

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

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

Maximum Marks: 50
Duration: 3hrs.

Date: 2nd April, 2019

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. All questions are compulsory.**

QUESTION 1

(10)

- a. 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	1.00	0.35	100
B	0.30	0.20	36
C	0.20	0.50	50
Profit Contribution/Unit	\$30	\$15	

- i. Develop a linear programming model of the Hartman Company problem. Solve the model to determine the optimal production quantities of products 1 and 2.
- ii. In computing the profit contribution 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 recommend scheduling for overtime?
- iii. 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 production 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 recommend using in each department? What is the increase in the total contribution to profit if overtime is used?

- b. Adirondack Paper Mills, Inc., operates paper plants in Augusta, Maine, and Tupper Lake, New York. Warehouse facilities are located in Albany, New York, and Portsmouth, New Hampshire. Distributors are located in Boston, New York, and Philadelphia. The plant capacities and distributor demands for the next month are as follows:

Plant	Capacity (units)
Augusta	300
Tupper Lake	100

Distributor	Demand (units)
Boston	150
New York	100
Philadelphia	150

The unit transportation costs (in dollars) for shipments from the two plants to the two warehouses and from the two warehouses to the three distributors are as follows:

Plant	Warehouse	
	Albany	Portsmouth
Augusta	7	5
Tupper Lake	3	4

Warehouse	Distributor		
	Boston	New York	Philadelphia
Albany	8	5	7
Portsmouth	5	6	10

- i. Draw the network representation of the Adirondack Paper Mills problem.
 ii. Formulate the Adirondack Paper Mills problem as a linear programming problem.

DO NOT SOLVE

QUESTION 2

(10)

The employee credit union at State University is planning the allocation of funds for the coming year. The credit union makes four type of loans to its members. In addition, the credit union invests in risk-free securities to stabilize income. The various revenue producing investments together with annual rates of returns are as follows:

Type of Loan/investment	Annual Rate of Return (%)
Automobile Loans	8
Furniture Loans	10
Other Secured Loans	11

Signature Loans	12
Risk-free Loans	9

The credit union will have \$2,000,000 available for investment during the coming year. State laws and credit union policies impose the following restrictions on the composition of the loans and investment.

- (i) Risk-free securities may not exceed 30% of the total funds available for investment.
 - (ii) Signature loans may not exceed 10% of the funds available in the loans (automobile, furniture, other secured, and signature loans).
 - (iii) Furniture loans plus other secured loans may not exceed the automobile loans.
 - (iv) Other secured loans plus signature loans may not exceed the funds invested in risk-free securities.
- (a) How should the \$2,000,000 be allocated to each of the loan/ investment alternatives to maximize total annual return? What is the projected total annual return?
- (b) Suppose that the annual rate of return increases to 9% for Automobile Loans and the annual rate of return for signature loans decreases to 7%. Would the optimal solution change?

QUESTION 3

(10)

- a. A market research firm's three clients each requested that the firm conduct a sample survey. Four available statisticians can be assigned to these three projects; however, all four statisticians are busy, and therefore each can handle only one client. The following data show the number of hours required for each statistician to complete each job; the differences in time are based on experience and ability of the statisticians.

Statistician	Client		
	A	B	C
1	150	210	270
2	170	230	220
3	180	230	225
4	160	240	230

Obtain the optimal assignment for this problem. Suppose that the time statistician 4 needs to complete the job for client A is increased from 160 to 165 hours. What effect will this change have on the solution?

- b. Forbelt Corporation has a one-year contract to supply motors for all refrigerators produced by the Ice Age Corporation. Ice Age manufactures the refrigerators at four

locations around the country: Boston, Dallas, Los Angeles, and St. Paul. Plans call for the following number (in thousands) of refrigerators to be produced at each location:

Boston	50
Dallas	70
Los Angeles	60
St. Paul	80

Forbelt's three plants are capable of producing the motors. The plants and production capacities (in thousands) are

Denver	100
Atlanta	100
Chicago	150

The following table gives the accounting department estimates of the cost per unit (shipments will be made in lots of 1000 units):

Produced At	Shipped To			
	Boston	Dallas	Los Angeles	St. Paul
Denver	7	11	8	13
Atlanta	20	17	12	10
Chicago	8	18	13	16

With cost minimization as a criterion, Forbelt's management wants to determine how many motors should be shipped from each plant to each destination.

- i. Develop a network representation of this problem.
- ii. Formulate the problem as LPP.

DO NOT SOLVE

QUESTION 4

(10)

- a. Wilson Publishing Company produces books for the retail market. Demand for a current book is expected to occur at a constant annual rate of 7200 copies. The cost of one copy of the book is \$14.50. The holding cost is based on an 18% annual rate, and production setup costs are \$150 per setup. The equipment on which the book is produced has an annual production volume of 25,000 copies. Wilson has 250 working days per year. Use the production lot size model to compute the following values:
 - i. Minimum production lot size i.e. Q^*
 - ii. Number of production runs per year
 - iii. Cycle time
 - iv. Total annual cost

- b. To generate leads for new business, Gustin Investment Services offers free financial planning seminars at major hotels in Southwest Florida. Attendance is limited to 25 individuals per seminar. Each seminar costs Gustin \$3500, and the average first-year commission for each new account opened is \$5000. Historical data collected over the past four years show that the number of new accounts opened at a seminar varies from no accounts opened to a maximum of six accounts opened according to the following probability distribution:

Number of New Accounts Opened	0	1	2	3	4	5	6
Probability	0.1	0.04	0.1	0.25	0.4	0.06	0.05

Use the following sequence of random numbers to simulate the number of new accounts opened for 10 seminars.

Random numbers: 03, 91, 38, 55, 17, 46, 32, 43, 69, 72.

Estimate the daily average number of new accounts opened on the basis of simulated data.

Would you recommend that Gustin continue running the seminars?

QUESTION 5

(10)

The Vintage restaurant is located on Captiva Island, a resort community near Fort Myers, Florida. The restaurant, which is owned and operated by Karen Payne, just completed its third year of operation. During this time, Karen sought to establish a reputation for the restaurant as a high quality dining establishment that specializes in fresh seafood. The efforts made by Karen and her staff proved successful and her restaurant are currently one of the best and fastest-growing restaurants on the island.

Karen concluded that, to plan better for the growth of the restaurant for the future, she needs

to develop a system that will enable her to forecast food and beverage sales by month for up to one year in advance. Karen compiled the data on total food and beverage sales for the three years (2015 Jan to 2017 Dec) of operations. **(File. Vintage sales)**

Perform an analysis of the sales data for the Vintage restaurant. Prepare the report for Karen that summarizes your findings, forecasts, and recommendations. Include the following

- a. A graph of the time series.
- b. An analysis of the seasonality of the data. Indicate the seasonal indexes for each month, and comment on the high seasonal and low seasonal sales months.
- c. Forecast sales for January through December of the fourth year.
