1.041/1.200 Spring 2024: Recitation 2

Date: Feb 20, 2:00 PM

1 Problem 1

A service desk at Department of Motor Vehicles will address two types of customers. It will take the service desk 2 minutes to solve the problem of a type A customer, and 3 minutes to solve the problem of a type B customer. Type A customers arrive at time $t = 0, 5, 6$ and 10 minute. Type B customers arrive at time $t = 2, 3$ and 7 minute.

We assume the customers are served in a first in first out (FIFO) schema. A customer will join the end of the waiting queue if the service desk is busy when he or she arrives.

1. Draw the cumulative plot for both arrival and departure. The time range is from 0 to the time when the last customer leaves the service desk.

2. Find the numerical value of the maximum observed length of the queue.

3. Which customer spends the longest time in the system? Write the type and arrival time of this customer.

4. What is the value of the average time a customer spends in the system?

5. Now assume, after the customers are served at the service desk, they need to visit the cashier to pay the bill. Assume that the time to walk from the service desk to the cashier is zero. There are two cashiers, Alice and Bob. For a type A customer, both Alice and Bob need 4 minutes to finalize the request. For a type B customer, both Alice and Bob need 5 minutes to finalize the request. If both Alice and Bob are idle or the queues in front of Alice and Bob have the same length, the arriving customer will always choose Alice. Otherwise, the customer will always join the queue in front of the cashier who has fewer customers waiting. Assume that the departures always happen before arrivals if both happen at the same cashier at a given time.

Draw the cumulative arrival and departure diagrams for Alice and Bob from $t=0$ to the time when the last customer leaves the cashiers.

2 Code the Cumulative Plots

1. **Prepare Time Points:** Collect data that records the times when new customers are served.

2. **Prepare Query Data:** Gather data on the number of customers being served at each time point. Use `numpy.cumsum` to calculate the cumulative number of customers served.

3. **Plot Cumulative Data:** Utilize `plt.step` to generate the cumulative plot, effectively visualizing the total number of customers served over time.

See *Rec2_Cumulative_Plot.ipynb*.