CS5224
2005/2006 Semester 1

Due: Aug 31, 2005 (Before Class Begins)

Notes:

(1) Homework assignment should be done independently though you are allowed to discuss with your fellow students.
(2) Submit a hardcopy
(3) Remember to write your name.
(4) Late homework will be penalized by 25% every 24 hours.

1. **(15 pts) A communication line capable of transmitting at a rate of 50Kb/s is used to transmit 10 sessions. Each session generate Poisson traffic at a rate of 150 packets/min. Packet lengths are exponentially distributed with mean 1000 bits. Find the average number of packets in queue, the average number in the system, and the average delay per packet when the line is allocated to the sessions by using (i) 10 equal capacity TDM channels (ii) statistical multiplexing.**

2. **(9pts) Consider a M/M/1/N queue. Calculate the values of N for $\rho = 0.8$, $P_B = 10^{-3}$, 10^{-6} and 10^{-9}.**

3. **(10pts) Customers arrive at a fast-food restaurant at a rate of 6 per minute, and wait to receive their orders for an average of 5 minutes. Customers eat in the restaurant with probability 0.5, and take away with probability 0.5. Eat-in customers spend an average of 30 minutes. What is the average number of customers in the restaurant (i) waiting (ii) eating?**

4. **(10pts) A communication line is divided into 2 identical channels each of which will serve a packet traffic stream where all packets have equal transmission time T, and equal inter-arrival time R>T. Consider, alternatively, statistical multiplexing of the two traffic streams by combining the channels into a single channel with transmission time T/2 for each packet. Show that the average system time of a packet will be decreased from T to somewhere between T/2 and 3T/4, while the variance of waiting time is the queue will be increased from 0 to as much as $T^2/16$.**

5. **(12pts) A telephone company establishes a direct connection between two cities expecting Poisson traffic with rate 30 calls/min. The durations of calls are independent and exponentially distributed with mean 3 minutes. Inter-arrival times and call durations are independent. How many circuits should the company provide to ensure that an attempted call is blocked (all circuits are busy) with probability 0.02 or less? It is assumed that blocked calls are lost, i.e. blocked call is not attempted again.**

6. **(12pts) A telephone company establishes a direct connection between two cities expecting Poisson traffic with rate 20 calls/min. The durations of calls have a Pareto distribution with mean 3 minutes. Inter-arrival times and call durations are independent. What is the approximate blocking rate if 60 circuits are available?**

7. **(6pts) Traffic on a switch can arrive at a peak rate of 10Mbps and will be served at the minimum rate of 5Mbps. The queuing delay on this switch should not be more than 10ms. What is the buffer size needed?**

8. **(6pts) Write a small program to generate a Pareto and exponential distribution with mean 2. Plot the probability distribution function (PDF) of the two distributions on the same graph.**

9. **(10pts) Consider a system that is identical to the M/M/1 except that when the system empties out, service does not begin again until k customers are present in the system (k is given). Once service begins, it proceeds normally until the system becomes empty again. Find the steady state probabilities of the number in the system, and write down the equations expressing the average number and average delay of the system.**

10. **(10pts) How many traffic classes should be supported by a network and what should they be? Discuss. Be brief and do not write more than 100 words.**