Estimating continuous treatment effect functions with joint sufficient dimension reduction

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Abstract

The estimation of continuous treatment effect functions using observational data often requires parametric specification of the effect curves, the conditional distributions of outcomes and treatment assignments given multi-dimensional covariates. While nonparametric extensions are possible, they typically suffer from the curse of dimensionality. To deal with this problem, dimension reduction is often inevitable and we propose a sufficient dimension reduction framework to balance parsimony and flexibility. The joint central subspace can be estimated at a $n^{1/2}$-rate without fixing its dimension in advance, and the treatment effect function is estimated by averaging local estimates of a reduced dimension. Asymptotic properties are also studied. Unlike binary treatments, continuous treatments require multiple smoothing parameters of different asymptotic orders to borrow different facets of information, and their joint estimation is proposed by a non-standard version of the infinitesimal jackknife.