

Article

Design and Analysis of Extended Exponentially Weighted Moving Average Signed-Rank Control Charts for Monitoring the Process Mean

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Abstract: In the real world, a nonparametric control chart is a powerful substitute for enhancing outcome quality, although the fundamental procedure characteristic often fails to match the distribution assumptions. This study aims to construct and evaluate an extended exponentially weighted moving average control chart based on signed-rank statistics (EEWMA-SR) for recognizing changes in procedures. According to the study, the proposed chart proves more potent recognition of shifts in the process mean, predominantly small shifts, than the other control charts by the average run length in Monte Carlo simulation. Applying the proposed control chart to an actual dataset yielded events that corroborated the study discoveries.

Keywords: signed-rank test; extended exponentially weighted moving average control chart; average run length; mean process; detection; nonparametric control chart

MSC: 65C60



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1. Introduction

Statistical process control (SPC) assists organizations in monitoring and controlling quality. It allows manufacturers to increase efficiency, decrease waste products, and detect concerns early. The monitoring of quality and processes is critical to manufacturing efficiency. A control chart is a statistical instrument used to track and control the performance of a process over a specific time. Control charts aim to detect and prevent irregularities or deviations in operation. Shewhart was the first author to develop a control chart [1], which was more effective at detecting significant large shifts. Next, the moving average (MA) [2], exponentially weighted moving average (EWMA) [3], and cumulative sum (CUSUM) control charts were utilized to identify small to medium-sized shifts [4]. In terms of rapidly detecting shifts, Naveed et al. developed an extended exponentially weighted moving average (EEWMA) control chart that was expanded from the EWMA structure for effectively tracking the process mean with the result outperforming the Shewhart and EWMA control charts [5].

For ordinary purposes, parametric control charts assume that process observations follow a normal distribution. Nevertheless, if the observations are from a non-normal distribution, employing counterparts of these control charts to monitor process shifts is not appropriate. As a result, constructing a nonparametric control chart is a viable option. Nonparametric control charts have many positives, including accessibility, no requirement for assuming a particular parametric distribution for the foundational process, more robustness and resistance to outliers, and no requirement for estimating the variance when creating charts for the location parameter. Many researchers use the sign and signed-rank statistics in conjunction with the other control charts, such as the EWMA-Sign control chart

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answers to many questions The principles are illustrated with a wide range of examples drawn from medicine agriculture industry and other disciplines Numerous exercises are given to help the reader practise techniques and to appreciate the difference that good design of experiments can make to a scientific project

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Design and Analysis of Experiments with SAS John Lawson, 2010-05-04 A culmination of the author's many years of consulting and teaching Design and Analysis of Experiments with SAS provides practical guidance on the computer analysis of experimental data It connects the objectives of research to the type of experimental design required describes the actual process of creating the design and collecting the data shows how to perform the proper analysis of the data and illustrates the interpretation of results Drawing on a variety of application areas from pharmaceuticals to machinery the book presents numerous examples of experiments and exercises that enable students to perform their own experiments Harnessing the capabilities of SAS 9.2 it includes examples of SAS data step programming and IML along with procedures from SAS Stat SAS QC and SAS OR The text also shows how to display experimental results graphically using SAS ODS graphics The author emphasizes how the sample size the assignment of experimental units to combinations of treatment factor levels error control and the selection of treatment factor combinations treatment design affect the resulting variance and bias of estimates as well as the validity of conclusions This textbook covers both classical ideas in experimental design and the latest research topics It clearly discusses the objectives of a research project that lead to an appropriate design choice the practical aspects of creating a design and performing experiments and the interpretation of the results of computer data analysis SAS code and ancillaries are available at <http://lawson.mooo.com>

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Mead, 2012-09-13 This book is about the statistical principles behind the design of effective experiments and focuses on the practical needs of applied statisticians and experimenters engaged in design implementation and analysis Emphasising the

logical principles of statistical design rather than mathematical calculation the authors demonstrate how all available information can be used to extract the clearest answers to many questions The principles are illustrated with a wide range of examples drawn from real experiments in medicine industry agriculture and many experimental disciplines Numerous exercises are given to help the reader practise techniques and to appreciate the difference that good design can make to an experimental research project Based on Roger Mead s excellent Design of Experiments this new edition is thoroughly revised and updated to include modern methods relevant to applications in industry engineering and modern biology It also contains seven new chapters on contemporary topics including restricted randomisation and fractional replication

An Introduction to the Design & Analysis of Experiments George C. Canavos, Ioannis A. Koutrouvelis, 2009

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