Operating Characteristic (O.C.) Curve

Semester IV

STAT CC410

Unit 3

- Operating Characteristic (O.C.) Curve
- Average Sample Number (ASN)
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Operating Characteristic (O.C.) Curve

Definition:- Operating Characteristic (O.C.) Curve of a sampling plan is a graphic representation of the relationship between the probability of acceptance $P_a(p)$ or generally denoted by $L(p)$, for variation in the incoming lot quality 'p' (fraction defective in the lot).

Average Sample Number (ASN) and Average Amount of Total Inspection (ATI)

Definition:- The average sample number (ASN) is the expected value of the sample size required for coming to a decision about the acceptance or rejection of the lot in an acceptance-rejection sampling plan. Thus, it is a function of the incoming lot quality 'p'.

On the other hand, the expected number of items inspected per lot to arrive at a decision in an acceptance-rejection sampling inspection plan calling for 100% inspection of the rejected lots is called average amount of total inspection (ATI). Thus, ATI is also a function of the lot quality 'p'.

Therefore,

ATI = ASN + (Average size of inspection of the remainder in the rejected lots)

……... (1)

Thus, if the lot is accepted on the basis of the sampling inspection plan then ATI = ASN, otherwise ATI > ASN. In other words, ASN gives the average number of units inspected per accepted lot.

Example:- If a single sampling acceptance-rejection plan is used, the number of items inspected from each lot will be the corresponding sample size n,

i.e., ASN = n ……... (2)

and this will be true independently of the quality of the submitted lots.

However, for an acceptance-rejection single sampling plan calling for 100% inspection of the rejected lots, additional (N - n) items will have to be inspected for each rejected lot, where N is the lot size. Thus, in this case, the number of items inspected per lot varies from lot to lot and is equal to n if the lot is accepted and equal to N if the lot is rejected on the basis of the sampling inspection plan. Hence the average amount of total inspection is a function of lot quality 'p' and is given by

$$ATI = n.L(p) + N[1 - L(p)] \quad \text{……... (3)}$$

where $L(p) = P_a(p)$ is the probability of acceptance of the lot of quality p on the basis of the sampling inspection.

Rewriting (3), we get,

$$\begin{aligned} ATI &= n.L(p) + (N - n + n)[1 - L(p)] \\ &= n.L(p) + (N - n)[1 - L(p)] + n[1 - L(p)] \\ &= n + (N - n)[1 - L(p)] \end{aligned}$$

Sampling Inspection Plans for Attributes

The commonly used sampling inspection plans for attributes and count of defects are:

1) Single Sampling Plan,
2) Double Sampling Plan, and
3) Multiple Sampling Plan.

The requirements (i) and (ii) in Acceptance Sampling Inspection Plans will be satisfied provided p_t, p and P_c are low. Using these principles, Harold F. Dodge and Harry G. Romig have developed a number of sampling plans which we shall discuss further. These plans enable us to judge the average quality of the product at a given stage of manufacturing process through the combination of production, sampling inspection and rectification of rejected lots. Dodge and Romig average quality protection plan are essentially based upon the A.O.Q.L.

Single Sampling Plan

Definition:- It is the decision about accepting or rejecting a lot is taken on the basis of one sample only, the acceptance plan is described as single sampling plan. It is completely specified by three numbers N, n and c, where:

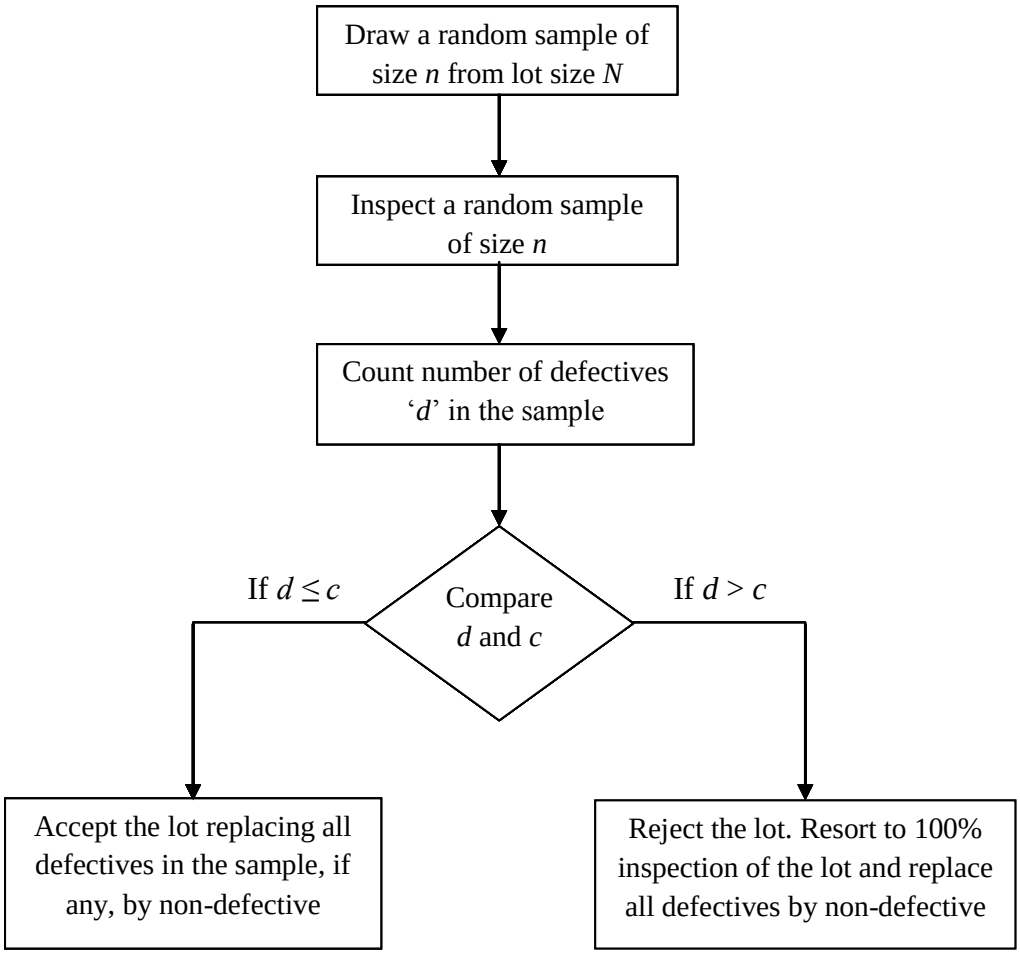
N is the lot size,
n is the sample size, and
c is the acceptance number, i.e., maximum allowable number of defectives in the sample.

The single sampling plan may be describe as follows:

(1) Select a random sample of size n from a lot of size N.
(2) Inspect all the articles included in the sample. Let d be the number of defectives in the sample.
(3) If $d \leq c$, accept the lot, replacing defective pieces found in the sample by non-defective (standard) ones.
(4) If $d > c$, reject the lot and in this case we inspect the entire lot and replace all the defective pieces by standard ones.

Thus, in this plan, the chance of cent-per-cent inspection increases as the percentage of defectives in the lot increases. Thus, the amount of inspection automatically increases as the lot quality deteriorates.

Flow-Chart of Single sampling Plan



Single sampling plan is very simple to understand, design and carry out. The basic problem in administering a single sampling plan is the choice of n (sample size) and c (acceptance number) which have to be determined in advance. The most economical single sampling inspection plan is obtained on minimizing the average total inspection by providing adequate protection to consumer and producer. Dodge and Romig have prepared extensive tables for minimizing values of n and c for consumer's risk $\beta = 0.10$ and for different values of p (the process average fraction defective).