Functional Additive Hazards Model with Application to COVID-19 Data

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Abstract:
We propose a new functional additive hazards model to investigate potential effects of functional and scalar predictors on mortality risks, and develop a penalized least squares estimation approach for model parameters. The consistency, the convergence rate and the asymptotic distribution of the resulting estimator are established. In particular, deriving the asymptotic joint distribution of the infinite-dimensional and the finite-dimensional estimators poses great challenges. To tackle this problem, we design a framework of the Sobolev space equipped with a proper inner product and obtain a joint Bahadur representation of the estimators of functional and scalar parameters in the space. Using this key result, we further establish the asymptotic joint normality of the proposed estimators. Our simulation studies demonstrate that the proposed estimation procedure performs well. For illustration, we apply the proposed method to the COVID-19 data that motivated this research. The analysis results provide evidence to support the claim that minimizing community interactions indeed reduces mortality risks induced by COVID-19.

Keywords:
Functional additive hazards model; Joint Bahadur representation; Penalized least squares; Right-censored data; COVID-19

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