

Z 4503

M.B.A. DEGREE EXAMINATION, JANUARY 2007.

First Semester

BA 1603 — APPLIED OPERATIONS RESEARCH FOR MANAGEMENT

(Regulations 2005)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define unbounded solution.
2. What is duality? Discuss its advantages.
3. Define degeneracy in transportation problem.
4. Compare transportation problem and assignment problem in terms of achieving feasible and optimal solution passing through iterations.
5. Distinguish between linear programming problem and integer linear programming problem.
6. What is two person zero-sum game?
7. Discuss the role of recursive function in dynamic programming.
8. Define discrete event simulation.
9. Define reneging.
10. Define group replacement.

PART B — (5 × 16 = 80 marks)

11. (a) Solve the following problem using graphical method.

$$\text{Max. } Z = 60x_1 + 90x_2$$

$$x_1 - 2x_2 \leq 40$$

$$2x_1 + 3x_2 \leq 90$$

$$x_1 - x_2 \geq 10$$

$$x_1 + x_2 \geq 0.$$

Or

- (b) Consider the following linear programming problem and solve it using its dual solution.

$$\text{Minimize } Z = 40X_1 + 30X_2 + 25X_3$$

subject to

$$4X_1 + 2X_2 + 5X_3 \geq 30$$

$$3X_1 + 6X_2 + X_3 \geq 20$$

$$X_1 + 3X_2 + 6X_3 \geq 36$$

$$X_1, X_2 \text{ and } X_3 \geq 0.$$

12. (a) Consider the following transshipment problem involving 4 sources and two destinations. The supply values of the sources S_1, S_2, S_3 and S_4 are 200 units, 250 units, 200 units and 450 units, respectively. The demand values of the destinations D_1 and D_2 are 550 units and 550 units, respectively. The transportation cost per unit between different sources and destinations are summarized in the following table. Solve the transshipment problem.

		Destination					
		S_1	S_2	S_3	S_4	D_1	D_2
Source	S_1	0	6	24	7	24	10
	S_2	10	0	6	12	5	20
	S_3	15	20	0	8	45	7
	S_4	18	25	10	0	30	6
	D_1	15	20	60	15	0	10
	D_2	10	25	25	23	4	0

Or

- (b) Solve the following assignment problem using Hungarian method. The matrix entries are processing times in hours.

		Operator				
		1	2	3	4	5
Job	1	20	22	35	22	18
	2	4	26	24	24	7
	3	23	14	17	19	19
	4	17	15	16	18	15
	5	16	19	21	19	25

13. (a) Solve the following integer linear programming problem optimality.

$$\text{Maximize } Z = 8X_1 + 6X_2$$

subject to

$$8X_1 + 4X_2 \leq 85$$

$$3X_1 + 6X_2 \leq 95$$

$$X_1, X_2 \geq 0 \text{ and integers.}$$

Or

- (b) Players A and B play a game in which each player has three coins (20 p, 25 p and 50 p). Each of them selects a coin without the knowledge of the coins is an even number, A wins B's coin. If that sum is an odd number, B wins A's coin.
- (i) Develop a payoff matrix with respect to the player A.
- (ii) Find the optimal strategies for the players.
14. (a) An electronic item has three components in series. So, the reliability of the system is equal to the product of the reliabilities of the three components ($R = r_1 \times r_2 \times r_3$). It is a known fact that the reliability of the system can be improved by providing standby units at extra cost. The details of costs and reliabilities for different number of standby units for each of the components of the system are summarized in the following table.

No. of standby units

Component

	Cost	Reliability	Cost	Reliability	Cost	Reliability
	Rs.		Rs.		Rs.	
1	1	0.70	3	0.85	2	0.85
2	2	0.85	4	0.95	3	0.92
3	3	0.95	6	0.98	5	0.97

The total capital budgeted for this purpose is Rs. 8. Determine the optimal number of standby units for each of the components of the system such that the total reliability of the system is maximized.

Or

- (b) A computer hardware company is planning to start a multi-centre Computer Software Training Organization. The company feels that such attempt would create an awareness of computer usage among public and employees of different organizations which in turn will improve the demand for computer hardwares.

The company has decided to start training centres as per any one of the following options or in a combination of them.

- Starting training centres only in urban areas
- Starting training centres in semi-urban areas
- Starting training centres in other countries.

There are three possible chance events for the demands of its services as listed below.

- High demand
- Medium demand
- Low demand.

The company has listed the following alternatives for consideration.

- (i) Starting training centres in urban areas, semi-urban areas and in other countries simultaneously and continue the business for the next five consecutive years by investing Rs. 50 crores.
- (ii) First starting training centres in urban areas only and continue the business for the next two years by investing Rs. 10 crores.

Then, based on the demand, the company will decide to do any one of the following :

- (1) On high demand,

- the company may start training centres in semi-urban areas and other countries simultaneously and continue the business for another three years by investing Rs. 60 crores. (08)
- the company may not expand the business for the next 3 years.

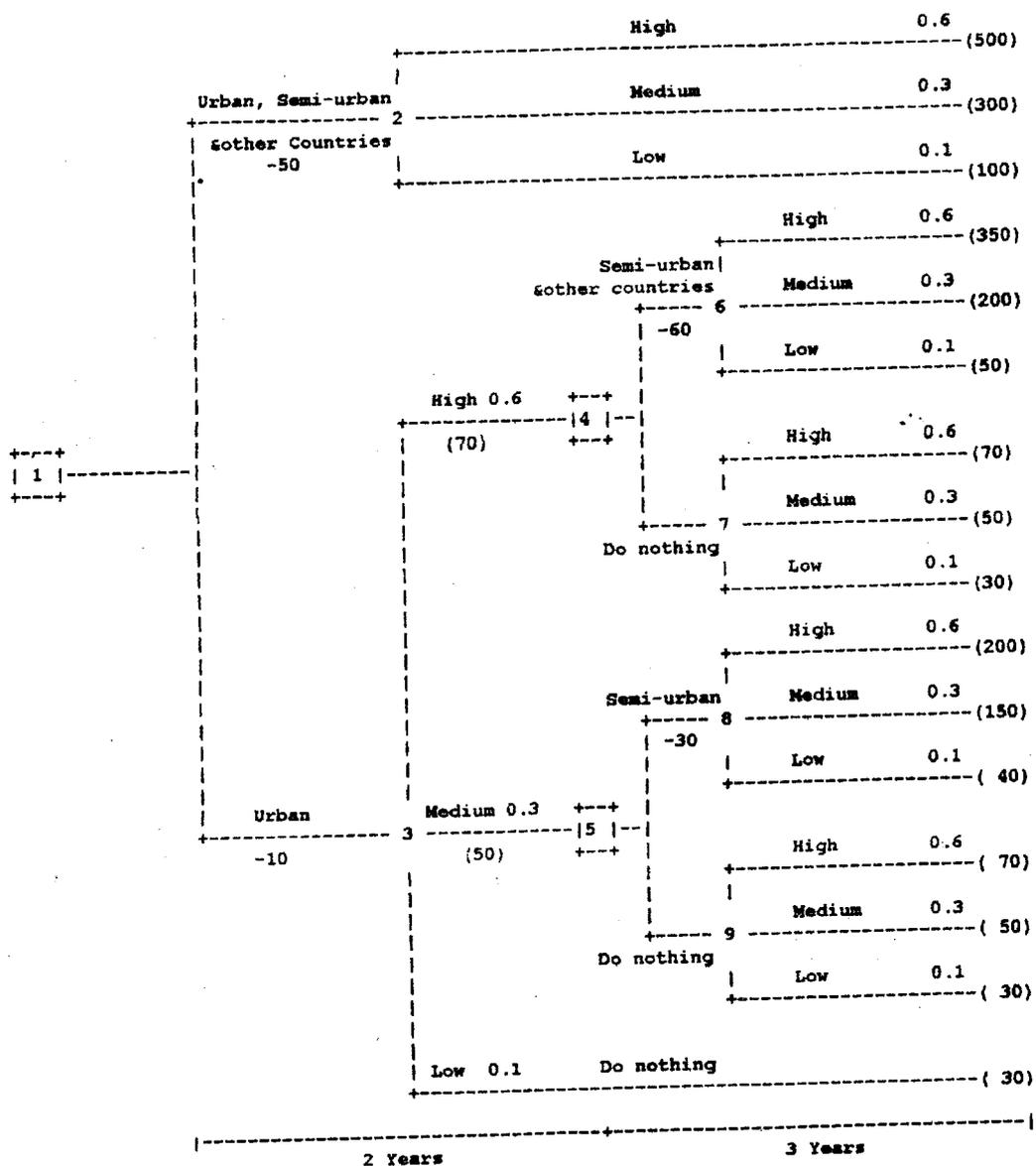
- (2) On medium demand,

- the company may start training centres only in semi-urban areas and continue the business for another 3 years by investing Rs. 30 crores. (08)
- the company may not expand the business for the next 3 years.

- (iii) On low demand, the company may not expand the business for the next 3 years.

Again, there are three possible chance events (high, medium and low) for the demands of its services for each of the decision points in the second stage.

The entire problem with the values of probability of occurrences of the chance events in both stages and the resultant annual revenues generated (in crores of rupees) are shown in the following figure. Revenues are shown within brackets and the investments are shown with minus sign. The decimal values represent probabilities of occurrences of the chance events. Determine the best investment decision using decision tree.



Decision tree of the given problem

15. (a) The arrival rate of breakdown machines at a maintenance shop follows Poisson distribution with a mean of 6 per hour. The service rate of machines by a maintenance mechanic also follows Poisson distribution with a mean of 4 per hour. The down time cost per hour of a breakdown machine is Rs. 300. The labour hour rate is Rs. 60. Determine the optimal number of maintenance mechanics to be employed to repair the machines such that the total cost is minimized.

Or

- (b) An electronic equipment contains 500 resistors. When any resistor fails, it is replaced. The cost of replacing a resistor individually is Rs. 20.00. If all the resistors are replaced at the same time, the cost per resistor is Rs. 5.00. The percent surviving, $S(i)$ at the end of month i is given in the following table.

Month i :	0	1	2	3	4	5
$S(i)$:	100	90	75	55	30	0

What is the optimum replacement plan?