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SELECTION PROCEDURE FOR QUICK SWITCHING SYSTEM WITH REPETITIVE DEFERRED SAMPLING PLAN THROUGH RELATIVE SLOPES

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Abstract:

Dodge has proposed a new sampling system, which consists of pairs of normal and tightened plans. Due to instantaneous switching between normal and tightened plan this system is referred as "Quick Switching system". Romboski has studied QSS-1 (n, c_N, c_T) and (n, kn, c_0) with single sampling plan as reference plans. This paper present selection of Quick switching system with Repetitive Deferred sampling plan as reference plan through relative slopes at various points on the OC- curve, which describes the degree of steepness about the OC – curve.

Keywords: Acceptable Quality Level, Limiting Quality Level, Quick Switching System, Repetitive Deferred Sampling Plan, Relative slopes.

Introduction:

A new sampling system which consists of pairs of normal and tightened a plan was proposed by Dodge. Any system of sampling inspection involving only normal and tightened inspection is usually refereed as two –plan system. This system considers tightened Inspection plan for the poor quality levels and normal plans involving smaller sample size for the good quality level. Due to instantaneous switching between normal and tightened plan this system is referred as "Quick Switching System".

Romboski has introduced the concept of QSS-1 (n, c_N, c_T) is a system which considers single sampling plan (n, c_N,) and (n, c_T) which are the normal tightened plans with c_N and c_T as their respective acceptance numbers.

Rambert vaerst (1980) has developed deferred state sampling plan in which disposal of a lot in deferred state is dependent on the sampling results of the preceding or succeeding lots under single sampling inspection system. The concept of Repetitive Deferred Sampling Plan was proposed by

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Sankar and Mahopatra (1991) and this plan is essentially an extension of the deferred sampling plan. Lilly Christina (1995) has designed Repetitive Deferred Sampling Plan indexed with quality levels.

Designing QSS-1 (n, kn, a_1,a_2) under the conditions:

1. Production is steady so that results on current and preceding lots are broadly indicative of a continuing process.
2. Lots are submitted substantially in the order of their production.
3. The inspection involves costly or destructive normally tests such that normally only a small number of tests per lot can be justified.

Construction and selection of QSS (n, kn, c_0) with Repetitive Deferred Sampling plan as reference plan where the normal and tightened plans have the sane acceptance number but on tightened inspection the sample size is a multiple of k of the normal inspection. If k>1, the system degenerates into single sampling plan.

Operating Procedure of QSS (n, kn, $a_{1,}$ a_2):

1. Step 1: From a lot, take a random sample of size 'n' at the normal level. Count the number of defectives 'd'.
2. If $d \leq a_1$ accept the lot and repeat step-1.
3. If $d \geq a_1$ reject the lot, and go to step-2.

   Step 2: From the next lot, take a random sample of size 'kn' at the tightened level. Count the number of defectives "D".

1. If $D \leq a_2$ accept the lot and go to step-1.
2. If $D \geq a_2$ reject the lot and repeat step-2.

Properties of OC- curve:

For a Quick Switching System (n, kn, $a_{1,}$ a_2) for k>0, the slope of the composite OC curve increases as k increases.

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The Operating Characteristic Function:

The operating characteristic function for QSS with RDS plan as (n, kn, a_1, a_2)

$$Pa(p) = \frac{P(d \le c_T \;\; ; n)}{1 - P(d \le c_N ; n) + P(d \le c_T \;\; ; n)}$$

Romboski (1969) has presented tables for the selected QSS-1 (n, kn, a_1, a_2) system for given p_1 , p_2 , α and β. Devaraj Arumainayagam (1991) has studied the QSS and its applications. Lilly Christina (1995) has studied the RDS plan indexed with specified quality levels. Suresh (1993) has studied the QSS-1 with SSP using Acceptable and Limiting Quality Levels through incentive and filter effects.

Incoming Qualities and Relative Slopes:

In this paper two incoming quality levels, namely Acceptable Quality Level (AQL) Limiting Quality Levels (LQL) are considered along with their corresponding relative slopes on the OC-curve for selection of QSS-1 plans. AQL denoted by p_1 is the maximum percentage or proportion of variant units in a lot or bath that, for the purpose of acceptance sampling which can be considered as a satisfactory process average.

The chief features of an OC- curve are its location and the relative slopes (denoted by 'h') at that location, which describes the degree steepness of the OC-curve. Hamaker (1950) has made elaborate studies about the slopes h_0, which along with p_0, may be used to design any sampling plan. In a similar manner various other sets of parameters, such as (p_1, h_1) (p_2, h_2) and (p_*, h_*) can also be considered for selection of such plans.

Vedaldi (1980) has studied two principal effects of sampling inspection, which are filter and incentive effect and has proposed a new criterion based on the AQL and LQL points on the OC-curve. Suresh (1993) has presented and constructed tables for the selection of QSS with single sampling plan as reference plan indexed through (p_1, h_1) and (p_2, h_2) involving incentive and filter effects.

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Designing Plans when p_1, h_1 Specified:

Designing plans for given values of p_1 and h_1 use the table-1 for finding the parameters of QSSRDS-1 (n, kn, c_0) plan. For given h_1, scan the column headed $h_1$using table-1 which is equal to or just greater than the desired value which locates the corresponding values for kn, c_0 and np_1.

For example, for given p_1=0.03 and h_1=1.50 from table -1 the value closest to 1.514. This h_1 value corresponding to a_1, a_2 and k values of 4, 8, 2.5 respectively. Corresponding to a_1 =4 a_2=8 and k=2.5 form table -1 one find the values of np_1 as 4.005.

The normal inspection sample size is obtained as n= np_1/p_1 =4.005/0.03 = 133.5

The tightened inspection sample size is determined as kn= 2.5 X 133.5 =333.75=334.

Designing Plans when p_2 and h_2 specified:

Designing plans for given values of p_2 and h_2 use the table -1 for finding the parameters of QSSRDS-1 (n, kn, c_0) plan. For given h_2 scan the column headed h_2 using table-1 which is equal to or just greater than the desired values which locates the corresponding values for n, kn, c_0 and np_2.

For example for given p_2=0.05, h_2=4.5 form table-1 under column headed specified h_2 which is 4.488 and corresponding to a_1, a_2 and k values of 3, 4, 2.25 respectively. Corresponding to a_1 =3, a_2=4 and k=2.25 form table -1 one find the values of np_2as 5.767.

The normal inspection sample size is obtained as n= np_2/p_2 =5.767/0.05=115.34

The tightened inspection sample size is determined as kn= 2.25X115=258.75 = 259.

Designing Plans through The Ratio of Relative Slopes:

Design plans for specified AQL (or LQL) with the ratio of relative slopes h_2/h_1. By using table -1 under the column headed h_2/h_1, one can locate the values which is equal to or just greater than the desired ratio, corresponding to this located values one can find (n, kn, c_0) and np_1 values.

For example given p_1=0.07 and h_1=1.25 and h_2= 3.5. One can obtain the ratio h_2/h_1 = 3.5/1.25=4.375. By using table-1 under the column headed h_2/h_1 one can locate the values which is equal to or just greater than the desired ratio. Which is 4.382. Corresponding to this locate values 2, 4, 2 and np_1 values 2.186.

The normal inspection sample size is obtained as n= np_2/p_2 =2.168/0.07=31.22

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The tightened inspection sample size is determined as kn=2X31.22 = 62.

Construction of Tables:

The Operating characteristic function for Quick Switching System with Repetitive Deferred Sampling Plan as

$$Pa(p) = \frac{P(d \le c_T \ ; n)}{1 - P(d \le c_N; n) + P(d \le c_T \ ; n)} \qquad (1)$$

$$P_N = \frac{P_a(1-P_c)^i + P_c P_a^i}{(1-P_c)}; P_T \frac{P_a(1-P_c)^i + P_c P_a^i}{(1-P_c)}$$

Here P_a =P [$d \le u_1$], P_a= P[$d \le v_1$], P_c= P [$u_1<d<u_2$], P_c =P [$v_1<d<v_2$] which is the OC function for QSS-1 with Repetitive Deferred Sampling Plan having parameter n, kn, c_0, under the conditions for application of Poisson model for OC curve. For given values of c_0 (a_1, a_2) and Pa(p) equation (1) can be solved for the values of np using method of iterations. The entries in the columns np_1, np_2 under table-1 are such np values with $P_a(p)$ =0.95 and 0.10 respectively.

The value of the column np_1 are such values of np which are obtained through equating First derivative of Pa(p). The entries under the column h_1, h_2 are calculated through the expression.

The entries under column (11) are the values of the ratio between h_2 and h_1.

$$h = -\frac{p}{P_a(p)} \frac{dP_a(p)}{dp} \text{ for } p = p_1, p_2.$$

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Annexure-1

Table-1: Certain parametric values for Quick Switching System with Repetitive Deferred Sampling Plan (QSSRDS-1 (n, kn, c_0)):

c_0		k	np_1	np_2	p_0	h_1	h_2	h_0	h_2/h_1
a_1	a_2								
0	1	1.25	0.283	3.785	1.253	0.051	3.454	0.636	67.725
0	2	1.25	0.564	3.786	1.448	0.064	3.455	0.603	53.984
0	3	1.25	0.86	3.786	1.693	0.076	3.456	0.552	45.474
0	4	1.25	1.162	3.789	1.963	0.085	3.462	0.493	40.729
1	2	1.5	0.705	3.892	1.846	0.165	3.143	1.559	19.043
1	3	1.5	1.05	3.9	2.079	0.232	3.207	2.083	13.823
1	4	1.5	1.389	3.921	2.348	0.298	3.388	2.688	11.369
1	5	1.5	1.721	3.974	2.635	0.36	3.827	3.335	10.631
2	3	2	1.765	5.508	3.368	0.633	3.894	2.245	6.151
2	4	2	2.186	5.537	3.625	0.901	3.949	2.771	4.382
2	5	2	2.586	5.595	3.912	1.192	4.066	3.453	3.411
2	6	2	2.971	5.694	4.215	1.506	4.287	4.284	2.846
3	4	2.25	2.274	5.767	3.874	0.709	4.488	2.965	6.33
3	5	2.25	2.7	5.839	4.158	0.951	4.678	3.685	4.919
3	6	2.25	3.107	5.955	4.462	1.217	5.01	4.55	4.116
3	7	2.25	3.498	6.116	4.778	1.501	5.523	5.54	3.679
4	5	2.5	2.769	6.083	4.36	0.781	5.269	3.698	6.746
4	6	2.5	3.198	6.205	4.666	1.005	5.675	4.566	5.646
4	7	2.5	3.609	6.371	4.986	1.252	6.281	5.551	5.016
4	8	2.53	4.005	6.577	5.313	1.514	7.094	6.624	4.685
5	6	3	3.488	7.384	5.368	0.766	5.636	3.813	7.357
5	7	3	3.944	7.48	5.668	0.966	5.96	4.611	6.169
5	8	3	4.379	7.619	5.985	1.184	6.459	5.526	5.455
5	9	3.	4.798	7.798	6.312	1.419	7.152	6.534	5.04

6	7	3.25	4.003	7.716	5.849	0.838	6.483	4.498	7.736
6	8	3.25	4.456	7.857	6.169	1.026	7.025	5.04	6.847
6	9	3.25	4.892	8.038	6.5	1.234	7.763	6.392	6.29
6	10	3.25	5.312	8.254	6.837	1.456	8.691	7.448	5.969
7	8	3.5	4.503	8.075	6.317	0.913	7.419	5.174	8.126
7	9	3.5	4.954	8.256	6.654	1.093	8.173	6.147	7.477
7	10	3.5	5.389	8.472	6.998	1.289	9.113	7.185	7.069
7	11	3.5	5.811	8.717	7.345	1.502	10.21	8.266	6.798
8	9	3.75	4.99	8.449	6.775	0.991	8.396	5.839	8.472
8	10	3.75	5.438	8.666	7.126	1.162	9.334	6.851	8.032
8	11	3.75	5.873	8.911	7.481	1.35	10.42	7.912	7.721
8	12	3.75	6.295	9.179	7.836	1.55	11.63	8.996	7.504
9	10	4	5.796	9.679	7.802	0.975	8.601	5.888	8.821
9	11	4	6.261	9.874	8.15	1.136	9.446	6.861	8.315
9	12	4	6.711	10.101	8.502	1.311	10.46	7.882	7.974
9	13	4	7.148	10.353	8.858	1.499	11.6	8.942	7.736