International Journal of Applied Engineering Research ISSN 0973-4562 Volume 12, Number 22 (2017) pp. 12246-12249

Two Sided Complete Bayesian Chain Sampling Plan with Beta Binomial as Prior Distribution

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Abstract

In this paper, the average probability of acceptance of Bayesian Two sided Complete Chain Sampling Plan is derived considering the beta binomial as the prior distribution. The values for the extract of Two Sided Complete Bayesian Chain Sampling Design on the basis of different combinations of argument are tabulated.

Keywords: Probability of acceptance, Bayesian Two sided complete chain sampling, Beta Binomial distribution, AQL, IQL, LQL

INTRODUCTION

Acceptance Sampling is an important tool in Statistical Quality Control. In acceptance sampling an item or product checked will be a defective or in defective. There are lots of steps for accepting an item or a product. Mainly two ways are available for sampling inspection (hundred percentage inspection and acceptance sampling) .The sampling inspection concerns with only the selective samples. So, the cost of testing an item or a product can be reduced and also the time of inspection may get reduced. For example, to know whether the bunch of grapes is good one or not, one or two grapes can be tested and if it is good, the purchase is made. And if it is a bad one, the purchase of the whole bunch is denied. For those types of examples this sampling inspection method is used. Therefore acceptance sampling is a technique for analyzing to know whether the product is a good item or a bad item.

BAYESIAN CHAIN SAMPLING PLAN

This type of sampling plan deals with the distribution that have been taken at the earlier stage for taking of samples. This is called the prior distribution. Here, the prior distribution as Beta distribution is used. The operating characteristic function of Chain Sampling Plan is given by Dodge (1955). M Latha (2001) has studied on Bayesian Chain Sampling Plan for a gamma prior. Previous i samples are used in Bayesian chain sampling. Latha and Rajeswari (2012) have studied Cost and Regret Function for Bayesian Chain Sampling plan-1 and Latha and Jeyabharathi (2014) have studied on Performance Measures for Bayesian Chain Sampling Plan using Binomial Distribution.

TWO SIDED COMPLETE CHAIN SAMPLING PLAN

The string of mountains sampling architectural plan is developed by many authors is a partial chaining or one sided chaining.ie, they will chain only the past tense quite a little which decides about the stream lot or they may differ the conclusion until few sample results are obtained. But the literature is scarce in growing of two sided chain sampling architectural plan. Hence, two sided complete chain sampling plan is developed by considering the results of past as well as future bunch if the stream sample does not track to credence of the lots and there will be possibilities in many yield diligence for past, stream and future samples, then the two sided complete chain sampling design can be applied. Many quality ascendance practician insist that , if any defective occurs in a sample then not only the preceding 'i' samples is taken in account but also the succeeding 'j' samples should also be considered for the decision of the current lot. Hence an attempt has been made to develop two sided complete chain sampling plans. Operating characteristic function for two sided complete chain sampling plan is given by Rebecca Jebaseeli Edna K (2012).

The operating characteristic function for Two Sided Complete Chain Sampling Plan is

$$p_{0,n} + (p_{0,n})^i p_{1,n} (p_{0,n})^j$$

The average probability of acceptance for Bayesian Two Sided Complete Chain Sampling Plan is given as

$$\bar{p} = \int_0^\infty p(n, {}^i\!/_p) w(p) dp$$

Where, $w(p) = \frac{1}{\beta(s,t)} p^{s-1} (1-p)^{t-1}\,; s,t > 0$

It is observed that p follows Beta distribution with density function,

Therefore,

$$\bar{p} = \frac{1}{\beta(s,t)}[\beta(s,n+t) + n\beta(s+1, n(i+j+1)+t-1)]; \quad if\ i \neq j$$

$$= \frac{1}{\beta(s,t)}[\beta(s,n+t) + n\beta(s+1, n(2i+1)+t-1)]; \quad if\ i = j \quad \text{(A)}$$

The average production quality level 'μ' using Newton's estimation method is obtained and those values are represented in the Table 1.

In the similar way, the above equation for $(i = j)$is equated to the average probability of acceptance 0.95 and 0.10, AQL and LQL are obtained in the Table 1.

The indifference Quality Level (IQL) or Point of Control condition μ_0 can be calculated by the above equating to 0.50 for various values of s, n, i using Newton's method of estimation and those values are presented in the table 1.

Construction of Tables

If i=j=1, s=1, $\bar{p}$ is reduced and μ_0 is the point of control

The above equation (A) can be reduced to

$$\bar{p} = (1-\mu)[\frac{1}{(n\mu-\mu+1)} + \frac{n\mu}{(3n\mu-2\mu+1)(3n\mu-\mu+1)}]$$

Where, $\mu = {}^{s}/_{s+t}$

If i=j=1,s=2,$\bar{p}$ is reduced to, $\bar{p}$

$$= (2-2\mu)(2-\mu)[\frac{1}{(n\mu-2\mu+2)(n\mu-\mu+2)} + \frac{2n\mu}{(3n\mu-3\mu+2)(3n\mu-2\mu+2)(3n\mu-\mu+2)}]$$

If i=j=1,s=3,$\bar{p}$ is reduced to, $\bar{p} = (3-3\mu)(3-2\mu)(3-\mu)$

$$[\frac{1}{(n\mu-3\mu+3)(n\mu-2\mu+3)(n\mu-\mu+3)} + \frac{3n\mu}{(3n\mu-4\mu+3)(3n\mu-3\mu+3)(3n\mu-2\mu+3)(3n\mu-\mu+3)}]$$

If i=j=2,s=1,$\bar{p}$ reduces to,

$$\bar{p} = (1-\mu)[\frac{1}{(n\mu-\mu+1)} + \frac{n\mu}{(5n\mu-2\mu+1)(5n\mu-\mu+1)}]$$

If i=j=2, s=2, $\bar{p}$ reduces to, $\bar{p} = (2-2\mu)(2-\mu)$

$$[\frac{1}{(n\mu-2\mu+2)(n\mu-\mu+2)} + \frac{2n\mu}{(5n\mu-3\mu+2)(5n\mu-2\mu+2)(5n\mu-\mu+2)}]$$

If i=j=2, s=3, $\bar{p}$ reduces to, $\bar{p} = (3-3\mu)(3-2\mu)(3-\mu)$

$$[\frac{1}{(n\mu-3\mu+3)(n\mu-2\mu+3)(n\mu-\mu+3)} + \frac{3n\mu}{(5n\mu-4\mu+3)(5n\mu-3\mu+3)(5n\mu-2\mu+3)(5n\mu-\mu+3)}]$$

If i=j=3, s=1, $\bar{p}$ reduces to,

$$\bar{p} = (1-\mu)[\frac{1}{(n\mu-\mu+1)} + \frac{n\mu}{(7n\mu-2\mu+1)(7n\mu-\mu+1)}]$$

If i=j=3, s=2, $\bar{p}$ reduces to, $\bar{p} = (2-2\mu)(2-\mu)$

$$[\frac{1}{(n\mu-2\mu+2)(n\mu-\mu+2)} + \frac{2n\mu}{(7n\mu-3\mu+2)(7n\mu-2\mu+2)(7n\mu-\mu+2)}]$$

If i=j=3, s=3, $\bar{p}$ reduces to, $\bar{p} = (3-3\mu)(3-2\mu)(3-\mu)$

$$[\frac{1}{(n\mu-3\mu+3)(n\mu-2\mu+3)(n\mu-\mu+3)} + \frac{3n\mu}{(7n\mu-4\mu+3)(7n\mu-3\mu+3)(7n\mu-2\mu+3)(7n\mu-\mu+3)}]$$

Example 1

For $i = 4, s = 4, n = 10$ and $\bar{p}$ =0.50 the corresponding IQL value μ_0 =0.3915

For $i = 5, s = 5, n = 10$ and $\bar{p}$ =0.50 the corresponding IQL value μ_0 =0.3632

Example 2

For $i = 3, s = 2, n = 10$ and $\bar{p} = 0.90$ the average product quality μ =0.3589

For $i = 4, s = 3, n = 10$ and $\bar{p} = 0.10$ the average product quality μ =0.5834

Example 3

For $i = 3, s = 2, n = 10$, the AQL value $\mu_1 = 0.3558$ and LQL value μ_2 =0.4829

For $i = 4, s = 5, n = 10$, the AQL value $\mu_1 = 0.3274$ and LQL value μ_2 =0.5241

Table 1: μ values for Bayesian Chain Sampling Plan for given average probability of acceptance for i=j

	$\bar{p}$ / i	0.99	0.95	0.90	0.50	0.10	0.05
s=2	1	0.4033	0.4057	0.4090	0.4438	0.5370	0.5765
	2	0.3718	0.3742	0.3773	0.4108	0.5025	0.5427
	3	0.3535	0.3558	0.3589	0.3917	0.4829	0.5239
	4	0.3410	0.3432	0.3462	0.3785	0.4697	0.5117
	5	0.3315	0.3337	0.3367	0.3686	0.4601	0.5029
s=3	1	0.4429	0.4466	0.4514	0.5027	0.6373	0.6925
	4	0.3513	0.3549	0.3597	0.4141	0.5834	0.6558
	5	0.3381	0.3418	0.3467	0.4022	0.5797	0.6541
	6	0.3280	0.3316	0.3365	0.3930	0.5774	0.6532
	7	0.3196	0.3233	0.3282	0.3857	0.5760	0.6527
s=4	2	0.3816	0.3847	0.3889	0.4349	0.5679	0.6268
	3	0.3542	0.3573	0.3615	0.4086	0.5540	0.6188
	4	0.3358	0.3390	0.3433	0.3915	0.5476	0.6158
	5	0.3224	0.3256	0.3299	0.3793	0.5442	0.6145
	6	0.3119	0.3151	0.3194	0.3700	0.5423	0.6138
s=5	1	0.4218	0.4247	0.4286	0.4699	0.5801	0.6268
	2	0.3714	0.3743	0.3781	0.4201	0.5437	0.5997
	3	0.3433	0.3462	0.3500	0.3931	0.5301	0.5922
	4	0.3245	0.3274	0.3313	0.3757	0.5241	0.5897
	5	0.3107	0.3137	0.3176	0.3632	0.5212	0.5887

Table 2: Certain Parametric Values of Bayesian Chain Sampling Plan for i=j

	i	μ_1	μ_2	μ_0	μ_2/μ_1
S=2	1	0.4057	0.5370	0.4438	1.3236
	2	0.3742	0.5025	0.4108	1.3429
	3	0.3558	0.4829	0.3917	1.3572
	4	0.3432	0.4697	0.3785	1.3686
	5	0.3337	0.4601	0.3686	1.3787
S=3	1	0.4466	0.6373	0.5027	1.4270
	4	0.3549	0.5834	0.4141	1.6438
	5	0.3418	0.5797	0.4022	1.6960
	6	0.3316	0.5774	0.3930	1.7413
	7	0.3233	0.5760	0.3857	1.7816
S=4	2	0.3847	0.5679	0.4349	1.4762
	3	0.3573	0.5540	0.4086	1.5505
	4	0.3390	0.5476	0.3915	1.6153
	5	0.3256	0.5442	0.3793	1.6713
	6	0.3151	0.5423	0.3700	1.7210
S=5	1	0.4247	0.5801	0.4699	1.3659
	2	0.3743	0.5437	0.4201	1.4526
	3	0.3462	0.5301	0.3931	1.5312
	4	0.3274	0.5241	0.3757	1.6008
	5	0.3137	0.5212	0.3632	1.6615

CONCLUSION

The sampling plan will be useful to the quality control practitioners since, it is less expensive. Main advantage of the plan is that it is more concerned about the future rather than the prior history.

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