香港科技大學
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY
ISOM 2700: Operations Management

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ISOM 2700

Spring 2023
Operations Management

Homework Assignment #2

Due: 23:59 pm, March 8 (Monday), 2023

- Turn in your solutions to Canvas before the deadline (email Stacy imsdeng@ust.hk if that does not work). When uploading your solutions to Canvas, name it: HW2_LX_YourName.pdf where you replace YourName by your name, and replace LX by the session you attend.
- Homework assignments are to be done individually, and without the use of anyone else's solutions. You may obtain tips/tutorials from the internet, but soliciting help from others online or in person is not permitted. ChatGPT is not allowed. Cheating will strictly not be tolerated.
- Explain clearly how you derive your solutions. Your solutions will be graded for the clarity of your arguments, in addition to correctness of the final answer.

Session _____

SIS ID _____

Name _____

Problem 1 [20 pts]

Eric Wong operates a real estate agency in Hong Kong that specializes in selling properties that are hard to sell. He is approached by a client who has three properties to sell. The client indicates the prices he wishes to receive for these properties as follows:

Property	Price ($)
A	2,500
B	5,000
C	10,000

Eric would receive a commission of 4% on any of the properties he is able to sell.

The client has the following conditions:

"Eric, you have to sell the property A first. If you can't sell it within a month, the entire deal is off--no commission and no chance to sell the other properties. If you sell property A within a month, then I'll give you the commission for it and the option of (a) stopping at this point; or (b) trying to sell either B or C next under the same conditions (i.e., sell within a month or no commission on the second property and no chance to sell the third property). If you succeed in selling the first two properties, you will also have the option of selling the third.

After the client has left, Eric proceeds to analyze the proposal to determine whether or not to accept it. He figures his selling costs and his chances of selling each property at prices set by the client to be:

Property	Cost ($)	Probability of Sale
A	80	.7
B	20	.6
C	40	.5

He believes that sale of a particular property would not make it any more or less likely that the two remaining properties could be sold. Selling costs would have to be incurred whether or not a particular property is sold but could be avoided by deciding not to attempt to sell the property.

Do you think Eric should accept the project? Why or why not? Draw the decision tree and discuss.

Problem 2 [20 pts]

AA diet is being prepared for the University dorms. The objective is to feed the students at the least cost, but the diet must have between 1,800 and 3,600 calories. No more than 1,400 calories can be starch, and no fewer than 400 can be protein. The varied diet is to be made of two foods: A and B. Food A costs $0.75 per pound and contains 600 calories, 400 of which are protein and 200 starches. No more than two

pounds of food A can be used per resident. Food B costs $0.15 per pound and contains 900 calories, of which 700 are starch, 100 are protein, and 100 are fat.

Formulate a linear program that solves for the optimal diet plan with the least cost, and solve it using the graphical method. What's the optimal diet plan?

Problem 3 [60 pts]

Susan Jetson is a transportation planner for Briton Paper Company. Ms. Jetson needs to assign truck carriers for shipments of finished paper to different destinations. Truckloads of paper need to be delivered from Briton's paper mill to each of 5 destinations labeled a through e. The data for the problem is given in Table 1. Two truckloads of paper must be delivered to location a, four truckloads to location b, etc. Briton uses four carriers and each carrier has a limited number of available trucks. The rate table in Table 2 indicates the amount that each carrier charges per truckload, in $ per mile. If the resulting charge of the truckload is less than the carrier's minimum charge, the carrier must be paid at least the minimum charge for the delivery of that truckload. For example, if Ms. Jetson decides to use carrier 3 to ship one truckload to location a, the charge is $624. If she uses carrier 3 to ship one truckload to location e the charge is $500. (All trucks must leave this morning. Because of the travel time involved, a truck can ship to a single destination only.) The data for the minimum charges and the number of trucks available from each carrier appear in Table 3.

Table 1. *Destinations, Distances and Requirements*

	a	*b*	*c*	*d*	*e*
Distance from mill (miles)	600	1500	1200	3000	150
Requirements (truckloads)	2	4	3	5	5

Table 2. *Rate table* ($ per mile per truckload)

	a	*b*	*c*	*d*	*e*
Carrier 1	$1.48	$1.45	$1.47	$1.22	$1.26
Carrier 2	$1.76	$1.46	$1.79	$1.63	$1.43
Carrier 3	$1.04	$1.37	$1.26	$1.17	$1.18
Carrier 4	$1.38	$1.45	$1.59	$1.44	$1.56

Table 3. *Carrier Information*

Carrier #	*1*	*2*	*3*	*4*
Trucks available	5	6	6	5
Minimum Charge (per truckload)	$400	$500	$500	$500

In the past Ms. Jetson has made carrier assignments by hand, relying on her experience as a transportation planner for the last several years.

(a) Develop a spreadsheet model that Ms. Jetson could use to determine the cost-minimizing assignment of carriers to shipments. Define and give a brief explanation of the decision variables, objective function, and constraints. [10 pts]

Hint: Let $x_{i,j}$ represent the number of truck from carrier i assigned for shipment to destination j.

(b) Solve your model as a continuous linear program (that is, do not define any of the decision variables as integer) and generate the Solver Sensitivity Report. What is the optimal assignment of trucks to shipments? What is the corresponding cost? [10 pts]

(c) Suppose that Ms. Jetson could negotiate with one carrier to provide an additional truck. An additional truck from which carrier (1, 2, 3, or 4) would provide the biggest reduction in cost? Use the Solver Sensitivity Report to answer the question – do not rerun the model. Explain your answer. [10 pts]

(d) Ms. Jetson just received new information that 2 extra truckloads of paper are needed at destination a. Using the Solver Sensitivity Report, calculate the new optimal cost. Explain. [10 pts]

(e) Carrier 2 has decided to change its rate agreement with Briton paper. Carrier 2 will now charge only $1.46 per mile for going to destination a. Using the Solver Sensitivity Report determine whether this new rate will change the optimal allocation? Explain why or why not. [10 pts]

(f) Briton Paper has agreed to give carrier 2 at least 25% of its business each day (i.e., 25% of the total shipping cost). Modify the formulation from part (b) to accommodate this agreement. Specify the modification as a linear constraint and resolve the model including the changes from d) and e) above. What is the new allocation and new objective function? What additional requirement did you need to add to make the results realistic? [10 pts]

Hint: Check if the new formulation results in an integer solution.