

A conjugate prior for discrete hierarchical loglinear models and a close look at Bayes factors.

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In Bayesian analysis of multi-way contingency tables, the selection of a prior distribution for either the loglinear parameters or the cell probabilities parameters is a major challenge. In this paper we define a flexible family of conjugate priors for the wide class of discrete hierarchical loglinear models which includes the class of graphical models. These priors are defined as the Diaconis-Ylvisaker conjugate priors on the loglinear parameters subject to “baseline constraints” under multinomial sampling. We also derive the induced prior on the cell probabilities and show that the induced prior is a generalization of the hyper Dirichlet prior. We show that this prior has several desirable properties and illustrate its usefulness by identifying the most probable decomposable, graphical and hierarchical loglinear models for a six-way contingency table. Applications raise the question of the stability of the Bayes factors under different choices of the hyperparameters. We will discuss some aspects of this problem.