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RESEARCH ARTICLE

DEVELOPMENT OF QUICK SWITCHING SYSTEM OF TYPE 3 BASED ON TRUNCATED LIFE TEST UNDER LOG-LOGISTIC DISTRIBUTION

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ABSTRACT

The Quality control procedures for the products mainly depends on the assumed probability distribution and its lifetime data. The principal objective of this paper is to determine optimal parameters of Quick switching system of type 3 through percentiles under a probability distribution called as Log-logistic distribution. This proposed systems helps to improve the consumer-producer relationship by maintaining the quality consciousness at various quality levels. The relationship between the producer and consumer is based on the quality of the products produced by the manufacturers. Now industries has become an imperative towards the manufacturers to create products that are in line with the general standards and their interest is on consumers. An optimization problem is outlined for determining the plan parameters of QSS-3 using two points on the OC curve approach. The operating procedure and designing methodology of the QSS-3 are discussed. Tables are constructed to select the optimal parameters of the QSS-3 with given specification. A real life example is presented to study the effectiveness of the proposed method.

KEYWORDS: Reliability, Quick switching sampling, Acceptance sampling plans. OC curve.

1. Introduction

Quality of a product is brought about by the strict and consistent adherence to measurable and verifiable standards to achieve uniformity of output that satisfies specific consumer or user requirements. The important techniques used for statistical quality control can be broadly classified into two categories they are Process Control and Product Control. The main tool used is product control in acceptance sampling plan. Acceptance sampling deals with procedures or algorithms by which decision to accept or reject a lot is based on the results of the inspection of samples. When the quality is dealing with time we can apply reliability analysis into sampling plan. That is sampling plans are used to determine the acceptability of product, with respect to its life time are known as reliability sampling plans. The process of assessing the lifetime of the product or item through experiments is called a life-test.

Dodge (1965) presented sampling inspection systems having rules for switching between normal and tightened inspections for sampling plans. Romboski (1969) proposed a new sampling inspection system called "Quick Switching System (QSS-1)" with single sampling plan as a reference plan under this two major types are QSS-1(n, C_N, C_T) and QSS-1(n, kn, C_0). He made certain modifications on the switching rules of QSS-1 when it is compared with other systems. The resulting systems are QSS-2 and QSS-3. These systems are having an operating characteristic curve (OC) which is more discriminating than the corresponding OC curves of normal and tightened plans. Guenther W C. (1969) given the procedure of the Binomial, Hyper-geometric and Poisson Tables to obtain Sampling Plans. Soundararajan and Arumainayagam (1992) constructed quick switching system for costly and destructive inspection and a selection procedure for system using binomial model. Suresh and Kaviyarasu (2008) has studied extensively the Quick Switching System with CRGS plan as reference plan for Poisson model for the development of the systems.

Epstein (1954) first introduced single acceptance sampling plan for truncated life test when the lifetime of the product follows exponential distribution by considering the lot quality in terms of mean lifetime. Shah, B. K., & Dave, P. H. (1963) has introduced a note on the log-logistic distribution. Kantam et al. (2001) and (2006) has studied the log-logistic distribution in acceptance sampling plans based on truncated life tests. Aslam, M., and C.-H. Jun (2010). A double acceptance sampling plan for generalized log-logistic distributions with known shape parameters. Rao, G.S. and Kantam, R.R.L. (2010) has studied the acceptance sampling plans from truncated life tests based on the log-logistic distribution for percentiles. Balamurali et al.(2017) have investigated Quick Switching System under the conditions of Weibull life time model. Kaviyarasu and Sivasankari (2020) has studied time truncated reliability single sampling plan for weighted Rayleigh distribution.

In this paper, the designing of QSS of type-3 is considered under truncated life test plan under single sampling plan as reference plan under QSS-3(n, C_N, C_T). Here the lifetime of the product follows the Log-Logistic distribution when the attribute acceptance truncated sampling plan is based on life test when the failure data follows the proposed distribution.

The minimum sample size are determine at the given consumer's confidence level by integrating the minimum ASN. Further the optimal plan parameters are studied by specifying the two points on the OC curve. The minimum ratio of the percentile life are obtained to be specified producer's risk. The OC values are provided for a suitable real life situation which are given for easy implementation of the proposed method. Producer risk and consumer risk of the designing plan are properly cared and analysed. A suitable numerical illustration are given for the selection of the plans. Related tables are computed and given for easy selection of the plan parameter.

2. Conditions for application of QSS-3

In order to implement the proposed QSS-3 under life testing, the following condition are to be satisfied

- The production is steady, so that results on current and preceding lots are largely indicative of a continuous process.

- Lots are submitted significantly in the order of production.
- Three consecutive lots are to be accepted at tightened level

Romboski (1969) has derived the OC function of QSS-3(n; c_N, c_T)and presented tables for the selection of as QSS-3(n; c_N, c_T**)** system for given p_1, p_2, α and β. Arumainayagam (1991) studied Quick Switching System with various references and its applications and represented of QSS-3**(**n; c_N, c_T**)** as

$$P_a(p) = \frac{P_N P_T^3 + P_T(1-P_N)(P_T^2+P_T+1)}{P_T^3+(1-P_N)(P_T^2+P_T+1)} \quad (4.1)$$

where, $\boldsymbol{P_a(p)}$ = the acceptance probability of the lot under QSS system for given failure probability *p*.

P_N = the acceptance probability of the lot under normal inspection for given failure probability *p*

P_T = the acceptance probability of the lot under tightened inspection for given failure probability *p*

It can be obtained using the following equation,

$$P_N(p)=\sum_{d=0}^{c_N}\binom{n}{d} p^d(1-p)^{n-d} \quad (4.2)$$

$$P_T(p)=\sum_{d=0}^{c_T}\binom{n}{d} p^d(1-p)^{n-d} \quad (4.3)$$

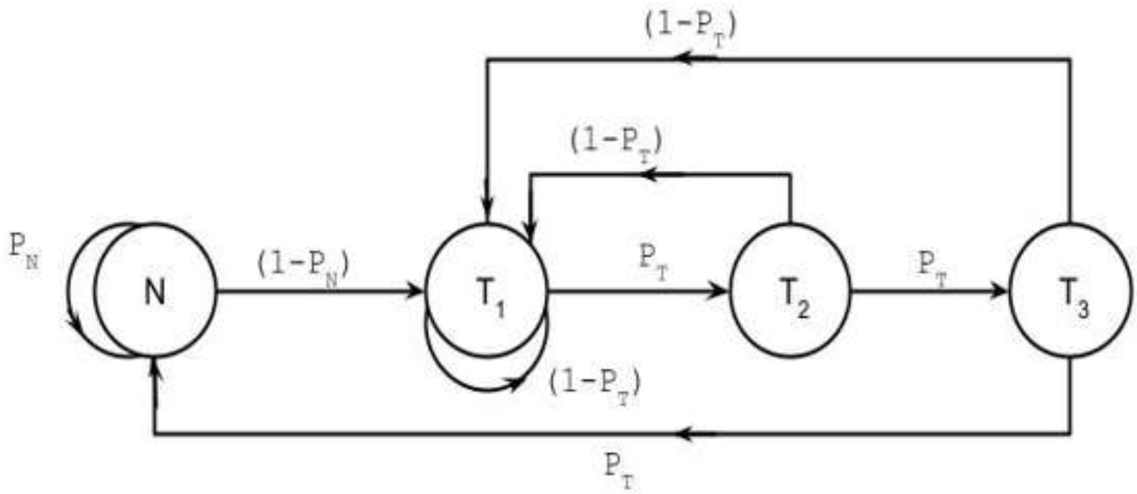


Figure 1 Oriented Graph for QSS-3 (n; c_N,c_T)

3. Operating procedure of QSS under truncated test

The following operating procedure can be executed in order to implement the proposed QSS-3 under truncated life test.

Step 1: Select a random sample of size *n* units from the submitted lot under normal inspection and put them on life test. Count the number of defects in the sample before the specified time t_0, denote it as d_N.

Step 2: Accept the lot if $\boldsymbol{d_N \leq c_N}$ or if $\boldsymbol{d_N} > c_N$, reject the lot and switch to tightened inspection.

Step 3: Under tightened inspection, select a random sample of size *n* units. Count the number of defects in the sample before the specified timet_0, denote it as d_T.

Step 4: Accept the lot if $\boldsymbol{d_T} \leq \boldsymbol{c_T}$ and continue inspection until three consecutive lots are accepted or if $\boldsymbol{d_T} > c_T$ reject the lot and go to Step 3 and the process will terminate when the continuous production is stopped.

where n = sample size,

c_N = acceptance number of the normal inspection

c_T = acceptance number of the tightened inspection($c_N > c_T$)

$\mathrm{d_N}$= number of defects in normal inspection

$\mathrm{d_T}$ = number of defects in tightened level

4. Construction of the plan

The proposed system gives the consumer more priority and increases the confidence of the producer in the quality of their product. The procedure of QSS-3 start with normal inspection and continue the sampling under normal inspection. If rejection occurs switch to tightened inspection and if a lot is accepted in tightened inspection continue tightened inspection until three consecutive lots are accepted then switch to normal inspection.

Suppose that the life-time 't' of a product follows a Log-Logistic distribution. Then the probability that the product fails before the experiment time t_0 is given by,

$$p = F(t_0) \tag{4.4}$$

Log-Logistic Distribution has a great application in Survival Analysis and Reliability studies. The Log-Logistic distribution is the probability distribution of a random variable whose logarithm has a Logistic distribution. The Probability Density Function (PDF) is given by ,

$$f(x)=\frac{\left(\frac{\gamma}{\sigma}\right)\left(\frac{t}{\sigma}\right)^{\gamma-1}}{\left[1+\left(\frac{t}{\sigma}\right)^{\gamma}\right]^2} \qquad t\geq 0,\ \gamma > 0,\ \sigma > 0 \tag{4.5}$$

and the Cumulative Distribution Function (CDF) of the Log-Logistic distribution is given by

$$F(x)=\frac{\left(\frac{t}{\sigma}\right)^{\gamma}}{1+\left(\frac{t}{\sigma}\right)^{\gamma}} \qquad t\geq 0,\ \gamma > 0,\ \sigma > 0 \tag{4.6}$$

whereγ is known shape parameter and σ is unknown scale parameter.

It is important to note that the CDF depends only on t/σ, since the shape parameter is known. The q^{th} percentile of the Log-logistic distribution is given as

$$\theta_q = \sigma\left(\frac{q}{1-q}\right)^{\frac{1}{\gamma}} \tag{4.7}$$

The probability that the product fails before the experiment time $t_0$under the Log-logistic

Distribution is given as

$$p=\frac{\left(\frac{t_0}{\sigma}\right)^{\gamma}}{1+\left(\frac{t_0}{\sigma}\right)^{\gamma}} \tag{4.8}$$

According to Aslam and Jun (2009), one can study the experiment time as a multiple of the specified q^{th}percentile life θ_0. That is, $t_0 = a\theta_0$ for a constant experiment termination ratio 'a'. Therefore Eqn. (2.8) can be rewritten as

$$p=\frac{a^{\gamma}\left(\frac{q}{1-q}\right)\left(\frac{\theta_0}{\theta_q}\right)^{\gamma}}{1+a^{\gamma}\left(\frac{q}{1-q}\right)\left(\frac{\theta_0}{\theta_q}\right)^{\gamma}} \quad (4.9)$$

The Operating Characteristic Function of the sampling plan is assumed to follow the B (n, c, p) gives the Probability of Acceptance ie. L(p) corresponding to their product quality.

$$L(p)=\sum_{i=0}^{c}\binom{n}{i}\,p^{i}\,(1-p)^{n-i}$$

5. Design of the proposed QSS-3

In this paper it is designed the QSS-3 with the simple objective of minimizing the ASN, the significance of such optimization eventually eases the inspection cost and time. The ASN of proposed QSS-3 has its sample size *n*. QSS-3 requires lesser sample size than that of corresponding matched single sampling plan of QSS-1 and QSS-2. Therefore the two points on the OC curve approach is followed to design the proposed QSS-3 with the intention of minimizing the ASN at both AQL and LQL. The optimal parameters are determined such that both the producer and consumer risks are satisfied with minimum sample size using the optimization problem. With the intention of determine the optimal parameters, the following optimization problem can be used,

:

$$\text{Minimize ASN}(p)=n$$
$$\text{Subject to } \mathrm{P_a}(\mathrm{p_1}) \geq 1-\alpha$$
$$\mathrm{P_a}(\mathrm{p_2}) \leq \beta$$
$$n>1,\ c_N > c_T \geq 0$$

where p_1 is the quality level corresponding to the producer's risk and p_2 is quality level corresponding to the consumer's risk also $P_a(p_1)$ is the acceptance probability of the lot under at p_1 and $P_a(p_2)$ is the acceptance probability of the lot under at p_2. The percentile ratio is described by, $\frac{\theta_q}{\theta_0}$=2, 2.5, 3, 3.5, 4 at producer's risk and that ratio is taken as 1 at consumer's risk.

When the size of lot is finitely large, the binomial model can be applied to determine the probability of acceptance. Stephens (2001) referred for more information on the use of binomial distribution. Accordingly the probabilities of acceptance for single acceptance sampling truncated life test plan under binomial model are given by

$L(p)=\sum_{d=0}^{c}\binom{n}{d}\,p^{d}(1-p)^{n-d}$ (4.10)

In this study, the optimal parameters of the proposed Quick Switching System-3 for assuring 20th and 50th product lifetime percentile are carried out based on binomial distribution. For determining the optimal parameters, various values of shape parameters are considered as 1,2,3 ($\gamma=$ 1,2,3). The producer's risk is fixed to be $\alpha=0.05$, the consumer risks are taken as β=0.25, 0.10, 0.05, 0.01 and the experiment test termination ratio is considered as following two cases when a=0.5 and a=1.0.

Table 1 Optimal parameters of the QSS-3 for 20th percentile with γ =1

β	θq/θo	a=0.5					a=1				
		n	c_N	c_T	$P_a(p_1)$	$P_a(p_2)$	n	c_N	c_T	$P_a(p_1)$	$P_a(p_2)$
0.25	2	18	5	0	0.9892	0.2286	12	6	0	0.9932	0.1354
	2.5	16	4	0	0.9929	0.237	10	4	0	0.9821	0.1354
	3	15	3	0	0.985	0.2097	8	3	0	0.9873	0.2186
	3.5	13	2	0	0.9669	0.2442	7	2	0	0.9664	0.2401
	4	13	2	0	0.9799	0.2442	7	2	0	0.9796	0.2401
0.10	2	23	6	0	0.9834	0.0909	12	6	0	0.9932	0.1354
	2.5	22	5	0	0.9889	0.0867	11	5	0	0.996	0.1287
	3	20	4	0	0.9891	0.105	10	4	0	0.9947	0.1354
	3.5	19	3	0	0.9745	0.1119	9	3	0	0.9881	0.1529
	4	19	3	0	0.9872	0.1119	9	3	0	0.994	0.1529
0.05	2	27	7	0	0.9846	0.0504	15	7	0	0.9857	0.0446
	2.5	26	5	0	0.9507	0.0482	14	6	0	0.9946	0.0506
	3	25	4	0	0.9454	0.0534	14	6	0	0.999	0.0506
	3.5	25	4	0	0.9804	0.0534	14	6	0	0.9998	0.0506
	4	25	4	0	0.9919	0.0534	14	6	0	0.9999	0.0506
0.01	2	42	10	0	0.9552	0.0072	23	10	0	0.9612	0.006
	2.5	39	8	0	0.9787	0.0102	22	8	0	0.9638	0.0074
	3	38	7	0	0.9887	0.0114	21	7	0	0.9848	0.0092
	3.5	37	6	0	0.9884	0.0128	19	6	0	0.9927	0.0145
	4	36	5	0	0.9814	0.0144	19	6	0	0.9979	0.0145

Table 2 Optimal parameters of the QSS-3 for 20th percentile with γ =2

β	θq/θo	a=0.5					a=1				
		n	c_N	c_T	$P_a(p_1)$	$P_a(p_2)$	n	c_N	c_T	$P_a(p_1)$	$P_a(p_2)$
0.25	2	12	6	0	0.9932	0.1354	8	3	0	0.9971	0.2186
	2.5	10	4	0	0.9821	0.1354	8	3	0	0.9997	0.2186
	3	8	3	0	0.9873	0.2186	7	2	0	0.9989	0.2401
	3.5	7	2	0	0.9664	0.2401	7	2	0	0.9996	0.2401
	4	7	2	0	0.9796	0.2401	7	2	0	0.9998	0.2401
0.10	2	12	6	0	0.9932	0.1354	10	3	0	0.9886	0.1144
	2.5	11	5	0	0.996	0.1287	9	2	0	0.9887	0.139
	3	10	4	0	0.9947	0.1354	9	2	0	0.9969	0.139
	3.5	9	3	0	0.9881	0.1529	9	2	0	0.9989	0.139
	4	9	3	0	0.994	0.1529	9	2	0	0.9996	0.139
0.05	2	15	7	0	0.9857	0.0446	14	4	0	0.9887	0.0445
	2.5	14	6	0	0.9946	0.0506	13	2	0	0.9494	0.0551
	3	14	6	0	0.999	0.0506	13	2	0	0.987	0.0551
	3.5	14	6	0	0.9998	0.0506	13	2	0	0.9957	0.0551
	4	14	6	0	0.9999	0.0506	13	2	0	0.9983	0.0551
0.01	2	23	10	0	0.9612	0.006	21	5	0	0.9554	0.0092
	2.5	22	8	0	0.9638	0.0074	20	4	0	0.9917	0.0115
	3	21	7	0	0.9848	0.0092	19	4	0	0.9994	0.0144
	3.5	19	6	0	0.9927	0.0145	19	4	0	0.9999	0.0144
	4	19	6	0	0.9979	0.0145	19	4	0	0.999	0.0144

Table 3 Optimal parameters of the QSS-3 for 20th percentile with γ =3

β	θq/θo	a=0.5					a=1				
		n	c_N	c_T	Pa(p1)	Pa(p2)	n	c_N	c_T	Pa(p1)	Pa(p2)
0.25	2	49	2	0	0.9983	0.2475	8	3	0	0.9999	0.2186
	2.5	47	1	0	0.9947	0.2436	7	2	0	0.9998	0.2401
	3	47	1	0	0.9984	0.2436	7	2	0	0.999	0.2401
	3.5	47	1	0	0.9994	0.2436	7	2	0	0.999	0.2401
	4	47	1	0	0.9997	0.2436	7	1	0	0.9997	0.216
0.10	2	76	3	0	0.9994	0.0993	11	3	0	0.9994	0.0886
	2.5	75	2	0	0.9992	0.1006	10	2	0	0.9993	0.1093
	3	75	1	0	0.9955	0.0998	9	1	0	0.9963	0.1353
	3.5	75	1	0	0.9983	0.0998	9	1	0	0.9986	0.1353
	4	75	1	0	0.9993	0.0998	9	1	0	0.9994	0.1353
0.05	2	97	3	0	0.9982	0.0508	15	3	0	0.9965	0.0353
	2.5	95	2	0	0.9983	0.0539	14	2	0	0.9976	0.044
	3	95	2	0	0.9997	0.0539	14	2	0	0.9996	0.044
	3.5	94	1	0	0.9973	0.0555	13	1	0	0.9969	0.055
	4	94	1	0	0.9988	0.0555	13	1	0	0.9987	0.055
0.01	2	149	4	0	0.9982	0.0102	22	4	0	0.9967	0.0074
	2.5	148	3	0	0.9994	0.0105	21	3	0	0.9992	0.0092
	3	148	2	0	0.9988	0.0105	20	2	0	0.9986	0.0115
	3.5	147	1	0	0.9928	0.0109	19	1	0	0.9927	0.0144
	4	147	1	0	0.997	0.0109	19	1	0	0.9969	0.0144

Table 4 Optimal parameters of the QSS-3 for 50th percentile with γ =1

β	θq/θo	a=0.5					a=1				
		n	c_N	c_T	Pa(p1)	Pa(p2)	n	c_N	c_T	Pa(p1)	Pa(p2)
0.25	2	7	5	0	0.9617	0.0836	9	7	2	0.9825	0.119
	2.5	6	4	0	0.9828	0.1177	9	7	2	0.9976	0.119
	3	6	4	0	0.995	0.1177	6	5	1	0.9984	0.1702
	3.5	6	4	0	0.9982	0.1177	6	5	1	0.9994	0.1702
	4	4	2	0	0.9802	0.2343	6	5	1	0.9998	0.1702
0.10	2	9	7	0	0.9922	0.043	8	7	1	0.98	0.0454
	2.5	8	5	0	0.9664	0.0417	7	6	1	0.9967	0.089
	3	7	4	0	0.9762	0.0623	6	4	1	0.9711	0.1176
	3.5	6	3	0	0.9689	0.0928	4	3	0	0.9537	0.0657
	4	6	3	0	0.9846	0.0928	4	3	0	0.9775	0.0657
0.05	2	11	8	0	0.9711	0.0127	9	8	1	0.983	0.0232
	2.5	10	7	0	0.9954	0.0188	9	8	1	0.9989	0.0232
	3	9	5	0	0.9702	0.0264	8	6	1	0.9924	0.0363
	3.5	8	4	0	0.971	0.0396	8	6	1	0.998	0.0363
	4	8	4	0	0.9882	0.0396	8	6	1	0.9993	0.0363
0.01	2	13	10	0	0.9936	0.0058	10	9	1	0.9852	0.012
	2.5	13	10	0	0.9998	0.0058	10	9	1	0.9993	0.012
	3	12	8	0	0.9991	0.0078	10	9	1	0.9999	0.012
	3.5	11	6	0	0.992	0.0116	9	8	0	0.9988	0.002
	4	11	6	0	0.9978	0.0116	8	7	0	0.9995	0.0039

Table 5 Optimal parameters of the QSS-3 for 50th percentile withγ =2

β	θq/θo	a=0.5					a=1				
		n	c_N	c_T	$P_a(p_1)$	$P_a(p_2)$	n	c_N	c_T	$P_a(p_1)$	$P_a(p_2)$
0.25	2	9	4	0	0.9996	0.2161	6	4	1	0.9944	0.1176
	2.5	8	2	0	0.9931	0.1798	5	3	1	0.9975	0.205
	3	7	1	0	0.9766	0.216	5	3	1	0.9994	0.205
	3.5	7	1	0	0.9884	0.216	3	1	0	0.9695	0.1263
	4	7	1	0	0.9936	0.216	3	1	0	0.9835	0.1263
0.10	2	11	3	0	0.9799	0.0886	7	5	1	0.9981	0.0657
	2.5	10	2	0	0.9826	0.1093	6	3	1	0.9919	0.1112
	3	10	2	0	0.9954	0.1093	6	3	1	0.9982	0.1112
	3.5	9	1	0	0.9786	0.1353	4	2	0	0.9959	0.063
	4	9	1	0	0.9883	0.1353	3	1	0	0.9835	0.1263
0.05	2	15	4	0	0.9809	0.0354	8	6	1	0.9993	0.0363
	2.5	14	3	0	0.9918	0.0442	6	5	0	0.9999	0.0159
	3	14	3	0	0.9986	0.0442	6	5	0	0.9999	0.0159
	3.5	13	1	0	0.948	0.055	5	3	0	0.9995	0.0314
	4	13	1	0	0.9719	0.055	5	3	0	0.9999	0.0314
0.01	2	22	5	0	0.9323	0.0074	8	6	0	0.9825	0.0039
	2.5	21	4	0	0.9882	0.0092	7	5	0	0.999	0.0078
	3	20	3	0	0.9907	0.0115	7	5	0	0.9999	0.0078
	3.5	19	2	0	0.9815	0.0144	6	2	0	0.972	0.0156
	4	19	2	0	0.993	0.0144	6	2	0	0.9896	0.0156

Table 6 Optimal parameters of the QSS-3 for 50th percentile withγ =3

β	θq/θo	a=0.5					a=1				
		n	c_N	c_T	$P_a(p_1)$	$P_a(p_2)$	n	c_N	c_T	$P_a(p_1)$	$P_a(p_2)$
0.25	2	14	2	0	0.9978	0.2096	5	2	1	0.9849	0.1908
	2.5	14	2	0	0.9998	0.2096	5	2	1	0.9978	0.1908
	3	12	1	0	0.9984	0.2533	3	1	0	0.9949	0.1263
	3.5	12	1	0	0.9994	0.2533	3	1	0	0.9981	0.1263
	4	12	1	0	0.9997	0.2533	3	1	0	0.9992	0.1263
0.10	2	20	2	0	0.9915	0.0959	5	4	0	0.9999	0.0321
	2.5	16	1	0	0.99	0.1536	4	3	0	0.9999	0.0657
	3	16	1	0	0.997	0.1536	4	3	0	0.9999	0.0657
	3.5	16	1	0	0.9989	0.1536	3	1	0	0.9981	0.1263
	4	16	1	0	0.9995	0.1536	3	1	0	0.9992	0.1263
0.05	2	27	3	0	0.9974	0.0417	11	7	2	0.9999	0.033
	2.5	26	2	0	0.9979	0.0468	6	3	0	0.9995	0.0156
	3	26	2	0	0.9997	0.0468	6	3	0	0.9999	0.0156
	3.5	25	1	0	0.997	0.0527	5	2	0	0.9998	0.0313
	4	25	1	0	0.9987	0.0527	5	2	0	0.9999	0.0313
0.01	2	38	5	0	0.9999	0.0114	8	5	0	0.9993	0.0039
	2.5	37	4	0	0.999	0.0128	7	3	0	0.9986	0.0078
	3	37	3	0	0.999	0.0128	7	3	0	0.9999	0.0078
	3.5	36	2	0	0.9998	0.0144	6	2	0	0.9997	0.0156
	4	36	2	0	0.9999	0.0144	6	2	0	0.9999	0.0156

From above tables, it's understood that when the percentile ratio is increases from 2 to 4 for fixed values of α, β and a then the sample size decreases. The optimal parameters of the QSS-3 are same when γ=2 and β =5%, for the 20th percentile ratio from 2.5 to 4 at both cases of a = 1.0 and a = 0.5 ie. n=14,$c_N = 6$ and $c_T = 0$ when the experiment termination ratio a=0.5 and n=13,$c_N = 2$ and $c_T = 0$ when the experiment termination ratio a=1..And also the optimal parameters of the QSS-3 are same when **σ**=3 and β =25%, for the 50th percentile ratio from 3 to 4 at both cases of a = 1.0 and a = 0.5.

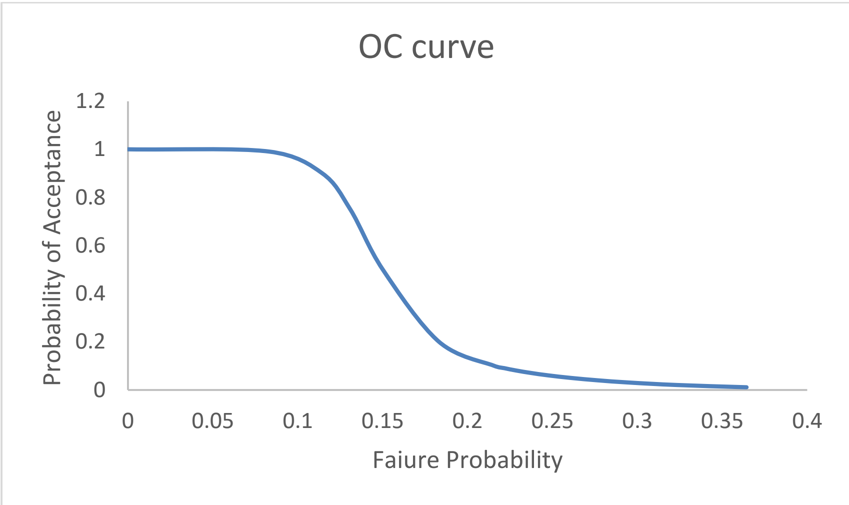
6.Plotting OC curve

The performance of the each sampling plan against good and bad quality can be portrays using OC curves. The OC curve for QSS-3 is constructed using the following table

p	0.3644	0.2611	0.2156	0.1501	0.131	0.1145	0.0831
$\boldsymbol{P_a(p)}$	0.01	0.05	0.10	0.50	0.75	0.90	0.99

under 20th percentile using log-logistic distribution with γ**=1** and experiment termination ratio a=1. Figure (4.2) ~~shows the~~ OC curve of QSS-3 with randomly chosen parameters n=10,c_N =4,$c_T = 0$

Figure 2 OC curve of QSS-3 (10,4,0)



7. Real life Example

The real time data is given to implement the proposed QSS-3 for assuring 20th percentile life of the product where the life time follows Log-Logistic distribution with shape parameter γ =1. The data is discussed by Schmee and Nelson (1977) and show the number of thousand miles at which different locomotive controls failed.The producer and consumer risks are considered as α=5% and β=25% respectively and the percentile ratio $\frac{\theta_q}{\theta_0}$=4

Let the specified percentile of the product θ_0=47 and the experiment time be t_0=47 so that the experiment termination ratio a=1.0. For the specified requirements, Table 1 yields the optimal parameters as n=7,$c_N = 2$, $c_T = 0$**).** Then using the data the proposed plan can be implemented with the above mentioned optimal parameters as follows

Start with Normal inspection and select a random sample of 7 units from the lot and put them on life test for specified time 47. The failure time for the 7 units are given as,

22.5	37.5	46.0	48.5	51.5	53.0	54.5

3 observations are failed. At the time 22.5, 37.5, 46.0 (i.e.d_N= 3). $d_N > c_N$- The lot is rejected under normal inspection and switch to tightened inspection for next lot.

57.5	66.5	68.0	69.5	76.5	77.0	78.5

From the table above data, it is observed that no item is failed before the experiment time 47 under tightened inspection. $d_T < c_T$ therefore accept the lot and continue the tightened inspection for next lot with sample size 7 and failure time of each item is observed as follows

80.0	81.5	82.0	83.0	84.0	91.5	93.5

It is observed that no item is failed before the experiment time 47 under tightened inspection.$d_T < c_T$therefore accept the lot and continue the tightened inspection for next lot with sample size 7 and failure time of each item is observed as follows

102.5	107.0	108.5	112.5	113.5	116.0	117.0

It is observed that no item is failed before the experiment time 47 under tightened inspection.$d_T < c_T$therefore accept the lot here three consecutive acceptance occur under tightened inspection so it can be switch to normal inspection for next lot.

8.Conclusion

The research paper is mainly focused on QSS of type 3 of (n, c_N, c_T). It is proposed a Quick Switching Single Sampling System 3for assuring product lifetime percentile under Log-logistic distribution with single sampling as reference plan. Tables have been provided for selecting the optimal parameters. It is concluded that the proposed system is very useful and effective in reducing the inspection time and cost. OC curve were developed. Determined the minimum number of sample size 'n' for several values of consumer's risk, percentile ratio are assumed to be specified. The probability of acceptance is also obtained for the two quality levels. The developed system helps to improve the consumer-producer relationship by maintaining the quality consciousness at all levels. For future study this work also extended to designing a reliability sampling plan for various percentile levels for the other continuous probability distributions. The efficiency of the proposed method can be developed using cost model.

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