Data Science Seminar

Hosted by the Department of Mathematics and Statistics

- Date: Tuesday, October 31, 2023
- Time: 12:00pm – 1:00pm
- Room: Zoom
- Speaker: Dr. Ruiqi Liu (Texas Tech University)
- Title: Estimation and Hypothesis Testing of Derivatives in Smoothing Spline ANOVA Models.

Abstract

This article studies the derivatives in models that flexibly characterize the relationship between a response variable and multiple predictors, with goals of providing both accurate estimation and inference procedures for hypothesis testing. Rooted in the setting of tensor product reproducing kernel Hilbert spaces, we propose a plug-in kernel ridge regression estimator to estimate the derivatives of the underlying multivariate regression function in the smoothing spline ANOVA model. This estimator has an analytical form, making it simple to implement in practice. We first establish L_∞ and L_2 convergence rates of the proposed estimator under general random designs. For derivatives with some selected interesting orders, we provide an in-depth analysis establishing the minimax lower bound, which matches the L_2 convergence rate. Additionally, motivated by a wide range of applications, we propose a hypothesis testing procedure to examine whether a derivative is zero. Theoretical results demonstrate that the proposed testing procedure achieves the correct size under the null hypothesis and is asymptotically powerful under local alternatives. For ease of use, we also develop an associated bootstrap algorithm to construct the rejection region and calculate the p-value, and the consistency of the proposed algorithm is established. Simulation studies using synthetic data and an application to a real-world dataset confirm the effectiveness of our methods. This is a joint work with Kexuan Li (Biogen) and Meng Li (Rice).

Biography of the speaker: Dr. Liu is an Assistant Professor of Statistics at Texas Tech University. He obtained his Ph.D. from Binghamton University in 2018 and dual Bachelor's degrees in Mathematics and Management from Sun Yat-sen University in 2013. Ruiqi's research lies in the interactions of statistics, econometrics, and machine/deep learning. He aims to develop provable and computationally efficient statistical procedures. Ruiqi's recent work includes nonparametric inference in Reproducing kernel Hilbert space, pattern recognition in econometric models, and online algorithms for statistical inference.

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