Semiparametric Analysis for Recurrent Event Data with Informative Censoring

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Recurrent event data analyses are usually conducted under the assumption that the censoring time is independent of the recurrent event process. In many applications the failure event, such as death, which terminates the observation of recurrent events could be correlated with the recurrent event process, thus violating the assumption of independent censoring. In this paper, we present a semiparametric model of recurrent event data that allows correlations between censoring times and recurrent event process via frailty. This flexible framework includes both time-dependent and time-independent covariates in the formulation, while leaving the distributions of frailty and censoring times unspecified. By applying the conditional likelihood method in a pairwise fashion to comparable pairs of event times, we propose a novel inference procedure that depends on neither the frailty, the time-independent covariates, nor the censoring time distribution for estimating the effects of time-dependent covariates. For the estimation of the baseline cumulative rate function and the regression coefficients of time-independent covariates, we first derive a modified product-limit estimator with bias correction in risk sets, and then solve estimating equations formulated based on expected number of observed recurrent events. Large sample properties of the regression parameter estimates and the estimated baseline cumulative intensity functions are studied. Numerical studies demonstrate that the proposed methodology performs well for practical sample sizes. An analysis of hospitalization data for patients in an AIDS cohort study is presented to illustrate the proposed method.

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