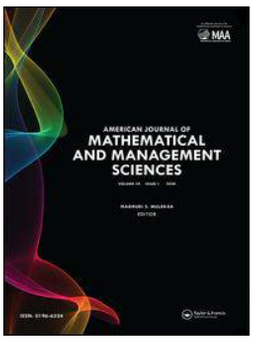

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# Bayesian Estimation of $M/E_k/1$ Queueing Model using Bivariate Prior

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**ABSTRACT**

This article describes Bayes estimation of various queue characteristics such as queue parameters $\lambda$ and $\mu$, and queue performance measures like traffic intensity, expected waiting time in the queue, and expected queue size of $M/E_k/1$ model using Mckay's bivariate gamma distribution as prior under squared error loss function as well as entropy loss function. Closed form expressions are obtained for the Bayes estimators of the queue parameters and various queue performance measures using the properties of confluent hyper geometric function and Gauss hyper geometric function. Bootstrap Bayes estimates and credible regions are computed using simulated data for different set of hyper parameter values. Also we apply Markov Chain Monte Carlo method and compute Bayes estimates and credible intervals of various queue characteristics using the same joint prior distribution and compare the values with bootstrap estimates.

**KEYWORDS AND PHRASES**

Bayes estimate; $M/E_k/1$ queueing model; McKay's bivariate gamma distribution; confluent hyper geometric function; Gauss hyper geometric function; Markov Chain Monte Carlo method

## 1. Introduction

The role of statistics in queuing data analysis focused on the estimation of queue characteristics such as, the arrival rate ($\lambda$), service rate ($\mu$), and various queue performance measures like traffic intensity ($\rho$), system size (L), expected waiting time in the system (W) etc. In classical inference procedures, the estimates of the queue parameters are obtained under the assumption that they are constants. The earliest attempt of statistical inference on M/M/1 queue from the frequentist standpoint was made by Clarke (1957) yielding the maximum likelihood estimates (MLE) of service rate, arrival rate, and traffic intensity. Basawa and Prabhu (1988) discussed the asymptotic properties of the estimates corresponding to different queuing data. Basawa et al. (1996) studied MLE of the parameters in the single server queue using waiting time data. Abou-El-Ata and Hariri (1995) derived both point estimates and confidence intervals of the truncated Poissonian queue M/M/2/N with balking and heterogeneous servers. They have obtained maximum likelihood point estimates for the parameters and confidence intervals for measures of effectiveness. MLE and confidence intervals of the multi-server queue with non-identical servers are obtained by Wang et al. (2006). Choudhury and

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