Estimating optimal shared-parameter dynamic regimens with application to a multistage depression clinical trial

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A dynamic treatment regimen consists of decision rules that recommend how to individualize treatment to patients based on available treatment and covariate history. In many scientific domains, these decision rules are shared across stages of intervention. As an illustrative example, we discuss STAR*D, a multistage randomized clinical trial for treating major depression. Estimating these shared decision rules often amounts to estimating parameters indexing the decision rules that are shared across stages. In this paper, we propose several methods for estimating the shared parameters based on Q-learning. In particular, we devise a `Q-learning analogue' of simultaneous g-estimation, a method from causal inference, and establish the connection between the two. We also consider simple and weighted averaging approaches. We provide an extensive simulation study to compare the various procedures in terms of bias and mean squared error of the individual parameter-estimates, as well as the treatment allocation matching of each procedure with the `oracle' procedure, defined as the one that makes treatment recommendations based on the true parameter values as opposed to their estimates. Finally, we analyze the STAR*D data using the developed methods.

Keywords: dynamic treatment regimens; Q-learning; shared parameters; depression.