IE 407 - FUNDAMENTALS OF OR | SPRING 2024

HOMEWORK 2

Due: 16.05.2024 23:59

GUIDELINE:

Please submit your work to the corresponding submission on ODTUClass. You may complete this homework assignment as a group comprising a maximum of two students.

Your submission should include:

1. *Homework report (.pdf file): Your report should include your model, results, and comments. It must be 5 pages at most. The format must adhere to Times New Roman font, size 12, and justified text alignment.*
2. *You should also submit the file of which software you use to solve the question (Excel, Pyomo, etc.). The file should include your model, solution, and sensitivity analysis results.*
3. *Your report should include a cover page including your names, surnames, and student ID numbers.*
4. *Make sure to organize your findings, data, and calculations neatly for easy review. Please submit a single compressed (.zip) file consisting all your documents.*

WateryCo. was founded to distribute drinkable packaged water by various brands, aiming to reach the entire region. The company opened 3 out-of-town warehouses and 5 distribution centers to provide service to 6 neighborhoods within the city. Transportation of products from warehouses to distribution centers costs \$0.03 per kilometer (per product). The deliveries from distribution centers to neighborhoods are carried by moto couriers and moto couriers are paid \$2.5 per kilometer (per delivery). The capacity of each warehouse is given in Table 1. The distances between each warehouse and distribution center are given in Table 2, and the average distances between an address within the neighborhoods and each distribution center are given in Table 3.

The moto couriers can carry one packaged water at a time. The average number of deliveries a moto courier can distribute in a month is 450. The numbers of moto couriers at each distribution center are given in Table 4.

The estimated monthly demand of each neighborhood is given in Table 5.

a) Model and solve the problem to find the minimum cost of serving neighborhoods.

b) Suppose that there is a monthly fixed cost of operating each warehouse and distribution center. The related information is given in Table 6. Besides, the monthly salary of a moto

courier is $2350, which should be included if a distribution center operates. Model and solve the problem again to find the optimal serving plan.

c) After negotiation, the moto couriers in distribution center 1 agreed to be paid $1 less per kilometer (per delivery), which decreases payment per kilometer (per delivery) from $2.5 to $1.5 after the total number of deliveries to a neighborhood exceeds 2500 within a month. Model and solve the problem again to find the optimal serving plan.

Table 1.

	Capacities
Warehouse 1	23000
Warehouse 2	11500
Warehouse 3	28000

Table 2.

	Distribution Center 1	Distribution Center 2	Distribution Center 3	Distribution Center 4	Distribution Center 5
Warehouse 1	13 km	17 km	11 km	13 km	16 km
Warehouse 2	7 km	13 km	5 km	9 km	11 km
Warehouse 3	20 km	10 km	8 km	15 km	9 km

Table 3.

	Neighborhood 1	Neighborhood 2	Neighborhood 3	Neighborhood 4	Neighborhood 5	Neighborhood 6
Distribution Center 1	1 km	4 km	3 km	3 km	2.5 km	6 km
Distribution Center 2	3 km	2.7 km	5 km	7 km	2 km	3 km
Distribution Center 3	4 km	8 km	2 km	3 km	1.5 km	6 km
Distribution Center 4	3 km	1.6 km	3.4 km	2 km	5 km	4 km
Distribution Center 5	2 km	3 km	3.5 km	6 km	8 km	3.4 km

Table 4.

	Numbers of Moto Couriers
Distribution Center 1	15
Distribution Center 2	20
Distribution Center 3	18
Distribution Center 4	12
Distribution Center 5	25

Table 5.

	Monthly Demand
Neighborhood 1	5000
Neighborhood 2	7000
Neighborhood 3	4000
Neighborhood 4	6000
Neighborhood 5	8000
Neighborhood 6	3000

Table 6.

	Operating Costs (in thousands)
Warehouse 1	$130
Warehouse 2	$106
Warehouse 3	$170
Distribution Center 1	$46
Distribution Center 2	$30
Distribution Center 3	$26
Distribution Center 4	$18
Distribution Center 5	$64