A SINGLE SERVER QUEUE WITH BATCH ARRIVALS AND SEMI-MARKOV SERVICES

ABHISHEK[1], MARKO BOON[2], ONNO BOXMA[2], AND RUDESINDO NÚÑEZ QUEIJA [1]

ABSTRACT. We investigate the transient and stationary queue-length distributions of a class of service systems with correlated service times. The classical $M^X/G/1$ queue with semi-Markov service times is the most prominent example in this class and serves as a vehicle to display our results. The sequence of service times is governed by a modulating process $J(t)$. The state of $J(\cdot)$ at a service initiation time determines the joint distribution of the subsequent service duration and the state of $J(\cdot)$ at the next service initiation.

Several earlier works have imposed technical conditions on the zeros of a matrix determinant arising in the analysis, that are required in the computation of the stationary queue length probabilities. The imposed conditions in several of these articles, are difficult or impossible to verify. Without such assumptions, we determine both the transient and the steady-state joint distribution of the number of customers immediately after a departure and the state of the process $J(t)$ at the start of the next service.

We numerically investigate how the mean queue length is affected by variability in the number of customers that arrive during a single service time. Our main observations here are that increasing variability may *reduce* the mean queue length, and that the Markovian dependence of service times can lead to large queue lengths, even if the system is not in heavy traffic.

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1 Korteweg-de Vries Institute for Mathematics, University of Amsterdam, Amsterdam, The Netherlands ({Abhishek,m.r.h.mandjes,nunezqueija}@uva.nl).

[2]Department of Mathematics and Computer Science, Eindhoven University of Technology, P.O. Box 513, 5600 MB Eindhoven, The Netherlands (marko@win.tue.nl,o.j.boxma@tue.nl).