

Faculty of Management Studies, University of Delhi

MBA (FT) I Year, Semester-I

Year 2013-2014

Time: 3 hours

MBAFT: 6102 Quantitative Methods

Max. Marks: 50

INSTRUCTIONS

- 1 This is a Close-book examination. You are allowed to carry probability distribution tables. Electronic calculator is allowed.
- 2 This question paper contains four pages.
- 3 Attempt any FIVE questions selecting at least TWO from each Section. All questions carry equal marks.

Section A

- 1(a). A market research firm used a sample of individuals to rate the purchase potential of a particular product before and after the individuals saw a new television commercial about the product. The purchase potential ratings were based on 0 to 10 scale, with higher values indicating a higher purchase potential. Test the hypothesis that the commercial improved the mean purchase potential rating. Use level of significance 5% and comment on the value of the commercial.

Individual: 1 2 3 4 5 6 7 8

Purchase rating: 6 6 7 4 3 9 7 6

After

Purchase rating: 5 4 7 3 5 8 5 6

Before

- (b) Conduct a statistical test to determine is a significant difference between the Mean and variances in the bag weights for the two machines. Use a 10% level of significance when weights are normally distributed. What is your conclusion? Which machine, if either, provides the greater opportunity for quality improvements?

	No of Observations	Mean	Standard Deviation
Machine 1	25	5.9	2
Machine 2	22	6.3	1.9

(10)

2. The ABC Investment Company is in the business of making bids on investments offered by various firms that desire additional financing. The company has collected the following data on yearly investments and interest rates

Year : 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010

Yearly Investments: 1060 940 920 1110 1590 2050 2070 2030 1780 1420

(thousands of dollars)

Average Interest rates(%): 4.8 5.1 5.9 5.1 4.8 3.8 3.7 4.5 4.9 6.2

Is the relationship between these variables significant? If the average interest rate is 4% five years from now, can yearly investment be forecast?

(10)

- 3(a) Security investments use three methods to select stocks for their portfolio. Test, at 5% level of significance, to determine if there is a significant difference in the rates of return for each method based on the following data.

Portfolio	Rate of return						
A	29	17	14	28	27	22	22
B	27	20	13	15	22	21	20
C	38	28	27	34	32	30	29

- (b) A vending machine automatically pours soft drinks into cups. The amount of soft drink dispensed into a cup is normally distributed with mean 7.6 oz and standard deviation 0.4 oz.

- Estimate the probability that the machine will overflow an 8 oz cup
 - Estimate the probability that the machine will not overflow an 8 oz cup
- The machine has just been loaded with 850 cups. How many of these do you expect will overflow when served?

(10)

Section B

4. Consider the following two LP formulations. Using a graphical approach in each case, determine
- Which formulation has more than one optimal solution? Find out optimal solution from two corner points.
 - Which formulation has an unbounded solution? In which direction the solution is unbounded?

Formulation 1

Maximize $3X + 6Y$

Subject to

$$7X + 6Y \leq 42$$

$$X + 2Y \leq 10$$

$$X \leq 4$$

$$2Y \leq 9$$

$$X, Y \geq 0$$

Formulation 2

$$3X + 6Y \geq 42$$

Subject to

$$X + 2Y \geq 12$$

$$8X + 7Y \geq 56$$

$$2Y \geq 5$$

$$X \leq 9$$

$$X, Y \geq 0$$

5. (a) Morton and Monson Inc. is a small manufacturer of parts for the aerospace industry. The production capacity for the next four months is given as follows:

(10)

Production Capacity in Units

Month	Regular Production	Overtime Production
January	3,000	500
February	2,000	400
March	3,000	600
April	3,500	800

The regular cost of production is \$500 per unit and the cost of overtime production is \$150 per unit in addition to the regular cost of production. The company can utilize inventories to reduce fluctuations in production, but carrying one unit of inventory costs the company \$40 per unit per month. Currently there are no units in inventory. However, the company wants to maintain a minimum safety stock of 100 units of inventory during the months of January, February, and March. The estimated demand for the next four months is as follows:

Month	January	February	March	April
Demand	2,800	3,000	3,500	3,000

The production manager is in the process of preparing a 4-month production schedule. Further the company wants to have 300 units in inventory at the end of April. Formulate the above production scheduling problem as a linear programming problem with a view to minimizing the total cost.

(b) Indian Bank is in the process of devising a loan policy that involves a maximum of Rs.12 Crores. The following table provides the pertinent data about available types of loans.

Type of loan	Interest rate	Bad-debt ratio
Personal	0.140	0.10
Car	0.130	0.07
Home	0.120	0.03
Farm	0.125	0.05
Commercial	0.100	0.02

Bad debts are unrecoverable and produce no interest revenue.

Competition with other financial institutions requires that the bank allocate at least 45% of the funds to farm and commercial loans. To assist the housing industry in the region, home loans must equal at least 40% of the personal, car and home loans. The bank also has stated policy of not allowing the overall ratio of bad debts on all loans to exceed 4%. Formulate the above problem as a linear programming problem with a view to maximizing the net return.

(5+5=10)

6. (a) What is a non-binding constraint? Write the dual associated with the following primal problem:

Maximize $Z = -2X_1 + 3X_2$

Subject to

$$X_1 + 2X_2 \leq 12$$

$$4X_1 - 2X_2 \geq 3$$

$$6X_1 - X_2 = 10$$

$$X_1, X_2 \geq 0$$

(b) For the following LP problem

Maximize $Z = 20X_1 + 12X_2$

Subject to

$$3X_1 + 2X_2 \leq 180 \quad (\text{Raw material 1})$$

$$X_1 \leq 50 \quad (\text{Raw material 2})$$

$$X_2 \leq 51 \quad (\text{Raw material 3})$$

$$X_1, X_2 \geq 0$$

(i) Find out the shadow price of the above raw materials and interpret the same.

- (ii) Which of the changes would have greater impact on the value of the objective function in the final solution: (1) Increase the RHS of second constraint by 10 units & (2) Increase the RHS of third constraint by 40 units. (4+6=10)

7. (a) A company manufactures three different products: A, B and C. The per-unit profit margins for the three products are Rs. 60, Rs 100 and Rs. 50. The products could be manufactured using one of the two processes. The per-unit production requirements for each product for each process is given in the following table:

Per-unit production requirements				
Process	Product A	Product B	Product C	Total Hrs per week
Process 1	4 hours	6 hours	3 hours	2000
Process 2	5 hours	7 hours	4 hours	2400

The demand for product A is predicted to be between 50 and 100 units per week, demand for product B is predicted to be within 150 and 200 units per week and demand for product C is within 100 and 150 units per week.

If the company decides to use process 1, it will incur a setup cost of Rs. 1000 and the setup will take 24 hours. If the company decides to use process 2, it will incur a setup cost of Rs. 800 and the setup will take 18 hours. Formulate the above problem as an integer linear programming problem with a view to maximizing the profit.

- (b) Solve the following integer linear programming problem by Branch and Bound method:

$$\text{Max } Z = 7X_1 + 9X_2$$

Subject to

$$-X_1 + 3X_2 \leq 6$$

$$7X_1 + X_2 \leq 35$$

$$X_1, X_2 \geq 0 \text{ \& integers}$$

$$(5+5 = 10)$$