EXERCISE QUESTIONS Process Flow Measures (Little's Law)

Question 1
A bank finds that the average number of people waiting in line during lunch hour is 10. On average, during this period, 2 people per minute leave the bank after receiving service. On average, how long do bank customers wait in line?

Question 2
At the drive-through counter of a fast-food outlet, an average of 10 cars waits in line. The manager wants to determine if the length of the line is having any impact on potential sales. A study reveals that, on average, 2 cars per minute try to enter the drive through area, but 25 percent of the drivers of these cars are dismayed by the long line and simply move on without placing orders. Assume that no car that enters the line leaves without service. On average, how long does a car spend in the drive-through line?

Question 3
Checking accounts at a local bank carry an average balance of $3,000. The bank turns over its balance 6 times a year. On average, how many dollars flow through the bank each month?

Question 4
Orange Juice Inc. Produces and markets fruit juice. During the orange harvest season, trucks bring oranges from the fields to the processing plant during a workday that runs from 7 am to 6pm. On peak days, approximately 10,000 kilograms of oranges are trucked in per hour. Trucks dump their contents in a holding bin with a storage capacity of 6,000 kilograms. When the bin is full, incoming trucks must wait until it has sufficient available space. A conveyor moves oranges from the bins to the processing plant. The plant is configured to deal with an average harvesting day, and maximum throughput (flow rate) is 8,000 kilograms per hour.

a) Assuming that oranges arrive continuously over time, construct an inventory buildup diagram for Orange Juice Inc. In order to process all the oranges delivered during the day, how long must the plant operate on peak days? (Assume, too, that because Orange Juice Inc. Makes fresh juice, it cannot store oranges.)

b) Assuming, finally, that each truck holds about 1,000 kilograms of oranges, at what point during the day must a truck first wait before unloading into the storage bin?

c) How long will truck wait, on average?

Question 5

Jasper Valley Motors (JVM) is a family-run auto dealership selling both new and used vehicles. In an average month, JVM sells a total of 160 vehicles. New vehicles represent 60% of sales, and used vehicles represent 40% of sales. Max has recently taken over the business from his father. His father always emphasized the importance of carefully managing the dealership's inventory. Inventory financing was a significant expense for JVM. Max's father consequently taught him to keep inventory turns as high as possible.

A) Examining the dealership's performance over recent years, Max discovered that JVM had been turning its inventory (including both new and used vehicles) at a rate of 8 times per year. What is JVM's average inventory (including both new and used vehicles)?

B) Drilling down into the numbers, Max has determined that the dealership's new and used businesses appear to behave differently. He has determined that turns of new vehicles are 7.2 per year, while turns of used vehicles are 9.6 per year. Holding a new vehicle in inventory for a month costs JVM roughly $175. Holding the average used vehicle in inventory for a month costs roughly $145. What are JVM's average monthly financing costs per vehicle?

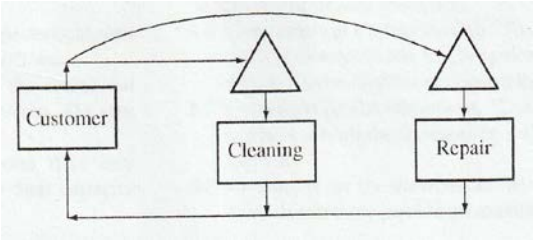
C) A consulting firm has suggested that JVM subscribe to its monthly market analysis service. They claim that their program will allow JVM to maintain its current sales rate of new cars while reducing the amount of time a new car sits in inventory before being sold by 20%. Assuming the consulting firm's claim is true, how much should Max be willing to pay for the service?

Question 6

Cheapest Car Rental rents cars at the Chicago airport. The car rental market consists of two segments: the short-term segment, which rents for an average of 0.5 week, and the medium-term segment, which rents for an average of 2 weeks. Cheapest currently rents an average of 200 cars a week to the short-term segment and 100 cars a week to the medium-term segment.

Approximately 20% of the cars returned (evenly distributed across both segments) are found to be defective and in need of repairs before they can be made available for rent again. The remaining cars not needing repairs are cleaned, filled with gas, and made available for rent. On average, there are 100 cars waiting to be cleaned. The average cost of this operation is 5$ per car. Cars needing repairs spend an average of 2 weeks in the repair shop and incur and average cost of $150 per car. Assume that cars are rented as soon as they are available for rent, that is, as soon as they have been cleaned or repaired.

Short-term renters pay $200 per week, while medium-term renters pay $120 per week. The flow of cars is shown in the figure below.



A) Identify throughput, inventory, and flow time at each stage.

B) What profit does Cheapest earn per week with the current system? Assume that each car loses $40 in value per week because of depreciation.

C) Cheapest is comparing two possible improvements:

1. Decrease time in repairs from 2 weeks to 1 week.
2. Decrease cost per repair from $150 per car to $120 per car while keeping flow time in repairs at 2 weeks.
   Assume that the effort that is required in which case is the same. Which change do you think will be more effective? Why?

Question 7

The Evanstonian is an upscale independent hotel that caters to both business and leisure travelers. On average, one-third of the guests checking in each day are leisure travelers. Leisure travelers generally stay for 3.6 nights – twice as long as the average business customer.

A) on an average day, 135 guests check into The Evanstonian. On average, how many guests of each type are in the hotel on any given day?

B) How many times per month does the hotel turn over its inventory of guests (assume 30 days per month)?

C) The average business traveler pays a rate of $250 per night, while leisure travelers pay an average rate of $210 per night. What is the average revenue The Evanstonian receives per night per occupied room?

Question 8 (Hospital ER)

A hospital emergency room (ER) is currently organized so that all patients register through an initial check in process. At his or her turn, each patient is seen by a doctor and then exits the process, either with a prescription or with admission to the hospital. Currently, 50 people per hour arrive at the ER, 10% of who are admitted to the hospital.

On average 30 people are waiting to be registered and 40 are registered and waiting to see a doctor. The registration process takes, on the average, 2 min/patient. Among patients who receive prescriptions, average time spent with a doctor is 5 minutes. Among those admitted to the hospital, average time is 30 min.

a) On average, how long does a patient stay in the ER?
b) On average, how many patients are being examined by doctors?
c) On average, how many patients are in the ER?

Question 9 (Mr. Penguin)

Mr. Penguin is a tuxedo rental agency, which provides the formal attire for special occasions at a price of $350 per week. On average Mr. Penguin serves 180 customers a week. Approximately one-third of the tuxedos returned are damaged during the rental period and require repairs before they can be made available for rent again. Damaged tuxedos are sent for repairs to a tailor (who fixes and cleans the tuxedos) and are ready for rent in 2 weeks. The remaining tuxedos, which do not require repairs, are cleaned in-house. On average there are 60 tuxedos waiting to be cleaned or being cleaned. The average cost of cleaning is $10/tux. Tuxedos needing repairs incur an average cost of $175/tux. Assume that tuxes are rented as soon as they are available for rent, that is, as soon as they have been cleaned or repaired.

a. Draw the process flow chart for Mr. Penguin.
b. If customers on average rent tuxedos for the entire week, then how many tuxedos does Mr. Penguin require to run their business? What is Mr Penguin's per week profit?
c. If customers on average rent tuxedos for a period of 0.5 weeks, then how does throughput, inventory, flow time, and profit change?

Mr. Penguin re-builds his system such that repairs are also in-house. The in-house repairs are substantially cheaper at a cost of $100/tux, but it takes 2.5 weeks to repair before being sent to the in-house cleaners. The additional work of repairing also has an impact on the cleaning service, slowing cleaning down to an average of 1 week per tux. For the new system, if necessary, he will purchase new tuxedos at $3000 per tuxedo. Assume that Mr. Penguin will only own the minimum number of tuxedos necessary to carry out the operation.

a. Draw the process flow chart for the new system.
b. How many weeks does Mr. Penguin need to recover his investment if rental periods are typically 0.5 weeks?
c. What about if customers rent for a period of 1 weeks?

Question 10 (Kingston Car Rentals)

Kingston Car Rentals (KCR) rents cars at Kingston airport. Their market consists of two segments: the short-term segment, which rents for an average of 0.5 weeks, and the medium-term segment, which rents for average of 2 weeks. KCR currently rents an average of 200 cars a week to the short-term segment and 10 cars a week to the medium-term segment.

Approximately 20% of the cars returned (evenly distributed across both segments) are found to be defective and in need of repair before they can be made available for rent again. The remaining cars not needing repair are cleaned and made available for rent. On average, there are 100 cars waiting to be cleaned. The average cost of cleaning is $5 per car. Cars needing repairs spend an average of 2 weeks in the repair shop and incur an average cost of $150 per car. Cars returning from repair are also cleaned before made available for rent. Assume that cars are rented as soon as they are available for rent, that is, as soon as they have been cleaned and repaired.

Short-term renters pay $200 per week, while medium-term renters pay $120 per week.

a. What profit does KCR earn per week with the current system? Assume that each car loses $40 in value per week because of depreciation.

b. KCR is comparing two possible improvements. Option 1: Decrease time in repairs from 2 weeks to 1 week. Option 2: Decrease cost per repair from $150 per car to $120 per car while keeping flow time in repairs at 2 weeks. Assuming that the effort required in each case is the same, which option will be more effective? Why?