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Original Article

Bayesian computation for geometric process in maintenance problems

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Abstract

Geometric process modeling is a useful tool to study repairable deteriorating systems in maintenance problems. This model has been used in a variety of situations such as the determination of the optimal replacement policy and the optimal inspection-repair-replacement policy for standby systems, and the analysis of data with trend. In this article, Bayesian inference for the geometric process with several popular life distributions, for instance, the exponential distribution and the lognormal distribution, are studied. The Gibbs sampler and the Metropolis algorithm are used to compute the Bayes estimators of the parameters in the geometric process. Simulation results are presented to illustrate the use of our procedures.
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Keywords: Geometric process; Gibbs sampling; Metropolis algorithm; Maintenance problem; Repairable deteriorating systems

1. Introduction

In the early studies of the maintenance problems, previous results on repair replacement models usually base on the assumption that a failure system after repair will be 'as good as new' and the repair times can be neglected. The successive operating times thus generate a renewal process. These models can be classified as perfect repair model. However, for repairable deteriorating systems, the problem is different from that described above. For example, in machine maintenance, in view of ageing and accumulated wear, the operating times of a machine after repair will become shorter and shorter and the repair times will become longer and longer. Thus, an appropriate model should be as follows: the operating times are stochastically decreasing and the consecutive repair times are stochastically increasing. Stadje and Zuckerman [20] developed a more general repair replacement model by introducing a monotone process. Lam [9,10,14] introduced a special monotone process which was called the geometric process. This process was applied to a replacement model in which the operating times of system form a non-increasing geometric process and consecutive repair times constitute a non-decreasing geometric process.

Let us define the geometric process (see Lam [9,10,14]). Suppose that $X_1, X_2, \ldots$, is a sequence of random variables. If there exists $a > 0$ such that $\{a^{i-1}X_i, i = 1, 2, \ldots\}$ forms a renewal process (RP), then $\{X_1, X_2, \ldots\}$ is called a geometric process (GP) and the real number a is called the ratio of the GP.

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