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Improved Semiparametric Estimation of the Proportional Rate Model with Recurrent Event Data

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Abstract

Owing to its robustness properties, marginal interpretations, and ease of implementation, the pseudo-partial likelihood method proposed in the seminal papers of Pepe and Chi (1993) and Lin et al. (2000) has become the default approach for analyzing recurrent event data with Cox-type proportional rate models. However, the construction of the pseudo-partial score function ignores the dependency among recurrent events and thus can be inefficient. An attempt to investigate the asymptotic efficiency of weighted pseudo-partial likelihood estimation found that the optimal weight function involves the unknown variance-covariance process of the recurrent event process and may not have closed-form expression. Thus, instead of deriving the optimal weights, we propose to combine a system of pre-specified weighted pseudo-partial score equations via the generalized method of moments and empirical likelihood estimation. We show that a substantial efficiency gain can be easily achieved without imposing additional model assumptions. More importantly, the proposed estimation procedures can be implemented with existing software. Theoretical and numerical analyses show that the empirical likelihood estimator is more appealing than the generalized method of moments estimator when the sample size is sufficiently large. An analysis of readmission risk in colorectal cancer patients is presented to illustrate the proposed methodology. This is a joint work with Prof. Chiung-Yu Huang (Department of Epidemiology and Biostatistics, University of California, San Francisco).

Keywords:
Empirical Likelihood; Generalized Method of Moments; Proportional Mean Models; Pseudo-Partial Likelihood; Semiparametric Efficiency Bound.