DESIGNING AND SELECTION OF QUICK SWITCHING DOUBLE SAMPLING SYSTEM USING *WEIGHTED POISSON DISTRIBUTION – SAMPLE SIZE TIGHTENING*

Dr. G. UMA
Assistant Professor, Department of Statistics
PSG College of Arts & Science, Coimbatore – 641 014
Tamil Nadu, India

ASTRACT

A sampling system is a grouping of two or 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 single sampling plans and incorporates a switching rule. In this paper, Quick Switching Double Sampling System (QSDSS) using weighted Poisson distribution as a base line distribution is introduced and designed. The measures of performance and the Operating Characteristic (OC) curve of the system are studied using MAM and presented with an example. Procedures and tables are constructed for the designing of the system indexed by various combinations of parameters.

Key Words*: QSS, QSDSS, DSP, AQL, LQL, IQL, MAAOQ, MAM, OR.*

Introduction and Review of Literature

Dodge (1967) proposed a new sampling inspection system consists of pairs of normal and tightened 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). Romboski (1969) 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_0), k >1. Romboski (1969) analyzed QSS (n, kn; c_0) and provided necessary tables for the selection of the system. Arumainayagam (1991) provided tables for the selection of this system under binomial conditions. Govindaraju (1984, 1991) and Soundararajan and Arumainayagam (1990, 1992) have introduced and designed a system namely QSS-r (n; kn; 0) with r = 1, 2, 3 useful for costly and destructive testing.

Radhakrishna Rao (1977) suggested a weighted Binomial Distribution, as the basic distribution in designing sampling plans. Later Sudeswari (2002) constructed sampling plans using Weighted Poisson distribution. Radhakrishnan and Mohana Priya (2008) constructed procedures and tables for the selection of single sampling plan using Conditional Weighted Poisson distribution.

Construction and selection of Quick Switching Double Sampling System-acceptance number tightening was initiated and derived by Devaraj Arumainayagam .S and Soundararajan .V(1994). Later Quick switching double sampling system indexed by the crossover point which was developed by Devaraj Arumainayagam .S and Soundararajan .V (1995). Construction and selection of quick switching systems: acceptance number tightening using weighted Poisson distribution as the base line distribution was studied by, Devaraj Arumainayagam and Uma. (2010). A study on modified Quick switching double sampling system-sample size tightening is developed by Uma G and Chitra Devi (2010) with necessary tables and examples.

Most of the designing procedures in the references cited are based on either Poisson or binomial distributions only. In this paper QSS is studied with Double Sampling Plan as a reference plan using Weighted Poisson distribution as a base line distribution. In recent years the Weighted Poisson distribution has an important role in the acceptance sampling, mainly in the construction of sampling plans and systems in order to safe guard both the producer as well as consumer. The following *assumptions* is to be carried under Weighted Poisson distribution *(i) each outcome (number of defectives) is specific but can be assigned with different weights based on its importance or usage and (ii) there should be atleast one defective in the lot.* Necessary procedures and tables are provided for designing the system indexed by various combinations of parameters. Advantages are highlighted with suitable illustrations that are useful for shop floor situations.

QUICK SWITCHING DOUBLE SAMPLING SYSTEM

The system with switching of two plans such as normal double sampling plan and tightened double sampling plan using weighted Poisson distribution is designated as Quick Switching Double Sampling System (QSDSS). Romboski had designed two categories of switching systems based on acceptance number tightening and sample size tightening. In this study a system with sample size tightening designed as **QSDSS – r (n, k; a_1, a_2),** r = 1, 2 and 3 [(n ; a_1, a_2) and(kn ; a_1,a_2), k>1 is designed switching from normal and tightened double sampling plans respectively where n_1=n_2=n and kn_1=kn_2=kn]

Conditions for Application

The conditions under which this system may be applied (in an industry) are as follows:

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

Operating Procedure - QSDSS (n; k; a_1, a_2)

Step1 : From a lot, take a random sample of size 'n'(Normal) count the number of non-conforming units (d_1).

(a) If $d_1 \leq a_1$, accept the lot and repeat step1 for the next lot.

(b) If $d_1 > a_2$, reject the lot and go to step2.

(c) If $a_1 < d_1 \leq a_2$, take a second random sample of size n, from the same lot and count the number of non-conforming units (X_2)

(d) If $d_1 + d_2 \leq a_2$, accept the lot and repeat step 1.

(e) If $d_1 + d_2 > a_2$, reject the lot and go to step2.

Step2: From the next lots, take a random sample of size' kn (Tightened) and count the number of non – conforming unit (d_1)

(a). If $d_1 \leq a_1$, accept the lot and go to step1 for the next lot.

(b) If $d_1 > a_2$, reject the lot and repeat step2 for the next lot.

(c) If $a_1 < d_1 \leq a_2$, take another random sample of size kn, from the same lot and count the number of non-conforming units (X_2)

(d) If $d_1 + d_2 \leq a_2$, accept the lot and use step1 for the next lot.

Performance Measures of QSDSS - 1(n, k ; a_1, a_2)

Under the assumption of Weighted Poisson model the OC function of QSDSS (n; k; a_1, a_2), is given by Romboski

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

where the values of P_N and P_T are defined below:

P_N : Proportions of lots expected to be accepted when using the normal double sampling plans. (n; a_1, a_2)

P_T: Proportions of lots expected to be accepted when using the tightened double sampling plans. (kn; a_1, a_2)

Under the assumption of Poisson model Hald (1981) and Schilling (1982), the values of P_N and P_T are respectively given as equation 1 with $\upsilon_1 = np$ and $\upsilon_2 = knp$

$$P_N = G(a_1, \nu_1) + \left[\sum_{x_1 = a_1+1}^{a_2} g(x_1, \nu_1) G(a_2 - x_1; \nu_1) \right]$$

$$P_T = G(a_1, \nu_2) + \left[\sum_{x_1 = a_1+1}^{a_2} g(x_1, \nu_2) G(a_2 - x_1; \nu_1) \right]$$

Where $g(x, \upsilon) = \frac{e^{-\upsilon} \upsilon^{x-1}}{x-1!}$; $G(a, \upsilon) = \sum_{x=0}^{a} g(x, \upsilon)$; and $\upsilon_1 = np$ and $\upsilon_2 = knp$

Minimum Angle Method (MAM)

The chief feature of this method is that OC curve is represented by a straight line that portrays the slope of the OC curve in a best way. The point of the inflection is easily picked up because it is the most representative point in the OC curve. The Smaller the value of Tan θ, closer is the angle θ approaches zero and chord length AB as in figure approaches AC which is the ideal condition. A design procedure is developed for designing of sampling systems by minimizing tangent of angle between the lines joining the points (AQL, β), (AQL, 1-α) and (AQL, 1-α), (LQL, β)which is illustrated in the figure 4.2.2. The method involves the comparison of some portion of each curve to be evaluated with the corresponding portion of the ideal OC curve.

The formula for tan θ is given as

$$\tan\theta = \frac{opposite\ angle}{adjacent\ side}$$

Tangent of angle made by AB and AC is

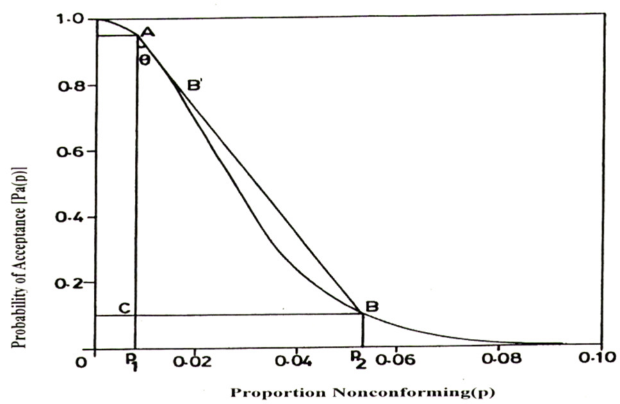
$$\tan\theta = \frac{p_2 - p_1}{(1-\alpha) - \beta}$$

$$= \frac{p_2 - p_1}{PA(p_1) - PA(p_2)}$$

$$= \frac{np_2 - np_1}{n[P_A(p_1) - PA(p_2)]}$$

$$n\tan\theta = \frac{np_2 - np_1}{PA(p_1) - PA(p_2)}$$

Using this relation, minimizing the angle for given nAQL ,nLQL and OR the parameters are determined.



Weighted Poisson distribution

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

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

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

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

where ‘x^{α}’ is the weight assigned to each outcome and may be termed as the weighting factor with ‘α’ being the constant ($\alpha \geq 0$). The Poisson distribution can be seen as the particular case of the weighted Poisson distribution when $\alpha = 0$.

The probability mass function of conditional weighted Poisson distribution is given by

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

$$= \frac{e^{-\lambda}\lambda^{x-1}}{(x-1)!} \quad ; \quad x = 0, 1, 2, \ldots\ldots\ldots.$$

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 QSDSS can be obtained,

Figure 1 gives the normal, tightened and composite OC curves of QSDSS (50; 2; 1, 3). From these Figure, it is observed that the composite OC curve is weighted average of the normal and tightened OC curves. It has a more desirable shape than the OC curves of corresponding normal and tightened plans. For small values of p, the normal OC curve is closer to the system OC curve and, for larger values of p the tightened OC curve is closer to the system OC curve

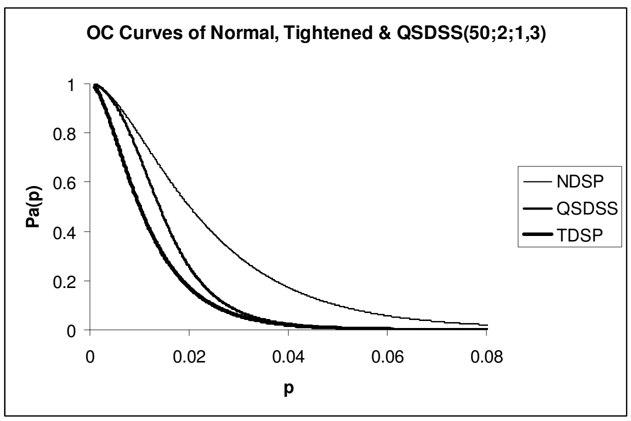


Figure 1: Normal, Tightened and Composite OC Curves of QSDSS (50; 2; 1, 3)

Selection of the QSDSS through AQL and LQL

Table 1 is used to construct the plan when p_1 (AQL) and p_2 LQL) are specified. The operating ratio $R_1 = p_2/p_1$ which is a function of a_1, a_2 and k and the nearest value of the ratio is obtained under the column R_1 in Table 1. The corresponding value of the parameters are noted and the sample size is determined as $n = np_2/p_2$. The parameters of the Quick Switching Double Sampling System are determined as (n, k; a_1, a_2)

Example

Given $p_1 = 0.0028$ and $p_2 = 0.0108$, the ratio $R_2 = 0.0108/0.0028 = 4.1538$ is computed. From the table 1 the value of R_1 nearest to 4.1538 is 4.152634, which is corresponding to $a_1 = 2$ and $a_2 = 4$ and $k = 2.25$ from which the sample size can be determined as $n = np_2/p_2 =$

2.0024/0.0108 = 185.41 ≈ 185. Hence the Quick Switching Double Sampling System with Weighted Poisson distribution is QSDSS (185, 2.25; 2, 4).

Selection of the system QSDSS (n, k; a_1, a_2) through AQL and IQL

Table 1 is used to construct the plans when p_1 (AQL) and p_0 (IQL) specified. Obtain the operation ratio $R_2 = p_1/p_0$ which is a function of and the value is obtained under the column R_2 in Table 1. The corresponding value of c is noted and the sample size is determined as $n = np_1/p_1$, the parameters n, a_1 and a_2 for the quick switching system is determined.

Example

Given $p_1 = 0.01$ and $p_0 = 0.0024$, the ratio $R_2 = 0.01/0.0024 = 4.167$ is computed. From the Table 1 the value of R_2 nearest to 4.167 is 4.0702, which is corresponding to $a_1 = 1$, $a_2 = 3$ and k = 1.5 from which the sample size can be determined as $n = np_1/p_1 = 0.2008/0.01 = 20.08 \approx 20$. Hence the Quick Switching Double Sampling System with Weighted Poisson distribution is determined as QSDSS (20, 1.5; 1, 3)

Average Outgoing Quality Curve

Figure 2 gives the average outgoing quality curve of QSDSS (50; 2; 1,3) with its normal and tightened plans. AOQ curves of the systems lies between those of normal and tightened plans. For small values of p, the outgoing quality under normal plan is equivalent to that of the system and for large values of p, it is same as that of the tightened plan. For intermediate quality, the outgoing quality of the system lies between those of the normal and tightened plans.

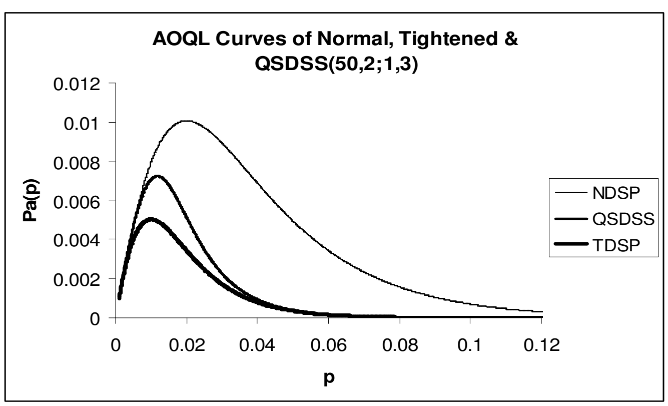


Figure 2 AOQL Curves of Normal, Tightened & QSDSS (50,2;1,3)

Designing of QSDSS (n, k; a_1, a_2) with Minimum Angle Method (MAM)

The chief feature of this method is that OC curve is represented by a straight line that portrays the slope of the OC curve in a best way. The point of the inflection is easily picked up because it is the most representative point in the OC curve. The smaller the value of tanθ, closer is the angle θ approaches zero and chord length AB as in Figure (Page No. 5) approaches AC which is the ideal condition.

Selection of QSDSS (n, k; a_1, a_2) with MAM

Table 1 is constructed with the base of Romboski (1969) having the operating ratio $R_1 = p_2/ p_1$, $R_2 = p_0/p_1$ and one more column 'ntanθ' for different combinations of acceptance numbers of the system arranged in descending order.

i) Compute the operating ratio $R_1 = p_2/p_1$.
ii) With computed value of R_1 the nearest value is determined.
iii) Determine the parameters of the system from Table 1.
iv) Obtain the sample size as $n = np_1/p_1$.
v) The minimum angle θ is obtained by tanθ = (ntanθ)/n.

Example

For given $p_1 = 0.013$, $p_2 = 0.075$, $\alpha = 0.05$ and $\beta = 0.10$, a QSDSS is obtained

i) $R_1 = 0.075/0.013= 5.769$.
ii) From Table 1 the nearest operating ratio $R_1 = 5.6672$ is obtained.
iii) The acceptance numbers are $a_1 = 1$, $a_2 = 4$ and k = 1.25 can be obtained.
iv) The sample size n = 0.4231/0.013 = 32.5 ≈ 33 is determined.
v) From Table 1 the corresponding ntanθ = 2.3231.*i.e.* tanθ = 0.070399.

Therefore the minimum angle θ is obtained as θ = 4° 02 69" The designed system is QSDSS(33; 1.25; 1,4).

Comparison of Quick Switching Double Sampling Systems

QSDSS (n, k; a_1, a_2) using Poisson and Weighted Poisson distribution

Quick switching double sample system - sample size tightening using Weighted Poisson and Poisson distribution is compared for various indexing parameters. Figure -3, gives OC curves of QSDSS (100, 2.25; 2, 5) of Poisson [Devaraj Arumainayagam (1993)] and QSDSS (100, 2.25; 2,5) of weighted Poisson distribution. One of the advantages of QSS is its shape of the OC curve in discriminating the good and bad qualities of the product. The composite OC curve of the system is in better shape than the normal and tightened single sampling plan. Accordingly it is observed that the OC of the QSDSS using weighted Poisson distribution is still more discriminating than the OC curve of QSDSS [Devaraj Arumainayagam(1993)] is an added advantage with minimum sample size.

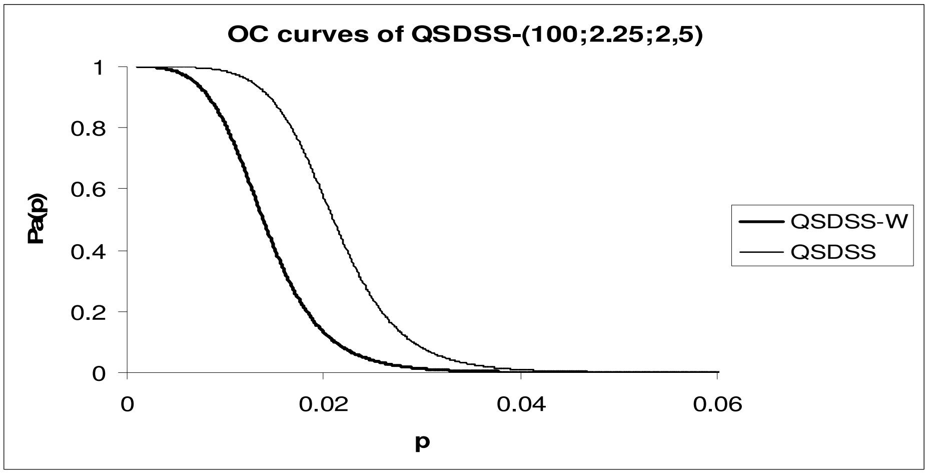


Figure 3 OC curves of QSDSS using Weighted Poisson & Poisson Distribution

From the Table 3, for the different values of p_1 and p_2, the operating ratio is found. Having the same operating ratio, comparisons of Quick Switching System with reference to Double Sampling Plan i.e. QSDSS (n; k; a_1, a_2)(Devaraj Arumainayagam-1993) and QSDSS (n; k; a_1, a_2) using weighted Poisson distribution is made.

Example

Given $p_1 = 0.024$ and $p_2 = 0.0785$, the operating ratio is 3.271 is computed. The sample size for the QSDSS (Devaraj Arumainayagam) is n = 29 with $a_1 = 1$, $a_2 = 3$ and k = 2.00 and whereas for QSDSS (W) n = 29 with acceptance numbers $a_1 = 2$, $a_2 = 5$ and k = 2.00. In this case, Quick Switching Double Sampling System –sample size tightening both QSDSS (W) and QSDSS (Devaraj Arumainayagam) gives same sample size with high acceptance number.

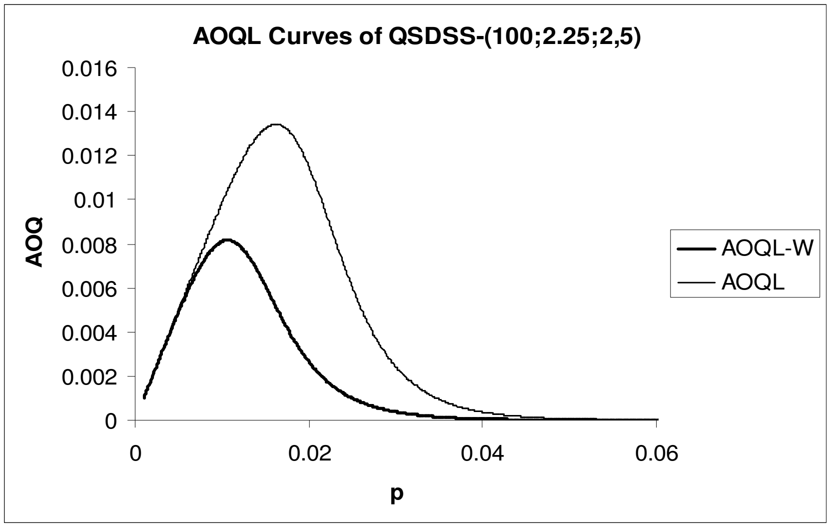


Figure 4 AOQL Curves QSDSS using Weighted Poisson & Poisson Distribution

Figure 4 gives AOQL curves of QSDSS (100; 2.25; 2, 5) with Weighted Poisson distribution and Poisson distribution. For small values of p, the outgoing quality under Poisson distribution is equivalent to that of the weighted Poisson and for large values of p, it is deteriorating

Comparison between the parameters (MAPD, MAAOQ) and (MAPD, AOQL)

Tables 1 and 2 are constructed having Quick switching Double sampling system using weighted Poisson distribution and Poisson distribution indexed through the selected points of (MAPD, MAAQO) and (MAPD, AOQL). The systems are matched with respect to the ratio R.

Example

For given MAPD (p*) =0.011 and MAAOQ = 0.008, the Quick Switching Double Sampling System for sample size tightening constructed using Poisson distribution gives n= 107, a_1 = 1, a_2 = 3 and k = 2.00 and constructed using Weighted Poisson distribution gives n= 63, a_1 = 2, a_2 = 4 and k = 2.00. The sample size of the system using weighted Poisson distribution is less than that of the system constructed using Poisson distribution that leads to the reduction is the sampling cost and also with the high acceptance number makes both consumer and producer benefited.

Similarly the table 2 presents the matched Double sampling plan, Quick Switching System with Poisson distribution as a base line distribution with Weighted Poisson distribution. For given MAPD (p*) =0.0106 and MAAOQ = 0.0085 with the operating ratio the sample size for the DSP is 485 with acceptance number (485; 5, 12), QSDSS is (147, 1, 4) and QSDSS using

Weighted Poisson distribution is 68with acceptance number 1and 4 respectively and hence the system is QDSS (68; 1,4).

Table 1 Comparison of Quick Switching System QSDSS – (n, k; a_1, a_2)

p*	AOQL	R	QSDSS- Weighted Poisson					QSDSS- Poisson distribution				
			np*	a_1	a_2	k	N	np*	a_1	a_2	K	n
0.0042	0.0033	0.833	0.4162	1	4	1.50	**172**	1.8102	1	5	1.50	**439**
0.0106	0.0085	0.80	0.5189	2	4	1.25	**100**	1.2876	1	3	1.25	**121**
0.0223	0.0174	0.78	0.696	1	4	2.00	**31**	1.0331	0	6	1.75	**78**
0.02	0.0152	0.76	1.0624	2	5	1.50	**63**	2.3974	1	7	2.00	**120**

Table 2 DSP and its Matched QSDSS of Poisson and Weighted Poisson Distribution

p*	MAAOQ	R	DSP-P			QSDSS-P				QSDSS-WP			
			n	a_1	a_2	n	K	a_1	a_2	n	K	a_1	a_2
0.0106	0.0085	0.80	**485**	5	12	**147**	1.50	1	4	**68**	1.50	1	4
0.0223	0.0174	0.78	**100**	2	5	**58**	1.25	1	3	**31**	2.00	1	4
0.035	0.027	0.77	**90**	3	7	**79**	1.75	0	8	**37**	1.25	2	5
0.02	0.015	0.75	**253**	5	11	**90**	1.75	1	5	**51**	1.50	2	4
0.0054	0.0039	0.72	**746**	4	8	**437**	2.00	0	7	**218**	2.00	2	5

From the tables it is observed that the Quick Switching Double Sampling System of Weighted Poisson requires lesser sample size than that of the system and plan using Poisson distribution. The indexing parameters such as (MAPD, MAAOQ) and (MAPD, AOQL) can be used as per the need of the shop floor situation in the manufacturing industries.

Practical Application

In the mobile parts manufacturing company by considering the Antenna Switch, if the producer fixes the maximum allowable percent defective as 0.002 (2 defectives out of 1000) and the maximum allowable average outgoing quality as 0.0134 (134 defectives out of 10000). From the batch of lots, a random sample of size 52 is taken from the lot and check for the number of non-conformities, if the number of defectives is less than or equal to one accept the lot and greater than 4 reject the lot. If the number of defective is greater than one and less than or equal to 4 then combine the number of defectives in the previous lot, the succeeding lot and the current lot. If that value is 3 or less than 3 accept the lot, otherwise reject the lot and inform the management for the improvement of the product quality.

Conclusion

In this paper, QSDSS with reference to Double 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 application in industries when atleast one defective in the majority of the manufactured products occurs. To ensure attainment of a standard quality in second quality lots and to overcome the loss for the producer, the system developed using Weighted Poisson distribution is highly applicable with ease use constructed tables for the desired performance measures.

Construction of Tables

Under the assumption of the Weighted Poisson model and using equation (1) is solved for 'np' using computer programming in C++ for various values of c_0 and k, and for values of Pa(p). Table 3 provides such 'np' values for given values of c_0, k and Pa(p). For given combinations of α and β, the values of the operating ratio, R, are calculated and presented in Table 3.

REFERENCES

Arumainayagam S.D and Soundararajan V (1994): Quick Switching Double Sampling System – Acceptance Number Tightening; Communication in Statistics- Theory and Methods, Vol. 23, No.7, pp. 2079-2100.

Arumainayagam S.D and Soundararajan V (1995b): Construction and Selection of Quick Switching Double Sampling System – Sample Size Tightening; Journal of Applied Statistics, Vol. 22, No.1, pp. 105-119.

Arumainayagam S.D and Soundararajan V (1996b): Quick Switching Double Sampling System Indexed by the Crossover Point, Communications in Statistics-Simulation and Computation, Vol. 24, No. 3, pp. 765-773.

Arumainayagam S.D and Soundararajan V, (1994): Quick Switching Double Sampling System (QSDSS) – Acceptance Number, Tightening- Communication Statistics-Theory and Methods, 23 (7), 2079-2100.

Arumainayagam S.D and Uma G (2009): Construction and Selection of Quick Switching System using Weighted Poisson Distribution, International Journal of Statistics and Systems, ISSN 0973-2675, Vol. 4, No. 2, pp.127-136. Research India Publications.

Arumainayangam, S.D and Soundarajan. V. (1995): Construction and Selection of Quick Switching Double-Sampling System; sample size tightening Journal of Applied statistics, Vol.22, No.1, pp.105-119.

Cameroson, J.M. (1952): Tables for constructing and for computing the Operating Characteristics of Single sampling Plan, Industrial Quality Control, 9(1), 37-39.

Dodge H.F. (1963): A General Procedure for Sampling Inspection-Based on the AQL Concept, American Society for Quality Control Convention Transactions, pp. 7-8.

Dodge H.F. (1965): Evaluation of a Sampling Inspection System having Rules for Switching between Normal and Tightened Inspection, Technical Report, No.14, The Statistics Centre, Rutgers-The State University, New Brunswick, New Jersey.

Dodge H.F. (1973): Keep it Simple, Quality Progress, Vol.6, No.8, pp.11-12.

Dodge H.F. and Romig H.G. (1959): Sampling Inspection Tables – Single and Double Sampling, 2nd Edition, John Wiley and Sons, New York.

Kirkpatrick R.L. (1965): Binomial Sampling Plan Indexed by AQL and LTPD, Industrial Quality Control, Vol.22, No. 6, pp.290-292.

Palaniswamy R.(2008): Contributions to the Study of Designing of Certain Continuous, Chain Sampling Plans and Inspection Error, Ph. D., Thesis, Department of Statistics, PSG College of Arts and Science, Coimbatore, Tamil Nadu, India.

Palanivel (1999): Results and Tables relating to QSVSS- Acceptanec Criterion Tightening, Sample size Tightening – Ph.D. Thesis Bharathiar University, Coimbatore.

Radhakrishnan R (2002): Contribution to the Study of Selection of Certain Acceptance Sampling Plans, Ph. D., Dissertation, Bharathiar University, Coimbatore.

Radhakrishnan R. and Mohana Priya L. (2008): Selection of Single Sampling Plan Using Conditional Weighted Poisson Distribution, International Journal of Statistics and Systems (IJSS), ISSN 0973-2675 Volume 3, N0. 1, pp. 91-98.

Radhakrishnan R. and Sambath Kumar R. (2007): Construction and Comparison of Mixed Sampling Plans having Double Sampling Plan as Attribute Plan, International Journal of Statistics and Systems, Vol. 2, No. 2, pp. 33-39.

Radhakrishnan R. and Mohana Priya L. (2008): Comparison of CRGS Plans Using Poisson and Weighted Poisson Distributions, ProbStat Forum, Vol. 1, No.10, pp.50-61.

Radhakrishnan Rao, C. (1977): A Natural Example of a Weighted Binomial Distribution, The American Statistician, Vol.31, No.1.

Ramkumar T.B. and Divya A.K. (2010): Double Sampling Plan ($n_2 = n_1$) on the Discriminant Tangential Distance at MAPD, National Conference on Recent Advances in Statistics and Computer Applications, RASCA 2010, Dec 21-23, Department of Statistics, Bharathiar University.

Romboski L.D. (1969): An Investigation of Quick Switching Acceptance Sampling System, Ph.D. Thesis, Rutgers-The State University, New Brunswick, New Jersey.

Schiling E.G. (1982): Acceptance Sampling in Quality Control, Statistics: Text Books and Monographs, Vol.42 Marcel Dekker, INC. New Yark and Basel.

Schilling E.G. (1982): Acceptance Sampling in Quality Control, Marcel Dekker, Inc., New York.

Suresh K.K. and Sangeetha V. (2009): Selection of One Plan Suspension System with Special Type of Double Sampling Plan Through Minimum Angle Method, Quality Improvement Concepts and their Implementations in Higher Educational Institutions(QICIHEI-2009), ISBN: 978-81-907870-4-8, pp. 94-102.

Suresh K.K (1993): A Study on Acceptance Sampling using Acceptable and Limiting Quality Levels, *Ph.D., Dissertation,* Department of Statistics, Bharathiar University, Coimbatore, Tamil Nadu, India.

Sudeswari (2002): Designing of sampling plan using Weighted Poisson distribution, *M.Phil., Thesis,* Department of Statistics, PSG College of Arts and Science, Coimbatore, Tamil Nadu, India.

Vijayaraghavan R., Rajagopal K. and Loganathan A. (2008): A Procedure for Selection of a Gamma Poisson Single Sampling Plan by Attributes, Journal of Applied Statistics, Vol. 35, No. 2, pp. 149-160.

Table 1 Parametric Values of Quick Switching Double Sampling System using WPD

a_1	a_2	K	nAQL	nIQL	nLQL	$R_1=p_2/p_1$	$R_2=p_0/p_1$	ntanθ
1	2	1.25	0.0506	0.6187	1.8882	37.31621	12.22727	2.16188
1	2	1.50	0.05	0.5623	1.6124	32.24800	11.24600	1.83812
1	2	1.75	0.0494	0.5177	1.4142	28.62753	10.47976	1.60565
1	2	2.00	0.0489	0.4812	1.2641	25.85072	9.84049	1.42965
1	2	2.25	0.0483	0.4506	1.1461	23.72878	9.32919	1.29153
1	2	2.50	0.0478	0.4245	1.0506	21.97908	8.88075	1.17976
1	3	1.25	0.2037	0.8986	2.0447	10.03780	4.41139	2.16588
1	3	1.50	0.2008	0.8173	1.7512	8.72112	4.07022	1.82400
1	3	1.75	0.1978	0.7531	1.5418	7.79474	3.80738	1.58118
1	3	2.00	0.1946	0.7007	1.3841	7.11254	3.60072	1.39941
1	3	2.25	0.1915	0.6569	1.2605	6.58225	3.43029	1.25765
1	3	2.50	0.1884	0.6196	1.1606	6.16030	3.28875	1.14376
1	4	1.25	0.4231	1.2705	2.3978	5.66722	3.00284	2.32318
1	4	1.50	0.4162	1.1551	2.0585	4.94594	2.77535	1.93212
1	4	1.75	0.4085	1.0638	1.8174	4.44896	2.60416	1.65753
1	4	2.00	0.4005	0.9892	1.6361	4.08514	2.46991	1.45365
1	4	2.25	0.3924	0.9268	1.494	3.80734	2.36188	1.29600
1	4	2.50	0.3842	0.8737	1.3791	3.58954	2.27408	1.17047
2	4	1.25	0.5189	1.6264	3.2272	6.21931	3.13432	3.18624
2	4	1.50	0.5105	1.48	2.7677	5.42155	2.89912	2.65553
2	4	1.75	0.5014	1.3645	2.4408	4.86797	2.72138	2.28165
2	4	2.00	0.4919	1.2703	2.195	4.46229	2.58244	2.00365
2	4	2.25	0.4822	1.1917	2.0024	4.15263	2.47138	1.78847
2	4	2.50	0.4726	1.1247	1.8468	3.90774	2.37981	1.61671
2	5	1.25	0.7499	1.8892	3.3671	4.49007	2.51927	3.07906
2	5	1.50	0.7364	1.7191	2.8947	3.93088	2.33446	2.53918
2	5	1.75	0.7212	1.585	2.5607	3.55061	2.19773	2.16412
2	5	2.00	0.7052	1.4758	2.3103	3.27609	2.09274	1.88835
2	5	2.25	0.6888	1.3846	2.1144	3.06969	2.01016	1.67718
2	5	2.50	0.6725	1.307	1.9561	2.90870	1.94349	1.51012
3	5	1.25	0.936	2.4404	4.3831	4.68280	2.60726	4.05541
3	5	1.50	0.9195	2.2201	3.764	4.09353	2.41446	3.34647
3	5	1.75	0.9011	2.0462	3.3244	3.68927	2.27078	2.85094
3	5	2.00	0.8818	1.9044	2.9938	3.39510	2.15967	2.48471
3	5	2.25	0.8621	1.7858	2.7346	3.17202	2.07145	2.20294

Table 1: Parametric Values of Quick Switching Double Sampling System using WPD

a_1	a_2	k	nMAPD	nMAAOQ	R	h*	np_t	np_m	nAOQL	h_m	R_3	R_4
1	3	1.00	0.4204	0.35235	0.83813	0.29499	1.84552	1.00010	0.50322	1.00013	4.38992	1.19699
1	3	1.25	0.4125	0.34337	0.83241	0.31118	1.73810	0.82960	0.45156	0.90477	4.21358	1.09469
1	3	1.50	0.4047	0.33432	0.82609	0.32750	1.64042	0.72220	0.41421	0.84310	4.05342	1.02350
1	3	2.00	0.3885	0.31595	0.81325	0.35846	1.47229	0.58950	0.36165	0.76311	3.78968	0.93088
1	3	2.25	0.3802	0.30686	0.80711	0.37268	1.40037	0.54450	0.34194	0.73470	3.68325	0.89936
1	4	1.00	0.7409	0.61653	0.83214	0.40538	2.56856	1.21670	0.72732	1.00011	3.46681	0.98167
1	4	1.25	0.7329	0.60098	0.82001	0.45096	2.35809	1.03830	0.66529	0.92020	3.21748	0.90775
1	4	1.50	0.7231	0.58275	0.80591	0.50060	2.16756	0.92250	0.61820	0.86460	2.99760	0.85492
1	4	2.00	0.696	0.54061	0.77674	0.59976	1.85647	0.77350	0.54845	0.78690	2.66734	0.78800
2	4	1.00	1.1066	0.84496	0.76357	0.54902	3.12218	1.59580	0.92338	1.00008	2.82142	0.83443
2	4	1.25	1.0624	0.80258	0.75544	0.58987	2.86346	1.35140	0.84180	0.91791	2.69528	0.79235
2	4	1.50	1.0219	0.76252	0.74618	0.62890	2.64681	1.19580	0.78101	0.86270	2.59008	0.76427
2	4	1.75	0.9837	0.72494	0.73696	0.66473	2.46355	1.08440	0.73259	0.82089	2.50437	0.74473
2	4	2.00	0.9478	0.69011	0.72812	0.69740	2.30685	0.99910	0.69248	0.78741	2.43390	0.73061
2	4	2.25	0.9144	0.65807	0.71967	0.72751	2.17129	0.93080	0.65835	0.75960	2.37455	0.71997
2	4	2.50	0.8833	0.62865	0.71171	0.75520	2.05293	0.87440	0.62875	0.73600	2.32416	0.71182
4	8	1.00	3.051	2.22309	0.72864	1.01350	6.06137	3.03520	2.22317	1.00008	1.98668	0.72867
4	8	1.25	2.9232	2.06486	0.70637	1.20385	5.35141	2.70190	2.08823	0.94104	1.83067	0.71436
4	8	1.50	2.7813	1.91105	0.68711	1.36826	4.81402	2.47080	1.97405	0.89292	1.73085	0.70976
4	8	1.75	2.6448	1.77220	0.67007	1.51112	4.39503	2.29380	1.87516	0.85232	1.66176	0.70900
4	8	2.00	2.5208	1.64859	0.65399	1.64081	4.05712	2.15110	1.78842	0.81792	1.60946	0.70946
4	8	2.25	2.4103	1.53798	0.63809	1.76354	3.77704	2.03210	1.71158	0.78837	1.56704	0.71011
4	8	2.50	2.3119	1.43833	0.62214	1.88213	3.54024	1.93060	1.64295	0.76289	1.53131	0.71065