CSC 777 Homework 2
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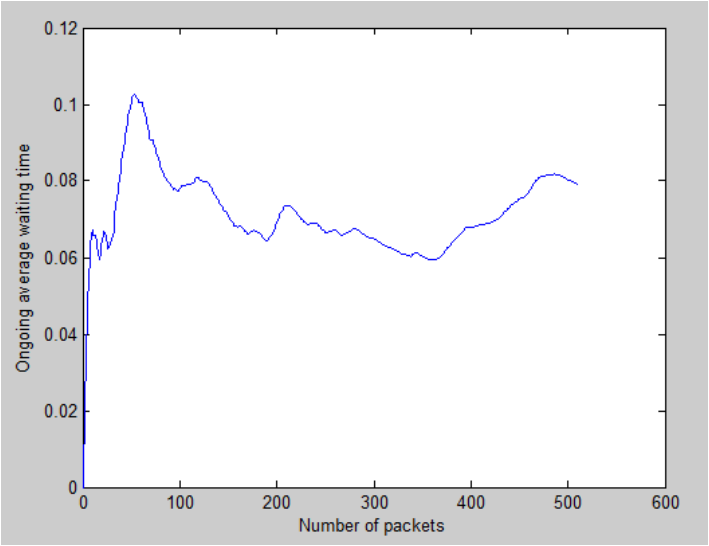
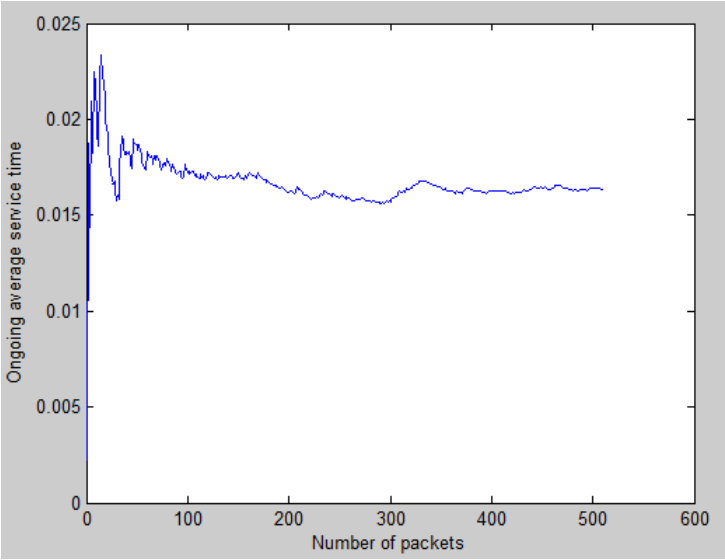
Question 1 (a)

M/M/1 queue
Exponential inter-arrival time with mean 20ms (arrival rate 50)
Exponential service time with mean 16ms (service rate 62.5)
Simulation time 10sec
Packets arrived=512
Packets departed=511
Uses the M/M/1 implementation in file SingleServer.java

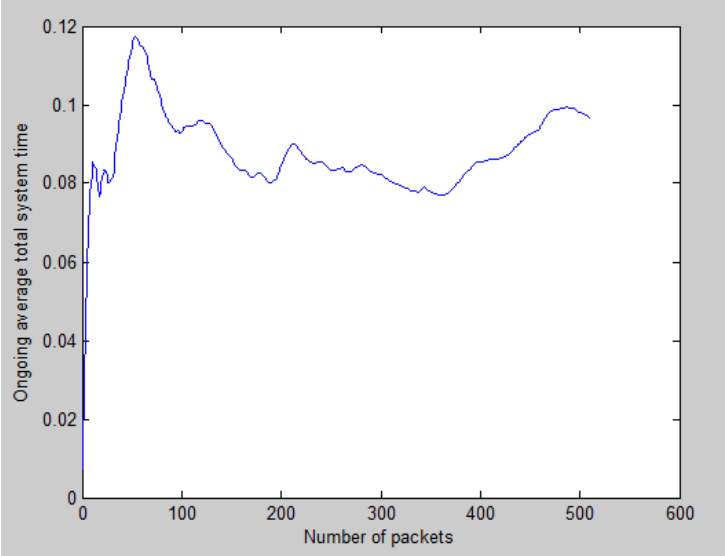
(a) Ongoing average waiting time



(b)Ongoing average service time



(c)Ongoing average of total system time



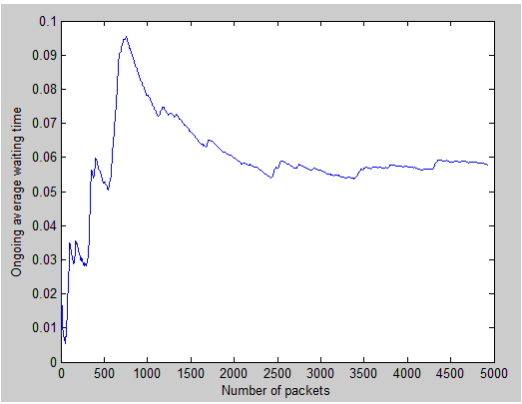
(d)Averages at the end of the simulation

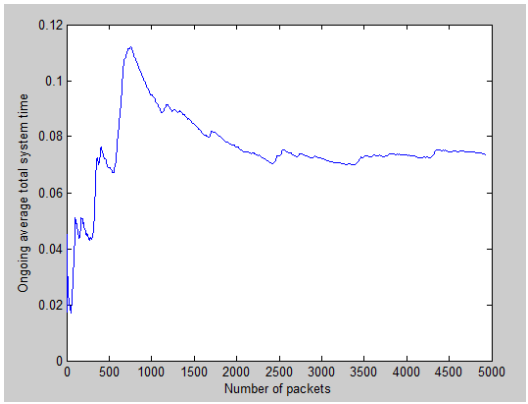
Average waiting time=0.079

Average service time=0.016

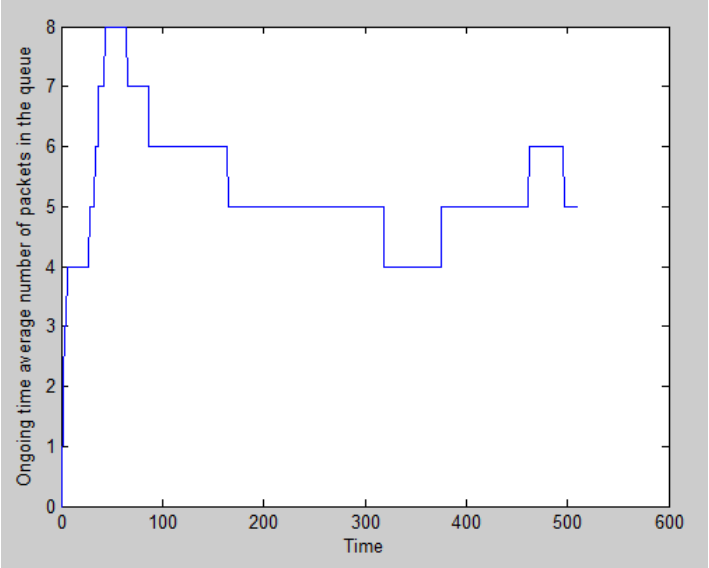
Average system time=0.097

(e) Plot (a) and (c) does not appear to settle for the amount of simulation time, but when I increased the simulation time to 100sec the plots settled at around 0.058 and 0.07 respectively as seen in the plots below. Plot (b) appears to settle at 0.018 with the 10sec simulation time.

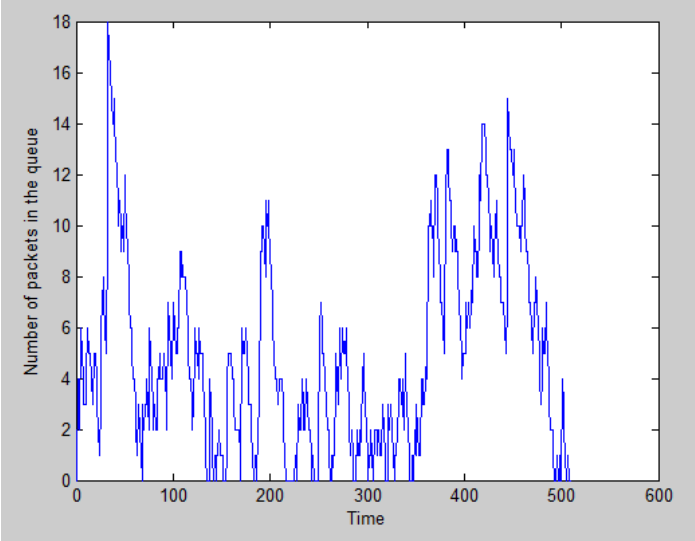




(f) Ongoing time average packets in the queue



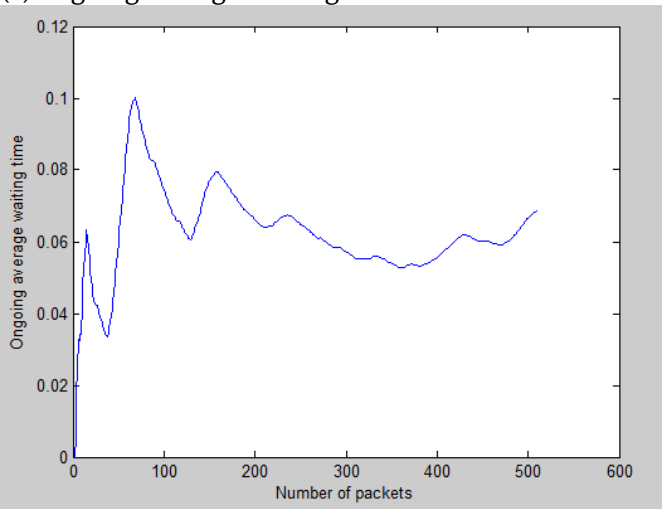
(g)Number of packets in queue



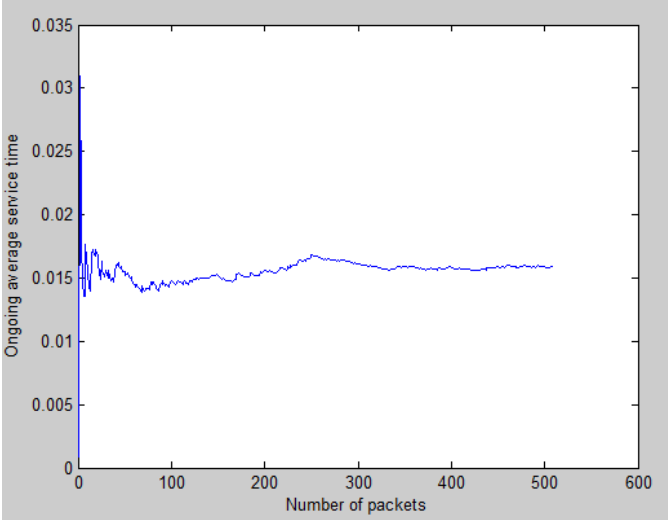
Question 1 (b)

M/M/1/20 queue
Exponential inter-arrival time with mean 20ms (arrival rate 50)
Exponential service time with mean 16ms (service rate 62.5)
Maximum queue size=20
Simulation time 10sec
Packets arrived=523
Packets departed=510
Uses the M/M/1/20 implementation in file SingleServerK.java

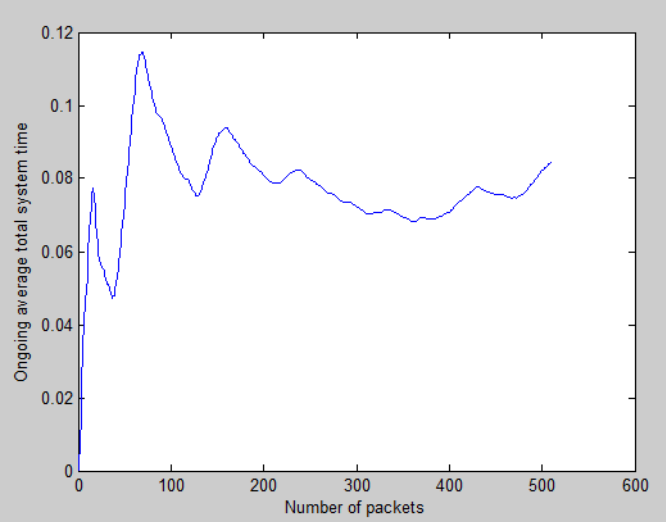
(a)Ongoing average waiting time



(b)Ongoing average service time



(c)Ongoing average total system time



(d)Averages at the end of the simulation

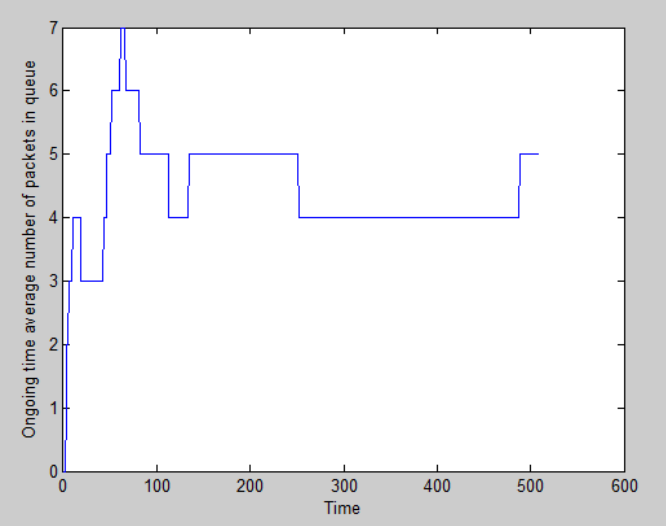
Average waiting time=0.069

Average service time=0.016

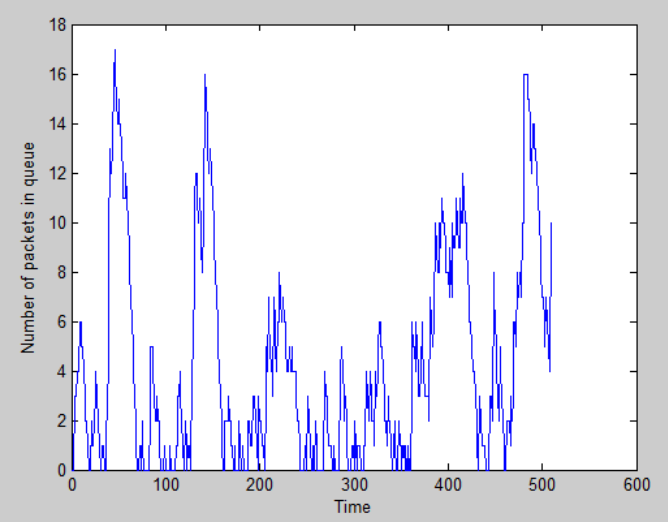
Average system time=0.085

(e) Plot (a) and (c) does not appear to settle for the amount of simulation time, I tried for 100sec and 1000sec but they don't seems to settle at these times either. Plot (b) appears to settle at 0.018 with the 10sec simulation time.

(f) Ongoing time average packets in the queue



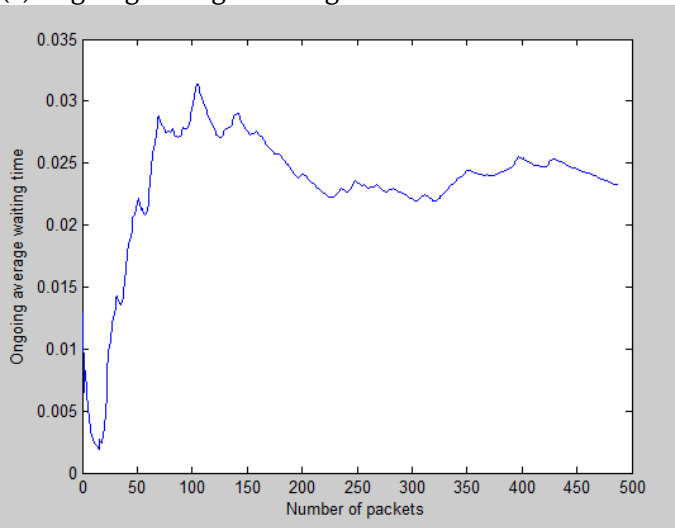
(g)Number of packets in queue



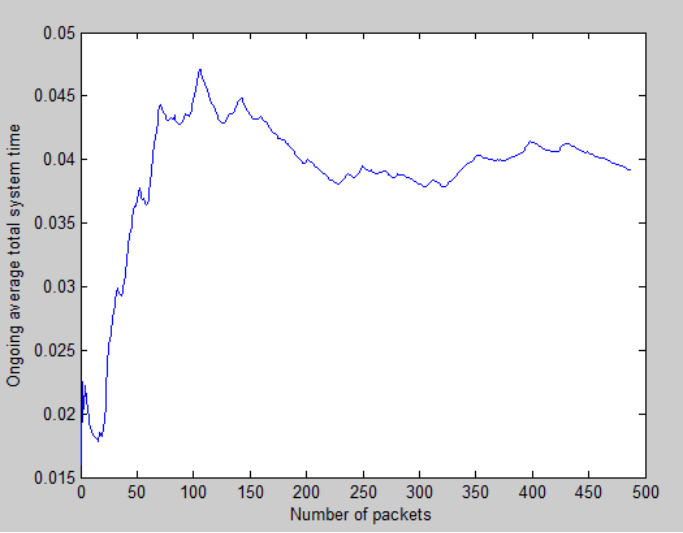
Question 1 (c)

M/D/1 queue
Exponential inter-arrival time with mean 20ms (arrival rate 50)
Constant service time with service rate 62.5
Simulation time 10sec
Packets arrived=490
Packets departed=488
Uses the M/M/1 implementation in file SingleSwitchD.java

(a)Ongoing average waiting time

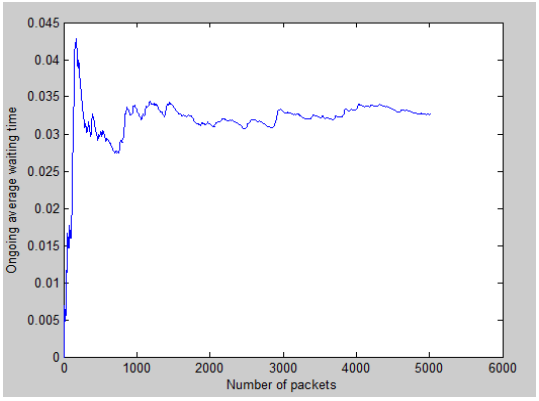


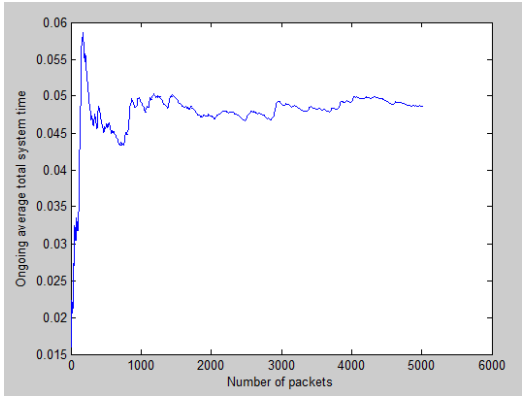
(c)Ongoing average total system time



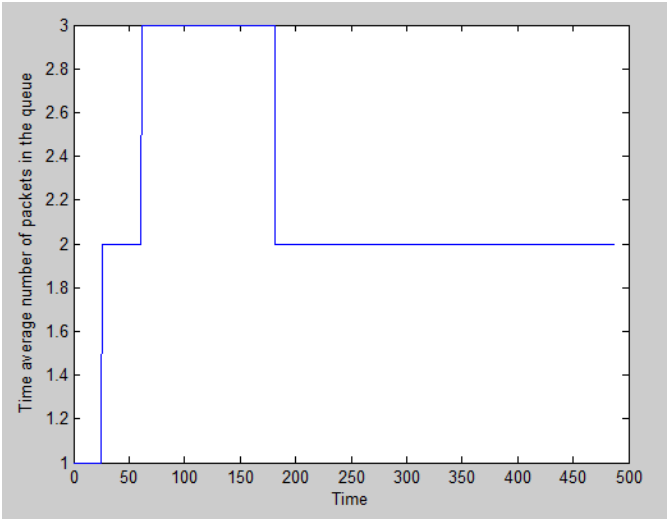
(d)Averages at the end of the simulation
Average waiting time=0.023
Average service time=0.016
Average system time=0.039

(e) Plot (a) and (c) does not appear to settle for the amount of simulation time, but when I increased the simulation time to 100sec the plots settled at around 0.032 and 0.045 respectively as seen in the plots below.

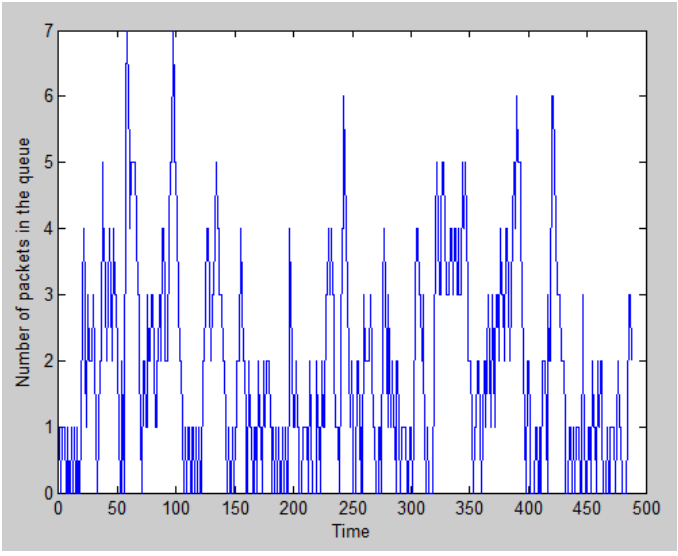




(f) Ongoing time average packets in the queue



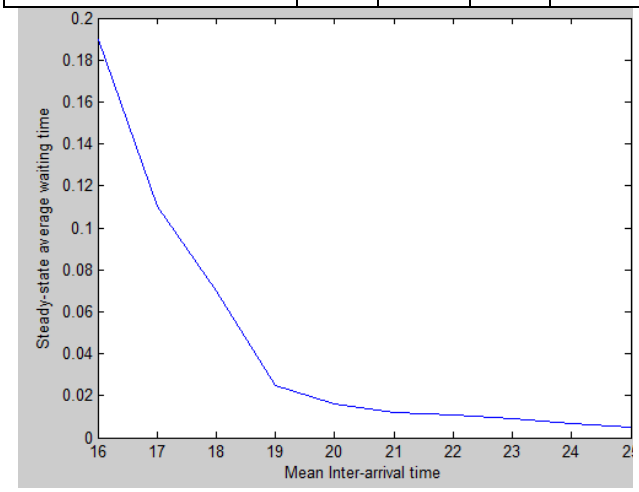
(g)Number of packets in queue

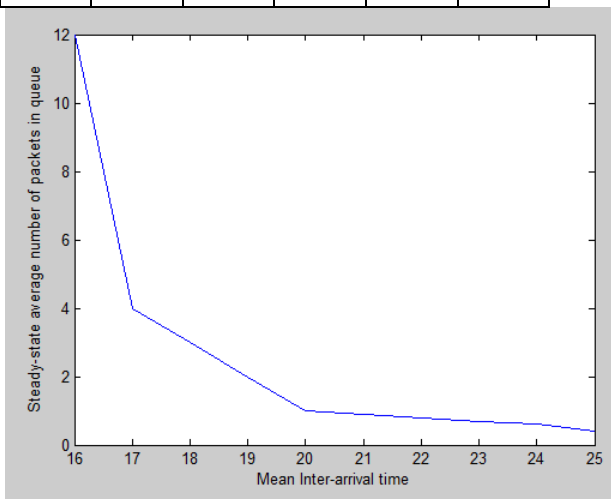


Question 2

Uses the M/M/1 implementation in file SingleServer.java

Mean inter-arrival	16	17	18	19	20	21	22	23	24	25
Steady-state average waiting time	0.19	0.11	0.07	0.025	0.016	0.012	0.011	0.009	0.007	0.005
Steady-state average number of customers	12	4	3	2	1	0.9	0.8	0.7	0.6	0.4

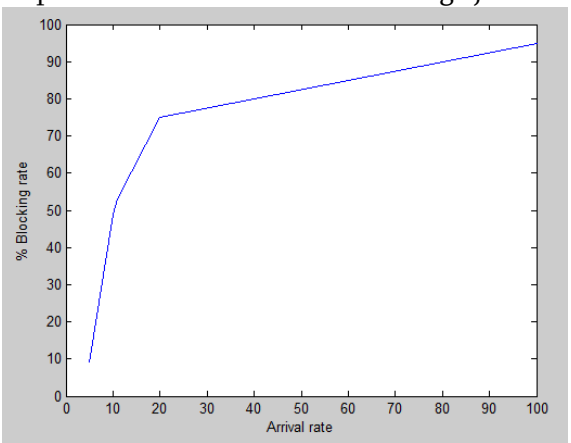




Question 3

M/M/50/k queue, where k=0

Implemented in the file CallExchange.java

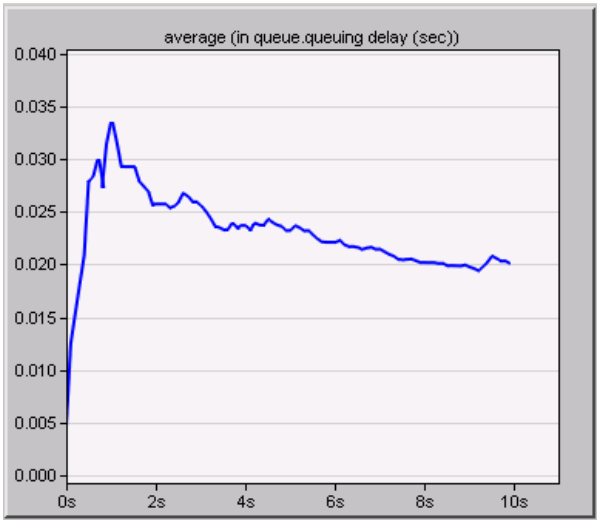


Arrival rate	90	10	7	5
Blocking rate (%)	90	50	20	10

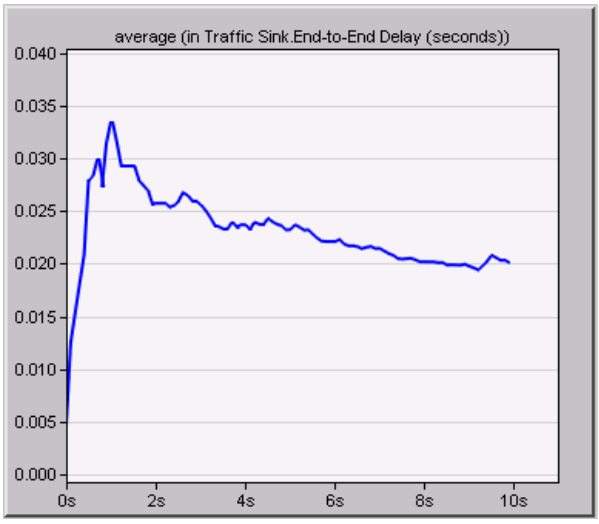
Question 4 (a)

The result below is from OPNET M/M/1 queue, the simulation was set to run for 10 sec with 128 seed, 50 mean outcome, and 562500 (65.5packets/sec * 9000 bits/packet) service rate. These results are a little different from the one obtained in question 1. With OPNET the time seems to stabilize, but with the simulation, the system is not reaching a stable state with this amount of simulation time.

(a) The service time of the switch is exponentially distributed, with infinite buffer



Queuing delay (Average)



Total system time (Average)

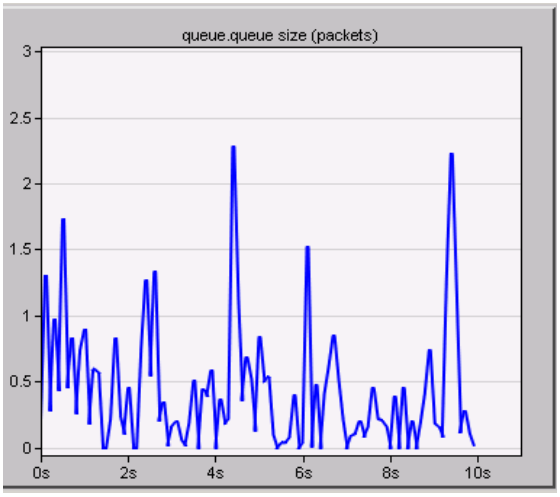
(d)Average waiting time= $\frac{1}{1.04-0.8} = 4.17\,\text{sec}$

Mean service rate= $\frac{562500}{9000} = 62.5$

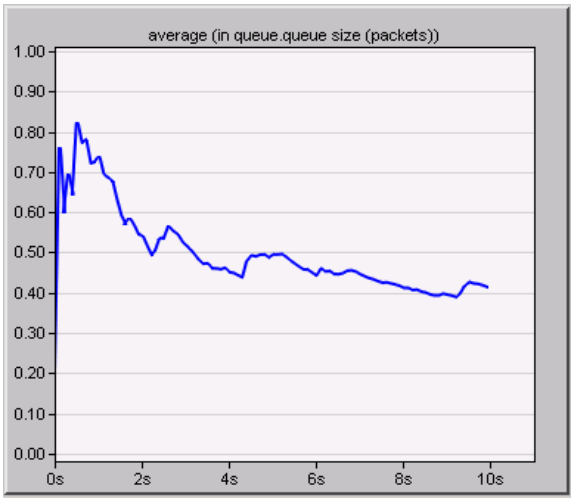
Average service time= $\frac{1}{62.5} = 0.016\,\text{sec}$

(e) The plot settles down at about 0.02sec

(f) and (g) Queue size and average queue size

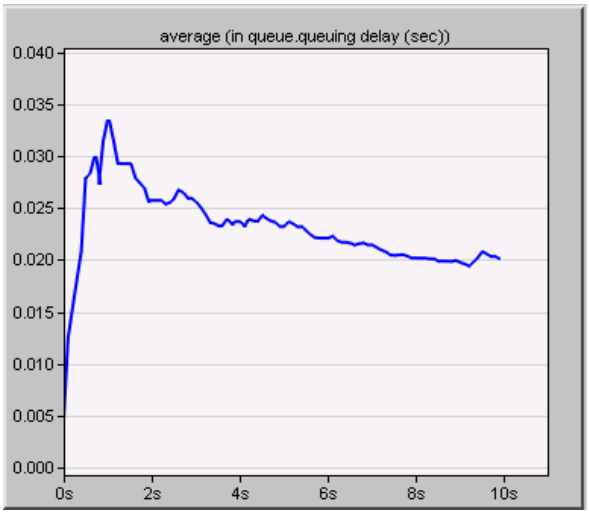


Queue Size (As Is)

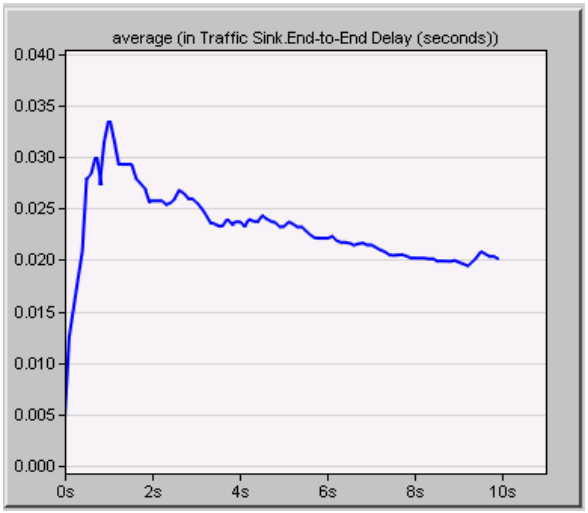


Queue Size (Average)

(b) The service time of the switch is exponentially distributed, at most 20 packets can be buffered at any one time



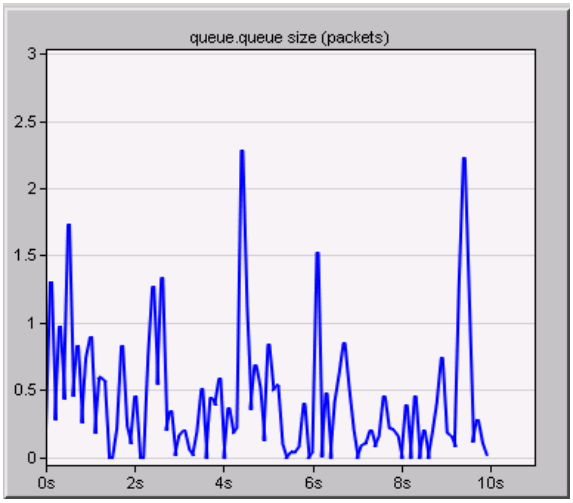
Queuing delay (Average)



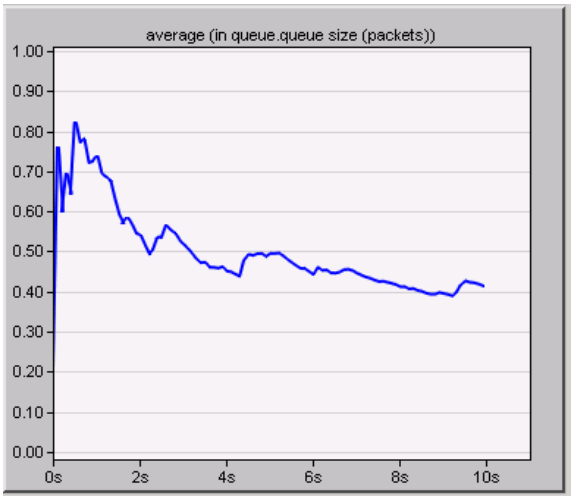
Total System time (Average)

(e) The plot settles down at about 0.02sec

(f) and (g) Queue size and average queue size

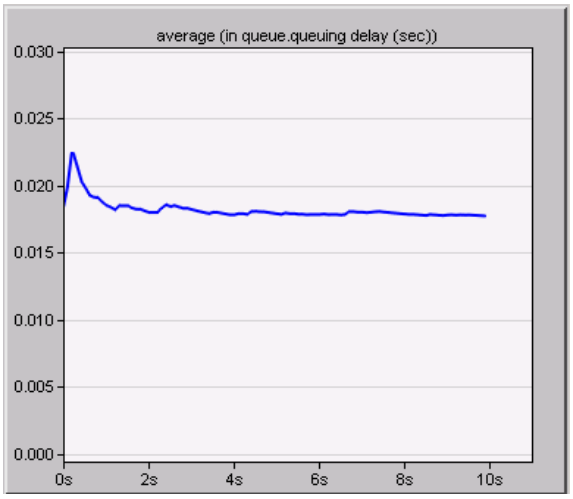


Queue Size (As Is)

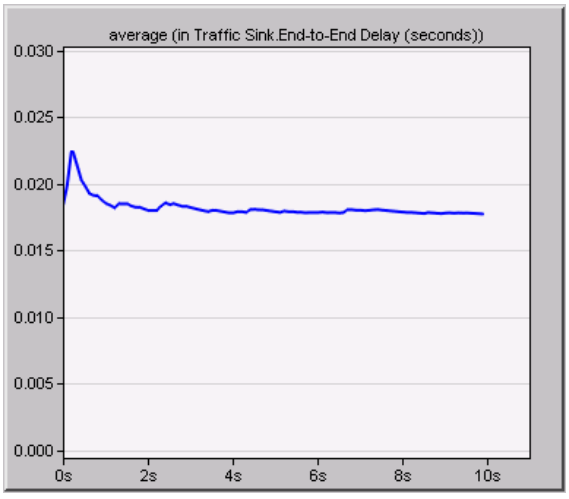


Queue Size (Average)

(c) The service time of the switch is deterministic (constant), with infinite buffer



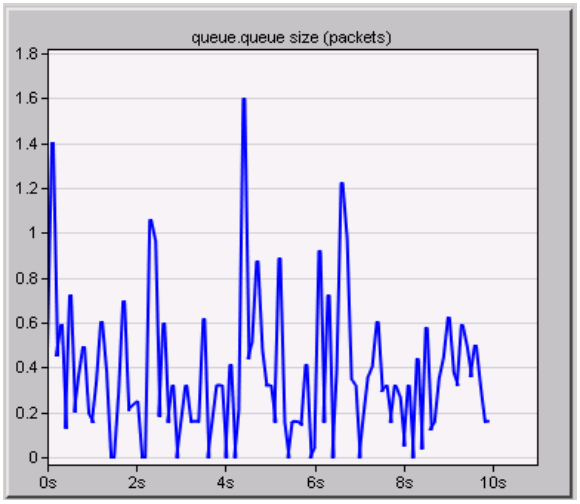
Queuing delay (Average)



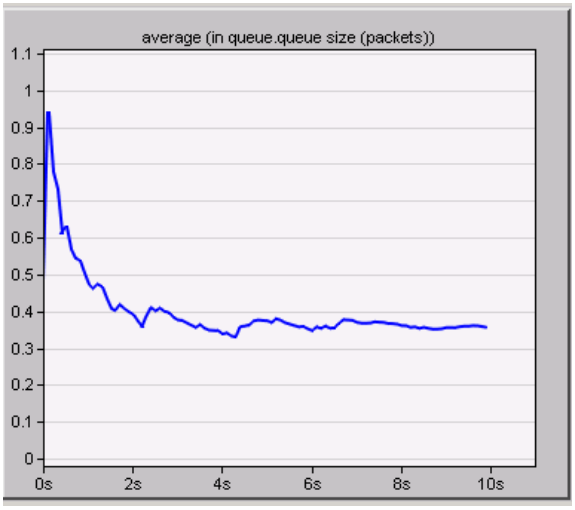
Total system time (Average)

(e) The plot settles down at about 0.0156sec

(f) and (g) Queue size and average queue size



Queue Size (As Is)



Queue Size (Average)