Objective Bayesian Model Selection: Multiple Comparisons, Parsimony, Prior Model Probabilities and Least Favorable Intrinsic Priors

DISSERTATION
DEPARTMENT OF MATHEMATICS

Fernando E. Betancourt Vélez,
fernando.betancourt@upr.edu
Department of Mathematics, UPR-RP.

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Abstract

This work studies several aspects of objective Bayesian model selection with particular attention to multiplicity, parsimonious model priors, and the behavior of Bayes factors under intrinsic methodologies. We study model priors induced by Beta Binomial distributions on model size and examined parsimonious specifications such as the $\pi(p) \sim Beta(1,2)$ prior and $\pi(p) \sim Beta(1,m+1)$. To evaluate competing prior choices, we proposed a cross-validated Bayesian model averaging (BMA) procedure in which predictive performance was assessed using the mean squared prediction error of the BMA predictor. We also studied intrinsic probabilities of hypotheses derived from the intrinsic Bayes factor framework of Berger & Pericchi (1996). We analyzed how minimal training samples induce prior probabilities on competing hypotheses in hypothesis testing and linear model selection settings. In addition, we derived least favorable priors associated with bounds for Bayes factors using the training-sample representation of intrinsic Bayes factors. The results showed that parsimonious priors provide a favorable balance between multiplicity control and predictive performance and should be considered as possible solution in variable selection problems. The analysis also illustrated how intrinsic probabilities reflect the structure of competing models and how Least Favorable priors can be constructed to attain approximations to intrinsic Bayes factors and useful dynamic bounds. Furthermore Least Favorable priors are simpler to calculate than other Intrinsic Priors like Arithmetic, Median etc.