Econometrics seminar
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Speaker:
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Title:
Deep learning for individual heterogeneity with generated regressors by adversarial training

Abstract:
We develop a semiparametric framework that uses machine learning to capture individual heterogeneity and simultaneously estimate the control function using generated regressors. It allows us to deal with endogeneity or sample selection bias in various semiparametric models with individual heterogeneity. This framework captures individual heterogeneity through high-dimensional or highly complex observable characteristics, while the control function with generated regressors handles endogeneity and sample selection bias. Our approach involves using a well-suited deep learning framework to uncover the parameter functions and integrate the control function with generated regressors that can be easily adjusted to fit the structural configuration of the economic model. Additionally, we demonstrate Sup-norm convergence rates of the estimated parameter functions through adversarial training to adapt to the impact of generated regressors. The adversarial training estimator achieves the optimal min-max rate. These parameter functions are crucial components of the finite-dimensional structure parameters of inferential interest. We derive an influence function or orthogonal score in the context of generated regressors, which allows us to obtain valid inference that covers any second-stage parameter and any parameter functions of different ML models. An automatic differentiation engine in Pytorch allows the influence functions to be applied directly to data without any additional calculations, as in Farrell's framework. As a result, they are particularly suitable for structure parameters of inferential interest without concrete analytical forms in our framework and can be broadly applied to various structure parameters studying their individual heterogeneities.