

ISyE 4803 Exam # 1
Summer 2010

Name

Please be neat and show all your work so that I can give you partial credit.
GOOD LUCK.

Question 1

Question 2

Question 3

Total

(35) **1.** Consider the queueing network in Figure 1. The external arrival process is Poisson with rate $\lambda = 20$ per hour. The probability of return to the first station from the second station is 0.3, and from the third station is 0.2. Forty percent of the customers from station 1 go to station 2 while the rest go to station 3. The service time of all servers are exponential random variables. The service rate of the server at the first station is $4/5$ per minute, the service rate of the server at the second station is $2/3$ per minute and the service rate of the server at the third station is $1/2$ per minute.

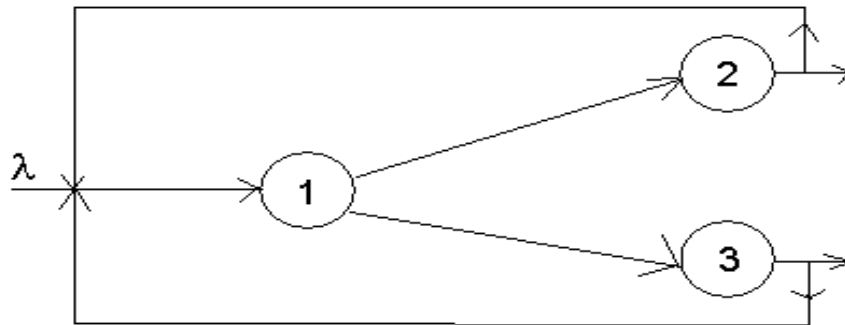


Figure 1: Queueing Network of Question 1.

a. (15) Does the joint distribution (in the long-run) for the number of customers at three stations exist? If it does, compute it.

b. (10) What is the expected number of customers in the system in the long-run?

- c.** (10) What is the expected time spent in the system in the long-run?

(35) **2.** Consider a network with two stations. Service time of both servers are exponential with rates 10/hr and 20/hr, respectively. If an arriving customer finds station 1 busy, she will leave the system without receiving service. After being served by station 1, if she finds station 2 idle, she will be served by this station; otherwise she will leave the system. Assume that the arrival process is Poisson with rate 10/hr. Compute

a. (15) steady state probability that server 1 is busy,

b. (10) expected number of customers in the system in the long-run

c. (10) and expected time spent in the system in the long-run.

(30) **3.** Consider a production system with two stations in series (i.e. all the jobs leaving station 1 go to station 2) operating under CONWIP (Constant Work In Process) policy. Recall that when the system is operating under CONWIP policy, only a job leaving station 2 triggers a new job to be released to station 1. Assume that the service times at both stations are exponential with rates 4/hr and 6/hr, respectively. Let $N = 2$ be the CONWIP level. Compute the utilization of both stations.