DESIGNING DOUBLE ACCEPTANCE SAMPLING PLANS BASED ON TRUNCATED LIFETESTS UNDER VARIOUS DISTRIBUTIONS USING MINIMUM ANGLE METHOD

Dr.A.R. Sudamani Ramasamy[1], R. Sutharani[2]

Abstract— In this paper double sampling plans for truncated life tests are developed using minimum angle method when the lifetimes of the items follows Various distribution. The values of operating ratio corresponding to the consumer's risk and producer's risk are calculated and using minimum angle method and the value θ is found. Tables are constructed and examples are provided.

Index Terms— Probability of acceptance, Generalized exponential distribution, Weibull distribution, Gamma distribution, Producer's risk, Consumer's risk, Minimum angle method.

1 INTRODUCTION

Acceptance sampling procedures play an important role in improving the quality. The basic aim of all companies in this world is to improve the quality of their products. The high quality product has the high probability of acceptance. 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.

These 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.

1. *Associate Professor, Department of Mathematics, Avinashilingam University, Coimbatore – 641043(T.N), India. Email - arsudamanni@hotmail.com.*

2. *Assistant professor, Department of Mathematics, Coimbatore Institute of Technology, Coimbatore-641014(T.N), India. Email – sutharanicit@gmail.com*

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

It is known that the double sampling plan (DASP) is more efficient than the single sampling plan in terms of the sample size required. Further, a DASP is expected to reduce the producer's risk when specifying the consumer's risk.

2 Operating Procedure for double sampling plan

1) From a lot, take a first sample of size n_1 and observe the number of nonconforming units, d_1.

2) If $d_1 \le c_1$, accept the lot; if $d_1 \ge c_2$, reject the lot. If $c_1 < d_1 < c_2$ take a second sample of size n_2 and observe the number of nonconforming units, d_2.

3) If $d_1 + d_2 \le c_2$, accept the lot; otherwise reject the lot.

Thus the double sampling plan is characterized by the parameters n_1, n_2, c_1, c_2, and designated as DASP – (n_1, n_2, c_1, c_2)

3 Double Sampling plans in Life Tests

We propose the following Double sampling plan procedure based on a truncated life test:

1. Draw the first sample of size n_1 and put them on test during time t_0
2. Accept the lot if there are no more than c_1 failures. Reject the lot and terminate the test if there are more than c_2 failures.
3. If the number of failures is between c_1 and c_2, then draw the second sample of size n_2 and put them on test during time t_0.
4. Accept the lot if the total number of failures not more

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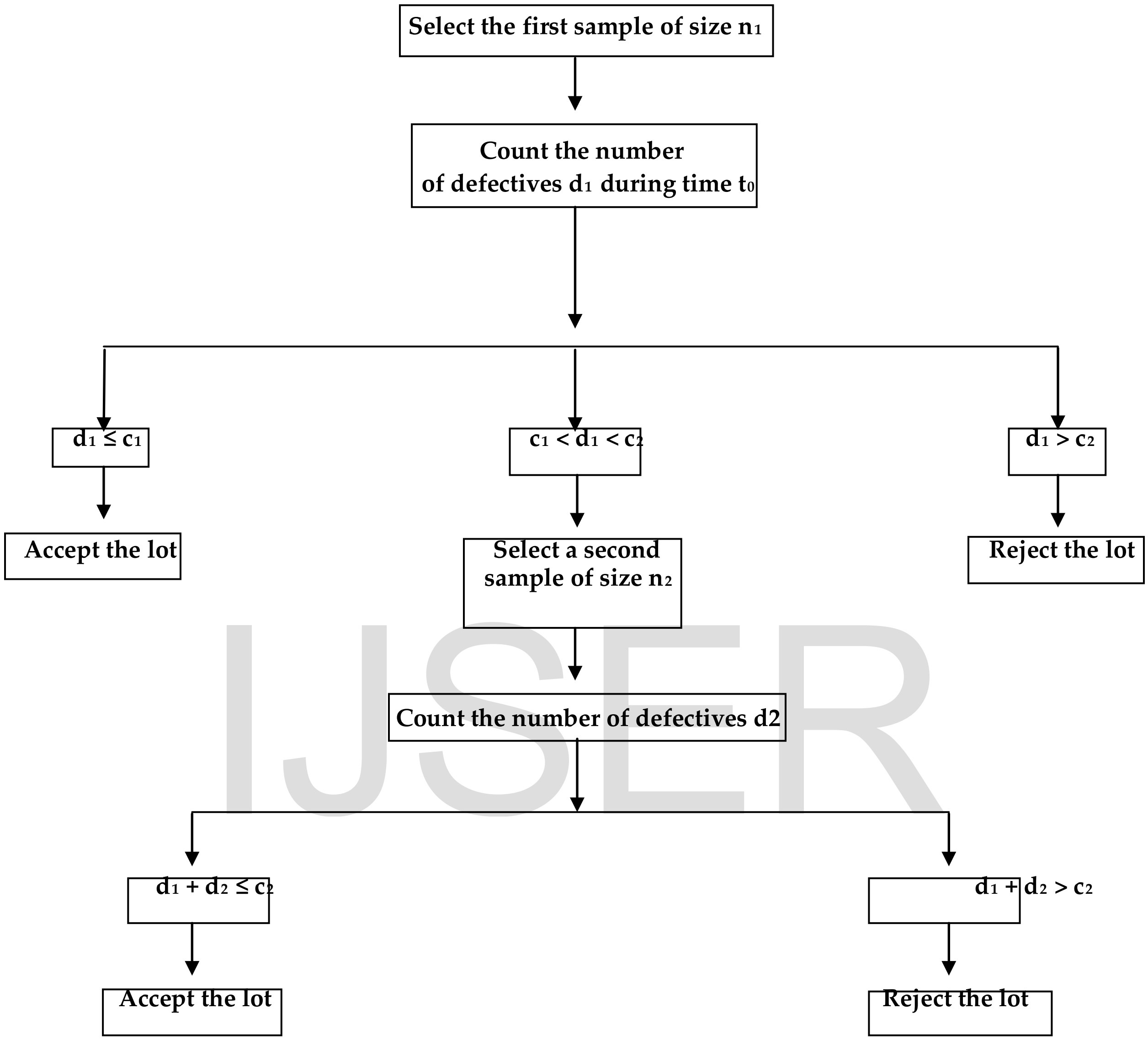
than c_2 during the time t_0.

DECISION FLOWCHART FOR DOUBLE SAMPLING PLAN IN LIFE TESTS.



The DASP is composed of four parameters of (n_1, n_2, c_1, c_2) if t_0 is specified. Here n_1 and n_2 are sample sizes of the first and second sample, whereas c_1 and c_2 are the acceptance numbers associated with the first and the second sample, respectively. 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.

We assume that the lot size is large enough to use the binomial distribution to find the probability of acceptance of the lot. In this paper we have considered c_1= 0 and c_2= 2, ie. DSP (c_1= 0 and c_2= 2).

Then the probability of acceptance for DASP is given by P (A) = P (no failure occur in sample 1) + P (1 failure occur in sample 1 and 0, 1 failure occur in sample 2) + P(2 failures occur in sample 1 and 0 failure occurs in sample 2).

The probability of acceptance DASP (n_1, n_2, 0,2) is given by,

$$L(p)=\binom{n_1}{0}p^0q^{n_1}+\binom{n_1}{1}p^1q^{n_1-1}\left[\sum_{i=0}^{1}\binom{n_2}{i}p^iq^{n_2-i}\right]+\binom{n_1}{2}p^2q^{n_1-2}\left[\binom{n_2}{0}p^0q^{n_2}\right] \qquad \text{………..(1)}$$

4 GENERALIZED EXPONENTIAL DISTRIBUTION:

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

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

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

5 WEIBULL DISTRIBUTION:

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

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

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

6 GAMMA DISTRIBUTION:

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

$$F(t,\lambda) = 1 - e^{-\frac{t}{\lambda}} \sum_{j=0}^{\gamma-1} \left(\frac{t}{\lambda}\right)^{j} / j! \quad [4]$$

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

7 OPERATING CHARACTERISTICS FUNCTION:

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. This function is called Operating Characteristic (OC) function of the sampling plan. For different time ratio t/λ_0 = 0.628, 0.942, 1.257, 2.356, 3.141, 3.927, 4.712. The parameters n_1 and n_2 are determined using minimum angle method.

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

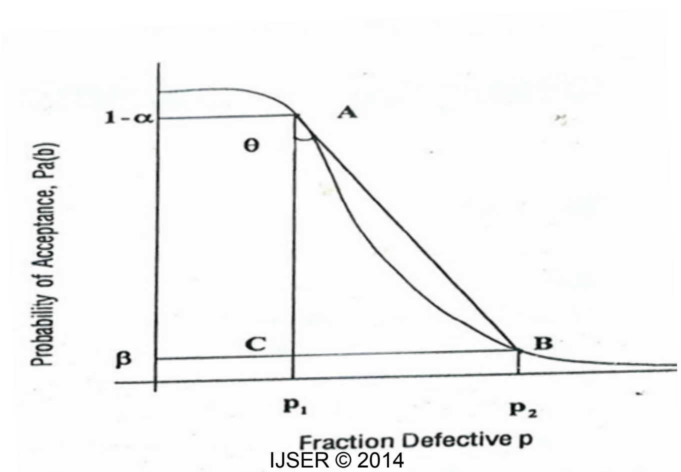
8 MINIMUM ANGLE METHOD:

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 θ = BC / AC

tan θ = $(p_2 - p_1) / (Pa(p_1) - Pa(p_2))$ ______ (5)

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.



Minimum angle for given p_1 and p_2

In this paper we design parameters of the double acceptance sampling plan based on truncated life tests for various distributions, using minimum angle method. The minimum angle method of the double sampling plan under various distributions for truncated life test is given below. Let us assume mean ratio λ/λ_0 (4, 6, 8, 10, 12), and the consumer's risk $\beta \leq .10$ and producer's risk $\alpha \leq 0.05$ are specified. The probability of acceptance $L(p_1)$ and $L(p_2)$ is placed in Table 1 to Table 3 for $c_1 = 0$ and $c_2 = 2$ and the time ratios t/λ_0 = 0.628, 0.942, 1.257, 2.356, 3.141, 3.927, 4.712.

From the Tables 1, 2 and Table 3 it can be noted that from the given values for fixed mean ratio and various time ratios. We select the parameters corresponding to minimum angle.

9 DESIGNING DSP BASED ON TRUNCATED LIFE TESTS UNDER VARIOUS DISTRIBUTIONS USING MINIMUM ANGLE METHOD.

- First let us fix the value of time ratio $\mathbf{t}/\lambda_0$ and mean ratio λ/λ_0 corresponding to $c_1 = 0$ and $c_2 = 2$. Where the mean ratio λ/λ_0 = 4,6,8,10 and 12 be the acceptable reliability level (ARL) at the producer's risk and the mean ratio $\boldsymbol{\lambda}/\lambda_0$ which is equal to 1, be the lot tolerance reliability level (LTRL) at the consumer's risk.
- The parameters n_1, n_2 can be obtained from the table along with producers and consumers risk.
- First select the time ratio the t/λ_0
- Select the parameter of the sampling plan corresponding to smallest value of θ. .

10 CONSTRUCTION OF TABLES:

The Tables are constructed using OC function for Double sampling plans under various distributions is given by the equations (1) to (4). Using the above values the minimum angle tan θ is calculated using the equation (5). For various time ratios t/λ_0 and mean ratios $\boldsymbol{\lambda}/\lambda_0$ the parameter values n_1 and n_2 are obtained by DASP under various Distribution for $c_1 = 0$ and $c_2 = 2$ and are presented in Table 1 to Table 3. Numerical value in these tables reveals the following facts.

For given mean ratio and time ratio $c_1 = 0$ and $c_2 = 2$, values in Tables 1-3 can be used to select the parameters of Double sampling plan under various distribution for certain specified values of AQL and LQL. The parameters n_1, n_2 and θ can be obtained from the selected table corresponding to λ/λ_0 along with producer's risk and consumer's risk.

EXAMPLE 1: Suppose one wants to design double sampling plan under Generalized exponential distribution for given α =0.033, β =0.022, λ/λ_0 = 4, given $\mathbf{t}/\lambda_0$ = 0.628, $c_1 = 0$ and $c_2 = 2$,.from Table1, one can observe that the minimum angle is θ = 11.74843° it corresponds to n_1= 17 8, n_2= 18. Thus the required single sampling plan has parameters (17, 18, 0, 2), which satisfies both the producers risk and consumer's risk.

EXAMPLE 2: Suppose one wants to design double sampling plan under Weibull distribution for given α =0.0143, β =0.004, λ/λ_0 = 4, given $\mathbf{t}/\lambda_0$ = 0.628, $c_1 = 0$ and $c_2 = 2$. From Table2, one can observe that the minimum angle is θ = 17.07785° it corresponds to n_1= 6, n_2= 20. Thus the required single sampling plan has parameters (6, 20, 0, 2), which satisfies both the producers risk and consumer's risk.

EXAMPLE 3: Suppose one wants to design double sampling plan under Gamma distribution for given α =0.0113, β =0.0911, λ/λ_0 = 4, given $\mathbf{t}/\lambda_0$ = 0.628, $c_1 = 0$ and $c_2 = 2$. From Table3, one can observe that the minimum angle is θ = 7.620928° it corresponds to n_1= 21, n_2= 23. Thus the required single sampling plan has parameters (21, 23, 0, 2), which satisfies both the producers risk and consumer's risk.

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MINIMUM ANGLE DOUBLE SAMPLING PLAN UNDER GENERALISESD EXPONENTIAL DISTRIBUTION C1 = 0 & C2 = 2

TABLE: 1

t/λ_0	λ/λ_0	n_1	n_2	$L(p_1)$	$L(p_2)$	Tanθ	Θ
0.628	4	15	18	0.972346	0.035394	0.209577	11.83659
	4	14	18	0.974901	0.044157	0.210975	11.91327
	4	16	18	0.96969	0.028373	0.208606	11.78325
	4	**17**	**18**	**0.966932**	**0.022747**	**0.207972**	**11.74843**
	4	15	20	0.968671	0.031901	0.209618	11.83881
	4	14	20	0.971466	0.040071	0.210828	11.90519
	4	18	20	0.959695	0.016109	0.208104	11.75569
	4	16	20	0.965777	0.0254	0.208814	11.79468
	4	14	23	0.966094	0.036387	0.21121	11.92619
	4	15	23	0.962935	0.028755	0.210199	11.87072
	4	16	23	0.95968	0.022727	0.209577	11.83657
	4	19	21	0.954155	0.012182	0.20846	11.77525
0.942	4	5	16	0.962026	0.099416	0.380543	20.83396
	4	8	12	0.95413	0.028467	0.354621	19.52559
	4	9	11	0.951616	0.019896	0.352316	19.40818
1.257	4	4	8	0.960566	0.06515	0.490513	26.12853
	4	5	7	0.955894	0.037699	0.478344	25.56385
1.571	4	3	6	0.952542	0.060601	0.585268	30.33909
0.628	6	15	33	0.991662	0.025653	0.214904	12.12862
	6	20	37	0.98581	0.007478	0.212197	11.98031
	6	25	37	0.980899	0.0022	0.212118	11.97594
	6	30	37	0.975432	0.000648	0.212969	12.02263
	6	12	37	0.992516	0.052979	0.220959	12.45983
	6	18	37	0.987619	0.0122	0.212831	12.01504
	6	12	19	0.997215	0.065726	0.222868	12.56408
	6	10	20	0.997673	0.099946	0.23125	13.02076
	6	8	19	0.998407	0.162078	0.248227	13.94059
	6	7	17	0.998882	0.215137	0.264881	14.83587
	6	12	21	0.996784	0.061251	0.221905	12.51148
	6	11	26	0.99607	0.070743	0.224352	12.64507
0.942	6	17	18	0.966932	0.000379	0.363327	19.96747
	6	15	20	0.968671	0.000938	0.362884	19.94505
	6	14	20	0.971466	0.001493	0.362046	19.9026
	6	18	20	0.959695	0.000233	0.366013	20.10327
	6	16	20	0.965777	0.00059	0.363841	19.99349

	6	15	23	0.962935	0.000929	0.365045	20.05436
	6	16	23	0.95968	0.000583	0.366152	20.11031
	6	19	22	0.951771	0.000145	0.369026	20.2554
	6	5	16	0.994439	0.099416	0.392365	21.42328
1.257	6	8	17	0.957519	0.003223	0.499013	26.5198
	6	4	9	0.992854	0.061239	0.511162	27.07441
	6	5	8	0.991898	0.033068	0.496654	26.41148
	6	6	8	0.989448	0.016808	0.489602	26.08646
	6	9	16	0.95458	0.001575	0.499689	26.55079
1.571	6	3	6	0.992392	0.060601	0.616507	31.65412
	6	4	8	0.982592	0.020066	0.596821	30.82965
	6	5	10	0.968209	0.007236	0.597785	30.87036
	6	6	11	0.954716	0.002683	0.603399	31.10675
2.356	6	3	5	0.963402	0.006326	0.745949	36.72106
	6	3	6	0.952584	0.005983	0.754203	37.0237
	6	2	7	0.963147	0.032685	0.767285	37.49848
	6	2	5	0.97835	0.034096	0.756078	37.09212
	6	2	4	0.98511	0.039365	0.754886	37.04864
0.628	8	17	21	0.998861	0.01931	0.216196	12.19935
	8	15	17	0.999297	0.037758	0.220246	12.42084
	8	13	17	0.99944	0.058299	0.225019	12.68143
	8	19	26	0.998194	0.010386	0.214389	12.10039
	8	11	17	0.999566	0.090038	0.23284	13.10724
0.942	8	15	33	0.995165	0.000926	0.366315	20.11852
	8	5	15	0.999672	0.10042	0.405009	22.04837
	8	8	16	0.999315	0.024939	0.373782	20.49485
	8	12	37	0.995658	0.003742	0.367173	20.16185
	8	18	37	0.992757	0.000229	0.366946	20.15041
	8	12	19	0.998418	0.003802	0.366176	20.11151
	8	10	20	0.99868	0.009577	0.368217	20.21454
	8	8	19	0.9991	0.02434	0.373635	20.48745
	8	7	17	0.999371	0.039148	0.379292	20.77131
	8	12	21	0.998169	0.003768	0.366255	20.11551
	8	11	26	0.997752	0.005966	0.367221	20.16428
1.257	8	10	19	0.982818	0.000767	0.49976	26.55404
	8	14	23	0.96597	0.000014	0.508102	26.93523
	8	15	23	0.962799	0.000012	0.509764	27.01084
	8	16	23	0.959534	0.000011	0.511493	27.08942
	8	11	14	0.9970603	0.00017	0.53556	28.1719
	8	11	20	0.97917	0.000374	0.501422	26.63018
	8	4	8	0.998647	0.06515	0.525753	27.7333
	8	5	12	0.996473	0.028111	0.506824	26.877
	8	6	14	0.994311	0.013585	0.500435	26.58497

1.571	8	7	12	0.983281	0.000997	0.606477	31.23584
	8	4	8	0.995706	0.020066	0.610607	31.40853
	8	3	6	0.998206	0.060601	0.635377	32.43092
	8	5	7	0.995173	0.008141	0.603559	31.11347
	8	6	9	0.990953	0.002746	0.602842	31.08333
	8	8	11	0.982116	0.000373	0.606811	31.24983
	8	9	11	0.978837	0.000139	0.608699	31.32884
	8	10	12	0.972625	0.000015	0.612532	31.48881
2.356	8	14	20	0.671148	0.000013	1.123919	48.3391
	8	18	20	0.587708	0.000014	1.283487	52.07687
	8	16	20	0.628645	0.000012	1.199907	50.19224
	8	14	23	0.636602	0.000013	1.18491	49.83744
	8	15	23	0.614472	0.000017	1.227583	50.83344
	8	16	23	0.95968	0.592878	0.119855	6.834584
	8	16	28	0.949045	0.020764	0.211535	11.94398
	8	22	28	0.924178	0.004877	0.213601	12.05727
	8	19	28	0.936967	0.010061	0.211849	11.96119
	8	13	28	0.960372	0.042878	0.214022	12.08032
	8	14	33	0.946878	0.032743	0.214808	12.12339
	8	18	33	0.928865	0.012337	0.214248	12.09267
	8	26	33	0.889685	0.001753	0.221148	12.47012
3.141	8	2	4	0.985117	0.007553	0.828538	39.64305
	8	3	4	0.973492	0.000661	0.832569	39.77973
	8	3	5	0.963418	0.000611	0.841237	40.07178
	8	2	5	0.97836	0.007199	0.834001	39.82813
3.927	8	2	3	0.975615	0.001911	0.832397	39.77391
	8	2	4	0.960993	0.001542	0.844763	40.18989
	8	3	4	0.933062	0.000016	0.868712	40.98123
	8	3	5	0.910449	0.000015	0.890288	41.6783
4.712	8	2	3	0.948507	0.000359	0.826851	39.58568
	8	2	4	0.920436	0.000321	0.852043	40.43241
	8	3	4	0.868827	0.000015	0.902346	42.06139
	8	3	4	0.000015	0.830149	0.944388	43.36171
	8	3	5	0.830149	0.000015	0.944388	43.36171
0.628	10	14	18	0.999805	0.044157	0.223691	12.60897
	10	13	16	0.999853	0.062217	0.227988	12.84323
	10	11	19	0.999854	0.082336	0.232987	13.11521
	10	12	31	0.999641	0.053699	0.225986	12.73416
	10	15	26	0.999629	0.027085	0.219805	12.39675
	10	11	16	0.999887	0.095206	0.236293	13.29474
0.942	10	15	33	0.995165	0.000926	0.366315	20.11852
	10	5	15	0.999672	0.10042	0.405009	22.04837
	10	8	16	0.999315	0.024939	0.373782	20.49485

	10	12	37	0.995658	0.003742	0.367173	20.16185
	10	18	37	0.992757	0.000229	0.366946	20.15041
	10	12	19	0.998418	0.003802	0.366176	20.11151
	10	10	20	0.99868	0.009577	0.368217	20.21454
	10	8	19	0.9991	0.02434	0.373635	20.48745
	10	7	17	0.999371	0.039148	0.379292	20.77131
	10	12	21	0.998169	0.003768	0.366255	20.11551
1.257	10	8	11	0.998142	0.003384	0.500603	26.59268
	10	18	33	0.973984	0.000012	0.511282	27.07983
	10	26	33	0.957945	0.000017	0.519841	27.46725
	10	15	33	0.979297	0.000012	0.508517	26.95413
	10	20	37	0.965656	0.000015	0.51569	27.27971
	10	4	8	0.999593	0.06515	0.532915	28.05383
	10	5	12	0.998912	0.028111	0.512957	27.15587
	10	6	15	0.998009	0.013552	0.505841	26.83217
	10	8	18	0.996138	0.003222	0.501531	26.6352
	10	10	20	0.993929	0.000767	0.501407	26.62953
1.571	10	3	7	0.999277	0.055439	0.642468	32.71946
	10	3	6	0.999448	0.060601	0.645884	32.85776
	10	4	7	0.998913	0.021226	0.620225	31.80822
	10	4	8	0.998648	0.020066	0.619658	31.78475
	10	4	6	0.999152	0.023972	0.62182	31.87417
	10	5	7	0.998479	0.008141	0.612302	31.47923
	10	6	8	0.997544	0.002858	0.609625	31.36755
	10	6	9	0.997084	0.002746	0.60984	31.37649
	10	9	12	0.992041	0.000138	0.611336	31.43896
	10	9	11	0.992909	0.000139	0.610802	31.41668
	10	11	13	0.988108	0.000019	0.613696	31.53728
2.356	10	2	23	0.97607	0.03262	0.821803	39.41347
	10	2	28	0.969011	0.03262	0.827999	39.62471
	10	3	28	0.953483	0.005892	0.818211	39.29041
	10	3	28	0.953483	0.005892	0.818211	39.29041
	10	3	28	0.953483	0.005892	0.818211	39.29041
3.141	10	2	3	0.9969	0.010805	0.854615	40.5177
	10	2	4	0.994758	0.007553	0.853653	40.48584
	10	3	4	0.990413	0.000661	0.851457	40.41298
	10	3	5	0.986467	0.000611	0.854822	40.52457
3.927	10	2	3	0.990983	0.001911	0.86496	40.8585
	10	2	4	0.985104	0.001542	0.869806	41.01694
	10	3	4	0.973469	0.000016	0.878878	41.31154
	10	3	5	0.963389	0.000015	0.888075	41.60746
4.712	10	2	3	0.979556	0.000359	0.858787	40.65554
	10	2	4	0.967077	0.000321	0.869838	41.01798

	10	3	4	0.943064	0.000015	0.891696	41.72325
	10	3	5	0.923342	0.000015	0.910742	42.32545
0.628	12	11	17	0.999956	0.090038	0.236148	13.28685
	12	14	25	0.999888	0.034948	0.222682	12.55393
	12	12	16	0.999954	0.076964	0.232803	13.10521
	12	16	24	0.999871	0.022152	0.219772	12.39494
	12	20	24	0.999818	0.008593	0.216777	12.23119
	12	15	24	0.999883	0.028077	0.221109	12.46801
0.942	12	17	21	0.998861	0.000368	0.36714	20.16019
	12	14	18	0.999319	0.001518	0.367394	20.17304
	12	15	17	0.999297	0.000971	0.367201	20.16329
	12	13	17	0.99944	0.002446	0.367691	20.18805
	12	19	26	0.998194	0.000144	0.367302	20.16841
	12	11	17	0.999566	0.006161	0.36902	20.25507
	12	5	16	0.999867	0.099416	0.407114	22.15193
	12	8	13	0.99982	0.027002	0.376829	20.64787
	12	9	14	0.99976	0.016521	0.372835	20.44724
1.257	12	8	19	0.9984	0.003221	0.504473	26.76971
	12	7	17	0.998877	0.006603	0.50595	26.83712
	12	12	21	0.996771	0.000183	0.50376	26.73713
	12	11	26	0.996053	0.000374	0.50422	26.75814
	12	17	21	0.994647	0.000015	0.504745	26.78214
	12	14	18	0.996742	0.000014	0.503704	26.73458
	12	15	17	0.996638	0.000012	0.503745	26.73646
	12	13	17	0.997304	0.000018	0.503443	26.72265
	12	5	10	0.999702	0.029209	0.517305	27.35275
	12	4	8	0.999851	0.06515	0.537114	28.24086
	12	6	18	0.998989	0.013522	0.509444	26.99631
	12	7	16	0.998981	0.006608	0.505899	26.83481
1.571	12	3	6	0.999795	0.060601	0.652117	33.10905
	12	3	7	0.999731	0.055439	0.648597	32.96731
	12	4	8	0.999492	0.020066	0.62533	32.01898
	12	4	7	0.999593	0.021226	0.626006	32.04683
	12	7	17	0.996328	0.000995	0.615336	31.60547
	12	9	13	0.996517	0.000138	0.61469	31.57863
	12	9	11	0.997236	0.000139	0.614247	31.56021
2.356	12	2	4	0.99952	0.039365	0.820296	39.36191
	12	2	5	0.999267	0.034096	0.816035	39.21563
	12	3	5	0.998684	0.006326	0.793678	38.43825
	12	3	6	0.998208	0.005983	0.793783	38.44196
3.141	12	2	3	0.998758	0.010805	0.87287	41.11672
	12	2	4	0.997871	0.007553	0.870785	41.04886
	12	3	4	0.996045	0.000661	0.866354	40.90414

	12	3	5	0.994341	0.000611	0.867796	40.95131
3.927	12	3	5	0.983647	0.001911	0.899517	41.97191
	12	2	4	0.993617	0.001542	0.890143	41.67364
	12	3	4	0.988373	0.000012	0.893531	41.78178
	12	3	5	0.983647	0.000011	0.897824	41.91824
4.712	12	2	3	0.990987	0.000359	0.884941	41.50694
	12	2	4	0.98511	0.000321	0.890188	41.6751
	12	3	4	0.973479	0.000012	0.900535	42.00415
	12	3	5	0.963402	0.000011	0.909955	42.30078

MINIMUM ANGLE DOUBLE SAMPLING PLAN

FOR WEIBULL DISTRIBUTION FOR $C_1 = 0$ & $C_2 = 2$

TABLE : 2

t/λ_0	λ/λ_0	n_1	n_2	$L(p_1)$	$L(p_2)$	tanθ	Θ
0.628	4	15	18	0.9604	0.002908	0.314937	17.48116
	4	14	18	0.963973	0.004288	0.314218	17.44364
	4	16	18	0.956699	0.001973	0.31585	17.5287
	4	17	18	0.952872	0.001338	0.316909	17.5839
	4	15	20	0.95532	0.0028	0.316581	17.56681
	4	**6**	**20**	**0.985695**	**0.004141**	**0.307217**	**17.07785**
	4	7	13	0.990823	0.074349	0.329033	18.2129
	4	8	11	0.991242	0.05989	0.323777	17.94074
0.942	4	4	11	0.971089	0.028919	0.567106	29.55782
	4	3	9	0.984808	0.071358	0.584936	30.3249
	4	4	9	0.978385	0.029634	0.563172	29.387
	4	5	12	0.957568	0.011876	0.564993	29.46616
	4	5	11	0.962264	0.011929	0.562233	29.34615
	4	6	11	0.952831	0.004921	0.563672	29.40872
1.571	4	2	5	0.951788	0.007224	0.817631	39.27051
	4	2	4	0.965971	0.00758	0.805835	38.86308
2.356	4	8	9	0.99931	0.076016	0.341181	18.83864
	4	14	18	0.995735	0.004288	0.317727	17.62648
	4	15	17	0.9956	0.002999	0.317358	17.60726
	4	13	17	0.996466	0.006488	0.318199	17.65102
	4	19	26	0.98921	0.00056	0.318626	17.67326
	4	11	17	0.99724	0.01405	0.320396	17.76525
0.628	6	9	11	0.998898	0.042217	0.329274	18.22537
	6	7	10	0.999351	0.093459	0.347734	19.17432
	6	11	13	0.998097	0.017059	0.321099	17.80175
	6	12	13	0.997813	0.011817	0.319484	17.71786

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	6	13	15	0.997007	0.007056	0.318208	17.65147
	6	13	16	0.996741	0.006723	0.318186	17.65035
0.942	6	7	9	0.994541	0.00213	0.568224	29.60628
	6	6	8	0.996341	0.005424	0.569081	29.6434
	6	5	7	0.997723	0.014184	0.57335	29.82781
	6	4	6	0.998724	0.038116	0.587036	30.41448
	6	4	5	0.99904	0.048734	0.5934	30.6849
	6	7	8	0.995348	0.002283	0.56785	29.59009
1.257	6	5	7	0.988944	0.000375	0.759779	37.22681
	6	4	7	0.991965	0.001814	0.758565	37.1827
	6	3	5	0.996883	0.009641	0.760801	37.2639
	6	4	6	0.993637	0.001863	0.757324	37.13751
	6	4	5	0.995151	0.002068	0.756325	37.10113
	6	5	6	0.991077	0.000388	0.758153	37.1677
1.571	6	3	4	0.992588	0.000665	0.855903	40.56032
	6	3	5	0.989491	0.000614	0.85854	40.64742
	6	4	6	0.97927	0.000015	0.867008	40.92554
	6	4	5	0.983951	0.000015	0.862884	40.79038
	6	5	7	0.965176	0.000014	0.879626	41.33569
2.356	6	2	4	0.966006	0.000015	0.883266	41.45306
	6	2	3	0.978865	0.000011	0.871663	41.07746
0.628	8	7	12	0.999838	0.078803	0.347174	19.1457
	8	7	11	0.999859	0.08497	0.349507	19.26487
	8	8	13	0.999777	0.051424	0.337174	18.63277
	8	8	14	0.99975	0.048879	0.336281	18.58684
	8	9	13	0.999733	0.035585	0.33165	18.34811
0.942	8	7	12	0.99833	0.002017	0.576616	29.96843
	8	7	11	0.998535	0.00203	0.576505	29.96367
	8	7	10	0.998728	0.002061	0.576411	29.95963
	8	6	9	0.99914	0.00512	0.577946	30.02559
	8	6	8	0.99928	0.005424	0.578042	30.02971
	8	5	8	0.999456	0.012901	0.582319	30.21306
	8	5	7	0.999558	0.014184	0.583017	30.2429
1.257	8	5	7	0.997711	0.000375	0.771695	37.6572
	8	5	6	0.998176	0.000388	0.771346	37.64466
	8	4	6	0.998718	0.001863	0.772068	37.67059
	8	3	5	0.999389	0.009642	0.777613	37.8691
	8	3	4	0.999581	0.012426	0.779654	37.94191
	8	3	6	0.999164	0.008954	0.77725	37.85612
	8	2	3	0.999874	0.083846	0.840193	40.03673
1.571	8	2	3	0.999539	0.010846	0.887455	41.58761
	8	3	4	0.998498	0.000665	0.879325	41.32598

	8	3	5	0.997828	0.000614	0.879871	41.34362
	8	4	5	0.996608	0.000015	0.880452	41.36237
	8	4	6	0.995534	0.000015	0.881402	41.39302
	8	5	6	0.993712	0.000014	0.882976	41.44373
2.356	8	4	7	0.953954	0.000012	0.957111	43.74459
	8	4	6	0.96255	0.000012	0.948564	43.48792
	8	5	8	0.927753	0.000018	0.984141	44.54206
	8	3	7	0.967843	0.000015	0.943376	43.33106
	8	2	5	0.988696	0.000011	0.923493	42.72226
	8	3	8	0.960967	0.000015	0.950127	43.53501
3.141	8	2	3	0.978877	0.000012	0.875585	41.20491
0.628	10	10	13	0.999914	0.024634	0.330121	18.26912
	10	9	13	0.999927	0.035585	0.333865	18.46234
	10	8	12	0.999946	0.05497	0.340707	18.81433
	10	7	11	0.999962	0.08497	0.351872	19.38554
0.942	10	6	10	0.999721	0.004983	0.58249	30.22060
	10	5	9	0.99982	0.012314	0.586761	30.40275
	10	4	8	0.999893	0.030717	0.597858	30.87345
	10	7	10	0.999647	0.002061	0.580832	30.14939
	10	7	9	0.999699	0.00213	0.580842	30.14983
1.257	10	4	7	0.999542	0.001815	0.780123	37.95861
	10	5	9	0.999046	0.000371	0.779383	37.93223
	10	5	8	0.999208	0.000372	0.779257	37.92774
	10	6	8	0.998952	0.000017	0.779226	37.92665
	10	6	9	0.998751	0.000017	0.779383	37.93223
1.571	10	4	7	0.998363	0.000015	0.892377	41.74499
	10	4	8	0.997968	0.000015	0.89273	41.75625
	10	5	7	0.997714	0.000014	0.892915	41.76215
	10	6	8	0.996327	0.000013	0.894155	41.80163
	10	5	8	0.997205	0.000014	0.893371	41.77669
2.356	10	5	7	0.979569	0.000018	0.961781	43.88391
	10	4	8	0.981776	0.000012	0.959618	43.81947
	10	4	9	0.978343	0.000012	0.962985	43.91974
	10	6	8	0.968543	0.000013	0.972729	44.20799
	10	5	8	0.975503	0.000018	0.965789	44.00297
0.628	12	8	10	0.999986	0.066687	0.346255	19.09869
	12	7	11	0.999987	0.08497	0.353174	19.45188
	12	7	10	0.999989	0.093465	0.356483	19.62027
	12	8	11	0.999984	0.05989	0.343753	18.97056
0.942	12	6	10	0.999904	0.004983	0.585092	30.33154
	12	5	10	0.999926	0.012048	0.589263	30.50927
	12	5	9	0.999938	0.012314	0.589415	30.51572

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	12	4	9	0.999955	0.029634	0.599925	30.9606
1.257	12	4	9	0.999757	0.001801	0.784723	38.12211
	12	4	8	0.999801	0.001803	0.784691	38.12095
	12	3	7	0.999895	0.008789	0.790147	38.31392
	12	3	6	0.999921	0.008954	0.790259	38.31786
	12	3	5	0.999943	0.009642	0.79079	38.3366
1.571	12	3	5	0.999788	0.000614	0.899003	41.95564
	12	3	6	0.999708	0.000609	0.89907	41.95777
	12	4	6	0.99955	0.000015	0.898711	41.94638
	12	4	5	0.999663	0.000015	0.89861	41.94317
	12	5	7	0.999188	0.000014	0.898994	41.95535
2.356	12	3	5	0.997832	0.000015	0.960393	43.84256
	12	3	4	0.9985	0.000015	0.959749	43.82339
	12	4	5	0.996613	0.000012	0.961566	43.87753
	12	4	6	0.99554	0.000012	0.962603	43.90837
	12	5	7	0.992193	0.000018	0.96585	44.00479
3.141	12	3	4	0.9926	0.000011	0.940691	43.24955
	12	3	5	0.989508	0.000011	0.943631	43.33878
	12	2	4	0.995975	0.000012	0.937503	43.15249
	12	2	3	0.99763	0.000012	0.935948	43.10503
	12	4	5	0.983976	0.000016	0.948936	43.49913

MINIMUM ANGLE DOUBLE SAMPLING PLAN FOR GAMMA DISTRIBUTION FOR $C_1 = 0$ & $C_2 = 2$

TABLE : 3

t/λ_0	λ/λ_0	n_1	n_2	$L(p_1)$	$L(p_2)$	tanθ	Θ
0.628	4	21	22	0.989277	0.09586	0.134425	7.656069
0.628	**4**	**21**	**23**	**0.988695**	**0.091108**	**0.1338**	**7.620928**
0.942	4	15	16	0.967471	0.022616	0.23197	13.05995
0.942	4	14	15	0.972646	0.03142	0.232865	13.10856
1.257	4	7	9	0.978911	0.070075	0.349584	19.2688
1.257	4	7	8	0.981837	0.081212	0.352771	19.43135
1.571	4	5	6	0.978368	0.078787	0.451357	24.29235
1.571	4	5	7	0.973493	0.064443	0.446655	24.06816
2.356	4	3	4	0.964029	0.057052	0.621364	31.85534
3.141	4	2	3	0.956586	0.060831	0.708932	35.33404
0.628	6	20	24	0.998714	0.097597	0.139932	7.965771
0.628	6	20	25	0.998642	0.093482	0.139307	7.930639
0.942	6	10	13	0.998268	0.097113	0.257236	14.42576
0.942	6	10	14	0.998078	0.089845	0.255231	14.31797
1.257	6	7	8	0.997646	0.081212	0.369652	20.28693

1.257	6	7	9	0.997228	0.070075	0.365378	20.07121
1.571	6	5	6	0.997061	0.078787	0.475682	25.4396
1.571	6	5	7	0.996324	0.064443	0.468737	25.11422
2.356	6	3	5	0.992162	0.041554	0.654591	33.20838
2.356	6	3	4	0.994497	0.057052	0.663782	33.57549
3.141	6	2	3	0.992807	0.060831	0.776342	37.82368
3.141	6	2	4	0.98805	0.060831	0.780325	37.96582
3.972	6	2	3	0.978938	0.013633	0.791086	38.34703
3.972	6	2	4	0.96612	0.009352	0.798145	38.59495
4.712	6	2	3	0.956567	0.0035	0.800282	38.66965
0.628	8	20	24	0.999743	0.097597	0.142195	8.092895
0.628	8	20	25	0.999728	0.093482	0.141551	8.056754
0.942	8	10	13	0.999643	0.097113	0.262047	14.68399
0.942	8	10	14	0.999603	0.089845	0.259965	14.57231
1.257	8	7	8	0.999502	0.081212	0.377599	20.68649
1.571	8	5	6	0.999362	0.078787	0.487431	25.98602
1.571	8	5	7	0.999196	0.064443	0.480038	25.64276
2.356	8	3	4	0.998727	0.057052	0.686154	34.4561
2.356	8	3	4	0.998727	0.057052	0.686154	34.4561
3.141	8	2	4	0.997025	0.060831	0.81325	39.11973
3.141	8	2	3	0.998256	0.060831	0.812181	39.08286
3.972	8	2	3	0.994417	0.013633	0.833215	39.80158
3.972	8	2	4	0.99067	0.009352	0.832762	39.78626
4.712	8	2	3	0.987532	0.0035	0.84385	40.15933
4.712	8	2	4	0.97959	0.002692	0.850012	40.36493
0.628	10	20	24	0.999928	0.097597	0.14331	8.155552
0.628	10	20	25	0.999924	0.093482	0.14266	8.119053
0.942	10	10	13	0.999899	0.097113	0.264458	14.8132
0.942	10	10	14	0.999887	0.089845	0.262349	14.70021
1.257	10	7	8	0.999856	0.081212	0.381651	20.88938
1.257	10	7	9	0.999829	0.070075	0.37709	20.66096
1.571	10	5	6	0.999813	0.078787	0.493503	26.26649
1.571	10	5	7	0.999763	0.064443	0.485961	25.91796
2.356	10	3	4	0.999612	0.057052	0.698204	34.9229
2.356	10	3	5	0.999434	0.041554	0.687037	34.4905
3.141	10	2	3	0.999452	0.060831	0.831884	39.75653
3.141	10	2	3	0.999452	0.060831	0.831884	39.75653
3.972	10	2	3	0.99815	0.013633	0.858843	40.65741
3.972	10	2	4	0.996847	0.009352	0.856254	40.57192
4.712	10	2	3	0.995668	0.0035	0.873913	41.15062
4.712	10	2	4	0.992722	0.002692	0.8758	41.21186
0.628	12	20	24	0.999975	0.097597	0.143933	8.190517
0.628	12	20	25	0.999974	0.093482	0.14328	8.153843
0.942	12	10	13	0.999964	0.097113	0.265816	14.88588

0.942	12	10	14	0.99996	0.089845	0.263694	14.77229
1.257	12	7	8	0.999949	0.081212	0.383953	21.00444
1.257	12	7	8	0.999949	0.081212	0.383953	21.00444
1.257	12	7	9	0.999939	0.070075	0.379358	20.77466
1.571	12	5	6	0.999933	0.078787	0.496982	26.42656
1.571	12	5	7	0.999915	0.064443	0.489371	26.07581
2.356	12	3	4	0.999857	0.060831	0.856225	40.57097
2.356	12	3	5	0.99979	0.060831	0.708155	35.3044
3.141	12	2	3	0.999793	0.060831	0.84361	40.15132
3.141	12	2	3	0.999793	0.060831	0.84361	40.15132
3.972	12	2	3	0.999278	0.013633	0.874838	41.18068
3.972	12	2	4	0.998755	0.009352	0.871516	41.07267
4.712	12	2	3	0.998255	0.0035	0.893759	41.78903
4.712	12	2	4	0.997023	0.002692	0.89414	41.80117

11 CONCLUSION:

In this paper designing of double sampling plan for truncated life tests by using minimum angle method is presented. It is assumed that a life time of the items follows various 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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