International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 10, October - 2017

Repetitive Deferred Variables Sampling Plan Indexed By Six Sigma Quality Levels

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Abstract- **This article proposes a repetitive deferred variable sampling plan (RDVSP) indexed by six sigma quality levels for the inspection of normally distributed quality characteristics. In this plan, the acceptance or rejection of a lot in the deferred state is dependent on the inspection results of the preceding or succeeding lots under repetitive group sampling (RGS) inspection is designing plan indexed by Six Sigma AQL (SSAQL, 1-α) and Six Sigma LQL (SSLQL, β) is indicated. Sampling plan tables are constructed for the selection of parameters indexed by SSAQL and SSLQL in the case of known and unknown standard deviation and sigma values.**

Keywords - Acceptable quality level, sampling plan, consumer's risk, limiting quality level, producer's risk. Repetitive group sampling, Deferred sampling, variables sampling plan, Six Sigma AQL and Six Sigma LQL.

Acceptance sampling was mainly designed to decide whether to accept or reject a lot on the basis of information provided by the sample taken from the particular lot. Acceptance sampling plan may be classified by attributes and variables. Acceptance sampling plan for attributes means that items will be judged as defective/bad or non-defective/well. Further, a sampling plan may be either type are Acceptance — Rejection type or Acceptance -Rectification type. In an acceptance-rejection sampling inspection plan, lots are either accepted or rejected by the sample. In an acceptance rectification sampling plan if we do not accept on the basis of the sample, we take recourse to 100% inspection and in either case replace all defectives by non-defectives.

The RDS plan has been developed by Sankar and Mahopatra (1991) and this plan is essentially an extension of the Multiple deferred sampling plan MDS–(c_1, c_2) which was proposed by Rambert and Vaerst (1981). In this plan, the acceptance or rejection of a lot in deferred state is dependent on the inspection results of the preceding or succeeding lots under repetitive group sampling (RGS) inspection. RGS is the particular case of RDS plan. Wortham and Baker (1976) have developed multiple deferred state sampling (MDS) plans and also provided tables for construction of plans. Suresh (1992) has proposed procedures to select deferred state sampling plan indexed through AQL and LQL. Suresh (1993) has proposed procedures to select Multiple Deferred State Plan of type MDS and MDS–1 indexed through producer and consumer quality levels considering filter and incentive effects. Senthulkumar et al (2015) have studied Repetitive Deferred Variables Sampling (RDVS) plan. The resulting plan would be designated as RDVSP and would be applied under the following conditions.

- ✓ Production is steady so that results on current preceding and succeeding lots are broadly indicative of a continuing process.
- ✓ Lots are submitted substantially in the order of production.
- ✓ Normally lots are expected to be essentially of the same quality.
- ✓ Inspection is by variables with quality defined as the fraction non - conforming.

Basic Assumptions

- ✓ The quality characteristic is represented by a random variable X measurable on a continuous scale.
- ✓ Distribution of X is normal with mean and standard deviation
- ✓ An upper limit U has been specified and a product is qualified as defective when X>U.

  [When the lower limit L is specified, the product is a defective one if X < L]
- ✓ The purpose of inspection is to control the fraction defective p in the lot inspected.

When the conditions listed above are satisfied the fraction defective in a lot will be defined by

P=1-F (v) with $v = (U-\mu) / \sigma$ and

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

Where Z -N(0,1). It is to be recalled, here, that the criterion for the σ -method variable plan is to accept the lot if $\overline{X} + k_1\sigma \leq U$ or $\overline{X} - k_1\sigma \geq L$, when the upper specification limit, U or the lower specification limit, L is specified.

Operating Procedure

Step 1: From each submitted lot take a random sample of size n ($x_1, x_2, \ldots x_3$) say and Compute $v = \frac{U - \overline{X}}{\sigma}$ Where, $\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$

Step 2: Accept the lot of $v \geq k_{1\sigma}$ and reject the lot if $v < k_{2\sigma}$

Step 3: If $k_{2\sigma} \leq v < k_{1\sigma}$ accept the lot provided i proceeding or succeeding lots are accepted under RGS inspection plan. Otherwise reject the lot.

Thus, the RDVS plan has the parameters of the sample size $n\sigma$ and the acceptable criterion k_1 and k_2. The RDS plan for variables is simply designated as RDVSP (n_σ; k_1, k_2).

Operating Characteristic Function

According to Sankar and Mohoputra (1991) the OC function of RDS is given

$$P_a(p) == \frac{P_a(1-P_c)^i + P_c P_a^i}{(1-P_c)^i} \quad (2)$$

Under the assumption of normal approximation to the non-central t distributes the values of P_a and P_c are respectively given by,

$$P_a = \phi(w_1) = P_r[\, v \geq k_{1\sigma} / p \,] \quad (3)$$

$$P_c = [\phi(w_2) - \phi(w_1)] = P_r[\, k_{2\sigma} \leq v < k_{1\sigma} / p] \quad (4)$$

Where, $P_a = P_r[\, v \geq k_{1\sigma} \,]$ is the probability of accepting a lot based on under VRGS plan with parameters (n_σ, $k_{1\sigma}$) and $P_c = P_r[\, k_{2\alpha} < v < k_{1a} / p \,]$ is the probability of repeating the sample a lot based on under VRGS plan with parameters (n_σ, $k_{1\sigma}$, $k_{2\sigma}$, i).

When the expression of P_a and P_c are substituted in equation (2), the OC function of known σ RDVS (n_σ; k_1 , k_2) would become

$$P_a(p) = \frac{P_r\{v \geq k_{1\sigma}/p\}\left[1-P_r\{k_{2\sigma}<v<k_{1\sigma}/p\}\right]^i + P_r\{k_{2\sigma}<v<k_{1\sigma}/p\}\left[P_r\{v\geq k_{1\sigma}/p\}\right]^i}{\left[1-P_r\{k_{2\sigma}<v<k_{1\sigma}/p\}\right]^i} \quad (5)$$

Where the first term in the right hand side represents the probability of accepting a lot based on a RGS and the second term is the probability of accepting a lot based on the states of the preceding lots. The probability of acceptance of the lot can be written as

$$P_a(p) = \frac{\phi(w_1)\left[1-\phi(w_2)+\phi(w_1)\right]^i + \left[\phi(w_2)-\phi(w_1)\right]\left[\phi(w_1)\right]^i}{\left[1-\phi(w_2)+\phi(w_1)\right]^i} \quad (6)$$

where

$$w_1 = \sqrt{n_\sigma}\,(U - k_{1\sigma\text{-}\mu}) / \sigma = (v - k_1)\sqrt{n_\sigma}$$

$$w_2 = \sqrt{n_\sigma}\,(U - k_{2\sigma\text{-}\mu}) / \sigma = (v - k_2)\sqrt{n_\sigma}$$

and $v = (U - \mu)/\sigma$

If SSAQL, SSLQL, the producer's risk (α) and the consumer's risk (β) are prescribed then we have

$$P_a(p_1) = \frac{\phi(w_{11})\left[1-\phi(w_{21})+\phi(w_{11})\right]^i + \left[\phi(w_{21})-\phi(w_{11})\right]\left[\phi(w_{11})\right]^i}{\left[1-\phi(w_{21})+\phi(w_{11})\right]^i} = 1-\alpha \quad (7)$$

$$P_a(p_2) = \frac{\phi(w_{12})\left[1-\phi(w_{22})+\phi(w_{12})\right]^i + \left[\phi(w_{22})-\phi(w_{12})\right]\left[\phi(w_{12})\right]^i}{\left[1-\phi(w_{22})+\phi(w_{12})\right]^i} = \beta \quad (8)$$

Here w_{11} is the value of w_1 at $p=p_1$, w_{21} is the value of w_2 at $p=p_1$, w_{12} is the value of w_1 at $p=p_2$ and w_{22} is the value of w_2 at $p=p_2$, That is,

$$w_{11} = (Z_{p1} - k_1)\sqrt{n_\sigma},\quad w_{21} = (Z_{p2} - k_2)\sqrt{n_\sigma},$$

$$w_{12} = (Z_{p1} - k_1)\sqrt{n_\sigma},\quad w_{22} = (Z_{p2} - k_2)\sqrt{n_\sigma}$$

And Z_p is the standard normal variate having upper tail probability of p. By fixing the probability of acceptance of the lot, $P_a(p)$ as 99.99% with normal distribution, where the value of v_1 at SSAQL and the value of v_2 at SSLQL. For example, if p_1 and p_2 are prescribed, then the corresponding value of v_1 and v_2 will be fixed and if $P_a(p_1)$ and $P_a(p_2)$ are fixed at 99.99966% and 0.000068% respectively, then we have

$$P_a(p_1) = \frac{\phi(w_{11})\left[1-\phi(w_{21})+\phi(w_{11})\right]^i + \left[\phi(w_{21})-\phi(w_{11})\right]\left[\phi(w_{11})\right]^i}{\left[1-\phi(w_{21})+\phi(w_{11})\right]^i} = 0.9999966 \quad (9)$$

and

$$P_a(p_2) = \frac{\phi(w_{12})\left[1-\phi(w_{22})+\phi(w_{12})\right]^i + \left[\phi(w_{22})-\phi(w_{12})\right]\left[\phi(w_{12})\right]^i}{\left[1-\phi(w_{22})+\phi(w_{12})\right]^i} = 0.0000068 \quad (10)$$

For given SSAQL and SSLQL, the parametric values of the RDVS plan namely k_1, k_2 and the sample size n_σ are determined by using a computer search.

Selection of known σ RDVS Plan Indexed by SSAQL and SSLQL

Example

Table 1 can be used to determine RDVS (n_σ; k_1, k_2, i) for specified values of SSAQL and SSLQL. For example, if it is desired to have a RDVS (n_σ; k_1, k_2, i) for given $p_1=0.00005$ $p_2=0.00006$ and i=1, α=0.00034%, β=0.00068%, Table 1 given n=417, $k_1=4.156$, $k_2=4.150$ as desired plan parameters with sigma level is 3.8. For the above example, the plan is operated as follows. Take a random sample of size 417 and compute, $v = U - \overline{X}/\sigma$. Accept the lot if $v \geq 4.153$ and reject the lot if $v < 4.150$. If $4.150 \leq v < 4.156$ accept the lot provided i proceeding or succeeding lots are accepted under RGS inspection plan.

Explanation

In screw manufacturing company if the manufacturer fixes the incoming quality p1=0.00005 and p2=0.00006 (5 to 6 defects out of one lack). Then take a sample of size 417 screw from a given lot. Then the lot has accepted if $v \geq 4.156$ and reject the lot if $v < 4.150$. If $4.150 \leq v < 4.156$ accept the lot provided i proceeding or succeeding lots are accepted under RGS inspection plan.

RDVS with unknown σ variables plan as the reference plan

If the population standard deviation σ is unknown, then it is estimated from the sample standard deviation S (n-1 as the divisor). If the sample size of the unknown sigma variables system (S-method) are n_s the acceptance constants are k_{1s} and k_{2s}, then the operating procedure is as follows:

Step 1: From each submitted lot take a random sample of size $n(x_1, x_2, \ldots x_n)$ say and compute $v = \frac{U - \bar{X}}{\sigma}$ Where, $\bar{X} = \frac{\sum_{i=1}^{n} Xi}{n}$

Step 2 : Accept the lot if $v \geq k_{1s}$ and reject the lot if $v < k_{2s}$ $(K_{1s} > k_{2s})$

Step 3 : If $k_{2s} < v < k_{1s}$ accept the lot provided i proceeding or succeeding lots are accepted under RGS inspection plan. Otherwise reject the lot.

Thus, the proposed unknown sigma variables RDVS plan is characterized by four parameters, namely, ns, i, k_{1s}, If k1s and k_{2s}. If $k_{1s} = k_{2s}$ then the proposed plan reduces to the RGS variables sampling plan with unknown standard deviation. The determination of parameters of the unknown sigma plan is slightly different from the unknown sigma case. It is known that $\bar{X}+k_{2s}S$ for a large sample size approximately follows (see Hamaker(1979), Duncan,(1986))

$$\bar{X} + k_{1s} \sim N\left(\mu + k_{1s}\sigma\frac{\sigma^2}{n} + k_{1s}^2\frac{\sigma^2}{2n}\right)$$

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

$$P\{\bar{X} \leq U - k_{1s} \mid p\} = \phi\left(\frac{U - k_{1s}s - \mu}{\sigma / \sqrt{n_s}\sqrt{1 + k_{1s}^2/2}}\right)$$

$$= \phi\left(\left(z_p - k_{1s}\right)\sqrt{\frac{n_s}{1 + k_{1s}^2/2}}\right) \qquad (11)$$

Analogously to equation (6), the lot acceptance probability for the sigma unknown case is given by

$$P_a(p) = \frac{\phi(w_{1s})\left[1 - \phi(w_{2s}) + \phi(w_{1s})\right]^i + \left[\phi(w_{2s}) - \phi(w_{1s})\right]\left[\phi(w_{1s})\right]^i}{\left[1 - \phi(w_{2s}) + \phi(w_{1s})\right]^i} \qquad (12)$$

Where,

$$\Phi(w_{2s}) = \left(z_p - k_{2s}\right)\sqrt{\frac{n_s}{1 + k_{2s}^2/2}}$$

$$\Phi(w_{1s}) = \left(z_p - k_{1s}\right)\sqrt{\frac{n_s}{1 + k_{1s}^2/2}}$$

Here w_{11s} the value of w_{1s} at $p=p_1$, w_{21s} is the value of w_{2s} at $p=p_1$, w_{12s} is the value of w_{1s} at $p=p_2$ and w_{22s} is the value of w_{2s} at $p=p_2$. That is , If (SSAQL, 1-α) and (SSLQL, β) are prescribed, then we require

and

$$P_a(p_1) = \frac{\phi(w_{11})\left[1 - \phi(w_{21}) + \phi(w_{11})\right]^i + \left[\phi(w_{21}) - \phi(w_{11})\right]\left[\phi(w_{11})\right]^i}{\left[1 - \phi(w_{21}) + \phi(w_{11})\right]^i} = 1 - \alpha \qquad (13)$$

$$P_a(p_2) = \frac{\phi(w_{12})\left[1 - \phi(w_{22}) + \phi(w_{12})\right]^i + \left[\phi(w_{22}) - \phi(w_{12})\right]\left[\phi(w_{12})\right]^i}{\left[1 - \phi(w_{22}) + \phi(w_{12})\right]^i} = \beta \qquad (14)$$

The design parameters of the unknown sigma variables RDS plan, namely n, i, k_{1s}, k_{2s} can be determined by solving the following optimization problem when SSAQL and SSLQL are specified.

Plotting the OC Curve

The OC curve for the repetitive deferred variables sampling plan with i=2, n=373, k_1=4.367, k_2=4.359

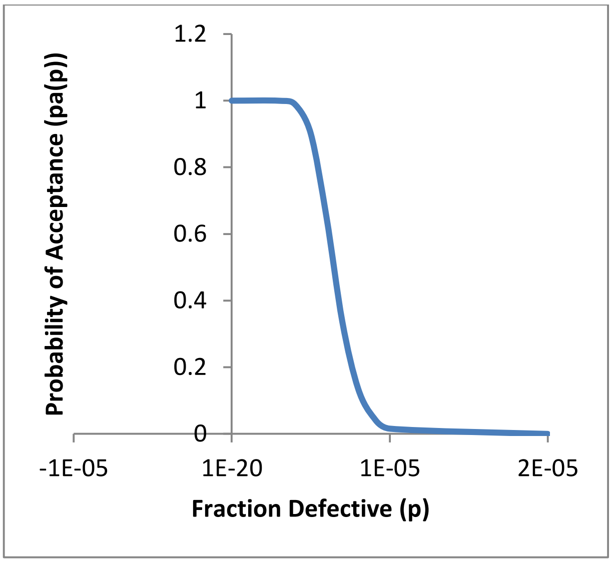

Figure 1: The OC curve of Repetitive deferred (n_σ; $k_{1\sigma}$, $k_{2\sigma}$, i) variables sampling plans where n_σ = 373, $k_{1\sigma}$ = 4.367, $k_{2\sigma}$ = 4.359, i=2.

Behavior of OC curve

Figure 1 shows that the OC curve of Repetitive Deferred (n_σ; $k_{1\sigma}$, $k_{2\sigma}$, i) variables Sampling plan with i=1, n=373, k_1=4.367, k_2=4.359.

Figure 2 shows that the comparison of OC curves of the above three nearly equivalent variables RDVS plans having different values of i. It can be seen that the RDVS plan with a larger value of i seems to be closer to the ideal OC curve in that the probability of acceptance at SSAQL, or smaller is increased and the slope at levels between SSAQL and SSLQL becomes sharper although it will require larger sample size. The decision upon choice of the value of i when implementing the plan could be made by considering the sample size and its OC curve.

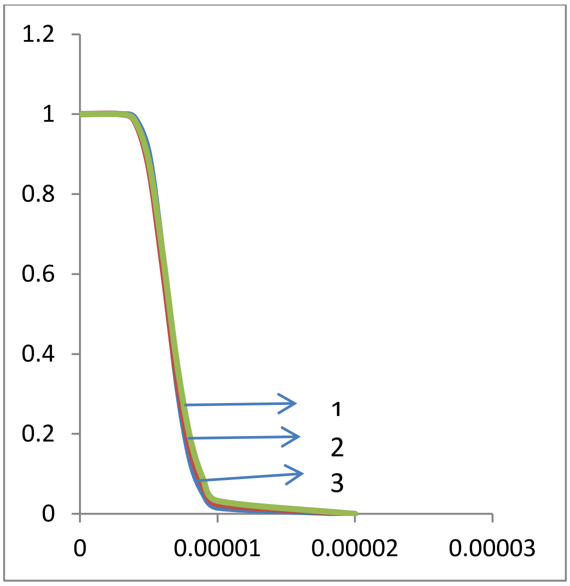

Figure 2: shows the comparison of OC curves of 1) i=1, n=386, k_1=4.375, k_2 = 4.348;2) i=2, n=373, k_1=4.367, k_2=4.359; 3) i=3, n=362, k_1=4.362, k_2=4.354;

Construction of table

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

Where

$$P_a(p)=\frac{P_r\{v\geq k_{1\sigma}/p\}\left[1-P_r\{k_{2\sigma}<v<k_{1\sigma}/p\}\right]^i+P_r\{k_{2\sigma}<v<k_{1\sigma}/p\}\left[P_r\{v\geq k_{1\sigma}/p\right]^i}{\left[1-P_r\{k_{2\sigma}<v<k_{1\sigma}/p\}\right]^i} \quad (15)$$

the first term in the right hand side represents the probability of accepting a lot based on a RGS and the second term is the probability of accepting a lot based on the states of the preceding lots. The probability of acceptance of the lot can be written as

$$P_a(p) = \frac{\phi(w_1)[1-\phi(w_2)+\phi(w_1)]^i+[\phi(w_2)-\phi(w_1)][\phi(w_1)]^i}{[1-\phi(w_2)+\phi(w_1)]^i} \quad (16)$$

Where $w_1 = \sqrt{n_\sigma}\,(U - k_{1\sigma\text{-}\mu})/\sigma = (v - k_1)\sqrt{n_\sigma}$

$w_2 = \sqrt{n_\sigma}\,(U - k_{2\sigma\text{-}\mu})/\sigma = (v - k_2)\sqrt{n_\sigma}$

and $v = (U - \mu)/\sigma$

If SSAQL, SSLQL, the producer's risk (α) and the consumer's risk (β) are prescribed then we have

$$P_a(p_1)=\frac{\phi(w_{11})[1-\phi(w_{21})+\phi(w_{11})]^i+[\phi(w_{21})-\phi(w_{11})][\phi(w_{11})]^i}{[1-\phi(w_{21})+\phi(w_{12})]^i}=1-\alpha \quad (17)$$

$$P_a(p_2) = \frac{\phi(w_{12})[1-\phi(w_{22})+\phi(w_{12})]^i+[\phi(w_{22})-\phi(w_{12})][\phi(w_{12})]^i}{[1-\phi(w_{22})+\phi(w_{12})]^i} = \beta \quad (18)$$

For given SSAQL and SSLQL, 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 equations (9) and (10). Optimization problem to determine the parameters is formulated as follows:

Values of the parameters (n_σ, $k_{1\sigma}$, and $k_{2\sigma}$) when i=1 and when sigma is known and unknown are tabulated in Table 1. Also i=2 and i=3, the value of the parameters are tabulated in Table 2 and Table 3

CONCLUSION

Acceptance sampling is the technique which deals with procedures in which decision to accept or reject lots or process based on the examination of samples. The percent work mainly relates to the construction and selection of tables for Six Sigma Repetitive Deferred Variables Sampling (SSRDVS – n_σ, k_1, k_2, i) plan through the SSAQL and SSLQL. Tables are provided here which tailor – made, handy and ready-made use to the industrial shop-floor condition.

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Table 1: Variables RDS sapling plans for i=1 indexed by SSAQL and SSLQL

p_1	p_2	n_σ	$k_{1\sigma}$	$k_{2\sigma}$	σ - Level	n_s	k_{1s}	k_{2s}	σ - Level
0.00001	0.00002	386	4.375	4.348	3.8	4057	4.375	4.348	4.6
	0.00003	303	4.275	4.248	3.7	3054	4.275	4.248	4.5
	0.00004	230	4.300	4.273	3.6	2343	4.300	4.273	4.4
	0.00005	203	4.200	4.173	3.5	1982	4.201	4.174	4.4
	0.00006	178	4.175	4.148	3.5	1719	4.176	4.149	4.3
	0.00007	164	4.174	4.147	3.5	1583	4.175	4.148	4.3
	0.00008	121	4.173	4.146	3.3	1168	4.174	4.147	4.2
	0.00009	105	4.165	4.138	3.3	1010	4.166	4.139	4.1
	0.0001	85	4.162	4.135	3.2	816	4.163	4.136	4.1
0.00002	0.00003	408	4.270	4.223	3.8	4090	4.270	4.223	4.6
	0.00004	310	4.295	4.248	3.7	3137	4.295	4.248	4.5
	0.00005	274	4.195	4.148	3.7	2654	4.195	4.148	4.5
	0.00006	240	4.170	4.123	3.6	2302	4.170	4.123	4.4
	0.00007	221	4.169	4.122	3.6	2120	4.169	4.122	4.4
	0.00008	163	4.168	4.121	3.5	1563	4.169	4.122	4.3
	0.00009	141	4.160	4.113	3.4	1352	4.161	4.114	4.2
	0.0001	115	4.157	4.110	3.3	1093	4.158	4.111	4.2
0.00003	0.00004	403	4.293	4.223	3.8	4055	4.293	4.223	4.6
	0.00005	356	4.193	4.123	3.8	3429	4.193	4.123	4.5
	0.00006	312	4.168	4.098	3.7	2975	4.168	4.098	4.5
	0.00007	287	4.167	4.097	3.7	2739	4.167	4.097	4.5
	0.00008	212	4.166	4.096	3.6	2020	4.166	4.097	4.4
	0.00009	184	4.158	4.088	3.5	1747	4.158	4.089	4.3
	0.0001	115	4.155	4.085	3.3	1092	4.155	4.086	4.2
0.00004	0.00005	462	4.190	4.098	3.9	4432	4.190	4.098	4.6
	0.00006	405	4.165	4.073	3.8	3844	4.165	4.073	4.6
	0.00007	373	4.164	4.072	3.8	3540	4.164	4.072	4.5
	0.00008	276	4.163	4.071	3.7	2611	4.163	4.071	4.5
	0.00009	239	4.155	4.063	3.6	2258	4.155	4.063	4.4
	0.0001	118	4.152	4.060	3.3	1113	4.153	4.061	4.2

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 10, October - 2017

Table 1 (continued …)

p_1	p_2	n_σ	$k_{1\sigma}$	$k_{2\sigma}$	σ - Level	n_s	k_{1s}	k_{2s}	σ - Level
0.00005	0.00006	417	4.156	4.150	3.8	4010	4.156	4.150	4.6
	0.00007	384	4.155	4.149	3.8	3693	4.155	4.149	4.6
	0.00008	283	4.154	4.148	3.7	2724	4.154	4.148	4.5
	0.00009	246	4.146	4.140	3.6	2355	4.146	4.140	4.4
	0.0001	121	4.143	4.137	3.3	1161	4.144	4.138	4.2
0.00006	0.00007	386	4.153	4.145	3.8	3711	4.153	4.145	4.6
	0.00008	285	4.152	4.144	3.7	2737	4.152	4.144	4.5
	0.00009	247	4.144	4.136	3.6	2366	4.144	4.136	4.4
	0.0001	122	4.141	4.133	3.3	1166	4.142	4.134	4.2
0.00007	0.00008	288	4.148	4.140	3.7	2756	4.148	4.140	4.5
	0.00009	250	4.147	4.139	3.6	2391	4.147	4.139	4.4
	0.0001	123	4.139	4.131	3.3	1176	4.140	4.132	4.2
0.00008	0.00009	269	4.145	4.136	3.7	2579	4.145	4.136	4.4
	0.0001	133	4.137	4.128	3.4	1268	4.138	4.129	4.2
0.00009	0.0001	134	4.134	4.125	3.4	1273	4.135	4.126	4.2

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 10, October - 2017

Table 2: Variables RDS sapling plans for i=2 indexed by SSAQL and SSLQL

p_1	p_2	n_σ	$k_{1\sigma}$	$k_{2\sigma}$	σ - Level	n_s	k_{1s}	k_{2s}	σ - Level
0.00001	0.00002	373	4.367	4.359	3.8	3923	4.367	4.359	4.6
	0.00003	291	4.267	4.259	3.7	2935	4.267	4.259	4.5
	0.00004	219	4.292	4.284	3.6	2232	4.292	4.284	4.4
	0.00005	193	4.192	4.184	3.5	1886	4.193	4.185	4.3
	0.00006	169	4.167	4.159	3.5	1633	4.168	4.160	4.3
	0.00007	157	4.166	4.158	3.4	1517	4.167	4.159	4.3
	0.00008	113	4.165	4.157	3.3	1091	4.166	4.158	4.2
	0.00009	96	4.157	4.149	3.2	924	4.158	4.150	4.1
	0.0001	77	4.154	4.146	3.1	740	4.155	4.147	4.0
0.00002	0.00003	395	4.262	4.254	3.8	3979	4.262	4.254	4.6
	0.00004	297	4.287	4.279	3.7	3020	4.287	4.279	4.5
	0.00005	261	4.187	4.179	3.6	2540	4.187	4.179	4.4
	0.00006	227	4.162	4.154	3.6	2188	4.162	4.154	4.4
	0.00007	208	4.161	4.153	3.6	2005	4.162	4.154	4.4
	0.00008	150	4.16	4.152	3.4	1446	4.161	4.153	4.3
	0.00009	128	4.152	4.144	3.3	1234	4.153	4.145	4.2
	0.0001	102	4.149	4.141	3.2	974	4.150	4.142	4.1
0.00003	0.00004	390	4.2845	4.2765	3.8	3962	4.285	4.277	4.6
	0.00005	343	4.1845	4.1765	3.8	3336	4.185	4.177	4.5
	0.00006	299	4.1595	4.1515	3.7	2879	4.160	4.152	4.5
	0.00007	274	4.1585	4.1505	3.7	2641	4.159	4.151	4.5
	0.00008	199	4.1575	4.1495	3.5	1915	4.158	4.150	4.4
	0.00009	171	4.1495	4.1415	3.5	1640	4.150	4.142	4.3
	0.0001	102	4.1465	4.1385	3.2	978	4.148	4.140	4.1
0.00004	0.00005	449	4.182	4.174	3.9	4371	4.182	4.174	4.6
	0.00006	392	4.157	4.149	3.8	3776	4.157	4.149	4.6
	0.00007	360	4.156	4.148	3.8	3468	4.156	4.148	4.5
	0.00008	263	4.155	4.147	3.6	2525	4.155	4.147	4.4
	0.00009	226	4.147	4.139	3.6	2167	4.147	4.139	4.4
	0.0001	105	4.144	4.136	3.3	1005	4.145	4.137	4.1

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Table 2 (continued …)

p_1	p_2	n_σ	$k_{1\sigma}$	$k_{2\sigma}$	σ - Level	n_s	k_{1s}	k_{2s}	σ - Level
0.00005	0.00006	404	4.148	4.14	3.8	3870	4.148	4.140	4.6
0.00005	0.00007	371	4.147	4.139	3.8	3554	4.147	4.139	4.5
0.00005	0.00008	270	4.146	4.138	3.7	2589	4.146	4.138	4.4
0.00005	0.00009	233	4.138	4.13	3.6	2222	4.138	4.130	4.4
0.00005	0.0001	108	4.135	4.127	3.3	1032	4.136	4.128	4.2
0.00006	0.00007	373	4.145	4.137	3.8	3573	4.145	4.137	4.5
0.00006	0.00008	272	4.144	4.136	3.7	2603	4.144	4.136	4.4
0.00006	0.00009	234	4.136	4.128	3.6	2234	4.136	4.128	4.4
0.00006	0.0001	109	4.133	4.125	3.3	1038	4.134	4.126	4.2
0.00007	0.00008	275	4.14	4.132	3.7	2623	4.140	4.132	4.5
0.00007	0.00009	237	4.139	4.131	3.6	2258	4.139	4.131	4.4
0.00007	0.0001	110	4.131	4.123	3.3	1048	4.132	4.124	4.2
0.00008	0.00009	256	4.137	4.129	3.6	2447	4.137	4.129	4.4
0.00008	0.0001	120	4.129	4.121	3.3	1141	4.130	4.122	4.2
0.00009	0.0001	121	4.126	4.118	3.3	1146	4.127	4.119	4.2

International Journal of Engineering Research & Technology (IJERT)
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Table 3: Variables RDS sampling plans for i=3 indexed by SSAQL and SSLQL

p_1	p_2	n_σ	$k_{1\sigma}$	$k_{2\sigma}$	σ - Level	n_s	k_{1s}	k_{2s}	σ - Level
0.00001	0.00002	362	4.362	4.354	3.8	3797	4.362	4.354	4.5
	0.00003	276	4.262	4.254	3.7	2776	4.262	4.254	4.5
	0.00004	207	4.287	4.279	3.5	2103	4.288	4.280	4.4
	0.00005	181	4.187	4.179	3.5	1762	4.188	4.180	4.3
	0.00006	158	4.162	4.154	3.4	1521	4.163	4.155	4.3
	0.00007	148	4.161	4.153	3.4	1424	4.162	4.154	4.3
	0.00008	105	4.16	4.152	3.3	1009	4.161	4.153	4.1
	0.00009	87	4.152	4.144	3.2	833	4.153	4.145	4.1
	0.0001	68	4.149	4.141	3.0	650	4.151	4.143	4.0
0.00002	0.00003	287	4.19	4.183	3.7	2802	4.190	4.183	4.5
	0.00004	299	4.215	4.207	3.7	2949	4.215	4.207	4.5
	0.00005	164	4.115	4.107	3.5	1546	4.116	4.108	4.3
	0.00006	231	4.09	4.082	3.6	2158	4.090	4.082	4.4
	0.00007	213	4.089	4.081	3.6	1990	4.090	4.082	4.4
	0.00008	153	4.088	4.08	3.4	1429	4.089	4.081	4.3
	0.00009	132	4.08	4.072	3.4	1233	4.081	4.073	4.2
	0.0001	104	4.077	4.069	3.3	962	4.078	4.070	4.1
0.00003	0.00004	392	4.2125	4.2045	3.8	3862	4.213	4.205	4.6
	0.00005	344	4.1125	4.1045	3.8	3244	4.113	4.105	4.5
	0.00006	301	4.0875	4.0795	3.7	2809	4.088	4.080	4.5
	0.00007	275	4.0865	4.0785	3.7	2569	4.087	4.079	4.4
	0.00008	201	4.0855	4.0775	3.5	1875	4.086	4.078	4.4
	0.00009	173	4.0775	4.0695	3.5	1608	4.078	4.070	4.3
	0.0001	106	4.0745	4.0665	3.3	985	4.076	4.068	4.1
0.00004	0.00005	436	4.11	4.102	3.8	4114	4.110	4.102	4.6
	0.00006	393	4.085	4.077	3.8	3669	4.085	4.077	4.6
	0.00007	362	4.084	4.076	3.8	3379	4.084	4.076	4.5
	0.00008	266	4.083	4.075	3.7	2475	4.083	4.075	4.4
	0.00009	230	4.075	4.067	3.6	2137	4.075	4.067	4.4
	0.0001	110	4.072	4.064	3.3	1020	4.073	4.065	4.2

Table 3 (continued …)

p_1	p_2	n_σ	$k_{1\sigma}$	$k_{2\sigma}$	σ - Level	n_s	k_{1s}	k_{2s}	σ - Level
0.00005	0.00006	404	4.076	4.068	3.8	3751	4.076	4.068	4.6
	0.00007	373	4.075	4.067	3.8	3463	4.075	4.067	4.5
	0.00008	274	4.074	4.066	3.7	2546	4.074	4.066	4.4
	0.00009	238	4.066	4.058	3.6	2200	4.066	4.058	4.4
	0.0001	113	4.063	4.055	3.3	1047	4.064	4.056	4.2
0.00006	0.00007	374	4.073	4.065	3.8	3472	4.073	4.065	4.5
	0.00008	274	4.072	4.064	3.7	2541	4.072	4.064	4.4
	0.00009	235	4.064	4.056	3.6	2174	4.064	4.056	4.4
	0.0001	112	4.061	4.053	3.3	1034	4.062	4.054	4.2
0.00007	0.00008	277	4.068	4.06	3.7	2560	4.068	4.060	4.5
	0.00009	238	4.067	4.059	3.6	2198	4.067	4.059	4.4
	0.0001	112	4.059	4.051	3.3	1034	4.060	4.052	4.2
0.00008	0.00009	259	4.065	4.057	3.7	2399	4.065	4.057	4.4
	0.0001	123	4.057	4.049	3.3	1133	4.058	4.050	4.2
0.00009	0.0001	126	4.054	4.046	3.3	1156	4.055	4.047	4.2