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A New Screening Procedure on Double Sampling Plan for Costly or Destructive items

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Abstract - Quality is a measure of excellence, a state of being free from Defects. Inspection provides a means for monitoring quality. Similarly, inspection can also be done on finished goods before deciding whether to make the shipment to the customer or not. However, performing 100% inspection is generally not economical or practical, therefore, sampling is used instead. Acceptance Sampling is therefore a method used to make a decision as to whether to accept or to reject lots based on inspection of sample(s). Sampling plans and operating characteristic (OC) curves are very useful for conducting acceptance sampling and provide the quality manager with tools to evaluate the quality of a production run or shipment. There are developed different sampling plans, but common used in practice are single and double acceptance sampling plans.

The goal of this paper is to test if applying of a new screening procedure in double sampling plan for costly or destructive items can lead to statistically significant different conclusion about quality level of observed lot. The concept of the double sampling plan and the procedure for implementing it and various features of the double sampling plan viz. the OC curve and also explained to design the double sampling plan for a costly or destructive items concerned with lower sample sizes for maximum acceptance chance with new implemented screening procedure plan.

Index Terms - Acceptance Sampling Plan, Double Sampling Plan, New Screening Procedure, Operating Characteristic Curve

1. INTRODUCTION

A sampling plan in which a decision about the acceptance or rejection of a lot is based on two samples that have been inspected is known as a double sampling plan.

The double sampling plan is used when a clear decision about acceptance or rejection of a lot cannot be taken on the basis of a single sample. In double sampling plan, generally, the decision of acceptance or rejection of a lot is taken on the basis of two samples. If the first sample is bad, the lot may be rejected on the first sample and a second sample need not be drawn. If the first sample is good, the lot may be accepted on the first sample and a second sample is not needed. But if the first sample is neither good nor bad and there is a doubt about its results, we take a second sample and the decision of acceptance or rejection of a lot is taken on the basis of the evidence obtained from both the first and the second samples.

A double sampling plan requires the specification of four quantities which are known as its parameters. These parameters are

n_1 – size of the first sample,
c_1 – acceptance number for the first sample,
n_2 – size of the second sample, and
c_2 – acceptance numbers for both samples combined.

2. IMPLEMENTATION OF DOUBLE SAMPLING PLAN

Suppose, lots of the same size, say N, are received from the supplier or the final assembly line and submitted for inspection one at a time. The procedure for implementing the double sampling plan to arrive at a decision about the lot is described in the following steps:

Step 1:Draw a random sample (first sample) of size n_1 from the lot received from the supplier or the final assembly.

Step 2: Inspect each and every unit of the sample and classify it as defective or non-defective. At the end of the inspection, count the number of defective units found in the sample. Suppose the number of defective units found in the first sample is d_1.

Step 3: Compare the number of defective units (d_1) found in the first sample with the stated acceptance numbers c_1 and c_2.

Step 4: Take the decision on the basis of the first sample as follows:

2.1 Under acceptance sampling plan

If the number of defective units (d_1) in the first sample is less than or equal to the stated acceptance number (c_1) for the first sample, i.e., if $d_1 \leq c_1$, we accept the lot and if $d_1 > c_2$, we reject the lot. But if $c_1 < d_1 \leq c_2$, the first (single) sample is failed.

2.2 Under rectifying sampling plan

If $d_1 \leq c_1$, we accept the lot and replace all defective units found in the sample by non-defective units. If $d_1 > c_2$, we accept the lot after inspecting the entire lot and replacing all defective units in the lot by non-defective units. But if $c_1 < d_1 \leq c_2$, the first (single) sample is failed.

Step 5**:** If $c_1 < d_1 \leq c_2$, we draw a second random sample of size n_2 from the lot.

Step 6: Inspect each and every unit of the second sample and count the number of defective units found in it. Suppose the number of defective units found in the second sample is d_2.

Step 7: Combine the number of defective units (d_1 and d_2) found in both samples and consider $d_1 + d_2$ for taking the decision about the lot on the basis of the second sample as follows:

2.3 Under acceptance sampling plan

If $d_1 + d_2 \leq c_2$, we accept the lot and if $d_1 + d_2 > c_2$, we reject the lot.

2.4Under rectifying sampling plan

If $d_1 + d_2 \leq c_2$, we accept the lot and replace all defective units found in the second sample by non-defective units. If $d_1 + d_2 > c_2$, we accept the lot after inspecting the entire lot and replacing all defective units in the lot by non-defective units.

3. A NEW SCREENING PROCEDURE

The purpose of this paper is to describe a method and to present a set of tables for constructing two and three stage drug screening procedures of the type discussed by Armitage and Schneiderman(1958) and Schneiderman(1961). These procedures allow rejection at any stage but acceptance at only final stage. Similar procedures have been advocated by Davies (1957) and Dunnett(1961), based on this operating characteristic curve and accept-reject rules for two and three stage screening procedures had been derived by Roseberry and Gehan (1964). Mixed sampling product control for costly or destructive items by Deva Arul and Rebecca (2011) for switching variable to attribute plan for accepting the lot.

Based on this screening procedure and switching rule of variable to attribute gives an idea for creating a new concept in double sampling plan. Generally we are going to second sample when the defective lies in between two acceptance number, but in this procedure we are allow to take second sample even it is not lie in the region but under the condition of past experience (i.e., last two rejection is nearer to third acceptance number).

3.1 Implementation of a new screening procedure in Double Sampling Plan

The procedure for implementing to arrive at a decision about the lot is described in the following steps:

Step 1: Draw a random sample (first sample) of size n_1 from the lot received from the supplier or the final assembly.

Step 2: Inspect each and every unit of the sample and classify it as defective or non-defective. At the end of the inspection, we count the number of defective units found in the sample. Suppose the number of defective units found in the first sample is d_1.

Step 3: Compare the number of defective units (d_1) found in the first sample with the stated acceptance numbers c_1 and c_2.

Step 4: Take the decision on the basis of the first sample as follows:

Step 5**:** If $d_1 > c_2$ but nearer value, can also draw a second random sample of size n_{22} from the lot. We inspect each and every unit of the third sample and count the number of defective units found in it. Suppose the number of defective units found in the third sample is d_{22}.

Step 6: Combine the number of defective units (d_1 and d_{22}) found in both samples and consider $d_1 + d_{22}$ for taking the decision about the lot on the basis of the third sample as follows:

Step 7: If $d_1 + d_{22} \leq c_2$, accept the lot otherwise reject the lot.

4. OPERATING CHARACTERISTIC (OC) CURVE

The operating characteristic (OC) curve displays the discriminatory power of the sampling plan. That is, it shows the probability that a lot submitted with a certain fraction defective will either be accepted or rejected. in a double sampling plan, the decision of acceptance or rejection of the lot is taken on the basis of two samples. The lot is accepted on the first sample if the number of defective units (d_1) in the first sample is less than the acceptance number c1. The lot is accepted on the second sample if the number of defective units ($d_1 + d_2$) in both samples is greater than c_1 and less than or equal to the acceptance number c_2. Therefore, if $Pa_1(p)$ and $Pa_2(p)$ denote the probabilities of accepting a lot on the first sample and the second sample, respectively, the probability of accepting a lot of quality level p is given by:

$$P_a(p) = P_{a1}(p) + P_{a2}(p) \text{----(1)}$$

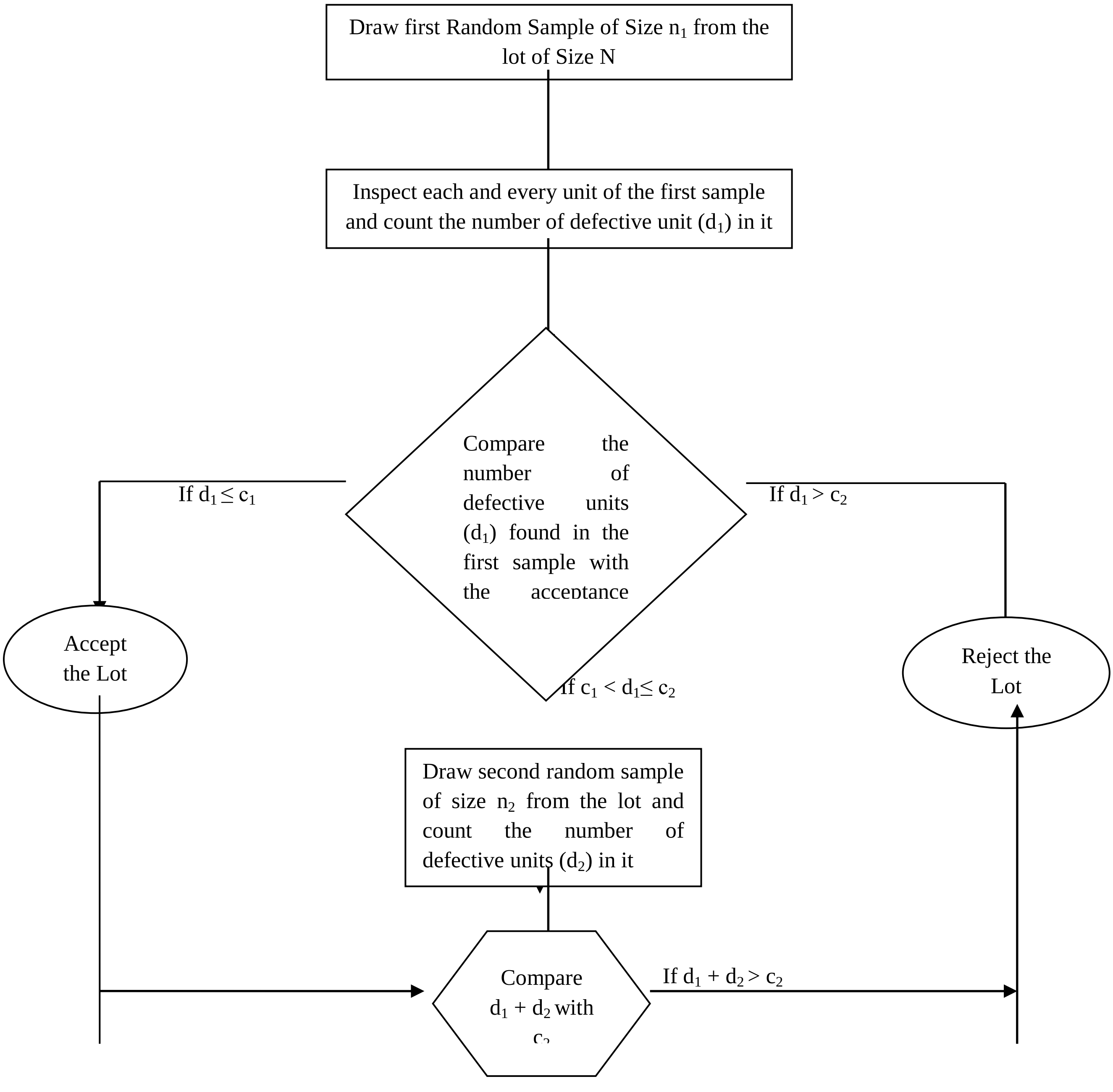
Then the new screening procedure OC function as,

$$P_a(p) = P_{a1}(p) + (P_{a21}(p) + P_{a22}(p)) \text{-----(2)}$$

5. CONCLUSION

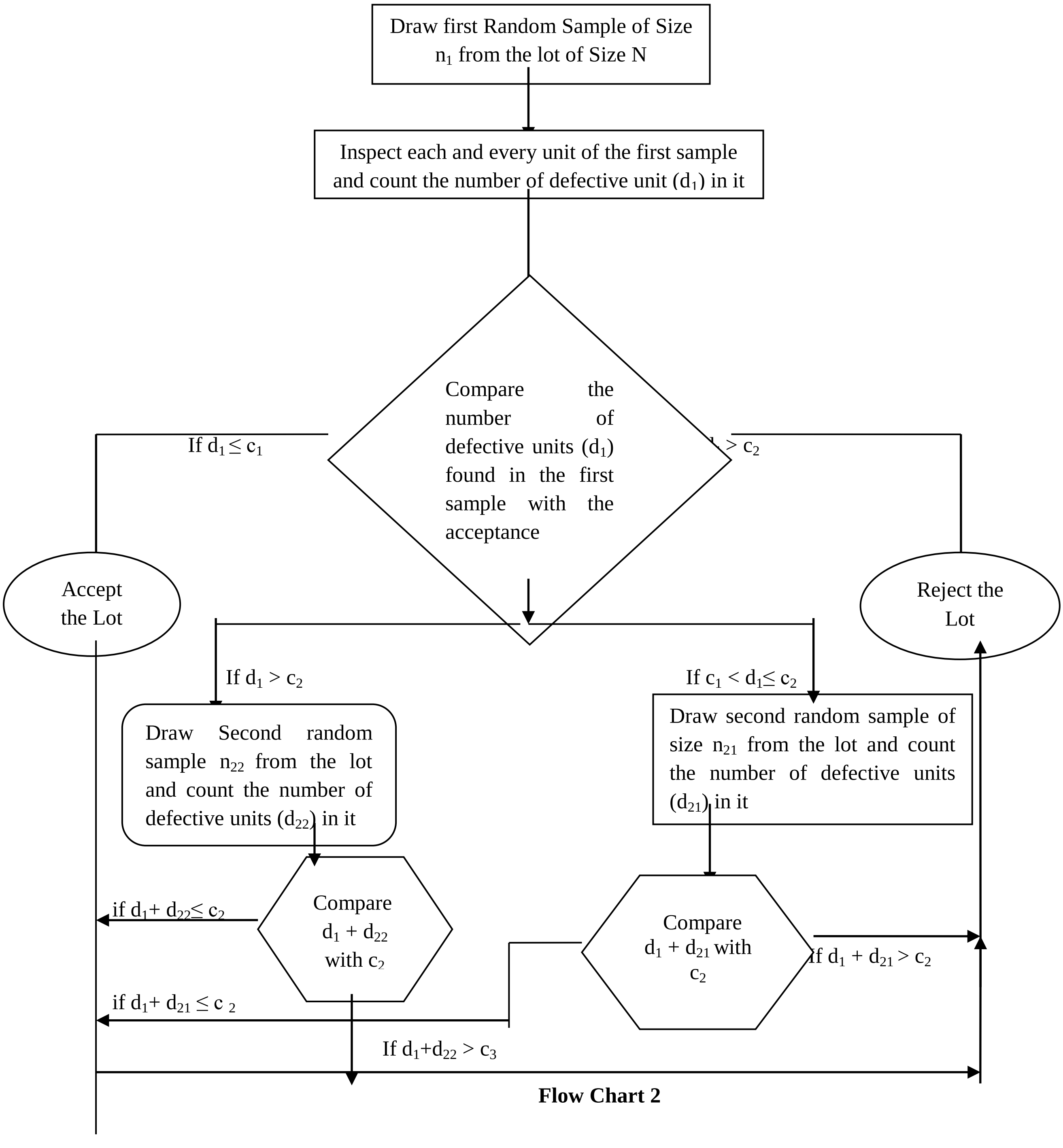
This paper presents the operating characteristic and associated performance measures with Double Sampling Plan and New Screening Procedure in Double Sampling Plan for costly or destructive items. From the OC curve it explained to design the double sampling plan for a costly or destructive items concerned with lower sample sizes for maximum acceptance chance with new implemented screening procedure plan. From the table value the producer and consumer risk also reduced. So this method is suggested for industries with costly or destructive items for minimum sample size with lower risk and maximum acceptance with good quality.

The steps described for Double sampling plan above are shown in following Figure1 for the acceptance sampling plan



Flow Chart – 1

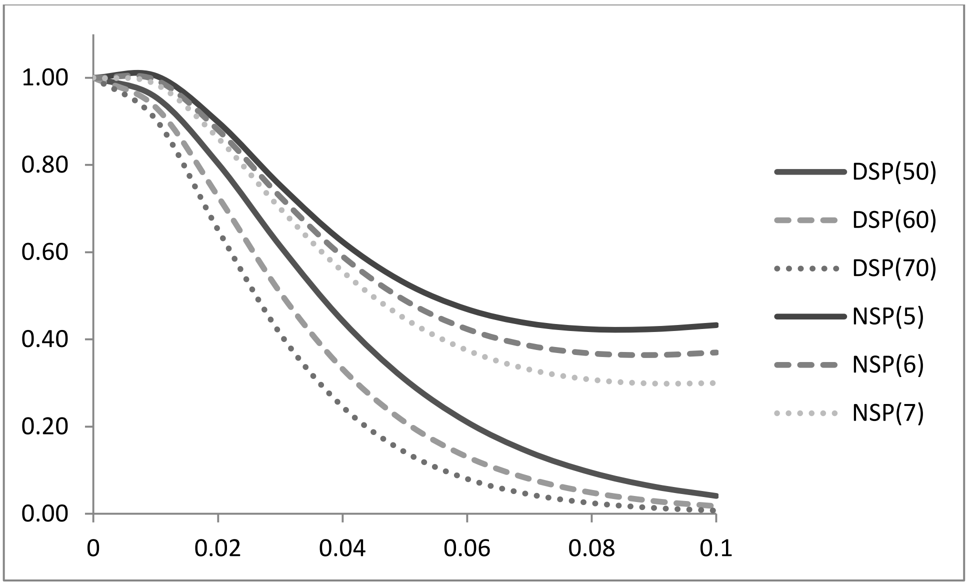
The steps described for New Screening Procedure are shown in following Flow Chart 2 for the Acceptance Sampling Plan.



Flow Chart 2

For various sample sizes the tables and OC curve as follows,

$c_1 = 1$, $c_{21} = 2$ & $c_{22} = 3$	DSP n=50	DSP n=60	DSP n=70	DSP_{NSP} n=5	DSP_{NSP} n=6	DSP_{NSP} n=7
0	1	1	1	1	1	1
0.01	0.9556	0.9323	0.9046	0.99987	0.99990	0.999998
0.02	0.8034	0.7279	0.6514	0.898586	0.91649	0.934054
0.03	0.6138	0.5071	0.4127	0.753109	0.77852	0.803183
0.04	0.4426	0.3321	0.2456	0.623849	0.65589	0.686648
0.05	0.3084	0.2103	0.1415	0.52942	0.56727	0.603193
0.06	0.2103	0.1305	0.08	0.469219	0.51210	0.552327
0.07	0.1415	0.08	0.0446	0.436313	0.48349	0.527219
0.08	0.0943	0.0485	0.0246	0.423166	0.47396	0.520424
0.09	0.0623	0.0292	0.0135	0.423525	0.47729	0.52577
0.1	0.041	0.0175	0.0073	0.432713	0.48882	0.538656



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