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05MBA21

Second Semester MBA Degree Examination, December 2010
Quantitative Techniques for Management

Time: 3 hrs.

Max. Marks:100

Note: Answer any FIVE full questions.

- 1 a. Explain the rule of dominance for mixed strategy of games. (03 Marks)
 b. Describe the process of problem solving in operations research, with a diagram. (07 Marks)
 c. Solve the following linear programming problem using graphical method:

$$\text{Maximize } z = 10x_1 + 15x_2$$

$$\text{Subject to } 2x_1 + x_2 \leq 26$$

$$2x_1 + 4x_2 \leq 56$$

$$x_1 - x_2 \geq -5$$

$$x_1, x_2 \geq 0$$

(10 Marks)

- 2 a. What do you understand by the critical path? How does it help the project manager? (03 Marks)
 b. Explain the terms saddle point, pure strategy and mixed strategy. (07 Marks)
 c. Solve the following assignment problem for maximization. There are four mechanics available to assign jobs for the day. There are five jobs offered with expected profit for each mechanic for each job as follows:

| | | | | | | |
|----------|---|----|----|-----|-----|----|
| | | A | B | C | D | E |
| Maximise | 1 | 62 | 78 | 50 | 111 | 82 |
| | 2 | 71 | 84 | 61 | 73 | 59 |
| | 3 | 87 | 92 | 111 | 71 | 81 |
| | 4 | 48 | 64 | 87 | 77 | 80 |

Find the assignment that given maximum profit to the mechanics and compute the total profit. Which job has to be declined? (10 Marks)

- 3 a. What is a random number? How is it generated? (03 Marks)
 b. Explain the terms total float, free float and crashing of an activity. (07 Marks)
 c. The data on the operating costs per year and resale price of equipment, whose purchase price is Rs.10000, are given:

| | | | | | | | |
|----------------------|------|------|------|------|------|------|------|
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Operating cost (Rs.) | 1500 | 1900 | 2300 | 2900 | 3600 | 4500 | 5500 |
| Resale value (Rs.) | 5000 | 2500 | 1250 | 600 | 400 | 400 | 400 |

- i) What is the optimum period of replacement?
 ii) When the equipment is 2 years old, a new model is available with an average cost of Rs.3600 and optimum period for replacement is 4 years. Should we change the equipment? If so when? (10 Marks)
- 4 a. What is the replacement problem? What are the types of replacement? (03 Marks)
 b. Explain the components and characteristics of a queuing system. What are the queuing rules (policies) in practice? (07 Marks)
 c. For the following project: i) Draw the network diagram ii) Calculate total float and free float iii) Determine the critical path and the duration for the critical path. (10 Marks)

| | | | | | | | | | | | | |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| Activity | 1-2 | 1-3 | 2-4 | 3-4 | 3-5 | 4-9 | 5-6 | 5-7 | 6-8 | 7-8 | 8-10 | 9-10 |
| Time (days) | 4 | 1 | 1 | 1 | 6 | 5 | 4 | 8 | 1 | 2 | 5 | 7 |

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

- 5 a. Bring out the differences between PERT and CPM. (03 Marks)
 b. Solve the following (2, n) game using graphical method: (07 Marks)

| | | | |
|-------|-------|-------|-------|
| | b_1 | b_2 | b_3 |
| a_1 | 6 | 4 | 3 |
| a_2 | 2 | 4 | 8 |

- c. A manufacturing company keeps stock of a special product. Previous experience indicates the daily demand as given below:

| | | | | | | |
|--------------|------|------|------|------|------|------|
| Daily Demand | 5 | 10 | 15 | 20 | 25 | 30 |
| Probability | 0.01 | 0.20 | 0.15 | 0.50 | 0.12 | 0.02 |

- i) Calculate tag numbers based on cumulative probability.
 ii) Simulate the demand for 10 days based on random numbers given : 88, 96, 18, 95, 20, 84, 56, 11, 52, 03.
 iii) Compute the total demand for 10 days and average demand for a day. (10 Marks)
- 6 a. What are the advantages of a model in operations research? (03 Marks)
 b. Explain the steps involved in solving a mX2 game matrix graphically. Write down the strategies and value of the game. (07 Marks)
 c. Solve the following transportation problem using least cost method for initial feasible solution and MODI method for optimal solution.

Cost Table

| | | | | |
|--------|----|----|----|--------|
| | X | Y | Z | Supply |
| A | 8 | 7 | 3 | 60 |
| B | 3 | 8 | 9 | 70 |
| C | 11 | 3 | 5 | 80 |
| Demand | 50 | 80 | 80 | 210 |

A, B, C are plants
 X, Y, Z are Ware houses

Find the allocation, so that the total transportation cost is minimum. (10 Marks)

- 7 a. How would you formulate an LP problem to minimize cost (z) with decision variables x_1, x_2, x_3 ? (03 Marks)
 b. Describe Monte Carlo simulation steps. (07 Marks)
 c. Formulate the dual of the following LP problem :

Maximize $z = 8x_1 + 10x_2 + 5x_3$

Subject to $x_1 - x_3 \leq 4$

$2x_1 + 4x_2 \leq 12$

$x_1 + x_2 + x_3 \geq 2$

$3x_1 + 2x_2 - x_3 = 8$

$x_1, x_2, x_3 \geq 0$

(10 Marks)

- 8 a. What is an unbalanced transportation problem? How is it balanced? (05 Marks)
 b. What are the applications of queuing models? Mention two examples from real life situations, giving details on arrival features, service features, etc. (05 Marks)
 c. At a petrol pump, customers arrive according to a Poisson process with an average time of 5 minutes between arrivals. The service time is exponentially distributed with mean time = 2 minutes. Find out the following:
 i) Average queue length.
 ii) Average number of customers in the queuing system.
 iii) Average time spent by a car in the petrol pump.
 iv) Average time wasted by a car before receiving petrol. What is the queuing model? (10 Marks)

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Note: 1. Answer any FIVE full questions.
2. Normal tables may be used.

- 1 a. What are the steps in O.R. problem solving? (03 Marks)
 b. What are the management applications of O.R? (07 Marks)
 c. A farmer wants to find the optimal cropping pattern in the area of 25 thousand acres. The crops are:

| | Water consumption (in feet/acre) | Profit per acre (Rs.) |
|-------|----------------------------------|-----------------------|
| Wheat | 9 | 2000 |
| Maize | 6 | 1500 |
| Jowar | 6.5 | 1200 |

He can't use more than 50% of land for wheat. Available water is 50,000 feet. At least 20% of land must be for maize. The ratio of land devoted to wheat and jowar should not be more than 3:2. Formulate the LPP. (10 Marks)

- 2 a. Give the statement of the transportation problem. (03 Marks)
 b. Briefly explain the models used in O.R. (07 Marks)
 c. Solve the following transport problem for maximum profit (in Rs.): (10 Marks)

| | Supply | | | | |
|--------|--------|-----|-----|-----|-----|
| | 12 | 18 | 6 | 25 | 200 |
| | 8 | 7 | 10 | 18 | 500 |
| | 14 | 3 | 11 | 20 | 300 |
| Demand | 180 | 320 | 100 | 400 | |

- 3 a. What are the advantages of LPP techniques? (03 Marks)
 b. Write the dual of the following:
 Maximize $Z = 7x_1 + 5x_2 - 2x_3$
 Subject to constraints, $x_1 + x_2 + 3x_3 = 10$; $3x_1 + x_2 - 2x_3 \geq 20$
 $2x_1 - x_2 + 3x_3 \leq 16$; $x_1, x_2 \geq 0, x_3$ unrestricted. (07 Marks)
 c. Solve graphically,
 Maximize $Z = 10x_1 + 15x_2$
 Subject to constraints, $2x_1 + x_2 \leq 26$; $x_1 - x_2 \geq -5$
 $2x_1 + 4x_2 \leq 56$; $x_1, x_2 \geq 0$. (10 Marks)
- 4 a. What are the common errors in drawing a network? (03 Marks)
 b. Solve the following assignment problem by HAM: (07 Marks)

| | | Jobs | | | |
|-----|---|----------------|----------------|----------------|----------------|
| | | J ₁ | J ₂ | J ₃ | J ₄ |
| Men | 1 | 12 | 30 | 21 | 15 |
| | 2 | 18 | 33 | 9 | 31 |
| | 3 | 44 | 25 | 24 | 21 |
| | 4 | 23 | 30 | 28 | 14 |

c. Calculate the total float, find the critical path and the project duration. [Refer Fig.Q4(c)]

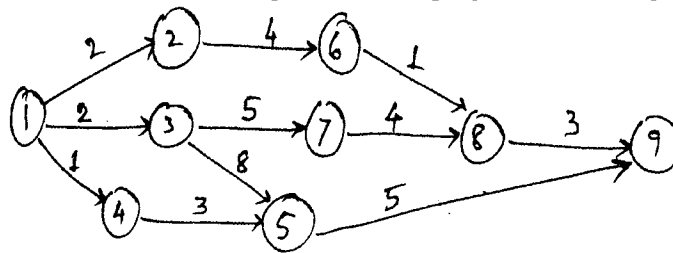


Fig.Q4(c)

(10 Marks)

- 5 a. What are the assumptions in solving sequencing problems? (03 Marks)
 b. Processing times of jobs on three machines are given. Find the optimal sequence of jobs and idle time of machines 2 and 3. (07 Marks)

| Machines \ Jobs | A | B | C | D | E | F | G |
|-----------------|---|---|---|----|---|---|----|
| M1 | 3 | 8 | 7 | 4 | 9 | 8 | 7 |
| M2 | 4 | 3 | 2 | 5 | 1 | 4 | 3 |
| M3 | 6 | 7 | 5 | 11 | 5 | 6 | 12 |

c. On an average 96 patients per 24 hour day require the service of a clinic. A patient on an average, requires 10 minutes of attention. Clinic can handle only one emergency at a time. It costs the clinic Rs.100 per patient treated to serve in 10 minutes and each minute of decrease in average time costs Rs. 10 per patient treated. How much should be budgeted to reduce average size of queue to 0.5 patients? (10 Marks)

- 6 a. Explain the rules of drawing a network and Fulkerson's rule of labelling. (05 Marks)
 b. A project has following tasks : (Time in weeks)

| | A | B | C | D | E | F | G | H | I |
|-------|----|----|----|----|----|----|----|---|---|
| t_0 | 5 | 18 | 26 | 16 | 15 | 6 | 7 | 7 | 3 |
| t_p | 10 | 22 | 40 | 20 | 25 | 12 | 12 | 9 | 5 |
| t_m | 8 | 20 | 33 | 18 | 20 | 9 | 10 | 8 | 4 |

Draw the network, find the critical path & probability of completing the project within 41.5 weeks. Given A B C D E F G H I
 1-2 1-3 1-4 2-5 2-6 3-6 4-7 5-7 6-7 (15 Marks)

- 7 a. Define: i) game ii) pure strategy iii) mixed strategy. (03 Marks)
 b. Describe the general structure of the queuing system. (07 Marks)
 c. A firm produces 30 units per day. Sales depends on demand as follows:

| | | | | | | |
|---------------|------|------|------|------|------|------|
| Sales (units) | 27 | 28 | 29 | 30 | 31 | 32 |
| Probability | 0.10 | 0.15 | 0.20 | 0.35 | 0.15 | 0.05 |

The production cost and sales price of each unit is Rs.40 and Rs.50 respectively. Any unsold item is disposed at a loss of Rs.15. There is a penalty of Rs.5 per item, if demand is unmet. Estimate the profit for ten days using random numbers 10, 99, 65, 99, 95, 01, 79, 11, 16, 20. If the firm produces 29 items per day, what is your opinion? (10 Marks)

- 8 a. What is simulation? (03 Marks)
 b. Explain steps in Monte-Carlo simulation. (07 Marks)
 c. Solve the following game by graphical method. (10 Marks)

| | | B | | | |
|---|-------|-------|-------|-------|-------|
| | | b_1 | b_2 | b_3 | b_4 |
| A | a_1 | 8 | 5 | -7 | 9 |
| | a_2 | -6 | 6 | 4 | -2 |
