

$$1. Z = 4a + b$$

s.a.

$$r_1: a + b \leq 150$$

$$r_2: 2a + b \leq 80$$

$$r_3: a \geq 0$$

$$r_4: b \geq 0$$

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$$r_1, r_3$$

$$a=0$$

$$(0) + b = 150$$

$$b = 150$$

$$a=0, b=150$$

$$r_1, r_4$$

$$b=0$$

$$a + (0) = 150$$

$$a = 150$$

$$a=150, b=0$$

$$r_1, r_2$$

$$a+b=150$$

$$(2a+b=80) - 1$$

$$-2a - b = -80$$

$$\cancel{a+b=150}$$

$$-a = 70$$

$$a = -70$$

$$(-70) + b = 150$$

$$b = 150 + 70$$

$$b = 220$$

$$a = -70, b = 220$$

$$r_2, r_3$$

$$a=0$$

$$2(0) + b = 80$$

$$b = 80$$

$$a=0, b=80$$

$$r_2, r_4$$

$$b=0$$

$$2a + (0) = 80$$

$$2a = 80, a = \frac{80}{2} = 40$$

$$a=40, b=0$$

$$r_3, r_4 \rightarrow a=0, b=0$$

$$r_1, r_2 (-70, 220) \times r_3 \text{ no cumple}$$

$$r_1, r_3 (0, 150) \times r_2 \text{ no cumple}$$

$$r_1, r_4 (150, 0) \times r_2 \text{ no cumple}$$

$$r_2, r_3 (0, 80) \checkmark \text{ Cumple}$$

$$r_2, r_4 (40, 0) \checkmark \text{ Cumple}$$

$$r_3, r_4 (0, 0) \checkmark \text{ Cumple}$$

$$Z(0, 80) = 4(0) + 80 = 80$$

$$Z(40, 0) = 4(40) + 0 = 160 \rightarrow \text{Mínimo}$$

$$Z(0, 0) = 4(0) + 0 = 0 \rightarrow \text{Mínimo}$$

$$r_2(0, 150)$$

$$2(0) + 150 \leq 80$$

$$150 \leq 80 \times$$

$$r_2(150, 0)$$

$$2(150) + 0 \leq 80$$

$$300 \leq 80 \times$$

$$r_1(0, 80)$$

$$(0) + (80) \leq 150$$

$$80 \leq 150 \checkmark$$

$$r_4(0, 80)$$

$$80 \geq 0 \checkmark$$

$$r_1(40, 0)$$

$$(40) + 0 \leq 150$$

$$40 \leq 150 \checkmark$$

$$r_3(40, 0)$$

$$40 \geq 0 \checkmark$$

$$r_1(0, 0)$$

$$(0) + (0) \leq 150 \checkmark$$

$$r_2(0, 0)$$

$$Z(0) + (0) \leq 80 \checkmark$$

$$2. Z = x + 3y$$

s.a.

$$r_1: x + y \geq 10$$

$$r_2: 2x + 2y \leq 25$$

$$r_3: x \leq 8$$

$$r_4: x \geq 0$$

$$r_5: y \geq 0$$

r_1, r_2

$$x + y = 10$$

$$2x + 2y = 25$$

$$x = 10 - y$$

$$2(10 - y) + 2y = 25$$

$$20 - 2y + 2y = 25$$

$$20 = 25 \times$$

r_1, r_3

$$x = 8$$

$$(8) + y = 10$$

$$y = 2$$

$$x = 8, y = 2$$

$$x = 0, y = 10$$

$$x = 10, y = 0$$

r_1, r_4

$$x = 0$$

$$(0) + y = 10$$

$$y = 10$$

$$x = 0, y = 10$$

$$x = 10, y = 0$$

r_1, r_5

$$y = 0$$

$$x + (0) = 10$$

$$x = 10$$

r_2, r_3

$$x = 8$$

$$Z(8) + 2y = 25$$

$$16 + 2y = 25$$

$$2y = 25 - 16 = 9$$

$$y = 9/2$$

$$x = 8, y = 9/2$$

r_2, r_4

$$x = 0$$

$$Z(0) + 2y = 25$$

$$2y = 25$$

$$y = 25/2$$

$$x = 0, y = 25/2$$

r_2, r_5

$$y = 0$$

$$Z(x + 2(0)) = 25$$

$$2x = 25$$

$$x = 25/2$$

$$x = 25/2, y = 0$$

r_3, r_4

$$x = 8$$

$$x = 0$$

$$y = 0$$

$$x = 8, y = 0$$

$$x = 0, y = 0$$

r_3, r_5

$$x = 8$$

$$y = 0$$

$$x = 0$$

$$y = 0$$

$$x = 0, y = 0$$

$$x = 0, y = 0$$

$$r_1, r_3 (8, 2) \checkmark \text{ Cumple}$$

$$r_1, r_4 (0, 10) \checkmark \text{ Cumple}$$

$$r_1, r_5 (10, 0) \times \text{ No cumple } r_3$$

$$r_2, r_3 (8, 9/2) \checkmark \text{ Cumple}$$

$$r_2, r_4 (0, 25/2) \checkmark \text{ Cumple}$$

$$r_2, r_5 (25/2, 0) \times \text{ No cumple } r_3$$

$$r_3, r_5 (8, 0) \times \text{ No cumple } r_1$$

$$r_4, r_5 (0, 0) \times \text{ No cumple } r_1$$

$$Z(8, 2) = 8 + 3(2) = 14 \rightarrow \text{Mínimo}$$

$$Z(0, 10) = 0 + 3(10) = 30$$

$$Z(8, 9/2) = 8 + 3(9/2) = 43/2$$

$$Z(0, 25/2) = 0 + 3(25/2) = 75/2 \rightarrow \text{Máximo}$$

$$r_2 (8, 2) = Z(8) + Z(2) \leq 25$$

$$16 + 4 \leq 25$$

$$20 \leq 25 \checkmark$$

$$r_4 (8, 2) = 8 \leq 8 \checkmark$$

$$r_5 (8, 2) = 2 \geq 0 \checkmark$$

$$r_2 (0, 10) = Z(0) + Z(10) \leq 25$$

$$20 \leq 25$$

$$r_3 (0, 10) = 0 \leq 8 \checkmark$$

$$r_5 (0, 10) = 10 \geq 0 \checkmark$$

$$r_2 (10, 0) = Z(10) + Z(0) \leq 25$$

$$20 \leq 25$$

$$r_3 (10, 0) = 10 \leq 8 \times$$

$$r_1 (8, 9/2) = (8) + (9/2) \geq 10$$

$$25/2 \geq 10 \checkmark$$

$$r_4 (8, 9/2) = 8 \geq 0 \checkmark$$

$$r_5 (8, 9/2) = 9/2 \geq 0 \checkmark$$

$$r_1 (0, 25/2) = (0) + (25/2) \geq 10$$

$$25/2 \geq 10 \checkmark$$

$$r_3 (0, 25/2) = 0 \leq 8 \checkmark$$

$$r_5 (0, 25/2) = 25/2 \geq 0 \checkmark$$

$$r_1 (25/2, 0) = 25/2 + 0 \geq 10$$

$$25/2 \geq 10 \checkmark$$

$$r_1 (8, 0) = 8 + 0 \geq 10$$

$$8 \geq 10 \times$$

$$r_1 (0, 0) = 0 + 0 \geq 10$$

$$0 \geq 10 \times$$

$$3. Z = 0.1x + 0.5y$$

s.a.

- r1: $4x + 3y \leq 30$
- r2: $6x + y \leq 36$
- r3: $x - y \leq 20$
- r4: $x \geq 0$
- r5: $y \geq 0$

r1, r2

$$\begin{aligned} 4x + 3y &= 30 \\ (6x + y = 36) - 3 & \\ -18x - 3y &= -108 \\ 4x + 3y &= 30 \\ -14x &= -78 \\ x &= 78/14 = 39/7 \\ 6(39/7) + y &= 36 \\ y &= 36 - 234/7 \\ y &= 18/7 \\ x &= 39/7, y = 18/7 \end{aligned}$$

r2, r3

$$6x + y = 36$$

$$x - y = 20$$

$$7x = 56$$

$$x = 8$$

$$8 - y = 20$$

$$-y = 12$$

$$y = -12$$

$$x = 8, y = -12$$

r2, r4

$$\begin{aligned} x &= 0 \\ 6(0) + y &= 36 \\ y &= 36 \\ x &= 0, y = 36 \end{aligned}$$

r2, r5

$$\begin{aligned} y &= 0 \\ 6x + (0) &= 36 \\ 6x &= 36, x = 6 \\ x &= 6, y = 0 \end{aligned}$$

r3, r4

$$x = 0, y = -50/7$$

r1, r4

$$\begin{aligned} x &= 0 \\ 4(0) + 3y &= 30 \\ 3y &= 30, y = 10 \\ x &= 0, y = 10 \end{aligned}$$

r1, r5

$$\begin{aligned} y &= 0 \\ 4x + 3(0) &= 30 \\ 4x &= 30, x = 15/2 \\ x &= 15/2, y = 0 \end{aligned}$$

r3, r5

$$\begin{aligned} y &= 0 \\ x - (0) &\leq 20 \\ x &\leq 20 \\ x &= 20, y = 0 \end{aligned}$$

r4, r5

$$\begin{aligned} x &= 0 \\ y &= 0 \end{aligned}$$

$$r1, r2 (39/7, 18/7)$$

✓ Cumple

$$r1, r3 (90/7, -50/7)$$

✗ No cumplen r5

$$r1, r4 (0, 10)$$

✓ Cumple

$$r1, r5 (15/2, 0)$$

✗ No cumplen r2

$$r2, r3 (8, -12)$$

✗ No cumplen r5

$$r2, r4 (0, 36)$$

✗ No cumplen r1

$$r2, r5 (6, 0)$$

✓ Cumple

$$r3, r4 (0, -20)$$

✗ No cumplen r5

$$r3, r5 (20, 0)$$

✗ No cumplen r1

$$r4, r5 (0, 0)$$

✓ Cumple

$$z(39/7, 18/7) = \frac{1}{10}(39/7) + \frac{1}{2}(18/7) = 39/70 + 18/14 = 39/70 + 90/70 = 129/70$$

$$z(0, 10) = 0.1(0) + 0.5(10) = 5 \text{ M\'aximo}$$

$$z(6, 0) = 0.1(6) + 0.5(0) = 0.6$$

$$z(0, 0) = 0.1(0) + 0.5(0) = 0 \text{ M\'inimo}$$

$$r3 (39/7, 18/7) = (39/7) - (18/7) \leq 20$$

$$21/7 \leq 20, 3 \leq 20$$

$$r4 (39/7, 18/7) = 39/7 \geq 0$$

$$r5 (39/7, 18/7) = 18/7 \geq 0$$

$$r2 (0, 10) = 6(0) + (10) \leq 36$$

$$10 \leq 36$$

$$r3 (0, 10) = (0) - (10) \leq 20$$

$$10 \leq 20$$

$$r5 (0, 10) = 10 \geq 0$$

$$r1 (15/2, 0) = 4(15/2) + 3(0) \leq 30$$

$$30 \leq 30$$

$$r2 (15/2, 0) = 6(15/2) + (0) \leq 36$$

$$45 \leq 36 \quad \times$$

$$r1 (6, 36) = 4(6) + 3(36) \leq 30$$

$$108 \leq 30 \quad \times$$

$$r1 (6, 0) = 4(6) + 3(0) \leq 30$$

$$24 \leq 30$$

$$r3 (6, 0) = (6) - 0 \leq 20, 6 \leq 20$$

$$6 \leq 20$$

$$r4 (6, 0) = 6 \geq 0$$

$$6 \geq 0$$

$$r1 (20, 0) = 4(20) + 3(0) \leq 30$$

$$80 \leq 30 \quad \times$$

$$r1 (0, 0) = 4(0) + 3(0) \leq 30, 0 \leq 30$$

$$0 \leq 30$$

$$r2 (0, 0) = 6(0) + (0) \leq 36, 0 \leq 36$$

$$0 \leq 36$$

$$r3 (0, 0) = 0 - 0 \leq 20, 0 \leq 20$$

$$0 \leq 20$$

$$4. Z = m + 2n$$

s.a.

- r1: $3m + n \leq 14$
- r2: $m + 5n \leq 20$
- r3: $m \leq n - 10$
- r4: $m \geq 0$
- r5: $n \geq 0$

r_2, r_4

$$\begin{aligned} m &= 0 \\ (0) + 5n &\leq 20 \\ 5n &\leq 20 \\ n &\leq 4 \\ m &= 0, n = 4 \end{aligned}$$

r_2, r_5

$$\begin{aligned} n &= 0 \\ m + 5(0) &\leq 20 \\ m &= 20 \\ m &= 20, n = 0 \end{aligned}$$

r_1, r_2

$$\begin{aligned} 3m + n &\leq 14 \\ (m + 5n = 20) - 3 &\quad | \\ -3m - 15n &\leq -60 \\ 3m + n &\leq 14 \\ -14n &\leq -46 \\ n &\leq 46/14 = 23/7 \\ 3m + (23/7) &\leq 14 \\ 3m = 14 - 23/7 &\leq 75/7 \\ m = 75/21 &= 25/7 \\ m = 25/7, n = 23/7 & \end{aligned}$$

r_1, r_3

$$\begin{aligned} 3m + n &\leq 14 \\ m = n - 10 &\quad | \\ m - n &\leq -10 \\ 3m + n &\leq 14 \\ 4m &\leq 4 \\ m &\leq 1 \\ 3(1) + n &\leq 14 \\ n = 14 - 3 & \\ n &= 11 \\ m = 1, n = 11 & \end{aligned}$$

r_1, r_4

$$\begin{aligned} m &= 0 \\ 3(0) + n &\leq 14 \\ n &= 14 \\ m = 0, n = 14 & \end{aligned}$$

r_2, r_3

$$\begin{aligned} m + 5n &\leq 20 \\ (m - n = 10) + 5n &\leq 20 \\ 5m - 5n + 5n &\leq 20 \\ 6m &\leq -30 \\ m &\leq -30/6 \\ m &\leq -5 \\ (-5) + 5n &\leq 20 \\ 5n &\leq 25 \\ n &= 5 \\ m = -5, n = 5 & \end{aligned}$$

r_3, r_4

$$\begin{aligned} m &= 0 \\ (0) - n &\leq -10 \\ n &\geq 10 \\ m = 0, n = 10 & \end{aligned}$$

r_3, r_5

$$\begin{aligned} n &= 0 \\ m - (0) &\leq -10 \\ m &\leq -10 \\ m = -10, n = 0 & \end{aligned}$$

r_4, r_5

$$\lambda = 0, y = 0$$

- | | |
|-------------------------|----------------|
| $r_1, r_2 (25/7, 23/7)$ | X No cumple r3 |
| $r_1, r_3 (1, 11)$ | X No cumple r2 |
| $r_1, r_4 (0, 14)$ | X No cumple r2 |
| $r_1, r_5 (14/3, 0)$ | X No cumple r3 |
| $r_2, r_3 (-5, 5)$ | X No cumple r4 |
| $r_2, r_4 (0, 4)$ | X No cumple r3 |
| $r_2, r_5 (20, 0)$ | X No cumple r1 |
| $r_3, r_4 (0, 10)$ | X No cumple r2 |
| $r_3, r_5 (-10, 0)$ | X No cumple r4 |
| $r_4, r_5 (0, 0)$ | X No cumple r3 |

No hay solución

$$5. Z = 4x + 3y$$

s.a.

$$r_1: 3x + 2y \leq 25$$

$$r_2: x \leq 5$$

$$r_3: 8x \leq 21 - 6y$$

$$r_4: x \geq -2$$

$$r_5: y \geq 1$$

$$r_1, r_2$$

$$x=5$$

$$3(5) + 2y = 25$$

$$2y = 25 - 15 = 10$$

$$y = 10/2 = 5$$

$$x=5, y=5$$

$$r_1, r_3$$

$$-3(3x + 2y \leq 25)$$

$$8x + 6y = 21$$

$$-9x - 6y = -75$$

$$-x = -54$$

$$x = 54$$

$$3(54) + 2y = 25$$

$$162 + 2y = 25$$

$$2y = 25 - 162 = -137$$

$$y = -137/2$$

$$x = 54, y = -137/2$$

$$r_1, r_4$$

$$x = -2$$

$$3(-2) + 2y = 25$$

$$-6 + 2y = 25$$

$$2y = 31$$

$$y = 31/2$$

$$x = -2, y = 31/2$$

$$x = 5, y = -19/6$$

$$r_2, r_3$$

$$x = 5$$

$$8(5) + 6y = 21$$

$$40 + 6y = 21$$

$$6y = 21 - 40 = -19$$

$$y = -19/6$$

$$x = 5, y = -19/6$$

$$r_3, r_4$$

$$x = -2$$

$$8(-2) + 6y = 21$$

$$-16 + 6y = 21$$

$$6y = 21 + 16 = 37$$

$$y = 37/6$$

$$x = -2, y = 37/6$$

$$r_3, r_5$$

$$y = 1$$

$$8x - 6(1) = 21$$

$$8x = 21 + 6 = 27$$

$$x = 27/8$$

$$x = 27/8, 1$$

$$r_4, r_5$$

$$x = -2, y = 1$$

$$r_1, r_5$$

$$y = 1$$

$$3(x) + 2(1) = 25$$

$$3x = 23$$

$$x = 23/3$$

$$x = 23/3, y = 1$$

$$r_2, r_4$$

$$x = 5$$

$$x = -2 \quad \text{X}$$

$$r_2, r_5$$

$$x = 5$$

$$y = 1$$

$$r_1, r_2 (5, 5) \quad \text{X} \quad \text{No cumple } r_3$$

$$r_1, r_3 (54, -137/2) \quad \text{X} \quad \text{No cumple } r_2, r_5$$

$$r_1, r_4 (-2, 31/2) \quad \text{X} \quad \text{No cumple } r_3$$

$$r_1, r_5 (23/3, 1) \quad \text{X} \quad \text{No cumple } r_2$$

$$r_2, r_3 (5, -19/6) \quad \text{X} \quad \text{No cumple } r_5$$

$$r_2, r_5 (-2, 1) \quad \text{X} \quad \text{No cumple } r_3$$

$$r_3, r_4 (-2, 37/6) \quad \checkmark \quad (\text{Cumple})$$

$$r_3, r_5 (27/8, 1) \quad \text{X} \quad \text{No cumple } r_2$$

$$r_4, r_5 (-2, 1) \quad \checkmark \quad (\text{Cumple})$$

$$Z(-2, 37/6) = 4(-2) + 3(37/6) = -8 + 37/2 = 21/2 \quad \text{Máximo}$$

$$Z(-2, 1) = 4(-2) + 3(1) = -8 + 3 = -5 \quad \text{Mínimo}$$

$$r_3(5, 5) = 8(5) \leq 21 - 6(5)$$

$$40 \leq 21 - 30$$

$$40 \leq -9 \quad \text{X}$$

$$r_3(-2, 31/2) = 8(-2) \leq 21 - 6(31/2)$$

$$-16 \leq 21 - 93$$

$$-16 \leq -72 \quad \text{X}$$

$$r_1(5, 1) = 3(5) + 2(1) \leq 25$$

$$15 + 2 \leq 25$$

$$17 \leq 25 \quad \checkmark$$

$$r_3(5, 1) = 8(5) \leq 21 - 6(1)$$

$$40 \leq 21 - 6$$

$$40 \leq 15 \quad \text{X}$$

$$r_1(-2, 37/6) = 3(-2) + 2(37/6) \leq 25$$

$$-6 + 37/3 \leq 25$$

$$19/3 \leq 25 \quad \checkmark$$

$$r_2(-2, 37/6) = -2 \leq 5 \quad \checkmark$$

$$r_5(-2, 37/6) = 37/6 \geq 1 \quad \checkmark$$

$$r_1(-2, 1) = 3(-2) + 2(1) \leq 25$$

$$-6 + 2 \leq 25$$

$$-4 \leq 25 \quad \checkmark$$

$$r_2(-2, 1) = -2 \leq 5 \quad \checkmark$$

$$r_3(-2, 1) = -2 \leq 21 - 6(1)$$

$$-2 \leq 21 - 6$$

$$-2 \leq 15 \quad \checkmark$$