

**K. J. SOMAIYA INSTITUTE OF MANAGEMENT STUDIES AND RESEARCH,**  
**Vidyavihar, Mumbai- 400077**

**Program: PGDM- RM, Trim-III**  
**Subject: Operations Research**  
**(End term exam)**

**Maximum Marks: 50**  
**Duration: 3hrs.**  
**2017**

**Date: 27th March,**

**Instructions**

- 1. This exam will be conducted in the computer lab. All answers are to be written in the answer sheet. Use Excel where required.**
- 2. Keep saving the folder on the desktop and d-drive every ten minutes or so.**
- 3. Question No 1 is compulsory.**
- 4. Attempt any four questions from the remaining five questions.**

**QUESTION 1**

(10)

The management of Hartman Company is trying to determine the amount of each of two products to produce over the coming planning period. The following information concerns labor availability, labor utilization, and product profitability.

Department	Product(hours/unit)		Labor-Hours Available
	1	2	
A	1	.35	100
B	.30	.20	36
C	.20	.50	50
Profit contribution/unit	\$30	\$15	

- a. Develop a linear programming model of the Hartman Company problem. Solve the model to determine the optimal production quantities of products 1 and 2.
- b. In computing the profit per unit, management doesn't deduct labor costs because they are considered fixed for the upcoming planning period. However, suppose that overtime can

be scheduled in some of the departments. Which departments would you recommended scheduling for overtime? How much would you be willing to pay per hour of overtime in each department?

- c. Suppose that 10, 6 and 8 hours of overtime may be scheduled in departments A, B, and C, respectively. The cost per hour of overtime is \$18 in department A, \$22.50 in department B, and \$12 in department C. Formulate a linear programming model that can be used to determine the optimal order quantities if overtime is made available. What are the optimal production quantities, and what is the revised total contribution to profit? How much overtime do you recommended using in each department? What is the increase in the total contribution to profit if overtime is used?

## **QUESTION 2**

(10)

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 requirements per unit are as follows:

	Number of Fans	Number of cooling coils	Manufacturing Time (hours)
Economy	1	1	8
Standard	1	2	12
Deluxe	1	4	14

For the coming production period, the company has 200 fan motors, 320 cooling coils and 2400 hours of manufacturing time available. How many economy models, standard models, and deluxe models should the company produce in order to maximize profit?

- What is the optimal solution, and what is the value of the objective function?
- Which constraints are binding?
- Which constraints are showing extra capacity? How much?
- If the profit for the deluxe model were increased to \$150 per unit, would the optimal solution change?
- Identify the range of optimality for each objective function coefficient.
- Suppose the profit for the economy model is increased by \$6 per unit, the profit for the standard model is decreased by \$2 per unit, and the profit for the deluxe model is increased by \$4 per unit. What will the new optimal solution be?
- Identify the range of feasibility for the right hand side values.
- If the number of fan motors available for production is increased by 100, will the dual price for the constraints change? Explain.

**QUESTION 3**

(5+5)

(i) A company must ship from 3 factories to 7 warehouses. The transportation cost per unit from each factory to each warehouse, the requirements of each warehouse, and the capacity of each factory are:

Warehouses	Factories			Warehouses Requirements
	1	2	3	
A	6	11	8	100
B	7	3	5	200
C	5	4	3	450
D	4	5	6	400
E	8	4	5	200
F	6	3	8	350
G	5	2	4	300
Factory Capacity	600	400	1000	

Find the minimum cost schedule.

(ii) A machine operator processes five types of items on his machine each week, and must choose a sequence for them. The set-up cost per change depends on the item presently on the machine and the set-up to be made, according to the following table:

For item	To item				
	A	B	C	D	E
A	-	4	7	3	4
B	4	-	6	3	4
C	7	6	-	7	5
D	3	3	7	-	7
E	4	4	5	7	-

- a. If he processes each type of item once and only once each week, how should he sequence the item on his machine in order to minimize the total set-up cost?
- b. What action would you recommended? What profit or loss can be anticipated?

**QUESTION 4**

(5+5)

(i) Westside Auto purchases a component, used in the manufacturer of automobile generators, directly from the suppliers. Westside’s generator production operation, which is operated at a constant rate, will require 1000 components per month throughout the year (12,000 units annually). Assume that the ordering costs are \$25 per order, the unit cost is \$2.50 per component, and holding cost per year is 20% of the value of the inventory. Westside has 250 working days per year and a lead time of 5 days. Answer the following inventory policy questions.

- (a) What is the EOQ for this component?
- (b) What is the reorder point?
- (c) What is the cycle time?
- (d) What are the total annual holding and ordering costs associated with your recommended EOQ?

(ii) Solve the following LPP by graphical method

$$\begin{aligned}
 \text{Max} \quad & 2x_1 + 6x_2 \\
 \text{s.t.} \quad & 4x_1 + 3x_2 \leq 12 \\
 & 2x_1 + x_2 \geq 8 \\
 & x_1, x_2 \geq 0
 \end{aligned}$$

**QUESTION 5**

(10)

Consider the following transshipment problem for a grain manufacturing company.

Farms		Mills		
Source Location	supply	Warehouse location	Destination Locations	Demand
Dubuque (IA)	2,000	Lowa City (IA)	St. Louis (MO)	2,500
Springfield (IL)	3,500	South Bend(IN)	Chicago(IL)	2,500

Omaha (NE)	2,000		Toledo (OH)	2,500
---------------	-------	--	----------------	-------

The supply and demand values are given in tons per week. The unit shipping cost from each source to each warehouse and from each warehouse to each destination is given in the following table.

Unit Shipping Cost from the Farms to the Warehouses		
From/To	Lowa City	South Bend
Dubuque	1	2.40
Springfield (IL)	1.50	2.20
Omaha (NE)	1.20	2.80

Unit Shipping Cost from the Farms to the Warehouses			
From/To	St. Louis	Chicago	Toledo
Lowa City	1	1.10	2.40
South Bend	2	.90	1.20

Formulate this problem as a LPP to minimize the total transportation cost and solve it.

### **QUESTION 6**

(5+5)

(i) A building contractor is preparing a bid on a new construction project. Two other contractors will be submitting bids for the same project. Based on past bidding practices, bids from the other contractors can be described by the following probability distribution:

Contractor	Probability distribution of bid
A	Uniform probability distribution between \$600,000 and \$800,000
B	Normal probability distribution with a mean bid of \$700,000 and a standard deviation \$50,000

- If the bidding contractor submits a bid of \$650,000, what is the probability that the contractor submits the lowest bid and wins the contract for the new construction project? Use a worksheet to simulate 1000 trials of the contract bidding process.
- The bidding contractor is also considering bids of \$625,000 and \$615,000. If the building contractor would like to bid such that the probability of winning the bid is about 0.80, what bid would you recommended?

(ii) The Garden Avenue Seven sells tapes of its musical performances. The following data show sales for the past 18 months. The group's manager wants an accurate method for forecasting future sales.

Month	Sales	Month	Sales	Month	Sales
1	293	7	381	13	549
2	283	8	431	14	544
3	322	9	424	15	601
4	355	10	433	16	587
5	346	11	470	17	644
6	379	12	481	18	660

- a) Use exponential smoothing to forecast this time series. Consider smoothing constants of  $\alpha = .2, .3,$  and  $.4$ . What value of the smoothing constant provides the best forecast?
- b) Use trend projection to provide a forecast. What is the value of MSE?
- c) Which method of forecasting would you recommend to the manager? Why?