

THE OPEN UNIVERSITY OF SRI LANKA
BACHELOR OF MANAGEMENT STUDIES DEGREE PROGRAMME
LEVEL 06 - 2005/2006
FINAL EXAMINATION - 2006
OPERATIONS RESEARCH - MCU 4202
DURATION : THREE (03) HOURS



Date : 18.06.2006

Time: 9.30 a.m. 12.30 p.m.

ANSWER ANY FIVE QUESTIONS
 GRAPH PAPERS WILL BE PROVIDED

01. Operations research also known as management science techniques are a set of mathematical tools used by managers in their day to day decision making. However, there are limitations to these techniques. What is more important for the managers is to know the capabilities of the techniques and develop the skills of interpreting the management problems so as to match a given technique. Elaborate on this statement in around 200 words giving examples.

02. a. Explain the limitations of graphical method in solving linear programming models.

b. An industry manufactures motor cars and commercial wagons. (They are not manufactured simultaneously). The manufacture of these vehicles has a fixed cost of Rs. 17 millions for cars and Rs. 25 millions for wagons. The profit made on a car is Rs. 1.4 millions and a wagon is Rs. 3 millions. One car would consume Rs. 1.5 millions of capital for raw material and would use 8 hours of manufacturing time. One wagon would consume Rs. 2.0 millions of capital for raw material and would use 5 hours of manufacturing time. There is Rs. 120 millions of capital to purchase raw material and 400 hours of manufacturing time available.

The company has already signed an agreement to supply 10 wagons and has to honour this agreement. The objective of the company is to cover the fixed costs in the earliest possible time and wishes to know how many cars and wagons they should manufacture.

- i. Formulate the linear programming model.
- ii. Solve the problem using graphical method.
- iii. If the manufacturer can negotiate with the company to cancel the agreement of supplying wagons, will it affect the solution? If so what is the change of profit?

03. The final optimal simplex table of a maximization linear programming problem is shown below. The slack variables S_1, S_2, S_3 and S_4 correspond to the resources R_1, R_2, R_3 and R_4 .

C_j C_b	BASIS	SOLUTION	40	35	45	0	0	0	0
			x_1	x_2	x_3	s_1	s_2	s_3	s_4
	s_1	10	$-\frac{1}{2}$					$\frac{1}{2}$	-4
	s_2	60	2					1	-5
	x_3	10	$\frac{1}{2}$					$\frac{1}{2}$	-1
	x_2	30	$\frac{1}{2}$					$-\frac{1}{2}$	2
	Z_j								
	$C_j - Z_j$								

- Copy the above table and complete the blank columns and rows in it.
 - Write down the objective function of the linear programming problem.
 - Is this solution feasible (give reasons)
 - Give reasons as to why it is stated an optimal solution.
 - Write down the optimal solution(or solutions.)
 - What are the remaining resources? How much?
 - What are the shadow prices of resources of the optimal solution?
 - Identify the range of the objective function value of the variable x_2 that will not change the results given in the above table.
04. i. Explain the nature of a transportation problem? Can a manager use this model for his decision making? Explain.
- ii. The World Food Aid programme is engaged in providing food relief to three rehabilitation centers R_1, R_2 and R_3 whose weekly demands are 300, 425 and 275 metric tons respectively. This food aid is supplied by three stores S_1, S_2 and S_3 whose weekly capacities are 275, 550 and 175 metric tons respectively. The cost of transporting one metric ton from a given store to a given rehabilitation center is indicated in the table below.

Cost of transport (Rs.)

	R_1	R_2	R_3
S_1	1	2	7
S_2	4	5	2
S_3	3	6	4

- Find an initial feasible solution to the problem using the north west corner rule method or the least cost method.
- By using the transportation algorithm find the optimal pattern of transporting food aid that would minimize total transportation cost.

05. i. Briefly explain the preliminary requirement for an assignment algorithm.
- ii. Four patients P_1, P_2, P_3 and P_4 suffering from the same illness could be treated with any one of the drugs D_1, D_2, D_3 and D_4 . The impact of the drug depends on the condition of the patient. The time taken to heal when a given drug is introduced to a given patient is explained in the table below (It is assumed that due to limited supply each drug type can be given to only one patient)

Time taken to heal (days)

	D_1	D_2	D_3	D_4
P_1	4	7	5	6
P_2	7	11	5	8
P_3	3	8	2	6
P_4	7	6	1	8

- a. How would you assign the four drugs among the four patients so that the total time taken to heal all four patients is minimum.
- b. Develop the assignment plan if there is a condition that Drug D_3 can not be given to patient P_4
06. At a laboratory, blood samples arrive in a Poisson fashion at the rate of 39 per hour. There is only one technologist who on the average takes 1-1/2 minutes to test one blood sample. The lab works 10 hours a day.
- a. i. Explain the parameters of this problem
- ii. How many hours does the technologist idle per day?
- iii. On the average how many blood samples are there at the laboratory?
- iv. How long will a person have to wait to get the blood report?
- v. How many samples are there ahead of the sample just taken for testing?
- vi. How long will a person have to wait until his sample is taken for testing?

b. The blood samples are put in a freezer as and when they are arrived. If ever the freezer is full the sample is kept outside until there is room in the freezer. The freezer has a capacity to store 50 blood samples.

- i. What is the average time a sample is kept outside freezer?
- ii. What should the minimum capacity of the freezer to ensure that a sample is not kept outside the freezer for more than 10 minutes?

c. Due to close down of a nearby laboratory the number of customer arrivals is expected to increase. Express your view on the equilibrium level of the service facility.

07. a. Explain "critical path" of a network.

b. A project consists of nine activities - A,B H, I, whose precedences and durations are given in the table below.

ACTIVITY	PRECEDANCE	DURATION (DAYS)
A	Project Start	4
B	Project Start	7
C	Project Start	8
D	After "A"	3
E	After "A"	5
F	After "B" and "E"	6
G	After "C"	4
H	After "D" and "F"	5
I	After "G" and "H"	10

- i. Construct the network diagramme.
- ii. Do a time analysis and name the critical path.
- iii. In respect of each activity find EST, EFT, LFT and LST.
- iv. Identify the floats (independent) of all the non-critical activities.
- v. Suppose, due to a machine breakdown the duration of activity (B) is increased by two days. Would this change the project completion date? (Explain with reasons)

standard notations

$$P(n) = \theta^n (1-\theta)$$

$$L_s = \theta / (1-\theta)$$

$$L_q = \theta L_s$$

$$L_s = \lambda W_s$$

$$L_q = \lambda W_q$$

$$\text{Idle time} = H(1-\theta)$$

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