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Determination of lot size in the construction of single sampling plan

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Abstract
Quality control is one of the major challenges in manufacturing industry today. It can be expensive and time consuming process. Determining lot size in any a sampling plan is Statistical method can be a constructive toll that can save a lot of time and money. This study aims to construct determination of lot size of single sampling plan using statistical quality control method and inspect some samples from lot, using ATI method with Poisson distribution and discuss about this process to the improvement of quality.

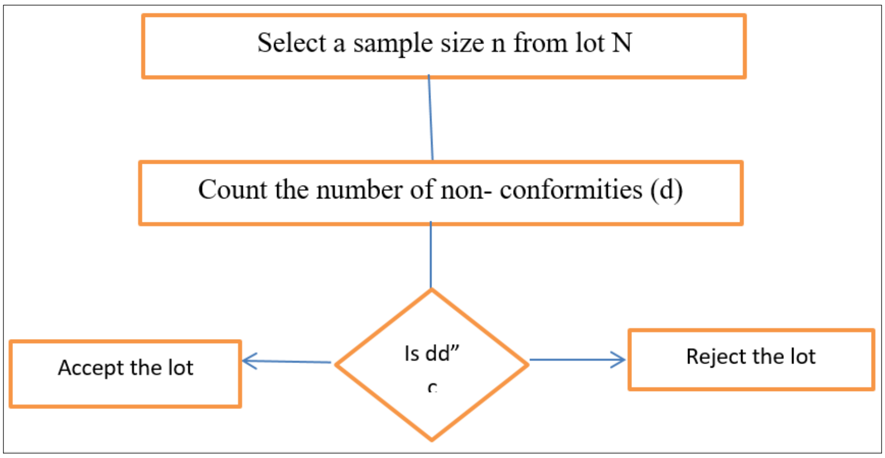
Keywords: Single sampling plan (SSP), size of the lot (N), size of the sample (n), average total inspection (ATI), operating characteristics FUNCTION (OC) and acceptance number (c)

Introduction
American National Standards Institute / American society for Quality Control (1947) defines Acceptance Sampling inspection in which decisions are made to accept or reject product or service, also the methodology that deals with procedures by which decisions to accept are based on the results of the inspection of samples. The major areas acceptance sampling according to (i) lot- by –lot sampling, method of attributes in which unit in a sample is inspected on a go-not –go basis for one or more characterises, (ii) Lot – by sampling by the method of variables, in which unit in sample is measured for a single characteristic such a weight or strength (iii) Continues sampling purpose plans, includes chain sampling, skip-lot sampling. In this paper certain concepts, terminology and symbols used in acceptance sampling in connection with this dissertation are explained.

Sampling plan and sampling system
ANSI/ASQC standard A_2 (1987) defines an acceptance sampling plan as “specific plan that the sampling rules to be used, and the associated acceptance and mon- acceptance criteria”, in a sampling plan operating Characteristics directly follow from the parameters specified and are uniquely determined. Stephens and Larson (1967) have described a sampling system as an assigned groping of two or more sampling plan and the rules for sentencing lots to achieve a blending of advantageous features of each the sampling plans. Quick switching system (QSS) of Rombiski (1969) is an example for such a sampling system.

Condition for the application
The sampling plan in which the acceptance or rejection of the current lot is not only on the sample information from that lot, also on the sample results from neighbouring lots. The entire conditional sampling plans will be conditions for applications.
1. Lot are submitted seriously in the order of production.
2. Lots are expected to be formed from continuing process constant fraction non-conforming p.

Operating procedure for Single sampling Plan
The operating procedure for single sampling plan procedure with given the flow chart
Step 1: Take a random size of n from the lot size N and count number of non- conformities Say d.
Step 2: If $d < c$ (acceptance number), accept the lot
Step 3: If $d > c$ (acceptance number), reject the lot



Flow chart

OC functions of Poisson distribution

From the random variable Xi = 1,2,3,4,……..n these follows Suppose the inspection procedure counts the number of defects instead defective in the sample, the number of defective in the i^{th} units' lot Poisson distribution with parameter λ >0. It means each unit on an average λ has defects. Taking λ= np the following Poisson approximation can be used evaluate the OC function.

$$L(p, n, c, Poisson) = \sum_{x=0}^{c} \frac{e^{-np}(np)^x}{x!}$$

The use of Poisson approximation works well when $p \leq 0.1$, $n \geq 30$ and $\frac{n}{N} < 0.1$. Very often Poisson OC functions are used by practitioners because cumulative Binomial table are used to adopt.

Methodology

Determination of lot Size by fixing ATI

The single sampling is specified with three parameters N (lot size), n (sample size) and c (acceptance number). In the sampling plan constructed earlier indexed through different parameters, the sizes of the sample were assumed to be selected from an infinite lot. But in practice does to true, because all the lots from which the samples are selected are finite only, and also selecting a sample of fixed quantity from an infinity lot is unconvincing. Further providing information on the size of the lot manufactured to the engineers will be of great help them, because that will assets them to decide about the sampling plan.

Radhakrishnan and Vasanthamni (2009) [3] determined lot size for the constructing single sampling plan using Average Outgoing Quality (AOQ) so in this chapter a procedure for the determination of size for the single sampling using Average Total Inspection (ATI) and then Uma and Ramya (2017) [4] determined cumulative Poisson probabilities for double sampling plan (DSP)

Result and Discussion

Determination lot size

For a specified ATI, n, p and acceptance number (c), the lot size (N) for the single sampling plan can be optioned using

ATI = n + (1- Pa) (N-n) ------------------------ (1)

The lot size calculated for the different value of ATI (200,300,400 and 500), sample size (100,200,300,400 and 500), lot quality (p=0.01 to 0.10) and acceptance number (c=0, 1 and 2) using excel packages and presented in different tables.

The table1 provided lot size lot size of single sampling plan for a fixed value of ATI = 200, n= 100 and c=0,1 and 2

The table 2 describes the lot size of single sampling for ATI =300, n=100 and c=0,1and 2

Example 1

For a specified ATI =200, lot quality (p) = 0.015, n=100 with acceptance number (c) = 0 the lot size selected from the table 1 is 327

Hence the single sampling plan for a specified p=0.015 is N=229, n=100 and c=100 with fixed ATI=200

The Operating Charactertic (OC) curve is presented in figure 1.

Practical application

A cell phone manufacturing company manufacturing lot of sizes 229 select a sample of 100 batteries from any lot and count for the number of defectives, if d=0 accept the otherwise reject the lot and inform the management quality improvement.

Example 2

For a specified lot quality (p) = 0.015, n=100 with acceptance number (c) =1 the lot size selected from the table 1 is 326

Hence the single sampling plan for a specified p=0.015 is N=326, n=100 and c=0with fixed ATI=200

The Operating Charactertic (OC) curve is presented in figure 2.

Practical application

In a courier service providing organization the letters are grouped in a lot of 326 each. Take a sample of 100 letters, from any lot and check for non- conformity service (d). If d≤ 1 accept the service provided as satisfied for the lot customers otherwise reject lot as not satisfied and inform the management for improving the quality.

Table 1: lot size (N) for a specification ATI=200

Sample size n/Lot size p	C	100
0.01	c=0	258.1977
	c=1	1077.129
	c=2	13513.58
0.02	c=0	215.6518
	c=1	268.3518
	c=2	838.9056
0.03	c=0	205.2396
	c=1	224.8671
	c=2	2108.554
0.04	c=0	201.8657
	c=1	210.081
	c=2	5559.815
0.05	c=0	200.6784
	c=1	204.2131
	c=2	14941.32
0.06	c=0	200.2485
	c=1	201.7658
	c=2	40442.88
0.07	c=0	200.0913
	c=1	200.7349
	c=2	109763.3
0.08	c=0	200.0336
	c=1	200.3028
	c=2	298195.8
0.09	c=0	200.0123
	c=1	200.1236
	c=2	810408.4
0.10	c=0	200.0045
	c=1	200.05
	c=2	2202747

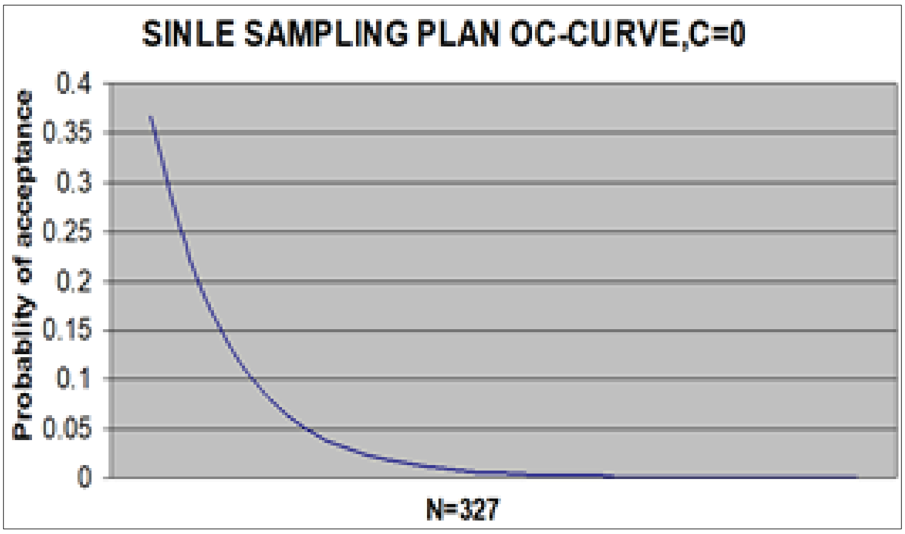


Fig 1: OC curve for N=229, n=120, c=2 and ATI= 200

Example 2

For a specified lot quality (p) = 0.015, n=100 with acceptance number (c) =1 the lot size selected from the table 1 is 326

Hence the single sampling plan for a specified p=0.015 is N=326, n=100 and c=0with fixed ATI=200

The Operating Charactertic (OC) curve is presented in figure 2.

Practical application

In a courier service providing organization the letters are grouped in a lot of 326 each. Take a sample of 100 letters, from any lot and check for non- conformity service (d). If d≤ 1 accept the service provided as satisfied for the lot customers otherwise reject lot as not satisfied and inform the management for improving the quality.

Table 2: Lot size N, for specification ATI =326

Sample size n/Lot size p	C	100
0.01	c=0	416.3953
	c=1	856.8845
	c=2	2590.617
0.02	c=0	331.3035
	c=1	436.7037
	c=2	1577.811
0.03	c=0	310.4791
	c=1	349.7341
	c=2	4117.107
0.04	c=0	303.7315
	c=1	320.162
	c=2	11019.63
0.05	c=0	301.3567
	c=1	308.4262
	c=2	29782.63
0.06	c=0	300.497
	c=1	303.5315
	c=2	80785.76
0.07	c=0	300.1825
	c=1	301.4697
	c=2	219426.6
0.08	c=0	300.0671
	c=1	300.6057
	c=2	596291.6
0.09	c=0	300.0247
	c=1	300.2471
	c=2	1620717
0.1	c=0	300.0091
	c=1	300.0999
	c=2	4405393

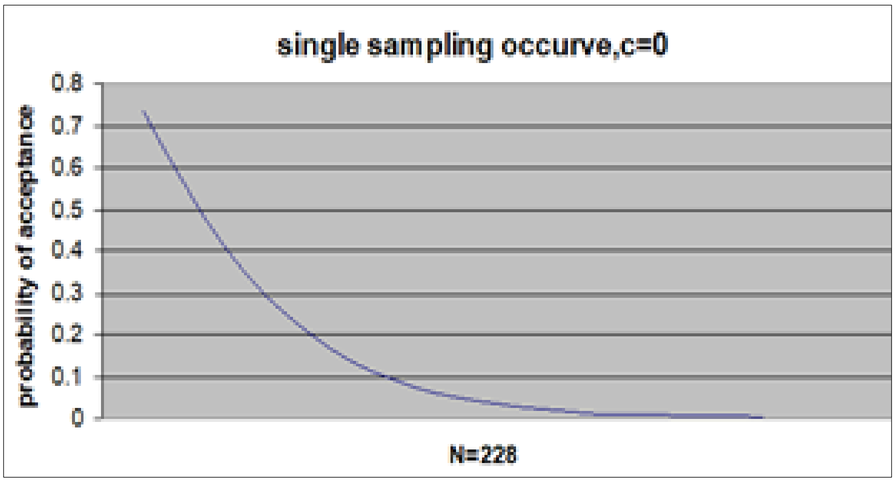


Fig 2: OC curve for N=326, n=100, c=2 and ATI= 200

Conclusion

It is unconvincing to select a fixed sample from an infinite or large lot. The lot size plays very important role in the construction of sampling plan. In the paper an attempt made to determine the size of the lot by fixing the ATI and sample size. A detailed procedure supported with examples and practical applications are provided. In this paper lot size for the single sampling plan alone is determined. Using this procedure the lot size for the other sampling plans, can be determined by fixing the ATI.

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