A two-part model for individualized treatment rule estimation with semi-continuous outcomes

Abstract: Health care costs in the United States have continued to rise despite little meaningful improvement in health outcomes. A significant portion of these health care costs come from hospital spending. To help improve patient outcomes while reducing the cost of care, health care systems have put a lot of effort into developing innovative interventions/treatments. Thus, determining target patients deemed likely to benefit from the innovative treatments is a key interest. In other words, we want to identify individualized treatment rules (ITRs) for targeted enrollment of patients. In this paper, we use the health care payments (which is a significant component to health care utilization) as our primary outcome. The problem is challenging such that health care payments often follow a mixture distribution with many patients incurring little to no payments over a given period of time and some patients incurring large costs: i.e. semi-continuous. We develop a general framework for estimation of ITRs based on a two-part modeling, where models are estimated for the zero part of the outcome and the positive part separately. To improve estimation performance in high dimensions, we leverage a scientifically-plausible penalty that encourages the signs of coefficients for each variable to agree between the two models. We also develop a highly efficient algorithm for computation. We demonstrate the effectiveness of our approach in simulated examples and in a study of two treatment plans of complex case management in a major health system.