Discrimination Measures for Survival Outcomes: Connection Between the AUC and the Predictiveness Curve

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Abstract

Finding out biomarkers and building risk scores to predict the occurrence of survival outcomes is a major concern of clinical epidemiology, and so is the evaluation of prognostic models. In this paper, we are concerned with the estimation of the time-dependent AUC – area under the receiver-operating curve – which naturally extends standard AUC to the setting of survival outcomes and enables to evaluate the discriminative power of prognostic models. We establish a simple and useful relation between the predictiveness curve and the time-dependent AUC – AUC(t). This relation confirms that the predictiveness curve is the key concept for evaluating calibration and discrimination of prognostic models. It also highlights that accurate estimates of the conditional absolute risk function should yield accurate estimates for AUC(t). From this observation, we derive several estimators for AUC(t) relying on distinct estimators of the conditional absolute risk function. An empirical study was conducted to compare our estimators with the existing ones and assess the effect of model misspecification – when estimating the conditional absolute risk function – on the AUC(t) estimation. We further illustrate the methodology on the Mayo PBC and the VA lung cancer data sets.

Keywords: AUC; Discrimination; Predictiveness curve; Prognostic models; ROC curve.

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