3MH501IC24

Operations Research

Name:- Nick Rohitbhai Patel

Roll No.:- 23BCE296

Ans2

let, x_1 = explosive for p

x_2 = " " q

x_3 = " " r

		Bombs		
explosive	P	Q	R	Capacity
A	3	1	4	600 Kg
B	2	4	2	480 Kg
C	2	3	3	540 Kg

max $z = 2x_1 + 3x_2 + 4x_3$

the max 600 Kg for A

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

at least 480 Kg of B.

$$2x_1 + 4x_2 + 2x_3 \geq 480$$

exactly 540 Kg of C

$$2x_1 + 3x_2 + 3x_3 = 540$$

$$x_1, x_2, x_3 \geq 0$$

Ans 2

max $z = 2x_1 + 5x_2$

subject to $x_1 + x_2 \geq 2$

$x_1 + x_2 \leq 5$

$x_1 + 6x_2 \geq 6$

$x_1, x_2 \geq 0$

$x_1 + x_2 = 2$

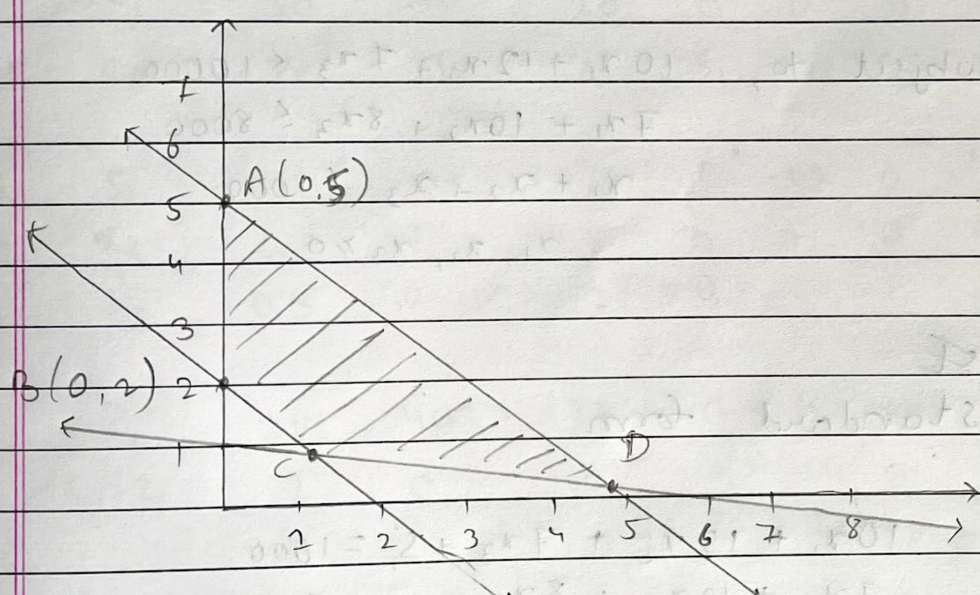
x_1	0	2
x_2	2	0

$x_1 + x_2 = 5$

x_1	0	5
x_2	5	0

$x_1 + 6x_2 = 6$

x_1	0	6
x_2	1	0



$\cancel{x_1} + x_2 = 2$

$\cancel{x_1} + 6x_2 = 6$

$- \quad -$

$-5x_2 = -4$

$x_2 = \frac{4}{5}$

$C\left(\frac{6}{5}, \frac{4}{5}\right)$

$x_1 + \frac{4}{5} = 2$

$x_1 + x_2 = 5$

$x_1 + 6x_2 = 6$

$- \quad -$

$-5x_2 = -1$

$x_2 = \frac{4}{5}, \quad x_1 = \frac{24}{5}$

$D\left(\frac{24}{5}, \frac{4}{5}\right)$

LAXMI PLUS
PAGE NO.
DATE : / /

CP	Z-value
$(0,5)$	$\boxed{25}$
$(0,2)$	10
$(6/5, 4/5)$	~~6.4~~ 6.4
$(24/5, 4/5)$	10.8

max $Z = 25$ at $(0,5)$

Ans 3

max $Z = 30x_1 + 40x_2 + 20x_3$

Subject to,

$$10x_1 + 12x_2 + 7x_3 \leq 10000$$
$$7x_1 + 10x_2 + 8x_3 \leq 8000$$
$$x_1 + x_2 + x_3 \leq 1000$$
$$x_1, x_2, x_3 \geq 0$$

~~st~~

standard form

$$10x_1 + 12x_2 + 7x_3 + S_1 = 1000$$
$$7x_1 + 10x_2 + 8x_3 + S_2 = 8000$$
$$x_1 + x_2 + x_3 + S_3 = 1000$$

$$x_1, x_2, x_3, S_1, S_2, S_3 \geq 0$$

B	C_B	x_1	x_2	x_3	S_1	S_2	S_3	Sol^n	Ratio
	C_j	30	40	20	0	0	0		
0	S_1	10	12	7	1	0	0	10000	83333
0	S_2	7	$\boxed{10}$	8	0	1	0	8000	800 ←
0	S_3	1	1	1	0	0	1	1000	1000
	Z_j	0	0	0	0	0	0	0	
	$C_j - Z_j$	30	40 ↑	20	0	0	0		

B	C_B	x_1	x_2	x_3	S_1	S_2	S_3	Sol^n	Ratio
	C_j	30	40	20	0	0	0		
0	S_1	$\boxed{1.6}$	0	-2.6	1	-1.2	0	400	250 ←
40	x_2	0.7	1	0.8	0	0.1	0	800	1142.8
0	S_3	0.3	0	0.2	0	-0.1	1	200	666.6
	Z_j	28	40	32	0	4	0	32000	
	$C_j - Z_j$	2 ↑	0	-12	0	-4	0		

B	C_B	x_1	x_2	x_3	S_1	S_2	S_3	Sol^n	Ratio
	C_j	30	40	20	0	0	0		
30	x_1	1	0	-13/8	5/8	-3/4	0	250	
40	x_2	0	1	1.93	-7/16	0.625	0	625	
0	S_3	0	0	0.98	-3/16	7/8	1	125	
	Z_j	30	40	28.45	1.25	25	0	32500	
	$C_j - Z_j$	0	0	-8.45	-1.25	-2.5	0		

LAXMI PLUS
PAGE NO.
DATE : / /

Solution of LPP is.

$x_1 = 250, \; x_2 = 625, \; x_3 = 0$

& solution = ₹ 32500

Ans 4 solve by 2-phase method

minimize $z = 600x_1 + 800x_2$

subject to : $2x_1 + x_2 \geq 80$

$x_1 + 2x_2 \geq 60$

$x_1, x_2 \geq 0$

convert to standard LPP.

$z = -600x_1 - 800x_2$

$2x_1 + x_2 - S_1 + A_1 = 80$

$x_1 + 2x_2 - S_2 + A_2 = 60$

$x_1, x_2, S_1, S_2, A_1, A_2 \geq 0$

$z^* = -A_1 - A_2$

C_B	Basic	x_1	x_2	S_1	S_2	A_1	A_2	Sol^n	Ratio
	C_j	0	0	0	0	-1	-1		
-1	A_1	$\boxed{2}$	1	-1	0	1	0	80	40 ←
-1	A_2	1	2	0	-1	0	1	60	60
	Z_j	-3	-3	1	1	-1	-1		
	$C_j - Z_j$	3	3	-1	-1	0	0		
		↑							

x_1	1	1/2	-1/2	0	-	0	40	80
A_2	0	$\boxed{3/2}$	1/2	-1	-	1	20	40/3 ←
z_j	0	-3/2	-1/2	1	-	-1	-20	
$c_j - z_j$	0	3/2	1/2	-1	-	1		
		↑						

x_1	1	0	-2/3	1/3	-	-	100/3
x_2	0	1	1/3	-2/3	-	-	40/3
z_j	0	0	0	0	-	-	0
$c_j - z_j$	0	0	0	0	-	-	

All $c_j - z_j \leq 0$ optimum sol^n of phase-I is optimized.

$z^* = 0$, no artificial variable appear

phase-II

c_j	CB	-600	-500	0	0	sol^n	Ratio
	Basis	x_1	x_2	s_1	s_2		
-600	x_1	1	0	-2/3	1/3	100/3	
-500	x_2	0	1	1/3	-2/3	40/3	
	z_j	-600	-500	700/3	400/3	-80000/3	
	$c_j - z_j$	0	0	-700/3	-400/3		

All $c_j - z_j \leq 0$, so optimum solution is optimized

optimize sol^n is $x_1 = \frac{100}{3}$, $x_2 = \frac{40}{3}$

$$z_{max} = -\frac{80000}{3}$$

$$z_{min} = -z_{max} = \frac{80000}{3}$$

Ans5

Destination

		D_1	D_2	D_3	D_4	D_5	Availabil
Source	S_1	12	15	14	18	20	50
	S_2	25	15	20	12	8	30
	S_3	12	14	16	20	15	10
	S_4	15	22	25	24	30	20
demand		25	20	28	27	10	

	D_1	D_2	D_3	D_4	D_5		Penalty					
S_1	$_{5}12$	$_{10}15$	$_{28}14$	$_{7}18$	$_{x}20$	50/22/17/7	3	3	2	2	$\boxed{3}$	3
S_2	$_{x}25$	$_{x}15$	$_{x}20$	$_{20}12$	$_{10}8$	30/20/0	4	3	3	-	-	-
S_3	$_{x}12$	$_{10}14$	$_{x}16$	$_{x}20$	$_{x}15$	10/0	2	2	2	2	2	$\boxed{6}$
S_4	$_{20}15$	$_{x}22$	$_{x}25$	$_{x}24$	$_{x}30$	20/0	7	$\boxed{7}$	-	-	-	-
	25/5/0	20/10/0	28/0	27/7/0	10/0	110						
Penalty	0	0	2	6	$\boxed{7}$							
	0	0	2	6	-							
	0	0	2	$\boxed{6}$	-							
	0	1	$\boxed{2}$	2	-							
	0	1	-	2	-							
	-	1	-	2	-							

$\text{cost} = 5(12) + 10(15) + 28(14) + 7(18) + 20(12) + 10(18)$
$+ 10(14) + 20(15)$
$= \boxed{1488}$

Ans 6

Tasks

		I	II	III	IV	V
Persons	P	102	110	145	125	90
	Q	80	95	120	110	80
	R	78	105	100	88	92
	S	50	58	46	65	70
	T	0	0	0	0	0

Row Reduction.

	I	II	III	IV	V
P	12	20	55	35	0
Q	0	15	40	30	0
R	0	27	22	10	14
S	4	12	0	19	24
T	0	0	0	0	0

- Column Reduction, both are same.

	I	II	III	IV	V	
P	12	20	55	35	$\boxed{0}$	✓
Q	$\boxed{0}$	15	40	30	$\cancel{0}$	✓
R	$\cancel{0}$	27	22	10	14	✓
S	4	12	$\boxed{0}$	19	24	
T	$\cancel{0}$	$\boxed{0}$	$\cancel{0}$	$\cancel{0}$	$\cancel{0}$	
					✓	

min. value = 10

	I	II	III	IV	V
P	2	10	45	25	$\boxed{0}$
Q	$\boxed{0}$	5	30	20	$\cancel{0}$
R	$\cancel{0}$	17	12	$\boxed{0}$	14
S	04	12	$\boxed{0}$	19	34
T	$\cancel{0}$	$\boxed{0}$	$\cancel{0}$	$\cancel{0}$	$\cancel{0}$

optimal assignment

cost = 90 + 80 + 88 + 46 + 0

= $\boxed{304}$

LAXMI PLUS
PAGE NO.
DATE : / /

Ans 7

	J_1	J_2	J_3	J_4	J_5	J_6	J_7
m_1	12	10	13	12	30	10	10
m_2	17	8	13	15	32	8	11
	X	X		X		X	X

optimum sequence,

J_7	J_1	J_4	J_3	J_5	J_6	J_2

	machine-1		machine-2		Ideal
	time In	time out	in	out	time for m_2
J_7	0	10	10	21	10
J_1	10	22	22	39	1
J_4	22	34	39	54	0
J_3	34	47	54	67	0
J_5	47	77	77	109	10
J_6	47	87	109	117	0
J_2	87	97	117	125	0

total = 21

total time elapse = 125 hr
ideal time of m_1 = 125 - 97 = 28 hr
ideal time of m_2 = 21 hr

LAXMI PLUS
PAGE NO.
DATE : / /

Ans8

OR is set of math-based method for making best possible decisions. It provides mathematical framework for optimizing complex system & enhancing efficiency. Its applications are widespread, touching nearly every domain of the field.

In computer network, OR is fundamental for routing protocols. Algorithm like Dijikstra's and Bellman-Ford, rooted in graph theory, are used to find shortest path for data packets to travel from source to destination.

In AI & ML heavily rely on optimization, a core concept of OR. Training a neural network minimizing a loss function, an optimization problem typically solved using techniques like gradient descent.

In operating system, OR is applied to process scheduling (eg. shortest Job first) & resource allocation to prevent deadlocks & maximize system performance.