Bayesian Inference and Prediction in an $M/D/1$ Queueing System *

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Abstract

In many real-life situations, certain infinite queueing systems arise in which the clients arrive according to a Poisson process and are served by a single server under an approximately constant service time. Examples of such systems include the cycle of a washing machine that takes a fixed length of time to finish one service and the automatic car wash station that uses a roughly constant washing time for each car. These examples represent the kind of queueing system that this article attempts to describe, which is accomplished by estimating the traffic intensity ρ, which, among other things, can estimate the fraction of time that it is busy and can be used to determine other subsequent performance measures of importance such as the average queue length L_q and the expected number of customers in the system L_s. Bayes estimators for ρ are obtained under the squared error loss function assuming three forms of prior information about ρ, *i.e.*, incomplete gamma prior, left-truncated beta prior, and the improper Jeffreys prior. Furthermore, the Bayes factor as a model comparison criterion is proposed to select a suitable model for Bayesian analysis. A comprehensive set of Monte Carlo simulations comprises our experimental set designed to attest to the efficacy and efficiency of the proposed algorithms. A real case situation is analyzed in detail to illustrate the applicability of the methods developed.

Keywords: Deterministic single server queues, Bayesian estimations, predictive distributions, Bayes factor.

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