Developing a Rectifying Inspection Plan with Repetitive Group Sampling Based on Loss-based Capability Index

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Abstract

In the field of quality assurance, acceptance sampling plan is a widely-used method which applies statistical and quality control concept. It provides an efficient way to decide whether to accept or reject the lot under the allowable risks without having a full inspection of all products. To reduce the average sample number or inspection cost, many scholars have proposed various acceptance sampling plans over the years.

Rectifying inspection plan is a sampling system which can help to provide the quality assurance of the incoming product lots to the custom. In rectifying inspection plan, only a sample of n units will be inspected and the defective units should be replaced by non-defective one if the lot is accepted. Instead, the remaining units will be 100% inspected once the lot is rejected by the rectifying inspection.

Process capability indices (PCIs) is a practical statistical tool to provide the information of the ability of a manufacturing process or procedure to meet specification limit. Juran (1974) proposed the first PCI, process precision index (C_{pk}) in 1986 and Kane (1986) proposed another index, C_{pk} , a yield-based process capability index, which is one of the most popular PCIs. However, since the degree of deviation from center of the process is not considered when evaluating process performance in the traditional capability indices, the concept of loss-based capability index C_{pm} was developed based on the Taguchi's loss function.

For the propose to minimize the number of average total inspection, we consider a variable rectifying inspection plan with repetitive group sampling based on loss-based capability index C_{pm}. The proposed C_{pm}-based VRRGS plan has three parameters, (n, k_a, k_r) to be solved. In order to protect both producer and consumer, the probability of acceptance cannot be less than $1-\alpha$ when the quality level reaches acceptable quality level (AQL) while the probability of acceptance should be less than β when the quality level is at rejectable quality level (RQL). Therefore, we use minimizing ATI as objective function and producer's and consumer's risk as two constraints to build an optimization model. Through this model, the required unknown parameter (n, k_a, k_r) can be solved.

Lastly, the performance of the proposed VRRGS plan is also discussed with operating characteristic (OC) curve, ATI and AOQ in this article. For example, the performance comparison between VRRGS plan and VRSS plan is tabulated. The results show that the ATI required by VRRGS plan is smaller than required by VRSS plan under the same condition. Also, since the slope of OC curve of proposed VRRGS plan is larger

than VRGS and VRSS plan, it proves that VRRGS plan has better discriminatory power compare to other sampling plans.

Keywords

Acceptance sampling, process capability index, average outgoing quality, average total inspection

Biographies

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Chien-wei Wu is currently a Professor in the Department of Industrial Engineering and Engineering Management at National Tsing Hua University (NTHU), Taiwan. Dr. Wu received his Ph.D. degree in Industrial Engineering and Management with Outstanding Ph.D. Student Award from National Chiao Tung University in 2004 and the M.S. degree in Statistics from NTHU in 2002. He is serving as one of Editors-in-Chief of Quality Technology and Quantitative Management (QTQM) and editorial board members for various international journals. His research interests include quality engineering and management, statistical process control, process capability analysis and data analysis.