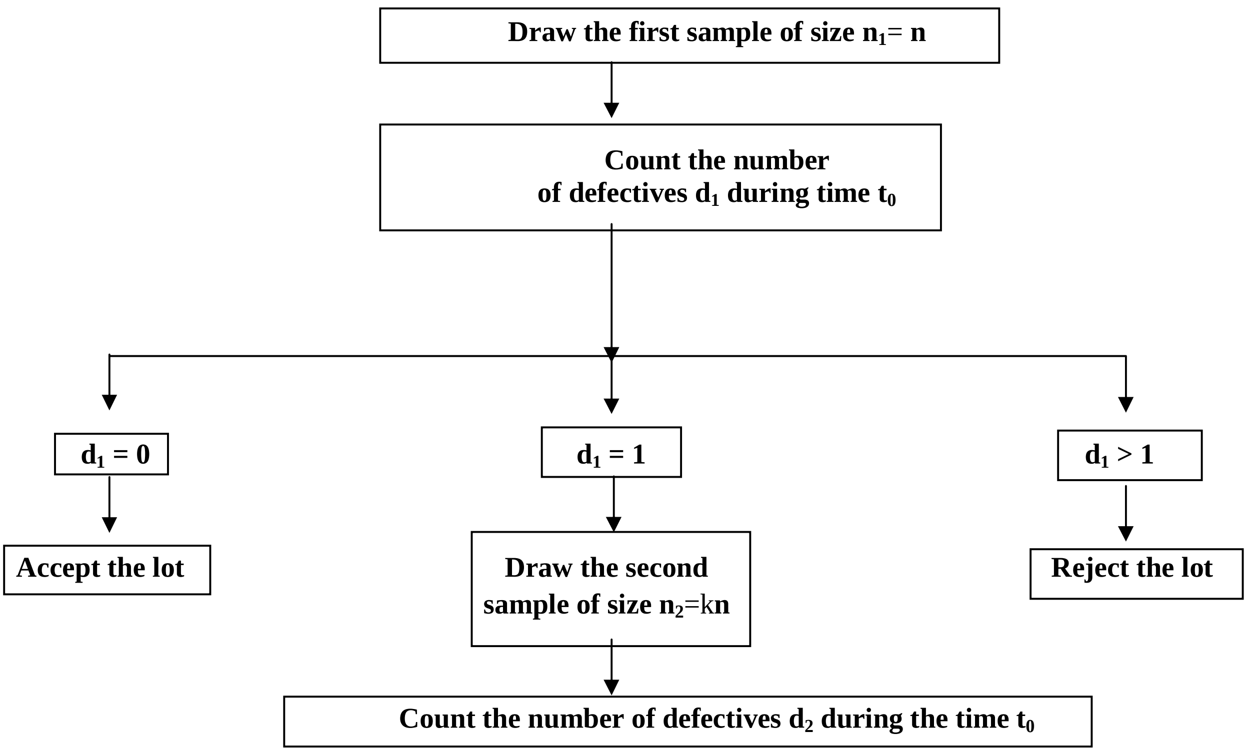
(iii) If $d_1 = 1$, select a second sample of size n_2 and observe d_2 during the time t_0..
If $d_2 = 0$, accept the lot. Otherwise reject the lot.

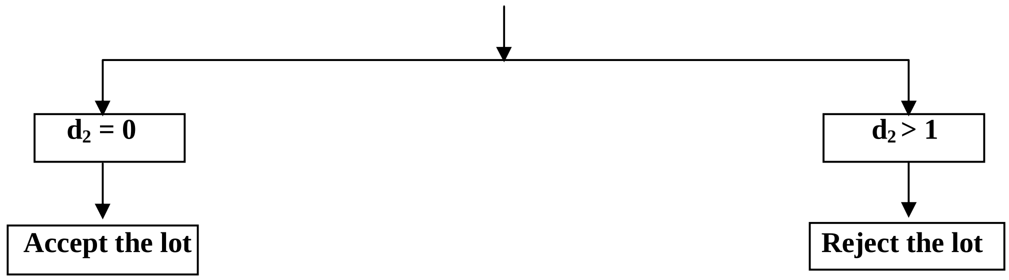
1.2 PROPERTIES

1. Fixing $n_1 = n$ and $n_2 = kn$ (k>0), the OC function of DSP – (0, 1) plan is identical to the OC function of ChSP – 1 plan.
2. When k = 0 and k = ∞, the OC function of DSP – (0, 1) plan reduces to the OC functions of single sampling plans with c = 0 and c = 1 respectively.
3. The OC curves of DSP – (0, 1) plans are lying between those of c = 0 and c = 1 single sampling plans.

The following is the operating procedure for DSP(0,1) for life test in the form of a flow chart.

FLOWCHART





The DSP (0, 1) is composed of parameters n_1 and n_2 if t_0 is specified. Let λ be the unknown average life and λ_0 be the specified average life. A lot is considered to be good if the true unknown average life is more than the specified average life. In this paper we have applied Rayleigh, Generalised exponential, Weibull and Gamma distribution to design DSP (0, 1) plan for life test.We assume that the lot size is large enough to use the binomial distribution to find the probability of acceptance of the lot. Then the probability of acceptance for DSP (0, 1) is given by

P (A) = P (no failure occur in sample 1) + P (1 failure occur in sample 1 and 0 failure occur in sample 2). Under the conditions for application of binomial model for the OC function of DSP – (0, 1) or the probability of acceptance DSP (0,1) is given by,

$$L(p) = (1-p)^{n_1} + n_1 p\,(1-p)^{(n_1+n_2-1)}$$

The usual practice is to choose the second sample size equals to some constant (k) multiple of first sample size which facilitates sample administration of the DSP(0,1) sampling plan.

Taking $n_1 = n$ and $n_2 = kn$ we get

$$L(p) = (1-p)^{n} + np\,(1-p)^{(n(k+1)-1)} \quad (1)$$

The failure probability of an item by time t_0 is given by

$$P = F(t_0, \lambda)$$

2. RAYLEIGH DISTRIBUTION:

The Cumulative Distribution Function (CDF) is given as,

$$F(t, \lambda) = 1 - e^{-\frac{1}{2}\left(\frac{t}{\lambda}\right)^2} \quad (2)$$

Where, λ is the scale parameter

3. GENERALIZED EXPONENTIAL DISTRIBUTION

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

$$F(t,\lambda) = \left(1 - e^{-\frac{t}{\lambda}}\right)^{\alpha} \quad (3)$$

Where λ is the scale parameter and α is the shape parameter and it is equal to 2

4. WEIBULL DISTRIBUTION:

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

$$F(t, \lambda) = 1 - e^{-\left(\frac{t}{\lambda}\right)^{m}} \quad (4)$$

Where λ is the scale parameter and m is the shape parameter and it is equal to 2

5. GAMMA DISTRIBUTION:

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

$$F(t,\lambda) = 1 - e^{-\frac{t}{\lambda}} \sum_{j=0}^{\gamma-1} \left(\frac{t}{\lambda}\right)^{j} / j! \quad (5)$$

Where λ is the scale parameter and γ is the shape parameter and it is equal to 2

The probability of acceptance can be regarded as a function of the deviation of the unknown average life λ_0 from its specified average life λ. By fixing the time termination ratio t/λ_0 as 0.628, 0.942, 1.257, 2.356, 3.141, 3.927, 4.712 and the mean ratios λ/λ_0 = 4,6,8,10 and 12 , producers risk $\alpha \leq 0.05$ and consumers risk $\beta \leq 0.10$ one can find the parameters.

6. NOTATION

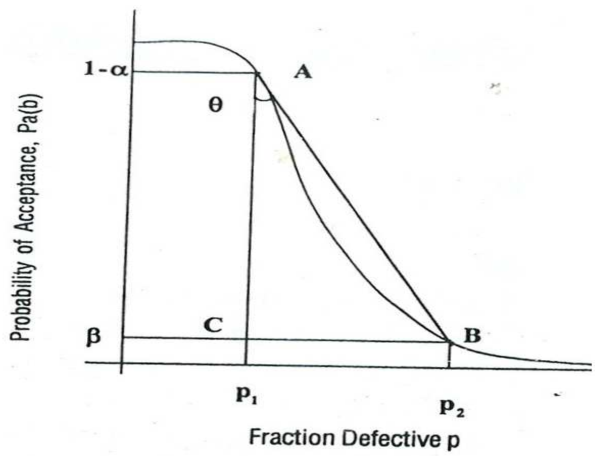
n - Sample size
c - Acceptance number
t_0 - Termination time
α - Producer's risk
β - Consumer's risk
P - Failure probability
L (p) - Probability of acceptance
λ - Mean life
λ_0 - Specified life
θ - Minimum angle
d - Number of defectives

7. MINIMUM ANGLE METHOD

The practical performance of a sampling plan is revealed by it operating characteristic curve. Norman Bush et. al. [7] have used different techniques involving comparison of some portion of the OC curve to that of the ideal curve. The approach of minimum angle method by considering the tangent of the angle between the lines joining the points (AQL, 1- α) & (LQL, β) is shown in Figure where p_1 = AQL, p_2= LQL. By employing this method one can get a better discriminating plan with the minimum angle. Tangent of angle made by lines AB and AC is

$$\tan \theta = BC / AC$$

$$\tan \theta = (p_2 - p_1) / (Pa(p_1) - Pa(p_2)) \quad (6)$$



Minimum angle for given p_1 and p_2

The smaller the value of this tanθ, closer is the angle θ approaching zero and the chord AB approaching AC, the ideal condition through (AQL, 1-α). This criterion minimizes simultaneously the consumer's and producer's risks. Thus both the producer and consumer favour the plans evolved by the criterion.

In this paper we design parameters of the DSP (0, 1) plan based on truncated life tests for various distributions, using minimum angle method. The minimum angle method of the DSP (0, 1) sampling plan under various distributions for truncated life test is given below.

8. CONSTRUCTION OF TABLES

The Tables are constructed using OC function for DSP (0, 1) sampling plans under various distributions. The test termination ratio t/λ_0 values are fixed as 0.628, 0.912, 1.257, 1.571, 2.356, 3.141, 3.927 and 4.712, and the mean ratio λ/λ_0 values are fixed as 4,6,8,10,12. For various time ratios t/λ_0 and mean ratios λ/λ_0 the parameter values n_1 and n_2 are obtained and satisfying $L(p_1) \geq 0.95$ and $L(p_2) \leq 0.10$ for various distribution and are provided in Table 1 to Table 4. The value θ and tanθ values are also provided in each table. The parameters can be selected such that the angle is minimum.

9. EXAMPLES

Assume that an experimenter wants to establish that the lifetime of the electrical devices produced in the factory ensures that the true unknown mean life is at least 1000 hours when the ratio of the unknown average life is 4. Following are the results obtained when the lifetime of the test items follows the Rayleigh, generalized exponential distribution, Weibull distribution, Gamma distribution respectively.

9.1 Rayleigh Distribution

Let the distribution followed be Rayleigh. Here we get the sample size as n = 15 and k = 2. The lot is accepted at given mean ratio λ/λ_0 = 6 during 628 hours which satisfies the condition of producer's risk and consumer's risk $\alpha \leq 0.05$, $\beta \leq 0.10$, from the Table 1, one can observe that the minimum angle is θ = 10.54134° and also α =0.0097 and β =0.057 which is very much less than the specified risk. Thus the required DSP (0, 1) plan has parameters (15,30) which satisfies both the producers risk and consumer's risk.

9.2 Generalized Exponential Distribution

Let the distribution followed be generalized exponential. Here we get the sample size as n = *10* and k = 3. The lot is accepted at given mean ratio λ/λ_0 = 6 during 628 hours which satisfies the condition of producer's risk and consumer's risk $\alpha \leq 0.05$, $\beta \leq 0.10$, from the Table 2, one can observe that the minimum angle is θ = 13.12339° and also α = .0225 and β =

.086 which is very much less than the specified risk. Thus the required DSP (0,1) plan has parameters (10,30) which satisfies both the producers risk and consumer's risk.

9.3 Weibull Distribution

Let the distribution followed be Weibull. Here we get the sample size as n = 7 and k = 2. The lot is accepted at given mean ratio $\lambda/\lambda_0 = 6$ during 628 hours which satisfies the condition of producer's risk and consumer's risk $\alpha \leq 0.05$, $\beta \leq 0.10$, from the Table 3, one can observe that the minimum angle is θ = 18.87288° and also α = .009 and β = .069 which is very much less than the specified risk. Thus the required DSP (0,1) plan has parameters (7,14) which satisfies both the producers risk and consumer's risk.

9.4 Gamma Distribution

Let the distribution followed be Gamma. Here we get the sample size as n = 18 and k = 2. The lot is accepted at given mean ratio $\lambda/\lambda_0 = 6$ during 628 hours which satisfies the condition of producer's risk and consumer's risk $\alpha \leq 0.05$, $\beta \leq 0.10$, from the Table 4, one can observe that the minimum angle is θ = 8.015064° and also α = .0119 and β = .092 which is very much less than the specified risk. Thus the required DSP (0,1) plan has parameters (18,36) which satisfies both the producers risk and consumer's risk.

Table – 1: Sample size for DSP (0, 1) using Minimum Angle Method for specified values of k when the life time of the items follows Rayleigh Distribution

t/λ_0	λ/λ_0	k	n	$L(p_1)$	$L(p_2)$	Tanθ	Θ
0.628	4	2	15	0.956604	0.057872	0.185504	10.50913
0.628	4	1	20	0.972999	0.088719	0.188536	10.67696
0.628	4	3	12	0.954543	0.095023	0.193967	10.97715
0.942	4	1	10	0.965085	0.054237	0.363377	19.96997
0.942	4	2	6	0.961153	0.076524	0.374147	20.51319
1.257	4	1	5	0.969421	0.071827	0.554805	29.02171
1.257	4	2	3	0.964615	0.099971	0.575947	29.93966
1.571	4	1	4	0.952636	0.027549	0.686047	34.45195
1.571	4	2	3	0.923221	0.025049	0.706606	35.24525
0.628	6	1	20	0.994152	0.088719	0.191626	10.84785
0.628	**6**	**2**	**15**	**0.990264**	**0.057872**	**0.186085**	**10.54134**
0.628	6	3	12	0.989616	0.095023	0.193948	10.97612
0.942	6	1	9	0.993676	0.077916	0.377918	20.70246
0.942	6	2	6	0.991334	0.076524	0.37831	20.72212
1.257	6	1	5	0.993332	0.071827	0.569135	29.6457
1.257	6	2	3	0.99213	0.099971	0.587855	30.44935
1.257	6	3	3	0.987437	0.093749	0.586849	30.40652
1.571	6	1	3	0.993489	0.077142	0.73682	36.38354
1.571	6	2	3	0.981802	0.025049	0.705703	35.21072
2.356	6	1	2	0.984301	0.003886	0.880726	41.3712
2.356	6	2	2	0.958039	0.01117	0.911928	42.36257
3.141	6	1	2	0.955007	0.000155	0.905629	42.16491
3.141	6	2	1	0.956838	0.007206	0.910607	42.32122
3.927	6	1	1	0.962828	0.000896	0.838678	39.98581
0.628	8	1	20	0.998088	0.088719	0.19342	10.94699
0.628	8	2	13	0.997538	0.088371	0.193464	10.94938

0.628	8	3	12	0.996539	0.095023	0.195105	11.04002
0.942	8	1	9	0.99793	0.077916	0.381975	20.90559
0.942	8	2	6	0.997137	0.076524	0.381726	20.89316
0.942	8	3	6	0.995343	0.070103	0.379817	20.79764
1.257	8	1	5	0.997815	0.071827	0.576571	29.96651
1.257	8	2	3	0.997403	0.099971	0.594918	30.74916
1.257	8	3	3	0.995777	0.093749	0.591887	30.62074
1.571	8	1	3	0.997867	0.077142	0.749174	36.83961
1.571	8	2	4	0.989991	0.007225	0.70188	35.06424
2.356	8	1	2	0.99475	0.000242	0.900179	41.99288
2.356	8	2	2	0.985256	0.000019	0.964629	43.96856
3.141	8	1	1	0.994497	0.014359	0.937228	43.14409
3.141	8	2	1	0.984686	0.007206	0.939777	43.22174
3.927	8	1	1	0.987117	0.000896	0.898427	41.93738
3.927	8	2	1	0.965571	0.000448	0.918067	42.55401
4.712	8	1	1	0.97464	0.000002	0.862638	40.78231
0.628	10	1	20	0.999205	0.088719	0.194398	11.00099
0.628	10	2	13	0.998973	0.088371	0.194374	10.99963
0.628	10	3	12	0.998548	0.095023	0.195896	11.08366
0.942	10	1	9	0.999139	0.077916	0.384167	21.01514
0.942	10	2	6	0.998804	0.076524	0.383727	20.99315
0.942	10	3	6	0.998037	0.070103	0.381389	20.87629
1.257	10	1	5	0.99909	0.071827	0.580523	30.13613
1.257	10	2	3	0.998915	0.099971	0.59881	30.91362
1.257	10	3	3	0.99822	0.093749	0.595152	30.75906
1.571	10	1	3	0.999112	0.077142	0.755573	37.07372
1.571	10	2	4	0.995738	0.007225	0.704711	35.17277
1.571	10	3	2	0.997845	0.077142	0.756614	37.11165
2.356	10	1	2	0.997793	0.01117	0.922643	42.69596
2.356	10	2	2	0.993656	0.003886	0.91971	42.60507
3.141	10	1	1	0.997683	0.014359	0.960682	43.85119
3.141	10	2	1	0.993379	0.007206	0.957907	43.76839
3.141	10	3	2	0.970927	0.000019	0.973001	44.21599
3.927	10	1	1	0.994493	0.000896	0.931306	42.96293
3.927	10	2	1	0.984675	0.000448	0.940173	43.23378
3.927	10	3	1	0.97626	0.000448	0.94828	43.47937
4.712	10	1	1	0.988959	0.000002	0.904929	42.14285
4.712	10	2	1	0.970236	0.000051	0.922378	42.68775
0.628	12	1	20	0.999613	0.088719	0.194972	11.03264
0.628	12	2	13	0.9995	0.088371	0.194921	11.02987

0.628	12	3	12	0.99929	0.095023	0.1964	11.11149
0.942	12	1	9	0.999581	0.077916	0.385448	21.07907
0.942	12	2	6	0.999417	0.076524	0.384935	21.05348
0.942	12	3	6	0.999038	0.070103	0.382432	20.92843
1.257	12	1	5	0.999557	0.071827	0.582815	30.23427
1.257	12	2	3	0.999471	0.099971	0.601106	31.01033
1.257	12	3	3	0.999128	0.093749	0.597203	30.84578
1.571	12	1	3	0.999568	0.025049	0.71866	35.70328
1.571	12	2	3	0.998727	0.025049	0.71928	35.72672
2.356	12	1	2	0.998921	0.01117	0.929976	42.92208
2.356	12	2	3	0.993859	0.000242	0.924486	42.75295
3.141	12	1	1	0.998866	0.014359	0.974212	44.25161
3.141	12	2	1	0.996711	0.007206	0.969291	44.1066
3.927	12	1	1	0.997282	0.000896	0.950851	43.55681
3.927	12	2	2	0.978225	0.000001	0.968503	44.08332
4.712	12	1	1	0.994495	0.000002	0.930941	42.95173
4.712	12	2	1	0.98468	0.000051	0.940207	43.23482
4.712	12	3	1	0.976267	0.000051	0.948309	43.48022

Table – 2: Sample size for DSP (0,1) using Minimum Angle Method for specified values of k when the life time of the items follows Generalized Exponential Distribution

t/λ_0	λ/λ_0	k	n	$L(p_1)$	$L(p_2)$	tanθ	Θ
0.628	4	1	16	0.950865	0.088555	0.227718	12.82855
0.628	6	1	16	0.987981	0.088555	0.230813	12.99701
0.628	6	2	10	0.985696	0.098711	0.23405	13.17298
0.628	**6**	**3**	**10**	**0.977404**	**0.086946**	**0.233138**	**13.12339**
0.942	6	1	8	0.985463	0.095894	0.39477	21.54261
0.942	6	2	6	0.975817	0.066422	0.386163	21.11474
1.257	6	1	5	0.982608	0.098585	0.538681	28.31052
1.257	6	2	4	0.967578	0.059963	0.524679	27.68504
1.257	6	3	4	0.950448	0.056834	0.532899	28.05312
1.571	6	1	4	0.974711	0.067565	0.633256	32.34427
1.571	6	2	3	0.957787	0.05355	0.635294	32.42753
2.356	6	1	2	0.96898	0.086077	0.808616	38.95956
3.141	6	1	2	0.926396	0.020265	0.82691	39.58767
3.141	6	2	1	0.930217	0.085164	0.886676	41.56263
0.628	8	1	16	0.995826	0.088555	0.23342	13.13871
0.628	8	2	10	0.994992	0.098711	0.236282	13.29412
0.628	8	3	10	0.991912	0.086946	0.234014	13.17102
0.942	8	1	8	0.994826	0.095894	0.400416	21.82197

0.942	8	2	6	0.991211	0.066422	0.38922	21.26701
0.942	8	3	5	0.989764	0.098135	0.403696	21.98373
1.257	8	1	5	0.993664	0.098585	0.54832	28.73682
1.257	8	2	4	0.987849	0.059963	0.528933	27.87583
1.257	8	3	4	0.980778	0.056834	0.531189	27.97675
1.571	8	1	4	0.990522	0.067565	0.645461	32.84066
1.571	8	2	3	0.983698	0.05355	0.640471	32.63838
2.356	8	1	2	0.987847	0.086077	0.836483	39.91192
2.356	8	2	2	0.967053	0.032935	0.807517	38.92146
3.141	8	1	1	0.988882	0.16206	0.979593	44.40937
3.141	8	2	1	0.970039	0.085164	0.915325	42.46865
3.927	8	1	1	0.977358	0.076512	0.89972	41.97836
4.712	8	1	1	0.960744	0.035465	0.847287	40.27418
0.628	10	1	16	0.998201	0.088555	0.235003	13.22473
0.628	10	2	10	0.997833	0.098711	0.237754	13.37398
0.628	10	3	10	0.996462	0.086946	0.235037	13.22655
0.942	10	1	8	0.997736	0.095894	0.403845	21.99107
0.942	10	2	6	0.996114	0.066422	0.391747	21.39261
0.942	10	3	5	0.995441	0.098135	0.405886	22.09157
1.257	10	1	5	0.997187	0.098585	0.554171	28.99395
1.257	10	2	4	0.994528	0.059963	0.532846	28.05072
1.257	10	3	4	0.991191	0.056834	0.532964	28.056
1.571	10	1	4	0.995719	0.067565	0.653325	33.15759
1.571	10	2	3	0.992524	0.05355	0.645797	32.85424
1.571	10	3	3	0.988052	0.051714	0.647614	32.92767
2.356	10	1	2	0.994347	0.086077	0.853634	40.4852
2.356	10	2	2	0.984166	0.032935	0.815081	39.18282
3.141	10	1	1	0.994721	0.16206	1.012095	45.3444
3.141	10	2	1	0.985285	0.085164	0.936242	43.11401
3.141	10	3	1	0.97717	0.084613	0.944176	43.35531
3.927	10	1	1	0.988875	0.076512	0.937684	43.158
3.927	10	2	1	0.970022	0.039074	0.918965	42.58192
3.927	10	3	1	0.954936	0.039017	0.934044	43.04682
4.712	10	1	1	0.980067	0.035465	0.89024	41.67674
0.628	12	1	16	0.999104	0.088555	0.235984	13.27796
0.628	12	2	10	0.998919	0.098711	0.238695	13.425
0.628	12	3	10	0.998224	0.086946	0.235795	13.26772
0.942	12	1	8	0.998861	0.095894	0.40598	22.09614
0.942	12	2	6	0.998034	0.066422	0.393496	21.47946
0.942	12	3	5	0.997684	0.098135	0.407522	22.17199

1.257	12	1	5	0.998571	0.098585	0.557832	29.15419
1.257	12	2	4	0.997198	0.059963	0.535662	28.17625
1.257	12	3	4	0.995444	0.056834	0.534877	28.1413
1.571	12	1	4	0.9978	0.067565	0.658397	33.36079
1.571	12	2	3	0.996125	0.05355	0.649778	33.01492
2.356	12	1	2	0.997035	0.086077	0.864598	40.84664
2.356	12	2	2	0.991534	0.032935	0.821629	39.40751
3.141	12	1	1	0.997187	0.16206	1.032602	45.91893
3.141	12	2	1	0.992001	0.085164	0.950947	43.55971
3.927	12	1	1	0.993932	0.076512	0.962577	43.90761
3.927	12	2	2	0.954136	0.001523	0.927016	42.83101
4.712	12	1	1	0.988878	0.035465	0.919483	42.59802
4.712	12	2	1	0.97003	0.017898	0.920721	42.63642
4.712	12	3	1	0.954947	0.017893	0.935535	43.09242

Table – 3: Sample size for DSP (0, 1) using Minimum Angle Method for specified values of k when the life time of the items follows Weibull Distribution

t/λ_0	**λ/λ_0**	**k**	**n**	**$L(p_1)$**	**$L(p_2)$**	**tanθ**	**Θ**
0.628	4	2	7	0.959278	0.0694	0.338875	18.72023
0.628	4	1	10	0.971826	0.082513	0.33909	18.73129
0.628	4	3	6	0.951752	0.094561	0.351797	19.3817
0.942	4	1	4	0.973909	0.096367	0.608871	31.33604
0.942	4	2	3	0.956501	0.073342	0.604999	31.17389
1.257	4	1	3	0.953363	0.029551	0.757731	37.15233
0.628	6	1	10	0.993884	0.082513	0.345644	19.06738
0.628	**6**	**2**	**7**	**0.990891**	**0.0694**	**0.341848**	**18.87288**
0.628	6	3	6	0.988892	0.094561	0.352229	19.40374
0.942	6	1	4	0.994355	0.096367	0.627973	32.12773
0.942	6	2	3	0.990188	0.073342	0.615057	31.59389
1.257	6	1	3	0.98956	0.029551	0.782382	38.039
1.257	6	2	2	0.984922	0.04301	0.797415	38.56937
1.257	6	3	2	0.976414	0.042427	0.80418	38.80555
1.571	6	1	2	0.987411	0.020331	0.87789	41.27956
1.571	6	2	1	0.987682	0.085308	0.94084	43.25406
2.356	6	1	1	0.979583	0.007754	0.87796	41.28185
3.141	6	1	1	0.94254	0.000104	0.806676	38.89227
0.628	8	1	10	0.997999	0.082513	0.349281	19.25332
0.628	8	2	7	0.996988	0.0694	0.344724	19.02029
0.628	8	3	6	0.996287	0.094561	0.35461	19.52503
0.942	8	1	4	0.998156	0.096367	0.637057	32.49947

0.942	8	2	3	0.996745	0.073342	0.622145	31.88762
0.942	8	3	3	0.994723	0.069904	0.621193	31.84825
1.257	8	1	3	0.996547	0.029551	0.795917	38.51689
1.257	8	2	2	0.994931	0.04301	0.808522	38.95631
1.257	8	3	2	0.991854	0.042427	0.810646	39.02981
1.571	8	1	2	0.995815	0.020331	0.899471	41.97047
1.571	8	2	1	0.995867	0.085308	0.963606	43.93818
2.356	8	1	1	0.993098	0.007754	0.92662	42.81881
2.356	8	2	1	0.980968	0.003885	0.934455	43.05938
3.141	8	1	1	0.979591	0.000104	0.875037	41.18714
3.927	8	1	1	0.95415	0.000001	0.823638	39.47617
0.628	10	1	10	0.999168	0.082513	0.351243	19.35349
0.628	10	2	7	0.998741	0.0694	0.346449	19.10858
0.628	10	3	6	0.99844	0.094561	0.356208	19.60629
0.942	10	1	4	0.999233	0.096367	0.641763	32.69085
0.942	10	2	3	0.998637	0.073342	0.626207	32.05508
0.942	10	3	3	0.997769	0.069904	0.624472	31.98364
1.257	10	1	3	0.998556	0.029551	0.803255	38.77335
1.257	10	2	2	0.997864	0.04301	0.81516	39.18554
1.257	10	3	2	0.996523	0.042427	0.815807	39.20782
1.571	10	1	2	0.998246	0.020331	0.91099	42.3332
1.571	10	2	1	0.99826	0.085308	0.975813	44.29865
1.571	10	3	1	0.99717	0.020331	0.911993	42.36461
2.356	10	1	1	0.997085	0.007754	0.952281	43.59981
2.356	10	2	1	0.991717	0.003885	0.953725	43.64316
3.141	10	1	1	0.991174	0.000104	0.914163	42.43241
3.141	10	2	1	0.975931	0.000019	0.928394	42.87343
3.141	10	3	1	0.963418	0.000019	0.940453	43.2423
3.927	10	1	1	0.979577	0.000001	0.874959	41.1846
4.712	10	1	2	0.896855	0.000072	0.893001	41.76487
0.628	12	1	10	0.999595	0.082513	0.352389	19.41191
0.628	12	2	7	0.999386	0.0694	0.3475	19.16233
0.628	12	3	6	0.999237	0.094561	0.357221	19.65782
0.942	12	1	4	0.999627	0.096367	0.644462	32.80026
0.942	12	2	3	0.999335	0.073342	0.628641	32.15516
0.942	12	3	3	0.998905	0.069904	0.626605	32.07147
1.257	12	1	3	0.999296	0.029551	0.807555	38.92278
1.257	12	2	2	0.998954	0.04301	0.819214	39.32481
1.257	12	3	2	0.998285	0.042427	0.819287	39.32732
1.571	12	1	2	0.999144	0.085308	0.982952	44.50741

1.571	12	2	1	0.999148	0.085308	0.982946	44.50726
2.356	12	1	1	0.99857	0.007754	0.967185	44.04432
2.356	12	2	1	0.995871	0.003885	0.966044	44.01053
3.141	12	1	1	0.995615	0.000104	0.93794	43.16579
3.141	12	2	1	0.987697	0.000019	0.94541	43.39264
3.927	12	1	1	0.989686	0.000001	0.907806	42.23335
3.927	12	2	1	0.972094	0.000001	0.924234	42.74516
4.712	12	1	4	0.848162	0.000067	1.010552	45.3007

Table – 4: Sample size for DSP (0, 1) using Minimum Angle Method for specified values of k when the life time of the items follows Gamma Distribution

t/λ_0	λ/λ_0	k	n	$L(p_1)$	$L(p_2)$	tanθ	Θ
0.628	4	2	18	0.950122	0.092504	0.140036	7.971624
0.628	4	1	28	0.958916	0.091065	0.138385	7.87882
0.942	4	1	14	0.951792	0.089443	0.254165	14.2606
0.628	6	1	28	0.990327	0.091065	0.14022	7.981991
0.628	**6**	**2**	**18**	**0.988006**	**0.092504**	**0.140809**	**8.015064**
0.628	6	3	17	0.982806	0.092828	0.141683	8.064164
0.942	6	1	14	0.988232	0.089443	0.257913	14.46213
0.942	6	2	9	0.985213	0.092765	0.259745	14.56054
0.942	6	3	9	0.976669	0.089443	0.261274	14.64258
1.257	6	2	6	0.979907	0.07688	0.37514	20.56306
1.257	6	1	9	0.985163	0.078344	0.373571	20.48425
1.257	6	3	6	0.968636	0.070409	0.377144	20.66367
1.571	6	1	6	0.984138	0.088316	0.487605	25.99408
1.571	6	2	4	0.978179	0.088142	0.490774	26.14061
1.571	6	3	4	0.96611	0.081815	0.493961	26.28757
2.356	6	1	3	0.980345	0.098071	0.70529	35.19494
3.141	6	1	2	0.973381	0.084701	0.814165	39.15128
0.628	8	1	28	0.996705	0.091065	0.141646	8.062078
0.628	8	2	18	0.995882	0.092504	0.142	8.081996
0.628	8	3	17	0.993998	0.092828	0.142349	8.10154
0.942	8	1	14	0.995917	0.092765	0.261866	14.67433
0.942	8	2	9	0.99482	0.092765	0.262185	14.6914
0.942	8	3	9	0.991638	0.082397	0.260112	14.58024
1.257	8	1	9	0.994752	0.078344	0.378374	20.72535
1.257	8	2	6	0.992795	0.07688	0.378578	20.73555
1.257	8	3	6	0.988449	0.070409	0.377702	20.69163
1.571	8	1	6	0.99431	0.081815	0.491747	26.18553
1.571	8	2	4	0.99205	0.088316	0.496514	26.40503

1.571	8	3	4	0.987296	0.081815	0.495556	26.361
2.356	8	1	3	0.992703	0.098071	0.722234	35.83809
2.356	8	2	3	0.979692	0.032876	0.682428	34.31072
3.141	8	1	2	0.989772	0.032363	0.795229	38.49275
3.141	8	2	2	0.972033	0.032363	0.810242	39.01583
3.927	8	1	2	0.978395	0.026441	0.856633	40.58445
4.712	8	1	2	0.961331	0.007635	0.870691	41.04579
0.628	10	1	28	0.998596	0.091065	0.142489	8.109444
0.628	10	2	18	0.998239	0.092504	0.142772	8.125309
0.628	10	3	17	0.997413	0.092828	0.142953	8.135509
0.942	10	1	14	0.998241	0.089443	0.262708	14.71947
0.942	10	2	9	0.997758	0.092765	0.263813	14.77865
0.942	10	3	9	0.99634	0.082397	0.261229	14.64016
1.257	10	1	9	0.997713	0.078344	0.38135	20.87433
1.257	10	2	6	0.996839	0.07688	0.381105	20.86209
1.257	10	3	6	0.994864	0.070409	0.379251	20.76929
1.571	10	1	6	0.997498	0.088316	0.499933	26.56197
1.571	10	2	4	0.996477	0.088142	0.500399	26.58332
1.571	10	3	4	0.99429	0.088316	0.501703	26.64305
2.356	10	1	3	0.99672	0.098071	0.73232	36.21608
2.356	10	2	3	0.99064	0.032876	0.68712	34.49375
3.141	10	1	2	0.9953	0.084701	0.857484	40.61255
3.141	10	2	2	0.986754	0.032363	0.818139	39.28793
3.141	10	3	2	0.979195	0.032062	0.824408	39.50245
3.927	10	1	2	0.989765	0.026441	0.875427	41.19977
3.927	10	2	2	0.972015	0.009439	0.876107	41.22183
4.712	10	1	2	0.981111	0.007635	0.890692	41.6912
4.712	10	2	2	0.950089	0.002636	0.915156	42.46339
0.628	12	1	28	0.999307	0.091065	0.143004	8.138349
0.628	12	2	18	0.999128	0.092504	0.143259	8.152669
0.628	12	3	17	0.998713	0.092828	0.143376	8.159233
0.942	12	1	14	0.999124	0.089443	0.26382	14.77903
0.942	12	2	9	0.998881	0.092765	0.264858	14.83462
0.942	12	3	9	0.998163	0.082397	0.262067	14.68509
1.257	12	1	9	0.998853	0.078344	0.383214	20.96752
1.257	12	2	6	0.998409	0.07688	0.382789	20.94632
1.257	12	3	6	0.997395	0.070409	0.380536	20.83361
1.571	12	1	6	0.998737	0.088142	0.502741	26.69055
1.571	12	2	4	0.998215	0.088142	0.50303	26.70375
2.356	12	1	3	0.998319	0.098071	0.738606	36.44979

2.356	12	2	3	0.995135	0.032876	0.691008	34.64479
3.141	12	1	2	0.997555	0.084701	0.867738	40.94942
3.141	12	2	2	0.992987	0.032062	0.82433	39.49977
3.141	12	3	2	0.988802	0.032062	0.827935	39.62255
3.927	12	1	2	0.994567	0.026441	0.88805	41.60667
3.927	12	2	2	0.984761	0.009439	0.881498	41.3961
3.927	12	2	2	0.984761	0.009439	0.881498	41.3961
4.712	12	1	2	0.989768	0.007635	0.905244	42.15279
4.712	12	2	2	0.972023	0.002636	0.917147	42.52541

Table – 5: comparison of results for DSP (0, 1) for different lifetime distributions

S.No	Distribution	Producer's risk	Consumer's risk	k	n_1	n_2
1	Rayleigh	0.0097	0.057	2	15	30
2	Generalized Exponential	0.0225	0.086	3	10	30
3	Weibull	0.009	0.069	2	7	14
4	Gamma	0.0119	0.092	2	18	36

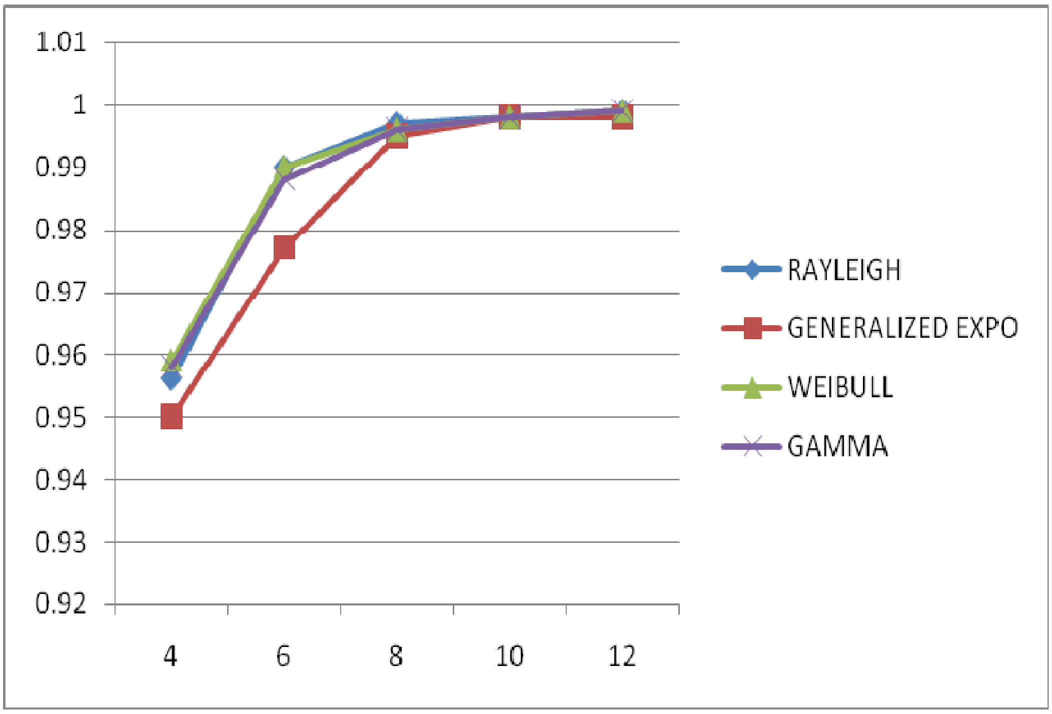


Fig – 1: OC curve for DSP(0,1) various lifetime distributions

CONCLUSIONS

In this paper designing of DSP (0, 1) sampling plan for truncated life tests by using minimum angle method is presented. The minimum sample sizes for various values of λ/λ_0 and different experiment times are calculated assuming that the lifetime of the test items follows different lifetime distributions. When the table values (Table 1 to Table 4) are compared one can say that weibull distribution is comparatively better than other distributions. It can be seen that by applying minimum angle method minimizes simultaneously the consumer's and producer's risk. This minimum angle method plan provides better discrimination of accepting good lots

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