Penalized Spline Estimation for Gaussian Function-on-Function Mixture-of-Experts Regression

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Abstract

Due to the fast growth in the amount of data collected in various fields, Functional Data Analysis has rapidly become the appropriate paradigm to deal with this type of data. Regression models with a functional response $Y(t)$ involving functional covariate $X(t)$, also called "function-on-function", are thus becoming very common. Studying this type of model in the presence of heterogeneous data can be particularly useful in various practical situations. We mainly develop in this work a Mixture-of-Experts designed for fully functional data. As most of the inference approach for models on functional data, we use B-splines basis expansion both for covariates and parameters to have an approximation in finite dimensional space. A regularized inference approach is also proposed, which accurately smoothes functional parameters in order to provide interpretable estimators. Numerical studies on simulated data with different scenarios illustrate the good performance of our method for capturing complex relationship between functional covariates and functional response. The method is finally applied to a real-world data set for comparison to competitors. We illustrate in particular performance of proposed method on Cycling data, where we aim at predicting the average power produced by a cyclist, based on their efforts parameters.

Keywords: Mixture of Experts; Functional regression; EM algorithm; Ridge regularized estimation.