

PGDM, 2018  
Management Science  
DM205

Trimester – II, End-Term Examination: Dec 2018

Time allowed: 2 hrs 30 min

Max Marks: 50

Roll No: \_\_\_\_\_

**Instruction:** Students are required to write Roll No on every page of the question paper, writing anything except the Roll No will be treated as **Unfair Means**. In case of rough work please use answer sheet.

**Section - A**

**Attempt any 3 out of 5 questions from this section. Each question carries 5 marks .**

Question 1 It is important to understand the assumptions underlying the use of any quantitative analysis model. What are assumptions and requirements for an LP model to be formulated and used?

Question 2 CarpetPlus sells and installs floor covering for commercial buildings. Brad Sweeney, a CarpetPlus account executive, was just awarded the contract for five jobs. Brad must now assign a CarpetPlus installation crew to each of the five jobs. Because the commission Brad will earn depends on the profit CarpetPlus makes, Brad would like to determine an assignment that will minimize total installation costs. Currently, five installation crews are available for assignment. Each crew is identified by a color code, which aids in tracking of job progress on a large white board. The following table shows the costs (in hundreds of dollars) for each crew to complete each of the five jobs.

	<b>Job</b>				
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>Red</b>	30	44	38	47	31
<b>White</b>	25	32	45	44	25
<b>Crew Blue</b>	23	40	37	39	29
<b>Green</b>	26	38	37	45	28
<b>Brown</b>	26	34	44	43	28

Obtain the optimal allocation so as to maximize the total profit.

Question 3 Under what conditions is it possible for an LP problem to have more than one optimum solution?

Question 4 Find the dual of the following Primal LP:

$$\text{Maximize } Z = 50X_1 + 80X_2$$

Subject to the constraints,

$$3X_1 + 5X_2 \leq 45$$

$$4X_1 + 2X_2 \geq 16$$

$$6X_1 + 6X_2 \leq 30$$

$$X_1, X_2 \geq 0$$

Question 5 An electronics company is engaged in the manufacture of two components C1 and C2 used in telecom tower sets. Each unit of C1 and C2 costs the company Rs. 13 and Rs. 43 respectively. The company sells both the products on selling price per unit of C1 is Rs. 40 and of C2 is Rs. 90. The company has an available 2500 hours of machine time and 1800 hours of assembly time. The production of C1 requires 4 hours of machine time & 2 hours of assembly time, whereas each



unit of C2 requires 3 hours of machine time and 4 hours of assembly time. Graphically solve the given LP problem maximizing profit.

**Attempt any 2 out of 3 questions from this section. Each question carries 10 marks.**

Question 1 First American Bank issues five types of loans. In addition, to diversify its portfolio, and to minimize risk, the bank invests in risk-free securities. The loans and the risk-free securities with their annual rate of return are given in Table.

Type of Loan or Security	Annual Rate of Return (%)
Home mortgage (first)	6
Home mortgage (second)	8
Commercial loan	11
Automobile loan	9
Home improvement loan	10
Risk-free securities	4

The bank's objective is to maximize the annual rate of return on investments subject to the following policies, restrictions, and regulations:

- The bank has \$90 million in available funds.
- Risk-free securities must contain at least 10 percent of the total funds available for investments.
- Home improvement loans cannot exceed \$8,000,000.
- The investment in mortgage loans must be at least 60 percent of all the funds invested in loans.
- The investment in first mortgage loans must be at least twice as much as the investment in second mortgage loans.
- Home improvement loans cannot exceed 40 percent of the funds invested in first mortgage loans.
- Automobile loans and home improvement loans together may not exceed the commercial loans and Commercial loans cannot exceed 50 percent of the total funds invested in Mortgage loans.

Formulate the model.

Question 2 An organization was investigating relocation its corporate headquarters to one of the three possible cities. The pair wise comparison matrix shows the president's judgment regarding the desirability for the three cities.

	City 1	City 2	City 3
City 1	1	5	7
City 2	1/5	1	3
City 3	1/7	1/3	1

- Determine the priorities for the three cities.
- Is the President consistent in terms of the judgment provided? Explain.

Question 3 The Krampf Lines Railway Company specializes in coal handling. On Friday, April 13, Krampf had empty cars at the following towns in the quantities indicated:

Town	Supply of Cars
Morgantown	35
Youngstown	60
Pittsburgh	25

By Monday, April 16, the following town will need coal cars as follows:



Town	Demand for Cars
Coal Valley	30
Coaltown	45
Coal Junction	25
Coalsburg	20

To	Coal Valley	Coaltown	Coal Junction	Coalsburg
From				
Morgantown	50	30	60	70
Youngstown	20	80	10	90
Pittsburgh	100	40	80	30

Using a railway city to city distance chart, the dispatcher constructs a mileage table for the preceding towns. The result is shown in the table below. Minimizing total miles over which cars are moved to new locations, compute the best shipment of coal cars.

### Section - C

#### Compulsory Case Study (15 Marks)

Burn-Off, a manufacturer of diet drinks is planning to introduce a drink that will magically burn away fat. The drink is bit expensive but Burn-Off guarantees that a person using this diet plan will lose up to 50 pounds in just three weeks. The drink is made up of four "mystery" ingredients (which we will call A, B, C and D). The plan calls for a person to consume at least 36 ounce per day. Each of the four ingredients contains different levels of three chemical compounds (which we will call X, Y and Z). Health regulations mandate that dosage consumed per day should contain minimum prescribed levels of chemicals X and Y and should not exceed maximum prescribed levels for the third chemical Z. The composition of the four ingredients in terms of the chemical compounds (units per ounce) is shown below along with the unit cost of prices of the ingredients. Burn-Off wants to find the optimal way to mix the ingredients to create the drink, at minimum cost per daily dose. Decision variables: Let A, B, C, and D denote the number of ounces of ingredients A, B, C, and D to use, respectively.

Units of Chemical per Ounce of Ingredient					
Chemical	Ingredient				Requirement
	A	B	C	D	
X	3	4	8	10	$\geq 280$ units
Y	5	3	6	6	$\geq 200$ units
Z	10	25	20	40	$\leq 1050$ units

\$ per ounce of ingredient			
0.40	0.20	0.60	0.30



The computer outputs of the sensitivity report for the problem are as follows.  
Adjustable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
\$B\$3	DVs A	10.25	0	0.4	0.061111111	0.25
\$C\$3	DVs B	0	0.06875	0.2	1E+30	0.06875
\$D\$3	DVs C	4.125	0	0.6	1.5	0.073333333
\$E\$3	DVs D	21.625	0	0.3	0.084615385	1E+30

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
	min req					
\$F\$5	LHS	36	0.375	36	16.5	1.277777778
\$F\$6	X LHS	280	0.0875	280	41	11
\$F\$7	Y LHS	205.75	0	200	5.75	1E+30
\$F\$8	Z LHS	1050	-0.02375	1050	47.14285714	346

**Formulate LP as minimization of cost.**

**Based on the sensitivity report answer the followings:**

- What is the impact on cost if Burn-Off insists on using 1 ounce of ingredients B to make the drink?
- There is some uncertainty in the cost of ingredient C. How sensitive is the current optimal solution?
- Burn-Off can decrease the minimum requirement for chemical X by 5 units (from 280 to 275) provided the maximum limit allowed for chemical Z is reduced to 1000 units (that is, reduced by 50 units). Is this trade-off cost-effective for Burn-Off to implement?