Ejercicios Tema 2:

1.

x_1 = Nº días mina 1
x_2 = Nº días mina 2
x_3 = Nº días mina 3

$$\text{Min } z = 20x_1 + 22x_2 + 18x_3$$
$$\text{s.a} \quad 4x_1 + 6x_2 + x_3 \geq 54$$
$$4x_1 + 4x_2 + 6x_3 \geq 65$$
$$x_1 + x_2 + x_3 \leq 7$$
$$x_1, x_2, x_3 \geq 0$$

2.

x_1 = Nº Unidades Modelo 1
x_2 = Nº Unidades Modelo 2
x_3 = Nº Unidades Modelo 3
x_4 = Nº Unidades Modelo 4

$$\text{Max } z = 7x_1 + 7x_2 + 6x_3 + 9x_4$$
$$\text{s.a} \quad 2x_1 + 1'5x_2 + 3x_3 + 3x_4 \leq 30.000$$
$$4x_1 + 5x_2 + 3x_3 + 5x_4 \leq 20.000$$
$$x_1, x_2, x_3, x_4 \geq 0$$

3.

x_1 = Artículo 1
x_2 = Artículo 2
x_3 = Artículo 3
x_4 = Artículo 4
x_5 = Artículo 5

$$\text{Max } z = 100x_1 + 60x_2 + 70x_3 + 15x_4 + 15x_5$$
$$\text{s.a} \quad 52x_1 + 23x_2 + 35x_3 + 15x_4 + 7x_5 \leq 60$$
$$x_1, x_2, x_3, x_4, x_5 \geq 0$$
$$x_1, x_2, x_3, x_4, x_5 \leq 1$$

4.

x_1 = Nº Juegos Tipo 1
x_2 = Nº Juegos Tipo 2

$$\text{Max } z = 29x_1 + 31x_2$$
$$\text{s.a.} \quad 3'5x_1 + 4x_2 \leq 50$$
$$x_1, x_2 \geq 0$$

5. x_1 = N° Alimentos A
x_2 = N° Alimentos B
x_3 = N° Alimentos C
x_4 = N° Alimentos D
x_5 = N° Alimentos E
x_6 = N° Alimentos F

Min $z = 2x_1 + 3x_2 + 5x_3 + 6x_4 + 8x_5 + 8x_6$

s.a $20x_1 + 30x_2 + 40x_3 + 40x_4 + 45x_5 + 30x_6 \geq 70$

$30x_1 + 30x_2 + 20x_3 + 25x_4 + 50x_5 + 20x_6 \geq 100$

$4x_1 + 9x_2 + 11x_3 + 10x_4 + 9x_5 + 10x_6 \geq 20$

$x_1, x_2, x_3, x_4, x_5, x_6 \geq 0$

---

6. x_1 = N° Unidades Prod 1
x_2 = N° Unidades Prod 2
x_3 = N° Unidades Prod 3
x_4 = N° Unidades Prod 4

Max $z = 6x_1 + 4x_2 + 6x_3 + 8x_4$

s.a $2x_1 + 3x_2 + 2x_3 + 4x_4 \leq 480$

$x_1 + x_2 + 2x_3 + 3x_4 \leq 400$

$2x_1 + x_2 + 2x_3 + x_4 \leq 400$

$x_1 \geq 50$ $\quad x_4 \leq 25$

$x_1 + x_2 + x_3 \geq 100$

$x_1, x_2, x_3, x_4 \geq 0$

---

7. x_1 = N° Dias Planta A
x_2 = N° Dias Planta B
x_3 = N° Dias Planta C

Min $z = 210.000\,x_1 + 190.000\,x_2 + 182.000\,x_3$

s.a. $40x_1 + 65x_2 \geq 1500$

$35x_1 + 53x_3 \geq 1100$

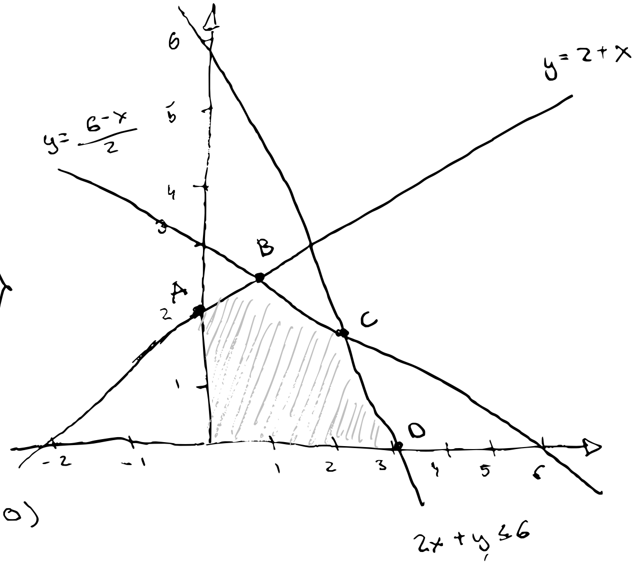
$x_1 + x_2 + x_3 \leq 30$

$x_1, x_2, x_3 \geq 0$

8.a

$$\text{Max } x+y$$

s.a
$$\left.\begin{aligned} -x+y &\le 2 \\ x+2y &\le 6 \\ 2x+y &\le 6 \\ x, y &\ge 0 \end{aligned}\right\}$$



$y = 2 + x \Rightarrow (0,2) / (-2,0)$

$y = \frac{6-x}{2} \Rightarrow (0,3) / (6,0)$

$y = 6 - 2x \Rightarrow (0,6) / (3,0)$

Punto A $\Rightarrow (0,2) \Rightarrow 2$

Punto B: $(2/3, 8/3) \Rightarrow 10/3$

$$\left.\begin{aligned} y &= \frac{6-x}{2} \\ y &= 2+x \end{aligned}\right\} \quad 4 + 2x = 6 - x \Rightarrow 3x = 2 \Rightarrow \boxed{\begin{array}{c} x = 2/3 \\ \hline y = 8/3 \end{array}}$$

Punto C: $(2,2) \Rightarrow 4 \Rightarrow \boxed{\text{Máximo}}$

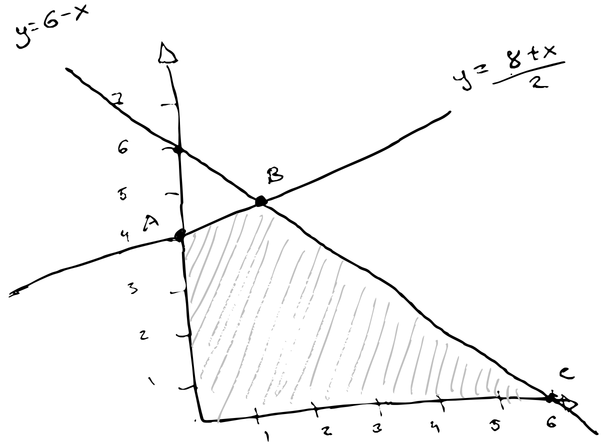
$$\left.\begin{aligned} y &= 6 - 2x \\ y &= \frac{6-x}{2} \end{aligned}\right\} \quad 12 - 4x = 6 - x \Rightarrow 6 = 3x \Rightarrow x = 2$$

$$y = 2$$

Punto D: $(3,0) \Rightarrow 3$

8. b

$$\left.\begin{array}{ll} \text{Max} & x+3y \\ \text{s.a} & x+y \le 6 \\ & -x+2y \le 8 \\ & x, y \ge 0 \end{array}\right\}$$



$y = 6 - x \Rightarrow (0,6) / (6,0)$

$y = \frac{8+x}{2} \Rightarrow (0,4) / (-8,0)$

Punto A $(0,4) \Rightarrow 12$

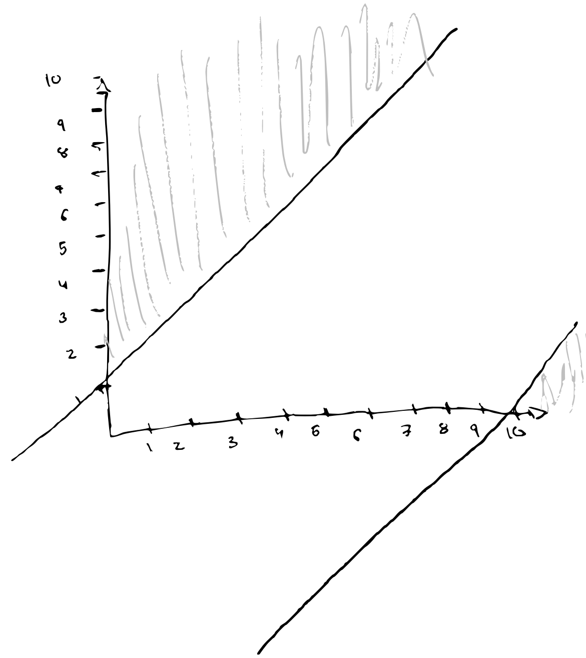
Punto B: $(4/3, 14/3) \Rightarrow 15'3 \Rightarrow$ $\boxed{\text{Maximo}}$

$$\left.\begin{array}{l} y = \frac{8+x}{2} \\ y = 6-x \end{array}\right\} \quad 12 - 2x = 8 + x \Rightarrow 4 = 3x \Rightarrow \boxed{x = \frac{4}{3}} \quad \boxed{y = \frac{14}{3}}$$

Punto C: $(6,0) \Rightarrow 6$

8.c

$$\left.\begin{array}{ll} \min & -x-y \\ \text{s.a} & x-y \geq 10 \\ & -x+y \geq 1 \\ & x,y \geq 0 \end{array}\right\}$$



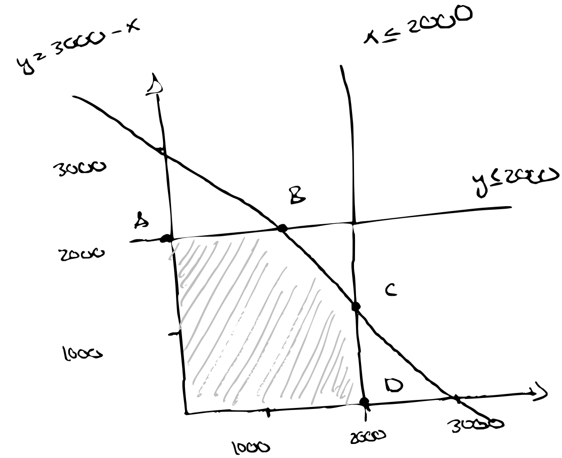
$y = x - 10 \Rightarrow (0,-10) / (10,0)$

$y = 1 + x \Rightarrow (0,1) / (-1,0)$

$\boxed{\text{*Regiones Incompatibles}}$

9. Max $f = 10x + 15y$

$$\left.\begin{aligned} \text{s.a} \quad & x + y \leq 3000 \\ & x \leq 2000 \\ & y \leq 2000 \\ & x, y \geq 0 \end{aligned}\right\}$$



$y = 3000 - x \Rightarrow (0, 3000) / (3000, 0)$

Punto A: $(0, 2000) \Rightarrow 30.000$

Punto B: $(1000, 2000) \Rightarrow \boxed{40.000} \Rightarrow \boxed{\text{Máximo}}$

$$\left.\begin{aligned} y &= 2000 \\ y &= 3000 - x \end{aligned}\right\} \quad 2000 = 3000 - x \Rightarrow \boxed{\begin{array}{c} x = 1000 \\ \hline y = 2000 \end{array}}$$

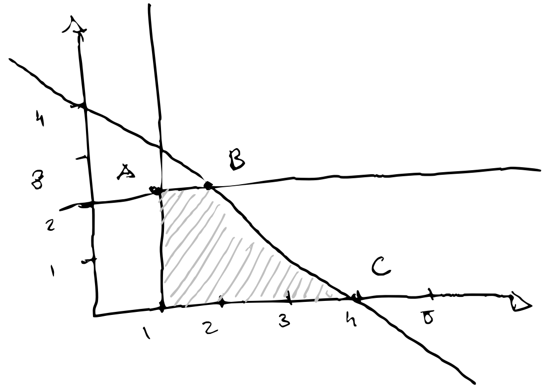
Punto C: $(2000, 1000) \Rightarrow 35000$

$$\left.\begin{aligned} x &= 2000 \\ x &= 3000 - y \end{aligned}\right\} \quad 2000 = 3000 - y \Rightarrow \boxed{\begin{array}{c} y = 1000 \\ \hline x = 2000 \end{array}}$$

Punto D: $(2000, 0) \Rightarrow 20.000$

10. a

$$\begin{cases} \text{Max} \quad x+y \\ \text{s.a} \quad x+y \leq 4 \\ \qquad x \geq 1 \\ \qquad y \leq 2 \\ \qquad x, y \geq 0 \end{cases}$$



$y = 4 - x \Rightarrow (0,4) / (4,0)$

Punto A: $(1,2) \Rightarrow 3$

Punto B: $(2,2) \Rightarrow 4$

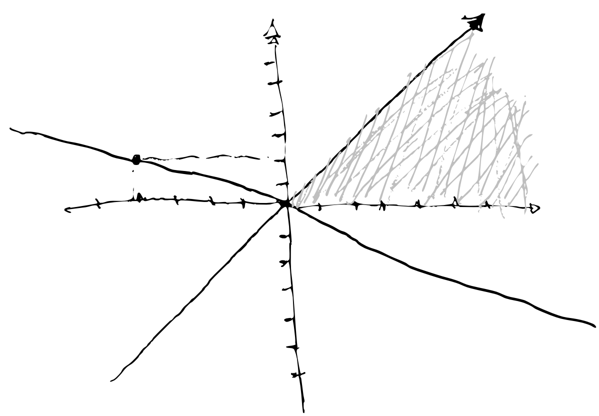
Punto C: $(0,4) \Rightarrow 4$

Solución segmento B-C

---

10. b.

$$\begin{cases} \text{Max} \quad x+y \\ \text{s.a} \quad x+2y \geq 0 \\ \qquad x-y \geq 0 \\ \qquad x, y \geq 0 \end{cases}$$



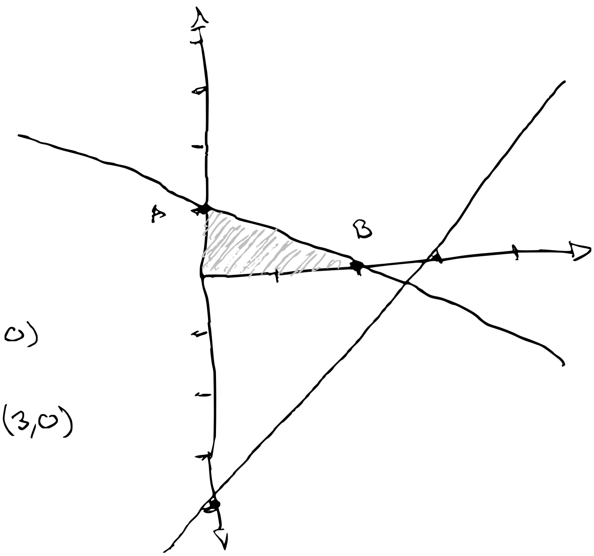
$y = \dfrac{-x}{2} \Rightarrow (0,0) / (-4,2)$

$y = x$

*No acotación

10. c.

$$\text{Max } 3x+4y$$
$$\text{s.a} \quad \left.\begin{array}{l} x+2y \le 2 \\ 4x-3y \le 12 \\ x, y \ge 0 \end{array}\right\}$$



$$y = \frac{2-x}{2} \Rightarrow (0,1) / (2,0)$$

$$y = \frac{12-4x}{-3} \Rightarrow (0,-4) / (3,0)$$

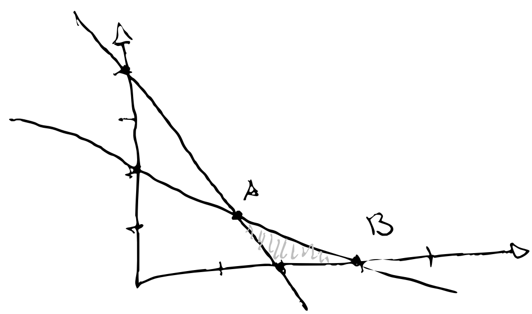
Punto A: $(0,1) \Rightarrow 4$

Punto B: $(2,0) \Rightarrow 6 \Rightarrow \boxed{\text{Maximo}}$

---

10. d.

$$\text{Max } x+y$$
$$\text{s.a} \quad \left.\begin{array}{l} 3x+2y \ge 6 \\ 2x+4y \le 8 \\ x, y \ge 0 \end{array}\right\}$$



$$y = \frac{6-3x}{2} \Rightarrow (0,3) / (2,0)$$

$$y = \frac{8-2x}{4} \Rightarrow (0,2) / (4,0)$$

Punto A: $(1, 3/2) \Rightarrow 5/2$

$$\left.\begin{array}{l} y = \frac{6-3x}{2} \\ y = \frac{8-2x}{4} \end{array}\right\} \quad 24 - 12x = 16 - 4x \Rightarrow 8 = 8x \Rightarrow \boxed{\begin{array}{c} x = 1 \\ y = 3/2 \end{array}}$$

Punto B: $(0,3) \Rightarrow 3 \Rightarrow \boxed{\text{Maximo}}$

- Ejercicio 1:

$$\left\{ \begin{array}{l} x \Rightarrow \text{Lote tipo A} \\ y \Rightarrow \text{Lote tipo B} \end{array} \right\}$$

$$\text{Max } 12'25x + 12'5y$$

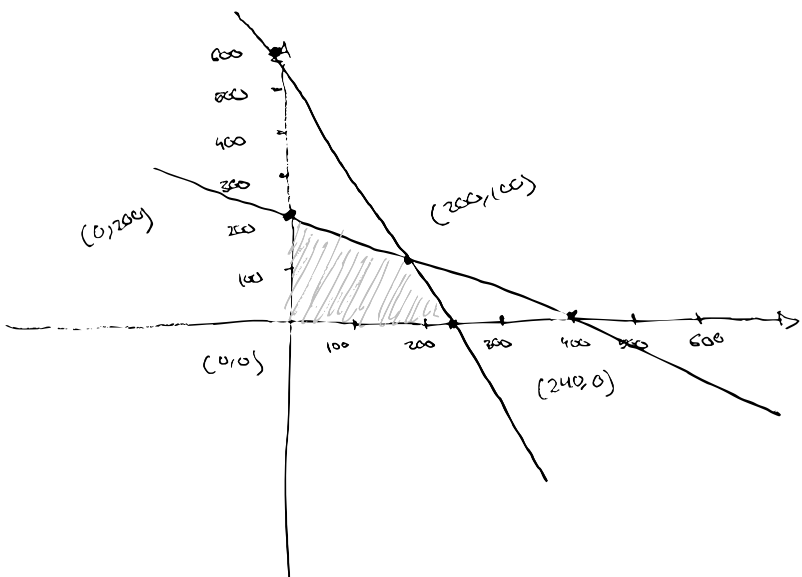
$$\text{s.a.} \quad x + 2y \leq 400$$

$$5x + 2y \leq 1200$$

$$x, y \geq 0$$

$$y = \frac{400 - x}{2} \Rightarrow (0, 200) \,/\, (400, 0)$$

$$y = \frac{1200 - 5x}{2} \Rightarrow (0, 600) \,/\, (240, 0)$$



$$\left. \begin{array}{l} y = \dfrac{400 - x}{2} \\[2ex] y = \dfrac{1200 - 5x}{2} \end{array} \right\} \quad 800 - 2x = 2400 - 10x \Rightarrow 8x = 1600$$

$$\boxed{\begin{array}{c} x = 200 \\ \hline y = 100 \end{array}}$$

- Ejercicio 2:

x = Avion Tipo A

y = Avion Tipo B

Min $80.000x + 20.000y$

s.a $600x + 300y \leq 4800$

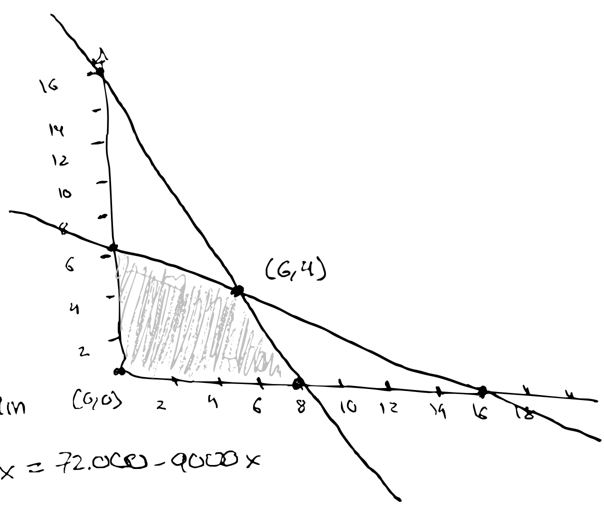
$6x + 15y \leq 96$

$x \leq 22$

$y \leq 32$

$y = \frac{4800 - 600x}{300} \Rightarrow (0,16) / (8,0)$

$y = \frac{96 - 6x}{15} \Rightarrow (0,6'4) / (16,0)$



$28.800 - 1800x = 72.000 - 9000x$

$7200x = 43.200$

$\boxed{x = 6 \\ y = 4}$ $\Rightarrow$ 560.000

$(0,6'4) \Rightarrow 128.000$

640.000

Ejercicio 3:

x = Albaricoque
y = Ciruela

Max $60x + 80y$

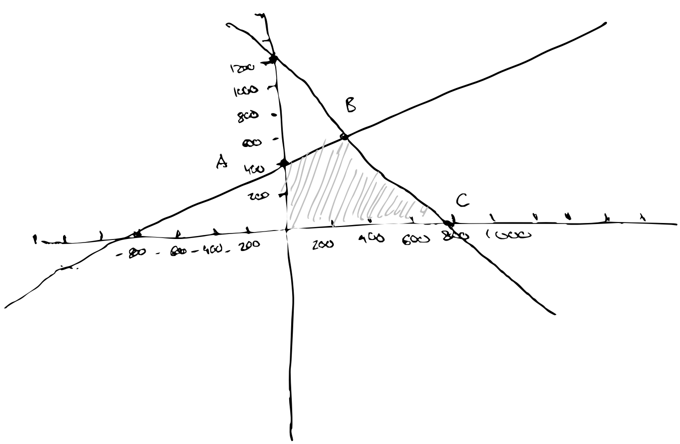
s.a $2y \leq x + 800$

$3x + 2y \leq 2400$

$x, y \geq 0$

$y = \dfrac{x+800}{2} \Rightarrow (0,400) \,/\, (-800,0)$

$\cancel{y = \dfrac{2400 - 3x}{2} \Rightarrow (0,1200) \,/\, (800,0)}$



Punto A $(0,400) \Rightarrow 32.000$ €

Punto C $(800,0) \Rightarrow 48.000$ €

Punto B: $(400,600) \Rightarrow \boxed{72.000\text{ €}} \Rightarrow$ Máximo

$2x + 1600 = 4800 - 6x \Rightarrow 8x = 3200 \Rightarrow \boxed{\begin{array}{c} x = 400 \\ \hline y = 600 \end{array}}$

Metodos Cuantitativos Tema 3:

Ejercicio 2: Expresa en forma canónica y estándar

$$
\begin{aligned}
\text{Max} \quad & x + y \\
\text{s.a} \quad & -x + y = 2 \\
& x + 2y \leq 6 \\
& 2x + y \geq 6 \\
& x \geq 0 \quad y \leq 0
\end{aligned}
$$

- Forma estandar:

$\boxed{y = -y_1}$

$$
\begin{aligned}
\text{Max} \quad & z = x - y_1 \\
\text{s.a.} \quad & -x - y_1 = 2 \\
& x - 2y_1 + a = 6 \\
& 2x - y_1 - b = 6 \\
& x \geq 0 \quad y_1 \geq 0 \\
& a, b \geq 0
\end{aligned}
$$

- Forma canónica:

$\boxed{y = -y_1}$

$$
\begin{aligned}
\text{Max} \quad & z = x - y_1 \\
\text{s.a} \quad & -x - y_1 \leq 2 \\
& x + y_1 \geq -2 \\
& x - 2y_1 \leq 6 \\
& -2x + y_1 \leq 6 \\
& x, y_1 \geq 0
\end{aligned}
$$

Relación ejercicios tema 3:

1. b) Max $2x + 3y + z$

s.a $4x + 3y + z \leq 20$

$x + y \leq 20$

$x, \geq 0 \quad y \leq 0$

• Forma estándar:

$\boxed{z = z_1 - z_2}$ $\boxed{y = -y_1}$

Max $2x - 3y_1 + (z_1 - z_2) + 0 \cdot a + 0 \cdot b$

s.a $4x - 3y_1 + (z_1 - z_2) + a = 20$

$x - y_1 + b = 20$

$x, y_1, z_1, z_2, a, b \geqslant 0$

• Forma canónica:

$\boxed{z = z_1 - z_2}$ $\boxed{y = -y_1}$

Max $2x - 3y_1 + (z_1 - z_2)$

s.a. $4x - 3y_1 + (z_1 - z_2) \leq 20$

$x - y_1 \leq 20$

$x, y_1, z_1, z_2 \geqslant 0$

Ejercicio 2 c)

$$\text{Min } x+y$$
$$\text{s.a } -x+y \leq 2$$

· Forma estandar:

$$\boxed{x = x_1 - x_2 \qquad y = y_1 - y_2}$$

$$\text{Max } f = -x_1 + x_2 - y_1 + y_2$$
$$\text{s.a } -x_1 + x_2 + y_1 - y_2 + s_1 = 2$$
$$x_1, x_2, y_1, y_2, s_1 \geq 0$$

· Forma canónica:

$$\boxed{x = x_1 - x_2 \qquad y = y_1 - y_2}$$

$$\text{Max } f = -x_1 + x_2 - y_1 + y_2$$
$$\text{s.a } -x_1 + x_2 + y_1 - y_2 \leq 2$$
$$x_1, x_2, y_1, y_2 \geq 0$$

Ejercicio 2:

$\boxed{x = x_1 - x_2}$

$$\left.\begin{aligned} &\text{Max} \quad -x + y \\ &\text{s.a} \quad -2x + y \leq 4 \\ &\qquad\quad x + y \leq 1 \\ &\qquad\quad y \geq 0 \end{aligned}\right\} \qquad \begin{aligned} &\text{Max } f = -x_1 + x_2 + y + 0s_1 + 0s_2 \\ &\text{s.a} \quad -2x_1 + 2x_2 + y + s_1 = 4 \\ &\qquad\quad x_1 - x_2 + y + s_2 = 1 \\ &\qquad\quad x_1, x_2, y, s_2, s_1 \geq 0 \end{aligned}$$

• Metodo Simplex:

		-1	1	1	0	0	
	V.B	x_1	x_2	y	s_1	s_2	x_B
0	s_1	-2	2	1	1	0	4
0	s_2	1	-1	$\boxed{1}$	0	1	1
	$z_j - c_j$	1	-1	-1 ↑	0	0	0

• Pivote 1:

		-1	1	1	0	0		
	V.B	x_1	x_2	y	s_1	s_2	x_B	
0	s_1	-3	$\boxed{3}$	0	1	-1	3	$-F_p$
1	y	1	-1	1	0	1	1	F_p
	$z_j - c_j$	2	-2 ↑	0	0	1	1	

- Pivote 3 :

		-1	1	1	0	0	
	V. B	x_1	x_2	y	s_1	s_2	x_B
1	x_2	-1	1	0	1/3	-1/3	1
1	y	0	0	1	1/3	2/3	2
	$z_j - c_j$	0	0	0	2/3	1/3	3

Solución $\Rightarrow$ $x_2 = 1,\ y = 2,\ x_1 = 0,\ s_1 = 0,\ s_2 = 0$

$x_B = 2 \cdot 1 + 1 \cdot 1 = 3$ Múltiple

Ejercicio 3 del Tema 3:

Opt $x-2y+3z$	Max $f = x-2y+3z$
	Min $f = \text{Max} - f = -x+2y-3z$
s.a $x+2y+z \leq 4$	s.a $x+2y+z+s_1 = 4$
$2x+y-z \leq 2$	$2x+y-z+s_2 = 2$
$x, y, z \geq 0$	$x, y, z, s_1, s_2 \geq 0$

• **Metodo Simplex:**

		1	-2	3	0	0	
	V.B	x	y	z	s_1	s_2	x_B
0	s_1	1	2	$\boxed{1}$	1	0	4
0	s_2	2	1	-1	0	1	2
	$z_j - c_j$	-1	2	-3	0	0	0

• **Pivote (-3):**

		1	-2	3	0	0	
	V.B	x	y	z	s_1	s_2	x_B
3	z	1	2	1	1	0	4
0	s_2	3	3	0	1	1	6
	$z_j - c_j$	2	8	0	3	0	12

$F_1 = \frac{F_1}{P}$

$F_2 = +F_1$

Solución $\Rightarrow$ $z=4$, $s_2=6$, $x=0$, $y=0$, $z=0$

$x_B = 3 \cdot 4 + 6 \cdot 0 \Rightarrow 12$

Ejercicio 3 ⇒ Modelo Min

$$\begin{cases} \text{Opt} & x - 2y + 3z \\ \text{s.a} & x + 2y + z \leq 4 \\ & 2x + y - z \leq 2 \\ & x, y, z \geq 0 \end{cases}$$

$$\begin{aligned} &\text{Min} && g = \text{Max} - g = -x + 2y - 3z \\ &\text{s.a} && x + 2y + z + s_1 = 4 \\ &&& 2x + y - z + s_2 = 2 \\ &&& x, y, z, s_1, s_2 \geq 0 \end{aligned}$$

- Metodo Simplex:

		-1	2	-3	0	0	
	V.B	x	y	z	s_1	s_2	X_B
0	s_1	1	2	1	1	0	4
0	s_2	2	$\boxed{1}$	-1	0	1	2
	$z_j - c_j$	1	-2 ↑	3	0	0	0

- Pivote (1):

		-1	2	-3	0	0	
	V.B	x	y	z	s_1	s_2	X_B
0	s_1	-3	0	3	1	-2	0
2	y	2	1	-1	0	1	2
	$z_j - c_j$	5	0	1	0	2	-4

$F_1 = -2F_2$

$F_2 = \dfrac{F_2}{1}$

⇒ Solución $= [s_1 = 0,\ y = 2,\ s_2 = 0,\ x = 0,\ z = 0]$

$X_{B\,MIN} = -4$ Óptima Única ⇒ (Solo hay 2 ceros)

Mas ceros ⇒ Solución Múltiple

Ejercicio 4 del tema 3:

a) Max $f = 3x + 2y + z$

s.a $2x - 3y + 2z \leq 3$

$-x + y + z \leq 5$

$x, y, z \geq 0$

Max $f = 3x + 2y + z$

s.a. $2x - 3y + 2z + s_1 = 3$

$-x + y + z + s_2 = 5$

$x, y, z \geq 0$

- Metodo Simplex:

		3	2	1	0	0	
	V. B	x	y	z	s_1	s_2	x_B
0	s_1	$\boxed{2}$	-3	2	1	0	3
0	S_2	-1	1	1	0	1	5
	$z_j - c_j$	-3 ↑	-2	-1	0	0	0

- Pivote 2:

		3	2	1	0	0	
	V. B	x	y	z	s_1	s_2	x_B
3	x	1	$-3/2$	1	$1/2$	0	$3/2$
0	S_2	0	$-1/2$	2	$1/2$	1	$13/2$
	$z_j - c_j$	0	$-13/2$	2	$3/2$	0	$9/2$

$F_p = \frac{F_1}{2}$

$F_2 = F_2 + F_p$

*Problema No Acotado

Puede entrar y pero no puede salir ninguna variable

Ejercicio 8c:

$$\begin{aligned} \text{Min} \quad & x_1 + x_2 \\ \text{s.a} \quad & x_1 + x_2 \leq 1 \\ & 4x_1 + 2x_2 \geq 6 \\ & x_1, x_2 \geq 0 \end{aligned} \quad \Bigg\} \quad \begin{aligned} \text{Max} \quad & -x - x_2 - 0 \cdot s_1 - 0 \cdot s_2 - M t_1 \\ \text{s.a} \quad & x_1 + x_2 + s_1 = 1 \\ & 4x_1 + 2x_2 - s_2 + t_1 = 6 \\ & x_1, x_2, s_1, s_2, t_1 \geq 0 \end{aligned}$$

		-1	-1	0	0	-M	
		x_1	x_2	s_1	s_2	t_1	
0	s_1	$\boxed{1}$	1	1	0	0	1
-M	t_1	4	2	0	-1	1	6
		-4M+1	-2M+1	0	M	0	

- **Pivote 1:**

		-1	-1	0	0	-M	
		x_1	x_2	s_1	s_2	t_1	
-1	x_1	$\boxed{1}$	1	1	0	0	1
-M	t_1	0	-2	-4	-1	1	2
		0	+2M	4M-1	M	0	$\boxed{-1-2M}$

$\Downarrow$

$\boxed{1+2M}$

- Como $t_1 > 0$ es infactible

- Ejercicio 9. a:

$$\begin{array}{ll} \text{Min} & 20x_1 + 25x_2 \\ \text{s.a} & 2x_1 + 3x_2 \geq 18 \\ & x_1 + 3x_2 \geq 12 \\ & 4x_1 + 3x_2 \geq 24 \\ & x_1, x_2 \geq 0 \end{array} \quad \Bigg\} \quad \begin{array}{l} \text{Max} \quad 0x_1 + 0x_2 + t_1 + t_2 + t_3 \\ 2x_1 + 3x_2 - s_1 + t_1 = 18 \\ x_1 + 3x_2 - s_2 + t_2 = 12 \\ 4x_1 + 3x_2 - s_3 + t_3 = 24 \\ x_1, x_2, s_1, s_2, s_3, t_1, t_2, t_3 \geq 0 \end{array}$$

		0	0	0	0	0	1	1	1	
	V_B	x_1	x_2	s_1	s_2	s_3	t_1	t_2	t_3	
1	t_1	2	3	$\boxed{-1}$	0	0	1	0	0	18
1	t_2	1	3	0	-1	0	0	1	0	12
1	t_3	4	3	0	0	-1	0	0	1	24
	$z_j - c_j$	7	9	-1	-1	-1	0	0	0	54

Ejercicio 9. b:

$$\begin{array}{ll} \text{Max} & f = 4x_1 + 3x_2 \\ \text{s.a} & 3x_1 + 4x_2 \leq 12 \\ & x_1 + x_2 \geq 4 \\ & 4x_1 + 2x_2 \leq 8 \\ & x_1, x_2 \geq 0 \end{array} \quad \Bigg\} \quad \begin{array}{ll} \text{Max} & f = 4x_1 + 3x_2 \\ \text{s.a} & 3x_1 + 4x_2 + s_1 = 12 \\ & x_1 + x_2 - s_2 + t_1 = 4 \\ & 4x_1 + 2x_2 + s_3 = 8 \\ & x_1, x_2, s_1, s_2, s_3, t_1 \geq 0 \end{array}$$

		0	0	0	0	0	-1	
		x_1	x_2	s_1	s_2	s_3	t_1	x_B
0	s_1	3	4	1	0	0	0	12
-1	t_1	1	1	0	-1	0	1	4
0	s_3	$\boxed{4}$	2	0	0	1	0	8
$c_j - z_j$		-1 ↑	-1	0	1	0	0	-4

- Pivote el 4:

		0	0	0	0	0	-1	
		x_1	x_2	s_1	s_2	s_3	t_1	x_B
0	s_1	0	$\boxed{2'5}$	1	0	-0'75	0	6
-1	t_1	0	0'5	0	-1	-0'25	1	2
0	x_1	1	0'5	0	0	0'25	0	2
$c_j - z_j$		0	-0'5 ↑	0	1	0'25	0	-2

• Pivote 2'5:

		0	0	0	0	0	-1	
		x_1	x_2	s_1	s_2	s_3	t_1	x_B
0	x_2	0	1	0'4	0	-0'3	0	2'4
-1	t_1	0	0	-0'2	-1	-0'4	1	0'8
0	s_3	1	0	-0'2	0	0'4	0	0'8
	$c_j - z_j$	0	0	0'2	1	0'1	0	-0'8

• Primero comprobamos si hay alguna variable artificial entre las básicas:

⇒ Si es 0 o positivas, pasamos a la fase 2.

⇒ Si es negativa, problema infactible.

- Ejercicio 9.c:

$$\begin{array}{ll} \text{Max} & x_1 - 2x_2 + 3x_3 \\ \text{s.a} & x_1 + x_2 + x_3 = 6 \\ & x_3 \leq 2 \\ & x_1, x_2, x_3 \geq 0 \end{array} \quad \Bigg\} \quad \begin{array}{l} \text{Max } 0x_1 - 0x_2 + 0x_3 + 0s_1 - 1t_1 \\ x_1 + x_2 + x_3 + t_1 = 6 \\ x_3 + s_1 = 2 \\ x_1, x_2, x_3, t_1, s_1 \geq 0 \end{array}$$

		0	0	0	0	-1	
	V_B	x_1	x_2	x_3	s_1	t_1	x_B
-1	t_1	$\boxed{1}$	1	1	0	1	6
0	s_1	0	0	1	1	0	2
		-1 ↑	-1	-1	0	0	-6

- Pivote 1:

		0	0	0	0	-1	
	V_B	x_1	x_2	x_3	s_1	t_1	
0	x_1	1	1	1	0	1	6
0	s_1	0	0	1	1	0	2
		0	0	0	0	1	0

⇒ Vemos que por ahora es factible pasamos a la fase 2.

- **Fase 2:** (Desaparece la t)

		1	-2	3	0	
	V_B	x_1	x_2	x_3	s_1	
1	x_1	1	1	1	0	6
0	s_1	0	0	$\boxed{1}$	1	2
		0	3	-2	0	6

- **Pivote 1:**

		1	-2	3	0	
	V_B	x_1	x_2	x_3	s_1	
1	x_1	1	1	0	-1	4
3	x_3	0	0	1	1	2
		0	3	0	2	10

Solución optima única:

$$\left.\begin{array}{l} x_1 = 4 \\ x_3 = 2 \\ x_2 = 0 \end{array}\right\} \quad x_B = 10$$

- **Ejercicio 9.d:**

$$\left.\begin{array}{ll} \text{Max} & x_1 + x_2 + 10x_3 \\ \text{s.a} & x_2 + 4x_3 = 2 \\ & -2x_1 + x_2 - 6x_3 = 2 \\ & x_1, x_2, x_3 \geq 0 \end{array}\right\} \begin{array}{l} \to x_2 + 4x_3 + t_1 = 2 \\ \to -2x_1 + x_2 - 6x_3 + t_2 = 2 \\ \quad x_1, x_2, x_3, t_1, t_2 \geq 0 \end{array}$$

Fase 1: $g = 0x_1 + 0x_2 + 0x_3 - t_1 - t_2$

		0	0	0	-1	-1	
	g	x_1	x_2	x_3	t_1	t_2	
-1	t_1	0	$\boxed{1}$	4	1	0	2
-1	t_2	-2	1	-6	0	1	2
		2	-2	2	0	0	4

- **Pivote 1:**

		0	0	0	-1	-1	
	g	x_1	x_2	x_3	t_1	t_2	
0	x_2	0	1	4	1	0	2
-1	t_2	-2	0	-10	-1	1	0
		2	0	10	2	0	0

- **Fase 2:** $f = x_1 + x_2 + 10x_3$

		1	1	10	
		x_1	x_2	x_3	
1	x_2	0	1	4	2
0	t_2	−2	0	$\boxed{-10}$	0
		−1	0	−6	

$$\left\{ \begin{array}{l} F_p = F_2/-10 \\ F_{1N} = F_1 - F_p \end{array} \right\}$$

- **Pivote −10:**

		1	1	10	
		x_1	x_2	x_3	
1	x_2	−0'8	1	0	2
10	x_3	0'2	0	1	0
		0'2	0	0	2

Sol. Óptima Única

$x_1 = 0$
$x_2 = 2$
$x_3 = 0$

$f = 2$

• Ejercicio 9. e:

$$\begin{aligned} \text{Max } & x_1 + 2x_2 \\ \text{s.a } & x_1 + x_2 = 4 \\ & 2x_1 - 3x_2 = 3 \\ & 3x_1 - x_2 = 8 \\ & x_1, x_2 \geq 0 \end{aligned} \Bigg\} \quad \begin{aligned} \text{Max } & 0x_1 + 0x_2 - t_1 - t_2 - t_3 \\ & x_1 + x_2 + t_1 = 4 \\ & 2x_1 - 3x_2 + t_2 = 3 \\ & 3x_1 - x_2 + t_3 = 8 \\ & x_1, x_2, t_1, t_2, t_3 \geq 0 \end{aligned}$$

• Fase 1:

		0	0	-1	-1	-1	
	V_B	x_1	x_2	t_1	t_2	t_3	
-1	t_1	1	1	1	0	0	4
-1	t_2	$\boxed{2}$	-3	0	1	0	3
-1	t_3	3	-1	0	0	1	8
		-6↑	3	0	0	0	

• Pivote 2:

		0	0	-1	-1	-1	
	V_B	x_1	x_2	t_1	t_2	t_3	
-1	t_1	0	$\boxed{5/2}$	1	$-1/2$	0	$5/2$
0	x_1	1	$-3/2$	0	$1/2$	0	$3/2$
-1	t_3	0	$7/2$	0	$-3/2$	1	$7/2$
		0	-6↑	0	1	0	

• Pivote $\frac{5}{2}$:

		x_1	x_2	t_1	t_2	t_3	
		0	0	-1	-1	-1	
	V_B	x_1	x_2	t_1	t_2	t_3	
0	x_2	0	1	$2/5$	$-1/5$	0	1
0	x_1	1	0	$3/5$	-1	0	3
-1	t_3	0	0	$-7/5$	$-9/5$	1	0
		0	0	1	$14/5$	0	

• Fase 2:

		x_1	x_2	
		1	2	
	V_B	x_1	x_2	
2	x_2	0	1	1
1	x_1	1	0	3
0	t_3	0	0	0
		0	0	

Solución óptima única:

$$\left.\begin{array}{l} x_2 = 1 \\ x_1 = 3 \end{array}\right\} \quad x_B = 5$$

		x_1	x_2	t_1	t_2	t_3	
		0	0	-1	-1	-1	
	V_B	x_1	x_2	t_1	t_2	t_3	
-1	t_1	0	$\boxed{5/2}$	1	$-1/2$	0	$5/2$
0	x_1	1	$-3/2$	0	$1/2$	0	$3/2$
-1	t_3	0	$7/2$	0	$-3/2$	1	$7/2$
		0	-6	0	1	0	

Ejercicio 10. a:

$$\text{Max} \quad 6x_1 + 4x_2$$

$$\text{s.a} \quad x_1 \leq 700$$

$$3x_1 + x_2 \leq 2400$$

$$x_1 + 2x_2 \leq 1600$$

$$x_1, x_2 \geq 0$$

$$C = \begin{pmatrix} 6 \\ 4 \end{pmatrix}$$

$$A = \begin{array}{c} \begin{array}{cc} x_1 & x_2 \end{array} \\ \begin{pmatrix} 1 & 0 \\ 3 & 1 \\ 1 & 2 \end{pmatrix} \end{array} \Rightarrow A' = \begin{array}{c} \begin{array}{ccc} y_1 & y_2 & y_3 \end{array} \\ \begin{pmatrix} 1 & 3 & 1 \\ 0 & 1 & 2 \end{pmatrix} \end{array}$$

$$b = \begin{pmatrix} 700 \\ 2400 \\ 1600 \end{pmatrix}$$

$\Rightarrow$ Dual:

$$\text{Min} \quad w = 700y_1 + 2400y_2 + 1600y_3$$

$$\text{s.a} \quad y_1 + 3y_2 + y_3 \geq 6$$

$$y_2 + 2y_3 \geq 4$$

$$y_1, y_2, y_3 \geq 0$$

• Ejercicio 10. b:

$$\text{Max } 4'5x_1 + 3x_2 + 1'5x_3$$
$$\text{s.a } \begin{cases} x_1 + 2x_2 - x_3 \leq 4 \\ 2x_1 - x_2 + x_3 = 8 \\ x_1 - x_2 \leq 6 \\ x_1, x_2, x_3 \geq 0 \end{cases}$$

$$\text{Max } 4'5x_1 + 3x_2 + 1'5x_3$$
$$\text{s.a } \begin{cases} x_1 + 2x_2 - x_3 \leq 4 \\ 2x_1 - x_2 + x_3 \leq 8 \\ -2x_1 + x_2 - x_3 \leq -8 \\ x_1 - x_2 \leq 6 \\ x_1, x_2, x_3 \geq 0 \end{cases}$$

• Matrices:

$$\text{Max } z = c'x \quad \text{s.a } Ax \leq b, \quad x \geq 0$$

$$c = \begin{pmatrix} 4'5 \\ 3 \\ 1'5 \end{pmatrix} \qquad b = \begin{pmatrix} 4 \\ 8 \\ -8 \\ 6 \end{pmatrix}$$

$$A = \begin{array}{c} \begin{array}{ccc} x_1 & x_2 & x_3 \end{array} \\ \begin{pmatrix} 1 & 2 & -1 \\ 2 & -1 & 1 \\ -2 & 1 & -1 \\ 1 & -1 & 0 \end{pmatrix} \end{array} \Rightarrow A' = \begin{array}{c} \begin{array}{cccc} y_1 & y_2 & y_3 & y_4 \end{array} \\ \begin{pmatrix} 1 & 2 & -2 & 1 \\ 2 & -1 & 1 & -1 \\ -1 & 1 & -1 & 0 \end{pmatrix} \end{array}$$

• Forma dual:

$$\text{Min } w = b'y \quad \text{s.a } A'y \geq c, \quad y \geq 0$$

$$\text{Min } w = 4y_1 + 8y_2 - 8y_3 + 6y_4$$
$$\text{s.a } \begin{cases} y_1 + 2y_2 - 2y_3 + y_4 \geq 4'5 \\ 2y_1 - y_2 + y_3 - y_4 \geq 3 \\ -y_1 + y_2 - y_3 \geq 1'5 \\ y_1, y_2, y_3, y_4 \geq 0 \end{cases}$$

Ejercicio 10. c:

$$\text{Min } 6x_1 + 4x_2 \Rightarrow \text{Max } -6x_1 - 4x_2$$

s.a

$x_1 \leq 700 \qquad\qquad -x_1 \geq -700$

$3x_1 + x_2 \geq 2400 \Rightarrow 3x_2 + x_2 \geq 2400$

$x_1 + 2x_2 \leq 1600 \qquad -x_1 - 2x_2 \geq -1600$

$x_1, x_2 \geq 0 \qquad\qquad x_1, x_2 \geq 0$

$$C = \begin{pmatrix} -6 \\ -4 \end{pmatrix} \quad A = \begin{pmatrix} -1 & 0 \\ 3 & 1 \\ -1 & 2 \end{pmatrix} \Rightarrow A' = \begin{pmatrix} -1 & 3 & -1 \\ 0 & 1 & 2 \end{pmatrix}$$

$\Rightarrow$ Dual:

$$\text{Max } w = -700y_1 + 2400y_2 - 1600y_3$$

s.a $\quad -y_1 + 3y_2 - y_3 \leq 6$

$y_2 - 2y_3 \leq 4$

$y_1, y_2, y_3 \geq 0$

• Ejercicio 10. d:

$$\text{Max} \quad 4'5x_1 + 3x_2 + 1'5x_3$$

$$\begin{aligned} \text{s.a} \quad & x_1 + 2x_2 - x_3 \leq 4 \\ & 2x_1 - x_2 + x_3 \leq 8 \\ & x_1 - x_2 \leq 6 \\ & x_1, x_3 \geq 0 \quad x_2 \text{ libre} \end{aligned}$$

$$c = \begin{pmatrix} 4'5 \\ 3 \\ 1'5 \end{pmatrix} \quad b = \begin{pmatrix} 4 \\ 8 \\ 6 \end{pmatrix}$$

$$A = \begin{pmatrix} 1 & 2 & -1 \\ 2 & -1 & 1 \\ 1 & -1 & 0 \end{pmatrix} \Rightarrow A^t = \begin{array}{c} \begin{array}{ccc} y_1 & y_2 & y_3 \end{array} \\ \begin{pmatrix} 1 & 2 & 1 \\ 2 & -1 & -1 \\ -1 & 1 & 0 \end{pmatrix} \end{array}$$

• Forma dual:

$$\text{Min} \quad w = 4y_1 + 8y_2 + 6y_3$$

$$\begin{aligned} \text{s.a} \quad & y_1 + 2y_2 + y_3 \geq 4'5 \\ & 2y_1 - y_2 - y_3 = 3 \\ & -y_1 + y_2 \geq 1'5 \\ & \\ & y_1, y_2, y_3 \geq 0 \end{aligned}$$

- Ejercicio 10. e:

$$\text{Min } 6x_1 + 4x_2$$

s.a $x_1 \leq 700 \Rightarrow -x_1 \geq -700$

$$3x_1 + x_2 \geq 2400$$

$$x_1 + 2x_2 = 1600$$

$x_1 \geq 0$ $\quad x_2$ sin restricciones

$$c = \begin{pmatrix} 6 \\ 4 \end{pmatrix} \quad b = \begin{pmatrix} -700 \\ 2400 \\ 1600 \end{pmatrix}$$

$$A = \begin{pmatrix} 1 & 0 \\ 3 & 1 \\ 1 & 2 \end{pmatrix} \Rightarrow A' = \begin{pmatrix} 1 & 3 & 1 \\ 0 & 1 & 2 \end{pmatrix}$$

- Forma dual:

$$\text{Min } w = -700y_1 + 2400y_2 + 1600y_3$$

s.a $y_1 + 3y_2 + y_3 \geq 6$

$$y_2 + 2y_3 = 4$$

$y_1, y_2 \geq 0$ $\quad y_3$ sin restricciones

- Ejercicio 11:

c) Max $2x_1 + x_2 + 3x_3$

s.a. $2x_1 - x_2 + 3x_3 \leq 6$

$x_1 + 3x_2 + 5x_3 \leq 10$

$2x_1 + x_3 \leq 7$

$x_1, x_2, x_3 \geq 0$

$2x_1 - x_2 + 3x_3 + s_1 = 6$

$x_1 + 3x_2 + 5x_3 + s_2 = 10$

$2x_1 + x_3 + s_3 = 7$

$x_1, x_2, x_3 \geq 0$

		2	1	3	0	0	0	
	VB	x_1	x_2	x_3	s_1	s_2	s_3	
0	s_1	2	-1	$\boxed{3}$	1	0	0	6
0	s_2	1	3	5	0	1	0	10
0	s_3	2	0	3	0	0	1	7
		-2	-1	-3	0	0	0	0

- Pivote

• Ejercicio 12.a:

$$\left.\begin{aligned} \text{Min} \quad & z = x_1 + 2x_2 \\ \text{s.a} \quad & x_1 + x_2 \geq 4 \\ & 2x_1 + x_2 \geq 6 \\ & x_1, x_2 \geq 0 \end{aligned}\right\} \qquad \begin{aligned} \text{Max} \quad & -x_1 - 2x_2 \\ \text{s.a} \quad & -x_1 - x_2 + s_1 = -4 \\ & -2x_1 - x_2 + s_2 = -6 \\ & x_1, x_2, s_1 \geq 0 \end{aligned}$$

		-1	-2	0	0	
	VB	x_1	x_2	s_1	s_2	
0	s_1	-1	-1	-1	0	-4
0	s_2	$\boxed{-2}$	-1	0	1	-6 ←
		1	2	0	0	

• Pivote -2:

		-1	-2	0	0	
	VB	x_1	x_2	s_1	s_2	
0	s_1	0	$-1/2$	1	$\boxed{-1/2}$	-1 ←
-1	x_1	1	$1/2$	0	$-1/2$	3
		0	$3/2$	0	$1/2$	-3

• Pivote $-1/2$:

		-1	-2	0	0	
	VB	x_1	x_2	s_1	s_2	
0	s_2	0	1	-2	1	2
-1	x_1	1	1	-1	0	4
		0	1	1	0	-4

Solución óptima única $\left\{\begin{aligned} & x_1 = 4 \quad s_2 = 2 \\ & x_2 = s_1 = 0 \end{aligned}\right\}$ $x_B = 4$

- Ejercicio 12.b:

$$\text{Min } x_1 + x_2 + x_3 + x_4$$

s.a

$$2x_1 + x_4 \geq 250$$
$$3x_2 \geq 1000$$
$$3x_2 + 10x_3 + 6x_4 \geq 750$$
$$x_1, x_2, x_3, x_4 \geq 0$$

$$\text{Max } -x_1 - x_2 - x_3 - x_4 + s_1 + s_2 + s_3$$

$$-2x_1 - x_4 + s_1 = -250$$
$$-3x_2 + s_2 = -1000$$
$$-3x_2 - 10x_3 - 6x_4 + s_3 = -750$$
$$x_1, x_2, x_3, x_4 \geq 0$$

		-1	-1	-1	-1	0	0	0		
	V_B	x_1	x_2	x_3	x_4	s_1	s_2	s_3		
0	s_1	-2	0	0	-1	1	0	0	-250	
0	s_2	0	$\boxed{-3}$	0	0	0	1	0	-1000	←
0	s_3	0	-3	-10	-6	0	0	1	-750	
		1	1	1	1	0	0	0		

- Pivote -3:

		-1	-1	-1	-1	0	0	0		
	V_B	x_1	x_2	x_3	x_4	s_1	s_2	s_3		
0	s_1	$\boxed{-2}$	0	0	-1	1	0	0	-250	←
-1	x_2	0	1	0	0	0	$-1/3$	0	$\frac{1000}{3}$	
0	s_3	0	0	-10	-6	0	-1	1	250	
		1	0	1	1	0	$1/3$	0		

• Pivote -2:

		-1	-1	-1	-1	0	0	0	
	V_B	x_1	x_2	x_3	x_4	s_1	s_2	s_3	
-1	x_1	1	0	0	$1/2$	$-1/2$	0	0	125
-1	x_2	0	1	0	0	0	$-1/3$	0	$\frac{1000}{3}$
0	s_3	0	0	-10	-6	0	-1	1	250
		0	0	1	$1/2$	$1/2$	$1/3$	0	-458'3

Solución óptima única:

$$\left.\begin{array}{l} x_1 = 125 \quad x_2 = \frac{1000}{3} \quad s_3 = 250 \\ x_3 = x_4 = s_1 = s_2 = 0 \end{array}\right\} x_B = 458'3$$

• Ejercicio 12.c:

$$\begin{aligned} \text{Max} \quad & -4x_1 - 6x_2 \\ \text{s.a} \quad & 3x_1 + x_2 \geq 2400 \\ & x_1 + 2x_2 \geq 1600 \\ & x_1, x_2 \geq 0 \end{aligned} \Rightarrow \begin{aligned} & -3x_1 - x_2 + s_1 = -2400 \\ & -x_1 - 2x_2 + s_2 = -1600 \\ & x_1, x_2, s_1, s_2 \geq 0 \end{aligned}$$

		-4	-6	0	0	
	V_B	x_1	x_2	s_1	s_2	x_B
0	s_1	$\boxed{-3}$	-1	1	0	-2400
0	s_2	-1	-2	0	1	-1600
		4	6	0	0	

• Pivote -3:

		-4	-6	0	0	
	V_B	x_1	x_2	s_1	s_2	x_B
-4	x_1	1	$1/3$	$-1/3$	0	800
0	s_2	0	$\boxed{-5/3}$	$-1/3$	1	-800 ←
		0	$14/3$	$4/3$	0	

• $\dfrac{4/3}{-1/3} \Rightarrow -4$ • $\dfrac{\frac{14}{3}}{-\frac{5}{3}} \Rightarrow \boxed{-2'8}$

• Pivote $-1/2$:

VB	x_1	x_2	s_1	s_2	
s_2	0	1	-2	1	2
x_1	1	2	-1	0	4
	0	1	1	0	-4

Solución óptima única:

$$\underbrace{x_1 = 4 \quad x_2 = 0 \quad s_1 = 0 \quad s_2 = 2}$$

Con $-z^* = -4 \Rightarrow \boxed{z^* = 4}$

---

a) Var. no. basica $\Rightarrow$ $\boxed{x_1 = \hat{c}_1}$

$z_1 - \hat{c}_1 \geq 0 \Rightarrow (2\ 0) \cdot \begin{pmatrix} 1 \\ 1 \end{pmatrix} - c_1 \Rightarrow 2 - c_1 \geq 0$

$x_2 = \hat{c}_2$

$z_2 - \hat{c}_2 \geq 0 \Rightarrow (2\ 0) \begin{pmatrix} 1 \\ 0 \end{pmatrix} - c_2 \Rightarrow 2 - c_2 \geq 0$

$2 \geq c_2$

Ejercicio 14.a:

$$\begin{array}{ll} \text{Max} & x_1 + 2x_2 \\ \text{s.a} & x_1 + x_2 \leq 4 \\ & 2x_1 + x_2 \leq 6 \\ & x_1, x_2 \geq 0 \end{array}$$

	1	2	0	0	
V_B	x_1	x_2	s_1	s_2	
x_2	1	1	1	0	4
s_2	1	0	-1	1	2
	1	0	2	0	8

a) Var. No. básica: $x_1 \rightarrow \boxed{\hat{c}_1}$

$$z_1 - \hat{c}_1 \geq 0 \rightarrow (2 \quad 0)\begin{pmatrix} 1 \\ 1 \end{pmatrix} - \hat{c}_1 \geq 0$$

$$\Rightarrow 2 - \hat{c}_1 \geq 0 \Rightarrow \boxed{\hat{c}_1 \leq 2}$$

↳ Tabla óptima

b) Var básica: $x_2 \rightarrow \boxed{\hat{c}_2}$

$$z_1 - \hat{c}_1 \geq 0 \Rightarrow (\hat{c}_2 \quad 0)\begin{pmatrix} 1 \\ 1 \end{pmatrix} - 1 \geq 0 \rightarrow \boxed{\hat{c}_2 \geq 1}$$

→ Tabla opt

$$z_3 - c_3 \geq 0 \Rightarrow (\hat{c}_2 \quad 0)\begin{pmatrix} 1 \\ -1 \end{pmatrix} - 0 \geq 0 \rightarrow \hat{c}_2 \geq 0$$

$$z = (\hat{c}_2 \quad 0)\begin{pmatrix} 4 \\ 2 \end{pmatrix} = 4\hat{c}_2$$

• Ejercicio 14.c:

$$\begin{aligned} \text{Max} \quad & x_1 + 2x_2 \\ \text{s.a} \quad & x_1 + x_2 \le 4 \\ & 2x_1 + x_2 \le 6 \\ & x_1, x_2 \ge 0 \end{aligned}$$

		1	2	0	0	
	V_B	x_1	x_2	s_1	s_2	
2	x_2	1	1	1	0	4
0	s_2	1	0	-1	1	2
		1	0	2	0	8

$$b = \begin{pmatrix} 4 \\ 6 \end{pmatrix} \begin{matrix} \to b_1 \\ \to b_2 \end{matrix}$$

$\boxed{\hat{b}_1}$

$$x_B = \begin{pmatrix} 1 & 0 \\ -1 & 1 \end{pmatrix} \cdot \begin{pmatrix} \hat{b}_1 \\ 6 \end{pmatrix} = \begin{pmatrix} \hat{b}_1 \\ -\hat{b}_1 + 6 \end{pmatrix} \begin{matrix} \ge 0 \\ \ge 0 \end{matrix}$$

$\boxed{0 \le \hat{b}_1 \le 6}$ → Tabla opt

$\boxed{\hat{b}_2}$

$$x_B = \begin{pmatrix} 1 & 0 \\ -1 & 1 \end{pmatrix} \cdot \begin{pmatrix} 4 \\ \hat{b}_2 \end{pmatrix} = \begin{pmatrix} 4 \\ -4 + \hat{b}_2 \end{pmatrix} \begin{matrix} \ge 0 \\ \ge 0 \end{matrix}$$

$\boxed{\hat{b}_2 \ge 4}$ → Tabla opt

$$z = (2 \;\; 0) \begin{pmatrix} 4 \\ -4 + \hat{b}_2 \end{pmatrix} = 8$$

$\boxed{\hat{b}_1 \text{ y } \hat{b}_2}$

$$x_B = \begin{pmatrix} 1 & 0 \\ -1 & 1 \end{pmatrix} \begin{pmatrix} \hat{b}_1 \\ \hat{b}_2 \end{pmatrix} = \begin{pmatrix} \hat{b}_1 \\ -\hat{b}_1 + \hat{b}_2 \end{pmatrix} \left.\begin{matrix} \ge 0 \\ \ge 0 \end{matrix}\right\} \; 0 \le \hat{b}_1 \le \hat{b}_2$$

$$z = (2 \;\; 0) \begin{pmatrix} \hat{b}_1 \\ -\hat{b}_1 + \hat{b}_2 \end{pmatrix} = 2\hat{b}_1$$

Ejercicio 24. d:

$$\begin{aligned} \text{Max} \quad & x_1 + 2x_2 \\ \text{s.a} \quad & x_1 + x_2 \leq 4 \\ & 2x_1 + x_2 \leq 6 \\ & x_1, x_2 \geq 0 \end{aligned}$$

		1	2	0	0	
	VB	x_1	x_2	s_1	s_2	
2	x_2	1	1	1	0	4
0	s_2	1	0	-1	1	2
		1	0	2	0	8

Var. no basica → x_1

$y_1 = \begin{pmatrix} 1 \\ 2 \end{pmatrix} \begin{matrix} \to a_{11} \\ \to a_{21} \end{matrix}$

$\boxed{\hat{a}_{11}}$ $\quad \hat{y}_1 = \begin{pmatrix} 1 & 0 \\ -1 & 1 \end{pmatrix} \begin{pmatrix} \hat{a}_{11} \\ 2 \end{pmatrix} = \begin{pmatrix} \hat{a}_{11} \\ -\hat{a}_{11} + 2 \end{pmatrix}$

$z_1 - c_1 = (2 \ \ 0) \begin{pmatrix} \hat{a}_{11} \\ -\hat{a}_{11} + 2 \end{pmatrix} - 1 =$

$2\hat{a}_{11} - 1 \geq 0 \Rightarrow \boxed{\hat{a}_{11} \geq 1/2}$

$\boxed{\hat{a}_{21}}$ $\quad \hat{y}_1 = \begin{pmatrix} 1 & 0 \\ -1 & 1 \end{pmatrix} \begin{pmatrix} 1 \\ \hat{a}_{21} \end{pmatrix} = \begin{pmatrix} 1 \\ -1 + \hat{a}_{21} \end{pmatrix}$

$z_1 - c_1 = (2 \ \ 0) \begin{pmatrix} 1 \\ -1 + \hat{a}_{21} \end{pmatrix} - 1 \geq 0$

$z_1 - c_1 \Rightarrow \boxed{2 \geq 0}$

$\boxed{\hat{a}_{11} \text{ y } \hat{a}_{21}}$ $\quad \hat{y}_1 = \begin{pmatrix} 1 & 0 \\ -1 & 1 \end{pmatrix} \begin{pmatrix} \hat{a}_{11} \\ \hat{a}_{21} \end{pmatrix} = \begin{pmatrix} \hat{a}_{11} \\ -\hat{a}_{11} + \hat{a}_{21} \end{pmatrix}$

$z_1 - c_1 = (2 \ \ 0) \begin{pmatrix} \hat{a}_{11} \\ -\hat{a}_{11} + \hat{a}_{21} \end{pmatrix} - 1$

$\Rightarrow 2\hat{a}_{11} - 1 \geq 0 \Rightarrow \boxed{\hat{a}_{11} \geq 1/2}$

- Ejercicio 14.e:

Solución óptima $\Rightarrow x_1 = 0; \quad x_2 = 4$

$4x_1 + x_2 \leq 5$

$4 \cdot 0 + 4 = 4 \leq 5$

↳ Verifica la restricción

⇓

Tabla óptima

- Ejercicio 14.f:

$x_1 + 4x_2 \leq 3$

$0 + 4 \cdot 4 = 16 \nleq 3$ → Tabla no óptima

$x_1 + 4x_2 + s_3 = 3$

	x_1	x_2	s_1	s_2	s_3	
x_2	1	1	1	0	0	4
s_2	1	0	-1	1	0	2
s_3	1	4	0	0	1	3
x_2	1	1	1	0	0	4
s_2	1	0	-1	1	0	2
s_3	-3	0	-4	0	1	-13
$z_j - c_j$	1	0	2	0	0	

$F_3 - 4F_1$

→ Simplex dual

→ Solución óptima única:

$x_1 = 3 \;/\; x = 0$

$s_1 = 1$

$s_2 = s_3 = 0$

$\boxed{z = 3}$

Examen 3 (2 fases y dual):

- Ejercicio 1:

$$\text{Max } z = 7x_1 + 6x_2 + 3x_3$$

s.a

$$4x_1 + 4x_2 - 8x_3 \geq 7 \Rightarrow -4x_1 - 4x_2 + 8x_3 \leq -7$$

$$6x_1 - 4x_2 + 6x_3 \leq 7$$

$$9x_1 - 3x_2 + 7x_3 = 7$$

$$x_1, x_2 \geq 0 \quad x_3 \text{ libre}$$

$$c = \begin{pmatrix} 7 \\ 6 \\ 3 \end{pmatrix} \quad b = \begin{pmatrix} -7 \\ 7 \\ 7 \end{pmatrix}$$

$$A = \begin{array}{c} \begin{matrix} x_1 & x_2 & x_3 \end{matrix} \\ \begin{pmatrix} -4 & -4 & +8 \\ 6 & -4 & 6 \\ 9 & -3 & 7 \end{pmatrix} \end{array} \Rightarrow A' = \begin{array}{c} \begin{matrix} y_1 & y_2 & y_3 \end{matrix} \\ \begin{pmatrix} -4 & 6 & 9 \\ -4 & -4 & -3 \\ 8 & 6 & 7 \end{pmatrix} \end{array}$$

$$\text{Min } w = -7y_1 + 7y_2 + 7y_3$$

s.a

$$-4y_1 + 6y_2 + 9y_3 \geq 7$$

$$-4y_1 - 4y_2 - 3y_3 \geq 6$$

$$8y_1 + 6y_2 + 7y_3 = 3$$

$$y_1, y_2 \geq 0 \quad y_3 \text{ libre}$$

Ejercicio 2:

Min $z = 4x_1 + 8x_2 + 7x_3$

sa $6x_1 + 3x_2 - 8x_3 = 9$

$7x_1 - 6x_2 + 6x_3 \leq 6 \rightarrow -7x_1 + 6x_2 - 6x_3 \geq -6$

$8x_1 - 2x_2 + 8x_3 \geq 6$

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

$c = \begin{pmatrix} 4 \\ 8 \\ 7 \end{pmatrix} \quad b = \begin{pmatrix} 9 \\ -6 \\ 6 \end{pmatrix}$

$A = \begin{pmatrix} 6 & 3 & -8 \\ -7 & 6 & -6 \\ 8 & -2 & 8 \end{pmatrix} \Rightarrow \begin{pmatrix} 6 & -7 & 8 \\ 3 & 6 & -2 \\ -8 & -6 & 8 \end{pmatrix}$

Max $w = 9x_1 - 6x_2 + 6x_3$

s.a $6x_1 - 7x_2 + 8x_3 \leq 4$

$3x_1 + 6x_2 - 2x_3 \leq 8$

$-8x_1 - 6x_2 + 8x_3 \leq 7$

x_1 libre

Ejercicio 3:

Max $x_1 - 2x_2 + x_3$

s.a $x_1 + x_2 + x_3 \leq 1$

$2x_1 + x_2 - x_3 \geq 4$

$\rightarrow x_1 + x_2 + x_3 + s_1$

$2x_1 + x_2 - x_3 - s_2 + \epsilon_1$

$z = \boxed{0x_1 + 0x_2 + 0x_3 + 0s_1 + 0s_2 - \epsilon_1}$

• Ejercicio 15:

$$\begin{aligned} \text{Max} \quad & 20x_1 + 30x_2 + 16x_3 \\ \text{s.a} \quad & 5x_1 + 3x_2 + x_3 \leq 3 \\ & x_1 + 3x_2 + 2x_3 \leq 4 \\ & x_1, x_2, x_3 \geq 0 \end{aligned}$$

		20	30	16	0	0	
	VB	x_1	x_2	x_3	S_1	S_2	
30	x_2	3	1	0	2/3	-1/3	2/3
16	x_3	-4	0	1	-1	1	1
		6	0	0	4	6	36

a) Var. no basicas: $\boxed{x_1 = \hat{c}_1}$

$$z_1 - \hat{c}_1 \geq 0 \Rightarrow (30 \quad 16)\begin{pmatrix} 3 \\ -4 \end{pmatrix} - \hat{c}_1 \geq 0$$

$$90 - 64 = 26 - c_1 \geq 0 \Rightarrow \boxed{26 \geq c_1}$$

b) Var. basicas = $\boxed{x_2 = \hat{c}_2}$ $\boxed{x_3 = \hat{c}_3}$

$$x_2: \bullet\ z_1 - c_1 \geq 0 \Rightarrow (c_2 \quad 16)\begin{pmatrix} 3 \\ -4 \end{pmatrix} - 20 \geq 0$$

$$3c_2 - 64 - 20 \geq 0 \Rightarrow \boxed{c_2 \geq \frac{80}{3}}$$

$$\bullet\ z_4 - c_4 \geq 0 \Rightarrow (c_2 \quad 16)\begin{pmatrix} 2/3 \\ -1 \end{pmatrix} - 0$$

$$\frac{2c_2}{3} - 16 \geq 0 \Rightarrow \boxed{c_2 \geq 24}$$

$$\bullet\ z_5 - c_5 \geq 0 \Rightarrow (c_2 \quad 16)\begin{pmatrix} -1/3 \\ 1 \end{pmatrix} - 0 \geq 0$$

$$-\frac{c_2}{3} + 16 \geq 0 \Rightarrow \boxed{c_2 \leq 48}$$

$$\boxed{24 \leq c_2 \leq 48}$$

$\rightarrow x_3 = \hat{c}_3$:

- $z_1 - c_1 \geq 0 \Rightarrow (30 \quad \hat{c}_3) \begin{pmatrix} 3 \\ -4 \end{pmatrix} - 20 \geq 0$

$90 - 4c_3 - 20 \geq 0 \Rightarrow \boxed{\frac{70}{4} \geq c_3}$

- $z_4 - c_4 \geq 0 \Rightarrow (30 \quad \hat{c}_3) \begin{pmatrix} 2/3 \\ -1 \end{pmatrix} - 0 \geq 0$

$20 - \hat{c}_3 \geq 0 \Rightarrow \boxed{20 \geq c_3}$

- $z_5 - c_5 \geq 0 \Rightarrow (30 \quad \hat{c}_3) \begin{pmatrix} -1/3 \\ 1 \end{pmatrix} - 0 \geq 0$

$-10 + c_3 \geq 0 \Rightarrow \boxed{c_3 \geq 10}$

$$\boxed{10 \leq c_3 \leq \frac{70}{4}}$$

---

c) Respecto a los recursos:

$b = \begin{pmatrix} 3 \\ 4 \end{pmatrix} \begin{matrix} \rightarrow b_1 \\ \rightarrow b_2 \end{matrix} \qquad B^{-1} = \begin{pmatrix} 2/3 & -1/3 \\ -1 & 1 \end{pmatrix}$

- $\hat{b}_1 \Rightarrow \begin{pmatrix} 2/3 & -1/3 \\ -1 & 1 \end{pmatrix} \begin{pmatrix} b_1 \\ 4 \end{pmatrix} \Rightarrow \begin{pmatrix} \frac{2b_1}{3} - \frac{4}{3} \\ -b_1 + 4 \end{pmatrix} \begin{matrix} \geq 0 \\ \geq 0 \end{matrix}$

$$\left.\begin{matrix} 2b_1 \geq 4 \Rightarrow b_1 \geq 2 \\ -b_1 + 4 \geq 0 \Rightarrow 4 \geq b_1 \end{matrix}\right\} \boxed{2 \leq b_1 \leq 4}$$

b_2: $\begin{pmatrix} 2/3 & 1/3 \\ -1 & 1 \end{pmatrix} \begin{pmatrix} 3 \\ b_2 \end{pmatrix} \Rightarrow \begin{pmatrix} 2 + \frac{b_2}{3} \\ -3 + b_2 \end{pmatrix} \begin{matrix} \geq 0 \\ \geq 0 \end{matrix}$

$$\left.\begin{matrix} 2 + \frac{b_2}{3} \geq 0 \Rightarrow b_2 \geq -6 \\ -3 + b_2 \geq 0 \Rightarrow b_2 \geq 3 \end{matrix}\right\} \boxed{-6 \leq b_2 \leq 3}$$

---

d) Respecto al recurso tecnológico a_{11}:

Tabla inicial

$$\begin{pmatrix} 2/3 & 1/3 \\ -1 & 1 \end{pmatrix} \begin{pmatrix} a_{11} \\ 1 \end{pmatrix} \Rightarrow \begin{pmatrix} \frac{2a_{11}}{3} - \frac{4}{3} \\ -a_{11} - 4 \end{pmatrix}$$

↳ Para que la tabla siga siendo óptima:

$$(30 \quad 36) \begin{pmatrix} \frac{2a_{11} - 4}{3} \\ -a_{11} - 4 \end{pmatrix} \Rightarrow 20a_{11} - 40 - 16a_{11} - 64$$

$$4a_{11} - 104 - 20 \geq 0$$

$$4a_{11} - 124 \geq 0 \Rightarrow \boxed{a_{11} \geq 31}$$

Ejercicio 27:

$$\text{Max } 600x_1 + 300x_2$$

s.a

$$2x_1 + 1'5x_2 \leq 1200$$
$$x_1 + 0'25x_2 \leq 375$$
$$x_1, x_2 \geq 0$$

		600	300	0	0	
	V_B	x_1	x_2	s_1	s_2	
300	x_2	0	1	1	-2	450
600	x_1	1	0	-1/4	3/2	262'5
	$z_j - c_j$	0	0	150	300	292 500

Sol. optima → $x_1 = 262'5$; $x_2 = 450$

Sol. dual → $y_1 = 150$, $y_2 = 300$

a) Restricción dual asociada

$$2y_1 + 0'25y_2 \geq 200$$

$$2 \cdot 150 + 0'25 \cdot 300 = 375 \geq 200$$

Verifica la restricción ⇒ La solución se mantiene opt

b) $y_1 + 0'15y_2 \geq 200$

↳ $150 + 0'15 \cdot 300 = 195 \not\geq 200$ → Tabla no opt

$$\hat{y}_3 = \underbrace{\begin{pmatrix} 1 & -2 \\ -1/4 & 3/2 \end{pmatrix}}_{B^{-1}} \begin{pmatrix} 1 \\ 0'15 \end{pmatrix} \Rightarrow \begin{pmatrix} 7/10 \\ -1/40 \end{pmatrix}$$

$$z_3 - c_3 \Rightarrow (300 \quad 600) \begin{pmatrix} 7/10 \\ -1/40 \end{pmatrix} - 200 = \boxed{-5}$$

		600	300	200	0	0	
		x_1	x_2	x_3	s_1	s_2	
300	x_2	0	1	$\boxed{7/10}$	1	-2	450 →
600	x_1	1	0	-1/40	-1/4	3/2	262'5
		0	0	-5	150	300	292 500
	x_3	0	10/7	1	10/7	-20/7	4500/7
	x_1	1	1/28	0	-3/14	10/7	1950/7
		0	50/7	0	1100/7	2000/7	2070000/7

• Ejercicios Tipo Examen:

• Ejercicio 1:

• Vemos la variable básica: $\boxed{x_2 = c_2}$

• $z_3 - c_3 \Rightarrow (c_2 \ 2)\begin{pmatrix} 1 \\ -1 \end{pmatrix} - 1 \geq 0;$

$$c_2 - 2 - 1 \geq 0 \Rightarrow \boxed{c_2 \geq 3}$$

• $z_4 - c_4 \Rightarrow (c_2 \ 2)\begin{pmatrix} 1 \\ -1 \end{pmatrix} - 0 \Rightarrow \quad c_2 - 2 \geq 0 \Rightarrow \boxed{c_2 \geq 2}$

• $z_5 - c_5 \Rightarrow (c_2 \ 2)\begin{pmatrix} -1 \\ 2 \end{pmatrix} - 0 \Rightarrow \quad -c_2 + 4 \geq 0 \quad \boxed{c_2 \leq 4}$

$\Rightarrow$ Solución:

$$\boxed{3 \leq c_2 \leq 4}$$

• Ejercicio 2:

• Var. no básica: $\boxed{x_3 = c_3}$

$z_3 - c_3 = (3 \ 4)\begin{pmatrix} -1 \\ 2 \end{pmatrix} - c_3 \Rightarrow -3 + 8 - c_3 \geq 0$

$5 - c_3 \geq 0 \Rightarrow \quad \boxed{5 \geq c_3}$

- Ejercicio 3:

- Recursos:

$$b = \begin{pmatrix} 10 \\ 20 \end{pmatrix} \begin{matrix} \to b_1 \\ \to b_2 \end{matrix} \qquad B^{-1} = \begin{pmatrix} 1 & -1/2 \\ 0 & 1/2 \end{pmatrix}$$

$$B^{-1} \cdot b \Rightarrow \begin{pmatrix} 1 & -1/2 \\ 0 & 1/2 \end{pmatrix} \cdot \begin{pmatrix} 10 \\ b_2 \end{pmatrix} \Rightarrow \begin{pmatrix} 10 - 5 \\ \frac{b_2}{2} \end{pmatrix} \begin{matrix} \geq 0 \\ \geq 0 \end{matrix}$$

$$\frac{b_2}{2} \geq 0 \Rightarrow \boxed{b_2 \geq 0}$$

- Ejercicio 4: $\boxed{x_1 = 2, \mid x_2 = 3 \mid x_3 = 0}$

$$2x_1 + 4x_2 + x_3 \leq 10 \Rightarrow 2 \cdot 2 + 4 \cdot 3 + 0 \leq 10$$

↳ No se cumple

		4	3	3	0	0	0	
	VB	x_1	x_2	x_3	s_1	s_2	s_3	
3	x_2	0	1	-1	1	-1	0	3
4	x_1	1	0	2	0	1	0	2
	s_3	2	4	1	0	0	1	10

- Hago cero en c1:

VB	x_1	x_2	x_3	s_1	s_2	s_3	
x_2	0	1	-1	1	-1	0	3
x_1	1	0	2	0	1	0	2
s_3	0	4	-3	0	-2	1	6

- Hago cero en c2:

		4	3	3	0	0	0	
	VB	x_1	x_2	x_3	s_1	s_2	s_3	
3	x_2	0	1	-1	1	-1	0	3
4	x_1	1	0	2	0	1	0	2
0	s_3	0	0	1	$\boxed{-4}$	2	1	-6 ←
		0	0	2	3	1	0	

- $-\frac{3}{4} =$

- Pivote -6:

	VB	x_1	x_2	x_3	s_1	s_2	s_3	
3	x_2	0	1	-3/4	0	-1/2	1/4	3/2
4	x_1	1	0	2	0	1	0	2
0	s_1	0	0	$-\frac{1}{4}$	1	$-\frac{1}{2}$	$-\frac{1}{4}$	6/4
								$\frac{25}{2}$

$$\left[x_1 = 2, \quad x_2 = 3/2 \quad x_3 = 0 \quad z = \frac{25}{2} \right]$$

• Ejercicio 5:

⇒ Coeficiente tecnológico a_{22}:

$$A = \begin{pmatrix} 4 \\ 5 \end{pmatrix} \begin{matrix} \to a_{12} \\ \to a_{22} \end{matrix} \qquad B^{-1} = \begin{pmatrix} 1 & -1/2 \\ 0 & 1/2 \end{pmatrix}$$

$$\Rightarrow \begin{pmatrix} 1 & -1/2 \\ 0 & 1/2 \end{pmatrix} \cdot \begin{pmatrix} 4 \\ a_{22} \end{pmatrix} \Rightarrow \begin{pmatrix} 4 - \frac{a_{22}}{2} \\ \frac{a_{22}}{2} \end{pmatrix}$$

$$\Rightarrow (0 \quad 5) \begin{pmatrix} 4 - \frac{a_{22}}{2} \\ \frac{a_{22}}{2} \end{pmatrix} - 2 \Rightarrow \frac{5}{2} a_{22} - 2 \geq 0$$

$$\Rightarrow \frac{5}{2} a_{22} \geq 2$$

$$\Rightarrow \boxed{a_{22} \geq \frac{4}{5}}$$

• Ejercicio 6:

$$y^* = (0, 1)$$

$$2y_1 + 10y_2 \geq 15$$

↳

$$2 \cdot 0 + 10 \cdot 1 \leq 15 \Rightarrow \text{No se cumple}$$

$$B^{-1} = \begin{pmatrix} 1 & -1 \\ 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} 2 \\ 10 \end{pmatrix} \Rightarrow \begin{pmatrix} 2 - 10 \\ 10 \end{pmatrix} \Rightarrow \begin{pmatrix} -8 \\ 10 \end{pmatrix}$$

$$z = (0 \quad 1) \begin{pmatrix} -8 \\ 10 \end{pmatrix} \Rightarrow 10 - 15 = -5$$

		-1	1	15	0	0	
	VB	x_1	x_2	x_3	s_1	s_2	
0	s_1	-3	0	-8	1	-1	3
1	x_2	1	1	$\boxed{10}$	0	1	1
		2	0	-5	0	1	1

- Pivote 10:

		-1	1	15	0	0	
	VB	x_1	x_2	x_3	s_1	s_2	
0	s_1	$-11/5$	$8/10$	0	1	$-1/5$	$19/5$
15	x_3	$1/10$	$1/10$	1	0	$1/10$	$1/10$
		$5/2$	$1/2$	0	0	$15/10$	$15/10$

• Ejercicio 7: $y^* = (0,\ 2'5)$

$5y_1 + 3y_2 \geq 6 \Rightarrow$ No se cumple

$$\begin{pmatrix} 1 & -1/2 \\ 0 & 1/2 \end{pmatrix} \begin{pmatrix} 5 \\ 3 \end{pmatrix} - 6 \Rightarrow \begin{pmatrix} 5 - \frac{3}{2} \\ \frac{3}{2} \end{pmatrix} \begin{pmatrix} 7/2 \\ 3/2 \end{pmatrix}$$

$$\begin{pmatrix} 0 & 5 \end{pmatrix} \begin{pmatrix} 5 - 3/2 \\ 3/2 \end{pmatrix} \Rightarrow \frac{15}{2} - 6 \Rightarrow 3/2$$

• Creamos la tabla:

		5	2	6	0	0	
	VB	x_1	x_2	x_3	s_1	s_2	
0	s_1	0	3/2	7/2	1	-1/2	0
5	x_1	1	5/2	3/2	0	1/2	10
		0	21/2	3/2	0	5/2	

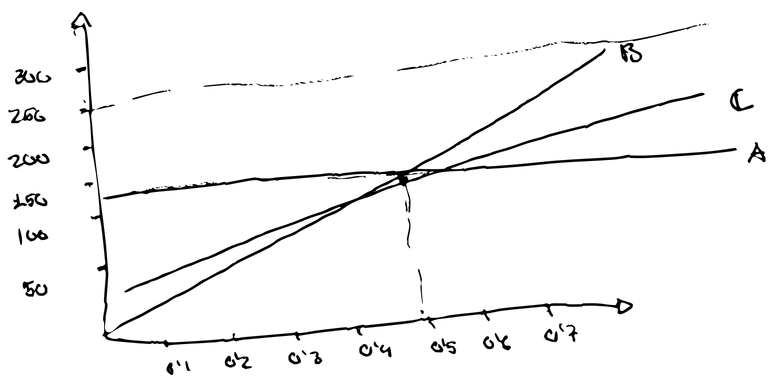
$$\left[\ x_1 = 10 \quad x_2 = 0 \quad x_3 = 0 \quad z = 50\ \right]$$

• Métodos Cuantitativos: Parte 2.

• Ejercicio 1.1:

⇒ Nuestro agente es el abogado:

	Ganar	Perder	La place	Wald	óptimo	Horwick
Opción A	125	125	$\boxed{125}$	$\boxed{125}$	125	$125\alpha + 125(1-\alpha)$
Opción B	250	0	$\boxed{125}$	0	$\boxed{250}$	250α
Opción C	200	50	$\boxed{125}$	50	200	$200\alpha + 50(1-\alpha)$



$$\left\{\begin{array}{l} \text{Para } \alpha < 0'5 \Rightarrow \text{Opción A} \\ \text{Para } \alpha > 0'5 \Rightarrow \text{Opción B} \end{array}\right\}$$

Savage:

	G	P	Savage
A	125	0	$A = 125$
B	0	125	$B = 125$
C	50	75	$C = 75$ → Éxito

- Ejercicio 1.2:

$$\text{Max} \quad f = 10x_1 + 8x_2 + 2x_3$$

$$\text{s.a} \quad 3x_1 + 2x_2 + 4x_3 \leq 2000000$$

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

$$x_1, x_2, x_3 \text{ enteros}$$

• Ejercicio 1.3:

	↑30%	↑20%	=	↓5%
Brasil	1000	900	600	400
China	1300	1100	700	300
España	1200	1400	600	-100
Alemania	1000	900	700	700

a)

• Indicadores de incertidumbre:

Laplace	Wald	Optimo	Horwicks
725	400	1000	$1000\alpha + 400(1-\alpha)$
850	300	1300	$1300\alpha + 300(1-\alpha$
775	-100	1400	$1400\alpha - 100(1-\alpha)$
825	825	1000	$1000\alpha + 700(1-\alpha)$

• Savage:

↑30%	↑20%	=	↓5%		PUE
400	300	100	300	400	240
100	200	0	400	400	$\boxed{120}$
0	0	100	800	800	$\boxed{120}$
400	300	0	0	400	170

b) VME:

Brasil = 1000·0'2 + 900·0'3 + 600·0'4 + 400·0'1 = 750

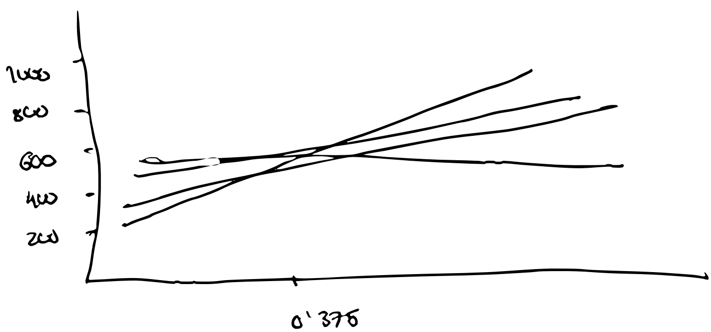
China = 1300·0'2 + 1100·0'3 + 700·0'4 + 300·0'1 = $\boxed{900}$

España = 1400·0'2 + 1200·0'3 + 600·0'4 - 100·0'1 = 870

Alemania = 1000·0'2 + 900·0'3 + 700·0'4 + 700·0'1 = 820

• Ejercicio 1.4:

	V. crecientes	V. decrecientes	
Horas extras	500	100	$500p + 100(1-p)$
Contratar mano	700	0	$700p + 0(1-p)$
Alquiler	900	-100	$900p - 100(1-p)$
Nada	400	200	$400p + 200(1-p)$



$$\begin{cases} \text{Si } p < 0'375 \Rightarrow \text{Nada} \\ \text{Si } p > 0'375 \Rightarrow \text{Alquiler maquinaria} \end{cases}$$

• Ejercicios Prueba Continua:

• Ejercicio 1:

	Ganador	Finalista	Normal	E[ai]
Modelo 1	94.000	86000	32.000	55780
Modelo 2	91.000	65.000	51.000	58840
Modelo 3	98.000	52.000	34.000	$\boxed{44966}$
Modelo 4	78.000	76.000	59.000	66450
Probabil.	7%	36%	57%	
	98.000	86.000	59.000	

⇒ a) 66.450 € ⇒ Valor Esperado ⇒ Beneficio

b) Savage:

	Ganador	Finalista	Normal	POE
Modelo 1	4000	0	27000	15418
Modelo 2	7000	21000	8000	12610
Modelo 3	0	34.000	25.000	26490
Modelo 4	20.000	10.000	0	5000
Probabil.	7%	36%	57%	

⇒ b) ⇒ 5000 € ⇒ P.O.E Óptima

c) $V.M.E = 66.450$ €

$V.M.E.I.P = 98000 \cdot 0'07 + 86000 \cdot 0'36 + 59000 \cdot 0'57$

$V.M.E.I.P = 71450$ €

La empresa esta dispuesta a pagar:

$VME - VMEIP = 66450 - 71450 = \boxed{5000 \text{ €}}$

• Ejercicio 2:

	Mantenimiento
Ourense	
Sevilla	
Valencia	
Toledo	
Vitoria	
Ou-Se-To	
Ou-Se-Vi	

· Ejercicios del examen.

1.12. Ejercicio

Cada CD a 1 $ y cuesta 0'50 $ producirlo.
Si no se vende en la quincena a 0'50 $.

La mitad de los sobrantes no se venden.

	Demanda	0'1	0'4	0'4	0'1		
oferta		3	4	5	6	VME	Máx. Prob.
3		18	18	18	18	18	18
4		15	24	24	24	23'1	24
5		12	21	30	30	24'6	30
6		9	18	27	36	22'5	27
		18	24	30	36		
POE		0	6	12	18	9	
		3	0	6	12	3'9	
		6	3	0	6	2'4	→ ✓
		9	6	3	0	4'5	

⇒ Cuando se demanda y oferta 3 docenas:

3 docenas ⇒ $3 \cdot 12$ ⇒ 36 CDs

Beneficio Total ⇒ $36 \cdot 1\$ - 36 \cdot 0'5\$$ ⇒ $\boxed{18\$}$

⇒ Cuando demanda 4 (4, 5 y 6) docenas y oferta 3:

48 CDs

Beneficios ⇒ $36 \cdot 1\$$

- Oferta 4k y Demanda 3k:

$4 \cdot 12 \Rightarrow 48$ cds

Beneficio = $36 \cdot 1\$ - 48 \cdot 0'5\$ + 6 \cdot 0'5\$ - 6 \cdot 0'8\$ = 15\$$

- Oferta 4k y Demanda 4k: y 5 y 6k

Beneficio = $48 \cdot 1\$ - 48 \cdot 0'5\$ = 24\$$

- Oferta 5k y Demanda 3k:

Beneficio = $36 \cdot 1\$ - 60 \cdot 0'5\$ + 12 \cdot 0'5\$ = 12\$$

• Ejercicio 2.4:

Primera Tabla:

	Precio	Distancia	m^2
GV - P.N	40^+	30^-	0
GV - L.R	140^+	50^+	10^-
P.N - L.R	100^+	100^-	10^+
	II q=100 30%	III p=100 26%	II q=75 25%

Tabla 2:

GV - PN	0^+	$0'5^-$	0
GV - LR	1^+	$0'5^+$	0^-
PN - LR	0^+	1^-	0^+

Perdedores ↓

Ganadores →

	GV	P.N	LR	ϕ^+
GV	-	0	0'625	0'3125
PN	0'125	-	0	0'0625
LR	0	0'25	-	0'125
ϕ^-	0'625	0'725	0'3125	

	ϕ^+	ϕ^-	ϕ
GV	0'3125	0'0625	-0'25
PN	0'0625	0'125	-0'0625
LR	0'125	0'3125	-0'1875

PN - LR - GV

- Examen Adelantado 2019:

3.

$$\begin{pmatrix} 12 & -\frac{\alpha}{2} & 25 \\ 15 & 20 & 5\alpha \\ 9 & 25 & -10 \end{pmatrix}$$

a)

$5\alpha < 15 \Rightarrow \boxed{\alpha < 3}$

b)

$$\begin{pmatrix} 12 & -7 & 25 \\ 15 & 20 & 70 \\ 9 & 25 & -10 \end{pmatrix}$$

Eq Nash = 15

- Ejercicio 4:

$$\left\{ \begin{array}{l} \phi = \phi^{+} - \phi^{-} \\ \phi^{-} = \phi^{+} - \phi \end{array} \right\}$$

	ϕ^{+}	ϕ^{-}	ϕ
A	0.2699	0.2816	-0'0117
B	0.3539	0.3647	-0'0108
C	0.4662	0.2425	0'2237
D	0.2379	0'3262	-0'0883
E	0.2105	0.3235	-0'1130

PROMETHEE II

C → B → A → D → E

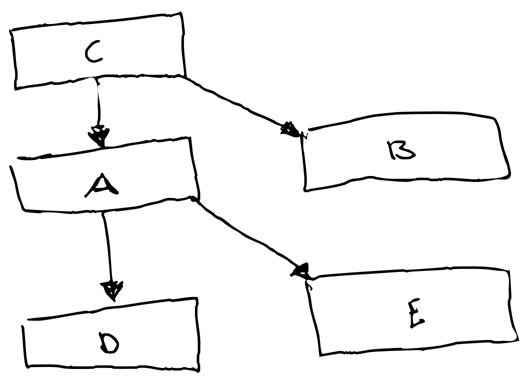
A = B
A < C
A > D
A > E

B < C
B = D
B = E

C > D
C > E

D = E

PROMETHE I



3. Empresa 1

	E_{21}	E_{22}	E_{23}
E_{11}	0	$\boxed{\alpha}$ → No	1
E_{12}	$\boxed{\alpha}$	0	$\boxed{3}$ → No
E_{13}	$\boxed{1}$ → No	3	0

$\alpha > 3$ Para ser Max Col

No > 0

- Para que haya Eq. Puro ⇒ Max Col y Min Fil:
- No existe valor de α que produzcan Eq. Puro de Nash

Para $\alpha = 1$

$$\begin{array}{c|ccc} & E_{21} & E_{22} & E_{23} \\ \hline E_{11} & \cancel{0} & \cancel{1} & \cancel{1} \\ E_{12} & 1 & 0 & 3 \\ E_{13} & 1 & 3 & 0 \end{array} \Rightarrow \begin{pmatrix} -1 & 3 \\ 1 & 0 \end{pmatrix}$$

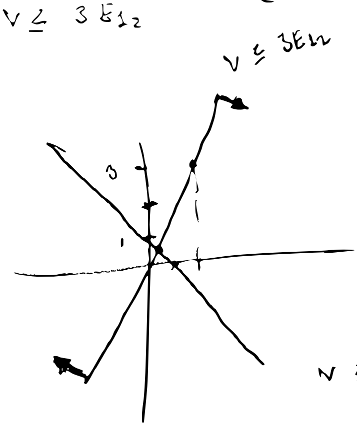
$J_1 \Rightarrow \text{Max } V$

$V \leq -1 E_{12} + E_{13}$; $\Rightarrow V \leq -E_{12} + (1 - E_{12})$

$V \leq 3E_{12}$

$V \leq -2E_{12} + 1$ $\begin{cases} (V=0 \quad E_{12} = \frac{1}{2}) \,/\, (V=1, \; E_{12}=0) \\ (V=0 \quad E_{12}=0) \,/\, (V=3, \; E_{12}=1) \end{cases}$

$V \leq 3E_{12}$



$-2E_{12} + 1 = 3E_{12}$

$5E_{12} = 1$

$E_{12} = \frac{1}{5}$

$V = 3 \cdot \frac{1}{5} = \boxed{\frac{3}{5}}$

1	2	3
familia	Amigo	vecinos

S	J	$P_3(S)$	J_1	J_2	J_3
∅	0	1/3	0	0	0
1	0	1/6	-	750	900
2	0	1/6	750	-	0
3	0	1/6	900	0	-
1, 2	750	1/3	-	-	450
1, 3	900	1/3	-	300	-
2, 3	0	1/3	1200	-	-
1, 2, 3	1200	—	675	225	300

$$P(0) = \frac{0!\,(3-0-1)!}{n!} \Rightarrow \frac{1}{3}$$

$$P(1) = \frac{1!\,(3-1-1)!}{3!} \Rightarrow \frac{1}{6}$$

$$P(2) = \frac{2!\,(3-2-1)!}{3!} \Rightarrow \frac{1}{3}$$

1 Proprietario

2 Empresario

3 Constructora

S	J	$P_3(S)$	J_1	J_2	J_3
$\emptyset$	0	1/3	350.000	0	0
1	350.000	1/6	-	350.000	425.000
2	0	1/6	700.000	-	0
3	0	1/6	775.000	0	-
1,2	700000	1/3	-	-	775.000
1,3	775.000	1/3	-	0	-
2,3	0	1/3	775.000	-	-
1,2,3	?	-			

$$P(0) = \frac{0!(3-0-1)!}{n!} \Rightarrow 1/3$$

$$P(1) = \frac{1!(3-1-1)!}{3!} \Rightarrow 1/6$$

$$P(2) = \frac{2!(3-2-1)!}{3!} \Rightarrow 1/3$$