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Selection Procedure for Quick Switching System With Single Sampling Plans through Relative Slopes (QSS-2 (n, c_N, c_T))

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Abstract

Quick Switching System with Single Sampling Plans is designed to reduce the inspection costs. This paper presents designing procedure of Quick Switching System with Single Sampling Plan as reference plan indexed through Relative slopes. Tables are constructed for various combinations of parameters involved in Quick Switching System with Single Sampling Plans.

Keywords: Acceptable Quality Level, Limiting Quality Level, Quick Switching System, Single sampling plan, Relative slopes.

Subject Classification: 62P30 / 62D05

INTRODUCTION:

A new sampling system, which consists of pairs of normal and tightened plans, was proposed by Dodge (1967). Any system of sampling inspection involving only normal and tightened inspection is usually referred as Two-Plan system. The system considers tightened inspection plans for the poor quality levels and normal plans involving smaller sample size for the good quality levels. Due to instantaneous switching between normal and tightened plan this system is referred as "Quick Switching System".

Romboski (1969) 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 & C_T and introduced another type denoted as QSS-1 (n, kn, C_0) which is QSS-1 with single sampling as reference plan. Under this system the single sampling plan with (n, C_0) and (kn, C_0), k>1 are considered as normal and tightened plan respectively.

Romboski (1969) has presented tables for the selected of QSS-1 (n, C_N, C_T) system for given p_1, p_2, α, and β. Devaraj Arumainayagam (1991) has studied the construction to the study of Quick Switching system (QSS) and its applications. Deepa (2002) has studied the QSSSTDS indexed with (p_1, h_1)and (p_2, h_2). Suresh (1993) has studied the QSS-1 with single sampling plan using acceptable and limiting quality levels through incentive and filter effects.

Conditions for Application:

1. The production is steady so that results on current and preceding lots are broadly indicative of a continuing process and submitted lots are accepted to be essentially of the same quality.
2. Lots are submitted substantially in the order of production.
3. Inspection is by attributes with quality defined as fraction nonconforming.

The Operating Procedure for QSS-2 (n, c_N, c_T) System:

Step1:- From the lot, take a random sample of size 'n' at the normal level, count the number of defectives 'd'.

1. If $d \leq c_N$ accept the lot and repeat step1.
2. If $d > c_N$ reject the lot and go to step2.

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

1. If $D \leq c_T$ accept the lot and continue inspection until two lots in succession are accepted. If so go to step-1 otherwise repeat step2.
2. If $D > c_T$ reject the lot and repeat step2.

Romboski (1969) has derived the OC function for QSS-2 (n, c_N, c_T) as

$$Pa(p) = \frac{P_N P_T^2 + P_T(1-P_N)(1+P_T)}{P_T^2 + (1-P_N)(1+P_T)}$$

Selection of QSS with SSP through Relative slopes (QSS-2 (n, c_N, c_T)):

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-2 plans. AQL denoted by $p_1$is the maximum percentage or proportion of variant units in a lot or batch 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 (1950a & b) has made elaborate studies about the slope 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 (1986) 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.

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 QSS-2 (n, c_N, c_T) 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 c_N, c_T and np_1. Example: For given p_1=0.02 and h_1=0.14, from Table 1 under column headed h_1, locate the equal to or just greater than specified h_1 which is 0.1485, corresponding to this h_1, the c_N, c_T and np_1values associated are 2, 1, 0.7323 respectively. From this one can obtain the sample size n=37. Thus the selected parameters for QSS-2 plan are n=37, c_N=2, c_T=1.

Designing Plans when (p_2, h_2) specified:

Designing plans for given values of p_2 and h_2 use the Table 1 for finding the parameters of QSS-2 (n, c_N, c_T) plan. For given h_2, scan the column headed h_2 using Table 1 which is equal to or just greater than the desired value which locates the corresponding values for c_N, c_T and np_1. Example: For given p_2=0.01 and h_2=4.0, from Table 1 under column headed h_2, locate the equal to or just greater than specified h_2 which is 4.1817, corresponding to this h_2, the c_N, c_T and np_1values associated are 4, 0, 2.6397 respectively. From this one can obtain the sample size n=26. Thus the selected parameters for QSS-2 plan are n=26, c_N=4, c_T=0.

Designing Plans through the ratio of relative slopes (n, c_N, c_T):

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 are equal to or just greater than the desired ratio, corresponding to this located value one can find n, c_N, c_T and np_1 values. Example: Given p_1= 0.02 h_1=0.14 and h_2=3.0 one can obtain the ratio h_2/ h_1 = 21.4286. 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 21.6405 Corresponding to this located value one can find n, c_N, c_T and np_1 values 2, 1, 0.7323 respectively. From this one can obtain the sample size n= 37. Thus the selected parameters for the plan are n=37, c_N=2, c_T =1.

Construction of Tables:

The expression for $P_a(p)$ of QSS-2 with single sampling plan with parameters for c_N, c_T and n has been derived by Romboski (1969)

$$Pa(p) = \frac{P_N P_T^2 + P_T(1-P_N)(1+P_T)}{P_T^2 + (1-P_N)(1+P_T)}$$

which is the OC function for QSS-2 with single sampling plan as reference plan having parameter c_N and c_T, under the conditions for application of poisson model for OC Curve. For given values of c_N, c_T and $P_a(p)$ 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 $P_a(p)$ to 0 for given values of c_N, c_T and $P_a(p)$. The entries under the column h_1, h_2 are calculated through the expression.

Table 1: Certain Parametric Values for QSS-2 with Single Sampling Plan

c_N	c_T	np_1	np_2	h_1	h_2	h_2/h_1
1	0	0.2275	2.3315	0.0743	2.4501	32.9751
2	1	0.7323	3.9122	0.1485	3.2129	21.6405
2	0	0.5468	2.3911	0.1800	2.7629	15.3526
3	2	1.2784	5.3422	0.1774	3.7865	21.3436
3	1	1.1093	3.9548	0.2089	3.4377	16.4533
3	0	0.8294	2.4925	0.2459	3.3250	13.5189
4	3	1.8808	6.6992	0.2030	4.2661	21.0156
4	2	1.7209	5.3776	0.2339	3.9751	16.9915
4	1	1.4745	4.0257	0.2719	3.8234	14.0637
4	0	1.1154	2.6397	0.3119	4.1817	13.4064
5	4	2.5226	8.0110	0.2262	4.6867	20.7215
5	3	2.3691	6.7304	0.2565	4.4341	17.2851
5	2	2.1410	5.4346	0.2941	4.2843	14.5685
5	1	1.8284	4.1323	0.3360	4.4268	13.1743
5	0	1.4024	2.8270	0.3778	5.3020	14.0349
6	5	3.1942	9.2913	0.2475	5.0658	20.4676
6	4	3.0454	8.0395	0.2773	4.8411	17.4564
6	3	2.8298	6.7794	0.3143	4.6999	14.9551
6	2	2.5420	5.5199	0.3563	4.7607	13.3617
6	1	2.1730	4.2776	0.4008	5.2790	13.1707
6	0	1.6895	3.0439	0.4435	6.6069	14.8980
7	5	3.7440	9.3179	0.2967	5.2106	17.5603

c_N	c_T	np_1	np_2	h_1	h_2	h_2/h_1
7	4	3.5378	8.0832	0.3330	5.0787	15.2496
7	3	3.2667	6.8517	0.3747	5.1011	13.6143
7	2	2.9275	5.6385	0.4198	5.4449	12.9715
7	1	2.5101	4.4591	0.4659	6.3662	13.6629
7	0	1.9764	3.2814	0.5091	8.0163	15.7475
8	7	4.6031	11.7866	0.2860	5.7372	20.0585
8	6	4.4610	10.5733	0.3150	5.5512	17.6238
8	4	4.0037	8.1468	0.3918	5.4301	13.8586
8	3	3.6845	6.9524	0.4368	5.6759	12.9940
8	2	3.3009	5.7919	0.4840	6.3534	13.1269
8	1	2.8411	4.6703	0.5312	7.6387	14.3791
8	0	2.2630	3.5326	0.5744	9.4697	16.4869
9	8	5.3330	13.0100	0.3037	6.0406	19.8918
9	7	5.1933	11.8105	0.3323	5.8688	17.6621
9	6	5.0005	10.6103	0.3674	5.7536	15.6586
9	5	4.7522	9.4151	0.4080	5.7441	14.0783
9	4	4.4479	8.2349	0.4527	5.9294	13.0990
9	3	4.0869	7.0848	0.5002	6.4516	12.8983
9	2	3.6645	5.9776	0.5487	7.4704	13.6139
9	1	3.1673	4.9040	0.5966	9.0358	15.1461
10	8	5.9388	13.0330	0.3488	6.1675	17.6842
10	7	5.7510	11.8453	0.3834	6.0594	15.8038
10	2	4.0201	6.1907	0.6137	8.7557	14.2666
10	1	3.4894	5.1542	0.6619	10.5024	15.8668
10	0	2.8351	4.0598	0.7046	12.3695	17.5555
11	8	6.5122	13.0660	0.3987	6.3486	15.9227
11	7	6.2792	11.8941	0.4382	6.3283	14.4414
11	6	5.9968	10.7346	0.4820	6.4461	13.3746
11	5	5.6657	9.5983	0.5290	6.7903	12.8368
11	4	5.2862	8.4981	0.5782	7.4759	12.9294
11	3	4.8561	7.4425	0.6286	8.5997	13.6808
11	2	4.3690	6.4255	0.6789	10.1601	14.9656
11	1	3.8080	5.4162	0.7272	11.9969	16.4975
11	0	3.1206	4.3310	0.7696	13.7820	17.9085
12	9	7.2828	14.2747	0.4134	6.6235	16.0206

c_N	c_T	np_1	np_2	h_1	h_2	h_2/h_1
12	5	6.0967	9.7306	0.5915	7.5696	12.7979
12	4	5.6860	8.6740	0.6422	8.5336	13.2891
12	3	5.2271	7.6608	0.6935	9.9161	14.2996
13	10	8.0617	15.4731	0.4276	6.8861	16.1030
13	7	7.2629	12.0472	0.5552	7.1956	12.9594
13	5	6.5142	9.8914	0.6548	8.5315	13.0287
13	4	6.0758	8.9764	0.7066	9.6169	13.6101
13	3	5.5908	7.8992	0.7585	11.3398	14.9507
13	2	5.0510	6.9406	0.8094	13.1483	16.2450
14	13	9.1528	18.9721	0.3810	7.3497	19.2915
14	10	8.6314	15.5142	0.4794	7.1134	14.8367
14	6	7.3428	11.0977	0.6669	8.5748	12.8579
14	4	6.4570	9.1013	0.7713	11.1108	14.4044
14	3	5.9485	8.1534	0.8238	12.8308	15.5758
14	2	5.3855	7.2135	0.8746	14.6663	16.7686
14	1	4.7477	6.2439	0.9227	16.4119	17.7871
14	0	3.9752	5.1595	0.9638	17.8239	18.4939
15	8	8.5451	13.3568	0.6280	7.9998	12.7388
15	6	7.7638	11.2721	0.7304	9.6249	13.1781
15	4	6.8311	9.3446	0.8364	12.5590	15.0149
15	3	6.3006	8.4197	0.8887	14.3557	16.1532

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