ABSTRACT

Risk-adjusted charting procedures such as the variable life-adjusted display and risk-adjusted cumulative sum (RA-CUSUM) chart have been developed in the literature for monitoring and detecting changes in cardiac surgical performances. Other than monitoring, it is also of great importance to test surgical performances in medical settings, which may be more useful in certain situations. Cardiac patients have different characteristics and health conditions which will affect their preoperative risks of different surgical outcomes. Therefore, it is important that we take into account the preoperative risks of patients when monitoring or testing surgical performances. In this thesis, we develop a risk-adjusted sequential probability ratio test (RA-SPRT) which can be used for testing the performances of cardiac surgeons. We risk-adjust the sequential probability ratio test by using risk-adjustment methodologies which have been developed in the literature for the RA-CUSUM chart. The average stopping time (AST) of the RA-SPRT is an important piece of information which characterizes the RA-SPRT procedure. However, approximating the AST is tedious and difficult for the RA-SPRT. In this thesis, we thus propose the use of the collocation method which calculates the AST of an RA-SPRT by numerically solving an integral equation for the exact AST. We then develop two approaches for designing RA-SPRT procedures, one based on prespecified probabilities of Type I and II errors, and the other based on prespecified average stopping times. Using real data, we demonstrate how the RA-SPRT is used in real medical settings for testing the performances of surgeons.

KEY WORDS: Average stopping time; Collocation method; Integral equation; Odds ratio; Parsonnet scores; Proportional odds logistic regression; Risk-adjusment; Surgical outcomes.