

DEPARTMENT OF CIVIL ENGINEERING: IIT DELHI

CVL 773: QUANTITATIVE METHODS IN CONSTRUCTION. MAJOR TEST

DURATION: 2.0 Hours. FIRST SEMESTER-2022-2023 Max. Marks: =50

DATE: - 17/11/2022 TIME: - 11.0 A.M. - 13.0 P M Venue: LH 526

ASSUME MISSING DATA SUITABLY IF REQUIRED

1. Solve the following linear programming problem by simplex method using matrix algebra.

Maximize

$$10x_1 + 9x_2 + 3x_3$$

Subject to:

$$3x_1 + 5x_2 + 7x_3 \leq 30$$

$$3x_1 + 2x_2 + 4x_3 \leq 21$$

$$x_1, x_2 \geq 0$$

2. An autoclaved aerated concrete (AAC) company has to supply blocks to three building sites where weekly requirements of blocks are 50000, 90000 and 60000 respectively. The company has three plants located nearby with production capacities 70000, 100000 and 30000 respectively. Costs of transportation/1000 blocks of AAC from plant to building sites are given in the following table. What is the most optimal scheme for supplying the AAC blocks for overall minimal cost?

Plant	Building sites		
	A	B	C
I	4000	16000	8000
II	8000	24000	16000
III	8000	16000	24000

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3. A contractor has been successful in obtaining 5 new projects. The projects however have different values and also differ in complexities. 5 managers are to be assigned the projects. The suitability of managers in a 100 point scale are given below for each of the 5 projects. Assign the projects most effectively to the managers.

Projects	Managers				
	I	II	III	IV	V
A	75	28	61	48	59
B	78	71	51	35	19
C	73	61	40	49	68
D	55	50	52	48	63
E	71	60	61	74	70



$$\begin{bmatrix} + & 3 \\ 2 & + \\ -5 & 3 \end{bmatrix}$$

$$\begin{bmatrix} 2 & -5 \\ -3 & 3 \end{bmatrix}$$

$$\begin{matrix} (2 \times 2) & (2 \times 1) \\ \hline & (2 \times 1) \end{matrix}$$

4. A construction company is to hire a Piece Rate Worker (PRW) i.e., subcontractor for erection of scaffolding, staging and working towers etc., in a bridge over land portion. Three prospective candidates, Bholaram (B), Kumaran (K) and Badan Singh (S) are available. The company's selection is based on based on three criteria, namely; personal interaction/interview with project managerial team (P), past experience (E) and reports from sites where they had worked earlier (R). The relative importance/preference among these criteria are pre-decided by the company given in matrix A. Similarly the performances of three PRWs in P, E and R, are given in A_P , A_E and A_R matrices below. Whom should the company hire? Check also the consistency of matrices.

Matrix A

	P	E	R
P	1	2	1/4
E	1/2	1	1/5
R	4	5	1

Matrix A_P

	B	K	S
B	1	3	4
K	1/3	1	1/5
S	1/4	5	1

Matrix A_E

	B	K	S
B	1	1/3	2
K	3	1	1/2
S	1/2	2	1

Matrix A_R

	B	K	S
B	1	1/2	1
K	2	1	1/2
S	1	2	1

5. Solve the following linear programming problem algebraically by simplex method.

Maximize
 $10x_1 + 9x_2$
 Subject to:
 $3x_1 + 5x_2 \leq 30$
 $3x_1 + 2x_2 \leq 21$
 $x_1, x_2 \geq 0$

6. *This question is related to previous question, question no. 5*

If a new constraint $x_1 + 3x_2 \leq 10$ is now added in the problem 5 will the solution obtained in the question number 5 remain optimal? If not what is the new optimal policy decision and the value of the objective function? Solve algebraically. If now a new variable x_3 with coefficients of 2 and 3 respectively in the first and second constraints is now added in the problem 5 will the solution obtained in the question number 5 remain optimal? If not what is the new optimal policy decision and the value of the objective function? Solve algebraically. Given that the objective function coefficients of the new variable is 20.

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