Computer Systems Modelling
Some Example Questions

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1. Show for the M/M/1 queue that the probability that there are n or more customers in the system is given by ρ^n.

   Use this result to find a service rate μ such that, for given λ, n, α where $0 < \alpha < 1$, the probability of n or more customers in the system is given by α

   Find a value of μ for an M/M/1 queue for which the arrival rate is 10 customers per second, and subject to the requirement that the probability of 3 or more customers in the system is 0.05

2. What is the average length of each idle period of an M/M/1 server, given its arrival rate λ service rate μ. What is the average length of a busy period?

3. Given an M/M/1/K queue with $\lambda = 10, \mu = 12, N = 15$ over what proportion of time are customers rejected from the queue? What is the effective arrival rate? What is the effective utilization of the server?

4. BrightnBrainy computer company's assembly machines break down according to a Poisson distribution with average rate 3 per hour. The company is considering the services of 2 service agents: I.M. Fast and I.M. Slow. The former can fix machines at a rate of 6 per hour, and charges £18 per hour whilst the latter can only service 4 per hour but charges only £10 per hour. If the cost of an idle machine is £30 per hour, which repair man should be used?

5. Repairing a computer takes 4 stages in sequence, namely removing the lid, finding the faulty part, replacing it, and reassembling the machine. Each step is independent and exponentially distributed with mean 3 minutes. What is the coefficient of variation of the repair time? Construct a Markov chain model of this system, assuming an infinite population of machines.

6. Try relevant old paper questions: CST 92.9 Q3, CST 93.9.2 Q3, CST 93.8.2 etc

7. How would you generate random variates for the Poisson distribution? Write pseudo code for a simulation component which models the Poisson arrival process of customers at a bank, given that the mean arrival rate is 40 customers per hour. What are the important events for this component (the generator).

8. How would you generate random variates from the mixed exponential distribution

$$f(x) = 1/3\lambda_1 \mathrm{e}^{-\lambda_1 x} + 2/3\lambda_2 \mathrm{e}^{-\lambda_2 x}$$

where $\lambda_1 = 5, \lambda_2 = 10$, which describes the joint arrival process of two separate exponentially distributed streams of customers to a single queue?