University of Dhaka

Department of Applied Mathematics

Fourth Year B.S. (Honors), Academic Session: 2023-2024

Course Title: Math Lab IV (Application Software), Course Code: AMTH 450

Assignment No.: 4 (Real-life Applications of Optimization Techniques)

Name:	**Roll No.:**	**Group:**

Instruction: *Write appropriate programming codes using* ***Python*** *to get the outputs of each of the following problems and hence visualize them properly.*

1. Use graphical method to solve the following linear programming problem:

$$\text{Maximize } Z = 2x_1 + x_2 .$$

$$\text{Subject to } x_1 + 2x_2 \le 10$$

$$x_1 + x_2 \le 6,$$

$$x_1 - x_2 \le 2,$$

$$x_1 - 2x_2 \le 1,$$

$$x_1, x_2 \ge 0.$$

2. A person wants to decide the constituents of a diet which will fulfill his daily requirement of proteins, fat, and carbohydrates at the minimum cost. The choice is to be made from four different types of foods. The yields per unit of these foods are given in the following table.

Food type	**Yield per unit**			**Cost per unit (in BDT)**
	Proteins	**Fat**	**Carbohydrates**	
1	3	2	6	45
2	4	2	4	40
3	8	7	7	85
4	6	5	4	65
Minimum requirement	800	200	700	

Formulate a linear programming model for the aforementioned problem and solve.

3. Three grades of coal A, B, and C contain phosphorous and ash as impurities. In a particular industrial process, fuel up to 100 ton (maximum) is required which should contain ash not more than 3% and phosphorous not more than 0.03%. It is desired to maximize the profit which satisfying these conditions. There is an unlimited supply of each grade. The percentage of impurities and profits of grades are given in the following table.

Coal	Phosphorous (%)	Ash (%)	Profit in BDT per ton
A	0.02	3	12
B	0.04	2	15
C	0.03	5	14

Now, find the proportions in which the three grades be used applying **simplex method**.

4. A diet for a sick person must contain at least 4000 units of vitamins, 50 units of minerals, and 1400 units of calories. Two food A and B are available at a cost of BDT. 4 and BDT. 3 per unit, respectively. It is known that one unit of food A contains 200 units of vitamins, 1 unit of mineral, and 40 units of calories and on the other hand one unit of food B contains 100 units of vitamins, 2 units of minerals, and 40 units of calories. Find the minimum cost of food mix using the Big-M method.

5. Find the basic feasible solution of the following transportation problem by:

(i). North – West Corner Rule

(ii). Least Cost Method

	P	Q	R	S	T	Available
A	4	3	1	2	6	80
B	5	2	3	4	5	60
C	3	5	6	3	2	40
D	2	4	4	5	3	20
Required	60	60	30	40	10	200 (Total)

6. A company has factories F_1, F_2, and F_3 which supply to warehouses W_1, W_2, and W_3. Weekly factory capacities are 200, 160, and 90 units, respectively. Weekly warehouse requirements are 180, 120, and 150 units, respectively. Unit shipping costs (in BDT) are as follows:

From \ To		Warehouse			Supply
		W_1	W_2	W_3	
Factory	F_1	16	20	12	200
	F_2	14	8	18	160
	F_3	26	24	16	90
Demand		180	120	150	

Determine the optimal solution using MODI method.

7. A company has a team of four salesmen and there are four cities where the company wants to start its business. After considering the capabilities of salesmen and the nature of the cities, the company estimates that the profit per day in BDT. for each salesman in each city is as below.

		City			
		1	**2**	**3**	**4**
Salesman	**A**	16	10	14	11
	B	14	11	15	15
	C	15	15	13	12
	D	13	12	14	15

Find the assignment of salesmen to various cities which will yield maximum profit.

8. Find the best strategy and the value of the following 3×3 game:

		Player A			
		I	**II**	**III**	
Player B	**I**	-1	-2	8	-2
	II	7	5	-1	-1
	III	6	0	12	0
		7	5	12	