

Bayesian Analysis of Semiparametric Hidden Markov Models with Latent Variables

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Abstract: In psychological, social, behavioral, and medical studies, hidden Markov models (HMMs) have been extensively applied to the simultaneous modeling of heterogeneous observation and hidden transition in the analysis of longitudinal data. However, the majority of the existing HMMs are developed in a parametric framework without latent variables. This study considers a novel semiparametric HMM, which comprises a semiparametric latent variable model to investigate the complex interrelationships among latent variables and a nonparametric transition model to examine the linear and nonlinear effects of potential predictors on hidden transition. The Bayesian P-splines approach and Markov chain Monte Carlo methods are developed to estimate the unknown functions and parameters. Penalized expected deviance, a Bayesian model comparison statistic, is employed to conduct model comparison. The empirical performance of the proposed methodology is evaluated through simulation studies. An application to a data set derived from the National Longitudinal Survey of Youth is presented.