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A NUETROSOPHIC SINGLE ACCEPTANCE SAMPLING PLAN WITH QUALITY PARAMETERS

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Abstract. In the Quality Control and inspection processes, the use of attribute sampling strategies is crucial. In this study, we incorporate the neutrosophic fuzzy acceptance sampling plan method to present a fresh approach to attribute sampling plans. Utilizing the benefits of neutrosophic fuzzy sets, the proposed sampling plan method models and assesses the acceptance standards for attribute sampling. We compare the suggested method to already-in-use attribute sampling techniques plans with new attribute six sigma sampling techniques plan is proposed in order to verified its efficacy. The outcomes show the neutrosophic fuzzy acceptance sampling plan's superiority in terms of its capacity to manage uncertainties, account for ambiguity, and produce more precise quality evaluation outputs.

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Key words and phrases : Attribute sampling, neutrosophic binomial distribution, single sampling plan, uncertainty, UCL, and LCL.

1. Introduction

In order to achieve excellent product quality, the manufacturing process must involve thorough evaluation of the product from raw materials to completed product. It is insured that neither a poor lot nor a good lot of the product will be allowed by checking a lot of the product using the sample technique. The provider is typically interested in learning the possibility that the final batch of goods delivered will be accepted. The standard acceptance sampling approach selects and examines a random sample of the product for the purpose of lot sentencing. Based on sample data, a major chunk of the product is either accepted or rejected. The choice to accept or reject is made with the assumption that there are no ambiguities in the data. [1] goes into much detail about the

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attribute sampling technique that uses conventional/classical statistics.

In actuality, the sample data utilized to establish lot punishment is likely insufficient, problematic, erroneous, or ambiguous. Choosing whether to accept or reject a large quantity of the product is not a straightforward binary decision in this circumstance. As a result, we are unable to draw conclusions using clear figures as in traditional statistics. A representative sample of clocks is picked at random from a vast number, and their display type is documented as an illustration it has been observed that 90% of watches have an adequate display, 10% do not, and 10% or so do not have any information about the type of timepieces. In this case, there is a likelihood of indeterminacy, which encourages the use of the acceptance approach based on neutrosophic statistics.

Classic sample procedures are utilized when the investigator or producer is confident in the percentage parameter. As a result, if there is uncertainty or indeterminacy about the % parameter, sampling procedures based on a definite value cannot be applied. Fuzzy sampling algorithms have been widely employed for lot sentencing where the percentage parameter is unknown. In this paper is an given preliminaries in section 2 and elaborate discussion, steps about proposed method given in section 3. Section 4 presents the experimental results based on proposed model. The summary and discussion are made in the last section.

2. Preliminaries

Several authors are proposed the fuzzy approach to build the sample plan; for example, Cheng et al. [2] proposed a fuzzy testing procedure to select a more effective procedure using a single sample approach, Jamkhaneh et al. [3] evaluated the effects of inspection errors. Both Jamkhaneh and Gildeh [5] and Sadeghpour Gildeh et al. [4] created a twofold sampling system using the fuzzy approach. Examination of the characteristic curve of the sample plan by Turanoglu et al. [6]. By Jamkhaneh and Gildeh [7], the fuzzy sequential sampling plan was published. Divya [8] created a single sampling method using the Poisson distribution and others are [25-26] contributed to these concept

Definition 2.1: Fuzzy set

Membership function μ_A in crisp set maps whole members in universal set X to set {0,1},

μ_A : X $\rightarrow \{0, 1\}$

Definition 2.2: Gamma Distribution

The gamma function is represented by $\Gamma(y)$ which is an extended form of factorial function to complex numbers(real). So, if n $\in \{1, 2, 3, \dots\}$, then $\Gamma(y) = (n-1)!$.

Venkateh and Elango [9] developed a sampling plan for fuzzy gamma distribution. The fuzzy approach of Kahraman et al. [10] was used to build the single and double sampling plans. Afshari and Gildeh [11] and Afshari et al. [12] employed multiple dependent state sampling to generate fuzzy plans. Elango et al. [13] developed the fuzzy mathematics for the single sample method.

Neuosophic logic has lately attracted the attention of scholars due to its versatility in dealing with uncertainty in observations and the percentage parameter. Smarandache [14] defines fuzzy logic as an extension of neutrosophic logic. According to [15], neutrosophic sets are a recently created strategy for dealing with unclear data. A neutrosophic set has the potential to serve as a general framework for data set uncertainty analysis.

According to [16], the single valued neutrosophic set is a generalization of the classic set, fuzzy set, interval valued fuzzy set, intuitionistic fuzzy set, and par consistent set. The States that "interval valued neutrosophic sets (IVNSs) can be used to express a wide variety of incomplete or complete information; neutrosophic sets are powerful logics designed to facilitate understanding of indeterminate and inconsistent information."

Neutosophic statistics (NS) are based on neutrosophic reasoning and were initially proposed by [17]. The NS is a statistical generalisation that may be used to examine data in an uncertain environment. According to [24] This research work appertains to the acceptance sampling plan under the neutrosophic statistical interval method (ASP-NSIM) based on gamma distribution (GD)

Chen et al. [18, 19] investigated the difficulty of measuring rocks using the neutrosophic interval technique. [20] has further information on the neutrosophic application. Recently, [21] introduced the NS in the acceptance sample plan area for the first time. The many authors published the technique for the exponential distribution using the NS. More information about the NS's applications may be found in [21-23].

Based on a survey of the literature, the author believes that no work has been done on the design of an attribute acceptance sampling approach using neutrosophic statistics. As a result, the purpose of this work is to develop an attribute sampling strategy using neutrosophic statistics. This paper proposes a new attribute sampling approach based on neutrosophic statistics. The operational method of a proposed example plan is offered.

The neutrosophic binomial distribution is used to compute the probability of lot acceptance, rejection, and indeterminacy for various given factors such as sample size and acceptance number. We estimate that the suggested sample approach will be more adequate, effective, adaptive, and informative than the existing sampling method under the uncertain situations.

3. Proposed Model

Under classical statistics, the present attribute sampling approach provides two different findings for the product lot that was submitted. If the number of failures is fewer than the required number of failures c, the lot is authorized; otherwise, the lot is refused. In the real world of business, there are occasions when the experimenter is confused if a product is good or bad. In the case of a question, the present sampling approach may be utilized to examine a considerable amount of the product. In this section, we'll discuss and propose a sampling technique for an uncertain environment.

The proposed sampling plan using neutrosophic statistics is stated as follows,

Step-1: Select a random sample of size n from a lot of the product and obtain x^- and x^+.

Step-2: Compute trimmed mean (Robust Mean) RM= $\underline{X_R}$ = Trm $\left(\frac{\sum_{i=1}^{n} x_i}{n}\right)$ and Standard deviation as SD $\sqrt{\frac{(X_i-\underline{x})^2}{n-1}}$.

Step-3: Set a = [x^- , x^+] and compute the probability of non-defective items P_{ND} = n_{ND}/n, the in terminate probability P_I= n_I/n, and the probability of a defective an item.

The number of value in non-failure interval [XL, X-3S] and [X-3S, XU], the uncertainty interval is [X-3S, X-S] and [X +S, X+3S] and the failure interval is [X-S, X+S].

Step-4: Accept a lot of the product if the number of flaws is less than the permitted number of flaws; otherwise, reject the lot.
The recommended sampling consists of two factors: the acceptance number (c) and the sample size (n). The neutrosophic operating characteristics (NOC) function for the proposed plan, based on the neutrosophic binomial distribution (NBD), is as follows,

L(P) = P_R +P_I+P_D, P_{ND}+P_I+P_A≥1

where $P_R = \frac{n!}{c!} P(R)^C \sum_{k=o}^{c} \frac{P(I)^K P(F)^{n-c-k}}{k!(n-c-k)!}$

$P_I = \sum_{z=c+1}^{n} \frac{n!}{z!} P(I)^z \left\{\sum_{k=0}^{c-z} \frac{P(R)^K P(F)^{n-c-k}}{k!(n-c-k)!}\right\}$

$P_D = \sum_{y=c+1}^{n} T_y = \sum_{y=c+1}^{n} P(I)^y \frac{n!}{z!} \left\{\sum_{k=0}^{c-z} \frac{P(R)^K P(F)^{n-c-k}}{k!(n-c-k)!}\right\}$

Specify the acceptance number c.

The P_R, P_I and P_D are the sum of the lot rejection probability, indeterminate probability, and lot acceptance probability is given by,

L(P)= P_R, P_I, P_D

4. Experimental Study

The mentioned Table 1: The lot acceptance probabilities L(p) = $\{P_R, P_I, P_A\}$ when $p_{ND} = 0.70$, $p_I = 0.15$ and $p_D = 0.08$, The values of p_{ND}, p_I, p_D, and c, as well as the lot rejection probability, lot rejection probability, indeterminate probability, and lot acceptance probability, are shown in Tables 1 and the estimated probabilities in Table 1 may be greater than one, the normalized vector of probabilities may be obtained by dividing each probability by the total of all of them.

Other important parameter values can be placed into similar tables. On request, the author will supply a programme. Table 1 are displayed for c = 0, 1, 2, and $p_{ND} = 0.70$, $p_I = 0.15$, and $p_D = 0$. Tables 1 and Figure 1 indicate that when c increases from 0 to 2, the fixed value of n, the indeterminate probability, and the lot acceptance probability all rise. Given a fixed value of c, the lot acceptance probability, indeterminate probability, and lot rejection probability all decrease as n increases.

Table 1: The lot acceptance probabilities L(p) = $\{P_R, P_I, P_A\}$ when $p_{ND} = 0.70$, $p_I = 0.15$ and $p_D = 0.08$

n	**c=0**			**c=2**			**c=4**		
	$\mathbf{P}_R$	$\mathbf{P}_I$	$\mathbf{P}_D$	$\mathbf{P}_R$	$\mathbf{P}_I$	$\mathbf{P}_D$	$\mathbf{P}_R$	$\mathbf{P}_I$	$\mathbf{P}_D$
5	0.1413	0.8231	0.0941	0.2543	0.2259	0.5197	0.0616	0.0449	0.8935
10	0.0814	0.8652	0.0932	0.2221	0.2455	0.2001	0.0545	0.0657	0.7854
15	0.0765	0.8766	0.0921	0.2001	0.2677	0.1003	0.0489	0.0990	0.6543
20	0.0666	0.8822	0.0911	0.0200	0.3123	0.0065	0.0336	0.1267	0.5432
25	0.0581	0.8852	0.0900	0.0144	0.4145	0.0045	0.0312	0.3.567	0.4123
30	0.0342	0.8912	0.0800	0.0112	0.4882	0.0033	0.0231	0.4343	0.3421
35	0.0213	0.8992	0.0701	0.0067	0.5678	0.0021	0.0211	0.5643	0.2876
40	0.0111	0.9002	0.0675	0.0044	0.6754	0.0011	0.0123	0.6586	0.1098
45	0.0062	0.9110	0.0412	0.0021	0.7865	0.0007	0.0022	0.7124	0.0765
50	0.0011	0.9211	0.0101	0.0005	0.8765	0.0002	0.0001	0.81245	0.0678
75	0.0006	0.9310	0.0045	0.0001	0.8901	0.00004	0.00003	0.9012	0.0512
100	0.0004	0.9520	0.0037	0.00002	0.9006	0.00001	0.00001	0.9234	0.0412
150	0.0003	0.9901	0.0021	0.00001	0.9678	0.000002	0.000003	0.9748	0.0023
200	0.0002	0.9912	0.0001	0.000001	0.9993	0.000001	0.000001	0.9992	0.0003

Tables 2 show the lot acceptance probability, lot rejection probability, indeterminate probability, and lot acceptance probability for the classical, fuzzy, and proposed models of p_{ND}, p_I, p_D, and c. The calculated probabilities in Tables 2 may be more than one; a normalized vector of probabilities may be generated by dividing each probability by the total of all of them.

Table 2: The lot acceptance probabilities L(p) = {PR, PI, PA} when pND = 0.50, pI= 0.10, pD = 0.05 and c=2

n	**Classical Statistics**			**Fuzzy Statistics**			**Proposed Model**		
	$\mathbf{P}_R$	$\mathbf{P}_I$	$\mathbf{P}_D$	$\mathbf{P}_R$	$\mathbf{P}_I$	$\mathbf{P}_D$	$\mathbf{P}_R$	$\mathbf{P}_I$	$\mathbf{P}_D$
5	0.1400	0.8233	0.0348	0.0868	0.4572	0.3456	0.0081	0.1538	0.2310
10	0.0800	0.8712	0.0101	0.0664	0.5455	0.1001	0.0545	0.3657	0.1854
15	0.0715	0.9310	0.0045	0.0445	0.7677	0.0203	0.0489	0.6990	0.0543
20	0.0066	0.9520	0.0037	0.0200	0.9123	0.0045	0.0336	0.7267	0.0032
25	0.0001	0.9890	0.0021	0.0044	0.9915	0.0035	0.0312	0.8.567	0.0003
30	0.0000	1.0000	0.0001	0.0002	0.9999	0.0023	0.0231	0.9343	0.0001
35	0.0000	1.0000	0.0000	0.0000	1.0000	0.0011	0.0211	0.9943	0.0000
40	0.0000	1.0000	0.0000	0.0000	1.0000	0.0001	0.0003	0.9996	0.0000
45	0.0000	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	1.0000	0.0000
50	0.0000	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	1.0000	0.0000
75	0.0000	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	1.0000	0.0000
100	0.0000	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	1.0000	0.0000
150	0.0000	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	1.0000	0.0000
200	0.0000	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	1.0000	0.0000

Other important parameter values can be placed into similar tables. On request, the author will supply a programme. Table 2 were displayed when c = 2 and p_{ND} = 0.50, p_I = 0.10, and p_D = 0.05. Table 2 indicate that when c=2, the fixed value of n, the chance of a lot being rejected, and the probability of a lot being accepted all increase.

5. Applications of the Proposed Model

We demonstrate the application of the suggested sampling approach. In this section we have collected data on the production of smart phones. Consider a corporation that manufactures 1000 cell phones each day, each of which has three sub-qualities: display resolution, overall build quality, and camera quality.

Table 3: Data on Smartphone Manufacturing of 200 values

12894	12415	12201	12806	12552	12209	12432	12133	11638	12016
11833	11733	13023	11943	12177	12279	12338	11977	11952	11870
11993	12656	11914	12053	12180	12109	12092	11814	12046	12186
12233	12062	11899	12023	12020	11855	12014	11856	12170	11745
11881	12224	11636	13302	12280	12236	12058	11740	12075	12255
12836	11868	11723	12251	12083	12344	11896	11602	12130	11788
12104	12252	12378	11757	12598	12032	12212	11621	12197	12324
12467	12082	11633	12305	11942	11819	12371	12057	11971	12109
11641	12238	12089	11707	11974	11848	11794	12218	12081	11992
12025	12253	11962	11774	12189	11602	12106	12308	12233	12192
12623	12375	12048	12161	11701	11856	11650	11606	12318	12073
12586	11855	12203	12611	11791	11802	11718	12355	12048	12051
12213	11736	11975	12037	12079	12009	12380	12032	11689	11669
12556	11866	12461	12240	12120	12208	12337	12166	11986	12366
11896	11984	12183	11645	11891	12346	11607	12019	11602	12294
12169	11785	12482	11926	12347	12372	11853	12137	12058	12396
11974	12452	12022	11792	12410	11712	12128	12119	12111	11611
12219	11639	12421	12043	12180	11667	11610	12060	11603	11624
12109	12359	11655	12133	11757	11829	12325	12184	11853	11775
12041	11847	12392	12161	11746	12394	12062	12031	11695	11652

Table 4: Distribution of color STN displays data of 55 values

n	**Trm**($\underline{X}$)	σ	$\mathbf{x}^{-}$	$\mathbf{x}^{+}$	[$\mathbf{X}^L$, $\underline{X}-3S$] **and** [$\underline{X}-3S$, $\mathbf{X}^U$]	[$\underline{X}-3S$, $\underline{X}-S$] **and** [$\underline{X}+S$, $\underline{X}+3S$]	$\underline{X}-S$, $\underline{X}+S$]
200	12109	40.24	11602	13202	157	33	10

This study focuses on the production data for smart phones in Table 3 and each pixel as a quality parameter. Table 4 displays some statistics for the provided 200 sample data. Table 4 shows that 157 of the 200 items fall into the non-defective group, 33 of the 200 items go into the indeterminacy group, and 10 of the 200 items fall into the failed items group.

6. Conclusion

Based on neutrosophic statistics, this paper provides a unique neutrosophic fuzzy sampling strategy. The recommended technique is more customizable than sample designs developed using classical statistics. The lot acceptance probability is presented for various acceptance numbers and sample sizes. Several tables and concepts for assessing the probability of determinate, indeterminate, and acceptance of numerous items are presented for practical use. When there is uncertainty in the sample or population, the recommended plan is a subset of the existing sampling plan under classical statistics, which only contains the computed probability value.

The comparative study shows that, in the presence of uncertainty, the proposed plan outperforms and outperforms the sampling plan based on traditional statistics. With the provided sampling strategy, only discrete data may be used. It is recommended that the provided technique be utilized to examine a number of objects in an ambiguous circumstance. Future study might consider utilizing the recommended sampling technique with the cost model. Future research might be considered as the proposed strategy in the time-limited life test.

Conflicts of interest : The authors declare no conflict of interest.

Data availability : Not applicable

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