
- Do exercises 10.11, 10.16, 15.2, 15.5, 15.11.
- Our goal is to use your previous simulation to consider how variations of policies can improve performance for distributed queueing systems. Consider a bank of $n$ FIFO queues, with a Poisson arrival stream of customers to the entire bank of rate $\lambda n$ per second, where $\lambda < 1$. Upon entry a customer chooses a queue for service. The customer can choose service in one of three ways.

1. The customer can choose a queue randomly. (This corresponds to your results from the last assignment. Please re-run the results to get the data required here.)
2. The customer can choose two (distinct) queues randomly, and go to the one with the shorter queue. (In case of a tie, you should choose a random one of the two.)
3. The customer can go to the queue with the shortest length. (Ideally, if there was more than one queue with the shortest length, you would have the customer choose one of these queues randomly. However, if the shortest length queue is 0, it does not matter which queue is chosen by symmetry.)

For this exercise, simulate all three scenarios above, for two service distributions: exponentially distributed service times with mean 1, and constant service times with value 1. Your simulation should run for $t$ seconds, and return the average amount of time each customer that has completed service spent in the system, and the average number of customers each incoming customer found waiting in the queue they selected for service. You should present results for your simulations for $n = 100$ and for $t = 10,000$ seconds with $\lambda = 0.5, 0.8, 0.9$, and 0.99.