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Non-parametric estimation of a time-dependent predictive accuracy curve

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A major biomedical goal associated with evaluating a candidate biomarker or developing a predictive model score for event-time outcomes is to accurately distinguish between incident events, or cases (subjects who would experience an event at a specified time $T = t$) from the controls (those who would survive beyond time t). Extensions of standard binary classification measures such as time-dependent sensitivity, specificity and ROC curves have been developed in this context (Heagerty, Lumley, and Pepe 2000). A plot of the time-dependent area under the ROC curve (AUC curve) has been introduced as a summary measure of the discriminatory capacity of a marker or a model score throughout the entire study period (Heagerty and Zheng 2005). However, existing AUC curve estimators are derived indirectly from semi-parametric estimation of time-dependent ROC curves. We propose a direct, non-parametric method to estimate the time-dependent AUC curve which we refer to as the Weighted Mean Rank (WMR) estimator. The proposed non-parametric estimator performs well relative to the semi-parametric AUC curve estimator of Heagerty and Zheng (2005). We establish the asymptotic properties of the proposed estimator and detail methods for the estimation of pointwise standard errors. In addition, we show that the accuracy of markers can be compared very simply using the difference in the WMR statistics, and we propose a variance estimator that accounts for the correlation between the markers. Finally, an overall measure of concordance is also proposed and the extension to time-dependent markers is discussed.

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