

MgtOp 470—Business Modeling with Spreadsheets
Washington State University
Spring 2020
Problem Set 6
Due: Midnight, Thursday, April 16, 2020

Please e-mail your completed files to gihan.mgtop470@gmail.com. This assignment may be completed in a group of up to four people. Please state in the email message the names of all persons turning in this assignment. Please put “MgtOp 470 Homework 6” followed by the name of the person who sent the email in the Subject of the email.

1. a. (35 points)

Judith Johnson is always on the lookout for entrepreneurial opportunities. Living in Six Mile, South Carolina, she recognizes that the nearest airport is 50 miles away. Judith estimates that, on average, there are about 45 people from Six Mile (and its vicinity) who need rides to or from the airport each day. To help them, Judith is considering leasing a 10-passenger van and offering a limousine service between Six Mile and the airport. There would be four trips per day: a morning trip and an evening trip to the airport, and a morning trip and an evening trip from the airport.

After researching the issue carefully, Judith sets some operating guidelines for her problem and estimates the following parameters for each trip:

- Reservations for a trip can be made up to 12 hours in advance, by paying a nonrefundable \$10 deposit. Judith will accept reservations up to her reservation limit (which this simulation model will help her decide).
- The ticket price is \$35 per passenger per trip. Passengers with reservations must pay the \$25 balance at the start of the trip.
- The number of reservations requested each trip follows a discrete uniform distribution between 7 and 14. Judith will, of course, reject a reservation request if she has reached her reservation limit.
- The probability that a person with a reservation shows up for the trip is 0.80. In other words, 20% of people with reservations do not show up. Anyone who does not show up forfeits the \$10 deposit.
- If the number of passengers who show up exceeds 10 (the passenger capacity of the van), alternate arrangements must be made to get these extra people to the airport. This will cost Judith \$75 per person. That is, Judith will lose \$40 ($=\$75 - \$35$) per overbooked person.
- The number of walk-up passengers (i.e., passengers without reservations) for a trip has the following discrete general distribution: probability of zero walk-ups is 0.30, probability of one walk-up is 0.45, and probability of two walk-ups is 0.25. Judith does not anticipate that there will ever be more than two walk-ups per trip.
- Walk-up passengers pay \$50 per trip. However, Judith does not have to make alternate arrangements for these passengers if her van is full.
- The total cost per trip (to or from the airport) to Judith is \$100. Note that due to the possibility of walk-up passengers on the return trip, Judith has to make a trip to the airport even if she has no passengers on that trip.

Judith wants to find out how many reservations she should accept in order to maximize her average profit per trip. Specifically, she is considering accepting 10, 11, 12, 13, or 14 reservations.

Using a sample size of 200, create a simulation using a Data Table to track both the profit and the occupancy rate for a given number of accepted reservations. *Hint: Your data table will effectively be recalculating the random numbers 200 times. Have the first column of the data table simply be the experiment numbers (1–200). Have the “Column input cell:” of your data table reference any empty cell in the spreadsheet.*

Please consider setting up your spreadsheet according to the template shown below. Note that rows 24 through 202 are hidden in this picture. *Hints: There are three random variables in this problem—(1) reservations requested, (2) number with reservations who show up, and (3) number of walk-up customers. (1) Use the RANDBETWEEN function to simulate reservations requested. (2) The number of reservations who show up can be modeled as a binomial distribution where the number of independent events (n) corresponds to the number of people with reservations (cell B5), and the probability of success in each event (p) is the probability the person will actually show up (cell G6). Use the CRITBINOM function, where the first argument is n, the second argument is p, and the third argument just generates a random probability: RAND(). (3) Finally, the number of walkup customers can be modeled using the LOOKUP function, where the first argument is a random probability, RAND(), the second argument is column F from the Walk-up Distribution table, and the third argument is column D from the Walk-up Distribution table.*

	A	B	C	D	E	F	G	H	I	J	K
1	Judith's Limousine Service								Data Table		
2											
3	Judith's reservation limit	14		Van's passenger capacity =			10		Run	Profit	Occ rate
4	Reservations requested	9		Minimum reservation request =			7		1	\$190	80.0%
5	Reservations accepted	9		Maximum reservation request =			14		2	\$190	100.0%
6	Number show up	8		Probability person shows up			0.80		3	\$225	80.0%
7	Number overbook	0		Reservation deposit amount =			\$10		4	\$185	70.0%
8	Seats remaining	2		Balance of ticket price =			\$25		5	\$245	90.0%
9	Number walk-up	0		Walk-up ticket price =			\$50		6	\$190	100.0%
10	Walk-up accepted	0		Cost per overbooked person =			\$75		7	\$240	100.0%
11	Total seats occupied	8		Fixed cost per trip =			\$100		8	\$210	80.0%
12	Revenue	\$290							9	\$120	60.0%
13	Cost	\$100		Walk-up Distribution					10	\$190	100.0%
14	Profit	\$190		Number	Probability	RN intvl LL	RN intvl UL		11	\$240	100.0%
15	Occupancy rate	80.0%		0	0.30	0.00	0.30		12	\$195	80.0%
16				1	0.45	0.30	0.75		13	\$230	100.0%
17				2	0.25	0.75	1.00		14	\$270	100.0%
18									15	\$215	80.0%
19				Based on 200 replications:					16	\$120	60.0%
20				Average profit =			\$216.30		17	\$185	70.0%
21				Average occupancy rate =			85.9%		18	\$175	70.0%
22									19	\$210	80.0%
23									20	\$190	100.0%
203									200	\$285	100.0%

Note: You will be entering formulas into the following cells: B4:B15, G20:G21, and J4:K4. The Data Table fills in cells J5:K203. All other numbers you can enter manually.

b. (5 points)

Use Excel's Scenario Analysis to run the simulation (with 200 replications each) for the five reservation levels that Judith is considering: 10, 11, 12, 13, or 14. Have Scenario Analysis report the average profit and the average occupancy rate of each policy. Which policy appears to be best? (Please type your answer to this somewhere on the Scenario Summary sheet.)

2. (4 points)

On a new sheet, use Excel's Random Number Generator to generate daily customer arrivals for 20 days in a row according to a Poisson distribution with an average of 200 customers per day. Use a starting seed of 45.

3. (6 points)

- a. Enter set of profit values below into a new sheet. Using Excel's risk analysis formulas to estimate the probability that profit will be greater than \$85,000.
- b. Create a histogram chart of the profit values below. Use bins of \$0, \$20,000, \$40,000, \$60,000, \$80,000, and \$100,000.

\$54,765
\$105,623
\$99,713
\$14,000
-\$965
-\$3,487
\$45,000
\$84,512
\$88,006
\$64,000
\$8,554
\$15,426
\$29,864
\$27,543
\$35,812
\$36,351
\$48,216