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CONSTRUCTION OF SINGLE SAMPLING PLAN INDEXED THROUGH SIX SIGMA QUALITY LEVEL -1 USING TRUNCATED BINOMIAL DISTRIBUTION

S. Pratheeba[1], R. Radhakrishnan[2]

[1]Assistant Professor
Department of Statistics, PSG College of Arts and Science
Coimbatore – 641014, India.

[2]Associate Professor
Department of Statistics, PSG College of Arts and Science
Coimbatore – 641014, India.

Abstract

Among the probability distributions that are used to describe the chance whose observational apparatus becomes active only when at least one event occurs is Zero Truncated Poisson Distribution (ZTPD). Shanmugam (1985) has shown that a Zero Truncated Poisson distribution (ZTPD) can be used to model such second quality lots which have the possibility of at least one defective in the sample information. In this paper the procedure for the construction of Single Sampling Plan indexed through Six Sigma Quality Level - 1 (SSQL-1) using Truncated Binomial Distribution (TBD) as the base line distribution is presented and a table is also provided using Excel packages for the easy selection of the plans.

Keywords: Six Sigma Quality Level -1, Truncated Binomial Distribution, Single Sampling Plan, Operating Characteristic Curve.

1. NTRODUCTION

The sampling plans can also be constructed by assuming the probability of acceptance of the lot, Pa(p) as 1-3.4 x 10^{-6}, the concept of Six Sigma quality suggested by Motorola (1980). The proportion defective corresponding to this probability on the OC curve is termed as Six Sigma Quality Level-1 (SSQL-1). This new sampling plan is constructed with a point on the OC curve (SSQL-1, 1-α_1), where α_1 = 3.4 x 10^{-6} suggested by Radhakrishnan and Sivakumaran (2008) similar to (AQL, 1- α) suggested by Dodge and Romig (1942). Further the proportion defective corresponding to the probability $2\alpha_1$ on the OC curve is termed as Six Sigma Quality Level-2 (SSQL-2, $2\alpha_1$) suggested by Radhakrishnan and Sivakumaran (2008) similar to (LQL,β) suggested by Dodge and Romig (1942). Radhakrishnan and Sivakumaran (2008) provided a procedure to construct Sampling Plans using SSQL-1 and SSQL-2 with Poisson distribution as the base line Distribution. Using this Six Sigma Quality Levels, Radhakrishnan (2009) has given a procedure to construct Single Sampling Plans (SSP) with base line distributions such as Poisson, Weighted Poisson and Intervened Random Effect Poisson Distributions.

2 CONDITIONS FOR APPLICATION

- Production is Continuous, so that results of the past, present and future lots are broadly the indicative of a continuous process.
- Lots are submitted sequentially.
- Inspection is by attributes, with the lot quality as the level defined as the proportion defective.
- Lots have at least one defective unit.
- Human involvement should be less in adopting Six Sigma Quality Levels

3 GLOSSARY OF SYMBOLS

p - Proportion Defective / Lot Quality
q - 1 – p
n - Sample Size
β - Consumer's Risk
$P_a(p)$ - Probability of acceptance of the lot quality p

4 OPERATING CHARACTERISTIC FUNCTION

The Operating Characteristic (OC) Function of the single sampling plan (SSP) using Truncated Binomial Distribution, truncated at x = 0 is given by

$$P_a(p) = \sum_{x=1}^{c} \frac{\binom{n}{x} p^x q^{n-x}}{\left(1-q^n\right)} \quad , x = 1, 2, \ldots\ldots c; \ldots\ldots (1)$$

5 CONSTRUCTION OF SINGLE SAMPLING

PLAN INDEXED THROUGH SSQL – 1

By fixing the probability of acceptance of the lot, Pa(p) as 1-3.4 x 10-^{6} with Truncated Binomial Distribution as the

basic distribution and from equation (1) the values of the SSQL-1 are obtained for the various combinations of 'n' and 'c' using a Excel package and are presented in Table 1. The parameters of the Single sampling plan, n and c are recorded for various combinations of SSQL - 1. The sigma levels of the process are calculated using the Process Sigma Calculator (http://www.isixsigma.com/) by providing the sample size and the acceptance number.

5.1 EXAMPLE

For a given SSQL - 1 = 0.0000001, the value of n and c are obtained from table 1 as n = 5500 and c = 1 which is associated with 5.07 sigma level. Hence the parameters of Single Sampling Plan are n = 5500 and c = 1 with the specified SSQL - 1 = 0.0000001. The OC curve for this plan is presented in figure 1.

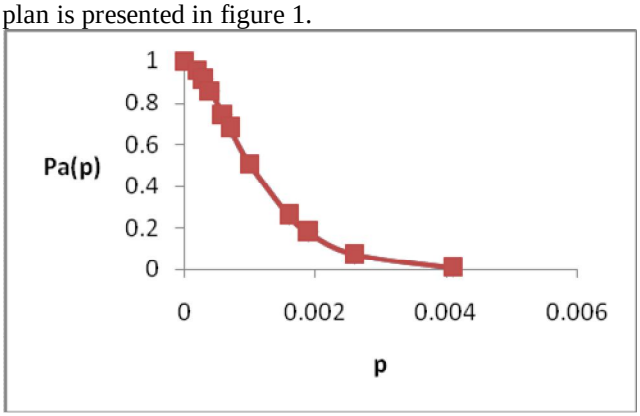

Figure 1:- OC curve of the SSP using TBD for n = 5500 and c = 1

5.2 PRACTICAL APPLICATION

Suppose a washers manufacturing company fixes SSQL–1 as 0.0000001 (1 Non – confirming units out of 1 Crore washers) then inspect a random sample of 5500 washers taken from a lot of units produced in a given period (day/week) and count the number of non – confirming washers (d). If $d \leq 1$, accept the lot of units processed during the period, otherwise reject the lot of units and inform the management for corrective action.

6 CONCLUSION

In this paper a procedure is given for constructing a Single Sampling Plan indexed through SSQL -1 using Truncated Binomial Distribution, Truncated at x = 0 and a table is also provided for the easy selection of the plans. These plans are very useful for the companies which has at least one defective unit in their lot and also useful to the companies which are using second quality lots.

References

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WEBSITE

[1] Motorola (1980): http://www.tech-faq.com/Six Sigma.shtml/

Table 1: Parameters of Single Sampling Plan for a specified SSQL - 1Using Truncated Binomial Distribution

n	C	SSQL-1
5500	1	0.00000010600
5500	2	0.00000025000
5500	3	0.00000520325
5500	4	0.00000386400
5500	5	0.00000830000
5250	1	0.00000008400
5250	2	0.00000015312
5250	3	0.00000108294
5250	4	0.00000199000
5250	5	0.00000235000
5000	1	0.00000011695
5000	2	0.00000013456
5000	3	0.00000123000
5000	4	0.00000020000
5000	5	0.00000226000
4750	1	0.00000005876
4750	2	0.00000010526
4750	3	0.00000234000
4750	4	0.00000500000
4750	5	0.00000037300
4500	1	0.00000003216
4500	2	0.00000005116
4500	3	0.00000143520
4500	4	0.00000258000
4500	5	0.00000404000