Estimating Changes in Traffic Intensity for Markovian Finite Queueing Systems: A Bayesian Perspective *

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Abstract

Detecting the change point between different distributions in queueing theory presents a significant challenge, especially when working with observed data. Traditionally, both parametric and non-parametric methods have been employed to address this issue in Markov single-server finite queueing models. While these methods can successfully identify the change point, they often come with the drawback of high variance in the estimates. This article introduces Bayesian approaches to improve precision in change point detection by utilizing squared error and precautionary loss functions. The study is based on a dataset that records the number of customers present in the system immediately before the arrival of the n-th customer, which is analyzed through an embedded Markov chain framework. The findings demonstrate that Bayesian methods achieve comparable error rates to traditional approaches but with a significant reduction in variance, particularly when dealing with smaller sample sizes. To showcase the practical benefits of this Bayesian methodology, a comprehensive numerical example is provided, illustrating how these approaches can enhance the accuracy and reliability of change point detection in queueing models.

Keywords: Finite queues; $M/M/1/m$ model; Bayesian estimator; change point; loss function.

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