Evaluating the Accuracy of Prognostic Biomarkers in the Presence of External Information

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The receiver operating characteristic (ROC) curve is widely used to assess the accuracy of continuous biomarkers for binary outcomes (e.g., healthy and diseased). However, evaluating the impact of additional patient or environmental information on diagnostic accuracy is also important. Furthermore, studies often focus on prognosis rather than diagnosis, especially in survival analysis, where outcomes evolve over time (e.g., alive and death). To assess the accuracy of continuous prognostic biomarkers for time-varying outcomes, time-dependent extensions of the ROC curve have been proposed.

This work introduces a novel penalised-based estimator of the cumulative-dynamic time-dependent ROC curve, which accounts for the potential modifying effects of covariates on biomarker accuracy. Building on previous approaches, we adopt a modelling framework that considers flexible models for the conditional hazard function and the biomarker, allowing for the accommodation of non-proportional hazards and nonlinear effects through penalised splines, thus addressing the limitations of earlier methods. We apply our method to evaluate the ability of the Global Registry of Acute Coronary Events (GRACE) risk score to predict mortality after discharge in patients who have experienced acute coronary syndrome, and how this ability may vary with left ventricular ejection fraction.

Keywords: acute coronary syndrome, location-scale regression model, piecewise exponential additive model, penalised splines, predictive accuracy, survival analysis.