DESIGN OF SKIP LOT SAMPLING PLAN (SKSP-3) WITH SINGLE SAMPLING PLAN AS A REFERENCE PLAN USING BOREL DISTRIBUTION

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Abstract

Skip-lot sampling plans (SkSPs) have long been recognized as effective strategies for minimizing inspection efforts in quality control, especially within high-volume manufacturing settings. This study proposes a Skip-Lot Sampling Plan of Type SkSP-3, constructed using Single Sampling Plans (SSPs) by attributes, under the probabilistic framework defined by the Borel distribution. Given its suitability for modeling rare or intermittent events, the Borel distribution provides a solid foundation for representing quality characteristics in such contexts. The presentation of the proposed SkSP-3 plan is assessed by means of Operating Characteristic (OC) curves and benchmarked against corresponding SSPs under identical conditions. The results reveal that the SkSP-3 plan achieves notably smaller sample sizes while preserving similar OC behavior, particularly at low defect levels. This work contributes to the body of literature by presenting a robust and cost-effective methodology for designing SkSPs under Borel distribution assumptions, thereby enhancing inspection efficiency without compromising quality standards.

Keywords: SkSP - 3, single sampling plans, Boral distribution, operating characteristic curves, average sample number.

I. Introduction

In contemporary quality assurance practices, minimizing inspection costs while maintaining acceptable product standards is a critical objective—especially in large-scale manufacturing environments. Acceptance sampling, a statistical quality control technique, provides a practical balance between exhaustive inspection and process efficiency. Within this domain, skip-lot sampling plans (SkSPs) have emerged as effective alternatives that capitalize on consistent supplier performance to reduce inspection frequency. Among the various SkSP variants, the Skip Lot Sampling Plan of Type SkSP-3 has garnered attention for its operational flexibility and ability to maintain desired quality levels through intelligent lot-skipping mechanisms.

The SkSP-3 plan incorporates historical lot performance by referencing outcomes from the current and preceding two lots to determine the level of inspection required for subsequent lots. This multi-lot referencing structure enables the plan to adapt dynamically to quality trends, thereby offering a robust approach in industries characterized by high-volume production and stable processes. Previous contributions from Soundararajan, Govindaraju, Subramani, and others have laid the foundational and structural frameworks for such plans, highlighting their benefits over classical single sampling schemes.

In parallel, the incorporation of probabilistic distributions to model defect occurrences enhances the analytical rigor of sampling plans. The Borel distribution, known for its suitability in modeling rare or sporadic events, offers a compelling framework for quality control systems where defects are infrequent yet critical. When applied to acceptance sampling, the Borel distribution enables a more nuanced estimation of acceptance probabilities and risk levels, especially in contexts where traditional distributions may fall short.

This study aims to design a Skip Lot Sampling Plan of Type SkSP-3 by integrating Single Sampling Plan (SSP) methodology under the assumptions of the Borel distribution. The approach combines the structural simplicity of SSPs with the probabilistic depth of Borel-based modeling to construct an efficient and cost-effective inspection system. Through analytical evaluation and comparison of Operating Characteristic (OC) curves and Average Sample Number (ASN) metrics, the future plan demonstrates its ability to reduce inspection loads while safeguarding both producer and consumer interests. The findings presented herein contribute meaningfully to the evolving landscape of statistical quality control, particularly in environments where defect events are both rare and critical.

Furthermore, the integration of Borel-based Skip Lot Sampling Plans not only enhances the theoretical robustness of quality control mechanisms but also aligns with contemporary trends in data-driven decision-making. By capturing the probabilistic nature of rare defect occurrences, this approach enables more informed and responsive inspection policies that are adaptive to real-time production data. The proposed SkSP-3 framework, grounded in both historical performance and advanced probabilistic modeling, supports strategic quality assurance with minimal resource expenditure. This dual focus on efficiency and precision positions the plan as a valuable tool for industries striving for zero-defect manufacturing, where predictive analytics and risk-based inspection are increasingly becoming standard practice.

II. Review of literature

Acceptance sampling has long served as a cornerstone in statistical quality control, offering structured approaches to determine lot acceptability without resorting to full inspection. The development of Skip Lot Sampling Plans (SkSPs), beginning with the foundational work of Dodge [1], sought to enhance inspection efficiency by reducing the frequency of inspections, especially for suppliers with consistent quality records. Over time, the SkSP concept evolved into more advanced variants such as SkSP-1, SkSP-3, and SkSP-3, each offering progressive improvements in operational adaptability and risk management. Soundararajan and Vijayaraghavan [2] contributed significantly to the field by proposing a generalized version of SkSP-3 based on the principles of cumulative sampling plans (CSP). Their formulation included structured switching rules dependent on the inspection history of multiple preceding lots, offering greater sensitivity to process shifts. Later, Govindaraju and Subramani [3] extended these models by incorporating both producer's and consumer's risks, making the design more aligned with industrial decision-making scenarios.

Latha and Soundararajan [4] further refined SkSP-3 by integrating triple-lot inspection references, leading to more robust decision-making under varying quality conditions. Their work laid the foundation for exploring parametric configurations that significantly reduced the Average Sample Number (ASN) without compromising the Operating Characteristic (OC) function's integrity. Rao and Srinivasan [5], followed by Subramani and Radhakrishnan [6], analyzed the statistical behavior of SkSP-3 through comprehensive performance evaluation and design tables, thus establishing its practicality in modern quality systems. Parallel to the structural advancement of sampling plans, researchers have explored the application of various probability distributions to better model defect occurrences. Among these, the Borel distribution has recently gained prominence due to its ability to model rare events and stochastic processes. Daly and Shneer [7] explored its application within the framework of Galton-Watson branching processes, emphasizing its suitability for systems with low defect probabilities. The use of Borel distribution in acceptance sampling aligns well with industrial environments where defects are infrequent but critical to quality assurance.

Swamy et al. [8] investigated mathematical properties and applications of the Borel distribution in broader statistical contexts, reinforcing its viability as a modeling tool in quality control environments. Similarly, Wanas and Khuttar [9] examined analytic functions defined by Borel-type series, contributing to a deeper understanding of its functional behaviours. In the realm of sampling plan performance, Hald [10] laid the groundwork for assessing OC curves and ASN values for single sampling schemes based on two-level quality thresholds, forming a basis for comparing newer models like SkSP-3 under varying conditions. Schilling and Neubauer [11], in their comprehensive work, emphasized the importance of optimizing sampling plans to balance cost, efficiency, and risk.

Recent developments by Veerakumari and Azarudheen [12] demonstrated the implementation of non-traditional distributions, such as the Intervened Poisson Distribution, in single sampling contexts, illustrating the growing trend toward probabilistic customization in quality control. Together, these contributions create a strong foundation for the current study, which aims to integrate SkSP-3 plans with the analytical robustness of Borel distribution modeling, thereby proposing a more refined and efficient acceptance sampling framework for contemporary industrial settings.

III. Features of Borel Distribution

The Borel distribution stays a discrete probability distribution with applications in modeling rare events and branching processes, making it highly suitable for quality control contexts where the occurrence of defects is infrequent but impactful. It originates from the analysis of Galton–Watson branching processes under Poisson offspring distributions. If each individual in a generation independently produces a Poisson-distributed number of offspring with mean λ, formerly the entire number of individuals in the process trails a Borel distribution.
The cumulative distribution function does not have a simple analytical form, but can be expressed as:

$$F(k;\lambda) = \sum_{i=1}^{k} \frac{(i\lambda)^{i-1}\, e^{-i\lambda}}{i!} \tag{1}$$

This form enables numerical approximation for tail probabilities, which are essential in acceptance sampling and quality control decision-making. A random variable X is supposed to follow a Borel distribution through constraint $\lambda \in (0,1)$, if it assumes values in the set $\mathbb{N} = \{1,2, 3,\ldots\}$ and its probability mass function (PMF) is given by:

$$P(X = k) = \frac{e^{-(\lambda k)}(\lambda k)^{(k-1)}}{k!} \quad \text{for } k=1,2,3,\ldots \tag{2}$$

This formulation indicates that the Borel distribution is skewed and strictly positive, with heavier tails than the Poisson distribution, which makes it adept at modeling sporadic yet critical quality issues. The mean, variance, Skewness and Kurtosis of the Borel Distribution with constraint λ are given by,

$$\mu = E(X) = (1-\lambda)^{-1} \tag{3}$$

$$\sigma^2 = Var(X) = \lambda(1-\lambda)^{-3} \tag{4}$$

$$\gamma_1 = \frac{1+\lambda}{\sqrt{\lambda}} \tag{5}$$

$$\gamma_2 = \frac{1}{\lambda} + 3 \tag{6}$$

IV. Skip Lot Sampling Plan of type - 3 (SkSP – 3)

According to Dodge (1955b), once a series of identical lots are submitted for inspection, the situation is not essential to inspect every lots instead the lots may be skipped below a related skip lot plan. Soundararajan and Vijayaraghavan (1989) presented skip lot sampling plan of type SkSP–3 based on the ideologies of CSP-2 of Dodge and Torrey (1951). A SkSP-3 plan consists of a procedure in which a given lot inspection plan is used as the location plan and a switching rule that calls for normally inspecting every lot, but for examining only a fraction of the lots when the quality is good. The operating procedure of SkSP-3 is like this below,

Operating Procedure of SkSP - 3

Step 1: Start the examination normally by inspecting i consecutive lots using the location plan.
Step 2: Once i lots are recognized then examine a fraction f of lots.
Step 3: If a lot is disallowed in skipping examination, then examine next successive k lots.
Step 4: If all the k lots are recognized continue skipping examination i.e. examine the fraction f lots.
Step 5: If a lot is rejected while inspecting k lots, resume normal inspection.
Step 6: Screen each rejected lot and correct or replace all the nonconforming items by good ones.

Thus, SkSP-3 is connected with a given reference plan and the constraints f, i and k. In general, $0 < f < 1$ and i and k are positive integers. The OC and ASN functions of SkSP-3 are assumed by,

$$P_a(p) = \frac{fP + (1-f)P^i(2-P^i)}{f + (1-f)P^i(2-P^i)} \tag{7}$$

$$ASN(SkSP-3) = ASN(R)F \tag{8}$$

where P is the probability of acceptance according to the reference plan, ASN(R) is the ASN function of the reference plan, F is the average fraction of total lots inspected and is given by, for $k = i$.

$$F = \frac{f}{f + (2-P^i)P^i(1-f)} \tag{9}$$

I. SSP under the conditions of Borel Distribution

A single sampling plan in attributes is described by the parameters lot size (N), sample size (n) and acceptance number (c). Let us consider a lot of size N units and a random sample of size n from the lot. If the number of defective units in the sample (X=x) is less than the acceptance number (c), then we accept the lot otherwise we reject the lot.

II. Analysis of operating characteristic curves

The Operating Characteristic (OC) function is one of the finest performance indicators for evaluating the efficacy of sampling plans. The OC function of SSP is well-defined as,

$$P_a\,(p) = P[x \le c] \tag{10}$$

where p is the lot quality, given as the proportion defective or fraction defective. The operating characteristics function of SSP under the condition of Borel distribution is given by the following,

$$P_a\,(p) = \sum_{k=1}^{c} P(X = k|\,\lambda) = \sum_{k=1}^{c} \frac{e^{-(\lambda k)}(\lambda k)^{(k-1)}}{k!} \tag{11}$$

where $\lambda = np$.

The performance of any acceptance sampling plans is usually assessed through its operating characteristic (OC) curves. A plot of $P_a(p)$ against p is called OC curve. It is observed from the Figure 1 the curve with parameters $n = 43$, $c = 1$, $i = 8$ and $f = 1/3$ the probability of acceptance $P_a(p)$ declines as the proportion defective p increases. That is the plan accepts the good quality lots with low proportion defective and rejects the lots with poor quality. For instance, the probability of acceptance at $p = 0.001$ is *0.99* and at $p = 0.01$ is *0.03*. This ensures the plan protects the consumers by not accepting the low-quality lots and producers are safeguarded by not getting rejected the good quality lots. Hence, the proposed plan favors both the consumer and producer by reducing their risks.

V. Comparison of SkSP-3 with SSP Under the Environments of the Boral Distribution

A standard approach for comparing two lot inspection sampling plans stands by analyzing their Operating Characteristic (OC) curves. Additionally, a widely used performance metric is the operating ratio (OR), defined as $OR=p_2/p_1$, where $p_1$and p_2 represent the acceptance quality limit (AQL) and the limiting quality limit (LQL), respectively. These parameters are defined such that $P_a(p_1) = 0.95$ and $P_a(p_2) = 0.10$. Here, the SkSP-3 plan with SSP under the environments of the Boral distribution is compared to a lot-by-lot SSP under the same distribution.

A SkSP-3 with SSP under the environments of Boral distribution as reference plan is to be established. Desired operating characteristics include a satisfactory producer's quality level of *4* percent nonconforming units, having *95%* acceptance probability and consumer's quality level of *15* percent nonconforming units having a *10%* acceptance probability. Hence, the desired operating ratio is $p_2/p_1 = 0.15/0.04 = 3.75$. Referring to the Table 1 with this OR value, one can locate SkSP-3 with SSP under the environments of IPD as reference plan with $c = 4$, $i = 8$ and $f = 3/5$ and corresponding np_1 value is obtained from Table 2 as *1.6753*. As p_1 is considered as *0.04*, the sample size n is determined as, $n = np_1/p_1 = 41.88$, which becomes *42*.

For the same operating ratio *3.75* with $\alpha = 0.05$ and $\beta = 0.10$, the operating ratio of SSP under the conditions of Boral distribution is obtained as *3.6556* which corresponds to acceptance number $c = 5$. The np_1 value corresponding to the specifications is *2.5317*. Thus, the sample size is determined as $n = np_1/p_1 = 63.2925$, which becomes *64*. Thus, for the given values of p_1, p_2, α and β, it is observed that the sample sizes required by SkSP-3 with SSP under the conditions of IPD as reference plan are smaller than those of the matched SSP under the environments of IPD.

Table 1: *Operating ratio values for Skip lot sampling plan of type- 3 (SkSP-3) with SSP under the environments of Boral Distribution*

c	i	f	α=0.05 β=0.10	α=0.05 β=0.05	α=0.05 β=0.01	α=0.01 β=0.10	α=0.01 β=0.05	α=0.01 β=0.01
1	4	1/2	18.534	23.025	33.365	87.717	108.971	157.909
		1/3	13.016	16.261	23.224	60.545	75.637	108.024
		2/3	23.974	29.888	43.153	121.201	151.098	218.163
		2/5	15.222	19.013	27.355	68.025	84.967	122.242
		3/5	21.720	27.194	39.622	108.789	136.207	198.451
	8	1/2	20.336	25.263	36.609	87.717	108.971	157.909
		1/3	15.524	19.394	27.698	60.545	75.637	108.024
		2/3	25.377	31.637	45.679	121.201	151.098	218.163
		2/5	17.469	21.820	31.392	68.025	84.967	122.242
		3/5	23.303	29.176	42.509	108.789	136.207	198.451
2	4	1/2	22.166	27.537	39.903	87.717	108.971	157.909
		1/3	17.739	22.162	31.651	60.545	75.637	108.024
		2/3	26.236	32.707	47.224	121.201	151.098	218.163
		2/5	19.495	24.351	35.033	75.089	93.789	134.935
		3/5	24.751	30.989	45.151	108.789	136.207	198.451
	8	1/2	6.246	7.412	9.879	14.457	17.157	22.866
		1/3	5.163	6.124	8.162	1.002	1.188	01.584
		2/3	7.257	8.615	11.481	16.182	19.210	25.602
		2/5	5.616	6.663	8.880	12.856	15.253	20.328
		3/5	6.881	8.167	10.885	15.221	18.067	24.079
	12	1/2	6.557	7.789	10.382	14.116	16.769	22.351
		1/3	5.661	6.724	8.962	11.826	14.048	18.723
		2/3	7.382	8.770	11.689	16.543	19.654	26.196
		2/5	6.029	7.161	9.545	12.470	14.812	19.743
		3/5	7.059	8.386	11.177	15.614	18.549	24.723
3	4	1/2	6.861	8.151	10.864	14.532	17.265	23.012
		1/3	6.078	7.222	9.625	11.935	14.180	18.900
		2/3	7.572	8.996	11.990	16.775	19.930	26.564
		2/5	6.403	7.608	10.140	13.029	15.480	20.632
		3/5	*4.538*	*5.269*	*6.797*	*8.283*	*9.616*	*12.406*
	8	*1/2*	*4.246*	*4.929*	*6.359*	*7.532*	*8.743*	*11.279*
		1/3	*3.695*	*4.287*	*5.531*	*6.559*	*7.610*	*9.817*
		2/3	*4.717*	*5.477*	*7.066*	*8.605*	*9.990*	*12.889*
		2/5	*3.928*	*4.558*	*5.881*	*6.979*	*8.099*	*10.448*
		3/5	*4.538*	*5.269*	*6.797*	*8.283*	*9.616*	*12.406*

c	i	f	α=0.05 β=0.10	α=0.05 β=0.05	α=0.05 β=0.01	α=0.01 β=0.10	α=0.01 β=0.05	α=0.01 β=0.01
	12	1/2	4.401	5.111	6.594	7.756	9.007	11.621
		1/3	3.927	4.561	5.884	6.716	7.799	10.062
		2/3	4.799	5.573	7.190	8.606	9.994	12.893
		2/5	4.119	4.784	6.172	7.162	8.317	10.730
		3/5	4.645	5.394	6.959	8.284	9.620	12.411
4	4	1/2	4.401	5.111	6.594	7.756	9.007	11.621
		1/2	3.460	3.961	5.001	5.585	6.393	8.072
		1/3	3.089	3.535	4.463	4.954	5.669	7.157
		2/3	3.767	4.313	5.445	6.083	6.964	8.793
		2/5	3.247	3.716	4.692	5.228	5.983	7.554
		3/5	3.650	4.179	5.277	5.896	6.749	8.522
	8	1/2	3.568	4.086	5.159	5.516	6.317	7.976
		1/3	3.274	3.749	4.734	5.008	5.735	7.241
		2/3	3.825	4.380	5.530	6.010	6.882	8.689
		2/5	3.394	3.887	4.908	5.158	5.906	7.458
		3/5	3.726	4.267	5.388	5.825	6.670	8.422
	12	1/2	3.667	4.199	5.302	5.596	6.409	8.092
		1/3	3.411	3.906	4.932	5.017	5.746	7.255
		2/3	3.884	4.448	5.616	6.068	6.948	8.774
		2/5	3.520	4.030	5.089	5.266	6.030	7.614
		3/5	3.800	4.352	5.495	5.891	6.746	8.518
		3/5	3.800	4.352	5.495	5.891	6.746	8.518

Table 2: *Unity values for Skip lot sampling plan of type - 3 (SkSP-3) with SSP under the environments of Boral Distribution*

c	i	f	0.99	0.95	0.75	0.5	0.1	0.05	0.01
1	4	1/2	0.0407	0.1926	0.7590	1.3808	3.5704	4.4355	6.4275
		1/3	0.0590	0.2744	0.8858	1.4731	3.5716	4.4619	6.3724
		2/3	0.0295	0.1492	0.6692	1.3187	3.5781	4.4607	6.4406
		2/5	0.0525	0.2346	0.8291	1.4312	3.5715	4.4609	6.4180
		3/5	0.0328	0.1643	0.7040	1.3411	3.5696	4.4692	6.5116
	8	1/2	0.0407	0.1756	0.6204	1.2481	3.5704	4.4355	6.4275
		1/3	0.0590	0.2301	0.6731	1.2589	3.5716	4.4619	6.3724
		2/3	0.0295	0.1410	0.5874	1.2407	3.5781	4.4607	6.4406
		2/5	0.0525	0.2044	0.6499	1.2524	3.5715	4.4609	6.4180

c	*i*	*f*	**0.99**	**0.95**	**0.75**	**0.5**	**0.1**	**0.05**	**0.01**
2	4	3/5	0.0328	0.1532	0.5995	1.2416	3.5696	4.4692	6.5116
		1/2	0.0407	0.1611	0.5710	1.2392	3.5704	4.4355	6.4275
		1/3	0.0590	0.2013	0.5932	1.2375	3.5716	4.4619	6.3724
		2/3	0.0295	0.1364	0.5571	1.2360	3.5781	4.4607	6.4406
		2/5	0.0476	0.1832	0.5828	1.2388	3.5715	4.4609	6.4180
		3/5	0.0328	0.1442	0.5620	1.2355	3.5696	4.4692	6.5116
	8	1/2	0.3595	0.8321	1.8330	2.6677	5.1967	6.1674	8.2194
		1/3	5.1904	1.0071	2.0138	2.7829	5.1997	6.1678	8.2194
		2/3	0.3210	0.7159	1.6987	2.5890	5.1953	6.1672	8.2194
		2/5	0.4043	0.9256	1.9336	2.7305	5.1982	6.1676	8.2194
		3/5	0.3414	0.7551	1.7485	2.6176	5.1958	6.1673	8.2194
	12	1/2	0.3677	0.7917	1.6246	2.4962	5.1911	6.1668	8.2194
		1/3	0.4390	0.9172	1.7041	2.5104	5.1917	6.1668	8.2194
		2/3	0.3138	0.7031	1.5722	2.4891	5.1907	6.1667	8.2194
		2/5	0.4163	0.8611	1.6684	2.5034	5.1914	6.1668	8.2194
		3/5	0.3325	0.7354	1.5889	2.4914	5.1908	6.1668	8.2194
3	4	1/2	0.3572	0.7565	1.5462	2.4822	5.1904	6.1667	8.2194
		1/3	0.4349	0.8539	1.5819	2.4826	5.1904	6.1667	8.2194
		2/3	0.3094	0.6855	1.5231	2.4821	5.1904	6.1667	8.2194
		2/5	0.3984	0.8106	1.5653	2.4823	5.1904	6.1667	8.2194
		3/5	0.3261	0.7117	1.5314	2.4821	5.1904	6.1667	8.2194
	8	1/2	0.8756	1.5531	2.8101	3.7811	6.5948	7.6551	9.8758
		1/3	1.0060	1.7857	3.0250	3.9130	6.5981	7.6555	9.8758
		2/3	0.7662	1.3977	2.6473	3.6913	6.5931	7.6548	9.8757
		2/5	0.9452	1.6794	2.9305	3.8519	6.5964	7.6553	9.8758
		3/5	0.7961	1.4529	2.7079	3.7239	6.5937	7.6549	9.8757
	12	1/2	0.8498	1.4977	2.5611	3.5868	6.5916	7.6546	9.8757
		1/3	0.9815	1.6784	2.6575	3.6032	6.5917	7.6546	9.8757
		2/3	0.7662	1.3977	2.6473	3.6913	6.5931	7.6548	9.8757
		2/5	0.9142	1.5239	2.4865	3.5707	6.5915	7.6546	9.8757
		3/5	0.7936	1.3865	2.4483	3.5699	6.5915	7.6546	9.8757
	4	1/2	1.4163	2.2860	3.7465	4.8341	7.9099	9.0542	11.4319
		1/3	1.5973	2.5617	3.9884	4.9789	7.9134	9.0547	11.4319

c	i	f	0.99	0.95	0.75	0.5	0.1	0.05	0.01
		2/5	1.5134	2.4365	3.8792	4.9132	7.9117	9.0545	11.4319
		3/5	1.3415	2.1665	3.6330	4.7691	7.9087	9.0541	11.4319
	8	1/2	1.4333	2.2159	3.4656	4.6177	7.9064	9.0537	11.4319
		1/3	1.5787	2.4148	3.5727	4.6355	7.9064	9.0538	11.4319
		2/3	1.3156	2.0671	3.3904	4.6079	7.9063	9.0537	11.4319
4		2/5	1.5329	2.3293	3.5244	4.6268	7.9064	9.0537	11.4319
		3/5	1.3573	2.1219	3.4179	4.6112	7.9063	9.0537	11.4319
	12	1/2	1.4127	2.1563	3.3496	4.5990	7.9063	9.0537	11.4319
		1/3	1.5758	2.3179	3.4034	4.6003	7.9063	9.0537	11.4319
		2/3	1.3030	2.0356	3.3229	4.5984	7.9063	9.0537	11.4319
		2/5	1.5014	2.2463	3.3791	4.5997	7.9063	9.0537	11.4319
		3/5	1.3415	2.1665	3.6330	4.7691	7.9087	9.0541	11.4319

Using these points, the OC curves are plotted and displayed in Figures 1 and 2. Figure 2 illustrates that the OC curves of SkSP-3 and SSP under the conditions of the Boral distribution coincide at p ≤ AQL and p ≥ LQL. Furthermore, the table indicates that the significant reduction in sample size for SkSP-3 with SSP under the environments of the Boral distribution compared to SSP for low proportions of defectives. Further, when the proportion defectives are very close to the matched sampling plans.

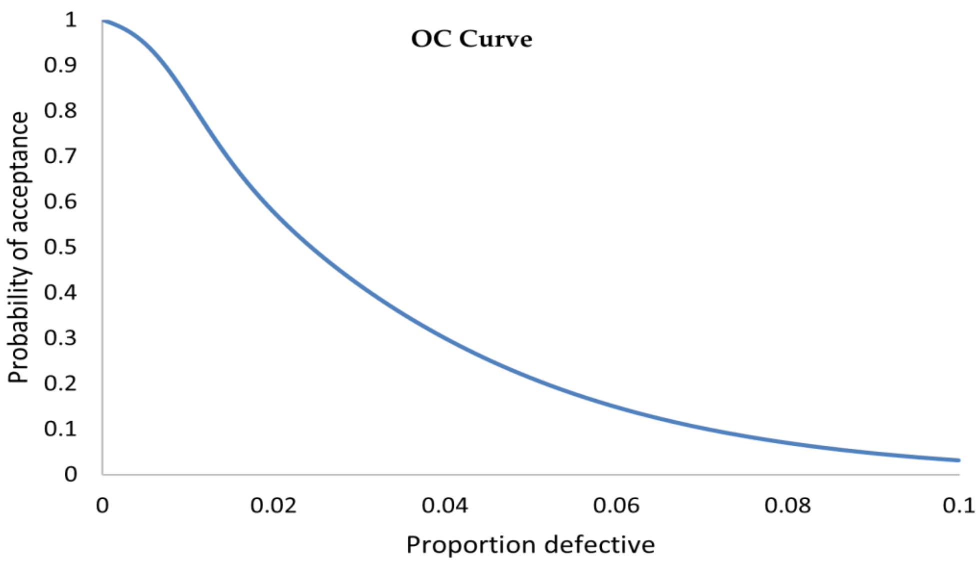

Figure 1: *Operating Characteristic curve for SkSP -3 with SSP under the conditions of Boral Distribution (n = 43, c = 1, i = 8, f = 1/3)*

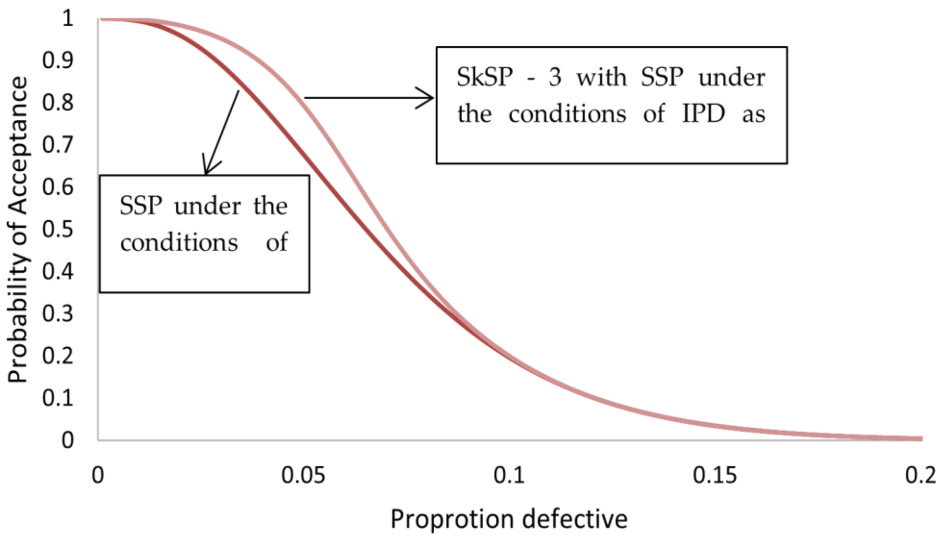

Figure 2: *OC curves of matched SSP under the conditions of IPD (n = 50, c = 3) and SkSP – 3 with SSP under the conditions of Boral Distribution (c = 3, i = 4, f = 2)*

Conclusion

This study presents the design and assessment of a skip-lot sampling plan of type SkSP-3, developed using single sampling plan principles under the conditions of the Boral distribution. The analytical framework demonstrates the plan's efficiency in terms of reduced sample size requirements, making it highly effective for processes with sporadic or rare defects. Comparison with equivalent SSPs under the Boral distribution reveals that the SkSP-3 plan exhibits comparable performance at critical quality levels (AQL and LQL) while significantly reducing inspection efforts, as evidenced by the operating characteristic and average sample number curves. This reduction in sample size offers practical benefits for industries seeking to balance quality control with operational efficiency. Future research may explore extensions of the SkSP-3 design for other complex probabilistic distributions or multi-stage sampling scenarios, broadening its applicability to diverse industrial settings. The integration of advanced statistical techniques and computational tools can further refine the design and analysis of sampling plans under non-standard conditions.

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