

**MONITORING SURGICAL PERFORMANCE USING RISK-ADJUSTED
MULTIVARIATE CUMULATIVE SUM CHARTS**

E.S. Abbas^{*} and L.P.N.D. Premarathna

Department of Mathematics, Faculty of Science, University of Kelaniya, Kelaniya, Sri Lanka
**sreeni.abbas@gmail.com*

Cumulative Sum (CUSUM) chart is a statistical process control technique that is used in detecting small changes or variations in data monitored over time. The use of CUSUM charts in monitoring and improving quality in the healthcare industry has replaced the use of standard control charts during the past years. Applications of CUSUM charts used in the medical field include monitoring of rates of congenital malformations, monitoring of adverse reactions to drug treatments, and assessing trainee competencies. This study is mainly based on an application of Risk-Adjusted Multivariate CUSUM (RA-MCUSUM) charts in monitoring surgical performance taking into consideration several risk factors associated with cardiac surgery mortality. The main objective of this study was to identify the effect of the surgeons and the type of surgical procedure on the mortality rate. Factors considered under this study include patient's pre-operative characteristics, also defined under the Parsonnet score, heterogeneity of surgeons, type and extent of the surgical procedure. Since each patient has a different level of risk, a vector of weights for every attribute is assigned for each patient. A novel scoring method based on the mortality rates associated with each surgeon was proposed. Similarly, depending on the failure rates of each procedure, scores were assigned to each type of procedure. A logistic regression model was fitted to estimate the mortality rates, and the RA-MCUSUM charts were then plotted to obtain the relevant results. It was noted that RA-MCUSUM control charts are much more stable in performance compared to the standard MCUSUM charts, as they are sensitive to different risk levels. Furthermore, results obtained show that there is a visible difference in the overall outcome and mortality rates if factors such as surgeons and the type of surgical procedure are not taken into consideration during risk-adjustment.

Keywords: Control charts, CUSUM, RA-MCUSUM, Surgical performance