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Selection of functional predictors and smooth coefficient estimation for scalar-on-function regression models

In the framework of scalar-on-function regression models – in which several functional variables are employed to predict a scalar response – we propose a methodology for selecting relevant functional predictors while simultaneously providing accurate smooth (or, more generally, regular) estimates of the functional coefficients.

We suppose that the functional predictors belong to a real separable Hilbert space, while the functional coefficients belong to a specific subspace of this Hilbert space. Such a subspace can be a Reproducing Kernel Hilbert Space (RKHS) to ensure the desired regularity characteristics, such as smoothness or periodicity, for the coefficient estimates. Our procedure, called SOFIA (Scalar-On-Function Integrated Adaptive Lasso), is based on an adaptive penalized least squares algorithm that leverages functional subgradients to efficiently solve the minimization problem.

We demonstrate that the proposed method satisfies the functional oracle property, even when the number of predictors exceeds the sample size. SOFIA's effectiveness in variable selection and coefficient estimation is evaluated through extensive simulation studies and a real-data application to GDP growth prediction.

Work in collaboration with Hedayat Fathi and Federico Severino.