

**Some Issues Using Risk-Adjusted Cumulative Sum Control
Charting Procedures to Monitor Performances of Surgeons**

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ABSTRACT

By taking into account patients' preoperative risks, the risk-adjusted cumulative sum chart developed to monitor surgeons' performance has become very popular in hospitals. In order to make more accurate inferences, a CUSUM chart based on multiresponses has been proposed. In addition, the dynamic probability control limits (DPCLs) for a CUSUM chart was developed to monitor an average surgeon which can maintain a specific in-control average run length (ARL) at a desirable level irrespective of the patients' risk distribution. However, there is great variability in surgeons' performance. Hence, applying the existing CUSUM chart to monitor any specific surgeon could quite likely not yield a specified in-control ARL and this could result in misleading inferences. In this thesis, we first investigate and discuss problems resulting from applying the existing CUSUM chart to monitor any specific surgeon. We then develop a method to estimate a surgeon's performance using the surgeon's past surgical data. With a proper estimate of a surgeon's performance, we propose modifications to the existing ways of determining control limits of risk-adjusted CUSUM chart such that a specified in-control ARL can be achieved. We demonstrate our procedure using real data sets.

KEY WORDS: Average run length; Cardiac operation; Dynamic probability control limits; Logistic regression; Odds ratio; Parsonnet scores; Risk distribution; Statistical quality control; Surgical outcomes.