Bayesian Group Chain Sampling Plan Based on Beta Binomial Distribution through Quality Region

Waqar Hafeez[1], Nazrina Aziz[*2]

[1,2]*School of Quantitative Sciences, College of Arts and Sciences, Universiti Utara Malaysia, 06010 Sintok, Kedah, Malaysia*

[1]waqarhafeez78601@gmail.com

[*2]nazrina@uum.edu.my

***Abstract*— In this article, we introduced Bayesian Group Chain Sampling Plan (BGChSP) using different combination of parameters. In acceptance sampling plan, the random fluctuations can be describe in the selection of distribution Bayesian approach which is based on prior process history. We apply beta distribution as a suitable prior distribution. By considering consumer's and producer's risks, we consider Probabilistic and Indifference Quality Regions for the specified AQL and LQL. For the selection of parameters in BGChSP, Maximum Allowable Percent Defectives (MAPD) is also considered.**

***Keywords*—** *acceptance sampling plan, binomial, beta distribution, quality region, consumer's risks, producer's risk, acceptance quality level, limiting quality level.*

1. Introduction

Bayesian acceptance sampling approach is based on the combination of lot information and the prior information for the selection of distribution. To describe the random variation, Bayesian approach required to specify from lot to lot a distribution of defectives. Prior distribution is the expected distribution of a lot quality, that is going for inspection. This distribution is formulated before taking the sample, so it is called prior. The empirical knowledge is based on sample under study is called sample distribution or data distribution. The combination of prior and empirical information's leads to take decision about lot.

For Bayesian sampling inspection a statistical model considers the following three components:

1. The prior distribution must according to quality of the submitted lot.
2. Sampling inspection cost on acceptance and rejection.
3. On the base of mean rejection, a class is designed in the sampling plans, to give acceptance protection against a poor quality lot.

The sampling plans based on economic consider different factors to design a cost effect plan: like cost of inspection rejecting a conforming product and accepting a non-conforming product. The history of similar lots that already submitted for inspection are count in to the Bayesian sampling plan. Non-Bayesian sampling methodology does not based on past history.

There is tough competition in industry by rapidly increasing in the needs of statistical and analytical techniques towards the improvement of product quality. This study is related to BGChSP by using a novel approach called quality region or quality interval sampling (QIS). Instead of point this plan is based on quality range. This plan delivers decision rules of acceptance for both supplier and customer to meet the present quality condition of the product. Improvement in the technology is rapidly increasing with the passage of time and supplier needs high quality products with low defective fraction. Unfortunately, in some particular situation traditional methods can not detect out defect in the product. QIS was introduced to overcome such problems. By involving QIS, this article designs the parameters for the plan indexed with quality region.

For inspection Chain sampling plan was introduced by Dodge [1]. Under an assumption that cost is linear in p that is fraction of defective; Hald [2] provide a system attribute single sampling plan obtain by minimizing average cost. By using gamma

International Journal of Supply Chain Management
IJSCM, ISSN: 2050-7399 (Online), 2051-3771 (Print)

prior a Bayesian chain sampling plan was discussed by Latha and Suresh [3] for the construction and performance measure. By using Beta prior, a Bayesian double sampling plan was discussed by Latha and Arivazhagan [4] for the construction and performance measure through quality region.

Designs the plan indexed parameters in this study are α, β, LQL, AQL, IQL, IQR and PQR for the specified value of s, r and g. Also, with the numerical illustrations of prior distribution parameters are provided.

2. Group Chain Sampling Plan (GChSP)

Aslam, Mughal, Ahmad and Yab [5] designed Group Acceptance Sampling Plan (GASP) for truncated life tests. Here the product life time was following pareto distribution of second kind. Later for a family of Pareto distribution, an efficient GASP was introduced by Mughal and Aslam [6], they assumed the total number of defectives as groups. The number of defectives in the proposed plan were recorded on the base of all groups instead of an individual group. Later, for a family of Pareto distribution Mughal and Ismail [7], proposed an economic reliability acceptance sampling plan by using an efficient group sampling technique. By satisfying design parameters for a given group and acceptance number a minimum termination time required for a proposed plan. Using group acceptance sampling plan for Pareto distribution of 2nd kind. An economic reliability group acceptance sampling plan was developed by Mughal, Zain and Aziz [8]. For the biased data theory to find the required design parameters they were used Poisson and weighted Poisson distributions. It was proved that the proposed plans required minimum testing time.

Mughal, Zain and Aziz [9], developed a GChSP plan for the lifetime of a product follow Pareto distribution of 2nd kind. To satisfying pre-assumed design parameters at several quality levels probability of lot acceptance was obtained. Mughal [10] extended and proposed a generalized GChSP on the base of sampling plan developed by Mughal, Zain and Aziz [9]. By considering several values of the proportion of defectives minimum sample size and probability of lot acceptance were found to satisfying pre-specified consumer's risk.

3. Methodology

3.1 Operational Procedure

The operating procedure of GChSP is as follow,

- Select minimum number of groups for each lot and each group contain *r* items, so that $n=r*g$ be the required sample size.
- The lot is accepted if $d=0$ and rejected if $d > 1$
- If $d = 1$ accept the lot, if no defectives are found in immediately preceding *i* sample of size $g*r$

Binomial distribution is applied in order to achieve the probability of lot acceptance for zero and one defective products. Here the binomial distribution is applicable because the product fulfils all four properties of binomial experiment. This is applicable, when lot consist on identical and independent trails, the inspection outcomes are categorized into two mutually exclusive and independent outcomes. So, the probability of lot acceptance can be written as:

$$L(p) = \sum_{c=0}^{1} \binom{r*g}{c} p^c (1-p)^{r*g-c} \quad (1)$$

where p is the proportion of defective.

By solving Equation (1) for zero and one defective product, each probability of lot acceptance is:

$$P_0 = (1-p)^{r*g} \quad (2)$$

$$P_1 = (r*g)p(1-p)^{r*g-1} \quad (3)$$

The operating characteristic function of ChSP-1 has given by Dodge [1].

$$P_a(p) = P_0 + P_1 P_0^i \quad (4)$$

Mughal [10] suggest probability of lot acceptance for (GChSP) after plugin equation (2) and (3) in (4) is:

$$L(p) = (1-p)^{r*g} + (r*g)p(1-p)^{r*g-1}(1-p)^{r*g*i} \quad (5)$$

where p represents the probability of defective in the lot of $g*r$.

The general expression of probability of lot acceptance in GChSP by considering Binomial distribution we can rewrite (5) the binomial model of OC function as:

$$L(p) = (1-p)^{r*g} + (r*g)p(1-p)^{r*g(1+i)-1} \quad (6)$$

Let the prior distribution of the process is beta distribution. That stat p process average follow beta prior distribution with s and t both are shape parameters and the probability distribution function PDF:

$$f(p) = \frac{1}{\beta(s,t)} p^{s-1}(1-p)^{t-1} \tag{7}$$

$0 < p < 1, s, t > 0$ and $q = 1 - p$

where $\mu = \frac{s}{s+t}$, under the proposed Sampling Plan.

On the base of beta binomial distribution in GChSP, probability of acceptance is as follows:

$$\bar{P} = \int_0^1 L(p) f(p)\, dp \tag{8}$$

After replacing (6) and (7) in equation (8) we get:

$$\bar{P} = \int_0^1 \left((1-p)^{r*g} + (r*g)p(1-p)^{r*g(1+i)-1}\right) * \frac{1}{\beta(s,t)} p^{s-1}(1-p)^{t-1}\, dp \tag{9}$$

$$\bar{P} = \frac{1}{\beta(s,t)}[\beta(s, r*g+t) + (r*g)\beta(s+1, r*g(1+i)+t-1)] \tag{10}$$

$$\bar{P} = \frac{\Gamma(s+t)\Gamma(r*g+t)}{\Gamma t\Gamma(s+r*g+t)} + (r*g) \frac{s\Gamma(s+t)\Gamma(r*g(1+i)+t-1)}{\Gamma t\Gamma(s+r*g(1+i)+t)} \tag{11}$$

Equation (11) is the mixed distribution of beta binomial distribution.

The above equation can be rewritten as by reducing $\bar{P}$ and μ_0 be the point of control:

For $s = 1$, after simplification Equation (11) is:

$$\bar{P} = \frac{1-\mu}{rg\mu + 1 - \mu} + \frac{rg\mu(1-\mu)}{(rg\mu(1+i)+1-\mu)(rg\mu(1+i)+1-2\mu)} \tag{12}$$

For $s = 2$, after simplification Equation (11) is:

$$\bar{P} = \frac{(2-\mu)(2-2\mu)}{(rg\mu+2-\mu)(rg\mu+2-2\mu)} + \frac{2rg\mu(2-\mu)(2-2\mu)}{(rg\mu(1+i)+2-\mu)(rg\mu(1+i)+2-2\mu)(rg\mu(1+i)+2-3\mu)} \tag{13}$$

For $s = 3$, after simplification Equation (11) is:

$$\bar{P} = \frac{(3-\mu)(3-2\mu)(3-3\mu)}{(rg\mu+3-\mu)(rg\mu+3-2\mu)(rg\mu+3-3\mu)} + \frac{3rg\mu(3-\mu)(3-2\mu)(3-3\mu)}{(rg\mu(1+i)+3-\mu)(rg\mu(1+i)+3-2\mu)(rg\mu(1+i)+3-3\mu)(rg\mu(1+i)+3-4\mu)} \tag{14}$$

3.2 Constructing Plans for given AQL, LQL, α and β

For the selection of (BGChSP) table 1 and 2 are used for specified AQL, LQL, α and β by using following steps:

1. First calculate the operating ratio μ_1/μ_2 to construct a plan for the given AQL (1-α) and LQL (1-β).
2. Locate table value of operating ratio which is equal or just less than the desired operating ratio in the column desired α, β for fixed value of r and g.
3. The value of s, r and g can be obtained for the corresponding located value of operating ratio.

Example 1: For $\bar{P} = 0.50$ s=1, g= 1 and r=3 the corresponding indifference Quality level (IQL) is $\mu_0 = 0.2980$ and for s=3, g= 3, r=3 the corresponding value of AQL is $\mu_1 = 0.0166$ and LQL value $\mu_2 = 0.3172$.

From the above equation in Table 1 average probability of acceptance for the given variation, by using newton's approximation the average product quality level μ is obtained. In Example 1 we can see that the average product quality decreased as the values of s and g increased.

Example 2: Let the values of μ_1 and μ_2 are assumed to be 0.008 and 0.90 respectively, then the operating ratio is 112.5. Now the value from table 2 is approximately equal to this calculated operating ratio is 111.6 and the corresponding parametric

values are $s = 1,\ g = 2,\ r = 3,\ i = 2$ and $\mu_1 = 0.0085$, $\mu_2 = 0.9486$ at ($\alpha = 0.01$ and $\beta = 0.01$).

Table 1. For specified values of P(μ) Certain μ values in BGChSP

s	g	r	i	0.99	0.95	0.9	0.5	0.25	0.1	0.05	0.01
	1	2	1	0.0341	0.0843	0.1292	0.4416	0.6812	0.8600	0.9276	0.9851
		3	2	0.0171	0.0440	0.0699	0.2980	0.5406	0.7741	0.8777	0.9738
		4	3	0.0109	0.0287	0.0465	0.2257	0.4520	0.7080	0.8358	0.9635
	2	2	1	0.0166	0.0421	0.0662	0.2751	0.5069	0.7474	0.8606	0.9696
		3	2	0.0085	0.0222	0.0357	0.1736	0.3685	0.6298	0.7809	0.9486
		4	3	0.0054	0.0144	0.0237	0.1268	0.2914	0.5474	0.7175	0.9295
	3	2	1	0.0109	0.0281	0.0445	0.2000	0.404	0.6613	0.8029	0.9546
		3	2	0.0056	0.0148	0.0240	0.1225	0.2796	0.5309	0.7034	0.9247
		4	3	0.0036	0.0096	0.0159	0.0882	0.2150	0.4462	0.6286	0.8978
	4	2	1	0.0082	0.0211	0.0336	0.1571	0.3359	0.5930	0.7525	0.9401
		3	2	0.0042	0.0111	0.0181	0.0947	0.2252	0.4589	0.6398	0.9020
		4	3	0.0027	0.0072	0.0119	0.0676	0.1704	0.3766	0.5592	0.8682
2	1	2	1	0.0386	0.0928	0.1393	0.4322	0.6494	0.8281	0.9054	0.9792
		3	2	0.0193	0.0479	0.074	0.2748	0.4748	0.6900	0.8082	0.9503
		4	3	0.0122	0.0309	0.0486	0.2017	0.3774	0.5932	0.7283	0.9189
	2	2	1	0.0187	0.046	0.0705	0.2527	0.4348	0.6433	0.7677	0.9340
		3	2	0.0095	0.024	0.0375	0.1525	0.2914	0.4835	0.622	0.8616
		4	3	0.0061	0.0155	0.0246	0.1089	0.2211	0.3909	0.5252	0.7951
	3	2	1	0.0123	0.0306	0.0472	0.1784	0.3252	0.5191	0.6543	0.8788
		3	2	0.0063	0.016	0.0251	0.1054	0.2097	0.3697	0.4996	0.7728
		4	3	0.0040	0.0104	0.0165	0.0746	0.1562	0.2903	0.4075	0.6879
	4	2	1	0.0092	0.0229	0.0355	0.1378	0.2594	0.4337	0.567	0.8226
		3	2	0.0047	0.0120	0.0189	0.0806	0.1637	0.2988	0.4162	0.6952
		4	3	0.0030	0.0078	0.0124	0.0567	0.1207	0.2307	0.3322	0.6025
3	1	2	1	0.0406	0.0966	0.1439	0.4286	0.6335	0.8071	0.8879	0.9731
		3	2	0.0202	0.0496	0.0759	0.2666	0.4484	0.6467	0.7630	0.9256
		4	3	0.0128	0.0320	0.0496	0.1934	0.3508	0.5429	0.6682	0.8736
	2	2	1	0.0196	0.0477	0.0724	0.2451	0.4072	0.5919	0.7086	0.8936
		3	2	0.0100	0.0248	0.0383	0.1456	0.2660	0.4275	0.5458	0.7792
		4	3	0.0064	0.0160	0.0251	0.1032	0.1999	0.3390	0.4480	0.6879
	3	2	1	0.0130	0.0317	0.0484	0.1714	0.2984	0.4607	0.5768	0.8003
		3	2	0.0067	0.0166	0.0257	0.1001	0.1887	0.3172	0.4201	0.6553
		4	3	0.0042	0.0107	0.0168	0.0704	0.1396	0.2455	0.3346	0.5565
	4	2	1	0.0097	0.0238	0.0364	0.1318	0.2352	0.376	0.4837	0.7158
		3	2	0.0050	0.0124	0.0193	0.0762	0.1461	0.2518	0.3406	0.5614
		4	3	0.0032	0.0080	0.0126	0.0534	0.1072	0.1923	0.2667	0.4651

Table 2. For given α and β in BGChSP Values of μ_2/μ_1 tabulated against s, g, r and i

s	g	r	i	α =0.05 β =0.1	α =0.05 β =0.05	α =0.05 β =0.01	α =0.01 β =0.1	α =0.01 β =0.05	α =0.01 β =0.01	α =0.10 β = 0.1	α = 0.10 β = 0.05	α =0.10 β = 0.01
1	1	2	1	10.2017	11.0036	11.6856	25.2199	27.2023	28.8886	6.6563	7.1796	7.6246
		3	2	17.5932	19.9477	22.1318	45.269	51.3275	56.9474	11.0744	12.5565	13.9313
		4	3	24.669	29.122	33.5714	64.9541	76.6789	88.3945	15.2258	17.9742	20.7204
	2	2	1	17.753	20.4418	23.0309	45.0241	51.8434	58.4096	11.29	13	14.6465
		3	2	28.3694	35.1757	42.7297	74.0941	91.8706	111.6	17.6415	21.8739	26.5714
		4	3	38.0139	49.8264	64.5486	101.3704	132.8704	172.1296	23.097	30.2743	39.2194
	3	2	1	23.5338	28.573	33.9715	60.6697	73.6606	87.578	14.8607	18.0427	21.4517
		3	2	35.8716	47.527	62.4797	94.8036	125.6071	165.125	22.1208	29.3083	38.5292
		4	3	46.4792	65.4792	93.5208	123.9444	174.6111	249.3889	28.0629	39.5346	56.4654
	4	2	1	28.1043	35.6635	44.5545	72.3171	91.7683	114.6463	17.6488	22.3958	27.9792
		3	2	41.3423	57.6396	81.2613	109.2619	152.3333	214.7619	25.3536	35.3481	49.8343
		4	3	52.3056	77.6667	120.5833	139.4815	207.1111	321.5556	31.6471	46.9916	72.958
2	1	2	1	8.9235	9.7565	10.5517	21.4534	23.456	25.3679	5.9447	6.4996	7.0294
		3	2	14.405	16.8727	19.8392	35.7513	41.8756	49.2383	9.3243	10.9216	12.8419
		4	3	19.1974	23.5696	29.7379	48.623	59.6967	75.3197	12.2058	14.9856	18.9074
	2	2	1	13.9848	16.6891	20.3043	34.4011	41.0535	49.9465	9.1248	10.8894	13.2482
		3	2	20.1458	25.9167	35.9	50.8947	65.4737	90.6947	12.8933	16.5867	22.976
		4	3	25.2194	33.8839	51.2968	64.082	86.0984	130.3443	15.8902	21.3496	32.3211
	3	2	1	16.9641	21.3824	28.719	42.2033	53.1951	71.4472	10.9979	13.8623	18.6186
		3	2	23.1063	31.225	48.3	58.6825	79.3016	122.6667	14.7291	19.9044	30.7888
		4	3	27.9135	39.1827	66.1442	72.575	101.875	171.975	17.5939	24.697	41.6909
	4	2	1	18.9389	24.7598	35.9214	47.1413	61.6304	89.413	12.2169	15.9718	23.1718
		3	2	24.9	34.6833	57.9333	63.5745	88.5532	147.9149	15.8095	22.0212	36.7831

		4	3	29.5769	42.5897	77.2436	76.9	110.7333	200.8333	18.6048	26.7903	48.5887
3	1	2	1	8.3551	9.1915	10.0735	19.8793	21.8695	23.968	5.6088	6.1703	6.7623
		3	2	13.0383	15.3831	18.6613	32.0149	37.7723	45.8218	8.5204	10.0527	12.195
		4	3	16.9656	20.8813	27.3	42.4141	52.2031	68.25	10.9456	13.4718	17.6129
	2	2	1	12.4088	14.8553	18.7338	30.199	36.1531	45.5918	8.1754	9.7873	12.3425
		3	2	17.2379	22.0081	31.4194	42.75	54.58	77.92	11.1619	14.2507	20.3446
		4	3	21.1875	28	42.9938	52.9688	70	107.4844	13.506	17.8486	27.4064
	3	2	1	14.5331	18.1956	25.2461	35.4385	44.3692	61.5615	9.5186	11.9174	16.5351
		3	2	19.1084	25.3072	39.4759	47.3433	62.7015	97.806	12.3424	16.3463	25.4981
		4	3	22.9439	31.271	52.0093	58.4524	79.6667	132.5	14.6131	19.9167	33.125
	4	2	1	15.7983	20.3235	30.0756	38.7629	49.866	73.7938	10.3297	13.2885	19.6648
		3	2	20.3065	27.4677	45.2742	50.36	68.12	112.28	13.0466	17.6477	29.0881
		4	3	24.0375	33.3375	58.1375	60.0938	83.3438	145.3438	15.2619	21.1667	36.9127

3.3 Construction of Quality interval for (BGChSP)

Probabilistic Quality Region (PQR)

In this interval of quality product is accepted with minimum and maximum probabilities $(\mu_1 < \mu < \mu_2)$ respectively 0.10 and 0.95. Here $d_2 = \mu_2 - \mu_1$ denotes the range of probability that derived from equation of the average probability of acceptance:

$$\bar{P}(\mu_1 < \mu < \mu_2) = \frac{\Gamma(s+t)\Gamma(r*g+t)}{\Gamma t\Gamma(s+r*g+t)} + (r*g) \frac{s\Gamma(s+t)\Gamma(r*g(1+i)+t-1)}{\Gamma t\Gamma(s+r*g(1+i)+t)}$$

Beta distribution is the prior distribution so mean of beta $\mu = \frac{s}{s+t}$ be approximately mean value of the product quality.

Indifference Quality Region (IQR)

In this interval of quality product is accepted with minimum and maximum probabilities $(\mu_1 < \mu < \mu_0)$ respectively 0.50 and 0.95. Here $d_0 = \mu_0 - \mu_1$ denotes the range of probability that derived from equation of the average probability of acceptance:

$$\bar{P}(\mu_1 < \mu < \mu_0) = \frac{\Gamma(s+t)\Gamma(r*g+t)}{\Gamma t\Gamma(s+r*g+t)} + (r*g) \frac{s\Gamma(s+t)\Gamma(r*g(1+i)+t-1)}{\Gamma t\Gamma(s+r*g(1+i)+t)}$$

Where $\mu = \frac{s}{s+t}$ be the approximate mean of product quality.

Table 3. For specified values of s, g, r and *i* values of PQR and IQR, $\boldsymbol{\mu_2/\mu_1}$

s	g	r	i	μ_1	μ_0	μ_2	d_2	d_0	τ	μ_2/μ_1
1	1	2	1	0.0843	0.4416	0.86	0.7757	0.3573	2.171	10.2017
		3	2	0.044	0.298	0.7741	0.7301	0.254	2.8744	17.5932
		4	3	0.0287	0.2257	0.708	0.6793	0.197	3.4482	24.669
	2	2	1	0.0421	0.2751	0.7474	0.7053	0.233	3.027	17.753
		3	2	0.0222	0.1736	0.6298	0.6076	0.1514	4.0132	28.3694
		4	3	0.0144	0.1268	0.5474	0.533	0.1124	4.742	38.0139
	3	2	1	0.0281	0.2	0.6613	0.6332	0.1719	3.6835	23.5338
		3	2	0.0148	0.1225	0.5309	0.5161	0.1077	4.792	35.8716
		4	3	0.0096	0.0882	0.4462	0.4366	0.0786	5.5547	46.4792
	4	2	1	0.0211	0.1571	0.593	0.5719	0.136	4.2051	28.1043
		3	2	0.0111	0.0947	0.4589	0.4478	0.0836	5.3565	41.3423
		4	3	0.0072	0.0676	0.3766	0.3694	0.0604	6.1159	52.3056
2	1	2	1	0.0928	0.4322	0.8281	0.7353	0.3394	2.1665	8.9235
		3	2	0.0479	0.2748	0.69	0.6421	0.2269	2.8299	14.405
		4	3	0.0309	0.2017	0.5932	0.5623	0.1708	3.2922	19.1974
	2	2	1	0.046	0.2527	0.6433	0.5973	0.2067	2.8897	13.9848
		3	2	0.024	0.1525	0.4835	0.4595	0.1285	3.5759	20.1458
		4	3	0.0155	0.1089	0.3909	0.3754	0.0934	4.0193	25.2194
	3	2	1	0.0306	0.1784	0.5191	0.4885	0.1478	3.3051	16.9641
		3	2	0.016	0.1054	0.3697	0.3537	0.0894	3.9564	23.1063
		4	3	0.0104	0.0746	0.2903	0.2799	0.0642	4.3598	27.9135
	4	2	1	0.0229	0.1378	0.4337	0.4108	0.1149	3.5753	18.9389
		3	2	0.012	0.0806	0.2988	0.2868	0.0686	4.1808	24.9
		4	3	0.0078	0.0567	0.2307	0.2229	0.0489	4.5583	29.5769
3	1	2	1	0.0966	0.4286	0.8071	0.7105	0.332	2.1401	8.3551
		3	2	0.0496	0.2666	0.6467	0.5971	0.217	2.7516	13.0383
		4	3	0.032	0.1934	0.5429	0.5109	0.1614	3.1654	16.9656

2	2	1	0.0477	0.2451	0.5919	0.5442	0.1974	2.7568	12.4088
	3	2	0.0248	0.1456	0.4275	0.4027	0.1208	3.3336	17.2379
	4	3	0.016	0.1032	0.339	0.323	0.0872	3.7041	21.1875
3	2	1	0.0317	0.1714	0.4607	0.429	0.1397	3.0709	14.5331
	3	2	0.0166	0.1001	0.3172	0.3006	0.0835	3.6	19.1084
	4	3	0.0107	0.0704	0.2455	0.2348	0.0597	3.933	22.9439
4	2	1	0.0238	0.1318	0.376	0.3522	0.108	3.2611	15.7983
	3	2	0.0124	0.0762	0.2518	0.2394	0.0638	3.7524	20.3065
	4	3	0.008	0.0534	0.1923	0.1843	0.0454	4.0595	24.0375

3.4 Selection of the Sampling Plans

For difference values of s, g and r in Table 3 the operating ratio T is given, i.e. $T = \frac{\mu_2 - \mu_1}{\mu_0 - \mu_1} = \frac{d_2}{d_0}$, where $d_2 = \mu_2 - \mu_1$ and $d_0 = \mu_0 - \mu_1$ is used to characterize the sampling plan. Operating ratio $T = \frac{d_2}{d_0}$ can be find for any given values of PQR (d_2) and IQR (d_0). Find the value that is equal to or just less than the specified ratio, "in Table 3 under the column of T" corresponding to s, g and r values are noted. For (BGChSP) the parameters can be determine from this operating ratio.

The above equation is used in the same way to the average probability of acceptance 0.95 AQL(μ_1) and 0.10 IQL(μ_2) are obtained μ_2/μ_1 in Table 3.

Example 3: Given that $\mu_1 = 0.01$ to compute the value of T, first compute PQR and IQR. From Table 3 select the respective value. The nearest values of PQR and IQR corresponding to $s = 3$, $g = 3$, $r = 4$, $i = 3$ and $\mu_1 = 0.0107$ are that $d_2 = 0.2348$ and that $d_0 = 0.0597$, then that $T = 3.933$. Hence through quality interval the required plan has parameters $s = 3$, $g = 3$, $r = 4$ and $i = 3$.

4. Conclusion

Bayesian acceptance sampling deals with the procedure to make acceptance decision about process or lot based on the combination of sample information and past history lot. There are many options to determine an appropriate sampling plan. There are sampling plans that consider the risk of producers and consumers and some plans are based on non-economic requirements. In the situation of unavailability of a prior distribution cost function to reduce the inspection sample size, Bayesian sampling attribute plan can be used. This article presented work is mainly related technique to proposed BGChSP for acceptance quality level, indifference quality levels, indifference and probabilistic quality region, producer's and consumer's risks.

References

[1] H. F. Dodge, *"Chain sampling inspection plan,"* Industrial Quality Control., vol. 11, no. 4, pp. 10-13, 1955.

[2] A. Hald, "*Bayesian Single Sampling Plans for Discrete Prior Distribution*," Mat. Fys. Skr. Dan. Vid. Selsk., vol. 3, no. 2, pp. 88, 1965, Copenhagen Munksgaard.

[3] M. Latha, K. K. Suresh, "*Construction and Ecaluation of Performance Measure for Bayesian Chain Sampling Plan (BChSP-1)*," Far East Journal of Theoretical Statistics., vol. 6, no. 2, pp. 129-139, 2002.

[4] M. Latha, R. Arivazhagan, "*Selection of Bayesian Double Sampling Plan Based on Beta prior Distribution Index Through Quality Region*," International Journal of Recent Scientific Research., vol. 6, no. 5, pp. 4328-4333, 2015.

[5] M. Aslam, A. R. Mughal, M. Ahmad, & Z. Yab, "*Group acceptance sampling plans for Pareto distribution of the second kind,"* Journal of Testing and Evaluation., vol. 38, no. 2, pp. 143-150, 2010.

[6] A.R. Mughal, & M. Aslam, "*Efficient group acceptance sampling plans for family Pareto distribution,"* Continental Journal of Applied Sciences., vol. 6, no. 3, pp. 40-52, 2011.

[7] A.R. Mughal, & M. Ismail, "*An economic reliability efficient group acceptance sampling plans for family Pareto distributions*," Res. J. Appl. Sci., Eng. and Tech., vol. 6, no. 24, pp. 4646-4652, 2013.

[8] A.R. Mughal, Z. Zain, & N. Aziz, "*2nd Kind Using Poisson and Weighted Poisson Distribution,*" Res. J. Appl. Sci., Eng. and Tech., vol. 10, no. 8, pp. 306-310, 2015.

[9] A.R. Mughal, Z. Zain, & N. Aziz, "*Time truncated Group Chain Sampling Strategy for Pareto Distribution of the 2nd Kind*," Res. J. Appl. Sci., Eng. and Tech., vol. 10, no. 4, pp. 471-474, 2015.

[10] A.R. Mughal, "*A family of group chain acceptance sampling plans based on truncated life test,*" PhD thesis, Universiti Utara Malaysia, 2018.