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DESIGN OF ACCEPTANCE SAMPLING PLAN FOR LIFE TESTS REJECTED LOTS ACCEPTANCE SAMPLING PLANS

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Abstract:

The principal objective of this paper is to obtain attribute characteristic parameter of Acceptance Single Sampling Plans through percentiles of Exponentiated Rayleigh distribution. The life distribution is assumed to follow Exponentiated Rayleigh distribution. The hazard function and the percentile estimator is derived and the Acceptance Single Sampling Plan is developed. The operating characteristic values are obtained and this work extends by finding the ratio which fixes the producer's risk at 5%. An example is given for the effective use of the developed plan.

Keywords: Acceptance Sampling Plan; Attribute characteristic parameters; Exponentiated Rayleigh distribution; percentiles.

1. INTRODUCTION

Acceptance Sampling first given by Dodge and Romig (1929) is a process of making decision whether to accept or reject a lot based on the information gained from the sample inspected. This type of sampling is also called attribute sampling, based on the item sampled is classified as acceptable or unacceptable, defective or non-defective, conforming or non- conforming, pass or fail, good or bad etc. The key objective of Attribute Acceptance Sampling Plan is not to assess the quality of lots but to take decision on lots. The literature evidently show the existence of several Acceptance Sampling Plans and in this paper Acceptance Single Sampling Plan (sentencing a lot using single sample) is used in the context of life testing.

In present situations, products are manufactured and guaranteed with high reliability. In order to know the lifetime information of a particular product, a destructive experiment is made on it. Since the process is long and time consuming, the life time is truncated for a pre-specified time. The life distribution is assumed to follow Exponentiated Rayleigh Distribution. This experiment is terminated in two cases, when the number of failure item exceeds the expected number of failures or when the pre-specified time is attained. While designing the Acceptance Sampling Plan for the truncated life test we consider both producer and consumer and so their respective risks are optimized. Balakrishnan et al. (2007), Lio et al. (2009), Rao and Kantam (2010), Roa et al. (2012), Rao(2014) developed the Acceptance Sampling plans based on percentiles for truncated life tests. Percentiles are taken into account because lesser percentiles provide more information than mean life regarding the life distribution. The 50th percentile is the median which is equivalent to the mean life. So, literatures prove this as the generalization of Acceptance Sampling Plans based on the mean life of products. The Rayleigh distribution (RD) was originally derived by Rayleigh (1880) in physical sciences for understanding the intensity of sound.

2. RELATED WORK

Sampling plans often used to determine the acceptability of lots of items. Although in recent years more emphasis is placed on process control and off-line quality control methods, acceptance sampling remains as a major tool of many practical quality control system. In acceptance sampling, if the quality variable is the lifetime of an item, the problem of acceptance sampling is known as the reliability sampling, and the test is called the life test. We would like to know whether the lifetimes of items reach our standard or not. When the life test shows that the mean lifetime of items exceeds or equals to the specified one, we treat the lot of items as acceptable; conversely, when the life test shows that the mean lifetime of the lot of items is less than our standard, we treat the lot as unacceptable and reject it. Whenever the quality of the product is related to its lifetime, it is then called as life testing. Here it is common practice to truncate the experiment during the sampling process if no failure occurs within the experimental time period or the number of failure exceeds the specified number.

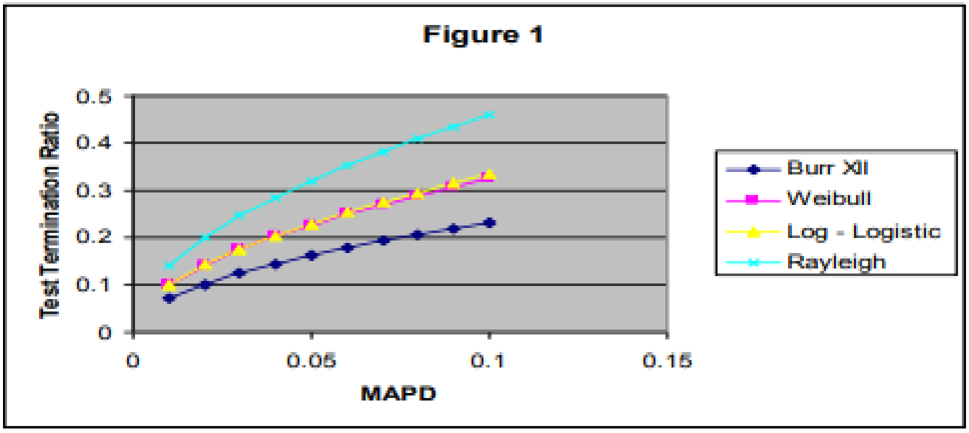

Fig.1.Test Figure

Acceptance sampling plan is an essential tool in the statistical quality control as hundred percent inspections of the products is not possible. This type of sampling plans was first applied by the US military for testing the bullets during World War II. Acceptance sampling plan is a middle path between hundred percent inspections and no inspection at all. Many authors have discussed acceptance sampling based on truncated life tests. Aslam M. (2007) has studied double acceptance sampling based on truncated life tests in Rayleigh distribution. Again Aslam M., with Jun, C.H. (2009) studied a group acceptance sampling plans for truncated life tests based on the inverse Rayleigh and log-logistic distributions. Fertig F.W. and Mann N.R. (1980) developed life-test sampling plans for two-parameter Weibull populations. Goode H.P., and Kao J.H.K. (1961) have studied Sampling plans based on the Weibull distribution. Kantam R.R. L., Rosaiah K. and Srinivasa Rao G. (2001) have studied acceptance sampling based on life tests. Muhammad Hanif, Munir Ahmad and Abdur Rehman (2011) developed economic reliability acceptance sampling plans from truncated life tests based on the Burr Type XII percentiles.

3. PROPOSED SYSTEM

MAPD is a key measure assessing to what degree the inflection point empowers the OC curve to discriminate between good and bad lots. Many authors have discussed MAPD, Mayor (1956) introduced the concept of MAPD in a SSP using Poisson model. MAPD locates a point of the OC curve at which the descent is steepest. It is defined as the proportion of defective beyond which consumer won't be willing to accept the lot. Mandelson (1962) has explained the desirability for developing a system of sampling plan indexed by MAPD and suggested a relation $p^* = c/n$. Soundararajan (1975) has indexed SSP through MAPD. Norman Bush (1953) developed a SSP based on tangent at inflection point. This technique states that a straight line will uniquely portray the slope of OC curve and hence the OC is fixed. According to Norman Bush the point of inflection has been chosen because it is most representative point of an OC curve showing the turning point of quality since the maximum tangent occurs at this point. Ramkumar (2009) developed Design of single sampling plan by discriminate at MAPD.

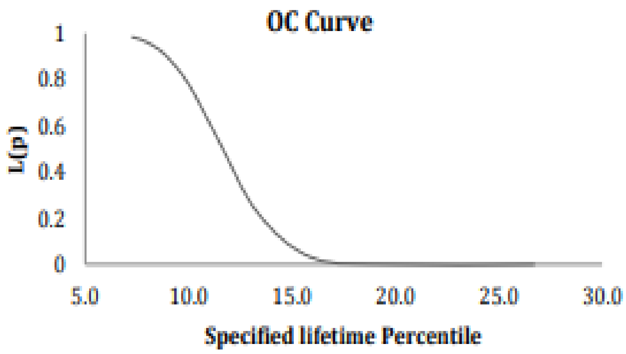

Fig.2.OC Curve

We in this paper has developed an acceptance plan by fixing MAPD, which has single sampling plan as attribute plan to obtain the test termination ratios, assuming that the life time of the product follows different distributions. The probability of acceptance can be regarded as a function of the deviation of the specified value μ0 of the median from its true value μ. This function is called Operating Characteristic (OC) function of the sampling plan. Once the minimum sample size is obtained, one may be interested to find the probability of acceptance of a lot when the quality (or reliability) of the product is sufficiently good. As mentioned earlier, the product is considered to be good if $\mu \geq \mu 0$. The probabilities of acceptance are displayed in Table 3 and 4 for various values of the median ratios μ/μ0, producer's risks β and time multiplier a. Suppose that an experimenter wants to run an experiment at t = 1500 hours ensuring that the specified average life is at least 1000 hours. This leads to the termination ratio of 1.5. For the producers risk of 0.05, the sampling plan (n = 4, c = 1, t/σ0 = 1.500), by Tsai and Wu (2006) states that, if during 1500 hours no more than 1 failure out of 4 is recorded, the lot is accepted, otherwise rejected. For the same sampling plan Mohammad Aslam (2008) with the proposed plan (n = 4, c = 1, t/σ0 = 0.362), states that, we reject the product if more than one failure occur during 362 hours, otherwise we accept it. Our proposed plan is to reduce the time to the minimum by introducing maximum allowable percent defective. Suppose that n = 100, c = 1 and p* = 0.01 then from the Table 2, t/σ0 = 0.070976 for that the life time that follows Burr XII distribution, t/σ0 = 0.100251 for that the life time that follows Weibull distribution, t/σ0 = 0.100504 for that the life time that follows Log – Logistic distribution, t/σ0 = 0.141777 for that the life time that follows Rayleigh distribution. This states that, we reject the product if more than one failure occurs within 71 hours for Burr XII distributions,100 hours for Weibull, 101 hours for Log – Logistic and 142 hours for Rayleigh distribution. Among these distributions Burr XII using MAPD is better than all other distributions.

4. ANALYSIS

If some other parameters are involved, then they are assumed to be known, for an example, if shape parameter of a distribution is unknown it is very difficult to design the acceptance sampling plan. In quality control analysis, the scale parameter is often called the quality parameter or characteristics parameter. Therefore it is assumed that the distribution function depends on time only through the ratio of t/ σ. Where L (p) is the probability of acceptance at quality level p fraction defectives. In our proposed plan we equate p to that of the fixed MAPD to obtain the test termination ratio. Soundarajan (1975) has proposed a procedure for designing a single sampling plan with quality standards p* and k = pt/p*, where pt is the tangent intercept to the p – axis from the inflection point of the OC curve. The paper determines the termination time according to different distributions with fixed MAPD. We have developed an acceptance plan by fixing MAPD, which has single sampling plan as attribute plan to obtain the test termination ratios, assuming that the life time of the product follows different distributions. This plan has reduced the test termination ratios to the maximum reducing the time of inspection and increasing the mean life of the product.

p*	t/σ_0			
	Burr XII	Weibull	Log - Logestic	Rayleigh
0.01	0.070976	0.100251	0.100504	0.141777
0.02	0.100760	0.142136	0.142857	0.201011
0.03	0.123880	0.174526	0.175863	0.246817
0.04	0.143599	0.202045	0.204124	0.285734
0.05	0.161178	0.226480	0.229416	0.320291
0.06	0.177260	0.248748	0.252646	0.351782
0.07	0.192228	0.269389	0.274352	0.380974
0.08	0.206330	0.288759	0.294884	0.408367
0.09	0.219738	0.307100	0.314485	0.434306
0.10	0.232578	0.324593	0.333333	0.459044

Table.1.Output Analysis

The paper can be extended by introducing more distributions which can be compared with the distributions present in the paper to reduce the termination. ratios even more. The paper can further be extended by fixing the existing time termination ratios one can try to find the mean ratios. ASSP is an inspection procedure used to determine whether to accept or reject a specific lot. Since the success and failure are experienced in frequent mode and also larger sized lots are taken, the parameter is said to follow binomial distribution with parameter.

CONCLUSION

This article establishes the Acceptance Sampling Plans based on percentiles of Exponentiated Rayleigh Distribution when the life test is truncated for a pre- specified time. The proposed plan is constructed with the shape parameter. This plan ensures the life time quality at the specified life percentile. The tables are provided for the effective use of the plan. This research work can be extended to all existing ASP.

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