

## COMP9334 Revision Questions for Week 7

### Question 1

The Matlab program *sim\_mm1\_func.m* simulates an M/M/1 queue with arrival rate  $\lambda$  and service rate  $\mu$  over a time period of  $T$ . It returns the average response time for the given  $\lambda$ ,  $\mu$  and  $T$ .

We would like to investigate the effect of the length of simulation  $T$  on the simulation. Let us fix  $\lambda = 0.7$  and  $\mu = 1$ . For each of the following values of  $T$ : 1000, 5000, 10000 and 50000, perform the simulation 20 times (with a different set of random numbers) and record the value of the average mean response time.

Answer the following:

1. What is the mean response time according to the M/M/1 result?
2. For each value of  $T$  used, compute the mean and standard deviation over 20 experiments.
3. How does the standard deviation vary with  $T$ ?

Note on using *sim\_mm1\_func.m*: If you type at the matlab prompt: *sim\_mm1\_func(0.7,1,1000)*, it will simulate an M/M/1 queue with  $\lambda = 0.7$ ,  $\mu = 1$  and  $T = 1000$ .

### Question 2

Write a simulation program (in whatever language you prefer) to simulate an M/M/2 queue. You should be able to control the arrival rate  $\lambda$ , service rate  $\mu$  and the length of simulation  $T$ .

Use your M/M/2 and M/M/1 simulation program to compare:

1. The mean response time of an M/M/1 queue with  $\lambda = 0.9$  and  $\mu = 1$ .
2. The mean response time of an M/M/2 queue with  $\lambda = 0.9$  and for each server,  $\mu = 0.5$ .

Simulate each of the above configurations 10 times and record the mean response time in the simulation. You may use a simulation time of  $T = 1000$ .

You have learnt in Week 3 that the the first system should have a smaller mean response time. Did your simulation results also suggest a smaller mean response time for the first system?

### Question 3

The Weibull distribution with parameters  $\alpha$  and  $\beta$  has a cumulative probability function  $F(x) = 1 - \exp(-\alpha x^\beta)$ . Write a computer program to generate random numbers that have a Weibull distribution with  $\alpha = 1.5$  and  $\beta = 6$ . Verify by using a histogram that the numbers that you have generated do have a Weibull distribution.