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Job Market Paper: Learning on semiparametric models with monotone functions

Abstract:

This paper studies a semiparametric estimator where the associated moment condition contains a nuisance monotone function estimated by isotonic regression. We show that the properties of the isotonic estimator satisfy the framework of Newey (1994), and that the associated sample moment function with a plug-in isotonic estimator is within a distance of $o_p(n^{-1/2})$ from its Neyman-orthogonalized sample moment function. As a result, the estimator is $\sqrt{n}$-consistent, asymptotically normally distributed, and tuning-parameter-free. Furthermore, in a number of relevant cases, the estimator is efficient.

The estimator we consider generalizes the estimation methods of existing semiparametric models with monotone nuisance functions, such as the monotone partially linear model and monotone single index model. We also apply the estimator to the case of inverse probability weighting, where the propensity scores are assumed to be monotone increasing. Simulations show that while the estimator we develop is more robust against misspecification than parametric plug-in estimators commonly adopted in applied work, it has similar performance to the latter under correct specifications. Compared to methods with other nonparametric plug-in estimators, the newly proposed method requires minimum smoothness conditions on nuisance functions. Furthermore, we establish the asymptotic validity of the bootstrap, which ensures that the estimator is tuning-parameter-free in both estimation and inference.