Approximate Bayesian model selection with the deviance statistic

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Bayesian model selection poses two main challenges: the specification of parameter priors for all models, and the computation of the resulting Bayes factors between models. There is now a large literature on automatic and objective parameter priors, which unburden the statistician from eliciting them manually in the absence of substantive prior information. One important class are g-priors, which were recently extended from linear to generalized linear models. To solve the computational challenge, we show that the resulting Bayes factors can conveniently and accurately be approximated by test-based Bayes factors (Johnson, 2008) using the deviance statistics of the models. For the estimation of the hyperparameter g, we show how empirical Bayes estimates correspond to shrinkage estimates from the literature, and propose a conjugate prior as a fully Bayes alternative. Connections to minimum Bayes factors are also discussed. We illustrate the methods with the development of a clinical prediction model for 30-day survival in the GUSTO-I trial, and with variable and function selection in Cox regression for the survival times of primary biliary cirrhosis patients.

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