Seat No. : _____

# XU-120

**April-2013**

## Five Years MBA Integrated (K.S.)

## T.Y. MBA

## Quantitative Techniques

**Time : 3 Hours]** **[Max. Marks : 70**

1. Attempt any **two** : **14**

(a) A company is planning to determine its product mix out of three different products : $P_1$, $P_2$ and $P_3$. The monthly sales of the product $P_1$ is limited to a maximum of 500 units. For every two units of $P_2$ produced, there will be one unit of by-product which can be sold at the rate of ₹ 20 per unit. The highest monthly demand for this by-product is 200 units. The contributions per unit of the products $P_1$, $P_2$ and $P_3$ are ₹ 50, ₹ 70 and ₹ 60, respectively. The processing requirements of these products are shown in the following table :

| | **Hours per unit** | | | |
|---|---|---|---|---|
| **Process** | $P_1$ | $P_2$ | $P_3$ | **Available hours** |
| I | 3 | 5 | 2 | 1000 |
| II | 4 | – | 3 | 700 |
| III | 4 | 3 | 2 | 1300 |

Formulate a linear programming model of this problem to find the optimum product mix such that the total contribution is maximized.

(b) Use the graphical method to solve the following linear programming problem.

Minimize $Z = 20x_1 + 10x_2$

Subject to the constraints

$$x_1 + 2x_2 \leq 40$$

$$3x_1 + x_2 \geq 30$$

$$4x_1 + 3x_2 \geq 60$$

$$x_1, x_2 \geq 0$$

(c) A company is manufacturing two products A and B. The manufacturing time required to make them, the profit and capacity available at each work centre are as follows :

| **Product** | **Work centre** | | | |
|---|---|---|---|---|
| | **Machining (hours)** | **Fabrication (hours)** | **Assembly (hours)** | **Profit per unit (₹)** |
| A | 1 | 5 | 3 | 80 |
| B | 2 | 4 | 1 | 100 |
| **Total capacity** | 720 | 1800 | 900 | |

If $x_1$ and $x_2$ represent the number of units of products A and B, respectively, while $S_1$, $S_2$ and $S_3$ represent the slack variables, indicating the unused capacity in the three work centres, the simplex algorithm, yields the following final table.

| **Basis** | $x_1$ | $x_2$ | $S_1$ | $S_2$ | $S_3$ | $b_i$ |
|---|---|---|---|---|---|---|
| $x_2$ 100 | 0 | 1 | $\frac{5}{6}$ | $-\frac{1}{6}$ | 0 | 300 |
| $x_1$ 80 | 1 | 0 | $-\frac{2}{3}$ | $\frac{1}{3}$ | 0 | 120 |
| $S_3$ 0 | 0 | 0 | $\frac{7}{6}$ | $-\frac{5}{6}$ | 1 | 240 |
| G | 80 | 100 | 0 | 0 | 0 | |
| Solution | 120 | 300 | 0 | 0 | 240 | |
| $\Delta j$ | 0 | 0 | –30 | –10 | 0 | |

(i) Formulate the dual for this problem.

(ii) Identify the values of all variables and the objective function for the dual problem.

(iii) Suppose that a price change is under consideration for the product A. This would raise the profit for this product to ₹ 100 per unit. Would this change the optimal production plan ? What is the maximum amount of change in profit for product A that would not cause a change in the optimum production plan ?

2. Attempt any **two** : **14**

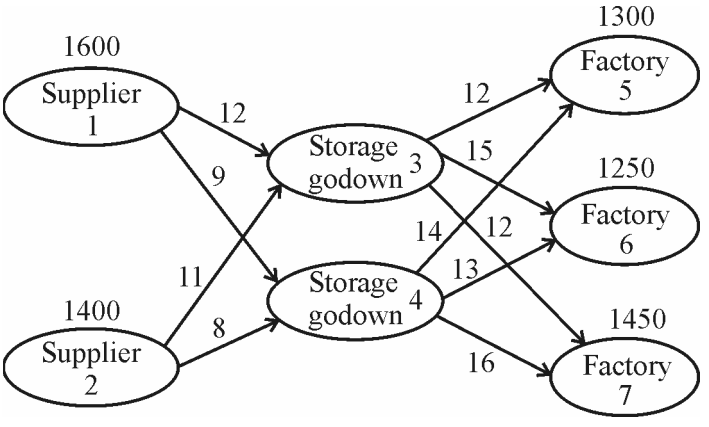
(a) A cement factory has two processing plants one in Ahmedabad with a supply capacity of 100 tons per day and one in Bhadravati with a supply capacity of 110 tons a day. The factory has three warehouses in Ranchi, Secunderabad and Trichy. The warehouses if possible 80, 120 and 60 tons of cement each day respectively to meet their distribution demands. The shipping costs from each plant to each warehouses are given below :

**Cost per ton (₹)**

| | **Ranchi** | **Secunderabad** | **Trichy** |
|---|---|---|---|
| Ahmedabad | 100 | 200 | 300 |
| Bhadravati | 400 | 100 | 500 |

Determine the distribution plans at the least possible shipment cost using a transportation model.

(b) Consider the trans-shipment problem faced by the factories for procuring raw materials from suppliers. There are two supply locations from two different suppliers. Raw materials will be supplied to the three factories through two intermediate nodes called storage godowns. The supply is limited whereas the demand is specified. The network model of the trans-shipment problem is given in the showing figure.




Formulate a transshipment model.

(c) A company plans to assign six salesmen to six cities in which it operates. The estimates of sales revenue (in thousand of rupees) for each salesman, when allocated to different cities, are given in the table. Identify the best allocation so that the sales revenue is maximized.

| **Salesman** | **Sales Revenue for various cities** | | | | | |
|---|---|---|---|---|---|---|
| | **City** | | | | | |
| | $C_1$ | $C_2$ | $C_3$ | $C_4$ | $C_5$ | $C_6$ |
| $S_1$ | 42 | 48 | 50 | 38 | 50 | 54 |
| $S_2$ | 50 | 34 | 38 | 31 | 46 | 48 |
| $S_3$ | 51 | 37 | 43 | 40 | 47 | 51 |
| $S_4$ | 32 | 48 | 51 | 46 | 46 | 48 |
| $S_5$ | 39 | 43 | 50 | 45 | 49 | 42 |
| $S_6$ | 37 | 47 | 44 | 46 | 47 | 52 |

3. (a) Define : **4**

(i) Statistic

(ii) Sampling Distribution

(b) 500 units from a factory are inspected and 12 are found to be defective, 800 units from another factory are inspected and 12 are found to be defective. Can it be concluded that at 5 percent level of significance production at the second factory is better than in first factory ? **5**

(c) If it costs ₹ 40 to draw one unit of sample how much would it cost in sampling from a universe with a mean as 100 and standard deviation as 10 to take sufficient number as to ensure that the mean of the sample with a 5% significance level be within 1% of the true value. **5**

**OR**

(a) Discuss Stratified and Systematic Sampling. **6**

(b) 600 units of a population are divided in two strata. The following results are obtained :

| **Stratum** | **Number of units in the stratum** | **Variance of stratum** |
|---|---|---|
| 1 | 400 | 180 |
| 2 | 200 | 120 |

A sample of 90 observations is taken from this population with proportional allocation. Find $V(\bar{y}_{st})$. **3**

(c) In order to test whether declaration of dividends has any effect on the market price of a share of a company a random sample of 8 companies was taken from companies which have declared at least 15% dividends. The data regarding share prices of the sample companies is

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Market price 10 days before dividends were declared | 70 | 65 | 112 | 58 | 25 | 147 | 95 | 68 |
| Market price 10 days after the declaration of dividends | 80 | 85 | 110 | 64 | 32 | 159 | 100 | 70 |

Can we say that the increase in average market price after declaration of dividends is significant (use 5% level of significance). Assume that the population is normal. **5**

4. (a) In 120 throws of a die, face marked on turned up 10 times, faces marked two or three 38 times, faces marked four or five 48 times and face marked six, remaining number of times. From the given information, would you conclude that the die is perfect ? **6**

**OR**

(a) (i) The value of r obtained from random sample of 19 pairs of observations from a normal population is 0.8. Compute 95% confidence limits for the population correlation coefficient r. **3**

(ii) Two independent samples of sizes 9 and 8 give the sum of squares of deviations from their respective means as 160 and 91 respectively. Can the samples be regarded as drawn from the normal populations with equal variances ? **3**

(b) A farmer applies three types of fertilizers on 4 separate plots. The figure on yield per acre are tabulated below :

| **Fertilizers** / **Plots** | **Yield** | | | |
|---|---|---|---|---|
| | A | B | C | D |
| Nitrogen | 6 | 4 | 8 | 6 |
| Potash | 7 | 6 | 6 | 9 |
| Phosphates | 8 | 5 | 10 | 9 |

Find out if the plots are materially different in fertility, as also, if the three fertilizers make any material difference in yields. **8**

5. (a) Explain the terms AOQL and OC curve. **4**

(b) In the production of tyres, the output of a given size was inspected every day prior to the tyres being delivered to the finished goods stores. The number of defectives found everyday was summarized in the following table. Draw the control chart for fraction defective. **10**

| **Date** | **Number inspected** | **Defectives** |
|---|---|---|
| March | | |
| 1 | 600 | 77 |
| 2 | 500 | 78 |
| 3 | 540 | 66 |
| 4 | 620 | 93 |
| 5 | 680 | 99 |
| 6 | 660 | 112 |
| 7 | 660 | 79 |
| 8 | 720 | 89 |
| 9 | 750 | 80 |
| 10 | 710 | 85 |
| 11 | 680 | 73 |
| 12 | 660 | 74 |
| 13 | 660 | 83 |
| 14 | 500 | 68 |
| 15 | 540 | 54 |
| 16 | 580 | 61 |
| 17 | 620 | 60 |
| 18 | 660 | 112 |
| 19 | 700 | 83 |
| 20 | 750 | 60 |