Stratified Doubly Robust Estimators for the Average Causal Effect

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Abstract

In causal inference from observational study, it is important to consider the influence of confounders that distort the effect of a treatment or an exposure on an outcome. As a method of adjusting for such confounders, the propensity score has been widely used since it was proposed by Rosenbaum and Rubin (1983). One popular way of using it is inverse probability weighting (IPW), which weights the crude estimate of the average causal effect by the inverse of the propensity score, but it gives a biased estimate if a model for estimating the propensity score is misspecified. The doubly robust (DR) estimator is a sort of extension of the IPW estimator by adding an augmented term which includes a regression (model) of the outcome on confounders. Although it is more robust against model misspecification in the sense that it gives a consistent estimate of the average causal effect if either the model for the propensity score or the regression model is correctly specified, the estimator can be heavily biased if both models are misspecified.

In this presentation, we propose a new estimator which overcomes this difficulty to some extent by extending the (usual) DR estimator. The key idea is to introduce the method of stratification to the DR estimator, that is, we first calculate the DR estimator in each stratum obtained by some score and then combine it over the whole strata. This estimator is ``triply robust'' in the sense that it is consistent if either of the three models (two models for the propensity score for weighting and stratification, and one regression model) are correctly specified. We examine its performance by both theory and simulation study. Furthermore, practical consideration is also made through an example of observational studies conducted in Japan.