Name → Mujahid Khan

ID → 14582

Subject → Operation Reasearch

Section → A

Class → Monday Timing 8:00 = 11:00

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Q1: There are total of 5 machines and five employments are to be relegated and the cost network is as per the following. Locate the best possible task ?

		MAChines				
		A	B	C	D	E
J	1	6	12	3	11	15
o	2	4	2	7	1	16
B	3	18	11	10	7	11
S	4	16	19	122	23	21
	5	9	5	7	6	10

Solutions

machines

		1	2	3	4	5	Row minimum
Jobs	1	6	12	$\boxed{3}$	11	$\boxed{15}$	
	2	4	2	7	$\boxed{1}$	10	
	3	8	17	10	7	$\boxed{11}$	
	4	$\boxed{10}$	19	122	23	21	
	5	9	$\boxed{5}$	7	6	10	

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Row Reduction

Machines

		1	2	3	4	5
	1	3	9	0	8	12
Jobs	2	3	1	6	0	9
	3	1	4	3	0	4
	4	0	3	106	7	5
	5	4	0	2	1	5
		0	0	0	0	4

Column reduction

	1	2	3	4	5
1	3	9	$\boxed{0}$	8	8
2	3	1	6	$\boxed{0}$	5
3	1	4	3	0	$\boxed{0}$
4	$\boxed{0}$	3	106	7	1
5	4	$\boxed{0}$	2	1	1

5 = 5 optimal solution

JOBS	MACHINES	TIME
1	3	3
2	4	1
3	5	11
4	1	10
5	2	5
		36

Total Processing Time = 36 km -

Q no: (2)

Solve the following linear programing problem-

$$\min = 2x_1 + 3x_2$$

$$S.T - (1/2)x_1 + (1/4)x_2 \leq 4$$

$$x_1 + 3x_2 \geq 20$$

$$x_1 + x_2 = 10$$

$$x_1, x_2 \geq 0$$

Solution:->

Big M method for a max(min) linear programming problem.

→ Introduce artificial variable in each row (with no basic variable).
Put the artificial variable into the objective function for max problem -

$max\ z = c^t x - Ma_1 - Ma_2 - \cdots - Ma_m$ -

(For minimum problem $min\ z = c^t x + Ma_1 + Ma_2 + \cdots + Ma_m$ -

→ "clean up" the objective function -

→ Solve the lp by simple -

If at option all $a_i = 0$ we got the optimal solution for the original LP otherwise (some $a_i > 0$ at opt) the original LP is infeasible -

$$\min z = 2x_1 + 3x_2$$

$$\text{s.t } (1/2)x_1 + (1/4)x_2 \le 4$$

$$x_1 + 3x_2 \ge 20$$

$$x_1 + x_2 = 10$$

$$x_1 + x_2 \ge 0$$

Standard forms.

$$\min = -2x_1 - 3x_2 = 0$$

$$\text{s.t } (1/2)x_1 + (1/4)x_2 + s_1 = 4$$

$x_1 + 3x_2 - e_2 = 20$

$x_1 + x_2 = 10$

$x_1, x_2, s_1, e_2 \geq 10$

⇒ Add artifical variable in constraints 2 and 3

$\min z - 2x_1 - 3x_2 - Ma_2 - Ma_3 = 0$

s.t $(1/2)x_1 + (1/4)x_2 + s_1 = 4$

$x_1 + 3x_2 - e_2 + a_2 = 20$

$x_1 + x_2 + a_3 = 10$

$x_1, x_2, s_1, e_2, a_2, a_3 \geq 0$

⇒ Tablow before "clean up"

z	x_1	x_2	s_1	e_2	a_2	a_3	RHS
1	-2	-3	0	0	-M	-M	0
0	1/2	1/4	1	0	0	0	4
0	1	3	0	-1	1	0	20
0	1	1	0	0	0	1	10

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⇒ First tableau (after "clean up") -

z	x_1	x_2	s_1	e_2	a_2	a_3	RHS
1	$2M-2$	$4m-3$	0	$-M$	0	0	$30m$
0	$1/2$	$1/4$	1	0	0	0	4
0	1	3	0	-1	1	0	20
0	1	1	0	0	0	1	10

⇒ x_2 enters a_2 leaves the basis

Next tableau -

z	x_1	x_2	s_1	e_2	a_2	a_3	RHS
1	$(2m-3)/3$	0	0	$(m-3)/3$	$(3-4m)/3$	0	$(60+10m)/3$
0	$5/12$	0	-1	$1/12$	$-1/12$	0	$7/3$
0	$1/3$	1	0	$-1/3$	$1/3$	0	$20/3$
0	$2/3$	0	0	$1/3$	$-1/3$	1	$10/3$

⇒ x_1 enters a_3 leaves the basic - Next tableau -

z	x_1	x_2	s_1	e_2	a_2	a_3	RHS
1	0	0	0	$-1/2$	$(1-2m)/2$	$(3-2m)/2$	25
0	0	0	1	$-1/8$	$1/8$	$-5/8$	$1/4$
0	0	1	0	$-1/2$	$1/2$	$-1/2$	5
0	1	0	0	$1/2$	$-1/2$	$3/2$	5

Q no 3 ⇒ use vogils Approximation method to obtain the initial feasibl solution of.

Destination -

Origin	1	2	3	4	Supply
1	20	22	17	4	120
2	24	37	9	7	70
3	32	37	20	15	50
Demand	60	40	30	110	240

Solutions-

	1	2	3	4	Supply
1	20	22	17	4	120
2	24	37	9	7	70
3	32	37	20	15	50
Demand	60	40	30	110	240

Demand = Supply -

Balance transportation problem -

	1	2	3	4					
1	x	40	x	80	0 ~~80~~				
	20	22	17	4	~~120~~	13	13	-	
2	10	x	30	30	0 ~~10~~ ~~40~~				
	24	37	9	7	~~70~~	2	2	2	17
3	50	x	x	x					
	32	37	20	15	~~50~~	5	5	5	17
	~~60~~	~~40~~	~~30~~	~~110~~					
	~~50~~ 0	0	0	~~30~~ 0					
	4	15	8	3					
	4	-	8	3					
	8	-	11	8					
	8	-	-	8					

$880 + 320 + 240 + 270 + 210 + (40 \times 22) + (80 \times 4)$
$+ (10 \times 24) + (30 \times 9) + (30 \times 7) + 1600$

(50×32) f $\boxed{3520}$