Estimation of Traffic Intensity from Queue Length Data in a Deterministic Single Server Queueing System *

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Abstract

A certain type of queueing system that is quite common in manufacturing systems occurs when the time between the arrivals of items approximately follows an exponential distribution with rate λ, the services are mechanized and their times may be considered approximately constant (b). In Kendall notation, such a queueing system is well known as an $M/D/1$ queue; despite being one of the simplest queueing models, it has wide applicability to numerous practical situations as a first approximation by a steady-state model before a deeper analysis can be performed by means of more sophisticated transient-regime stochastic models that consider, for example, burst arrival, block arrivals, congestion, and so on. In queues, one very important parameter that must estimated is the traffic intensity, defined for an $M/D/1$ queue as $\rho = \lambda b$. This article aims to investigate statistical methods to estimate ρ, namely, the maximum likelihood and Bayes estimators, by considering the number of customers present in the system at successive departure epochs, which is a very natural way to collect data. An extensive set of computational results from Monte Carlo simulations is shown to establish the efficiency and effectiveness of the proposed approaches, which will possibly enhance practical applications.

Keywords: Maximum likelihood estimation, Bayesian estimation, queue Length, squared error loss Function, precauationary loss function, general entropy loss function, confluent hypergeometric prior, beta prior.

*Journal of Computational and Applied Mathematics, 2021, Volume 398, p. 113693. DOI: 10.1016/j.cam.2021.113693. The final publication is available at https://www.sciencedirect.com.