

Designing of New Attribute Control Chart with Multiple Dependent State Sampling using a Cost Model Based on Loss Functions

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Abstract

The np control chart is used to monitor the number of nonconforming items in a sample. A new np control chart was introduced recently by utilizing the information on the past subgroups via the idea of multiple dependent state sampling. Unlike traditional control charts, this chart is known with two pairs of control limits. This paper proposes an economic model with statistical constraints based on Lorenzen & Vance cost function in order to determine best design parameters of the new np chart. Moreover, the model is extended under linear, quadratic, exponential, and inverted normal loss functions. Accordingly, the same magnitude of deviations from the target results in different quality costs. A solution procedure is presented for optimally specification of five design parameters. Based on numerical studies, the algorithm procedure is illustrated and some comparisons are made to evaluate the performances of economic design (ED) versus economic-statistical design (ESD). The sensitivity of the optimal cost and the chart parameters for different loss functions and input parameters is investigated. The results have indication of significant improvement in statistical performance for ESD despite a small increase in cost due to the statistical constraints added to ED.

Keywords

np control chart, Multiple dependent, State sampling, Economic-statistical model, Loss functions

Biographies

Muhammad Aslam did his M.S. in Statistics (2004) from GC University Lahore with Chief Minister of the Punjab merit scholarship, M. Phil in Statistics (2006) from GC University Lahore with the Governor of the Punjab merit scholarship, and Ph.D. in Statistics (2010) from National College of Business Administration & Economics Lahore under the kind supervision of Prof. Dr. Munir Ahmad. Currently, he is working as a Full Professor of Statistics in department of Statistics, King Abdul-Aziz University Jeddah, Saudi Arabia. He has published more than 245 research papers in well reputed journals. He received meritorious services award in research from National College of Business Administration & Economics Lahore in 2011, Research Productivity Award for the year 2012 by Pakistan Council for Science and Technology, King Abdulaziz University Excellence Awards in Scientific Research, and selected for "Innovative Academic Research & Dedicated Faculty Award 2017" by SPE, Malaysia. His name Listed at 2nd Position among Statistician in the Directory of Productivity Scientists of Pakistan 2013 and listed at 1st Position in 2014. His areas of interest include Reliability, Decision Trees, Industrial Statistics, Acceptance Sampling, Rank Set Sampling and Applied Statistics.

Mohammad Saber Fallah Nezhad is Associate Professor at Yazd University, Iran. He received his B.S., M.S. and Ph.D. degrees, all in Industrial Engineering from Sharif University of Technology, Tehran, Iran under the supervision of Professor Akhavan Niaki. He was a visiting researcher at the Karlsruhe University under the supervision of Professor Juergen Branke. Also he is awarded a Silver medal in 16th National Mathematics Olympiad in Iran and he is ranked 1st and 8th in the graduate national university comprehensive exam in System Management and Industrial Engineering in Iran respectively. He is ranked 47th among all high school graduates in Iran. His areas of interest include: dynamic programming, quality control, Bayesian inference and operations research.

Samrad Jafarian-Namin is a Ph.D. candidate in Industrial Engineering at Yazd University where currently research under the supervision of Dr. Mohammad Saber Fallah Nezhad. He holds M.S. degree in Industrial Engineering from Islamic Azad University, South Tehran Branch, Iran, and B.S. degree from Mazandaran University of Science and Technology, Iran. Mr. Jafarian-Namin is granted from Iran National Elites Foundation (INEF) since 2017. He has memberships of Iran Institute of Industrial Engineering and Young Researchers and Elite Club (Islamic Azad University). As a lecturer, he has taught courses in Statistical Quality Control, Engineering Statistics, and Probability in Islamic Azad University, West Tehran Branch, Iran. His fields of interest include Statistical Quality Control, Design of Experiments, Time Series Analysis and Multi-criteria Decision Making.