On P-value Combination of Independent and Frequent Signals: Asymptotic Efficiency and Fisher Ensemble

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Abstract

Combining p-values to integrate multiple effects is of long-standing interest in social science and biomedical research. In this paper, we focus on revisiting a classical scenario closely related to meta-analysis, which combines a relatively small number of p-values while the sample size for generating each p-value is large (asymptotically goes to infinity). We evaluate a list of traditional and recently developed modified Fisher's methods to investigate their asymptotic efficiencies and finite-sample numerical performance. The result concludes that Fisher and adaptively weighted Fisher method have top performance and complementary advantages across different proportions of true signals. Consequently, we propose an ensemble method, namely Fisher ensemble, to combine the two top performing Fisher-related methods using a robust truncated Cauchy ensemble approach. We show that Fisher ensemble achieves asymptotic Bahadur optimality and integrates the strengths of Fisher and adaptively weighted Fisher methods in simulations.