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THE OPEN UNIVERSITY OF SRI LANKA
BACHELOR OF MANAGEMENT STUDIES DEGREE PROGRAMME
LEVEL 06
FINAL EXAMINATION 2011
OPERATIONS RESEARCH – MCU 4202
DURATION: THREE (03) HOURS

DATE : 27.02.2011 ***TIME: 1.30 pm to 4.30 pm***

Instructions

- This Paper carries 7 questions.
- **Answer any FIVE (5) questions.**
- All questions carry equal marks.
- Use of a non-programmable calculator is allocated.

Q1. The following is an incomplete simplex final table of a maximization problem.

C_j / C_b	BASIC	SOLUTION	120	150		
			X_1	X_2	S_1	S_2
	X_1	40			⅔	-½
	X_2	20			⅓	½
	Z					
	$C_j - Z_j$					

i) Copy this table and complete it by filling the blank cages.

ii)
a) Write down the objective function.
b) Is the solution feasible? Give Reasons.
c) Write down the optimal solution. Explain why it is considered to be the optimal solution.
d) Are there multiple optimal solutions? Give Reasons
e) Write down the shadow prices of resources.
f) Write down the range of values of the coefficient of X_1 for which the optimal solution would remain optimal.

Q2. An organization has a monthly budget of Rs. 60,000 for sales promotion work. They hope to advertise both on two media, Media 1 and Media 2. One advertisement in Media1 costs Rs. 4,000 and they have a maximum limit of 10 advertisements per month. One advertisement in Media 2 would cost Rs. 3,000 and they have a maximum limit of 15 advertisements per month. It is estimated that one advertisement on Media1 will attract 8,000 viewers while one advertisement on Media 2 would attract 10,000 viewers. The organization wishes to find how many advertisements should be published on each media so as to maximize the number of viewers attracted.

(i) Formulate the above as a linear programming problem and formulate it as a LP model. (Write down the LP Model)
(ii) Use Graphical method to solve the problem.
(iii) It is now observed that Media1 has improved their programmes and have increased the attracted viewers beyond 8,000. By how much should it increase the viewership to change the optimal solution?

Q3. S_1, S_2 and S_3 are three suppliers of a certain building material whose daily capacities are 30, 40 and 30 tons respectively. W_1, W_2, W_3 and W_4 are four work-sites that use these material and their weekly demands are 20, 20, 25 and 35 tones respectively.

The cost of transporting one ton from a given supplier to a given work site is shown in the table below.

COST OF TRANSPORT (Rs.000)

SUPPLIER	WORK - SITE			
	W_1	W_2	W_3	W_4
S1	7	10	14	8
S2	7	11	12	16
S3	5	6	15	9

(i) Find an initial feasible solution using North –West Corner rule method or least cost method.

(ii) Solve the transportation problem.

(iii) Suppose it is now necessary to purchase material from suppliers and then transport and the purchasing unit price of suppliers S_1, S_2, and S_3 are 2,1 and 3 (measured in Rs. 000), respectively. Show that your present optimal solution still remains optimal even though you need to purchase and transport the material.

Q4. (i) What conditions should be satisfied to solve an assignment problem? Explain.

(ii) Five cranes C_1, C_2, C_3, C_4 and C_5 are located at five different places. These cranes are required at five worksites W_1, W_2, W_3, W_4 and W_5, and one crane for each worksite. The distances between the worksites and the cranes are explained in the table below.

DISTANCE IN "KM"

CRANES	WORK SITES				
	W_1	W_2	W_3	W_4	W_5
C1	10	5	9	18	9
C2	13	19	6	12	14
C3	3	2	4	4	5
C4	18	9	12	17	15
C5	11	6	14	9	10

(a) Use Assignment Theory to find how the cranes should be assigned to the work sites so that the total distance covered by all five cranes is a minimum.

(b) Find the optimal assignment plan that minimize total distance covered if it is told that crane C1 should be assigned to work site W2 and that crane C2 should not be assigned to work site W3.

Q5. A project consists of seven activities A, B, C, D, E, F and G whose precedence, duration in days, cost slope and maximum possible days that could be crashed is explained in the table below (Cost slope is given as "Rs. 000" per day).

ACTIVITY	PRECEDANCE	DURATION DAYS	COST SLOPE (000"/Day)	MAXIMUM POSSIBLE DAYS CRASHED
A	-	8	4	2
B	-	5	1	4
C	A	6	3	3
D	A	4	1	3
E	B,C	5	7	2
F	D,E	4	6	3
G	F	2	8	1

(i) Construct the network diagramme for the above.
(ii) Calculate floats for each activity and name the critical path.
(iii) Calculate EST, EFT, LFT, and LST, of activity "D".
(iv) Draw the time scale net work.
(v) Suppose the management wants to reduce project duration by 5 days. What are the activities that you would crash and what is the total cost involved.

Q6. At a laboratory blood samples are received in a Poisson fashion at the rate of 8 per hour. There is only one technologist who on the average takes 6 minutes to test one blood sample. The laboratory works 10 hours a day.

(i) How many hours does the technologist idle per day?
(ii) What is the probability that there are three blood samples at the laboratory
(iii) On the average how many blood samples are there in the laboratory?
(iv) How long will a blood sample have to be kept at the laboratory?
(v) On the average how many blood samples are there waiting to be tested in the laboratory?
(vi) How long must a blood sample be kept until it is taken for testing?
(vii) Blood samples, as they are received are put in a freezer that has a capacity to hold 8 blood samples. If the freezer is full the sample is kept out side.
   a) What is the probability that a blood sample just received is kept outside the freezer?
   b) What is the average number of blood samples that are kept outside the freezer?

Q7. Write short notes on the followings with suitable illustrations.

(i) Economic Order Quantity – (EOQ)
(ii) Re-Order Level (ROL)
(iii) Simulation
(iv) Critical Path

Variables

λ Rate of arrival of units

μ Rate of service completion

$\theta = \lambda / \mu$

H = Number of working hours per day.

$P_{(n)}$ = Probability of "n" units in the queuing system

L_s = Average number of units in queuing system

L_q = Average number of units in queue

W_s = Average time spent by unit in queuing system

W_q = Average time spent by unit in queue.

Formulae

$$P(n) = \theta P(n-1) \quad \text{——————} \quad (1)$$

$$P(n) = \theta^n P(0) \quad \text{——————} \quad (2)$$

$$P(n) = \theta^n (1-\theta) \quad \text{——————} \quad (3)$$

$$\left(\begin{array}{l}\text{Probability that}\\ \text{queuing system empty}\end{array}\right) = (1-\theta) \quad \text{——————} \quad (4)$$

$$\left(\begin{array}{l}\text{Probability that the}\\ \text{server is idle}\end{array}\right) = (1-\theta) \quad \text{——————} \quad (5)$$

$$\left(\begin{array}{l}\text{Number of hours}\\ \text{server idle per day}\end{array}\right) = H(1-\theta) \quad \text{——————} \quad (6)$$

$$L_s = \theta / (1-\theta) \quad \text{——————} \quad (7)$$

$$L_q = \theta^2 / (1-\theta) \quad \text{——————} \quad (8)$$

$$L_s = \lambda W_s \quad \text{——————} \quad (9)$$

$$L_q = \lambda W_q \quad \text{——————} \quad (10)$$