Homework #1

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Management Science

1. **A. Crucial information before we start analyzing the problem:**

Rental cost	₩2,000,000
Print and Gift cost (/person)	₩2,400
Revenue (/order)	₩35,000
Margin rate	40%
Purchase rate	35%

In order to figure out the break even point, we need to figure out when **revenue-cost=0**

a. Figuring out the cost

We have a fixed cost of ₩2,000,000 and a variable cost of ₩2,400 which means total cost would be ₩2,000,000+ ₩2,400* number of customer which can be labled as =$B$3+$B$4*B11 in the formula assuming B11 is the number of customer,$B$3 the fixed cost, and $B$4 the variable cost.

b. Figuring out the revenue

Now for every customer, there is a purchase rate of 35%, and each order on average brings in about ₩35,000 with a 40% margin. This can be expressed by number of customer* 0.35* ₩35,000* 0.40 which in the model we'll express it by =B11*$B$7*$B$5*$B$6

c. Creating a model

Lets create an model to solve by enumerating the number of customer. Inserting the cost formula, revenue formula and subtracting the two values will give us profit. Modeling this would like:

1. Solution by Enumeration				
Model	Number of Customers	Cost	Revenue	Profit
	500	₩3,200,000	₩2,450,000	(₩750,000)
	550	₩3,320,000	₩2,695,000	(₩625,000)
	600	₩3,440,000	₩2,940,000	(₩500,000)
	650	₩3,560,000	₩3,185,000	(₩375,000)
	700	₩3,680,000	₩3,430,000	(₩250,000)
	750	₩3,800,000	₩3,675,000	(₩125,000)
Break Even point	800	₩3,920,000	₩3,920,000	₩0
	850	₩4,040,000	₩4,165,000	₩125,000
	900	₩4,160,000	₩4,410,000	₩250,000
	950	₩4,280,000	₩4,655,000	₩375,000
	1000	₩4,400,000	₩4,900,000	₩500,000

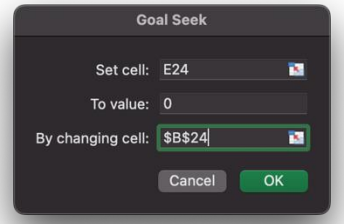
Formula

	Go-Qual Coffee			
Rental cost	2000000			
Print and Gift cost (/person)	2400			
Revenue (/order)	35000			
Margin rate	0.4			
Purchase rate	0.35			
1. Solution by Enumeration				
Model	Number of Customers	Cost	Revenue	Profit
	500	=$B$3+$B$4*B11	=B11*$B$7*$B$5*$B$6	=D11-C11
	550	=$B$3+$B$4*B12	=B12*$B$7*$B$5*$B$6	=D12-C12
	600	=$B$3+$B$4*B13	=B13*$B$7*$B$5*$B$6	=D13-C13
	650	=$B$3+$B$4*B14	=B14*$B$7*$B$5*$B$6	=D14-C14
	700	=$B$3+$B$4*B15	=B15*$B$7*$B$5*$B$6	=D15-C15
	750	=$B$3+$B$4*B16	=B16*$B$7*$B$5*$B$6	=D16-C16
Break Even point	800	=$B$3+$B$4*B17	=B17*$B$7*$B$5*$B$6	=D17-C17
	850	=$B$3+$B$4*B18	=B18*$B$7*$B$5*$B$6	=D18-C18
	900	=$B$3+$B$4*B19	=B19*$B$7*$B$5*$B$6	=D19-C19
	950	=$B$3+$B$4*B20	=B20*$B$7*$B$5*$B$6	=D20-C20
	1000	=$B$3+$B$4*B21	=B21*$B$7*$B$5*$B$6	=D21-C21

And we can find that the break even point is 800 customers by using enumeration.

Solving with Goal Seek

We can use the same formulas as we did for enumeration. I just copied a row and used the goal seek function to set the cell of profit to value 0 by changing the cell for the number of



customers. Doing so will give us 800 customers.

2. Solution by Goalseek	Number of Customers	Cost	Revenue	Profit
	800	₩3,920,000	₩3,920,000	₩0

2. Solution by Goalseek	Number of Customers	Cost	Revenue	Profit
	800	=$B$3+$B$4*B24	=B24*$B$7*$B$5*$B$6	=D24-C24

Obtaining via algebra

This is essentially a revenue-cost =0 equation. Simply by plugging the constants, we can find X, which is the number of customers. Doing so, the equation would like (x*0.40*0.35*35,000)-(2,000,000+x*2400)=0 which can be simplified as 2500x- 2,000,000=0 which would give us 800 customers

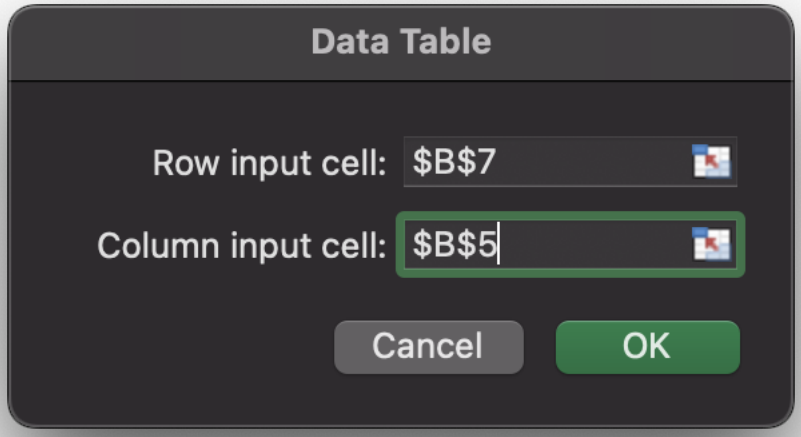
1.b

To conduct a sensitivity analysis by using a two way data table, we first need an anchor equation to tell us the break even point. By shifting the equation shown above in the 'algebra' section, we can get an

equation of x= 2,000,000/((order*margin*purchaserate)- printcost). We then label the columns and rows with the given purchase rates and average order sizes like such:

BE Point:	800	26000	29000	32000	35000	38000	41000
Average order size	25%	10000	4000	2500	1818.182	1428.571	1176.471
	30%	2777.777778	1851.851852	1388.888889	1111.111	925.9259	793.6508
	35%	1612.903226	1204.819277	961.5384615	800	684.9315	598.8024
	40%	1136.363636	892.8571429	735.2941176	625	543.4783	480.7692
	45%	877.1929825	709.2198582	595.2380952	512.8205	450.4505	401.6064

Then we can use the data table function under what if analysis and set the row & column input cells as cells that indicate purchase rates and revenues and we are given an analysis of all break even points.



Formula:

BE Point:	=$B53/(($B56*$B57*$B55)-$B54)	26000	29000	32000	35000	38000	41000
Average order size	0.25	=TABLE(B7,B5)	=TABLE(B7,B5)	=TABLE(B7,B5)	=TABLE(B7,B5)	=TABLE(B7,B5)	=TABLE(B7,B5)
	0.3	=TABLE(B7,B5)	=TABLE(B7,B5)	=TABLE(B7,B5)	=TABLE(B7,B5)	=TABLE(B7,B5)	=TABLE(B7,B5)
	0.35	=TABLE(B7,B5)	=TABLE(B7,B5)	=TABLE(B7,B5)	=TABLE(B7,B5)	=TABLE(B7,B5)	=TABLE(B7,B5)
	0.4	=TABLE(B7,B5)	=TABLE(B7,B5)	=TABLE(B7,B5)	=TABLE(B7,B5)	=TABLE(B7,B5)	=TABLE(B7,B5)
	0.45	=TABLE(B7,B5)	=TABLE(B7,B5)	=TABLE(B7,B5)	=TABLE(B7,B5)	=TABLE(B7,B5)	=TABLE(B7,B5)

2.

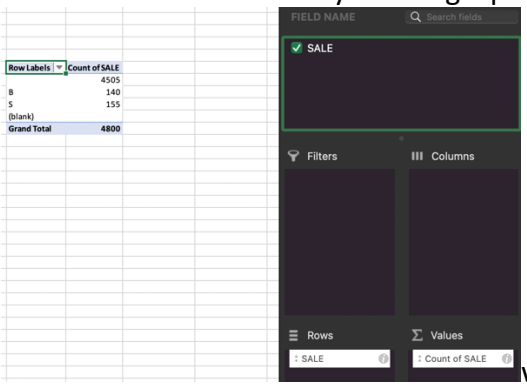
a. **How many records are in this dataset?**
4800, by selecting one column of the data set we can see that the count is:
Count: 4801 since the first row is for labels, we can claim that there are 4800 records.

b. **How many fields are in this dataset?**

14, pressing the row would give us 

c. Is the field "SALE" nominal or numerical?

Sale is nominal because by creating a pivot table



we can conclude that this data field only consists of B, S and blanks which are nominal values.

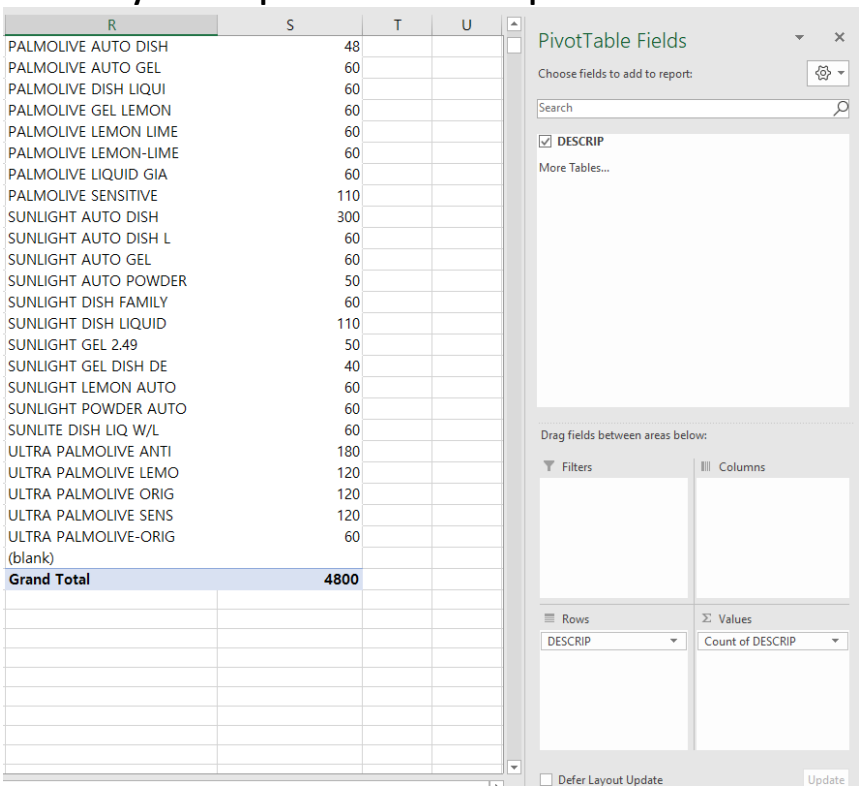
d. Which field contains blank cells, and how many does it contain?

Sales field contains blank cells and according to the pivot table above, 4505cells are blank.

e. What is the highest price in the dataset?

By selecting the entire data set and sorting them from largest to lowest for the column K, we get that the "CASCADE POWDER" are the highest prices.

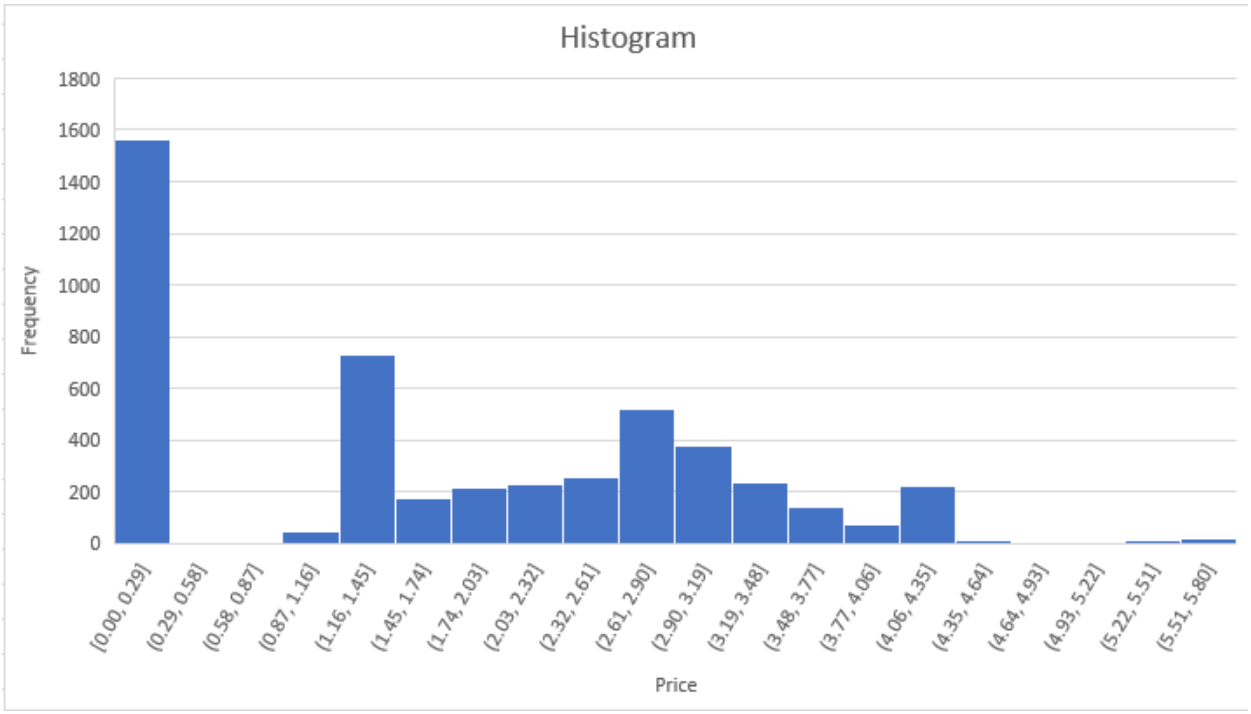
f. How many records pertain to the description "SUNLIGHT GEL 2.49"?



R	S	T	U
PALMOLIVE AUTO DISH	48		
PALMOLIVE AUTO GEL	60		
PALMOLIVE DISH LIQUI	60		
PALMOLIVE GEL LEMON	60		
PALMOLIVE LEMON LIME	60		
PALMOLIVE LEMON-LIME	60		
PALMOLIVE LIQUID GIA	60		
PALMOLIVE SENSITIVE	110		
SUNLIGHT AUTO DISH	300		
SUNLIGHT AUTO DISH L	60		
SUNLIGHT AUTO GEL	60		
SUNLIGHT AUTO POWDER	50		
SUNLIGHT DISH FAMILY	60		
SUNLIGHT DISH LIQUID	110		
SUNLIGHT GEL 2.49	50		
SUNLIGHT GEL DISH DE	40		
SUNLIGHT LEMON AUTO	60		
SUNLIGHT POWDER AUTO	60		
SUNLITE DISH LIQ W/L	60		
ULTRA PALMOLIVE ANTI	180		
ULTRA PALMOLIVE LEMO	120		
ULTRA PALMOLIVE ORIG	120		
ULTRA PALMOLIVE SENS	120		
ULTRA PALMOLIVE-ORIG	60		
(blank)			
Grand Total	**4800**		

by setting the pivot table as the Count of Description, we can tell that there are 50 records that pertain to “SUNLIGHT GEL 2.49”

g. Create a histogram of the “PRICE“ variable and interpret it.



This histogram tends to follow the normal distribution with quite a few outliers. The biggest outlier is that there are quite a lot of products that cost 0 therefore the mode is between 0.00-0.29. Another outlier is between 1.16-1.45 mark.

h. What is the average price?

Using Descriptive Statistics in data analysis and selecting the Price range,

Column1	
Mean	1.694052
Standard Error	0.020205
Median	1.55
Mode	0
Standard Deviation	1.399835
Sample Variance	1.959537
Kurtosis	-1.04106
Skewness	0.162002
Range	5.79
Minimum	0
Maximum	5.79
Sum	8131.45
Count	4800
Largest(1)	5.79
Smallest(1)	0

we get the following data. Mean is approximately 1.694

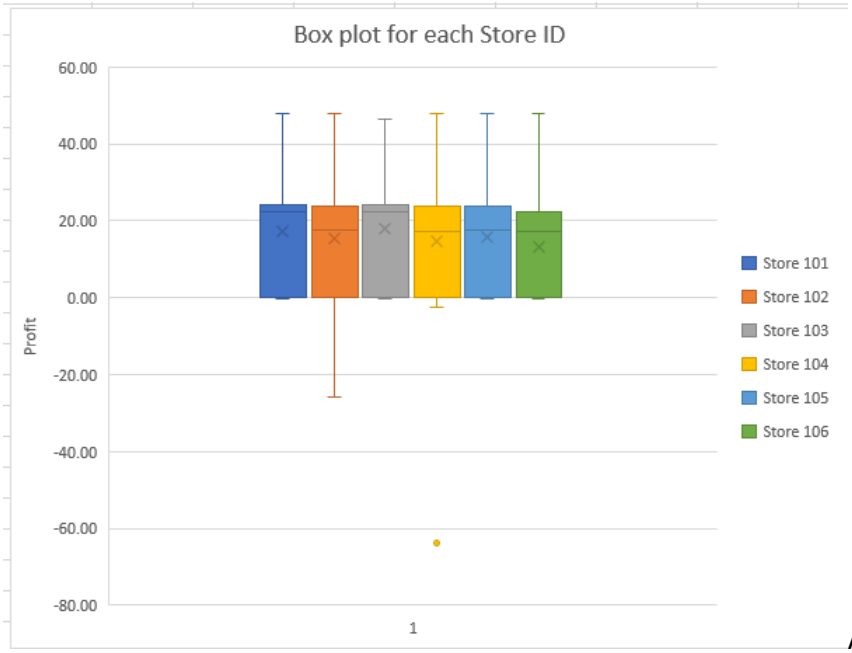
i. What is the 88th percentile value of the variable PRICE?

Selecting the Price array and using the excel formula ‘=percentile .inc(selection array, 0.88)’ we get 3.29.

j. Are higher priced products generally more profitable? Examine the correlation between the two.

Looking at the scatter plot and adding a line of best fit, we can sort of see that there is a positive correlation between higher priced goods and profitability. Analyzing the data by "correlation" also gives us approximately 0.740447 which we can state that the two data seems highly correlated.

k. Does profit vary systematically across stores? Examine by showing a boxplot.



After creating a new pivot table with stores as columns and each respective profitability listed aterwards, we create a

boxplot which shows that there is no significant variance in profit between the stores. Only thing alittle bit different is that store 102 has a longer tail, which indicates their negative profits.

l. In week 387, which stores had average profit over $18?

Average of PROFIT	Column Labels									
Row Labels	(blank)	-63.96--53.96	-33.96--23.96	-3.96-6.04	6.04-16.04	16.04-26.04	26.04-36.04	36.04-46.04	46.04-56.04	Grand Total
100				0.056303502	12.02846154	22.79991329	30.91195804	40.1437931	47.92	17.39244304
101			-25.77	0.043117409	11.938	19.62191646	30.04804878	40.56058824	47.92	15.55584975
102				0.058438819	11.55454545	22.3730163	30.99158537	40.76047619	46.285	17.93945205
103		-63.96		0.06252669	12.46357143	19.52637602	30.11598425	40.16052632	47.92	14.76929716
104				0.049358974	12.16083333	19.47258065	30.33716535	40.1325	47.175	15.71503277
105				0.033175074	12.24352941	19.56907781	30.08619048	39.23428571	47.92	13.11332521
(blank)										
Grand Total		**-63.96**	**-25.77**	**0.049761456**	**12.08658537**	**20.52950159**	**30.46329531**	**40.20793103**	**47.48727273**	**15.73151458**

After filtering out all the other weeks except week 387 by using the filter function, we create a pivot table with profit and store id. Then we change the value as the average of profit. By taking a look at the grand total, we can tell that no stores had an average profit over $18.

3. Your neighbor is wondering whether the average price of the products from CASCADE is different from the average price of the products from DAWN. Use the data in the “Q3” worksheet and conduct a hypothesis test to give her your advice.
a. What are the null hypothesis and alternative hypothesis?

Null hypothesis is there is no difference between the average price of CASCADE products and DAWN products and alternative hypothesis is that there is a diffence between the average prices of two products.

b. What is the difference in average price?

After filtering only to CASCADE and using formula =SUBTOTAL(1,Table3[PRICE]), we can get an average price of 3.301. Next filtering only DAWN and using the same formula gives us 2.21. Therefore the difference between the average prices is 1.089876.

c. Compute the z-statistic and p-value.

z-Test: Two Sample for Means		
	PRICE	PRICE
Mean	2.211401709	3.301278
Known Variance	0.718514	0.615004
Observations	585	446
Hypothesized Mean Di	0	
z	-21.34485574	
P(Z<=z) one-tail	0	
z Critical one-tail	1.644853627	
P(Z<=z) two-tail	0	
z Critical two-tail	1.959963985	

The P value is approximately 0 and Z value is -21.3448.

d. What is your conclusion if you use 0.01 as the level of significance? Explain your answer

We reject the Null hypothesis because p value is very small and it means the difference between the average price is very likely. If we rejected the null at 0.05, then that means if we take 0.01 as the level of significance we should also reject the null.

z-Test: Two Sample for Means		
	PRICE	PRICE
Mean	2.211401709	3.301278
Known Variance	0.718514	0.615004
Observations	585	446
Hypothesized Mean Di	0	
z	-21.34485574	
P(Z<=z) one-tail	0	
z Critical one-tail	2.326347874	
P(Z<=z) two-tail	0	
z Critical two-tail	2.575829304	