ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 7, July 2014

Construction and Selection of Multiple Deferred State (MDS-1) Variables Sampling Plan Involving Minimum Sum of Risks

Dr. D. Senthilkumar[1]*, K. Lokanayaki[2] , B. Esha Raffie[2]

Associate Professor, Department of Statistics, PSG College of Arts & Science, Coimbatore -14, Tamil Nadu, India[1]

Research Scholar, Department of Statistics, PSG College of Arts & Science, Coimbatore – 14, Tamil Nadu, India[2]

ABSTRACT: In this paper, Multiple Deferred State Variables Sampling Plan is presented. The plan parameters are determined by minimizing sum of risks for specified acceptable quality level and limiting quality level. Tables are constructed for the selection of parameters for this plan under the specific values of the producer's and consumer's risks indexed by acceptable quality level and limiting quality level, when the standard deviation is known and unknown for which the results are explained with examples.

KEY WORDS: Multiple Deferred State, Variables Sampling, Acceptable Quality level (AQL), Limiting Quality Level (LQL) and Minimum Sum of Risks.

I. INTRODUCTION

Acceptance sampling plan is a specific plan that clearly states the rules for sampling and the associated criteria for acceptance or otherwise. Acceptance sampling plans can be applied for inspection of end items, components, raw materials, operations, materials in process, supplies in storage, maintenance operations, data or records and administrative procedures. The above process involves attributes and variables. Quality is measured by observing the presence or absence of any characteristic or attribute in each of the units in the sample or lot under consideration, and the number of items counted which do or do not possess the quality attribute, or how many events occur in the unit area, etc in the attribute method. Variable sampling plans constitute one of the major areas of the theory and practice of acceptance sampling. The principle prerequisite for variables sampling is that the quality characteristic of interest is measured on a continuous scale. The primary advantage of the variables sampling plan is that the same operating characteristic (OC) curve can be obtained with a smaller sample size than would be required by an attributes sampling plan. Thus, a variables acceptance sampling plan would require less sampling. The variables sampling provides more information than the attributes sampling, and therefore the same protection is attained with partly considerable smaller sample size.

Wortham and Baker (1976) have introduced a new controlling procedure for continuous process is Multiple Dependent (or deferred) State (MDS) sampling. That process involves a combination of attribute sampling plan and the group of conditional sampling plans. In these procedures, acceptance or rejection of a lot is based not only on the sample from that lot, but also on sample results from past lots (in the case of the dependent state sampling) or from future lots (in the case of deferred state sampling). MDS plans are extensions of Chain Sampling plans of the type (Dodge 1955). This plan was studied further by Vaerst (1982). Govindaraju and Subramani (1990) have developed a table and procedure for finding the multiple deferred sampling plan of the type MDS-1 involving a minimum sum of risks for specified acceptable quality level and limiting quality level. Soundararajan and Vijayaraghavan (1990) have designed multiple deferred state MDS-1 (0,2) sampling plan indexed by acceptable quality level and limiting quality level. Balamurali and Kalyanasundaram (1999) have studied further of this MDS sampling plan. Balamuralli and Chi-Hyuck-Jun (2007) have constructed a table for the selection of parameters of this plan under the specific values of the

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 7, July 2014

producer's and consumer's risks indexed by AQL and LQL when the standard deviation is known and unknown. Subramani and Haridoss (2012) have developed a table and procedures for finding the multiple deferred state-1 (MDS-1) (c_1, c_2) sampling plan involving a minimum sum of producer's and consumer's risks for specified Acceptable Quality Level and Limiting Quality Level.

In this paper, the procedure for designing Multiple Deferred State Variables Sampling Plan is obtained by minimizing the sum of risks given AQL and LQL. Extensive tables are provided for selection of parameters of the proposed plan for selected combinations of the two quality levels and the results are explained with examples.

II. MULTIPLE DEFERRED STATE VARIABLES SAMPLING PLAN (n_σ, m_σ, $k_{a\sigma}$, $k_{r\sigma}$)

The conditions and the assumptions under which the Multiple Deferred State Variables Sampling Plan can be applied are as follows;

CONDITIONS FOR APPLICATIONS

- The cost or destructiveness of testing is such that a relatively small sample size is necessary although other factors make a large sample desirable.
- The product to be inspected comprises a series of successive lots produced by a continuing process.
- Normally, lots are expected to be of essentially the good quality.
- The consumer has faith in the integrity of product.

BASIC ASSUMPTIONS

The following assumptions should be valid for application of the variables MDS plan.

- Lots are submitted for inspection serially in the order of production from a process having a constant proportion of non-conforming.
- The consumer has confidence in the supplier and there should be no reason to believe that a particular lot is poorer than the preceding or succeeding lots.
- The quality characteristic of interest follows a normal distribution.

III. OPERATING PROCEDURE

The Operating Procedure of the Multiple Deferred State (MDS – 1) Variables Sampling Plan is as follows:

Step 1: For each lot, select a random sample of size n_σ, (X_1, X_2, .., $X_{n\sigma}$) from the submitted lot and compute

$$\overline{X} = \frac{1}{n_\sigma}\sum_{i=1}^{n_\sigma} X_i$$

Step 2: Accept the lot if $\overline{X}+k_a\sigma \leq U$ and reject the lot if $\overline{X}+k_r\sigma > U$.

Step 3: If $\overline{X}+k_r\sigma<U<\overline{X}+k_a\sigma$ then accept the current lot provided that the preceding or succeeding m lots were accepted on the condition that $\overline{X}+k_a\sigma \leq U$. The lot is otherwise rejected.

Thus, the proposed variables MDS plan is characterized by four parameters, namely n_σ, m, $k_{a\sigma}$ and $k_{r\sigma}$. Where n_σ is sample size, $k_{r\sigma}$ is acceptance constant, $k_{a\sigma}$ is conditional acceptance constant and mis number of future lots in which conditional acceptance is based (m>0). If $k_{a\sigma}$= $k_{r\sigma}$, then the proposed plan reduces to the variables single sampling plan.

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 7, July 2014

When the lower specification limit L is required instead of U, the operating procedure would be same as above. Note that in the case of the multiple deferred state sampling plan, the forthcoming m lots will be considered for acceptance of the current lot, so that the accept/reject decision is effectively postponed.

CASE OF KNOWN STANDARD DEVIATION

MDS plans are designed by considering two points on the OC curve, namely (p_1, 1- α) and (p_2, β), where p_1 is called the acceptable quality level (AQL), p_2 is the limiting quality level (LQL), α is the producer's risk and β is the consumer's risk. The proposed variables MDS plan minimizing the sum of risks under the restriction that a point on the OC curve has been fixed.

The fraction non-conforming in a lot will be defined by

$$p = 1-\phi(v) = \phi(-v) \text{ with } v=(U-\mu)/\sigma \text{ and}$$

$$\phi(y) = \int_{-\infty}^{y} \frac{1}{\sqrt{2\pi}} e^{-z^2/2}\, dz \qquad (1)$$

where z ~ N (0, 1).

The OC function of the variables MDS sampling plan, which gives the proportion of lots that are expected to be accepted for a given lot quality p, is obtained by

$$P_a(p) = \Pr\{\bar{x} + k_{a\sigma} \le U \mid p\} + \Pr\{\bar{x} + k_{r\sigma} < U < \bar{x} + k_{a\sigma} \mid p\}[\Pr\{\bar{x} + k_{a\sigma} \le U \mid p\}]^{m\sigma} \qquad (2)$$

where the first term in the right hand side represents the probability of accepting a lot based on a single (current) sample and the second term is the probability of accepting a lot based on the stats of the preceding lots. The probability of acceptance of the lot can be written as

$$P_a(p)=\phi(w_2)+[\phi(w_1)-\phi(w_2)][\phi(w_2)]^m \qquad (3)$$

where $w_1 = (z_p - k_{r\sigma})\sqrt{n_\sigma}$

$w_2 = (z_p - k_{a\sigma})\sqrt{n_\sigma}$

Let w_{11} be the value of w_1 at p = AQL (or p_1), w_{21} be the value of w_2 at p = AQL, w_{12} be the value of w_1 at p_2 = LQL and w_{22} be the value of w_2 at p = LQL. If (AQL, 1-α) and (LQL, β) are prescribed, then we require

$$P_a(p_1)=\phi(w_{21})+[\phi(w_{11})-\phi(w_{21})][\phi(w_{21})]^{m\sigma} \ge 1-\alpha \qquad (4) \quad \text{and}$$

$$P_a(p_2)=\phi(w_{22})+[\phi(w_{12}) - \phi(w_{22})][\phi(w_{22})]^{m\sigma} \le \beta \qquad (5)$$

The expression for the sum of Producer's and Consumer's risk is given by

$$\alpha+\beta=1-P_a(p_1)+P_a(p_2) \qquad (6)$$

For given AQL and LQL, the parametric values of MDS plan, namely n_σ, $k_{a\sigma}$, $k_{r\sigma}$, α and β are determined by using a computer program.

A PROCEDURE FOR MDS SAMPLING PLAN WITH KNOWN SIGMA INVOLVING MINIMUM SUM OF RISKS

From Tables 1, 2 and 3, a procedure for designing Multiple Deferred State variables sampling plan involving minimum sum of risks for the given values of AQL and LQL is indicated below.

Tables 1, 2 and 3 are used to select the MDS for the given values of (AQL. 1- α), (LQL, β). The plans given here have the minimum sum of risks fix the values of p_1 and p_2 from which a Multiple Deferred State variables sampling plan can be selected under known σ- method. Entering the row giving $p_1$and column giving p_2, one gets the acceptance criteria $k_{a\sigma}$, $k_{r\sigma}$, α and β and the sample size n_σ. For example, for given p_1=0.002, p_2= 0.005 and m=1, Table 1 gives n_σ=119, $k_{a\sigma}$=2.82, $k_{r\sigma}$=2.65 ,α=8% and β=1% as desired plan parameters.

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 7, July 2014

CASE OF UNKNOWN STANDARD DEVIATION

Whenever the standard deviation is unknown, we may use the sample standard deviation S instead of σ. In this case, the plan operates as follows:

Step 1: For each lot, select a random sample of size n_S, $(X_1, X_2, .. X_{n\sigma})$ from the submitted lot compute where

$$\bar{X} = \frac{1}{n_S}\sum_{i=1}^{n_\sigma} X_i \text{ and } S = \sqrt{\sum (X_i - X)^2 / n_S - 1}.$$

Step 2: Accept the lot if $\bar{X} + k_a S \le U$ and reject the lot if $\bar{X} + k_r S > U$.

Step 3: If $\bar{X} + k_r S < U < \bar{X} + k_a S$ then accept the current lot provided that the preceding or succeeding m lots were accepted on the condition that $\bar{X} + k_a S \le U$. The lot is otherwise rejected

Thus, the proposed unknown sigma variables MDS plan is characterized by four parameters, namely n_S, m, k_{aS} and k_{rS}. If $k_{as} = k_{rs}$, then the proposed plan reduces to the single variables sampling plan with unknown standard deviation. The determination of parameters of the unknown sigma plan is slightly different from the known sigma case.

It is known that $\bar{X} \pm k_{as} S$ for a large sample size approximately follows (see Hamaker, (1979), Duncan, (1986)).

Therefore, the probability of accepting a lot based on a single sample is given approximately by

$$P\{\bar{X} \le U - k_{as} S | p\} = \phi\left(\frac{U - k_{aS}\sigma - \mu}{(\sigma/\sqrt{n_S}\sqrt{1 + k^2{}_{aS}/2}}\right) = \phi\left((z_p - k_{aS})\sqrt{\frac{n_S}{1 + k^2{}_{aS}/2}}\right) \quad (7)$$

If we let

$$\phi(y_1) = (z_p - k_{rs})\sqrt{\frac{n_S}{1 + k_{rs}^2/2}}$$

then the probability of acceptance under tightened inspection is considered ϕ (y_1). Similarly, if we let

$$\phi(y_2) = (z_p - k_{as})\sqrt{\frac{n_s}{1 + k_{as}^2/2}}$$

then the probability of acceptance under normal inspection is considered ϕ (y_2). Hence, the lot acceptance probability for the unknown sigma case is given by

$$P_a(p) = \phi(y_2) + [\phi(y_1) - \phi(y_2)][\phi(y_2)]^{ms} \quad (8)$$

Let y_{11} be the value of y_1 at p = AQL (or p_1), y_{21} be the value of y_2 at p = AQL, y_{12} be the value of y_1 at p = LQL (or p_2) and y_{22} be the value of y_2 at p = LQL. If (AQL, 1 -α) and (LQL, β) are prescribed, then we require

$$P_a(p_1) = \phi(y_{21}) + [\phi(y_{11}) - \phi(y_{21})][\phi(y_{21})]^{ms} \ge 1 - \alpha \quad (9)$$

and

$$P_a(p_2) = \phi(y_{22}) + [\phi(y_{12}) - \phi(y_{22})][\phi(y_{22})]^{ms} \le \beta \quad (10)$$

A PROCEDURE FOR MDS SAMPLING PLAN WITH UNKNOWN SIGMA INVOLVING MINIMUM SUM OF RISKS

Tables 1, 2 and 3 are used to determine MDS(n_s, k_{aS}, k_{rS}) for specified values of $p_1$and p_2. For example, if it is desired to have a MDS(n_s, k_{aS}, k_{rS}) for given p_1= 0.003 p_2=0.005 and m =1,Table 1 gives n_s= 567, k_{aS}= 2.741,k_{rS}= 2.691 α=7% and β=1% as desired plan parameters.

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 7, July 2014

IV. PLOTTING THE OC CURVE

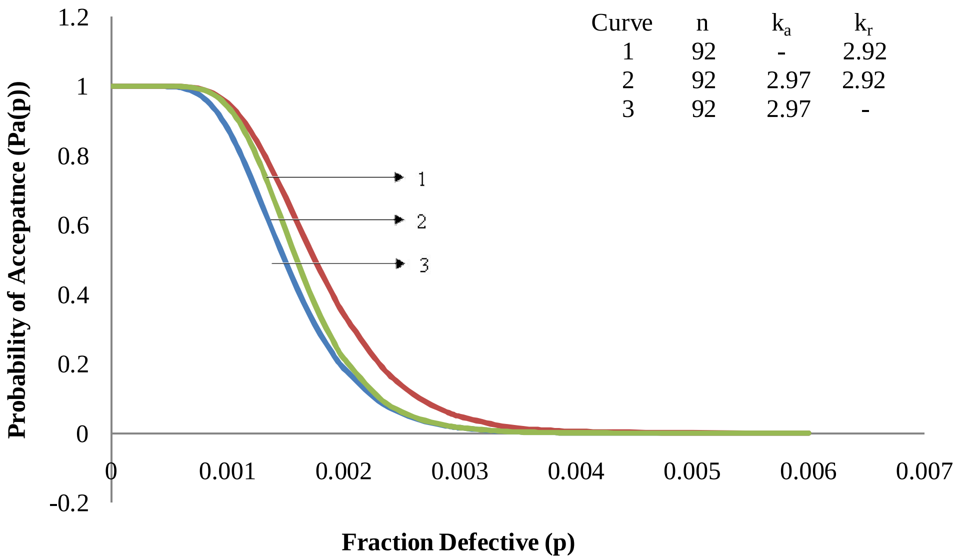

Figure 1: The OC curve of MDS-1(n_σ; $k_{a\sigma}$,$k_{r\sigma}$) variables sampling plans, curve 1, n_σ = 92, $k_{r\sigma}$ = 2.92, α = 7, β =0; curve 2, n_σ = 92, $k_{a\sigma}$ = 2.97, $k_{r\sigma}$ = 2.92, α = 7, β = 0; curve 3, n = 92, $k_{a\sigma}$ = 2.97, α = 7, β = 0;

The OC curve of MDS-1(n; $k_{a\sigma}$,$k_{r\sigma}$) variables sampling plans, curve 1, n_σ = 92, $k_{r\sigma}$ = 2.92, α = 7, β =0; curve 2, n = 92, $k_{a\sigma}$ = 2.97, $k_{r\sigma}$ = 2.92, α = 7, β = 0; curve 3, n_σ = 92, $k_{a\sigma}$ = 2.97, α = 7, β = 0;and Figure 1 shows that the OC curves of multiple deferred state sampling by variables involving a minimum sum of the risks.

Figure 2 shows the OC curves of the variables MDS plan having different values of m and the same values of the AQL and LQL. It can be seen that the MDS plan with a larger value of m seems to be closer to the ideal OC curve.

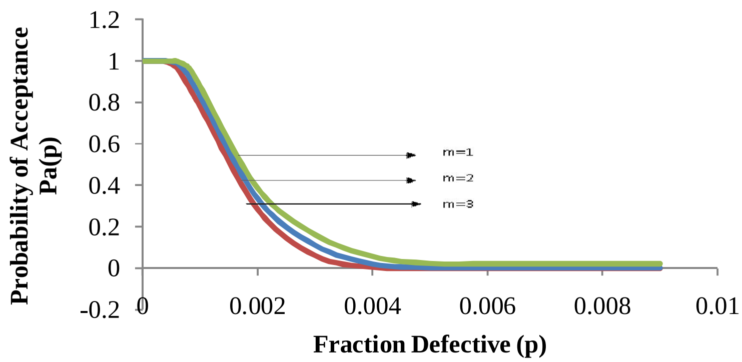

Figure 2: mparison of OC curves with minimum sum of risks for MDS n_σ = 59, $k_{a\sigma}$= 2.90 and $k_{r\sigma}$ = 2.88 when m=1;n_σ = 65, $k_{a\sigma}$= 2.88 and $k_{r\sigma}$ =2.86 when m=2;n_σ = 71, $k_{a\sigma}$= 2.88 and $k_{r\sigma}$ = 2.86 when m= 3;

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 7, July 2014

V. CONSTRUCTION OF TABLE

The OC function of the variables MDS sampling plan, which gives the proportion of lots that are expected to be accepted for a given lot quality p, is obtained by using the expression (3) and (6).

The probability of acceptance of the lot in equation (2) can be expressed in equation (3). (AQL, 1-α) and (LQL, β) can be required in the expression (4) and (5). The expression for the sum of Producer's and Consumer's risks is given in the equation (6).For given AQL and LQL, the design parameters of the variables MDS plan, namely n_σ, m_σ, $k_{a\sigma}$ and $k_{r\sigma,}$ may be determined by satisfying the required producer and consumer conditions in equation (2) are obtained using equation (6)

For given various values of AQL and LQL, the values of n_σ, $k_{a\sigma}$, $k_{r\sigma,}$ n_s, k_{aS}, and k_{rS} are obtained by using computer search routine through C++ programme. The values of the parameters (n_σ, $k_{a\sigma}$ and $k_{r\sigma}$), when m= 1 and when sigma is known and unknown are tabulated in Table 1. The above procedure followed by when m=2 and m=3, the value of the parameters are tabulated in Table 2 and Table 3.

Table 1, 2 and 3 provides the values of n_σ, $k_{a\sigma,}$ $k_{r\sigma,}$ n_s, k_{as} and k_{rs} which satisfying the equation (2) are obtained using equation (6).

VI. CONCLUSION

In this paper, the optimal design parameters of the proposed plan are determined using the two points on the OC curve approach for Multiple Deferred State Variables Sampling Plan for given Acceptable Quality Level and Limiting Quality Level involving minimum risks.

REFERENCES

[1]. Balamurali, S.. and Kalyanasundaram, M., "Determination of conditional double sampling scheme", Journal of Applied Statistics, Vol 26, No.8, pp.893-902, 1999.

[2]. Balamurali, S.. and Chi-Hyuck Jun, "Multiple dependent state sampling plans for lot acceptance based on measurement data", European Journal of Operations Research, Vol.180, pp. 1221-1230, 2007.

[3]. Govindaraju, K. and Subramani, K., "Selection of Multiple deferred state MDS-1 sampling plan for given acceptable quality level and limiting quality level involving minimum risks", Journal of Applied Statistics, Vol. 17, pp. 427-434, 1990.

[4]. Soundararajan, V. and Vijayaraghavan, R. "Construction and Selection of Multiple Deferred State Sampling Plan", Journal of Applied Statistics, Vol.17, No.3, pp.397-409, 1990.

[5]. Subramani, K. and Haridoss, V. "Selection of Multiple Deferred State Sampling for given AQL and LQL involving Minimum Risks using Weighted Poisson Distribution", 2012

[6]. Vaerst, R. "A Procedure to construct Multiple Deferred State Sampling Plan", Methods of Operations Research, Vol. 37, pp. 477-485. 1982.

[7]. Wortham, A.W and Baker, R.C, "Multiple Deferred State Sampling Inspection", The International Journal of Production Research, Vol.14, No.6, 719-731, 1976.

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 7, July 2014

Table 1: Variables MDS sampling plans having m_σ (or m_S) = 1 indexed by AQL and LQL Involving Minimum Sum of Risks

p_1	p_2	n_σ	$k_{a\sigma}$	$k_{r\sigma}$	α	β	n_s	k_{as}	k_{rs}
0.001	0.003	115	3.03	2.93	9	0	626	3.031	2.931
	0.004	69	3	2.89	9	0	368	3.002	2.892
	0.005	44	2.97	2.83	8	0	229	2.973	2.833
	0.006	30	2.92	2.78	7	0	152	2.925	2.785
	0.007	15	2.92	2.56	6	0	71	2.930	2.569
	0.008	13	2.9	2.52	5	0	61	2.912	2.531
	0.009	12	2.9	2.5	4	0	56	2.913	2.511
	0.01	8	2.9	2.41	3	0	36	2.921	2.427
	0.03	7	2.87	2.41	2	0	31	2.894	2.430
	0.05	6	2.85	2.22	1	0	25	2.880	2.243
	0.07	5	2.82	2.15	1	0	20	2.857	2.178
	0.09	3	2.77	1.87	1	0	11	2.840	1.918
0.002	0.005	65	2.8	2.65	9	3	306	2.802	2.652
	0.006	53	2.77	2.65	9	3	248	2.773	2.653
	0.007	44	2.75	2.64	8	3	204	2.753	2.643
	0.008	35	2.75	2.58	7	2	159	2.754	2.584
	0.009	24	2.73	2.51	6	2	106	2.736	2.516
	0.01	23	2.72	2.5	6	1	101	2.727	2.506
	0.03	15	2.7	2.43	5	1	64	2.711	2.440
	0.05	7	2.62	2.12	4	0	27	2.646	2.141
	0.07	5	2.6	2.01	3	0	18	2.638	2.040
	0.09	3	2.52	1.81	1	0	10	2.592	1.862
0.003	0.007	74	2.67	2.54	9	3	325	2.672	2.542
	0.008	57	2.67	2.53	8	3	250	2.673	2.533
	0.009	44	2.65	2.47	7	3	188	2.654	2.473
	0.01	35	2.63	2.39	7	2	145	2.635	2.394
	0.03	16	2.6	2.23	6	1	63	2.611	2.239
	0.05	9	2.55	2.06	5	1	33	2.570	2.076
	0.07	7	2.52	1.96	4	0	25	2.547	1.981
	0.09	4	2.47	1.92	3	0	14	2.520	1.959
0.004	0.03	18	2.52	1.95	8	0	63	2.530	1.958
	0.05	10	2.47	1.94	7	0	34	2.489	1.955
	0.07	9	2.45	1.93	6	0	31	2.471	1.946
	0.09	4	2.37	1.82	5	0	13	2.421	1.859

IJIRSET

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 7, July 2014

Table 1: (continued…)

p_1	p_2	n_σ	$k_{a\sigma}$	$k_{r\sigma}$	α	β	n_s	k_{as}	k_{rs}
0.005	0.03	22	2.42	2.15	8	0	79	2.428	2.157
	0.05	11	2.4	1.96	7	0	37	2.417	1.974
	0.07	10	2.27	1.84	6	0	31	2.289	1.855
	0.09	5	2.27	1.7	5	0	15	2.312	1.731
0.006	0.03	23	2.4	2.11	8	0	81	2.407	2.117
	0.05	17	2.37	2.06	7	0	59	2.380	2.069
	0.07	12	2.35	1.96	6	0	40	2.365	1.973
	0.09	5	2.25	1.65	5	0	15	2.292	1.681
0.007	0.03	28	2.35	2.05	8	0	96	2.356	2.055
	0.05	20	2.32	2	7	0	67	2.329	2.008
	0.07	15	2.3	1.95	6	0	49	2.312	1.960
	0.09	6	2.22	1.68	5	0	17	2.254	1.706
0.008	0.03	31	2.3	2.05	8	1	104	2.306	2.055
	0.05	23	2.27	2.01	8	0	76	2.278	2.017
	0.07	17	2.25	1.96	7	0	55	2.261	1.969
	0.09	7	2.2	1.66	6	0	20	2.229	1.682
0.009	0.03	32	2.27	2.04	9	1	106	2.275	2.045
	0.05	25	2.25	2.03	8	0	82	2.257	2.036
	0.07	18	2.22	1.94	7	0	57	2.230	1.949
	0.09	8	2.17	1.67	6	0	23	2.195	1.689

IJIRSET

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 7, July 2014

Table 2: Variables MDS sampling plans having m_{σ} (or m_S) = 2 indexed by AQL and LQL Involving Minimum Sum of Risks

p_1	p_2	n_{σ}	$K_{a\sigma}$	$k_{r\sigma}$	α	β	n_s	k_{as}	k_{rs}
0.001	0.003	117	3.000	2.940	9	0	633	3.001	2.941
	0.005	85	2.970	2.910	8	0	452	2.972	2.912
	0.007	40	2.920	2.840	7	0	206	2.924	2.843
	0.009	22	2.900	2.710	6	0	109	2.907	2.716
	0.01	10	2.850	2.520	5	0	46	2.866	2.534
	0.03	8	2.800	2.500	4	0	36	2.820	2.518
	0.05	7	2.800	2.350	3	0	30	2.824	2.370
	0.07	6	2.770	2.090	2	0	24	2.801	2.113
	0.09	4	2.700	2.080	1	0	15	2.748	2.117
0.003	0.007	86	2.650	2.570	8	3	379	2.652	2.572
	0.009	53	2.620	2.510	7	1	227	2.623	2.513
	0.01	44	2.600	2.510	6	0	188	2.603	2.513
	0.03	17	2.550	2.260	5	0	66	2.560	2.269
	0.05	10	2.500	2.170	4	0	37	2.517	2.185
	0.07	8	2.450	2.080	3	0	29	2.472	2.099
	0.09	5	2.400	1.880	2	0	16	2.439	1.911
0.005	0.03	25	2.400	2.120	8	1	89	2.407	2.126
	0.05	15	2.350	2.020	7	0	51	2.362	2.030
	0.07	9	2.300	1.930	6	0	29	2.321	1.947
	0.09	5	2.200	1.730	5	0	15	2.241	1.762
0.007	0.03	27	2.300	2.080	8	0	92	2.306	2.086
	0.05	22	2.270	2.070	7	0	74	2.278	2.077
	0.07	16	2.250	1.980	6	0	52	2.261	1.990
	0.09	6	2.150	1.630	5	0	17	2.185	1.656
0.009	0.03	34	2.250	2.040	8	2	112	2.255	2.045
	0.05	26	2.200	2.010	7	0	84	2.207	2.016
	0.07	18	2.170	1.900	6	0	55	2.180	1.909
	0.09	7	2.070	1.640	5	0	19	2.099	1.663

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 7, July 2014

Table 3: Variables MDS sampling plans having m_{σ} (or m_S) = 3 indexed by AQL and LQL Involving Minimum Sum of Risks

p_1	p_2	n_σ	$K_{a\sigma}$	$k_{r\sigma}$	α	β	n_s	k_{as}	k_{rs}
0.001	0.003	118	3.000	2.920	9	0	635	3.001	2.921
	0.005	92	2.970	2.900	8	0	488	2.972	2.901
	0.007	51	2.950	2.840	7	0	265	2.953	2.843
	0.009	30	2.920	2.670	6	0	147	2.925	2.675
	0.01	15	2.850	2.560	5	0	70	2.860	2.569
	0.03	11	2.820	2.520	4	0	50	2.834	2.533
	0.05	9	2.770	2.440	3	0	40	2.788	2.456
0.003	0.009	63	2.620	2.530	8	2	272	2.622	2.532
	0.01	48	2.600	2.510	7	1	205	2.603	2.513
	0.03	18	2.520	2.300	6	0	70	2.529	2.308
	0.05	13	2.500	2.110	5	0	48	2.514	2.121
	0.07	11	2.470	2.060	4	0	39	2.486	2.074
	0.09	6	2.370	2.020	3	0	20	2.401	2.046
0.005	0.03	33	2.400	2.190	9	0	120	2.405	2.195
	0.05	14	2.320	2.070	8	0	48	2.332	2.081
	0.07	12	2.300	2.040	7	0	40	2.315	2.053
	0.09	7	2.220	1.840	6	0	21	2.248	1.863
0.007	0.03	41	2.300	2.060	9	0	138	2.304	2.064
	0.05	16	2.220	2.040	8	0	52	2.231	2.050
	0.07	14	2.200	1.970	7	0	44	2.213	1.981
	0.09	8	2.150	1.780	6	0	23	2.174	1.800
0.009	0.03	42	2.220	2.060	8	1	138	2.224	2.064
	0.05	17	2.150	1.950	7	0	53	2.160	1.959
	0.07	15	2.120	1.940	6	0	46	2.132	1.951
	0.09	9	2.070	1.740	5	0	25	2.091	1.758