Error controls in multiple testing under dependence

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False discovery rate (FDR) has received great attention in the error control of multiple tests. However, conventional FDR control ignores the signs of the effects, which is, in principle, confusing. Thus, it is desirable to modify the current FDR for accommodating such a need. Furthermore, most multiple tests are derived based on the model for test statistics rather than for basic responses, assuming independence among the tests. However, observations (and therefore, tests) in areas like genomics and neuroimaging are often correlated. In this paper, the optimal likelihood tests are derived for basic responses, having hidden Markov random field models. Using a numerical study, we show that the proposed method greatly improves existing methods. Real data examples for the gene expression data and the neuroimage data show that finding the best-fitting model is crucial for the behavior of multiple tests. Model selection tools in the likelihood approach are useful in this respect.

Key Words: Multiple testing, false discovery rate, extended likelihood, hidden Markov random field models