KATHMANDU UNIVERSITY
End Semester Examination [C]
June/July 2024

Level : B.Sc.
Year : III
Time : 2 hrs. 30mins.

Course : COMP 317
Semester : I
F. M. : 50

SECTION "B"
[3 Q × 7 = 21 marks]

30 JUN 2024

1. Using Charne's big-M method solve the following linear programming problem: [7]

Maximize $Z=2x_1 + 3x_2 + 4x_3$ Subject to the constraints

$$3x_1 + x_2 + 4x_3 \leq 600,$$

$$2x_1 + 4x_2 + 2x_3 \geq 480;\ 2x_1 + 3x_2 + 3x_3 = 540;\ x_1, x_2, x_3 \geq 0$$

OR

What sort of LP problem does the dual-simplex method solve? By using this method find the optimal solution of following LP-problem: [1+6=7]

Minimize $Z = 3x_1 + x_2$ subject to $x_1 + x_2 \geq 1$

$$2x_1 + 3x_2 \geq 2$$

$$x_1, x_2 \geq 0$$

2. What is Monte Carlo Simulation? In a single channel queuing system random numbers for arrivals of customers are 90,67,16, 74,47,68 and random numbers for services of customers are: 77,28,89,14,76, 82, and using Monte Carlo simulation for the queuing system for the table given below: Find [7]

i. Mean number of customers waiting.
ii. Mean inter arrival time of a customer.
iii. Mean service time of a customer.
iv. Mean idle time of server.
v. Mean time that a customer spends in the system.
vi. Percentage of time that a server remains busy.

Inter-arrival time (min)	Probability	Service time (min)	Probability
6	0.15	7	0.15
7	0.35	6	0.40
2	0.35	9	0.45
8	0.15	10	

3. What the project net analysis is about? With the help of following information (i) Draw the network diagram (ii) find the expected project length (iii) What is the probability that the project will be completed at least 4 weeks earlier than expected time. [1+2+2+2=7]

	Predecessors	Optimistic time(Weeks)	Most likely	Most pessimistic
A	--	3	4	5
B	---	4	8	10
C	B	5	6	8
D	A,C	9	15	10
E	B	4	6	8
F	D,E	3	4	5
G	D,E	5	6	8
H	D,E	1	3	4
I	G	2	4	5
J	F,I	7	8	10
K	G	4	5	6
L	H	8	9	13
M	J,K,L	6	7	8

SECTION "D"

[5 Q × 5 = 25 marks]

4. A firm manufactures pain relieving pills in two sizes A and B .Size A contains 4grains of element X ,7 grains of element Y and 2 grains of element Z .Size B contains 2 grains of element X,10 grains of element Y,8 grains of element Z. It is found by users that it requires at least 12 grains of element X, 74 grains of element Y, 24 grains of element Z to provide immediate relief. (a) Formulate the problem as the linear programming problem (b) determine by using graphical method that the number of pills a patient should take to get immediate relief. [2.5+2.5=5]

5. Waiting room does not accommodate more than 10 patients. Patient arrive in clinic in first come first served basis 5 per minute Examination time per patient is exponential with mean rate 20 per hour. [2.5+2.5=5]

a. What is the probability that an arriving patient will not wait
b. What is the expected time spent until s/he is discharged from the clinic?

6. For the linear programming problem Minimize $Z = 3x_1 - 3x_2 + 5x_5$ 30 JUN 2024

$$3x_1 - x_3 + 2x_5 \leq 7$$
$$-x_2 + 4x_3 \leq 12$$
$$-4x_2 + 3x_3 + 8x_5 \leq 10$$
$$x_1, x_2, x_5 \geq 0$$

That has optimal table is

		C_j	1	-3	2	0	0	0
C_B	Basis	$X_B = b$	x_2	x_3	x_5	s_1	s_2	s_3
1	x_2	4	1	0	4/5	2/5	1/10	0
-3	x_3	5	0	1	2/5	1/5	3/10	0
0	s_3	11	0	0	10	1	-1/2	1
		$Z_j - C_j$	0	0	-12/5	-1/5	- 4/5	0

a. What is the new objective function value when x_5 is forcefully introduced into solution?
b. List dual prices
c. Does this problem have alternative solution? If yes/no why?
d. What do you mean by $S_3 = 11$?
e. What is the new objective function value when second resource is increased by unit amount?

OR

Find the optimal solution for following linear programming problem by using the slack variable simplex method [5]
$Maximize\ Z = 2x_1 + x_2$ Subject to $4x_1 + 3x_2 \leq 12$, $4x_1 + x_2 \leq 8$, $4x_1 - x_2 \leq 8$, $x_1, x_2 \geq 0$

7. An airline company has drawn up a new flight schedule involving five flights. To assist in allocating five pilots to the flights, it has asked them to state their preference scores by giving each flight a number of 10.The higher the number, the greater is the preference. Some of these flights are unsuitable to pilots owing to domestic reasons. Find optimal allocation of pilots to flights in order to meet as many preferences as possible? [5]

	Flight Numbers					
		P	Q	R	S	T
Pilots	A	10	2	---	5	6
	B	7	9	10	8	4
	C	5	4	9	6	---
	D	4	6	2	8	7
	E	5	6	1	4	3

8. Goods have to be transported from factories F_1, F_2, F_3 which supply to warehouses W_1, W_2, W_3, W_3, Find the optimal quantities of goods to be transported so that following costs becomes minimum. [5]

	W_1	W_2	W_3	W_3	Supply
F_1	15	11	17	18	10
F_2	16	14	16	16	80
F_3	13	12	15	15	15
Demand	50	20	50	25	

SECTION "E"

[2Q × 2 = 4 marks]

9. Convert the following assignment problem into linear programming problem

3	2	10
6	4	2
10	5	3

10. Discuss Queueing theory

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Time: 30 mins.
F. M. : 10

Registration No.:
Date 30 JUN 2024

SECTION "A"
[20Q. × 0.5 = 10 marks]

Fill in the blank space(s) by writing the most appropriate word(s) or symbol(s).

1. The shortest possible time in which an activity can be achieved under ideal circumstances is known as _____

2. Effective arrival rate in queueing system with actual arrival rate λ and Probability of N customers in the system P_N is given by λ_{eff} = _____

3. Simulation is not the _____ technique

4. In interger programming problem the new constrain so determined is named as _____

5. If initial solution of transportation problem does not show number of basic cells = value of $m + n - 1$ then such a solution is called _____

6. Mathematical formula for sales man problem is _____

7. Maximization Assignment problem is converted into minimization by _____

8. The linear programming problem whose objective function is parallel to one of the constraints then such a problem possesses _____ solution.

9. If a tourist cannot visit a city twice then such a problem is termed as _____

10. If $E_3 = 8, L_2 = 5, t_{23} = 2\ min$ then independent float is _____

Fill in the blank spaces (Question number 11 through 20) by choosing the most appropriate answers from among the given ones. **DO NOT TICK** the answers.

11. If the function $f(x_1 + x_2) = f(x_1) + f(x_2)$ then $f(x)$ indicates _____
[$f(x)$ is quadratic f(x) is cubic f(x) is biquadratic f(x) is linear]

12. Meaning of PERT is _____
[Program Evaluation and Rate Technology
Program Evaluation and Robot Technique
Program Evaluation and Robot Technology
Program Evaluation and Review Technique]

13. Assignment problem is the special case of _____
[Linear programming problem Transportation Problem
Travelling salesman Problem Integer Programming Problem]

14. $Maximize\ z = 3x_1 + 4x_2\ subject\ to\ the\ constrains\ 8x_1 + 9\,x_2 \geq 100$ Where coefficient 9 indicates_____
[Profit per unit production of product x_2
Objective function value when resource is increased by unit amount
1st resource required to produce one unit of second product
The amount by which the objective value changes when x_2 is brought into solution]

15. In M/M/1 queueing system if $\frac{1}{\lambda} = 10\ min, \mu = 30/hr$ then probability of server being busy is_____
[0.1 0.2 0.3 0.4]

16. Which one of the following is the indication of transportation problem has alternative solution _____
[$d_{ij} > 0$, $d_{ij} < 0$,
$d_{ij} = 0$, $d_{ij} < 0$ and $d_{ij} = 0$ simultaneously]

17. In queueing model M/M/7/8/9 the value 9 defines_____
[Number of servers System capacity
Population size Waiting number of customers]

18. Linear Programming is the _____
[Approximation technique Numerical technique
Optimization technique Simulation technique]

19. Monte Carlo technique is_____
[Dynamic simulation technique Static simulation technique
Probabilistic simulation technique Deterministic simulation technique]

20. $r_0 = 37, p = 47, m = 100\ then\ r_1 =$ _____
[37, 17, 39, 17.39]