Pure Mathematics 30

Student Project: Holiday Travel

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Introduction

Many transportation industries overbook their charters in order to maximize their revenue. This project will simulate the practice and help you to understand why it takes place.

Part A

Peter owns a shuttle bus that transports airline passengers between the airport and a downtown hotel. The bus holds a maximum of 9 passengers for each trip. Tickets to ride the bus are sold in advance. On average, 10% of those who buy tickets do not show up for their ride. To compensate for this, Peter sells 10 tickets for each one-way trip. Sometimes, all 10 people show up and one person needs to be "bumped" from the bus. Peter must then pay the taxi fare for a bumped customer. On a typical day, the shuttle bus completes 50 one-way trips and rarely carries fewer than 7 passengers. Table 1 below shows a typical summary of 50 one-way trips.

Table 1

Number of No-Shows L_1	**Tally**	**Frequency Values L_2**
0 (one customer bumped)	𝍸 𝍸 𝍸 ||||	
1 (no customers bumped)	𝍸 𝍸 𝍸 |	
2 (1 empty seat)	𝍸 ||||	
3 (2 empty seats)	𝍸 |	

1. • Complete the frequency values (L_2) in the table above.

• Based on the data, what is the expected number of times, out of 50, that Peter will have 0 no-shows?

2. Enter the data from Table 1 into your graphing calculator. Enter the number of no-shows (0, 1, 2, and 3) in L_1.

Enter the frequency values in L_2.

- Use your calculator and the data from L_1 and L_2 to construct a histogram. Explain why the data do not form a normal distribution.
- Use an exponential regression to find the equation, in the form $y = ab^x$, that can be used to model these data. State the values of a and b to the nearest hundredth and any restrictions on the values of x.
- Is the set of data continuous or discrete? Justify your answer.
- Does an exponential function seem a reasonable model for these data? Justify your answer.

3. Peter's profit on a one-way trip is based on the number of occupied seats. When Peter has to turn away a paid customer, he must pay his or her cab fare. His profit can be modelled in the following manner.

Table 2	
Two or more empty seats	\$0
One empty seat	\$15
A full bus without a bumped customer	\$30
A full bus with one bumped customer	\$10

Based on the data in Tables 1 and 2, determine Peter's expected profit for the day if he makes 50 trips.

4. Peter tracked the number of times he had a full bus with one bumped passenger over an entire season. He found that 45% of the time he had 0 no-shows. In any given day, in 50 bus trips, what is the probability to the nearest hundredth that

- Peter would have exactly 20 trips with a full bus and a bumped customer?
- Peter would have from 15 to 20 trips with 0 no-shows?

Part B

An airline company is investigating the practice of overbooking. For a flight from Calgary to Winnipeg, the company uses a plane with a seating capacity of 133 passengers. The company found that, on average, only 90% of passengers show up for any given flight. To determine the number of passengers who show up for their flight, the company conducted a simulation. A record of the simulation data from 100 samples is shown below.

# of passengers	123	124	125	126	127	128	129	130	131	132
Frequency	1	2	0	0	6	4	4	8	12	10

# of passengers	133	134	135	136	137	138	139	140	141	142
Frequency	8	14	10	6	5	6	1	2	1	0

1.
- Based on the tabulated results, determine the probability that, at most, 133 passengers will check in.

- If 147 tickets are sold and the airplane can only accommodate 133 passengers, then what is the probability that one or more passengers will be bumped (i.e., 134 or more passengers check in)?

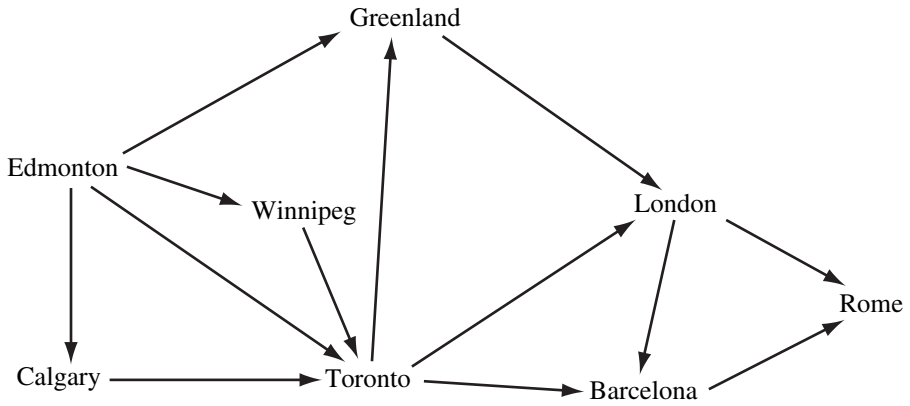
2. The data can also be represented by using a normal distribution.

- For the data above, estimate the mean to the nearest tenth and the standard deviation to the nearest tenth.
  Note: You can enter the number of passengers in L_1 and the frequency in L_2, and use 1-Var Stats.

- Using a normal distribution, make a second estimate of the probability that one or more passengers will be bumped.

3. The company has tracked the probability of a passenger being bumped from the airplane. The company found that on any given flight it happens 35% of the time. What is the probability that a passenger will be bumped from **both** the shuttle bus and the airplane in the same day?

4. The airline company is planning a network of flight paths between Edmonton and Rome. The airline has a limited number of cities to travel through. The cities and flight directions are pictured below.



- How many flight paths are possible between Edmonton and Rome?

- The airline decides that it is not economically feasible to use Greenland as a stopover on the way to Rome. How many flight paths are now possible from Edmonton to Rome?

- If the airline adds a direct flight from Calgary to London, then how many **more** routes from Edmonton to Rome are there, not including the stopover in Greenland?

5. One of the airline's airplanes requires a flight crew of 2 pilots and 2 flight attendants. For this airplane, the company has Jackie and 3 others who can act as pilots and 10 flight attendants to choose from.

- How many different flight crews are possible?

- How many different flight crews are possible if the airline designates them as pilot, co-pilot, flight attendant, and assistant flight attendant?

- If Jackie was preselected as one of the pilots, then how many flight crews of 2 pilots and 2 flight attendants are possible?

Part C

1. Research the reasons airlines overbook their flights, and briefly discuss your findings.

2. What type of compensation do passengers receive when they are bumped from a flight?

3. Name another industry that follows the practice of overbooking, and explain why it may benefit the industry and what problems it may cause.

The following web sites may help in your research.

Canadian Transport Agency
www.cta-otc.gc.ca
www.ttgweb.com/cms/11.html

Note: Web-site addresses sometimes change. If the web sites above are not available, use a search engine and type in key words such as "overbooking."