Ann. Inst. Statist. Math.
Vol. 55, No. 1, 7–19 (2003)

BAYESIAN ESTIMATION OF SYSTEM RELIABILITY IN BROWNIAN STRESS-STRENGTH MODELS

SANJIB BASU AND RAMA T. LINGHAM

Division of Statistics, Department of Mathematical Sciences, Northern Illinois University, DeKalb, IL 60115-2854, U.S.A., e-mail: basu@niu.edu; rama@math.niu.edu

(Received November 9, 2000; revised December 3, 2001)

Abstract. A stress-strength system fails as soon as the applied stress, X, is at least as much as the strength, Y, of the system. Stress and strength are time-varying in many real-life systems but typical statistical models for stress-strength systems are static. In this article, the stress and strength processes are dynamically modeled as Brownian motions. The resulting stress-strength system is then governed by a time-homogeneous Markov process with an absorption barrier at 0. Conjugate as well as non-informative priors are developed for the model parameters and Markov chain sampling methods are used for posterior inference of the reliability of the stress-strength system. A generalization of this model is described next where the different stress-strength systems are assumed to be exchangeable. The proposed Bayesian analyses are illustrated in two examples where we obtain posterior estimates as well as perform model checking by cross-validation.

Key words and phrases: Cross-validation, first-passage time, Gibbs sampler, hitting time, non-informative prior, prediction.