A VARIABLE-ATTRIBUTE TESTING PLAN DONE ON PROCESS POTENTIAL INDEX AND LEAST TANGENT ANGLE PRINCIPLE

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ABSTRACT

In this study, a design procedure of variable-attribute testing plan is presented. The variable testing is done by using process potential index $\widehat{C}_k$, and the attribute testing is done by using least tangent angle principle with two sided complete chain sampling plan as reference plan. In this article, the sampling risks are reduced by reducing the tangent angle, which passes through (AQL, $1-\alpha$) and (LQL, β). Designing strategies are delivered with illustration.

KEYWORDS: Two Sided Complete Chain Sampling Plan, Process Potential Measure $\widehat{C}_k$ & Least tangent Angle

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1. INTRODUCTION

Now a days, acceptance sampling plan is also used to reduce both producer's and consumer's risk. In quality control, quality of an item is achieved only if the process control is effective. To achieve effective process control, process potential index is used in the first stage variable testing. The second stage attribute testing is achieved by using minimum angle technique. Here the two sided complete chain sampling plan is used as reference plan, since it considers the testing results of past and future. In two sided complete chain sampling plan, if any defective is found in a sample then the preceding 'i' samples and the succeeding 'j' samples should be tested, for a unique decision on the present lot. The least tangent angle technique on the operating characteristic curve gives security to both the client and the producer by reducing the risks.

2. LITERATURE REVIEW

A variable sampling plan with process capability index was developed by CheinWei and Pearn in the year 2008. Negrin, Parmet and Schechtman (2010) have made a Sampling plan based on C_{pk} - Unknown Variance. ChuanWu and

Lin (2003) have contributed sample size determination for the estimate of process capability indices. Lin and Pearn (2003) have studied Distributions of the estimated process capability index. Suresh, K.K. and Deva Arul, S. (2002) have developed sampling plans combining Process and Product Control for reducing sampling costs. JemmyJoyce, Deva Arul, S. (2013) have contributed mixed sampling plans based on Tangent Angle. Deva Arul and Edna (2013) designed mixed sampling plans for costly or destructive items.

3. THE DESIGN OF SAMPLING PLAN USING $\widetilde{C}_k$, IS INDICATED BY FOUR PARAMETERS, m_1 , m_2 , K , i and $\tan \theta$.

Where,

m_1 is the first stage testing sample size

m_2 is the second stage testing sample size, if the process is not accepted in first stage testing

K is the critical acceptance value.

i is the index of connecting the lots

4. ALGORITHM OF THE INDEPENDENT VARIABLE-ATTRIBUTE SAMPLING PLAN (M_1 , M_2 , K , I)

- Take a random sample of size m_1 from the lot
- Calculate the process potential measure $\widetilde{C}_k$
- If the process potential measure $\widetilde{C}_k \geq K$, then admit the entire lot or process.
- If $\widetilde{C}_k < K$ then draw a sample of size m_2 for attribute inspection.
- Examine and count the numeral of imperfections in the attribute inspection sample. If the following conditions are true, then admit the lot.
 - Accept the lot, if D (the number of imperfections) is zero in the sample
 - of m_2 items and reject if $D > 1$.
 - Accept the lot, if $D = 1$ and if no defectives are found in the immediately past
 - 'i' samples and the next 'j' samples of size m_2 .

5. OPERATING CHARACTERISTICS FUNCTION

The operating characteristics function $P_a(p)$ of two sided complete chain sampling plan is

$$P_a(p) = P_{m_1}(\widetilde{C}_k \geq K) + P_{m_2}(\widetilde{C}_k < K)e^{-m_2 p} \{1 + m_2 p e^{-2im_2 p}\}, \text{ if } i=j$$

i = immediately past sample

j = immediately next sample

m = Sample size

p = Fraction defective

6. The Tangent of angle of line joining the points $(p_1, 1-\alpha)$ and (p_1, β) and the line joining the points $(p_1, 1-\alpha)$ and (p_2, β) is given by

$$\tan \theta = (p_2 - p_1) / (p_2 - p_1 (P_{1m_1}(\widetilde{C}_k \geq K) + P_{1m_2}(\widetilde{C}_k < K)e^{-m_2 p_1} \{1 + m_2 p_1 e^{-2im_2 p_1}\}) - (P_{2m_1}(\widetilde{C}_k \geq$$

$$K) + P2_{m_2} (\widetilde{C}_k < K) e^{-m_2 P_2} \{1 + m_2 P_2 e^{-2im_2 P_2}\}, \text{if } i=j$$

Table 1 Tan θ , Sum of the Risks and M_2 values for Various P_1 , P_2 are Tabulated below

P1	P2	m_1	K	$P_a(p_1)=1-\alpha$	$P_a(p_2)=\beta$	Tan θ	Value of m_2					$\alpha+\beta$
							$i = j = 1$	$i = j = 2$	$i = j = 3$	$i = j = 4$	$i = j = 5$	
.001	.35	98	1.20	0.9981	0.0167	0.3329	180	162	146	135	120	0.0186
.002	.50	85	1.204	0.9872	0.0841	0.5514	95	82	80	76	75	0.0969
.003	.65	83	1.206	0.9446	0.1442	0.7608	87	80	76	75	64	0.1996
.004	.70	74	1.208	0.9007	0.1791	0.9645	78	77	73	66	52	0.2789
.005	.85	63	1.30	0.8988	0.1992	1.2061	66	63	57	46	42	0.2994
.006	.95	59	1.308	0.8274	0.2005	1.5058	45	42	39	37	31	0.3731

Example: In an industrial manufacturing of copper bowls, obtain the sample size having $P_1=0.001$, $P_2 = 0.35$ using process potential index and least of tangent angle process potential index with two sided complete chain sampling plan as reference plan. Also given $i=j=3$.

Solution: The parameters are attained, from the table, with minimum Tan $\theta = .3329$ and the sum of the risks is 0.0186.

Take a sample of 98 copper bowls.

Calculate process potential measure, If $K < 1.213$ then reject the lot, otherwise take second stage sample of size 146, find the number of imperfections D . If $D=0$, accept the items. If $D>1$, then reject the items.

If $D=1$, then test the immediately past $i=3$ samples and immediately next $j=3$ samples. There if $D=0$, then accept the items.

CONCLUSIONS

In the above table, the tangent angle and the sum of the risks for different P_1 and P_2 are presented. One can observe that, at a point where the tangent angle is least, the sum of the risks is also least. The outcome presented in this study is a new principle for designing testing plan with process potential index and least tangent angle.

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