FACULTY OF MANAGEMENT STUDIES
UNIVERSITY OF DELHI
MBA FT - November, 2022
6102: Data Analysis & Decision Tools

Max. Marks: 70

Time: 3 hours

Answer any *FIVE* questions selecting at-least TWO questions from each group

Section A

1. (a) Consider the following two LP formulations. Using a graphical approach in each case, determine

(i) Which formulation does have more than one optimal soluton?

(ii) Which formulation has an unbounded solution? In which direction the solution is unbounded?

Formulation 1

Max Z = 2x1 + 4x2
Subject to
x1 + 2x2 <= 5
x1 + x2 <= 4
x1, x2 >= 0

Formulation 2

Max Z = 2x1 + x2
Subject to
x1 - x2 <= 10
2x1 <= 40
x1, x2 >= 0

(b) Write the dual of the following problem:

Max $Z = 5X_1 + 6X_2$
Subject to

$X_1 + 2X_2 = 5$
$-X_1 + 5X_2 >= 3$
$4X_1 + 7X_2 <= 8$
X_1 unrestricted, $X_2 >= 0$

(8+6 = 14)

2. (a) A production manager wants to determine how many units of each product to produce weekly to maximize weekly profits. Production requirements for the products are shown in the following table.

Product	Material 1 (lbs.)	Material 2 (lbs.)	Labor (hours)
A	3	2	4
B	1	4	2
C	5	none	3.5

Material 1 costs $7 a pound, material 2 costs $5 a pound, and labor costs $15 per hour. Product A sells for $101 a unit, product B sells for $67 a unit, and product C sells for $97.50 a unit. Each week there are 300 pounds of material 1; 400 pounds of material 2; and 200 hours of labor. Moreover, there is a standing order of 10 units of product C each week.

Sensitivity Report

Adjustable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
B4	Optimal Values: A	0	-10	10	10	1E+30
C4	Optimal Values: B	82.5	0	10	1E+30	4.285
D4	Optimal Values: C	10	0	10	7.5	1E+30

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H.S. Side	Allowable Increase	Allowable Decrease
E7	Constraint 1	132.5	0	300	1E+30	167.5
E8	Constraint 2	330	0	400	1E+30	70
E9	Constraint 3	200	5	200	35	165
E10	Constraint 4	10	-7.5	10	47.142	10

Constraint 1: Material 1
Constraint 2: Material 2
Constraint 3: Labour hours
Constraint 4: Standing order of C

Answer the following questions:

(i) What is the optimal value of the objective function?

(ii) Suppose that we force the production of one unit of product A. What will be the value of new objective function?

(iii) Suppose that the production manager procures an additional 10 labor hours. What impact will this have on the current optimal objective function value?

(iv) Suppose the standing order of C increases by 40 units? What impact it will have on the objective function value?

(b) A small trucking company is determining the composition of its next trucking job. The load master has his choice of seven different types of cargo, which may be loaded in full or in part. The specifications of the cargo types are shown in the following table. The goal is to maximize the amount of freight in terms of dollars for the trip. The truck can hold up to 900 pounds of cargo in a 2500 cubic foot space.

Cargo type	Freight per pound	Volume per pound (cu.ft.)	Pounds available
A	$8.00	3.0	210
B	$6.00	2.7	150
C	$3.50	6.3	90
D	$5.75	8.4	120
E	$9.50	5.5	130
F	$5.25	4.9	340
G	$8.60	3.1	250

Formulate the above problem as a linear programming problem. You are not required to find out solution to the above problem. (8+6 = 14)

3. (a) Laurence County has six communities that need to be served by fire stations. The number of minutes it takes to travel between the communities is shown in the following table. The county would like to establish the minimum number of fire stations so that each community can get a response in five minutes or less. How many stations will be needed, and what communities will each station serve?

	A	B	C	D	E	F
A	-	4	6	3	5	8
B		-	4	10	6	5
C			-	9	3	5
D				-	6	3
E					-	10

Formulate the above problem as an integer linear programming problem. You are not required to find out the solution to the above problem.

(b) The Central Police Department has five detective squads available for assignment to five open crime cases. The Chief of detective wishes to assign the squads so that the total time to conclude the cases is minimized. The average number of days, based on past performance, for each squad is shown in the following table.

	Case				
Squad	A	B	C	D	E
1	27	7	3	7	14
2	30	6	12	7	20
3	21	5	4	3	10
4	21	12	7	12	8
5	8	26	24	25	13

Find the optimal assignment of detective squads to crime cases that will minimize the total time. Use Hungarian method of assignment to find out the optimal assignment.

(6+8 = 14)

4. (a) A company has decided to initiate the production of some or all of the four new products at 3 branch plants with excess production capacity. The available capacities in the three plants are 40, 50 and 30 units per week while the demand for the four products is 50, 30, 40 and 20 units respectively. Plant B cannot produce product 2. The cost per unit of production in the plants are given in the following table:

Costs per unit of production

		Products			
		1	2	3	4
Plants	A	3	6	5	2
	B	4	-	5	4
	C	3	4	4	4

Formulate the above problem and find out the initial basic feasible solution with the help of Vogel's Approximation Method.

(b) Define the following terms as obtained from the Excel solver output

(i) Binding constraint

(ii) Non-binding constraint

(iii) Shadow price and

(iv) Reduced cost

(8+6 = 14)

Section B

5. The raw data displayed below are the observations on the number of cases of distress violent victimization among young adolescents reported in 35 cities in the year 2007.

36	54	51	49	30	43	40	46
35	40	52	57	51	40	40	45
40	60	20	25	50	40	65	58
43	59	49	55	30	33	60	30
46	65	28					

(a) Construct a frequency distribution using the above data.

(b) Make a Histogram from your frequency table. Would you say this distribution is best described as symmetric or skewed?

(c) Find mean, median, variance and coefficient of variation for the above data.

(14)

6. (a) State Bank of India reviews its credit card policy with the intention of recalling some of its credit cards. The data shows that approximately 7.9% of cardholders defaulted in the past, leaving the bank unable to collect outstanding balances. The bank also found that the probability of missing a monthly payment is 0.26 for customers who do not default. Of course, the probability of missing a payment for those who default is 1.

(i) What is the probability that the customer will default if he missed a monthly payment?

(ii) The bank would like to recall its card if the probability that a customer will default is greater than 0.26. Should the bank recall its card if the customer misses a monthly payment. Why or not Why??

(b) A vending machine automatically pours soft drinks into cups. The amount of soft drink dispensed into a cup is normally distributed with mean 7.6 oz and standard deviation 0.4 oz.

(i) Estimate the probability that the machine will overflow an 8 oz cup

(ii) Estimate the probability that the machine will not overflow an 8 oz cup

(iii) The machine has just been loaded with 850 cups. How many of these do you expect will overflow when served?

(14)

7. (a) The Aditya Birla Sun Life AMC Limited is in the business of making bids on investments offered by various firms that desire additional financing. The company has collected the following data on yearly investments and interest rates

Year:	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Yearly Investments: (thousands of dollars)	1080	930	940	1120	1790	2150	2270	2130	1980	1620
Average Interest rates: (%)	5.8	6.1	6.9	7.2	5.7	4.7	4.7	5.5	5.9	7.2

Is the relationship between these variables significant? If the average interest rate is 5.6% five years from now, can yearly investment be forecast?

(b) Newspapers in India are complaining that rising level of Unemployment is affecting the level of crime in the country. To study this claim; a research team studied a random sample of 12 States in the country. For each state they measured the level of unemployment rate and the crime rate in the state. Then they did a ranking X=level of unemployment, Y=crime rate, the results are shown in the following table. Higher X ranks mean more unemployment, and higher Y ranks mean higher crime rate. Test the claim of Newspapers.

States:	1	2	3	4	5	6	7	8	9	10	11	12
Level of X : Unemployment	4	9	3	2	6	1	11	12	7	5	8	10
Crime Rate Y :	9	7	8	12	6	11	3	1	5	10	4	2

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