## Modeling and Simulation Assignment 4 Due Date: 28th Nov, 2005

## November 14, 2005

- 1. Consider the simplified model of the coffee board. The customers arrive with an interarrival time distribution  $expo(\lambda_a)$  and stand in a queue. The coffee board services each customer one at a time in a first come first serve basis in  $expo(\lambda_s)$  distributed time.
  - (a) Breifly describe with a flow chart how will you simulate such a system for the time interval [0,T].
  - (b) Let N(t) be the number of customers in the system at time t also let  $W_i$  be the waiting time for the *i*th customer before he leaves the system. Simulate the system for T = 20min given that  $\lambda_a = 0.2min^{-1}$  and  $\lambda_s = 0.25min^{-1}$ . Ploat N(t) versus t. Also tabulate  $W_i$ .
  - (c) Simulate the system for T = 480min. Let  $T_j$  be the total time in which the system has exactly j customers. Tabulate  $T_j$ . Compute  $\tilde{N} = \frac{1}{T} \sum_j jT_j$ . Also report  $\tilde{w} = \frac{1}{N} \sum_i W_i$  where N is the total number of customers. Report  $\eta = \frac{T_0}{T}$ , the fraction of time the coffee board is idle.
  - (d) Redo the previous question 10,000 times and plot the histogram of N(t) = n. Fit an appropriate distribution.
  - (e) Redo part c for various values of k = (0.2, 0.5, 1, 1.5) where  $\lambda_s = 0.2k$ . Also plot  $\eta$  versus k.
  - (f) If you are to give the best service what k will you choose. 30 marks
- 2. Let the service time of each customer be  $N(\mu, \sigma^2)$ . Let  $\sigma^2 = \frac{r}{\mu^2}$ .
  - (a) Simulate the coffee board with T = 480min with an exponential interarrival time with rate  $\lambda_a = 0.2min^{-1}$ . Experiment with different values of  $\mu$  and plot  $\eta$  versus  $\mu$ . Assume r = 1. Suggest suitable values of  $\mu$ .
  - (b) Using your suggested value of  $\mu$  experiment with r. Study the effect of r on  $\tilde{N}$ . 20 marks

3. Bholu wanted to open a coffee shop. The customers arrive with an interarrival time exponentially distributed as  $\lambda_a = \frac{1}{30}min^{-1}$ . He has been approached by both Bunty and Bubly for a position as the coffee shop attendent. Given that Bholu can hire only one person who should Bholu hire? It is known that Bunty has service time which is distributed as  $N(\mu, \sigma^2)$ , where  $\mu = 20min$  while  $\sigma = 15min$ . It is also known that Bubly has service time which is distributed as  $N(\mu, \sigma^2)$ , where  $\mu = 24min$  while  $\sigma = 2min$ . Justify your answer with simulation results. 20 marks