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QUALITY PAPER

Robust approaches for monitoring logistic regression profiles under outliers

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Abstract

Purpose – The purpose of this paper is to develop some robust approaches to estimate the logistic regression profile parameters in order to decrease the effects of outliers on the performance of T^2 control chart. In addition, the performance of the non-robust and the proposed robust control charts is evaluated in Phase II.

Design/methodology/approach – In this paper some, robust approaches including weighted maximum likelihood estimation, redescending M-estimator and a combination of these two approaches (WRM) are used to decrease the effects of outliers on estimating the logistic regression parameters as well as the performance of the T^2 control chart.

Findings – The results of the simulation studies in both Phases I and II show the better performance of the proposed robust control charts rather than the non-robust control chart for estimating the logistic regression profile parameters and monitoring the logistic regression profiles.

Practical implications – In many practical applications, there are outliers in processes which may affect the estimation of parameters in Phase I and as a result of deteriorate the statistical performance of control charts in Phase II. The methods developed in this paper are effective for decreasing the effect of outliers in both Phases I and II.

Originality/value – This paper considers monitoring the logistic regression profile in Phase I under the presence of outliers. Also, three robust approaches are developed to decrease the effects of outliers on the parameter estimation and monitoring the logistic regression profiles in both Phases I and II.

Keywords Statistical process control, Outlier, Logistic regression profiles, Robust approach, Weighted maximum likelihood estimation, Model parameters

Paper type Research paper

1. Introduction

In some statistical process control (SPC) applications, a relationship between a response variable and one or more explanatory variables known as profile describes the quality of a process. Note that, selecting the type of profile depends on the response variable. If the response variable is binary, then we use the logistic regression profile to model the relationship. Profile monitoring can be considered in Phases I and II. In Phase I, a control chart is applied on a set of historical data to check whether a process is in statistical control or not. The goals of Phase I are to understand the variation of a process, to evaluate the process stability, and, after omitting any assignable causes, to estimate the in-control values of the process parameters. Phase II is concerned with process monitoring using online data to quickly detect shifts in the process from the baseline established in Phase I analysis. In the previous decade, there has been an increasing research interest on profile monitoring. Kang and Albin (2000), described the monitoring of simple linear profile in Phase II. They proposed the T^2 and exponentially weighted moving average (EWMA)/R control charts for monitoring the

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