

Adaptive Design of Personalized Dose-Finding Trials

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Abstract: Personalized medicine is believed to be the future of healthcare. A key and challenging step toward personalized medicine is the ability to redesign dose-finding clinical trials to find the right therapeutic dose for each patient type. In this work we study the problem of fully adaptive Bayesian design of dose-finding clinical trials with patient information, which has unique features in terms of the objective function. In particular, the decision maker seeks to identify the right dose for each patient type with the highest precision. We formulate the problem by a stochastic dynamic program, by which we show structural properties of this class of learning problems. Because solving the formulation is intractable, we propose two heuristic policies by the adaptation of look-ahead framework and posterior sampling. We show that the proposed policies learn almost surely the right dose for each patient type asymptotically. We also analyze the one-step look-ahead policy, show its optimality and find its asymptotic rate of sampling in a special setting. Our analysis sheds light on the behavior of the proposed policies in this class of learning problems. We test the performance of the proposed policies via simulation using synthetic and real data. Numerical results show that an improvement up to 20 percent in terms of the number of assignments to the right dose is achievable over uniform allocation for the real dataset. Also, our numerical analysis provides novel insights regarding the connection between the structure of the dose-response curve for each patient type and the behavior of proposed policies.

Talk will take place from 1:00PM - 2:00PM through Zoom (invitation will be emailed to everyone soon).