Analytical of quick switching system using weighted Poisson distribution

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Abstract : The author has considered a sampling system is a grouping of two more sampling plans with specified rules for switching between the plans for sentencing lots of finished products. Quick Switching System (QSS) is a sampling system which involves normal and tightened sampling plans and incorporates a switching rule. In this paper, QSS using weighted Poisson distribution as a base line distribution is introduced.

Key Words : QSS, SSP, LQL, OR.

Introduction : In this paper, QSS is studied with Single Sampling Plan as a reference plan using weighted Poisson distribution as a base line distribution. The Weighted Poisson distribution has an important role to play in the acceptance sampling, mainly in the construction of sampling plans. The highlight of the system is an immediate switching from normal plan to tightened plan when rejection of the lot arises in the normal inspection, and switching to normal inspection when a lot is accepted under tightened inspection. Due to instantaneous switching between normal and tightened plans, this system is termed as 'Quick Switching System' (QSS). Investigated the QSS with single sampling plan as a reference plan and two systems were introduced namely QSS $(n; c_N, c_T), c_T < c_N$ and QSS $(n; kn, c_o), k > 1$

Quick switching system : This system is designated as Quick Switching System QSS $(n; kn, c_o)$, where the single sampling normal plan has a sample of size 'n' and an acceptance number $'c_o'$, and the tightened single sampling plan having the same acceptance number $'c_o'$, but with sample size 'kn' (k > 1).

Conditions for application : The conditions under which this system may be applied are –

1. Production is steady, so that results of past, present and future lots broadly indicative of a continuing process.
2. Lots are submitted sequentially in the order of their production.
3. Inspection is by attributes, with the lots quality defined as the production defective.
4. Lots have at least one defective unit.

Operating procedure :

Step 1 : Under normal inspection, take a random sample of size n from the lot and count the number of non-conforming units (D).

(a) If $D \le c_o$, accept the lot and start normal inspection for the next lot.

(b) If $D > c_o$, reject the lot and go to Step 2.

Step 2 : Under Tightened Inspection, take a random sample of size 'kn' from the lot and count the number of non-conforming units (D).

(a) If $D \le c_o$, accept the lot and repeat Step 1 for the next lot.

(b) If $D > c_o$, reject the lot.

Performance measures : Romboski (1969) derived the OC function of the QSS. Based on this, the OC function of QSS $(n; kn, 'c_o')$ is given by

$$P_a(p) = \frac{P_T}{1 - P_N + P_T'} \quad (1)$$

Where, P_N is the probability of acceptance using normal single sampling plan $(n; c_o)$.

Here, P_T is the probability of acceptance using the tightened single sampling plan (kn, c_o).

Weighted Poisson distribution :

It is know that Poisson distribution is seen as the limiting form of the Binomial distribution and is defined

$$p(x,\lambda) = \frac{e^{-\lambda}\lambda^x}{x!}, \quad x = 0,1,2..., \quad \text{where} \quad \lambda = np.$$

The weighted Poisson distribution can also be obtained and is given by

$$p(x,\lambda,\alpha) = \frac{x^\alpha p(x,\lambda)}{\sum_{x=0}^{\infty} x^\alpha p(x,\lambda)}; \quad x = 0,1,2... \text{ ; where } \lambda = np.$$

The probability mass function of weighted Poisson distribution is given by

$$p(x;\lambda) = P(x;\lambda,\alpha), \quad \alpha = 1$$

$$= \frac{e^{-\lambda}\lambda^{x-1}}{(x-1)!}; \quad x = 1,2,...$$

Under the assumption of Weighted Poisson model, the values of P_N and P_T are given respectively by

$$P_N = \sum_{x=1}^{c} \frac{e^{-\lambda_1}\lambda_1^{x-1}}{(x-1)!}; \quad P_T = \sum_{x=1}^{c} \frac{e^{-\lambda_2}\lambda_2^{x-1}}{(x-1)!} \quad (2)$$

Where $\lambda_1 = np$ and $\lambda_2 = knp$, p is the proportion defective of the lot.

Using equation (2) in (1), the properties of the OC curve of the QSS can be considered as follows.

Conclusion :

In this paper, QSS with Single Sampling Plan as the reference plan using Weighted Poisson distribution is presented. This type of sampling system is also much essential to floor engineers to accept or reject the lot with the minimum sample size for the second quality lots. This system has wide applications in industries when at least one defective in the majority of the manufactured products occurs.

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