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Scalar-on-function local linear regression: functional derivative and beyond

Frédéric Ferraty
Toulouse Mathematics Institute

Abstract: It is common to want to regress a scalar response on a random function. This paper presents results that advocate local linear regression based on a projection as a nonparametric approach to this problem. Our asymptotic results demonstrate that functional local linear regression outperforms its functional local constant counterpart. Beyond the estimation of the regression operator itself, local linear regression is also a useful tool for predicting the functional derivative of the regression operator, a promising mathematical object on its own. For both the estimator of the regression operator and the estimator of its derivative, theoretical properties are detailed. On simulated datasets we illustrate good finite sample properties of the proposed methods. On a real data example of a single-functional index model we indicate how the functional derivative of the regression operator provides an original, fast, and widely applicable estimation method. We also show how the functional derivative of the regression operator allows the simultaneous estimation of functional directions in the multiple functional index model, without knowing the additive components. This new approach provides new interpretations in the multiple functional index model.

Vitae: Frédéric Ferraty is Full Professor at Toulouse Jean Jaurès University, France. His research area includes Functional Data Analysis, High-Dimensional Statistics, Linear/nonlinear structures, Semi/Non-parametric Statistics, Model Selection, Applications (Biology, Chemometrics, Criminology, Econometrics, Environmetrics, Image Processing, Medicine, Remote Sensing, etc). Webpage: `https://www.math.univ-toulouse.fr/~ferraty/`

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