PGDM, Retail Management

Management Science

RM-202

**Trimester – II End-Term Examination: December 2019**

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.** All other instructions on the reverse of Admit Card should be followed meticulously.

**SECTION A – (10 marks * 3 questions) = 30 Marks (CILO-1)**

**A1a** A company that is introducing a new product would like to generate maximum market exposure. The marketing department currently has $100,000 of advertising budget for the year and is considering placing ads in three media: radio, television, and newspapers. The cost per ad and the exposure rating are as follows:

| | Cost/ad | Exposure/ad |
|---|---|---|
| Radio | $10,000 | 30,000 individuals |
| Television | $25,000 | 50,000 individuals |
| Newspaper | $5000 | 20,000 individuals |

The marketing department would like to place twice as many radio ads as television ads. They also would like to place at least 4 ads in each advertising media. What is the optimal allocation to each advertising medium to maximize audience exposure? Formulate LPP.

**b** Minimize $6X_1 + 3X_2$
Subject to:

$2X_1 + 4X_2 \geq 16$
$4X_1 + 3X_2 \geq 24$
$X_1, X_2 \geq 0$

Use graphical approach to find the optimal values of $X_1$ and $X_2$. Also find the dual of the problem.

**(5+5=10 marks)**

**OR**

**A1** A real estate developer is planning to build an office complex. Currently, there are three office sizes under consideration: small, medium, and large. Small offices can be rented for $600 per month, medium offices can be rented for $750 per month, and large offices can be rented for $1000 per month. Each small office requires 600 square feet, each medium office requires 800 square feet, and each large office requires 1000 square feet. The current plot of land available to the developer is 100,000 square feet. The developer wants to ensure that the office complex has at least 3 units of each office size. Moreover, zoning restrictions limit the total number of offices to 50.

Max: 600X1 + 750X2 + 1000X3
Subject to:
600X1 + 800X2 + 1000X3 ≤ 100,000 (square footage)
X1≥ 3 (minimum number of small offices)
X2≥ 3 (minimum number of medium offices)
X3 ≥ 3 (minimum number of large offices)
X1 + X2 + X3 ≤ 50 (maximum number of total offices)
X1, X2, and X3 ≥ 0

Sensitivity Report

Adjustable Cells

| Cell | Name | Final Value | Reduced Cost | Objective Coefficient | Allowable Increase | Allowable Decrease |
|---|---|---|---|---|---|---|
| $B$4 | Optimal Values Small | 3 | 0 | 600 | 400 | 1E+30 |
| $C$4 | Optimal Values Medium | 3 | 0 | 750 | 250 | 1E+30 |
| $D$4 | Optimal Values Large | 44 | 0 | 1000 | 1E+30 | 250 |

Constraints

| Cell | Name | Final Value | Shadow Price | Constraint R.H. Side | Allowable Increase | Allowable Decrease |
|---|---|---|---|---|---|---|
| $E$8 | Square footage | 48200 | 0 | 100000 | 1E+30 | 51800 |
| $E$9 | Minimum no. of small | 3 | -400 | 3 | 41 | 3 |
| $E$10 | Minimum no. of medium | 3 | -250 | 3 | 41 | 3 |
| $E$11 | Minimum no. of large | 44 | 0 | 3 | 41 | 1E+30 |
| $E$12 | Total no. of offices | 50 | 1000 | 50 | 51.8 | 41 |

a. How many small, medium, and large offices should the developer build?
b. What is the total optimal monthly revenue?
c. Define binding and non binding constraints.
Which constraints are binding in this problem? Which constraints are non-binding?
d. What would be the impact on the optimal allocation of offices and the objective function value if small offices can be rented for $800 per month rather than $600 per month?
e. Why is reduced cost zero corresponding to optimal value of small offices?
f. If total number of offices are increased to 55, what impact would this have on the current optimal objective function value?

**(1+1+3+2+1+2=10 marks)**

**A2** A manufacturer has distribution centres located at location X, Y, Z. These centres have available 50, 100 and 150 units of his products. His retail outlets at A, B, C, D and E requires 100, 70, 50, 40 and 40 units of the product respectively. The shipping cost per unit in rupees between each centre and outlet is given in the following table:

| Distribution Centre | Retail Outlets | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| X | 20 | 28 | 32 | 55 | 70 |
| Y | 48 | 36 | 40 | 44 | 25 |
| Z | 35 | 55 | 22 | 45 | 48 |

a. Determine initial basic feasible solution using VAM
b. Check using MODI method if the solution obtained is optimal.

**(5+5=10 marks)**

**OR**

A2 a. Citing a relevant example, write short notes on sensitivity analysis on
i. RHS of the constraints
ii. Objective function
b. Write general form of a transportation model.

**(5+5=10 marks)**

**A3a** Four different machines can do any of the four required jobs, with different costs resulting from each assignment as shown below, find minimum cost possible through optimal assignment

| Job | Machine | | | |
|---|---|---|---|---|
| | A | B | C | D |
| 1 | 18 | 26 | 17 | 11 |
| 2 | 13 | 28 | 14 | 26 |
| 3 | 38 | 19 | 18 | 15 |
| 4 | 19 | 26 | 14 | 10 |

**A3b** Write short notes on Travelling salesman problem citing an example.

**(5+5=10 marks)**

**OR**

**A3a** Five different machines can do any of the five required jobs, with different profits resulting from each assignment as shown below, find maximum profit possible through optimal assignment

| Job | Machine | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| 1 | 30 | 37 | 40 | 28 | 40 |
| 2 | 40 | 24 | 27 | 21 | 36 |
| 3 | 40 | 32 | 33 | 30 | 35 |
| 4 | 25 | 38 | 40 | 36 | 36 |
| 5 | 29 | 62 | 41 | 34 | 39 |

b. Write general form of assignment model.

**(5+5=10 marks)**

**SECTION B – (10 marks * 2 questions) = 20 Marks (CILO-1)**

**A5** A project of a Research and Development Department is composed of nine activities whose time estimates are listed in the table below.

| **Activity** | **Estimated Duration (weeks)** | | |
|---|---|---|---|
| ***i - j*** | **Optimistic** | **Most Likely** | **Pessimistic** |
| 1 – 2 | 3 | 6 | 15 |
| 2 – 3 | 6 | 12 | 30 |
| 3 – 5 | 5 | 11 | 17 |
| 7 – 8 | 4 | 19 | 28 |
| 5 – 8 | 1 | 4 | 7 |
| 6 – 7 | 3 | 9 | 27 |
| 4 – 5 | 3 | 6 | 15 |
| 1 – 6 | 2 | 5 | 14 |
| 2 – 4 | 2 | 5 | 8 |

a. Draw the network diagram.
b. Number the network using Fulkerson's rule
c. Compute critical path.
d. Compute early and late event time and slack.
e. Compute ES, EF, LS, LF,slack for all the activities

**(1+1+2+2+4=10 marks)**

**A6.** Mr. Adam wants to purchase a new mountain bike, and he is considering three models- A, B, C. He has identified three criteria for selection on which he will base his decision: purchase price, gear action, and weight. The following are the pairwise matrices for the three criteria:

| | Price | | |
|---|---|---|---|
| Bike | A | B | C |
| A | 1 | 3 | 6 |
| B | 1/3 | 1 | 2 |
| C | 1/6 | 1/2 | 1 |

| | Gear Action | | |
|---|---|---|---|
| Bike | A | B | C |
| A | 1 | 1/3 | 1/7 |
| B | 3 | 1 | 1/4 |
| C | 7 | 4 | 1 |

| | Weight | | |
|---|---|---|---|
| Bike | A | B | C |
| A | 1 | 3 | 1 |
| B | 1/3 | 1 | 1/2 |
| C | 1 | 2 | 1 |

Adam has prioritized his decision criteria according to the following pairwise comparisons:

| Criteria | Price | Gears | Weight |
|---|---|---|---|
| Price | 1 | 3 | 5 |
| Gears | 1/3 | 1 | 2 |
| Weight | 1/5 | 1/2 | 1 |

Using AHP, develop an overall ranking of the three bikes Adam is considering.

**(10 marks)**