Preface

Though there are many recent additions to graduate-level introductory books on Bayesian analysis, none has quite our blend of theory, methods, and applications. We believe a beginning graduate student taking a Bayesian course or just trying to find out what it means to be a Bayesian ought to have some familiarity with all three aspects. More specialization can come later.

Each of us has taught a course like this at Indian Statistical Institute or Purdue. In fact, at least partly, the book grew out of those courses. We would also like to refer to the review (Ghosh and Samanta (2002b)) that first made us think of writing a book. The book contains somewhat more material than can be covered in a single semester. We have done this intentionally, so that an instructor has some choice as to what to cover as well as which of the three aspects to emphasize. Such a choice is essential for the instructor. The topics include several results or methods that have not appeared in a graduate text before. In fact, the book can be used also as a second course in Bayesian analysis if the instructor supplies more details.

Chapter 1 provides a quick review of classical statistical inference. Some knowledge of this is assumed when we compare different paradigms. Following this, an introduction to Bayesian inference is given in Chapter 2 emphasizing the need for the Bayesian approach to statistics. Objective priors and objective Bayesian analysis are also introduced here. We use the terms *objective* and *nonsubjective* interchangeably. After briefly reviewing an axiomatic development of utility and prior, a detailed discussion on Bayesian robustness is provided in Chapter 3. Chapter 4 is mainly on convergence of posterior quantities and large sample approximations. In Chapter 5, we discuss Bayesian inference for problems with low-dimensional parameters, specifically objective priors and objective Bayesian analysis for such problems. This covers a whole range of possibilities including uniform priors, Jeffreys' prior, other invariant objective priors, and reference priors. After this, in Chapter 6 we discuss some aspects of testing and model selection, treating these two problems as equivalent. This mostly involves Bayes factors and bounds on these computed over large classes of priors. Comparison with classical P-value is also made whenever appropriate. Bayesian P-value and nonsubjective Bayes factors such as the intrinsic and fractional Bayes factors are also introduced.

Chapter 7 is on Bayesian computations. Analytic approximation and the E-M algorithm are covered here, but most of the emphasis is on Markov chain based Monte Carlo methods including the M-H algorithm and Gibbs sampler, which are currently the most popular techniques. Follwing this, in Chapter 8 we cover the Bayesian approach to some standard problems in statistics. The next chapter covers more complex problems, namely, hierarchical Bayesian (HB) point and interval estimation in high-dimensional problems and parametric empirical Bayes (PEB) methods. Superiority of HB and PEB methods to classical methods and advantages of HB methods over PEB methods are discussed in detail. Akaike information criterion (AIC), Bayes information criterion (BIC), and other generalized Bayesian model selection criteria, high-dimensional testing problems, microarrays, and multiple comparisons are also covered here. The last chapter consists of three major methodological applications along with the required methodology.

We have marked those sections that are either very technical or are very specialized. These may be omitted at first reading, and also they need not be part of a standard one-semester course.

Several problems have been provided at the end of each chapter. More problems and other material will be placed at `http://www.isical.ac.in/~tapas/book`

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