Joint Analysis of Bivariate Longitudinal Ordinal Outcomes and Competing Risks Survival Times with Nonparametric Distributions for Random Effects

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In clinical studies it is common to collect both the elapsed time to an event and multiple repeatedly measured outcomes on each patient. Often, the event of interest is censored by some competing risks (e.g., disease-related dropout) and the competing risks are known to be correlated. In many circumstances the research interest focuses on the joint evolution of the longitudinal and survival endpoints and at the same time adjustment of inferences about the longitudinal data for missing values caused by the events. In this work we propose a semiparametric joint model for bivariate longitudinal ordinal outcomes and competing risks failure time data, as seen in a scleroderma lung study. The association between the longitudinal and survival endpoints is captured by latent random effects. One unique feature of the proposed model is that we relax the commonly used normality assumption for random effects and leave the distribution completely unspecified. We use a modified version of the vertex exchange method in conjunction with an expectation–maximization algorithm to estimate the random effects distribution and model parameters. Our simulations show that the model produces robust parameter estimates under various scenarios. The approach is illustrated using cough severity and frequency data from the scleroderma lung study.

Key Words: Bivariate ordinal data, competing risks, joint model, missing data, nonparametric distribution