

The Optimal Discovery Procedure in Multiple Significance Testing: an Empirical Bayes Approach

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Abstract

Multiple testing has been widely adopted for genome-wide studies such as microarray experiments. To improve the power of multiple testing, Storey (2007, *J. Royal Statist Soc B* 69: 347-368) recently developed the optimal discovery procedure (ODP) which maximizes the number of expected true positives for each fixed number of expected false positives. However, in applying the ODP, we must estimate the true status of each significance test (null or alternative) and the true probability distribution corresponding to each test. In this study, we derive the ODP under hierarchical, random effects models and develop an empirical Bayes estimation method for the derived ODP. Our methods can effectively circumvent the estimation problems in applying the ODP presented by Storey (2007). Simulations and applications to clinical studies of leukemia and breast cancer demonstrated that our empirical Bayes method achieved theoretical optimality and performed well in comparison with existing multiple testing procedures.