

COMP SCI/SFWR ENG 4/6E03 — Assignment 7

1. An M/M/m//K queue with a finite population of size K can be modeled as follows

$$\begin{aligned}\lambda(n) &= (K - n)\lambda & n = 0, 1, 2, \dots, K - 1 \\ \mu(n) &= n\mu & n = 1, 2, \dots, m - 1 \\ \mu(n) &= m\mu & n = m, m + 1, \dots, K\end{aligned}$$

Derive an expression for the probability p_n of n jobs in the system, throughput, and mean response time of the system.

For $m = 3$, $\lambda = 1/10$, $\mu = 1$, plot the throughput as a function of K .

2. Consider the client/server model with $\mu = 1$ and $\lambda = 0.1$. The throughput at the server is bounded above by μ (you should convince yourself of this). What value of M (number of users) leads to a throughput of 90 percent of this upper bound?
3. An existing system consists of a single server. Requests arrive according to a Poisson process with rate three per hour. The processing times are exponentially distributed with mean 18 minutes. You are asked whether it would be beneficial to add a second (identical) processor. The two processors would share a common queue. The costs are as follows: operating costs of 25 dollars per hour per processor and cost of delay of five dollars per hour per request.