OMIS 327 Decision Analysis

Homework 1

Due Date: 3/1/23, Wednesday, 30mins before class on Blackboard

General Requirements

You should submit one Excel file including your answers and your model formulation. Your answer should be in the order of the questions, and should be neat, clearly written, and concise. Highlight your answers to the questions in yellow. No credit will be given if TA or I cannot easily find your answers.

There are **four** problems. Must put each problem in a different worksheet.

(i) Name each model worksheet by the problem #, for example, "Problem1", "Problem2".

(ii) Name your file by last name and homework number, for example, LastName _Homework1.xlsx.

Problem 1

A sample of eighteen universities was taken. The total cost for the year (including room and board) and the median SAT score at each school were recorded. It was felt that school with higher median SAT scores would have a better reputation and would charge more tuition as a result of that. The data are in the file named "HW1_Problem1_Data".

Answer the following questions based on the sample data.

a) Develop a regression model to predict the total tuition and fees based on SAT scores. show hand computation by showing all the computational steps. See "Lecture 2" slides 14-19. Do **NOT** use the Excel Regression function.

b) Use the model from part (a) to predict the total cost for a university with a median SAT score of 1900.

Make sure to retain all the formulas in the worksheet. If I cannot verify the formulas used and see static results only, a minimum 50% penalty will be applied.

Problem 2

A sample of 20 observation is collected. A linear regression model has been developed to predict Y, using X1, X2, X3 as independent variables. The regression output is present below.

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SUMMAR
Y OUTPUT

Regression Statistics	
Multiple R	0.933
R Square	***(h)***
Adjusted R Square	0.846
Standard Error	23.244
Observations	20

ANOVA

	df	*SS*	*MS*	*F*
Regression	***(a)***	***(c)***	***(d)***	***(f)***
Residual	16	8644.31	***(e)***	
Total	***(b)***	66839.75		

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	20.577	23.367	0.88	0.26
X1	2.442	0.537	4.55	0.0003
X2	0.489	0.489	1.00	0.3328
X3	-4.778	2.139	-2.23	0.0401

There is many missing information in the output report. Answer the following questions to fill in the blanks. **Must show detailed formulas and computations**. Providing the final results only will receive at least 50% penalty.

(a) What is the degrees of freedom of regression?
(b) What is the total degrees of freedom?
(c) What is the *SSR*?
(d) What is the *MSR*?
(e) What is the *MSE*?
(f) What is the *F* statistics?
(g) Test the model significance at the level of significance of 0.05. State the hull hypothesis and alternate hypothesis. What is the critical *F* value used? Can you reject the null hypothesis?
(h) What is the *R* square? Explain the *R* square in the context of this model.
(i) Determine if the *X1* variable is significant at the level of significance of 0.05. State the

hull hypothesis and alternate hypothesis. Can you reject the null hypothesis?

(j) Determine if the *X2* variable is significant at the level of significance of 0.05. State the hull hypothesis and alternate hypothesis. Can you reject the null hypothesis?

(k) Determine if the *X3* variable is significant at the level of significance of 0.05. State the hull hypothesis and alternate hypothesis. Can you reject the null hypothesis?

Problem 3

In August of the current year, a car dealer is trying to evaluate the monthly profitability. Below is information the car dealer observed based on historical data:

- The ordering cost of cars follows a triangular distribution, with a minimum cost of $5,000, a maximum cost of $17,000, and most likely to be $11,000.
- The monthly demand for the dealer's cars is normally distributed with mean of 50 and standard deviation of 10 (**use an excel function to round the sales quantity to the nearest integer**).
- Depending on the model and year, the dealer sets the selling price of each car following a uniform distribution between $8,000 and $30,000. Assume that there is no association between each car's ordering cost and selling price.
- In addition, the dealer expends $100,000 every month on the employees' salary.

(2) Build a profit model for this car dealer that incorporates the uncertainties in selling price, ordering cost, and sales quantity. (Hint: Use the Uncertain Profit example as a template, **BUT there are not exactly the same!** You need to use the corresponding formulas to simulate each variable.)

(3) Use Data Table function to generate 100 trials of profit. Copy these 100 random values, and in another blank cell in the same worksheet, paste in the values only.

(4) Use these 100 "frozen" values to report the Descriptive Statistics (output option: Summary Statistics), and percentiles. Provide a brief summary on the dealer's prospective profit.

Make sure to retain all the formulas in the worksheet. If I cannot verify the formulas used and see static results only, a minimum 50% penalty will be applied.

Problem 4

Billy's bank is the only bank in a small town in Arkansas. On a typical Friday, an average of 10 customers per hour arrives at the bank to transact business. Assume the arrivals follow a Poisson distribution. There is one single teller at the bank, and the average time required to transact business is 4 minutes. It is assumed that service times can be described by the exponential distribution. Calculate the following operating characteristics for this single-teller bank:

b) the average time a customer spends in the line.
c) the average number of customers in the line.
d) the average time a customer spends in the bank.
e) The average number of customers in the bank.
f) The probability that the bank is empty.
g) What is the probability that there are no more than 4 customers in the bank?
h) What is the probability that the teller is working with a customer?

Hint for (f): Probability of Event (#customer ≤ 4) = 1 - Probability of Event (#customer > 4)

For all questions, must show computational steps (e.g., the calculations are verifiable via checking the excel formulas). Providing only the final results will receive at least 50% penalty.