

Nonparametric Estimation for Multi-server Queues Based on the Number of Clients in the System *

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Abstract

In this article, we introduce a nonparametric (or distribution-free) estimator for traffic intensity in multi-server queues, which has not yet been discussed in the literature. Because this is a very useful model with many potential practical applications, it is the main focus of this study. We compare the performance of a new nonparametric estimator for situations in which the use of Markovian multi-server queues ($M/M/s$ queues in Kendall notation) is adequate or in which it is necessary to consider multi-server queues with general arrival and general service times. We show that, when the parametric Markovian assumptions of $M/M/s$ queues are satisfied, the new estimator is not superior to the maximum likelihood estimator based on the Markovian assumption with respect to $M/M/s$ queues. However, for situations in which the interarrival time distribution and/or the service time distribution cannot be considered exponential (that is, non-Markovian), the new nonparametric estimator is superior. All evaluations are carried out using Monte Carlo simulations. A detailed numerical example is presented to show the usefulness of the technique for practical applications.

Keywords: Multi-server queues; Markovian queues; general queues; traffic intensity; maximum likelihood estimator; nonparametric estimator; bootstrap.