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Bayes and empirical-Bayes multiplicity adjustment in the variable-selection problem

James G. Scott, James O. Berger

(Submitted on 10 Nov 2010)

This paper studies the multiplicity-correction effect of standard Bayesian variable-selection priors in linear regression. Our first goal is to clarify when, and how, multiplicity correction happens automatically in Bayesian analysis, and to distinguish this correction from the Bayesian Ockham's-razor effect. Our second goal is to contrast empirical-Bayes and fully Bayesian approaches to variable selection through examples, theoretical results and simulations. Considerable differences between the two approaches are found. In particular, we prove a theorem that characterizes a surprising aymptotic discrepancy between fully Bayes and empirical Bayes. This discrepancy arises from a different source than the failure to account for hyperparameter uncertainty in the empirical-Bayes estimate. Indeed, even at the extreme, when the empirical-Bayes estimate converges asymptotically to the true variable-inclusion probability, the potential for a serious difference remains.

Submission history

From: James G. Scott [view email]

[v1] Wed, 10 Nov 2010 10:27:54 GMT (1528kb)

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