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Second Semester MBA Degree Examination, June/July 2011
Quantitative Techniques for Management

Time: 3 hrs.

Max. Marks:100

Note: 1. Answer any FIVE full questions.
2. Use of statistical tables and calculators is allowed.

- 1 a. What do you mean by operations research? (03 Marks)
 b. Describe any five models used in operations research. (07 Marks)
 c. ABC Co. Ltd, is using a machine whose purchase price is Rs.13000. The installation charge is Rs.3600 and the machine has scrap value of only Rs.1,600. The maintenance cost in various years are :

| | | | | | | | | | |
|------------|-----|-----|------|------|------|------|------|------|------|
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Cost (Rs.) | 250 | 750 | 1000 | 1500 | 2100 | 2900 | 4000 | 4800 | 6000 |

Calculate the optimal replacement period on economic consideration, assuming that replacement can be done only at the year ends. (10 Marks)

- 2 a. Explain zero sum game. (03 Marks)
 b. Solve the following game using rule of dominance :

$$\begin{bmatrix} 2 & -2 & 4 & 1 \\ 6 & 1 & 12 & 3 \\ -3 & 2 & 0 & 6 \\ 2 & -3 & 7 & 1 \end{bmatrix}$$

(07 Marks)

- c. Solve by graphical method :
 Maximize, $Z = 8x_1 + 16x_2$
 Subject to $x_1 + x_2 \leq 200$, $x_2 \leq 125$, $3x_1 + 6x_2 \leq 900$, $x_1, x_2 \geq 0$. (10 Marks)

- 3 a. What do you mean by PERT and CPM? (03 Marks)
 b. Explain and compare replacement policy for gradually deteriorating items and for suddenly failing items. (07 Marks)
 c. Solve the following game using graphical approach : (10 Marks)

| | | | | | |
|--------------|----------------|----------------|----------------|----------------|----------------|
| | | B's strategy | | | |
| | | b ₁ | b ₂ | b ₃ | b ₄ |
| A's strategy | a ₁ | 8 | 5 | -7 | 9 |
| | a ₂ | -6 | 6 | 4 | -2 |

- 4 a. Write a note on structure of queuing system. (03 Marks)
 b. Explain the process or phases of simulation. (07 Marks)
 c. Find the optimal solution for the cost and supply/demand matrix using VAM for this transportation problem: (10 Marks)

| | | | | | |
|----------------|----------------|----------------|----------------|----------------|--------|
| Supply Points | Destinations | | | | Supply |
| | D ₁ | D ₂ | D ₃ | D ₄ | |
| P ₁ | 19 | 30 | 50 | 12 | 7 |
| P ₂ | 70 | 30 | 40 | 60 | 10 |
| P ₃ | 40 | 10 | 60 | 20 | 18 |
| Demand | 5 | 8 | 7 | 15 | 35 |

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. 2. Any revealing of identification, or use of calculator and/or equations written eg, 42+8 = 50 will be treated as malpractice.

- 5 a. What are the limitations of OR? (03 Marks)
 b. Discuss the scope of LPP in the field of management. (07 Marks)
 c. Consider the network data given below. Calculate the slacks for the events and determine the critical path. (10 Marks)

| | | | | | | | | | | | |
|-----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Activities | 1-2 | 1-3 | 1-4 | 2-5 | 3-5 | 3-6 | 3-7 | 4-6 | 5-7 | 6-8 | 7-8 |
| Duration (days) | 2 | 7 | 8 | 3 | 6 | 10 | 4 | 6 | 2 | 5 | 6 |

- 6 a. What do you mean by simulation? (03 Marks)
 b. Explain deterministic and probabilistic queuing models. (07 Marks)
 c. A company manufactures around 150 mopeds. The daily production varies from 146 to 154 depending upon the viability of raw materials and other working conditions.

| | | | | | | | | | |
|----------------|------|------|------|------|------|------|------|------|------|
| Production/day | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 |
| Probability | 0.04 | 0.09 | 0.12 | 0.14 | 0.11 | 0.10 | 0.20 | 0.12 | 0.08 |

The finished mopeds are transported in a specially arranged lorry accommodating only 150 mopeds. Using following random numbers 80, 81, 76, 75, 64, 43, 18, 26, 10, 12, 65, 68, 69, 61, 57 simulate the process to find out :

- i) What will be the average number of mopeds waiting in the factory?
 ii) What will be the average number of empty spaces on the lorry? (10 Marks)
- 7 a. What are the applications of assignment problem? (03 Marks)
 b. Explain any two methods of solving transportation problem. (07 Marks)
 c. A production supervisor is considering how he should assign the four jobs that are to be performed, to four of the workers. Based on the information given below, he wants to assign jobs to the workers such that the aggregate time to perform the jobs is the least. Using HAM find the optimal solution. (10 Marks)

Time taken (in minutes) by 4 workers

| Workers | Job | | | |
|---------|-----|----|----|----|
| | A | B | C | D |
| 1 | 45 | 40 | 51 | 67 |
| 2 | 57 | 42 | 63 | 55 |
| 3 | 49 | 52 | 48 | 64 |
| 4 | 41 | 45 | 60 | 55 |

- 8 a. Solve the following game using analytical method :

$$\begin{bmatrix} 9 & -7 \\ 6 & 7 \end{bmatrix}$$

(05 Marks)

- b. Write the dual of the following LPP :

Minimize, $Z_x = 3x_1 - 2x_2 + 4x_3$

Subject to constraints, $3x_1 + 5x_2 + 4x_3 \geq 7$

$6x_1 + x_2 + 3x_3 \geq 4$

$7x_1 - 2x_2 - x_3 \leq 10$

$x_1 - 2x_2 + 5x_3 \geq 3$

$4x_1 + 7x_2 - 2x_3 \geq 2$

$x_1, x_2, x_3 \geq 0$

(15 Marks)

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08MBA21

Second Semester MBA Degree Examination, June/July 2011
Quantitative Techniques for Management

Time: 3 hrs.

Max. Marks:100

Note: Answer any FIVE full questions.

- 1 a. Define operations research. Mention the characteristics of OR. (03 Marks)
 b. Give a description of various types of models. (07 Marks)
 c. A firm uses Lathes, milling and grinding machines to produce two types of equipments A and B. Equipment A requires 12 hours on lathe, 4 hours on milling and 2 hours on grinding machine. Equipment B requires 6 hours on lathe, 10 hours on milling and 3 hours on grinding machine. The total available time on each machine are 6000 hours on lathe, 4000 hours on milling and 1800 hours on grinding machine. Equipment A fetches a profit of Rs.400 per unit and equipment B fetches a profit of Rs.1000 per unit. Formulate the above problem as a LPP and solve it graphically. (10 Marks)

- 2 a. Write the dual of the following LPP:
 Minimize $Z = 10x_1 + 2x_2$ (03 Marks)
 subject to $3x_1 + 2x_2 \geq 18$; $x_1 + 3x_2 \geq 8$
 $2x_1 - x_2 \leq 6$ and $x_1, x_2 \geq 0$

- b. Solve the assignment problem for optimal solution using HAM. (07 Marks)

| Worker | Job | | | |
|--------|-----|----|----|----|
| | A | B | C | D |
| 1 | 45 | 40 | 51 | 67 |
| 2 | 57 | 42 | 63 | 55 |
| 3 | 49 | 52 | 48 | 64 |
| 4 | 41 | 45 | 60 | 55 |

- c. The transportation cost matrix for a given situation for supply of the commodity from sources A, B, C to points of usage P, Q, R is given below:

| | P | Q | R | Supply |
|--------|----|-----|----|--------|
| A | 4 | 8 | 8 | 76 |
| B | 16 | 24 | 16 | 82 |
| C | 8 | 16 | 24 | 77 |
| Demand | 72 | 102 | 41 | |

- i) Work out the initial basic feasible solution by VAM. ii) Does this problem have more than one optimal solution? If so, show all of them. (10 Marks)

- 3 a. Explain pure strategy, mixed strategy and saddle point with reference to game theory. (03 Marks)

- b. A typist at an office receives, on an average 22 letters per day of typing. The typist works 8 hours a day and it takes on an average 20 minutes to type a letter. i) What is the typist's utilization rate? ii) What is the average number of letters waiting to be typed? iii) What is the average waiting time needed to have a letter typed? (07 Marks)

- c. The following table lists the jobs of a project with their time estimates

| Job | 1-2 | 1-6 | 2-3 | 2-4 | 3-5 | 4-5 | 5-8 | 6-7 | 7-8 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| to (days) | 3 | 2 | 6 | 2 | 5 | 3 | 1 | 3 | 4 |
| tm (days) | 6 | 5 | 12 | 5 | 11 | 6 | 4 | 9 | 19 |
| tp (days) | 15 | 14 | 30 | 8 | 17 | 15 | 7 | 27 | 28 |

Important Note : 1. On completing your answers, carefully draw diagonal cross lines on the remaining blank pages. 2. Any revealing of identification, appeal to evaluator and/or equations written eg, 42+8 = 50, will be treated as malpractice.

i) Draw the project network. ii) Calculate length and variance of the critical path. iii) What is the probability that the jobs on critical path will be completed by the due date of 42 days? The table of area of the normal curve at selected values is as follows: (10 Marks)

| | | | |
|------|--------|--------|--------|
| Z | 1.1 | 1.2 | 1.3 |
| Area | 0.3643 | 0.3849 | 0.4032 |

- 4 a. State the assumption made in solving sequencing problems. (03 Marks)
 b. Explain i) PERT. ii) Total float. iii) Independent float. iv) Crashing. (07 Marks)
 c. Solve the following game graphically (10 Marks)

B's Strategy

A's Strategy

| | | |
|----------------|----------------|----------------|
| | b ₁ | b ₂ |
| a ₁ | -7 | 6 |
| a ₂ | 7 | -4 |
| a ₃ | -4 | -2 |
| a ₄ | 8 | -6 |

(10 Marks)

- 5 a. Write the general structure of a transportation problem. (03 Marks)
 b. Seven jobs are required to be processed through two machines A and B. the processing time (in hours) of each job on the two machines is given below.

| Job | Processing time (hrs) | |
|-----|-----------------------|-----------|
| | Machine A | Machine B |
| 1 | 10 | 5 |
| 2 | 20 | 21 |
| 3 | 5 | 4 |
| 4 | 25 | 15 |
| 5 | 15 | 14 |
| 6 | 12 | 12 |
| 7 | 6 | 9 |

- Suggest optimal sequence of processing the jobs and total minimum elapsed time. (07 Marks)
 c. Solve graphically the following LPP.

Maximize $Z = 10x_1 - 4x_2$

subject to $2x_1 - 6x_2 \leq 0$; $-x_1 + 2x_2 \geq -2$

$-3x_1 - 3x_2 \geq -24$; $x_1 \geq 2$ and $x_1, x_2 \geq 0$

Also write the dual of the above LPP.

(10 Marks)

- 6 a. Distinguish between assignment problem and transportation problem. (03 Marks)
 b. Explain the characteristics of queuing system. (07 Marks)
 c. A firm owns facilities at six places. It has manufacturing plants at places A, B and C with daily production of 50, 40 and 60 units. At point D, E and F it has three warehouses with daily demands of 20, 95 and 35 units respectively. Per unit shipping costs are given in the following table.

| | | Warehouse | | |
|-------|---|-----------|---|---|
| | | D | E | F |
| Plant | A | 6 | 4 | 1 |
| | B | 3 | 8 | 7 |
| | C | 4 | 4 | 2 |

- i) Obtain the IBFS (Initial Basic Feasible Solution) by North west corner rule. ii) Is this IBFS optimal? If not, obtain the optimal solution. (10 Marks)

- 7 a. "When it becomes difficult to use optimization technique for solving a problem, one has to resort to simulation". Discuss. (03 Marks)
- b. Find the optimal strategies for A and B in the following game. Also obtain the value of the game. (07 Marks)

B's Strategy

| | | | | |
|--------------|----------------|----------------|----------------|----|
| | b ₁ | b ₂ | b ₃ | |
| A's Strategy | a ₁ | 9 | 8 | -7 |
| | a ₂ | 3 | -6 | 4 |
| | a ₃ | 6 | 7 | -7 |

- c. Following are activities in a construction project:

| Activity | 1-2 | 1-3 | 2-4 | 2-6 | 3-4 | 4-5 | 4-6 | 5-7 | 6-7 | 7-8 |
|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Normal Time(days) | 10 | 11 | 13 | 14 | 10 | 7 | 17 | 13 | 9 | 1 |

- i) Draw the network diagram. ii) Find out total float and free float for each activity. (10 Marks)

- 8 a. Describe simulation process. (05 Marks)
- b. Divya scientific laboratories has two different assembly lines to produce its most popular product 'Pressurex'. The processing time for each of the assembly lines is regarded as a random variable and is described as follows.

| Processing Time(min) | Assembly A ₁ | Assembly A ₂ |
|----------------------|-------------------------|-------------------------|
| 10 | 0.10 | 0.20 |
| 11 | 0.15 | 0.40 |
| 12 | 0.40 | 0.20 |
| 13 | 0.25 | 0.15 |
| 14 | 0.10 | 0.05 |

Using the following random numbers, simulate the data on process times for 15 units of the item and compute the expected process time for the product. For the purpose read the numbers vertically taking the first two digits for the processing time on assembly A₁ and the last two digits for processing time on assembly A₂.

| | | | | |
|------|------|------|------|------|
| 4134 | 8345 | 3602 | 7505 | 7428 |
| 7476 | 1183 | 9445 | 0089 | 3424 |
| 4943 | 1915 | 5415 | 0880 | 9309 |

(15 Marks)



Second Semester MBA Degree Examination, June/July 2011
Quantitative Techniques for Management

Time: 3 hrs.

Max. Marks:100

Note: 1. Answer any FIVE full questions.
2. Use of statistical tables is permitted.

- 1 a. Give the main characteristics of operation research. (03 Marks)
 b. Discuss the various phases in solving an operation research problem. (07 Marks)
 c. What is model? Discuss various classifications of models in operation research. (10 Marks)
- 2 a. Explain some special cases in graphical method with an illustration. (03 Marks)
 b. An agriculturist has a 125 acre farm. He produces radish, mutter and potato. Whatever he raises is sold fully in the market. He gets Rs.5/kg for radish, Rs.4/kg for mutter and Rs.5/kg for potato. The average/acre yield is 1500 kg of radish, 1800 kg of mutter and 1200 kg of potato. To produce each 100 kg of radish and mutter and 80 kg of potato a sum of Rs.12.50 has to be used for manure. Labour required for each acre to raise the crop is 6 man-days for radish and potato each and 5 man-days for mutter. Formulate this as a LPP model to maximize the agriculturist total profit. (07 Marks)
 c. Solve the given problem by graphical method.
 Maximize $Z = 0.10x_1 + 0.20x_2$
 Subject to constraints, $x_1 + x_2 \leq 100000$
 $x_1 \leq 75000$
 $x_2 \leq 75000$
 $-2x_1 + 3x_2 \leq 0$
 $-2x_1 + 8x_2 \geq 0$
 $x_1, x_2 \geq 0$ (10 Marks)
- 3 a. Briefly explain the general structure of Queuing model with a neat sketch. (03 Marks)
 b. "When it becomes difficult to use the optimization technique for solving problem, one has to resort to simulation technique". Discuss. (07 Marks)
 c. Obtain the dual of following LPP:
 Maximize $Z = 3x_1 + 4x_2 + 7x_3$
 Subjected to constraints, $x_1 + x_2 + x_3 \leq 10$
 $4x_1 - x_2 - x_3 \geq 15$
 $x_1 + x_2 + x_3 = 7$
 where $x_1, x_2 \geq 0$ and x_3 is unrestricted. (10 Marks)
- 4 a. Solve the following transportation problem for maximum profit by using VAM. (10 Marks)

Per Unit Profit (Rs.)

| Warehouse | | Market | | | | Availability (Units) |
|------------------------------|--|--------|-----|-----|-----|-------------------------|
| | | A | B | C | D | |
| X | | 12 | 18 | 6 | 25 | 200 |
| Y | | 8 | 7 | 10 | 18 | 300 |
| Z | | 14 | 3 | 11 | 20 | 300 |
| Demand in the market (Units) | | 180 | 320 | 100 | 400 | |

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
 2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

- b. You are given the information about the cost of performing different jobs by different persons. The job person making 'X' indicates that the individual involved cannot perform the particular job. Using the information, state

i) Optimal assignment of jobs and ii) The cost of such assignment.

(10 Marks)

| Person | Job | | | | |
|----------------|----------------|----------------|----------------|----------------|----------------|
| | J ₁ | J ₂ | J ₃ | J ₄ | J ₅ |
| P ₁ | 27 | 18 | X | 20 | 21 |
| P ₂ | 31 | 24 | 21 | 12 | 17 |
| P ₃ | 20 | 17 | 20 | X | 16 |
| P ₄ | 22 | 28 | 20 | 16 | 27 |

- 5 a. List some general assumptions of sequencing problem. (03 Marks)

- b. Find the optimal strategy for A & B in the following game. Also obtain the value of the game. (07 Marks)

| | | B's strategy | | |
|--------------|----------------|----------------|----------------|----------------|
| | | b ₁ | b ₂ | b ₃ |
| A's strategy | a ₁ | 9 | 8 | -7 |
| | a ₂ | 3 | -6 | 4 |
| | a ₃ | 6 | 7 | 7 |

- c. A book binder has one printing press and one binding machine and manuscripts of different books. The time in manuscripts of different books. The time in minutes required for printing and binding is known. Determine the order in which the books should be processed in order to minimize total time require to process all the books. Also clearly state the algorithm you use.

| Book | 1 | 2 | 3 | 4 | 5 |
|---------------|----|----|----|----|----|
| Printing time | 40 | 90 | 80 | 60 | 50 |
| Binding time | 50 | 60 | 20 | 30 | 40 |

Suppose that an additional operation of finishing is added to the process. Describe the time in minutes required for the operations given below:

| Book | 1 | 2 | 3 | 4 | 5 |
|----------------|----|-----|----|----|-----|
| Finishing time | 80 | 100 | 60 | 70 | 110 |

What is the order in which the book should be processed? Also determine minimal total elapsed time. (10 Marks)

- 6 a. Elucidate striking difference between infeasibility v/s unboundedness. (03 Marks)

- b. List some noticeable differences between PERT and CPM. (07 Marks)

- c. A project consists of nine activities whose time estimates (in weeks) and other characteristics are given below:

| Activity | Preceding Activity | Time estimates (in weeks) | | |
|----------|--------------------|---------------------------|------------|------------------|
| | | Most optimistic | Mot likely | Most pessimistic |
| A | - | 2 | 4 | 6 |
| B | - | 6 | 6 | 6 |
| C | - | 6 | 12 | 24 |
| D | A | 2 | 5 | 8 |
| E | A | 11 | 14 | 23 |
| F | B, D | 8 | 10 | 12 |
| G | B, D | 3 | 6 | 9 |
| H | C, F | 9 | 15 | 27 |
| I | E | 4 | 10 | 16 |

- i) Draw the network for the project and find the expected project completion time.
 ii) What is the probability of completing the project one week before the expected time?
 iii) If the probability of completing the project is 95% sure of meeting deadline, find the due date. (10 Marks)

- 7 a. What is degeneracy? (03 Marks)
 b. Solve the following game using graphical method. (07 Marks)

| | | | | | |
|--------------|----------------|----------------|----------------|----------------|----------------|
| | | B's strategy | | | |
| | | b ₁ | b ₂ | b ₃ | b ₄ |
| A's strategy | a ₁ | 8 | 5 | -7 | 9 |
| | a ₂ | -6 | 6 | 4 | -2 |

- c. The rate of arrival of customers at a public telephone follows Poisson distribution, with an average time of ten minutes between one customer and the next. The duration of a phone call is assumed to follow exponential distribution with a mean time of three minutes.
- i) What is the probability that a person arriving at the booth will have to wait?
 - ii) What is the average length of queue?
 - iii) The Mahanagar Telephone Nigam Ltd. will install another booth when it is convinced that the customers would have to wait for atleast three minutes for their turn to make a call. How much should be the flow of customers in order to justify a second booth? (10 Marks)

- 8 a. The following table gives that the list of activity with their duration in days:
- i) Draw a project network and calculate early start, late start, early finish, late finish, total slack, free slack.
 - ii) Mark the critical path. What is the project duration? (10 Marks)

| | | | | | | | | | | | |
|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Activity | 1-2 | 1-6 | 2-3 | 2-4 | 3-4 | 3-5 | 4-5 | 4-6 | 5-8 | 6-7 | 7-8 |
| Duration in days | 4 | 5 | 3 | 5 | 2 | 4 | 7 | 5 | 4 | 2 | 3 |

- b. The occurrence of rain in a city on a day is dependent upon whether it rained on the previous day. If it rained on the previous day, the rain distribution is given by

| | | | | | | |
|-------------|---------|-----------|-----------|-----------|-----------|-----------|
| Event | No rain | 1 cm rain | 2 cm rain | 3 cm rain | 4 cm rain | 5 cm rain |
| Probability | 0.50 | 0.25 | 0.15 | 0.05 | 0.03 | 0.02 |

If did not rain the previous day, the rain distribution is given by

| | | | | |
|-------------|---------|-----------|-----------|-----------|
| Event | No rain | 1 cm rain | 2 cm rain | 3 cm rain |
| Probability | 0.75 | 0.15 | 0.06 | 0.04 |

Simulate the city's weather by 10 days and determine by simulation the total days without rain as well as the total rainfall during the period. Use the following random numbers:

67, 63, 39, 55, 29, 78, 70, 06, 78, 76.

for simulation. Assume that for the first day of the simulation it had not rained the day before. (10 Marks)

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