Efficient Adaptive Experimental Design for Average Treatment Effect Estimation

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Abstract

The goal of many scientific experiments including A/B testing is to estimate the *average treatment effect* (ATE), which is defined as the difference between the expected outcomes of two or more treatments. In this paper, we consider a situation where an experimenter can assign a treatment to research subjects sequentially. In *adaptive experimental design*, the experimenter is allowed to change the probability of assigning a treatment using past observations for estimating the ATE efficiently. However, with this approach, it is difficult to apply a standard statistical method to construct an estimator because the observations are not independent and identically distributed. We thus propose an algorithm for efficient experiments with estimators constructed from dependent samples. We also introduce a *sequential testing* framework using the proposed estimator. To justify our proposed approach, we provide finite and infinite sample analyses. Finally, we experimentally show that the proposed algorithm exhibits preferable performance.