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Kolloquium über Mathematische Statistik und Stochastische Prozesse

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Statistical inference in sparse high-dimensional nonparametric models

Abstract:

In this talk we discuss the estimation of a nonparametric component f_1 of a nonparametric additive model $Y = f_1(X_1) + ... + f_q(X_q) + \varepsilon$. We allow the number q of additive components to grow to infinity and we make sparsity assumptions about the number of nonzero additive components. We compare this estimation problem with that of estimating f_1 in the oracle model $Z = f_1(X_1) + \varepsilon$, for which the additive components $f_2, \ldots, f_q$ are known. We construct a two-step presmoothing-and-resmoothing estimator of f_1 in the additive model and state finite-sample bounds for the difference between our estimator and some smoothing estimators $\tilde{f}_1^{oracle}$ in the oracle model which satisfy mild conditions. In an asymptotic setting these bounds can be used to show asymptotic equivalence of our estimator and the oracle estimators; the paper thus shows that, asymptotically, under strong enough sparsity conditions, knowledge of $f_2, \ldots, f_q$ has no effect on estimation efficiency. Our first step is to estimate all of the components in the additive model with undersmoothing using a group-Lasso estimator. We then construct pseudo responses $\hat{Y}$ by evaluating a desparsified modification of our undersmoothed estimator of f_1 at the design points. In the second step the smoothing method of the oracle estimator $\tilde{f}_1^{oracle}$ is applied to a nonparametric regression problem with "responses" $\hat{Y}$ and covariates X_1. Our mathematical exposition centers primarily on establishing properties of the presmoothing estimator. We also present simulation results demonstrating close-to-oracle performance of our estimator in practical applications. The main

results of the paper are also important for understanding the behavior of the presmoothing estimator when the resmoothing step is omitted. The talk reports on joint work with Karl Gregory, South Carolina, and Martin Wahl, Berlin.

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