Doubly robust treatment effect estimation with incomplete confounders

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Abstract

In healthcare and social sciences research, prospective observational studies are frequent, relatively easily put in place (compared to experimental randomized trial studies for instance) and can allow for different kinds of posterior analyses such as causal inferences. Average treatment effect (ATE) estimation for instance is possible through the use of propensity scores which allow to correct for treatment assignment biases in the non-randomized study design. However, a major caveat of large observational studies is their complexity and incompleteness: the covariates are often taken at different levels and stages, they can be heterogeneous – categorical, discrete, continuous – and almost inevitably contain missing values. The problem of missing values in causal inference has long been ignored and only recently gained some attention due to the non-negligible impacts in terms of power and bias induced by complete case analyses and misspecified imputation models. We discuss conditions under which causal inference can be possible despite missing confounder values, we compare different methods proposed in the past to deal with missing confounder values and propose two doubly robust ATE estimators which directly account for the missing values. We assess the performance of our estimators on a large prospective database containing detailed information about over 20,000 severely traumatized patients in France. Using the proposed ATE estimators and this database we study the effect on mortality of tranexamic acid administration to patients with traumatic brain injury in the context of critical care management.