Module 4 – Homework Questions

Please submit your answers to these homework questions via the Coursera website.

The Right to Vote (and not to wait)

In the previous two presidential elections in the United States, very long wait times have been witnessed at precincts (voting stations) in states that ultimately decided the election (Florida in 2000 and Ohio in 2004).

In Philadelphia as well, some voters complained about the long lines in some precincts, with most complaints coming from precinct A. In 2004, the average number of voters arriving at Precinct A was 35 per hour, and the arrivals of voters were random with inter-arrival times that had a coefficient of variation of 1 (CVa=1).

Philadelphia had deployed 1 voting machine in Precinct A. Suppose that each voter spent on average of 100 seconds in the voting booth (this is the time needed to cast her/his vote using a voting machine), with a standard deviation of 120 seconds.

RTV1. How long on average did a voter have to wait in line precinct at A in 2004 *before* entering in a booth to cast her/his vote?

Grand Hotel

The managers of the Grand Hotel are evaluating the possibility of setting up a computer area where conference attendees can check their e-mail on computers provided by the conference organizers. There will be one common queue for all computers, and only one person uses a computer at a time. On average there are 12 attendee arrivals per hour, and the standard deviation of the time between arrivals is 2.5 minutes. The average time that a person spends on the computer is 20 minutes, with a standard deviation of 10 minutes.

Suppose the organizers decide to install 5 computers.

GH1. What is the average utilization of the 5 computers?

GH2. What is the expected time (in minutes) that an attendee will have to wait for a computer to become available?

GH3. How long (in minutes) will the average computer be empty during an 8-hour day?

GH4. What is going to be the average number of attendees in the computer area (either waiting for a computer or using a computer)? (Your answer does NOT have to be an integer.)

GH5. The firm does not want the average waiting time to be higher than 0.1 minute. What is the minimum total number of computers that the firm will have to install to meet this goal?

UPS Shipping

A UPS employee, Davis, packs and labels three types of packages: basic packages, business packages, and oversized packages. Business packages take priority over basic packages and oversized packages because those customers paid a premium to have guaranteed two-day delivery. During his 9-hour shift, he has, on average, one container of packages containing a variety of basic, business, and oversized packages to process every 3 hours. As soon as Davis processes a package, he passes it to the next employee, who loads it onto a truck. The times it takes him to process the three different types of packages and the average number of packages per container are shown in the table below.

	Basic	Business	Oversized
Avg # of min to label and package each unit	5 min	4 min	6 min
Avg # of units per container	10	10	5

Davis currently processes packages from each container as follows. First, he processes all business packages in the container. Then he randomly selects either basic packages or oversized packages for processing until the container is empty. However, his manager suggested to Davis that, for each container, he should process all the business packages first, then the basic packages second, and then the oversized packages last.

UPS1. If Davis follows his supervisor's advice, what will happen to Davis's utilization?

a. His utilization will increase
b. His utilization will decrease
c. His utilization will stay the same

UPS2. What will happen to the average time that a package spends in the container?

a. The average wait time will increase
b. The average wait time will decrease
c. The average wait time will stay the same

Process Design

Consider the following three process designs to organize a call center with 12 employees. The center handles calls for two customer types. Type 1 customers call with credit card-related questions and type 2 customers call with questions related to online account opening. On a busy day the call center receives 60 calls per hour from type 1 customers and 30 calls per hour from type 2 customers. It takes on average 2 minutes to service both kinds of calls.

Process design 1: 6 employees handle type 1 calls; the other 6 employees handle type 2 calls
Process design 2: 8 employees handle type 1 calls; 4 employees type 2 calls
Process design 3: 12 persons (cross-trained) handle all calls

PD1. Which of the three process designs leads to the shortest and longest average waiting times for a random incoming request?

a. 1 is the shortest, 2 is the longest
b. 2 is the shortest, 1 is the longest
c. 3 is the shortest, 2 is the longest
d. 2 is the shortest, 3 is the longest
e. 3 is the shortest, 1 is the longest
f. 1 is the shortest, 3 is the longest
g. 3 is the shortest, 1 and 2 are the same
h. Cannot be determined
i. None of the above

Train Massage

There are 5 coin-operated massage chairs at Philadelphia's 30th Street train station. The length of time that each customer spends in a massage chair averages 12 minutes and has a standard deviation of 5 minutes. Customers pay $0.50 per minute for the massage. On average, every hour there are 15 potential customers interested in receiving a massage at one of these chairs. The inter-arrival times are assumed to be exponentially distributed. If no spot is available when the customer arrives, then the customer goes away.

TM1. What is the probability that an arriving customer will find all massage chairs occupied?

TM2. On average, how much revenue does Train Massage collect over the course of one hour?

TM3. How would that number change if the coefficient of variation of the massage time were reduced to zero?