1

Introduction

Some basic ideas and history concerning Bayesian methods

Bayesian methods have become commonplace in modern statistical applications. The acceptance of these methods is a relatively recent phenomenon however. This acceptance has been facilitated in large measure by the development of fast computational algorithms that were simply not commonly available or accessible as recently as the late 1980s.The widespread adoption of Markov chain Monte Carlo (McMC) methods for posterior distribution sampling has led to a large increase in Bayesian applications. Most recently Bayesian methods have become commonplace in epidemiology, and the pharmaceutical industry, and they are becoming more widely accepted in Public Health practice. As early as 1993, review articles appeared extolling the virtues of McMC in medical applications (Gilks et al., 1993). This increase in use has been facilitated by the implementation of software which provides a platform for the posterior distribution sampling which is necessary when relatively complex Bayesian models are employed. The development of the package BUGS (Bayesian inference Using Gibbs Sampling) and its Windows incarnation WinBUGS (Spiegelhalter et al., 2007) have had a huge effect on the dissemination and acceptance of these methods. To quote Cowles (2004): "A brief search for recently published papers referencing WinBUGS turned up applications in food safety, forestry, mental health policy, AIDS clinical trials, population genetics, pharmacokinetics, pediatric neurology, and other diverse fields, indicating that Bayesian methods with WinBUGS indeed are finding widespread use."

Basic ideas in Bayesian modeling stem from the extension of the likelihood paradigm to allow parameters within the likelihood model to have distributions. These distributions are called prior distributions. Thus parameters are allowed to be stochastic. By making this allowance, in turn, parameters in the prior distributions of the likelihood parameters can also be stochastic. Hence a natural parameter hierarchy is established. These hierarchical models form the basis of inference under the Bayesian paradigm. By combining the likelihood (data) model with suitable prior distributions for the parameters, a so-called posterior distribution is formed which describes the behavior of the

Carlo methods, Gibbs sampling, the Metropolis–Hastings algorithm, goodness-of-fit measures, and