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Roll no :-
002

Programme :~ BS-SE

Operational Research

Question no #1

Time Period Covered

Time period	1	2	3	4	5	Minimum number of Agent needed
6:00 Am to 8 Am	✓					48
8:00 Am to 10 Am	✓	✓				79
1:00 Pm to Noon	✓	✓				65
Noon to 2:00 Pm	✓	✓	✓			87
2:00 Pm to 4 Pm	✓	✓	✓			64
4:00 pm to 6 Pm		✓	✓	✓		73
6:00 pm to 8 pm			✓	✓		82
8:00 pm to 10:00 pm				✓	✓	43
10:00 pm to Midnight				✓	✓	52
Midnigt to 8:00 am					✓	15
Daily Cost per Agent						

Minimize $Z = 170x_1 + 160x_2 + 175x_3 + 180x_4 + 195x$

Subject to

$x_1 \quad Z = 48 \rightarrow (a)$

$x_1 + x_2 \quad Z = 79 \rightarrow (b)$

$x_1 + x_2 + x_3 \quad 7 = 87 \rightarrow (d)$

$x_2 + x_3 \quad > = 64 \rightarrow (e)$

$x_3 + x_4 \quad 7 = 73 \rightarrow (f)$

$x_3 + x_4 \quad 7 = 82 \rightarrow (g)$

$x_4 \quad 7 = 43 \rightarrow (h)$

$x_4 + x_5 \quad 7 = 52 \rightarrow (i)$

$x_5 \quad 7 = 15 \rightarrow (j)$

from eq (a), (b) & j

$x_1 = 48$

$x_4 = 43$

$x_5 = 15$

as in eq (c), 65 is lesser than 79 in eq (b) so we neglect eq (c) now we have

$$x_1 + x_2 = 79$$

Putting the value of x_1

$$49 + x_2 = 79$$

$$x_2 = 31$$

From x_3, we take eq (g) as in eq (g), 82 is greater than other eq (f, h, e) & of so taking equation (g)

$x_3 + x_4 = 82$

$x_3 + 43 = 82$

$$\boxed{x_3 = 39}$$

Now we have (x_1, x_2, x_3, x_4, x_5) values (48, 31, 39, 43, 15) respectively.

Now the minimize equation:

$Z = 170x_1 + 160x_2 + 175x_3 + 180x_4 + 195x_5$

$= 170(48) + 160(31) + 175(39) + 180(43) + 195(15)$

$$\boxed{Z = 30650}$$

Question no#2

1)

Maximize Subject to:

→ $Z = x_1 - 3x + 3x^3$

to

$3x_1 - x2 + 2x3_2 = 7$

$-2x_1 - 4x2_4 = 12$

$-4x_1 + 3x2 + 8x3_4 = 10$

Solution:

$7 = x1 - 3x2 + 3x3$

$3x1 - x2 + 2x3 + S_1 = 7$

$-2x1 - 4x2 + 0.5_1 + S_2 = 12$

$-4x1 + 3x2 + 8x3 + 0.5_1 + 0.52 + 5_3 = 12$

	C_j	1	-3	3	0	0	0	B	θ
CB	Basis	x_1	x2	x3	S_1	S_2	S_3	7	
0	S_1	3	-1	2	1	0	0	12	
0	S_2	-2	-4	0	0	1	0	10	
0	S_3	-4	3	8	0	0	1	0	
	$Z_j = C_B a_4$	0	0	0	0	0	0		
	$C_j - Z_j$	1	-3	3	0	0	0		
				↓ Key	column				

(Not Possible)

2)

$Z = 5x_1 + 3x_2$

Minimize to:

$x_1 + x_2 \leq 2$

$5x_1 + 2x \leq 10$

$3x_1 + 8x_2 \leq 12$

$Z = 5x_1 + 3x_2 + 0S_1 + 0S_2 + 0S_3$

$x_1 + x_2 + S_1 + 0.S_2 + 0.S_3 = 2$

$5x_1 + 2x_2 + 0S_1 + S_2 + 0.S_3 = 10$

$3x_1 + 8x_2 + 0S_1 + 0S_2 + S_3 = 12$

C_j	5	3	0	0	0		
Basic	x_1	x_2	S_1	S_2	S_3	B	$\frac{x_2}{a_{ij}}$
S_1	1	1	1	0	0	2	$4_1 = 2$
S_2	5	2	0	1	0	10	$10/2 = 5$
S_3	3	8	0	0	1	12	$12/3$
$Z_j = \sum C_B \cdot a_{ij}$	0	0	0	0	0	0	
$C_j = C_j - Z_j$	5	3	0	0	0		

x_2 is Key Column as

3 is minimum value in C_j

S_2 is Key row as 5 is max value

2 is Key element.

$C_j z = 0$ for Minimization function
There is no negative value in C_j

$x_1 = 0 \quad x_2 = 0 \quad Min(z) = 0$

So

$$z = 5(0) + 3(0)$$
$$= 0$$

3) $Z = 2x_1 - x_2 + 2x_3$

Maximize subject to

$$2x_1 + x_2 L = 10$$
$$x_1 + 2x_2 - 2x_3 L = 20$$
$$x_1 + 2x_3 \; L = 5$$

$$L = 2x_1 - x_2 + 2x_3 + 0s_1 + 0s_2 + 0s_3$$
$$2x_1 + x_2 + 0x_3 + s_1 + 0s_2 + 0s_3 = 10$$
$$x_1 + 2x_2 - 2x_3 + 0s_1 + s_2 + s_3 = 20$$
$$x_1 + 0x_2 + 2x_3 + 0s_1 + s_2 + s_3 = 5$$

	C_j								
OB	Basic	x_1	x_2	x_3	S_1	S_2	S_3	B	θ
	S_1	2	1	0	1	0	0	10	$\frac{10}{2}=5$
	S_2	1	2	-2	0	1	0	20	$\frac{20}{1}=20$
	S_3	1	0	2	0	0	1	5	$5/1=5$
		1							
	$Z_j=\sum c_i a_{ij}$	0	0	0	0	0	0	0	0
	$C_j=C_j-Z_j$	2	-1	-1	2	0	0	0	
		Key column							

1 is the key element

$R_1 \Rightarrow R_1 - 2R_3 = 0$

$R_2 \Rightarrow R_2 - R_3 = 0$

$C_j \angle = 0$

	C_j	2	-1	0	0	0	0	
CB	Basic	x_1	x_2	x_3	S_1	S_2	S_3	B
0	S_1	0	1	-4	1	0	-2	0
0	S_2	0	2	-4	0	1	-1	15
2	x_1	1	0	2	0	0	1	5
	$y=\sum c_j a_{ij}$	2	0	4	0	0	2	10
	$C_j=C_j-y$	0	-1	-2	0	0	-2	

Optimal Solution

$x_1 = 5 \quad x_2 = 0 \quad x_3 = 0$

Z (maximum Value) $= 10$

Check :-

$$Z = 2x_1 - x_2 + 2x_3$$

$$= 2(5) - 0 + 2(0)$$

$$Z = 10 \text{ (Confirmed)}$$