Statistical estimation and inference for the associations of multivariate recurrent event processes

Peilin Chen

Preprint no. 2019-10

Abstract

In this dissertation, we aim to develop a brand new method with a two-stage procedure to investigate the association between multivariate recurrent event processes. First, under the assumption of independent censoring, we model each recurrent event process marginally through a mean rate model. There are two popular mean rate assumptions - multiplicative or additive to an unspecified baseline rate function. The robust semiparametric approaches can be applied to estimate the covariate effects as well as the baseline rate function. Second, inspired by Kendall's tau, we propose the rate ratio as an association measurement, which is the quotient of two conditional rates - the mean rate of two joint events over the marginal rates, both conditional on the covariates. Utilizing the information from the first stage, an unbiased and consistent estimator of the rate ratio is developed under the Generalized Estimation Equation method. The asymptotic properties of the rate ratio estimators are derived theoretically. Without modeling the joint events directly, the rate ratio can measure the association between two recurrent processes over time. Since the rate ratio we proposed can be parametric, time and covariate dependent, it has a good interpretability. We developed a formal hypothesis testing procedure to validate the parametric assumption of the rate ratio. Simulation studies shows it is quite powerful under moderate to strong association.

Department of Mathematics and Statistics, UNC Charlotte, Charlotte, NC 28223