International Journal of Applied Research 2020; 6(6): 347-349

ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2020; 6(6): 347-349
www.allresearchjournal.com
Received: 09-04-2020
Accepted: 12-05-2020

Dr. V Sangeetha
Department of Statistics, PSG College of Arts and Science, Coimbatore, Tamil Nadu, India

S Nandhini
Ph. D Research Scholar, Department of Statistics, PSG College of Arts and Science, Coimbatore, Tamil Nadu, India

Corresponding Author:
Dr. V Sangeetha
Department of Statistics, PSG College of Arts and Science, Coimbatore, Tamil Nadu, India

Optimal designing of two stage chain sampling plan (0,2) with double sampling plan as reference plan

Dr. V Sangeetha and S Nandhini

Abstract
This paper deals with the optimal designing of a two-stage chain sampling plan of type ChSP (0,2) by considering the double sampling plan as the reference plan indexed through Acceptable Quality Level (AQL), Limiting Quality Level (LQL), Indifference Quality Level (IQL) and its operating ratio. Poisson unity values have been tabulated to facilitate the operation and construction of the plan. The tables are constructed by considering the various combinations of acceptable and limiting quality levels.

Keywords: Two stage chain sampling plan, double sampling plan, acceptable quality level, indifference quality level, limiting quality level

Introduction

Acceptance sampling uses statistical sampling to determine whether to accept or reject a production lot of material. It has been a common quality control technique used in industry. It is usually done as products leaves the factory, or in some cases even within the factory. Most often a producer supplies a consumer a number of items and a decision to accept or reject the items is made by determining the number of defective items in a sample from the lot. The lot is accepted if the number of defects falls below where the acceptance number or otherwise the lot is rejected. The basic acceptance sampling plan called the double sampling plan is widely used in industry to inspect items due to its easiness of implementation. Often a lot of items are so good or so bad that we can reach a conclusion about its quality by taking a smaller sample than would have been used in a single sampling plan. If the number of defects in this smaller sample (of size n_1) is less than or equal to some lower li it (c_1), the lot can be accepted. If the number of defects exceeds an upper limit (c_2), the whole lot can be rejected. But if the number of defects in the n1 sample is between c_1 and C_2, a second sample (of size n_2) is drawn. The cumulative results determine whether to accept or reject the lot.

Review of literature: The general extension of the ChSP-1 plan is the two-stage chain sampling plan and was proposed by Dodge and Stephens (1964, 1966) [4] and Stephens and Dodge (1965) [3]. A specific series of ChSP-(c_1, $c_2$plans have been studied and presented by Stephens (1966) [4]. These include the sets (c_1, c_2), values for (0,1), (0,2), (0,3), (0,4) and (1,4). A generalized two-stage chain-sampling plan with different sample sizes in the two stages can be represented as ChSP- (n_1, n_2, k_1, k_2, c_1, c_2). An important subset of the two-stage chain sampling plan is that for fixing P_0, the indifference quality level (IQL), gives adequate protection not only to the consumer but also to the producer. The advantage of selecting plans for a given (IQL), gives adequate protection not only to the consumer but also to the producer. The advantage of selecting plans for a given IQL and relative slope of the OC curve at P_0has been explained by Hamaker (1960). The proportion defective corresponding to the inflection point of the OC curve denoted by p,, is interpreted as the maximum allowable percent defective (MAPD) [see Mayor (1967)]. The desirability of developing a set of sampling plans indexed by p has been explained by Mandelson (1962) and Soundararajan (1975) [8]. In the case of rectifying inspection, the relevant index for the selection of the plan will be average outgoing quality limit (AOQL) and plans can be selected for given IQL or MAPD and AOQL. Soundararajan and Govindaraju (1983) [8] have constructed tables for the selection of ChSP-(0, 1) plans for the given two points on the OC curve based based on the Poisson model. Govindaraju and Subramani (1993) have presented the tables for selection of ChSP-(Q, 1) plan for the given IQL and MAPD. Jothikumar (1996) has discussed the construction and selection for ChSP-(0, 2) plan for given two points on the OC curve.

Selection of sampling plan

In Double sampling plan by attributes the lot acceptance procedure is characterized by the parameters N, n_1, n_2, C_1, C_2. The operating procedure for double sampling plan is given below:

1. Select a random sample of size 'n_1' from a lot of size 'N'
2. Inspect all the items in the sample. Let 'd_1' be the number of non – conformities in the sample.
3. If $d_1 \leq C_1$, accept the lot.
4. If $d_1 > C_2$, reject the lot.
5. If $C_1+1 \leq d_1 \leq C_2$, take a second sample of size 'n_2' from the remaining lot and find the number of non–conformities 'd_2'.
6. If $d_1 + d_2 \leq C_2$, accept the lot.
7. If $d_1 + d_2 > C_2$, reject the lot.

Operating Characteristic function Under Poisson model, the OC function of the Double sampling plan as given by Dodge (1959) is

$$p_a(p) = \sum_{r=0}^{c_1} \frac{e^{-n_1 p}\,(n_1 p)^r}{r!} + \sum_{k=c_1+1}^{c_2} \frac{e^{-n_1 p}\,(n_1 p)^k}{k!} \left\{ \sum_{r=0}^{c_2+1} \frac{e^{-n_1 p}\,(n_1 p)^k}{k!} \right\}$$

Two stage chain sampling plans (0,2)

As mentioned already, two stage ChSP (0,2) plan is An extension of two stage ChSP(0,1)plan. Before presenting the procedure for the two-stage chain sampling plan of type ChSP (0,2) with a double sampling plan as the reference plan, we recall the operation of two stage chain sampling plan. The operating procedure of such plan provided as follows.

Operating procedure for two stage Chain sampling plans (0,2)

Step 1: At the outset, select a random sample of n units from the first lot, and from each succeeding lot.

Step 2: Record the number of nonconforming units, d, in each sample and sum the number of nonconforming units, D, in all samples from the first upto and including the current sample.

Step 3: Accept the lot associated with each new sample during the cumulation as long as $D_i \leq c_1$;$1 < i \leq k_1$

Step 4: When k_1 consecutive samples have all resulted in acceptance, it is continued to sum the nonconforming units, D, in the $k_1$samples plus additional samples up to not more than k_2 samples.

Step 5: Accept the lot associated with each new sample during the cumulation as long as $D_i \leq c_2$; $k_1 < i \leq k_2$

Step 6: When the second stage of the restart period has been successfully completed (i.e. $k_2$consecutive samples have resulted in acceptance), start cumulation of nonconforming units as a moving total over $k_2$samples by adding the current sample result while dropping from the sum, the sample result of the $k_2 th$ preceding sample. Continue this procedure as long as $D_i \leq c_2$, and in each instance accept the lot.

Step 7: If for any sample at any stage of the above procedure, D_i is greater than the corresponding c, reject the lot.

Step 8: When a lot is rejected return to Step 1 and a fresh restart of the cumulation procedure.

Selection procedure

Selection of CHSPDSP (0,2) For construction and evaluation of the Two Stage Chain with double Sampling plan, the np values presented in tables were derived under the procedure stated by Duncan [1965] [3]. Tables are used to derive individual plan to meet specified values of fraction defectives and probability of acceptance. It requires the specifications of AQL (p_1), LTPD (p_2), Producers risk (α), Consumers risk (β) and acceptance criteria i. The steps to be followed are,

1. Specify p_1 - Acceptable Quality Level (AQL), p_2- Lot Tolerance Proportion Defective (LTPD), producer risk (α) and consumer risk (β).
2. The operating ratio is OR = p_2 / p_1 and m = np.
3. Choose the plan parameters having k_1, k_2, c_1, c_2, and i associated with an operating ratio which is nearest in the corresponding table.
4. Determine the sample size n = np_2 / p_1.
5. The OC Curve may be drawn by dividing the values of np shown for the plan by sample size n to obtain p associated with 0.95 for P_a(p).
6. Thus, the plan consists of six parameters namely: n, k_1, k_2, c_1, c_2 and i may choose from the given tables.

Designing of two stage Chspdsp (0,2) plan

In general, any sampling plan or any sampling system can be designed for specified two points on the operating characteristic (OC) curve namely, acceptable quality level (AQL) and limiting quality level (LQL), along with the corresponding producer's risk (α) and the consumer's risks (β). AQL is usually defined as the worst-case quality level, in percentage or ratio, which is still considered acceptable. As an AQL is an acceptable level, the probability of acceptance of a lot at the AQL should be high. LQL is used as an index for consumer protection for designing an acceptance sampling plan. AQL is denoted by p_1 and the LQL is denoted by p_2.

Construction and evaluation of the plan

The probability for accepting a lot given the proportion nonconforming under the ChSP(0,2) plan with parameters n, $k_1$and $k_2$was derived by Dodge and Stephens (1966) [4] as

$$P_a(p) = \left\{ \frac{p_0 + (p_1 + p_2) {p_0}^{k_1} \left[\frac{1-{p_0}^{k_2-k_1}}{(1-p_0)}\right] + {p_1}^2\, {p_0}^{k_1} \left[\frac{1-{p_0}^{k_2-k_1}}{(1-p_0)^2} - \frac{(k_2-k_1)\, {p_0}^{k_2-k_1-1}}{(1-p_0)}\right]}{1 + (p_1 + p_2) {p_0}^{k_1} \left[\frac{1-{p_0}^{k_2-k_1-1}}{(1-p_0)}\right] + {p_1}^2\, {p_0}^{k_1} \frac{1-{p_0}^{k_2-k_1-1}}{(1-p_0)^2} - \frac{(k_2-k_1)\, {p_0}^{k_2-k_1-1}}{(1-p_0)^2}} \right\}$$

The expression for probability of acceptance under the assumption with Poisson model, the composite OC function is given by

Here, $p_0 = p_a(p)$

$$p_a(p) = \sum_{r=0}^{c_1} \frac{e^{-n_1 p}\,(n_1 p)^r}{r!} + \sum_{k=c_1+1}^{c_2} \frac{e^{-n_1 p}\,(n_1 p)^k}{k!} \left\{ \sum_{r=0}^{c_2+1} \frac{e^{-n_1 p}\,(n_1 p)^k}{k!} \right\}$$

Conclusion

The present development would be a valuable addition to the literature and a useful device to the quality practitioners. The concept of this article may be used for assistance to quality control engineers and plan designers in the development of further plans, which were useful, and tailor made for industrial shop-floor situation

References

1. Dodge HF. Chain Sampling Inspection Plan; Industrial Quality Control. 1955; 11:10-13.
2. Dodge HF. Roming. Sampling Inspecting tables - Single Double sampling, 2nd edition, John Wiley and Sons, New York, 1959.
3. Stephens KS, Dodge HF. Chain Sampling Inspection Plans - ChSP - (0,2), ChSP - (1,2), Technical Report No. N-21, Statistics Center, Rutgers-The State University, 1965.
4. Dodge HF, Stephens KS. Some New Chain Sampling Inspection Plans, Industrial Quality Control. 1966; 23(2):61-67.
5. Stephens KS, Dodge HF. Comparison of Chain Sampling Plans with Single and Double Sampling Plans, Journal of Quality Technology. 1976; 8(4):24-33.
6. Stephens KS, Dodge HF. Two-Stage Chain Sampling Inspection Plans with Different Sample Sizes in the Two Stages, Journal of Quality Technology. 1976; 8(4):209-224.
7. Bachi SB. An extension of chain sampling plan Iapqr Trans. 1976; 1:19-22.
8. Soundararajan V, Govindaraju K. Construction and Selection of Chain Sampling Plans ChSP-(0, l), Journal of Quality Technology. 1983;15(4):180-185.
9. Anamiya B. Selection of Three Stage Chain Sampling Plan of type ChSP (0,1,2) through Minimum Angle Method, submitted for publication JQT, 2012.
10. Anamiya Baby B. Designing of three stage Chain sampling plans with single sampling plan as reference plan. International journal of statistics. 2014; 38(1):1114-1118.