Estimation in a general bulk-arrival Markovian multi-server finite queue *

F. R. B. Cruz [1], M. A. C. Santos [1], F. L. P. Oliveira [2], R. C. Quinino [1]

[1]*Departamento de Estatística*
Universidade Federal de Minas Gerais
31270-901 - Belo Horizonte - MG, Brazil

[2]*Departamento de Estatística*
Universidade Federal de Ouro Preto
35400-000 - Ouro Preto - MG, Brazil

fcruz@est.ufmg.br, msantos@est.ufmg.br
fernadoluiz@iceb.ufop.br, roberto@est.ufmg.br

Abstract

Queues with general inter-arrival times in batches of random sizes, multi-servers, and finite-buffer spaces are studied, as the determination of their performance measures is a challenging inferential problem. This study focuses on estimating the important performance measures of $GI^X/M/c/N$ queues under finite samples. In Kendall notation, this abbreviation represents independent general (GI) distributed inter-arrival times for bulk arrivals of size X, Markovian (M) service times, c identical servers working in parallel, and a maximum number of N users simultaneously allowed in the system, including those under service. Kernel-based methods (constituting a class of well-known nonparametric methods) and classical methods are used to adjust the arrival and service processes. Extensive simulations are performed to verify the quality of the estimations for samples sizes of approximately 500 to provide estimates with a relative error of less than 10%. We also relate notable new insights, for example, that simpler models, such as finite Markovian multi-server queues, $M/M/c/N$ in Kendal notation, are in certain cases sufficiently robust and precise to satisfactorily solve the problem of performance measure determination. The limitations of the results are discussed, and notable topics to be further developed in this research area are presented.

Keywords: Queueing; multi-server; finite-buffer; inference in queues; finite sample.

*Operational Research, March 2021, Volume 21, Issue 1, p. 73–89. DOI: 10.1007/s12351-018-0433-y. The final publication will be available at http://link.springer.com/.