Network Performance Analysis: Tutorial 2

1. In the lecture notes we saw that the average number of customers in the system for an $M/M/1$ queue was given by

$$E\{k\} = \frac{\rho}{1-\rho}$$

Show that the variance of k is given by

$$E\left\{k^2\right\} - \left(E\{k\}\right)^2 = \frac{\rho}{(1-\rho)^2}$$

2. One thousand calls per hour arrive at a telephone exchange, and the arrivals have a Poisson distribution. What is the probability that one or more calls arrive in an interval of one second?

3. Students arrive randomly at a cash-dispensing machine with an average interarrival time of 5 minutes. The length of time that a student spends on the machine is exponentially distributed with an average of 2 minutes. The system is modelled as an M/M/1 queue.

   (a) What is the probability that a student arriving at the machine will have to wait?

   (b) What is the average total time (queuing and being served) time for a student?

   (c) The bank plans to install a second machine when the total time in the system is 5 minutes or longer. At what average arrival rate will this occur? For this arrival rate, what is the average time that a person waits in the queue at the machine?

   (d) What is the average number of people in the queue for the arrival rate in part (c)?