Improved doubly robust estimation in learning optimal individualized treatment rules

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Abstract: Individualized treatment rules (ITRs) recommend treatment according to patient characteristics. There is a growing interest in developing novel and efficient statistical methods in constructing ITRs. We propose an improved doubly robust estimator of the optimal ITRs. The proposed estimator is based on a direct optimization of an augmented inverse-probability weighted estimator (AIPWE) of the expected clinical outcome over a class of ITRs. The method enjoys two key properties. First, it is doubly robust, meaning that the proposed estimator is consistent when either the propensity score or the outcome model is correct. Second, it achieves the smallest variance among the class of doubly robust estimators when the propensity score model is correctly specified, regardless of the specification of the outcome model. Simulation studies show that the estimated ITRs obtained from our method yield better results than those obtained from current popular methods. Data from the Sequenced Treatment Alternatives to Relieve Depression (STAR*D) study is analyzed as an illustrative example.