

PGDM, 2017-2019  
Management Science  
DM205

Trimester – II, End-Term Examination: December 2017

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 (3\*5=15 Marks).**

Question 1 What is a shadow price? Describe how a firm would use the shadow price associated with a given constraint.

Question 2 'Linear programming is one of the most frequently and successfully applied operations research technique to managerial decisions.' Elucidate this statement with some examples.

Question 3 Woofers Pet Foods products a low-calorie dog food for overweight dogs. This product is made from beef products and grain. Each pound of beef cost \$0.90, and each pound of grain cost \$0.60. a pound of the dog food must contain at least 9 units of Vitamin I and 10 units of Vitamin 1 and 2. A pound of beef contains 10 units of Vitamin 1 and 12 units of Vitamin 2. A pound of Grains contains 6 units of Vitamin 1 and 9 units of Vitamin 2. Formulate this is an LP problem to minimize the cost of the dog food. How many pounds of beef and grain should be included in each pound of dog food? What is the cost and Vitamin content of the final product?

Question 4 Will the northwest-corner solution rule always result in a higher total cost than the Vogel's approximation rule? Why, or why not?

Question 5 Four professors are each capable of teaching any one of four different courses. Class preparation in hours for different topics varies from professors to professors and is given in the table below. Each professor is assigned only one course so as to minimize the total course preparation time for all courses:

| PROFESSORS | LINEAR PROGRAMMING | QUEUEING THEORY | DYNAMIC PROGRAMMING | REGRESSION ANALYSIS |
|------------|--------------------|-----------------|---------------------|---------------------|
| A          | 2                  | 10              | 9                   | 7                   |
| B          | 15                 | 4               | 14                  | 8                   |
| C          | 13                 | 14              | 16                  | 11                  |
| D          | 4                  | 15              | 13                  | 9                   |

**Section – B: Attempt any 2 out of 3 questions (2\*10=20 Marks)**

Question 1 Innis Investments manages funds for a number of companies and wealthy clients.

The investment strategy is tailored to each client's needs. For a new client, Innis has been authorized to invest up to \$1.2 million in two investment funds: a stock fund and a money market fund. Each unit of the stock fund costs \$50 and provides an annual rate of return of 10%; each unit of the money market fund costs \$100 and provides an annual rate of return of 4%.

The client wants to minimize risk subject to the requirement that the annual income from the investment be at least \$60,000. According to Innis's risk measurement system, each unit invested in the stock fund has a risk index of 8, and each unit invested in the money market fund has a risk index of 3; the higher risk index associated with the stock fund simply indicates that it is the riskier investment. Innis's client also specified that at least \$300,000 be invested in the money market fund. Innis needs to determine how many units of each fund to purchase for the client to minimize the total risk index for the portfolio.

Find the dual of the above problem.

Question 2 Test the consistency of the following pairwise comparison matrix.

$$\begin{pmatrix} 1 & 5 & 7 \\ 1/5 & 1 & 6 \\ 1/7 & 1/6 & 1 \end{pmatrix}$$

Question 3 Quality Air Conditioning manufactures three home Air Conditioners: an economy model, a standard model, and a deluxe model. The profits per unit are \$63, \$95, and \$135 respectively. The production requirement per unit is as follows:

|                 | Number of Fans | Number of Cooling Coils | Manufacturing Time |
|-----------------|----------------|-------------------------|--------------------|
| <b>Economy</b>  | 1              | 1                       | 8                  |
| <b>Standard</b> | 1              | 2                       | 12                 |
| <b>Deluxe</b>   | 1              | 4                       | 14                 |

For the coming production period company has 200 fan motors, 320 cooling coils, and 2400 hours of manufacturing time available.

Formulate the model which will optimize the profit?

**Sensitivity Report**

Variable Cells

| Cell   | Name                    | Final Value | Reduced Cost | Objective Coefficient | Allowable Increase | Allowable Decrease |
|--------|-------------------------|-------------|--------------|-----------------------|--------------------|--------------------|
| \$D\$4 | Number of Fans          | 80          | 0            | 63                    | 32                 | 15.5               |
| \$E\$4 | Number of Cooling Coils | 120         | 0            | 95                    | 31                 | 32                 |
| \$F\$4 | Manufacturing Time      | 0           | -497         | 135                   | 497                | 1E+30              |

Constraints

| Cell   | Name         | Final Value | Shadow Price | Constraint R.H. Side | Allowable Increase | Allowable Decrease |
|--------|--------------|-------------|--------------|----------------------|--------------------|--------------------|
| \$G\$7 | Economy LHS  | 200         | 31           | 200                  | 120                | 40                 |
| \$G\$8 | Standard LHS | 320         | 32           | 320                  | 80                 | 120                |
| \$G\$9 | Deluxe LHS   | 560         | 0            | 2400                 | 1E+30              | 1840               |

Based on the sensitivity report answer the followings:

- A. What if the supply of fans changes?
- B. What happens if the supply of cooling Coils
  - a. Increased by 30?
  - b. Increased by 50?
- C. What if would get an additional 250 hours of manufacturing time by paying \$2 per hour more than usual? Would this be profitable?
- D. What happens to profit if this value drops to \$10 per cooling coils?
- E. The reduced cost of manufacturing time is -497. How it can be calculated and interpreted?

**Compulsory Case Study (15 Marks)**

Harley's Sand and Gravel Pit have contracted to provide topsoil for three residential housing developments. Topsoil can be supplied from three different "farms" as follows:

| Weekly Capacity | Farm (cubic yards) |
|-----------------|--------------------|
| A               | 100                |
| B               | 200                |
| C               | 200                |

Demand for the topsoil generated by the construction projects is

| Weekly Demand | Project (cubic yards) |
|---------------|-----------------------|
| 1             | 50                    |
| 2             | 150                   |
| 3             | 300                   |

The manager of the sand and gravel pit has estimated the cost per cubic yard to ship over each of the possible routes:

| Cost per Cubic Yard to |            |            |            |
|------------------------|------------|------------|------------|
| From                   | Project #1 | Project #2 | Project #3 |
| Farm A                 | \$4        | \$2        | \$8        |
| Farm B                 | \$5        | \$1        | \$9        |
| Farm C                 | \$7        | \$6        | \$3        |

This constitutes the information needed to solve the problem. Arrange the above information and find the optimal solution.