Globally efficient nonparametric inference of average treatment effects by empirical balancing calibration weighting

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Abstract

The estimation of average treatment effects based on observational data is extremely important in practice and has been studied by generations of statisticians under different frameworks. Existing globally efficient estimators require non-parametric estimation of a propensity score function, an outcome regression function or both, but their performance can be poor in practical sample sizes. Without explicitly estimating either function, in this talk, I shall consider a wide class calibration weights constructed to attain an exact three-way balance of the moments of observed covariates among the treated, the controls, and the combined group. The wide class includes exponential tilting, empirical likelihood and generalized regression as important special cases, and extends survey calibration estimators to different statistical problems and with important distinctions. Global semiparametric efficiency for the estimation of average treatment effects is established for this general class of calibration estimators. The results show that efficiency can be achieved by solely balancing the covariate distributions without resorting to direct estimation of propensity score or outcome regression. Besides, I shall introduce a consistent estimator of the efficient asymptotic variance, which does not involve additional functional estimation of either the propensity score or the outcome regression functions. The proposed variance estimator outperforms existing estimators that require a direct approximation of the efficient influence function. This is a joint work with Gary Chan (Uni. Washington) and Zheng Zhang (CUHK).