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

Maximum Marks: 50
Duration: 3hrs.   **Date: 6th April, 2018**

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)

Gulf coast Electronics is ready to award contracts for printing their annual report. For the past several years, the four-color annual report has been printed by Johnson Printing and Lakeside Litho. A new Firm, Benson Printing, has inquired into the possibility of doing a portion of the printing. The quality and service level provided by Lakeside Litho has been extremely high; in fact, only 0.5% of their reports have had to be discarded because of quality problems. Johnson printing has also had a high quality level historically, producing an average of only 1% unacceptable reports. Because Gulf Cost Electronics lacks any experience with Benson Printing, they estimate their defective rate to be 10%. Gulf Coast would like to determine how many reports should be printed by each firm to obtain 75000 acceptable quality reports. To ensure that Benson Printing will receive some of the contract, management specified that the number of reports awarded to Benson Printing must be at least 10% of the volume given to Johnson Printing. In addition, the total volume assigned to Benson Printing, Johnson Printing, and Lakeside Litho should not exceed 30000, 50000, and 50000 copies, respectively. Because of their long term relationship with Lakeside Litho, management also specified that at least 30000 reports should be awarded to Lakeside Litho. The cost per copy is $2.45 for Benson Printing, $2.50 for Johnson Printing, and $2.75 for Lakeside Litho.

    a. Formulate and solve a Linear Programming Problem for determining how many copies should be assigned to each printing firm to minimize the total cost of obtaining 75,000 acceptable quality reports.
    b. Suppose that the quality level for Benson Printing is much better than estimated, what effect, if any, would this quality level have?
    c. Suppose the management is willing to reconsider their requirement that Lakeside Litho be awarded at least 30000 reports. What effect, if any, would this consideration have?

QUESTION 2
(10)

A major source of revenue in Texas is a state sales tax on certain types of goods and services. Data are compiled and the state comptroller uses them to project future revenues for the state budget. One particular category of goods is classified as Retail trade. Four years of quarterly data (in $millions) for one particular area of southeast Taxes follows:

Year	Quarter1	Quarter2	Quarter3	Quarter4
1	218	225	234	250
2	247	254	265	283
3	243	255	264	289
4	292	299	327	356

    a. Compute the seasonal indexes for the four quarter based on a central Moving Average.
    b. Depeasonalize the data and develop a trend line on the deseasonalized data.
    c. Use the trend line to forecast the sales for each quarter of year 5.

QUESTION 3
(10)

George Nanchoff owns a gas station. The cars arrive at the gas station according to the following inter-arrival time distribution. The time to service a car is follow the Normal distribution with a mean of 5 minutes and a standard deviation of 0.5 minutes. As a general policy, the manager wishes to offer service such that average customer waiting time does not exceed 5 minutes. Simulate the arrival and service times of 100 cars at the gas station. Estimate the average customer waiting time and interpret.

Inter-arrival Time (Minutes)	P(x)
4	.35
7	.40
10	.20
20	.10

QUESTION 4 (10)

The Sunshine Tomato Soup Shippers produce tomato soup at three West Coast canneries in Bakersfield, Phoenix, and Eugene. The soup is shipped to four regional warehouses. Due to high demand, the company is considering opening a fourth cannery. The company is considering opening up the fourth cannery either at San Diego, San Jose, and Los Angeles. The following table shows the cost of shipping a case from each cannery (existing and proposed) to each regional warehouse. The company wishes to ship all of its cannery capacity to the regional warehouses so that monthly transportation cost is minimized.

Source	Warehouse				
	Seattle, Washington	Los Angeles California	Denver Colorado	Dallas Texas	Maximum Monthly Cannery Capacity
Phoenix	2.80	0.60	1.20	1.50	70000
Eugene	0.50	1.20	2.20	2.90	80000
Bakersfield	1.80	0.40	1.80	2.20	90000
Los Angeles	1.70	0.75	1.75	2.50	110000
San Diego	1.80	0.60	1.60	2.60	110000
San Jose	1.40	0.70	2	2.40	110000
Demand	80000	90000	70000	100000	

a. Formulate as Linear Programming Problem.
b. What is the total transportation cost if each of the three sites should be selected?
c. Which site should be selected to locate the next cannery? Why?

. **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
Springfiel	3,500	South	Chicago(	2,500

d (IL)		Bend(IN)	IL)	
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

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

QUESTION 6
(5+5)

    (i)   Consider the following LPP

$$Max \quad 3x_1 + 4x_2$$
$$s.t. \quad -x_1 + 2x_2 \le 8$$
$$x_1 + 2x_2 \le 12$$
$$2x_1 + x_2 \le 16$$
$$x_1, x_2 \ge 0$$

    a. Show the feasible region.
    b. What are the extreme points of the feasible region?
    c. Find the optimal solution using the graphical procedure.
    d. What are the values of the three slack variables at the optimal solution.

(ii)   Keith shoe stores carries a basic black dress shoe for men that sells at an approximate constant rate of 500 pairs of shoes every three months. Keith's current buying policy is to order 500 pairs each time an order is placed. It costs Keith $30 to place an order. The annual holding cost rate is 20%. With the order quantity of 500, Keith obtains the shoes at the lowest possible unit cost of $28 per pair. Other quantity discounts offered by the manufacturer are as follows. What is the minimum cost order quantity for the shoes? What are the annual savings of your inventory policy over the policy currently being used by Keith?

Order- Quantity	Price per Pair
0-99	$38
100-199	$34
200-299	$32
300 or more	$30