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Q.2.

A]

ii] using Kuhn - Tukor conditions solve the NLPP ....

=> we rewrite the problem as

$$f(x_1, x_2) = 8x_1 + 10x_2 - x_1^2 - x_2^2$$

and $h(x_1, x_2) = 3x_1 + 2x_2 - 6$

Now, Kuhn - Tucker conditions are,

$$\frac{\partial f}{\partial x_1} - \lambda \frac{\partial h}{\partial x_1} = 0, \quad \frac{\partial f}{\partial x_2} - \lambda \frac{\partial h}{\partial x_2} = 0$$

$$h(x_1, x_2) \leq 0$$

$$\lambda h(x_1, x_2) = 0, \quad \lambda \geq 0$$

$\therefore$ we get

$8 - 2x_1 - 3\lambda = 0$ .... (1)

$10 - 2x_2 - 2\lambda = 0$ (2)

$\lambda(3x_1 + 2x_2 - 6) = 0$ ..(3)

$3x_1 + 2x_2 - 6 \leq 0$ .... (4)

$x_1, x_2, \lambda \geq 0$ .. (5)

From (3), we get either $\lambda = 0$ or $3x_1 + 2x_2 - 6 = 0$

case 1 : If $\lambda = 0$, from (1) and (2), we get

$8 - 2x_1 = 0$ and $10 - 2x_2 = 0$

$\therefore x_1 = 4, x_2 = 5.$

But then for $x_1 = 4$ and $x_2 = 5$, the condition (3) is not satisfied.

$\therefore$ Hence, $\lambda = 0$ does not yield a feasible solution.

we reject these values.

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case II: If $\lambda \neq 0$, $3x_1 + 2x_2 - 6 = 0$ ... (6)

To find x_1, x_2, we obtain one more relation between x_1, x_2 by eliminating λ from (1) and (2).

Now, multiply (1) by 2, (2) by 3 and subtract

$\therefore 16 - 4x_1 - 30 + 6x_2 = 0$

$\therefore -2x_1 + 3x_2 - 7 = 0$ ... (7)

Multiply (6) by 3 and (7) by 2 and subtract.

$\therefore 9x_1 - 18 + 4x_1 + 14 = 0$

$\therefore 13x_1 = 4$

$\therefore x_1 = \frac{4}{13}$

$\therefore$ From (7), $-\frac{8}{13} + 3x_2 - 7 = 0$

$\therefore 3x_2 = \frac{99}{13}$

$\therefore x_2 = \frac{33}{13}$

Now from (1), $4 \times \frac{4}{13} + 12 \times \frac{33}{13} = 2\lambda$

$\therefore 2\lambda = \frac{412}{33}$

$\therefore \lambda > 0$

These values satisfy all the necessary conditions.

$\therefore$ The optimal solution is $x_1 = \frac{4}{13}$, $x_2 = \frac{33}{13}$

$\therefore Z_{max} = 8\left(\frac{4}{13}\right) + 10\left(\frac{33}{13}\right) - \frac{16}{169} - \frac{1089}{169} = \frac{3601}{169} = 21.3$ //

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B]

i] Solve the L.P.P. by simplex method.

=> We first express the problem in standard form.

$$z - 3x_1 - 2x_2 + 0s_1 + 0s_2 = 0$$
$$x_1 + x_2 + s_1 + 0s_2 = 4$$
$$x_1 - x_2 + 0s_1 + s_2 = 2$$

We now express the above information in tabular form

Simplex Table

Iteration Number	Basic variables	x_1	x_2	s_1	s_2	R.H.S. solution	Ratio
0	z	-3	-2	0	0	0	
s_2 leaves	s_1	1	1	1	0	4	$4/4 = 4$
		1^*	-1	0	1	2	$2/1 = 2 \leftarrow$
1	z	0	-5	0	3	6	
s_2 leaves	s_1	0	2^*	1	-1	2	$2/2 = 1 \leftarrow$
x_2 enters	x_1	1	-1	0	1	2	$2/-1 = -2$
2	z	0	0	5/2	1/2	11	
	x_2	0	1	1/2	-1/2	1	
	x_1	1	0	1/2	1/2	3	

$\therefore x_1 = 3, x_2 = 1, z_{max} = 11$