Bayesian Robustness
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A PRACTICAL, ROBUST METHOD FOR BAYESIAN MODEL SELECTION: A CASE STUDY IN THE ANALYSIS OF CLINICAL TRIALS

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We present a method for model selection based on a proper reference prior. The choice of prior is somewhat arbitrary so Bayesian sensitivity analysis plays an important role in the analysis. We illustrate the methods in the context of a case study. We consider survival times (e.g., time to recurrence of depression) from a clinical trial. Because of the nature of the application we consider a mixture model that allows for a "surviving fraction." A Bayesian treatment of this model has been considered previously by Chen, Hill, Greenhouse and Fayos (1985), Greenhouse and Paul (1995) and Stangl (1991). In this paper, we are concerned with the question: does treatment effect both the probability of being a survivor and the survival times of "non-survivors"? The question is cast as a model selection problem. Reference priors give rise to improper posteriors and, moreover, do not lead to well defined Bayes factors. We adapt the idea of Kass and Wasserman (1995) who proposed "unit information priors." These priors are somewhat ad-hoc. To address this concern, we perform a sensitivity analysis with respect to the priors. We also consider case influence. Our conclusion is that treatment is important for determining long term survival but, among short term survivors, treatment may be less predictive of survival time.

1. Introduction: The Scientific Problem and Previous Analyses. This paper is about model selection for clinical trials data. We present a modest case study to illustrate a general strategy for Bayesian model selection. We suggest a simple method for constructing proper reference priors. The argument for this prior might be considered tenuous but we address the arbitrariness of the prior by performing sensitivity analysis. The calculations are performed using a combination of asymptotic approximations and Markov chain Monte Carlo. We will analyze survival data from a randomized controlled clinical trial but the methods we present are applicable to many model selection problems. There is some debate about whether model selection is appropriate in Bayesian inference. Some authors have argued that many model selection problems should be treated as estimation problems. There is much virtue in these arguments but we do not wish to enter into this debate here. We shall begin by assuming that the model selection is appropriate for our problem. The current problem provides an interesting case study and is a chance to explore the methodology we are proposing.