Forecasting of High-resolution Electricity Consumption with Stochastic Climatic Covariates via a Functional Time Series Approach

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Abstract

This paper proposes a functional autoregressive model with stochastic functional covariates, denoted by FARSX, to depict high-resolution data dynamics. An easy-to-implement procedure is proposed to estimate the model parameters under the frameworks of an expansion of multiresolution B-spline basis functions and an adaptive lasso criterion with a two-layer sparsity assumption. We derive the consistency of the proposed estimators under mild conditions. The effectiveness of the estimation procedure allows us to further construct a FARSX model with time-varying parameters under a rolling window framework to capture stochastic effects of functional covariates timely and enhance the prediction accuracy. In the empirical study, the FARSX method with time-varying parameters is applied to the high-resolution electricity consumption and intraday temperatures in Belgium and the U.S. separately. The investigation results reveal that the FARSX model with time-varying parameters provides more reliable day-ahead predictions than several existing models.

Keywords: energy demand; functional time series; high-resolution data; stochastic covariate; time-varying coefficients.