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Selection of Bayesian Single Sampling Plan with Zero – Inflated Poisson Distribution Based on Quality Region

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Abstract – Acceptance sampling procedures are the practical tools for quality assurance application involving product control. Acceptance sampling systems are advocated when small sample size are necessary or desirable towards costlier testing for product quality. This paper is concerned with the set of tables for selection of Bayesian Single Sampling Plan with Zero – Inflated Poisson distribution on this basic of different combinations of entry parameter single sampling plan involving producer's and consumer's risks and probabilistic Quality Region, Indifference Quality Region for Specified AQL and LQL. Beta distributions are considered as prior distribution. Comparison is made with conventional Single Sampling Plan.

Keywords: *Bayesian Single Sampling Plan, Gamma Prior, Zero – Inflated Poisson distribution, Average Quality Limit (AQL), Limiting Quality Limit (LQL), Producer's Risk (α),Consumer Risk (β), Indifference Quality Level (IQL), Probabilistic Quality Region (PQR), Indifference Quality Region (IQR).*

I. INTRODUCTION

Acceptance Sampling uses sampling procedures to determine whether to accept or reject a product. It has been a common quality control technique that used in industry and particularly in military for contracts and procurement of products. Most often a producer supplies number of items to consumer and decision to accept or reject the lot is made through determining the number of defective items in a sample from the lot. The lot is accepted, if the number of defectives falls below the acceptance number (or) otherwise, the lot is rejected. A sample taken contains too many non-conforming items, then the batch is rejected otherwise it is accepted. Bayesian Acceptance sampling approach is associated with utilization of prior process history for the selection of distribution (viz. Gamma Poisson, Beta Binomial) to describe the random fluctuations involved in acceptance sampling. Bayesian Sampling Plan requires the uses to explicitly specify the distribution of defectives from lot-to-lot quality on which the sampling plan is going to operate. The distribution is called prior because it is formulated prior to the taking of samples.

Bayesian Sampling inspection contains three components:

- The prior distribution (i.e.,) the expected distribution of submitted lots according to quality
- The cost of sampling inspection, acceptance (or) rejection
- A class of sampling plans that usually defined by means of a restriction designed to give a protection against accepting lots of poor quality.

The operating characteristic function is influenced by the plan parameters such as sample size (n), acceptance number (c) and the parameters of prior distribution is p. Analysis of OC function for different values of these parameters can determine range of the protection to both producer and consumer. This paper provides a new procedure for designing attribute single sampling plan indexed through ratios. Also considering the ability of the declination angles of the tangent at the inflection point on the OC curve for discrimination of the Single Sampling Plan (SSP).

The Zero-Inflated Poisson (ZIP) is an alternative process that can be considered here. This model allows for over dispersion assuming that there are two different types of individuals in the data: (1) Those who have a zero count with a probability of 1 (*Always-0 group*), and (2) those who have counts predicted by the standard Poisson (*Not always-0 group*). Observed zero could be from either group, and if the zero is from the Always-0 group, it indicates that the observation is free from the probability of having a positive outcome. The overall model is a mixture of the probabilities from the two groups, which allows for both the over dispersion and excess zeros that cannot be predicted by the standard Poisson model. An industry expects no defective items in the lot. The expectation to fulfill the probability distribution is Zero – inflated Poisson distribution. The production process may consider prior information so gamma prior also may be applied.

ZIP distribution has been used in a wide range of disciplines such as agriculture, epidemiology, econometrics, public health, process control, medicine, manufacturing, etc. Some of the applications of ZIP distribution can be found in Bohning et al. [1], Lambert [4], Yang et al. [13]. Construction of control charts using ZIP distribution are discussed in Sim and Lim [9] and Xie et al. [13]. Some theoretical aspects of ZIP distributions are mentioned in McLachlan and Peel [7]. Suresh and Latha [11] have studied Bayesian single sampling plan through Average Probability of Acceptance involving Gamma Poisson model. Calvin [2] has provided procedures and tables for implementing Bayesian Sampling Plans. Hald [3] has given a rather complete tabulation and discussed the properties of a system of single sampling attribute plans obtained by minimizing average costs that are linear with fraction defective p and that the distribution of the quality is a double binomial distribution.Single sampling plans by attributes under the conditions of Zero – inflated Poisson distribution are determined by Loganathan and Shalini [5], Latha and Subbiah [6] have studied the selection of Bayesian Multiple Deferred State (BMDS-1) sampling plan based on quality regions

This paper deigns the parameter of the with (AQL), (LQL), and α, β and IQL, PQR and IQR for specified φ i, and C the parameters of the ZIP distribution with numerical illustration are also provided.

II. Operating procedure of SSP

The operating procedure of a Bayesian SSP described as follows:

1) Draw a random sample of n units from a lot of N units.
2) Count the number of defective units, x in the sample.
3) If x ≤ c, accept the lot, otherwise, reject the lot.

Where, N, n, c are parameters of SSP, N is lots, n is sample, and c is acceptance constant.

Operating Characteristic function of SSP with Gamma-ZIP model

The OC function of SSP is defined as

$$P_a(p) = P[X \le c] \quad (1)$$

Where 'p' is the probability of fraction defective

The numbers of defects are zero for many samples there may consider Zero – inflated Poisson probability distribution. The probability mass function of the ZIP (φ, λ) distribution is given by Lambert [4] and McLachlan and peel [7]

$$P(X = x \mid \phi, \lambda) = \varphi\, f(x) + (1-\varphi) P(X=x \mid \lambda) \quad (2)$$

Where

$$f(x) = \begin{cases} 1, & if\ x = 0 \\ 0, & if\ x \neq 0 \end{cases}$$

and

$$P(X = x/\lambda) = \frac{e^{-\lambda}\lambda^x}{x!}, \quad \text{when } x = 0, 1, 2, \ldots$$

The above probability mass function can also be expresses as

$$P(X = x \mid \varphi, \lambda) = \begin{cases} \varphi + (1-\varphi)e^{-\lambda} & when \quad x = 0 \\ (1-\varphi)\dfrac{e^{-\lambda}\lambda^x}{x!}, & when \quad x = 1, 2, \ldots, 0 < \varphi < 1,\ \lambda > 0 \end{cases}$$

In this distribution, φ may be termed as the mixing proportion. φ and λ are the parameters of the ZIP distribution. According to McLachlan and Peel [7], a Zip distribution is a special kind of mixture distribution.

The OC function of the SSP under the conditions of ZIP (φ, λ) distribution can be defined as

$$P_a(p) = \sum_{x=0}^{c} P(X = x \mid \phi, \lambda)$$

$$P_a(p) = \varphi + (1-\varphi)e^{-\lambda} + \sum_{x=1}^{c} (1-\varphi)\frac{e^{-\lambda}\lambda^x}{x!} \quad (3)$$

From the history of inspection it is known that *p* follows a Beta distribution which is for convenience approximated by a Gamma distribution (see Hald, 1981, p. 133) with density function *f*(*p*).

$$f(p) = \frac{\beta^s}{\Gamma(s)} p^{(s-1)} e^{-\beta p} \quad (4)$$

Thus, the average probability of acceptance $\bar{P}$ is approximately obtained by

$$\bar{P} = \int_1^c P_{(a)}(p) f(p)\,dp$$

$$\bar{P} = \varphi + (1-\varphi)(1-y)^s + \sum_{x=1}^{c}(1-\varphi)\binom{x+s-1}{s-1} y^x (1-y)^s \quad (5)$$

Table 1 provides the average probability of acceptance against different values of s and acceptance number *c* as function of *y*.

The curve $\bar{P}(\mu)$ of the average probability of acceptance (*APA*), as function of *μ* with

$n\mu = \dfrac{sy}{(1-y)}$ for different values of *n*, *s* and *c* can be taken instead of the *OC* curve for different values of *n* and *c* as done conventionally.

III.Designing Bayesian Single Sampling Plans

Sampling plans are constructed in such a way that protection to the producer as well as the consumer is ensured. The optimum (n, c) could be determined satisfying the conditions

$$P_a(p_1) = 1-\alpha$$

$$P_a(p_2) = \beta$$

where p_1, α, p_2, and β represent respectively, acceptable quality level, producer's risk, reject able quality level and consumer's risk.

Hence, for specified (p_1, α, p_2, β) and φ a zero-acceptance number sampling plan can be determined from

$$n = \frac{s}{\mu}\left[\left(\frac{1-\varphi}{\beta-\varphi}\right)^{\frac{1}{s}} - 1\right]$$

Satisfying $P_a(p) = 1-\alpha$ and $P_a(p) = \beta$. Here, p_1, α, p_2, and β denote, respectively acceptable quality level, producer's risk, reject able quality level and consumer's risk.

Designing Plans for given AQL, LQL, α and β

Tables 1 and 2 are used for selecting a Bayesian single Sampling Plan for specified AQL and LQL, α ,β and n by the following steps.

The steps utilized for selecting Bayesian single ***Sampling Plan are as follows***

- To design a plan for given (AQL, 1-α) and (LQL, β) first calculate the operating ratio μ_2/μ_1.
- For a fixed n, locate the tabular value of p2/p1 which is equal to or just less than the desired μ_2/μ_1 in the column of desired α and β.
- Corresponding to the located value of μ_2/μ_1 the value of φ and i, can be obtained.

Example 1: For φ=0.0001, i=3, c=1, and = 0.50 the corresponding IQL value μ_0 =1.884978
For φ=0.09, i=3, C=1 and AQL value μ_1= 0.344004 and LQL values μ_2=17.81303.

From Table 1 for the given variation Average Probability of Acceptance of the above equations. The average product obtained. The above examples, we can understand that when φ and i are increased, the average product quality is decreased.

Example 2:

Suppose the value for μ1 is assumed as 0.00095 and value for μ_2 is assumed as 0.085 then the operating ratio is calculated as 89.5. Now the integer approximately equal to this calculated operating ratio and their corresponding parametric values are observed from the table 2. The actual μ_1=0.138895 and μ_2=12.77723 at (α=0.01 and β=0.01).

IV. Designing of quality interval Bayesian Single Sampling Plan with Zero - Inflated Poisson Model

Probabilistic Quality Region (PQR)

The PQR is an interval of quality ($\mu_1 < \mu < \mu_2$) in which product is accepted with a minimum probability 0.10 and maximum probability 0.95. The probabilistic quality range, denoted by d_2= ($\mu_2 - \mu_1$), is derived through the probability of acceptance

$$\bar{p}(\mu_1 < \mu < \mu_2) = \varphi + (1-\varphi)(1-y)^s + \sum_{x=1}^{c}(1-\varphi)\binom{x+s-1}{s-1} y^x (1-y)^s$$

$$\text{for } \mu_1 < \mu < \mu_2, \quad (6)$$

Where $\mu = \dfrac{sy}{n(1-y)}$, is the expectation of beta distribution and approximately the mean values of product quality.

Indifference Quality Region (IQR)

The IQR is an interval of quality ($\mu_1 < \mu < \mu_0$) in which product is accepted with a minimum probability 0.50 and maximum probability 0.95. The indifference quality range, denoted as d_0= ($\mu_0 - \mu_1$), is derived through the probability of acceptance.

$$\bar{p}(\mu_1 < \mu < \mu_2) = \varphi + (1-\varphi)(1-y)^s + \sum_{x=1}^{c}(1-\varphi)\binom{x+s-1}{s-1} y^x (1-y)^s$$

$$\text{for } \mu_1 < \mu < \mu_0 \quad (7)$$

Where $\mu = \dfrac{sy}{n(1-y)}$, is the expectation of beta distribution and approximately the mean values of product quality

V. Selection of the Sampling Plan.

Table 3, gives unique values of T for different values of 'φ'and '*i*'. Here operating Ratio $T = \dfrac{\mu_2 - \mu_1}{\mu_0 - \mu_1} = \dfrac{d_2}{d_0}$, where $d_2 = (\mu_2 - \mu_1)$, and $d_0 = (\mu_0 - \mu_1)$ is used to characterize the sampling plan. For any given values of PQR (d_2), and IQR (d_0), one can find the ratio $T = \dfrac{d_2}{d_0}$, Find the value in the Table 3, under the column T, which is equal to or just less than the specified ratio, corresponding 'φ' and 'i' values are noted. From this ratio one can determine the parameters for BSSP with Zero- inflated Poisson distribution.

Example 3. Given φ =0.001, i=5,c =1 and μ1= 0.138895 compute the values of PQR and IQR then compute T. Select the respective values from Table 3. The nearest values of PQR and IQR corresponding to φ =0.001, i=5, C=1 and μ1=0.00094 are d2= 4.89625 and d_0= 1.462297, Then T= 3.34832 Hence the required plan has parameters φ =0.001, i=5 ,c =1, through Quality Interval. In the similar way, the above equations are equated to the average probability of acceptance 0.95 and 0.10; AQL (μ_1) and IQL (μ_2) are obtained in Table 3.

VI. Conclusion

Bayesian Acceptance Sampling is the best technique, which deals with the procedure in which decision to accept or reject lots or process based on their examination of past history or knowledge of samples. This paper deals with Bayesian single sampling plan with zero inflated Poisson model based on prior distribution and cost, which encompasses most of the existing Bayesian models based on costs. The Risks and Quality Region for specified AQL and LQL sampling plan possesses wider potential applicable in industry ensuring higher standard of quality attainment for product or process. The ZIP distribution has been shown to be useful for modelling outcomes of manufacturing process producing numerous defect-free products. The ZIP distribution has been shown to be useful for modelling outcomes of manufacturing process producing numerous defect-free products. When there are several types of defects, the multivariate ZIP model can be useful to detect specific process equipment problems and to reduce multiple types of defects simultaneously.

Table 1: Certain μ values for specified values of P(μ) BSSP under Gamma-Zero inflated Poisson

φ	i	c	Pa(p)						
			0.99	0.95	0.9	0.5	0.1	0.05	0.01
0.0001	2	1	0.122188	0.312766	0.486886	2.000268	8.200134	12.7853	31.76196
	3		0.135309	0.325244	0.49952	1.884978	6.36598	9.103863	18.65064
	4		0.137847	0.33128	0.505905	1.829798	5.624323	7.689015	14.09868
	5		0.138838	0.337242	0.512445	1.797922	5.214353	6.929164	12.38244
	6		0.140959	0.338062	0.513168	1.776911	4.961326	6.549437	11.06745
	7		0.144235	0.340996	0.51618	1.76468	4.800601	6.265588	10.30765
	8		0.146376	0.344993	0.520804	1.751926	4.667704	6.01961	9.757229
	9		0.148525	0.344495	0.519786	1.743443	4.590836	5.888776	9.353703
0.001	2		0.120816	0.314883	0.488624	2.002301	8.239079	12.91717	33.48231
	3		0.135033	0.325466	0.499834	1.887035	6.394443	9.178611	19.44632
	4		0.137849	0.331456	0.506196	1.831688	5.646741	7.744723	14.56650
	5		0.138895	0.337419	0.512736	1.799716	5.233669	6.976761	12.77723
	6		0.139829	0.339547	0.514874	1.775986	4.972853	6.591229	11.37637
	7		0.144818	0.34116	0.516568	1.763497	4.820559	6.303805	10.57766
	8		0.146966	0.345158	0.518026	1.753669	4.683058	6.05449	9.998793
	9		0.146853	0.345291	0.520886	1.745236	4.600838	5.922305	9.575623
0.01	2		0.123303	0.314701	0.48991	2.026329	8.714429	14.50081	57.13290
	3		0.136142	0.327174	0.502756	1.907947	6.737653	9.960013	54.79610
	4		0.138601	0.333225	0.509133	1.850878	5.88772	8.363157	31.56632
	5		0.139577	0.339202	0.515668	1.817924	5.439771	7.505125	22.75611
	6		0.140504	0.341334	0.5178	1.793467	5.188716	6.978705	22.06032
	7		0.145516	0.34295	0.519491	1.78061	4.991583	6.684158	19.02663
	8		0.147673	0.34696	0.520947	1.770486	4.846502	6.397664	17.15907
	9		0.147558	0.347091	0.523805	1.761794	4.758684	6.247487	15.94937

0.05	2		0.121649	0.325046	0.506511	2.145492	12.32499	147.0046	58.80866
	3		0.137316	0.334361	0.515521	2.002794	8.82999	44.76398	56.93906
	4		0.139886	0.343492	0.525485	1.938108	7.507113	33.15916	38.15538
	5		0.142895	0.346722	0.52854	1.902189	6.817185	24.14969	80.07684
	6		0.135292	0.349166	0.530965	1.879073	6.363328	19.86259	44.31983
	7		0.141882	0.351064	0.532993	1.862814	6.091586	17.51151	33.50408
	8		0.145789	0.352716	0.532243	1.850386	5.89397	15.85167	27.93111
	9		0.147558	0.350697	0.535902	1.839997	5.722639	14.80847	24.92914
0.09	2		0.132085	0.328831	0.51915	2.28265	30.04075	52.31754	79.74102
	3		0.143187	0.344004	0.531281	2.124481	17.81308	22.30789	25.25202
	4		0.145118	0.354167	0.537519	2.048323	14.03717	16.39107	17.76145
	5		0.146006	0.356708	0.543982	2.004582	11.85247	13.4439	14.32446
	6		0.146951	0.358528	0.546049	1.972212	10.7567	12.04698	12.74340
	7		0.152174	0.360149	0.547704	1.955349	10.01012	11.13848	11.73828
	8		0.154414	0.364262	0.552339	1.941976	9.494808	10.53231	11.07826
	9		0.154279	0.364374	0.552128	1.930457	9.111523	10.09526	10.60920

Table 2: Values of μ_2/μ_1 tabulated against φ, i and c for given α and β for Bayesian SSPs under Gamma-Zero inflated Poisson

φ	i	c	μ_2/μ_1 $\alpha=0.05$ $\beta=0.10$	μ_2/μ_1 $\alpha=0.05$ $\beta=0.05$	μ_2/μ_1 $\alpha=0.05$ $\beta=0.01$	μ_2/μ_1 $\alpha=0.01$ $\beta=0.10$	μ_2/μ_1 $\alpha=0.01$ $\beta=0.05$	μ_2/μ_1 $\alpha=0.01$ $\beta=0.01$
0.0001	2	1	26.21811	40.87815	101.5518	67.11063	104.636	259.9427
	3		19.57295	27.99089	57.34357	47.04775	67.28207	137.8375
	4		16.97753	23.20998	42.55813	40.80107	55.77917	102.2774
	5		15.46175	20.54655	36.71677	37.55719	49.90839	89.18646
	6		14.67579	19.37349	32.73795	35.19689	46.46335	78.51528
	7		14.07818	18.37439	30.22808	33.28312	43.44004	71.46411
	8		13.52986	17.44851	28.28241	31.88842	41.12425	66.6586
	9		13.32630	17.09396	27.15196	30.90961	39.6485	62.97748
0.001	2		26.16551	41.02208	106.3325	68.19545	106.9163	277.1355
	3		19.64703	28.20143	59.74914	47.35475	67.9732	144.0118
	4		17.03615	23.36574	43.94696	40.96312	56.18251	105.6697
	5		15.51089	20.67685	37.86754	37.68063	50.2303	91.9917
	6		14.64555	19.41183	33.50455	35.56376	47.1377	81.35903
	7		14.12991	18.47757	31.005	33.28699	43.52912	73.04102
	8		13.56787	17.54122	28.96875	31.86485	41.19646	68.03462
	9		13.32454	17.15165	27.73207	31.3295	40.32806	65.20541
0.01	2		27.69116	46.0781	499.309	70.67465	117.6026	463.3521
	3		20.59348	30.44256	167.4831	49.48977	73.15883	402.4913
	4		17.66892	25.09766	94.72986	42.47961	60.33976	227.7494

	5		16.03696	22.12582	67.08715	38.97315	53.77034	163.0358
	6		15.20129	20.44538	64.62971	36.92918	49.66891	157.0079
	7		14.55483	19.49017	55.47927	34.30272	45.93428	130.7531
	8		13.96849	18.43922	49.45554	32.81925	43.32332	116.1968
	9		13.71021	17.99959	45.9516	32.24969	42.33933	108.0891
0.05	2		37.91768	452.2581	14009.74	101.316	1208.433	483.4291
	3		26.40855	133.8792	170.2921	64.30404	325.9919	414.6564
	4		21.85529	96.53554	111.0809	53.66593	237.0442	272.7605
	5		19.66184	69.65154	230.9543	47.70762	169.003	560.389
	6		18.22434	56.88574	126.9304	47.0341	146.813	327.587
	7		17.35176	49.8812	95.43572	42.93431	123.4235	236.1412
	8		16.71022	44.94168	79.18857	40.42821	108.7306	191.5865
	9		16.31791	42.22587	71.08462	38.78243	100.3573	168.9453
0.09	2		91.35625	159.1017	242.4987	227.4343	396.0889	603.7082
	3		51.78167	64.84784	73.40626	124.4041	155.7952	176.3566
	4		39.63437	46.28068	50.14999	96.72942	112.95	122.3932
	5		33.22742	37.68884	40.15744	81.17796	92.07768	98.10871
	6		30.00243	33.60124	35.54369	73.19921	81.9795	86.71866
	7		27.79437	30.92742	32.59284	65.78063	73.19559	77.13712
	8		26.06590	28.91413	30.41291	61.48941	68.20838	71.74400
	9		25.00598	27.70577	29.11626	59.05868	65.435	68.76626

Table 3: Value of PQR and IQR, μ_2/μ_1 for specified value of φ, i and c

φ	i	c	μ_1	μ_0	μ_2	d_2	d_0	T	μ_2/μ_1
0.0001	2	1	0.312766	2.000268	8.200134	7.887368	1.687502	4.673991	26.21811
	3		0.325244	1.884978	6.36598	6.040737	1.559735	3.872926	19.57295
	4		0.33128	1.829798	5.624323	5.293043	1.498517	3.532187	16.97753
	5		0.337242	1.797922	5.214353	4.877111	1.46068	3.338933	15.46175
	6		0.338062	1.776911	4.961326	4.623264	1.438849	3.213169	14.67579
	7		0.340996	1.76468	4.800601	4.459605	1.423684	3.132439	14.07818
	8		0.344993	1.751926	4.667704	4.322711	1.406933	3.072435	13.52986
	9		0.344495	1.743443	4.590836	4.246342	1.398949	3.03538	13.3263
0.001	2		0.314883	2.002301	8.239079	7.924195	1.687417	4.696049	26.16551
	3		0.325466	1.887035	6.394443	6.068977	1.561569	3.886461	19.64703
	4		0.331456	1.831688	5.646741	5.315284	1.500232	3.542976	17.03615
	5		0.337419	1.799716	5.233669	4.89625	1.462297	3.348328	15.51089
	6		0.339547	1.775986	4.972853	4.633306	1.436439	3.225549	14.64555
	7		0.34116	1.763497	4.820559	4.479399	1.422337	3.149324	14.12991
	8		0.345158	1.753669	4.683058	4.3379	1.408511	3.079777	13.56787
	9		0.345291	1.745236	4.600838	4.255547	1.399945	3.039795	13.32454
0.01	2		0.314701	2.026329	8.714429	8.399729	1.711628	4.90745	27.69116

	3		0.327174	1.907947	6.737653	6.410479	1.580773	4.055281	20.59348
	4		0.333225	1.850878	5.88772	5.554496	1.517653	3.659925	17.66892
	5		0.339202	1.817924	5.439771	5.100569	1.478722	3.449309	16.03696
	6		0.341334	1.793467	5.188716	4.847382	1.452133	3.338111	15.20129
	7		0.34295	1.78061	4.991583	4.648633	1.43766	3.233471	14.55483
	8		0.34696	1.770486	4.846502	4.499543	1.423526	3.160843	13.96849
	9		0.347091	1.761794	4.758684	4.411593	1.414703	3.118388	13.71021
0.05	2		0.325046	2.145492	12.32499	11.99994	1.820446	6.591757	37.91768
	3		0.334361	2.002794	8.82999	8.495629	1.668433	5.09198	26.40855
	4		0.343492	1.938108	7.507113	7.163621	1.594616	4.492381	21.85529
	5		0.346722	1.902189	6.817185	6.470463	1.555468	4.159819	19.66184
	6		0.349166	1.879073	6.363328	6.014161	1.529906	3.931065	18.22434
	7		0.351064	1.862814	6.091586	5.740522	1.511749	3.797271	17.35176
	8		0.352716	1.850386	5.89397	5.541254	1.49767	3.699917	16.71022
	9		0.350697	1.839997	5.722639	5.371942	1.489301	3.607023	16.31791
0.09	2		0.328831	2.28265	30.04075	29.71191	1.953819	15.20709	91.35625
	3		0.344004	2.124481	17.81308	17.46908	1.780478	9.811457	51.78167
	4		0.354167	2.048323	14.03717	13.683	1.694156	8.076588	39.63437
	5		0.356708	2.004582	11.85247	11.49576	1.647875	6.976115	33.22742
	6		0.358528	1.972212	10.7567	10.39818	1.613684	6.443749	30.00243
	7		0.360149	1.955349	10.01012	9.649969	1.5952	6.049378	27.79437
	8		0.364262	1.941976	9.494808	9.130546	1.577714	5.787199	26.0659
	9		0.364374	1.930457	9.111523	8.747149	1.566083	5.585367	25.00598

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