Estimating the Number of True Null Hypotheses in Multiple Hypothesis Testing

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Abstract

The family-wise error rate (FWER) and false discovery rate (FDR) are some of commonly used error rates to measure Type I error under the multiple hypothesis setting. Many controlling FWER and FDR procedures have been proposed and have the ability to control the desired FWER/FDR under certain scenarios. Nevertheless, these controlling procedures become too conservative when some hypotheses are from the alternative. Benjamini and Hochberg (2000) proposed an adaptive FDR-controlling procedure that adapts the information of the number of true null hypotheses (m_0) to overcome this problem. Since m_0 is unknown, estimators of m_0 are needed. Benjamini and Hochberg (2000) suggested a graphical approach to construct an estimator of m_0 and constructed an adaptive procedure. Hwang (2009) demonstrated that under certain simulation settings, adaptive procedures can not control the desired level. Following a similar construction, this paper proposes better estimators of m_0 which are further used to construct adaptive controlling procedures. The performance of new estimators and the ability to preserve the FDR for the proposed adaptive controlling procedures are good based on Monte Carlo simulations.

Keyword: False discovery rate; Familywise error rate; Multiple hypothesis testing; Number of true null hypotheses; Sensitivity.