A Structure-Adaptive Learning Algorithm for Online False Discovery Rate Control

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Abstract: Consider the online testing of a stream of hypotheses where a real-time decision must be made before the next data point arrives. The error rate is required to be controlled at {all} decision points. Conventional simultaneous testing rules are no longer applicable due to the more stringent error constraints and absence of future data. Moreover, the online decision-making process may come to a halt when the total error budget, or alpha--wealth, is exhausted. This work develops a new class of structure adaptive rules for online false discover rate control. The proposed algorithm is a novel alpha--investment rule that precisely characterizes the tradeoffs between different actions in online decision making. It captures useful structural information of the dynamic model, learns the optimal threshold adaptively in an ongoing manner and optimizes the alpha-wealth allocation in the next period. We present theory and numerical results to show that the proposed method controls the FDR at all decision points and achieves substantial power gain over existing online FDR procedures.