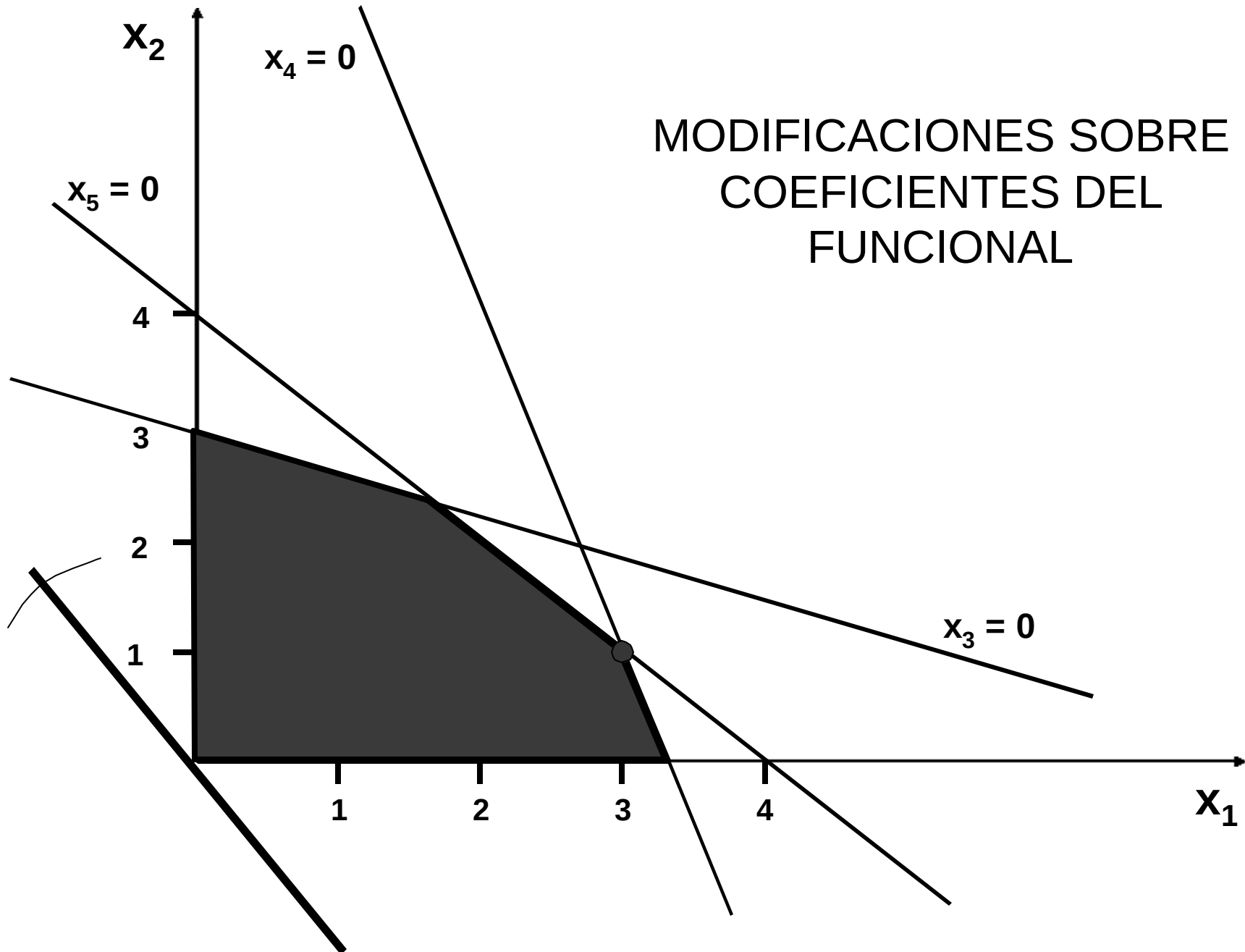


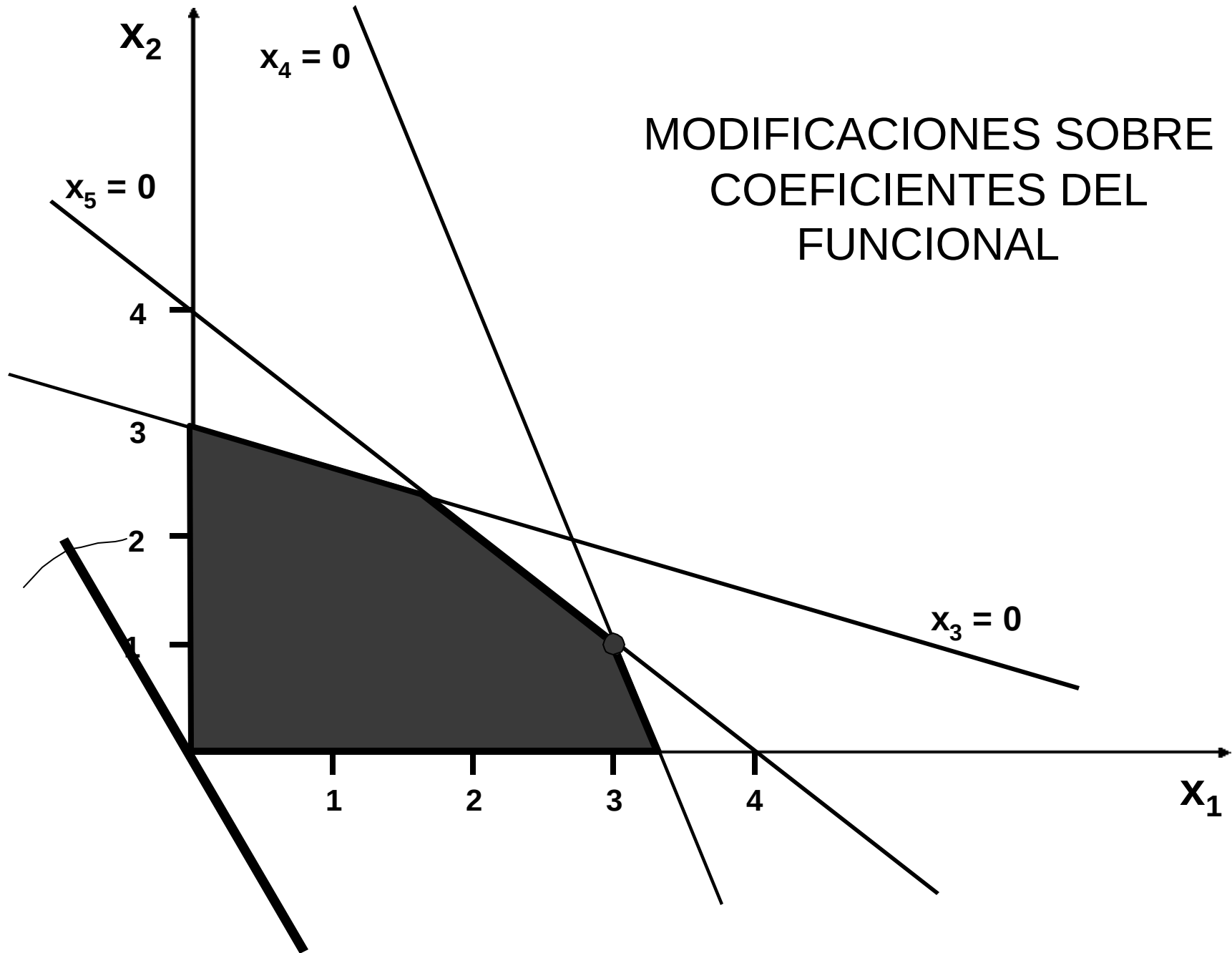
ANÁLISIS DE SENSIBILIDAD

- MODIFICACIONES SOBRE
 - COEFICIENTES DE EFICIENCIA (c_j)
 - TÉRMINOS INDEPENDIENTES (b_i)
- AGREGADO DE
 - NUEVOS PRODUCTOS
 - NUEVAS RESTRICCIONES
- RANGOS DE VALIDEZ DE LA SOLUCIÓN ÓPTIMA
 - DIRECTA
 - DUAL

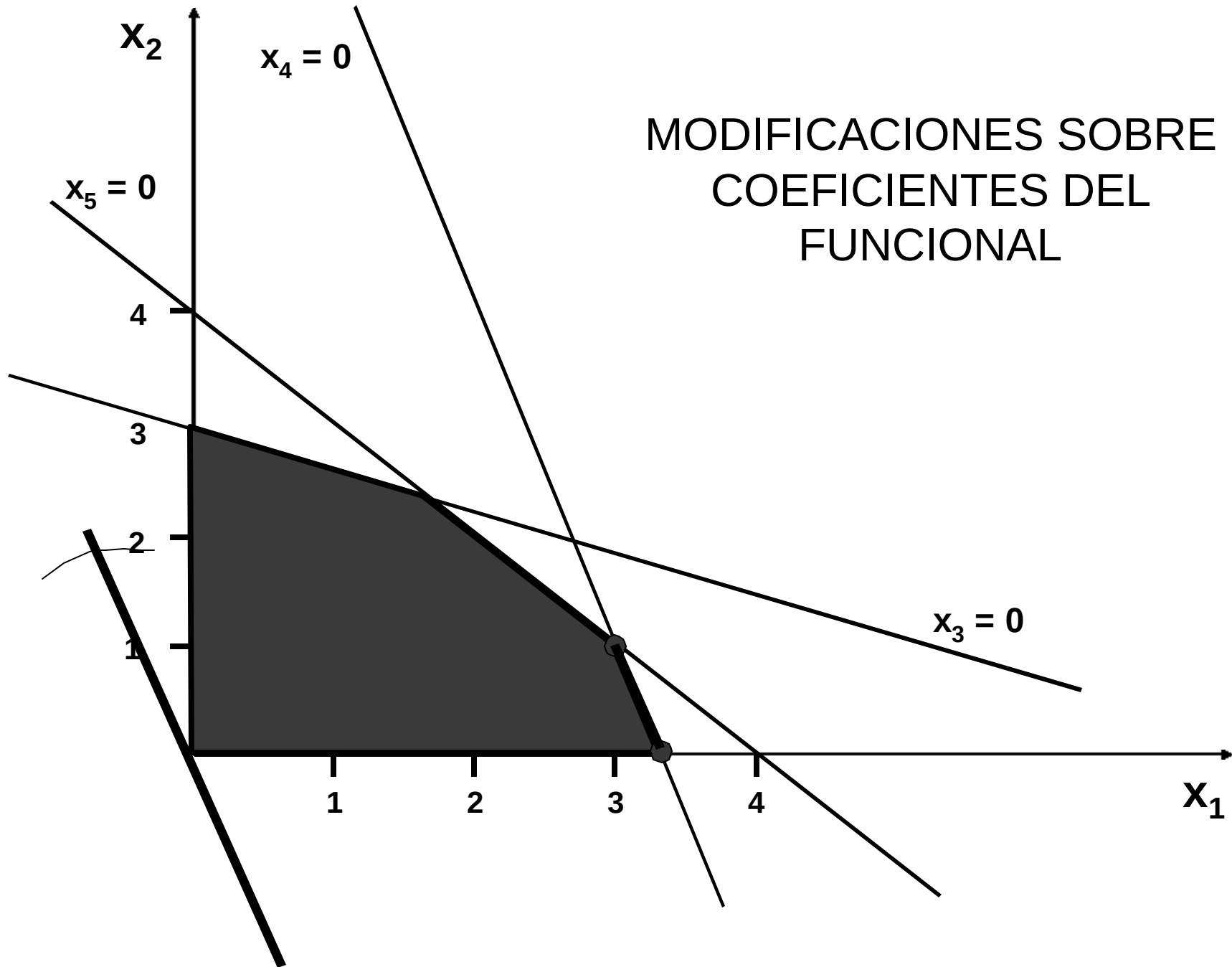
MODIFICACIONES SOBRE COEFICIENTES DEL FUNCIONAL



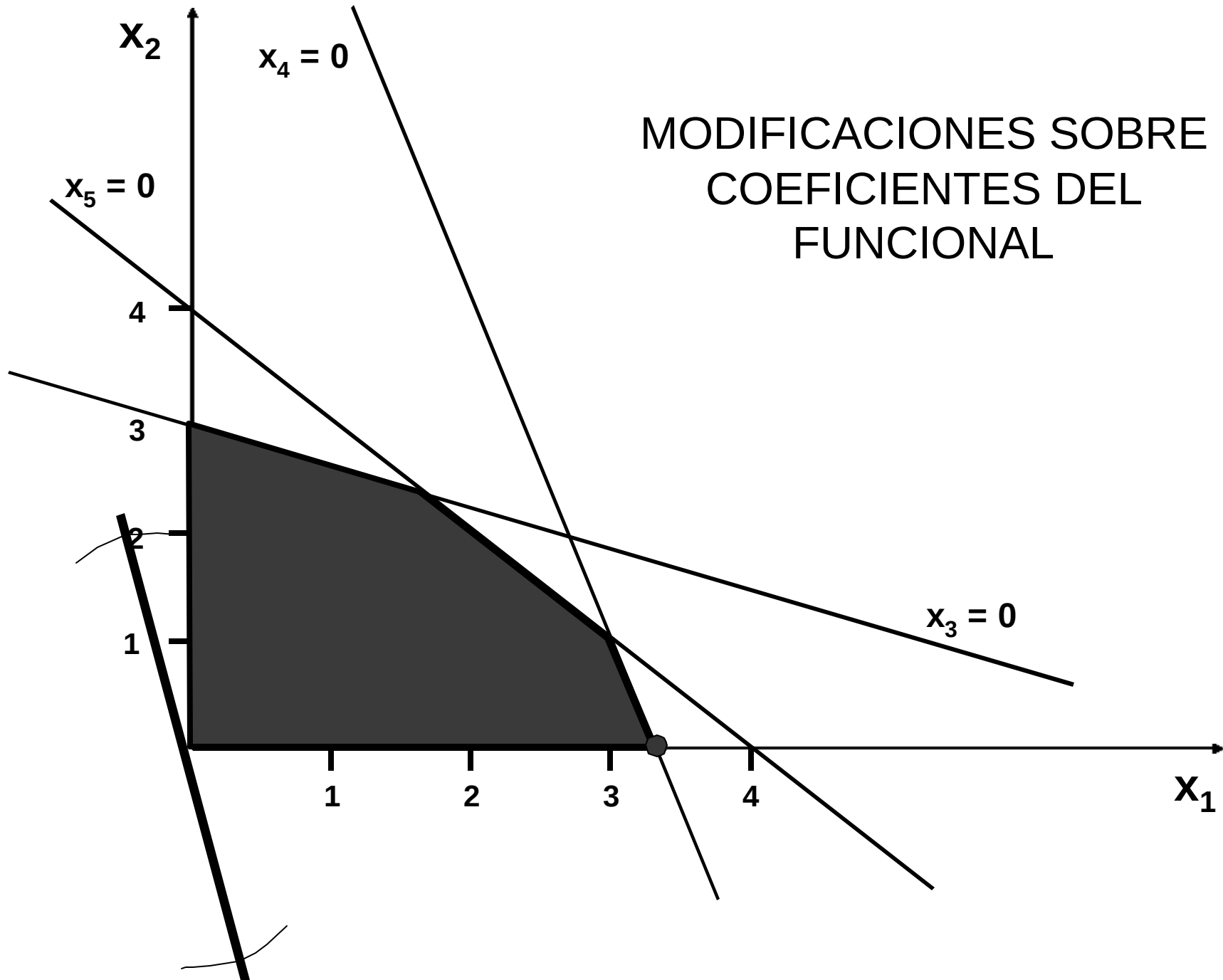
MODIFICACIONES SOBRE COEFICIENTES DEL FUNCIONAL



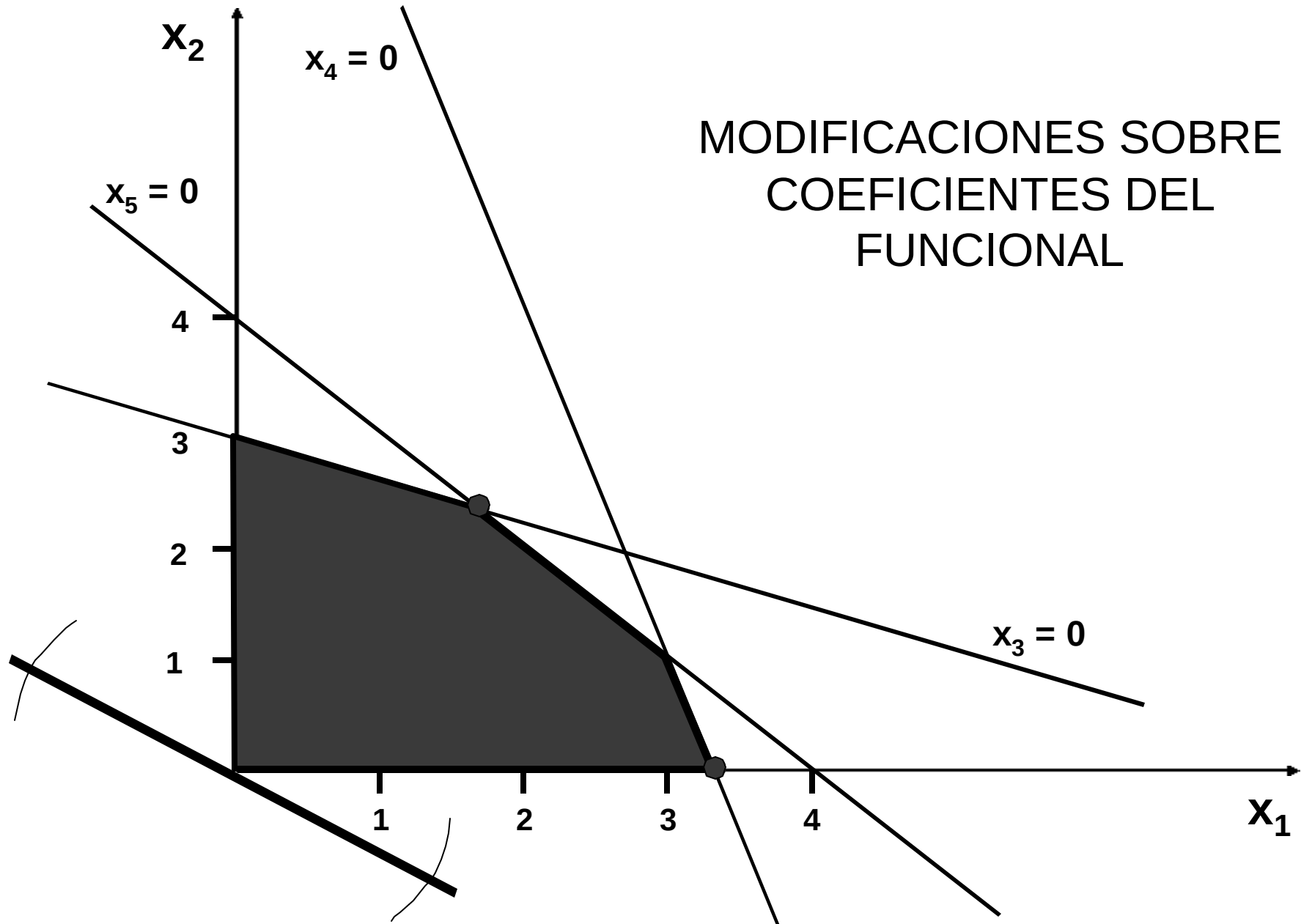
MODIFICACIONES SOBRE COEFICIENTES DEL FUNCIONAL



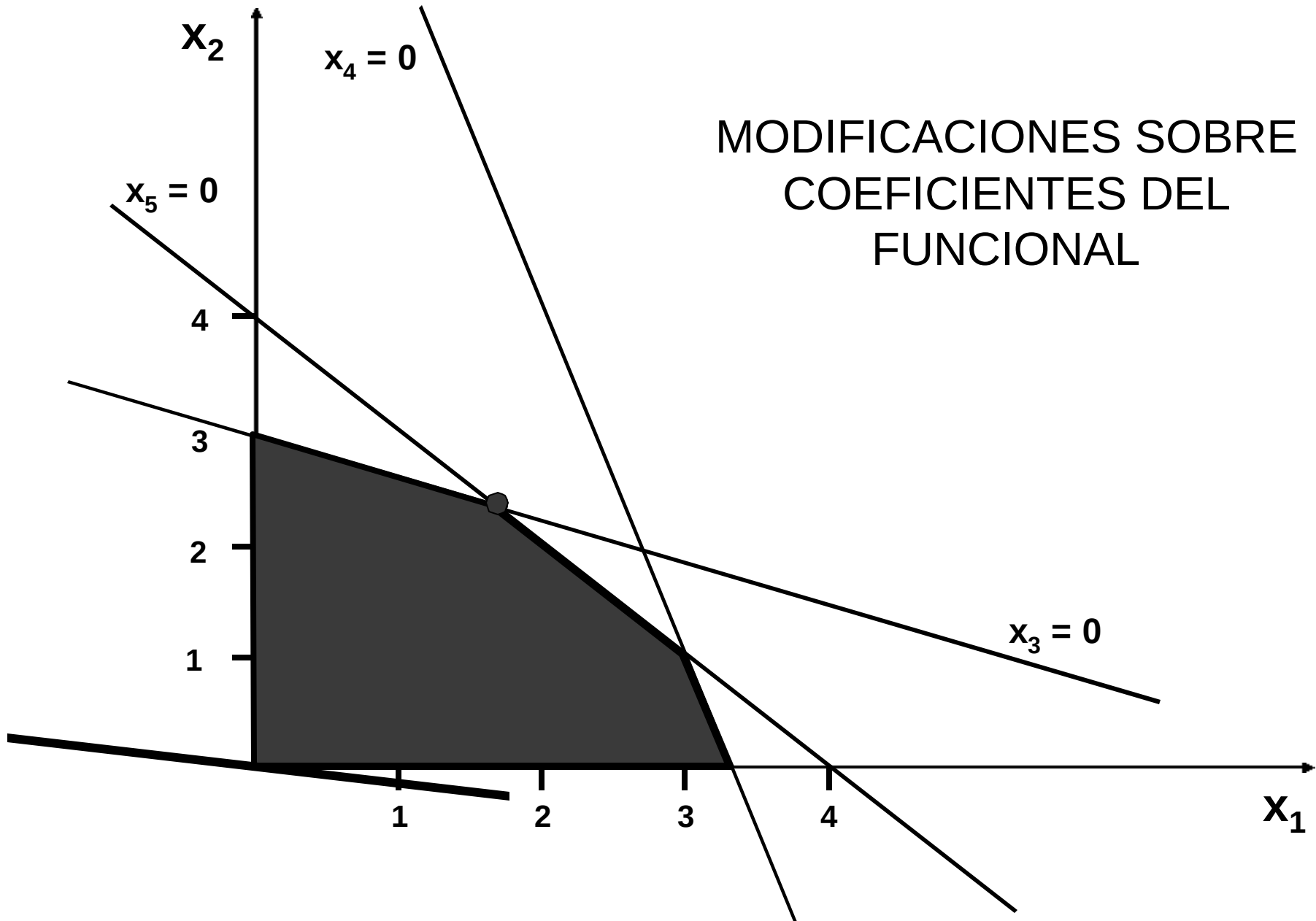
MODIFICACIONES SOBRE COEFICIENTES DEL FUNCIONAL



MODIFICACIONES SOBRE
COEFICIENTES DEL
FUNCIONAL



MODIFICACIONES SOBRE
COEFICIENTES DEL
FUNCIONAL



$$\text{MAX: } Z = 4x_1 + \cancel{6}x_2$$

$$6x_1 + 16x_2 \text{ £ } 48000$$

$$12x_1 + 6x_2 \text{ £ } 42000$$

$$9x_1 + 9x_2 \text{ £ } 36000$$

		C_j	4	6	0	0	0
C_k	x_k	B	A_1	A_2	A_3	A_4	A_5
← 0	x_3	14.000			1	<u>5/3</u>	-26/9
4	x_1	3.000	1			1/6	-1/9
6 3	x_2	1.000		1		-1/6	2/9
Z = 15.000			0	0	0	1/6	2/9
Z = 18.000			0	0	0	-1/3	8/9

↑

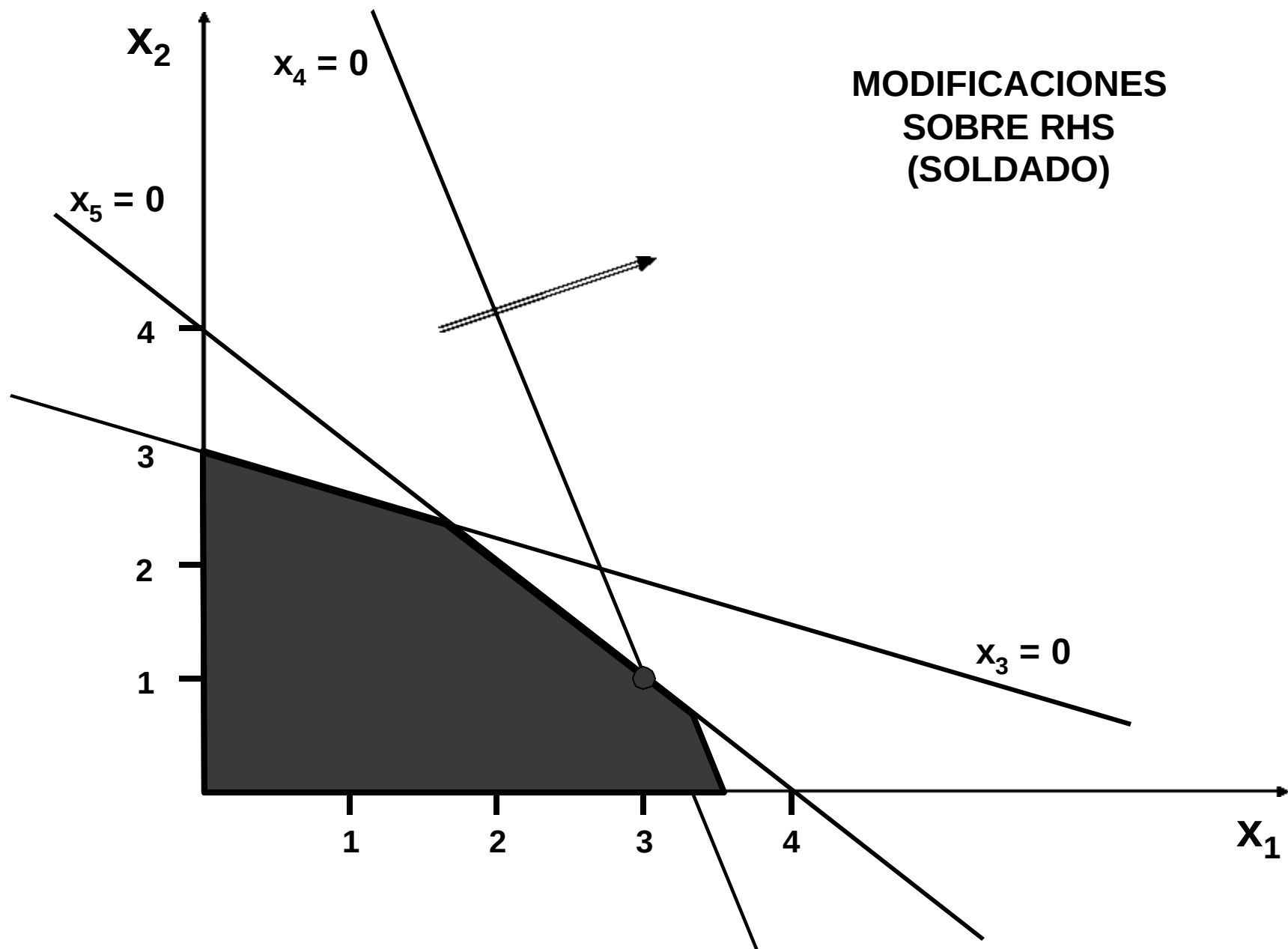
MAX: $Z = 4x_1 + \cancel{3}^6x_2$

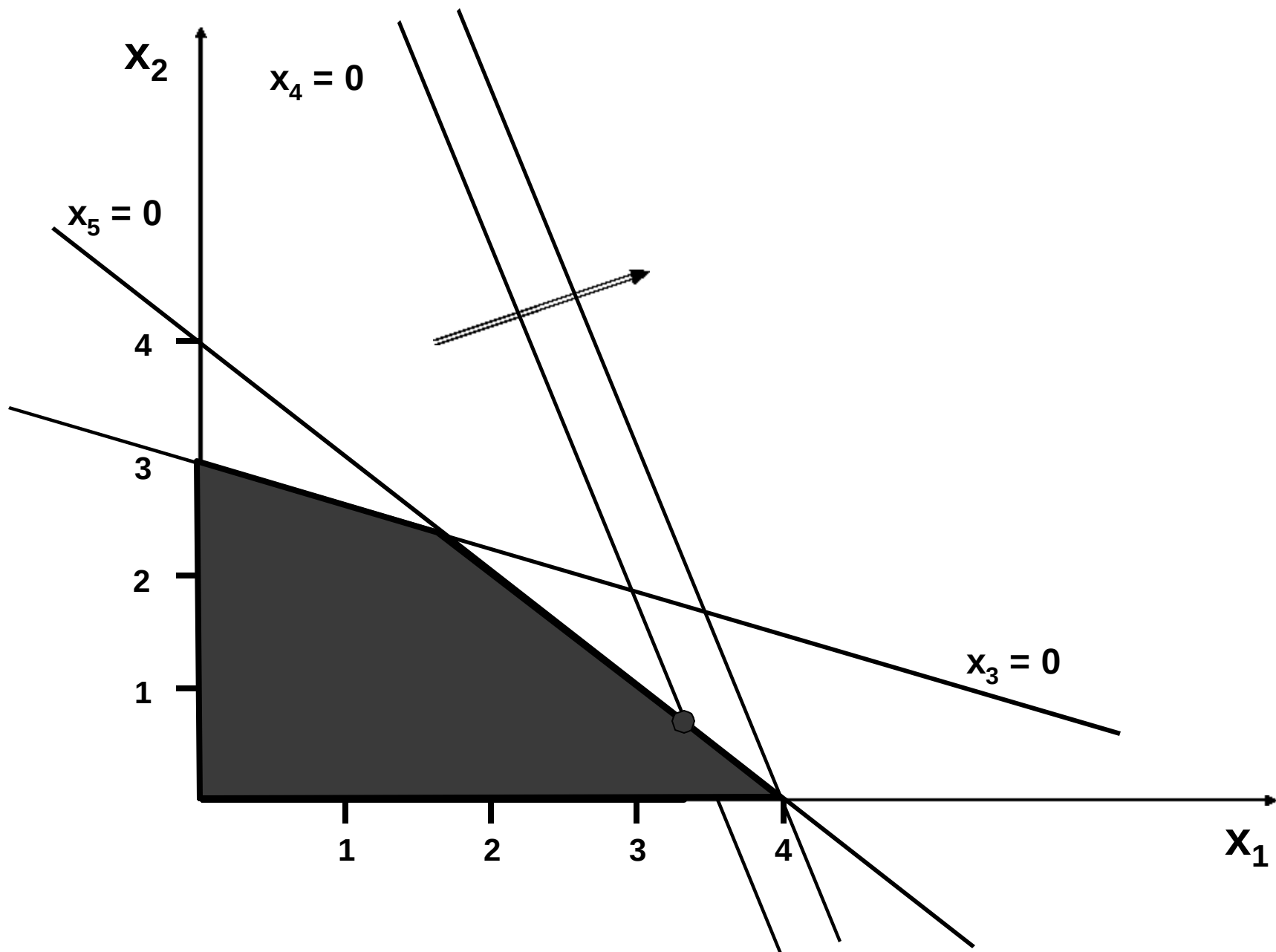
$6x_1 + 16x_2 \text{ £ } 48000$

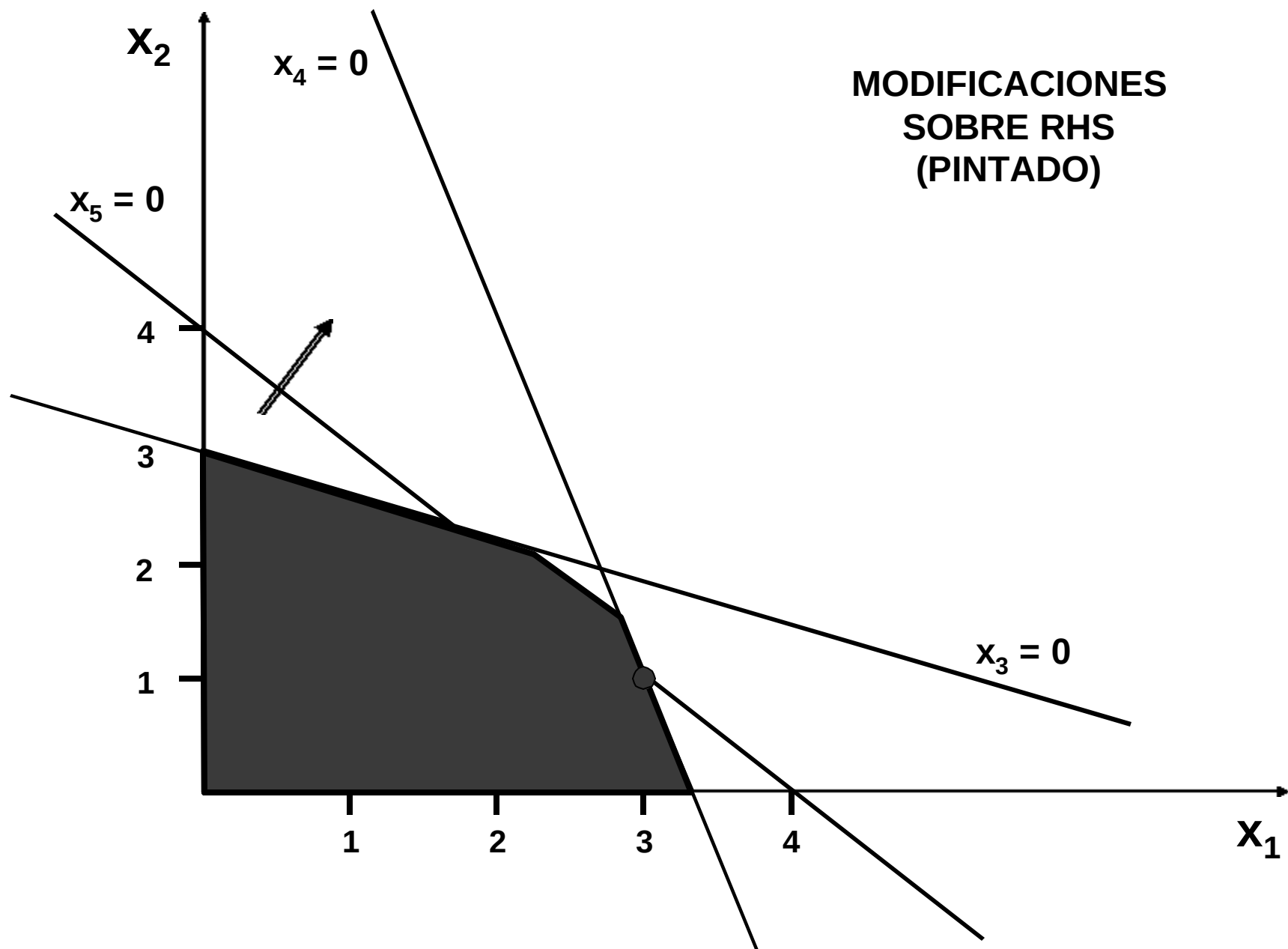
$12x_1 + 6x_2 \text{ £ } 42000$

$9x_1 + 9x_2 \text{ £ } 36000$

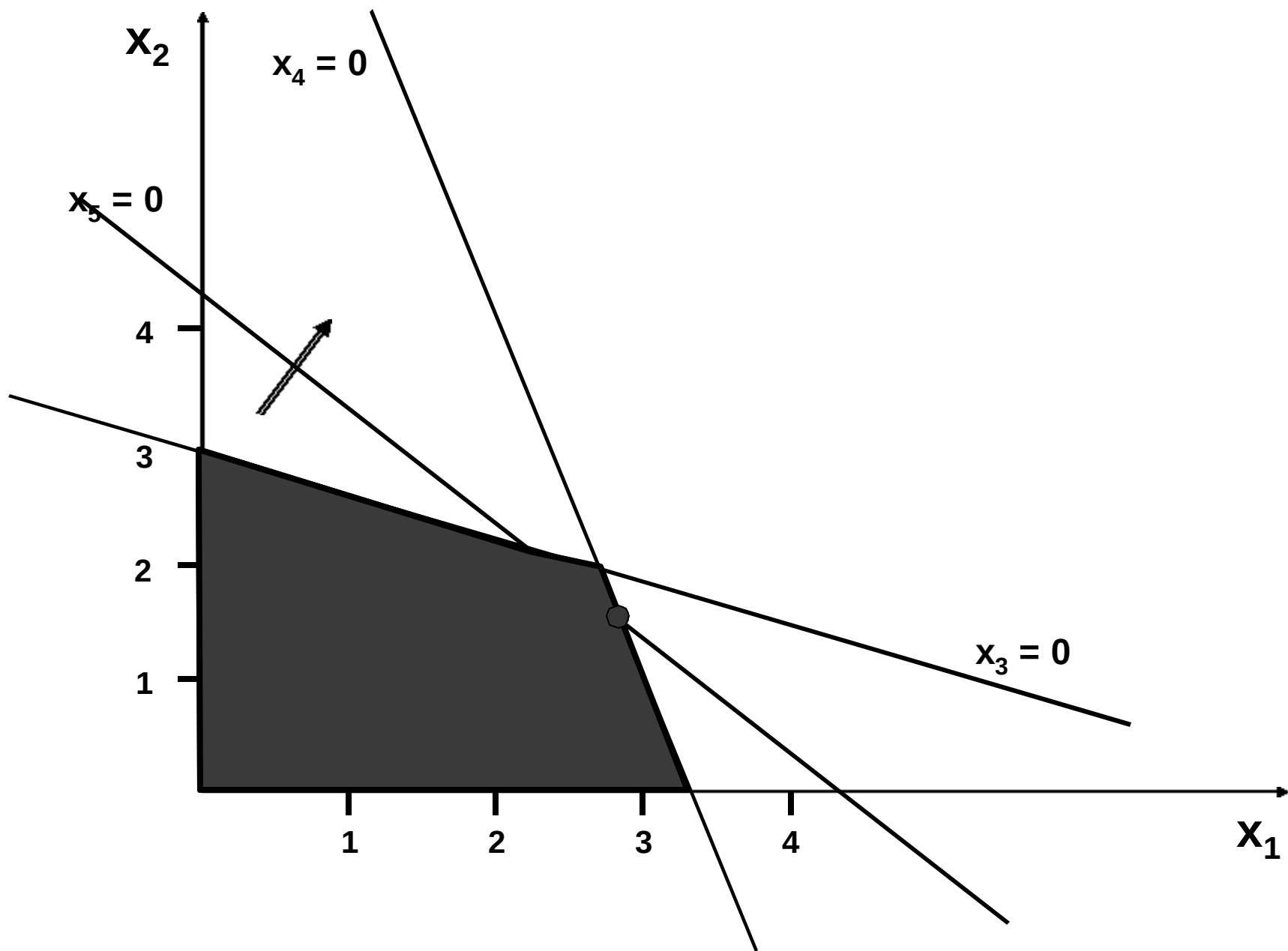
		C_j	4	6	0	0	0
C_k	x_k	B	A_1	A_2	A_3	A_4	A_5
0	x_4	8.400			3/5	1	-26/15
4	x_1	1.600	1		-1/10		8/45
6	x_2	2.400		1	1/10		-1/15
$Z = 18.400$			0	0	1/5	0	14/15

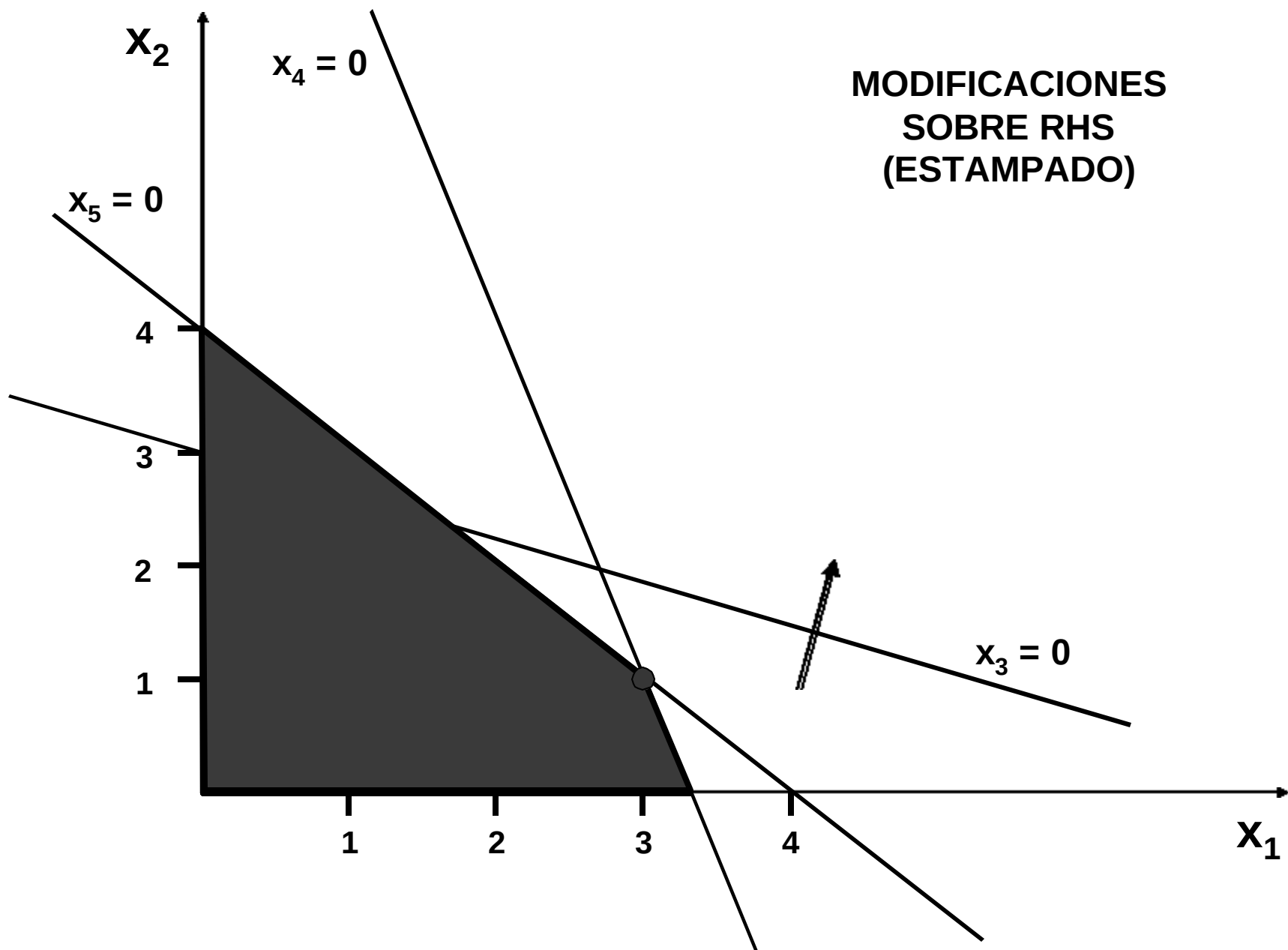


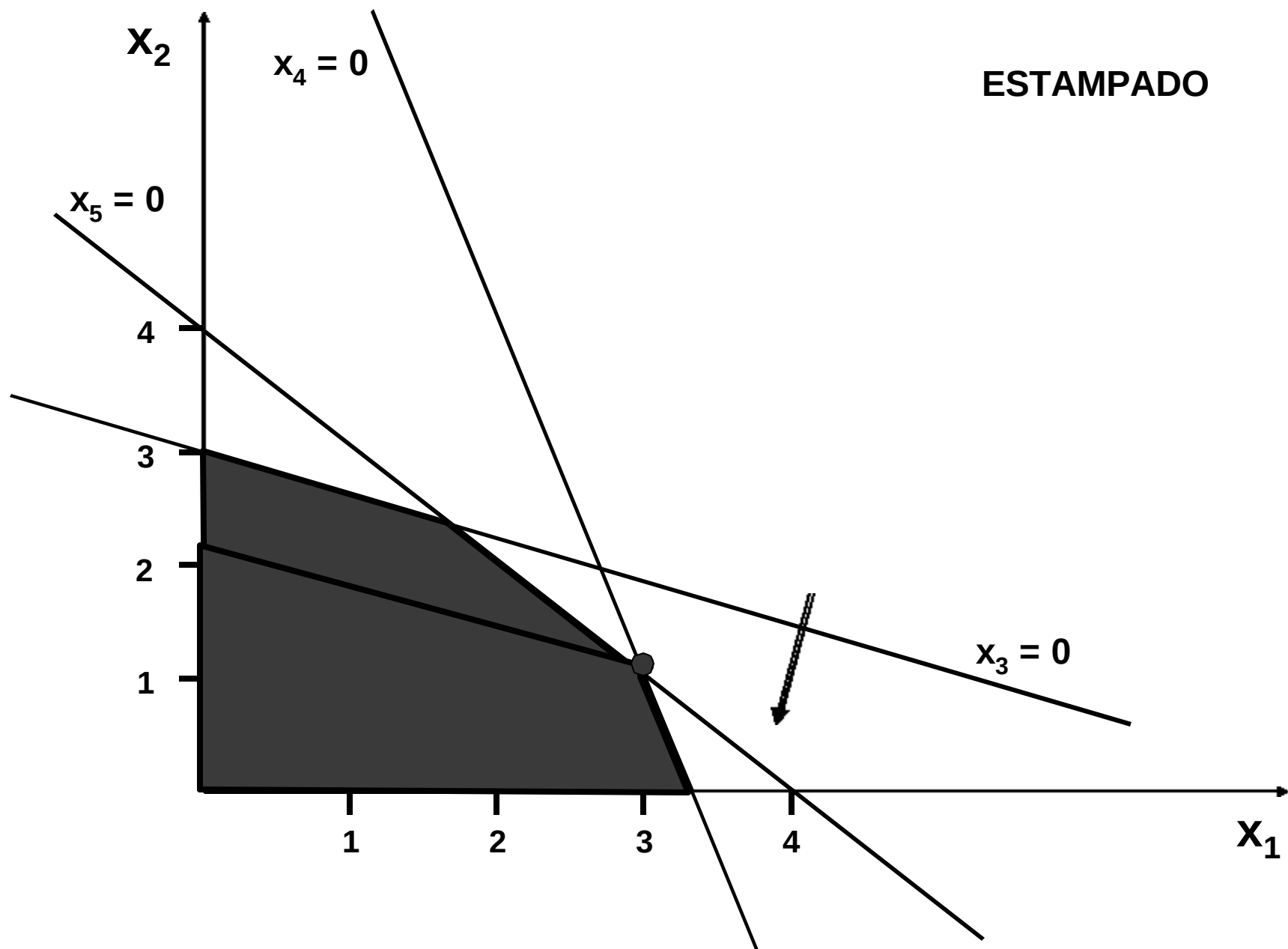


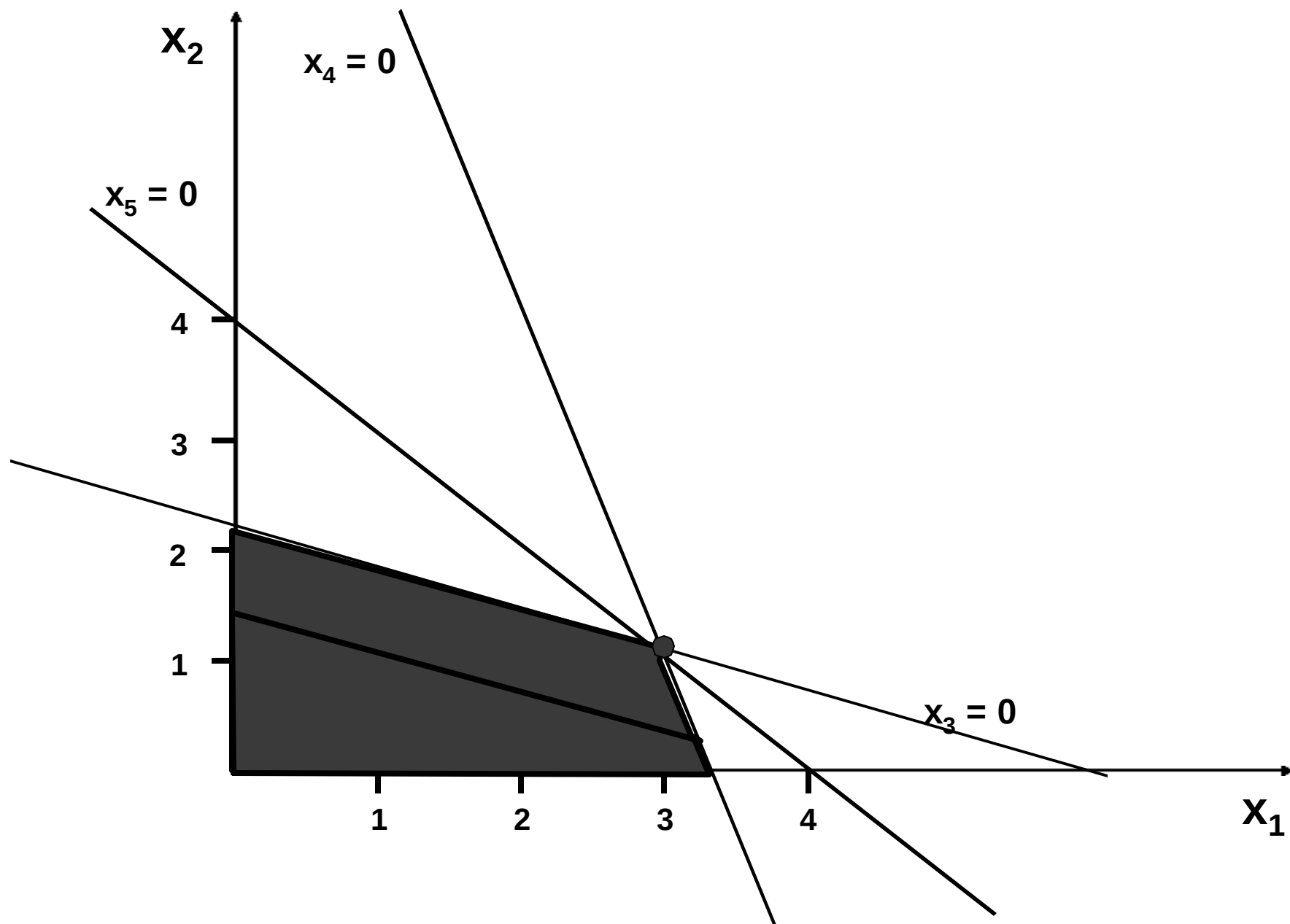


MODIFICACIONES
SOBRE RHS
(PINTADO)







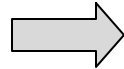


$$\text{MAX: } Z = 4x_1 + 3x_2$$

$$6x_1 + 16x_2 \leq 48.000$$

$$12x_1 + 6x_2 \leq 42.000$$

$$9x_1 + 9x_2 \leq 36.000$$



$$\text{MIN: } Z = 48.000y_1 + 42.000y_2 + 36.000y_3$$

$$6y_1 + 12y_2 + 9y_3 \leq 4$$

$$16y_1 + 6y_2 + 9y_3 \leq 3$$

			54.000					
			C_j	48.000	42.000	36.000	0	0
C'_k	y_k	B'	A'_1	A'_2	A'_3	A'_4	A'_5	
54.000	42.000	y_2	1/6	-5/3	1	-1/6	1/6	
36.000	y_3	y_3	2/9	26/9		1	1/9	-2/9
$Z = 15.000$			-14.000	0	0	-3.000	-1.000	
$Z = 17.000$			-34.000	0	0	-5.000	1.000	

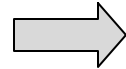


$$\text{MAX: } Z = 4x_1 + 3x_2$$

$$6x_1 + 16x_2 \leq 48.000$$

$$12x_1 + 6x_2 \leq 42.000$$

$$9x_1 + 9x_2 \leq 36.000$$

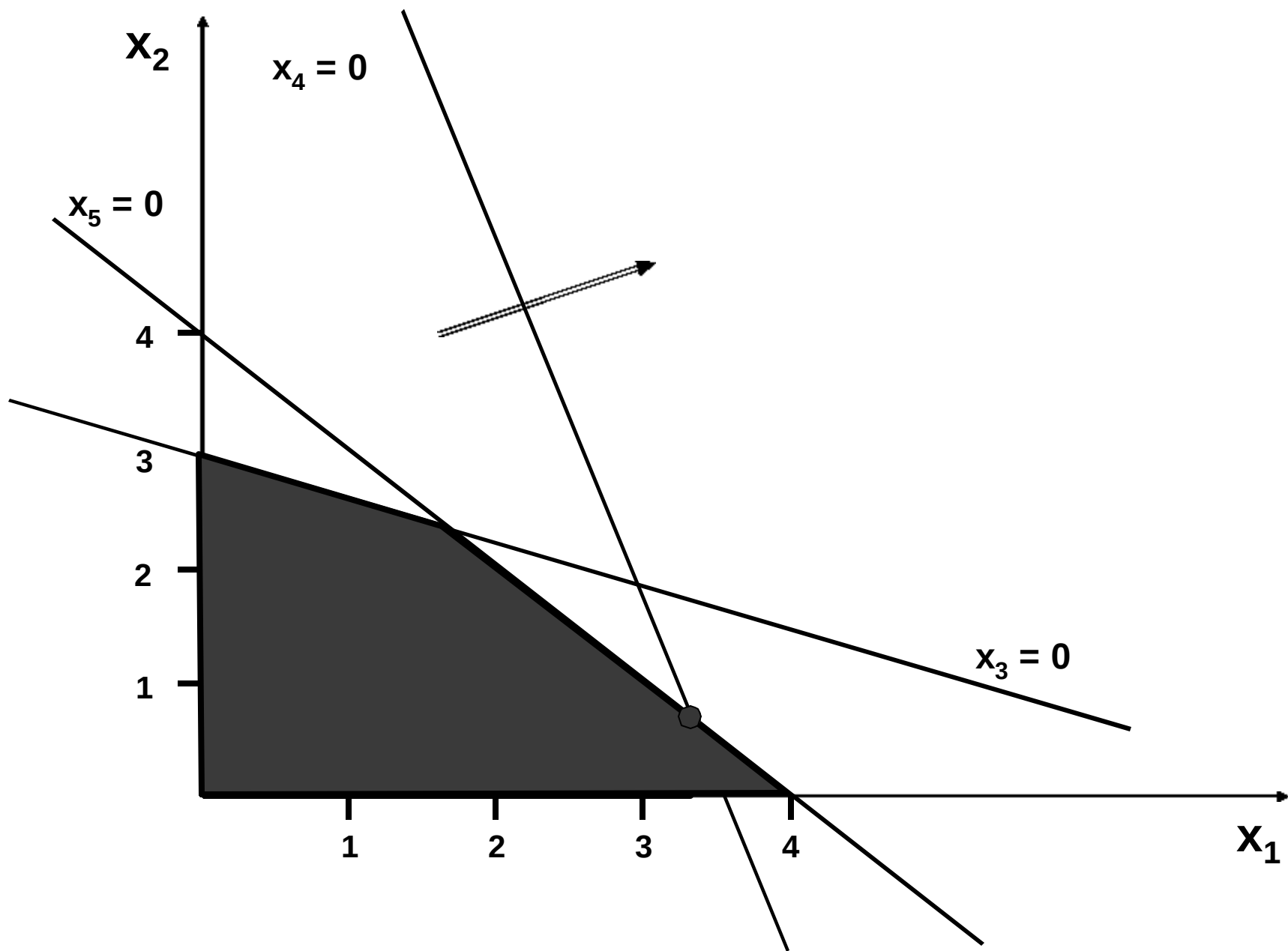


$$\text{MIN: } Z = 48.000y_1 + 42.000y_2 + 36.000y_3$$

$$6y_1 + 12y_2 + 9y_3 \leq 4$$

$$16y_1 + 6y_2 + 9y_3 \leq 3$$

			54.000					
			C_j	48.000	42.000	36.000	0	0
C'_k	y_k	B'	A'_1	A'_2	A'_3	A'_4	A'_5	
0	y_5	1	-10	6		-1	1	
36.000	y_3	4/9	2/3	4/3	1	-1/9		
Z = 16.000			-24.000	-6.000	0	-4.000	0	



AGREGADO DE UNA NUEVA ACTIVIDAD

$$\text{MAX: } Z = 4 x_1 + 3 x_2 + 7,5 x_6$$

$$\left\{ \begin{array}{l} 6 x_1 + 16 x_2 + 23 x_6 \quad \text{£ } 48.000 \\ 12 x_1 + 6 x_2 + 18 x_6 \quad \text{£ } 42.000 \\ 9 x_1 + 9 x_2 + 18 x_6 \quad \text{£ } 36.000 \end{array} \right.$$

SOLUCIÓN ÓPTIMA ANTERIOR: $y_1 = 0$ $y_2 = 1/6$ $y_3 = 2/9$

$$23 \cdot y_1 + 18 \cdot y_2 + 18 \cdot y_3 = 23 \cdot 0 + 18 \cdot 1/6 + 18 \cdot 2/9 = 7 < 7,5$$

		c_j	4	3	0	0	0	7,5
c_k	x_k	B	A₁	A₂	A₃	A₄	A₅	A₆
0	x_3	48.000	6	16	1			23
0	x_4	42.000	12	6		1		18
0	x_5	36.000	9	9			1	18
Z = 0			- 4	- 3	0	0	0	

0	x_3	14.000			1	5/3	-26/9	
4	x_1	3.000	1			1/6	-1/9	
3	x_2	1.000		1		-1/6	2/9	
Z = 15.000			0	0	0	1/6	2/9	

		c_j	4	3	0	0	0	7,5
c_k	x_k	B	A₁	A₂	A₃	A₄	A₅	A₆
0	x_3	48.000	6	16	1	1	1	23
0	x_4	42.000	12	6				18
0	x_5	36.000	9	9				18
$Z = 0$			- 4	- 3	0	0	0	

0	x_3	14.000			1	5/3	-26/9	
4	x_1	3.000	1			1/6	-1/9	
3	x_2	1.000		1		-1/6	2/9	
$Z = 15.000$			0	0	0	1/6	2/9	

1	5/3	-26/9
	1/6	-1/9
	-1/6	2/9

.

23
18
18

=

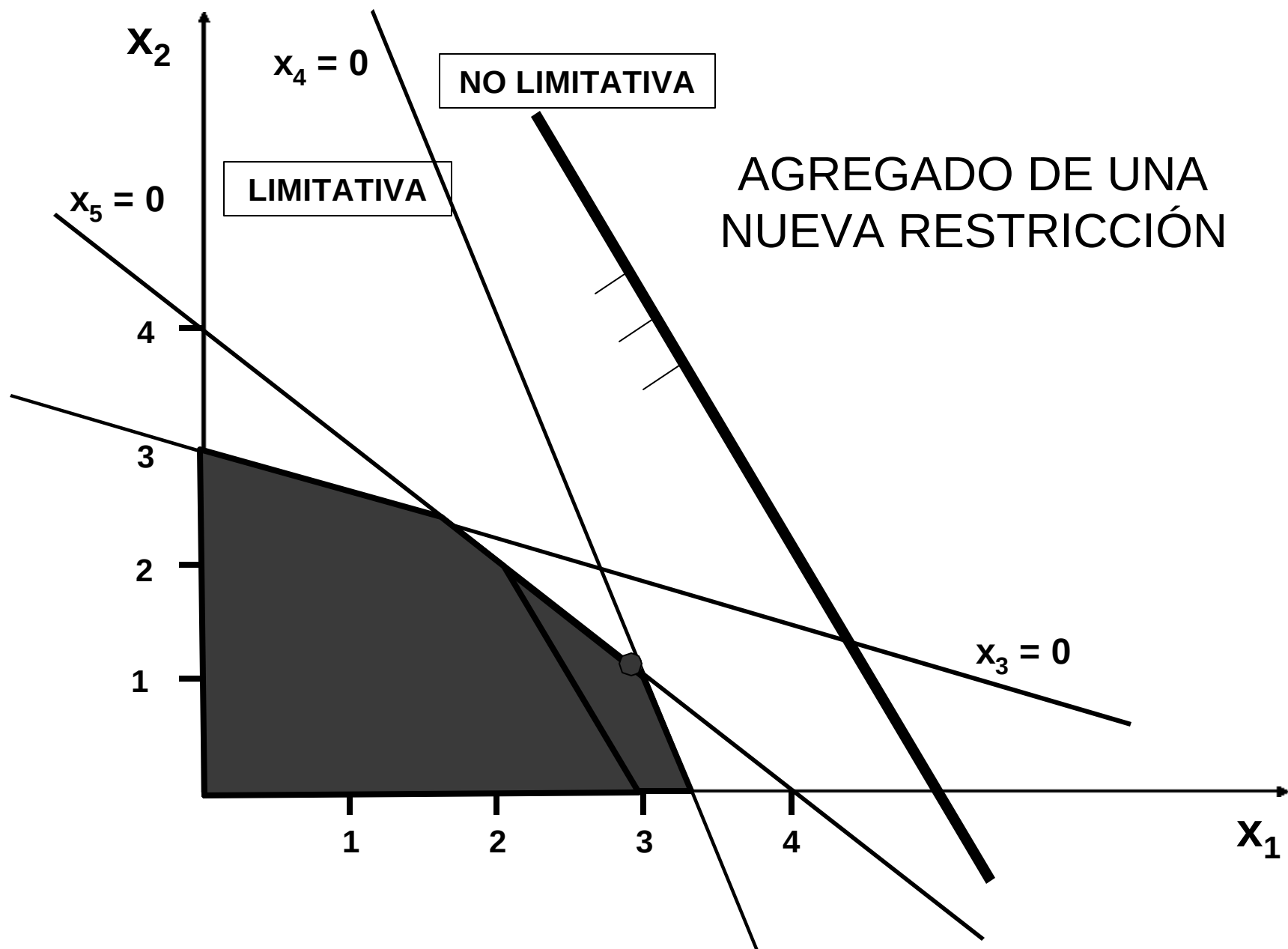
1
1
1

		c_j	4	3	0	0	0	7,5
c_k	x_k	B	A₁	A₂	A₃	A₄	A₅	A₆
0	x_3	48.000	6	16	1			23
0	x_4	42.000	12	6		1		18
0	x_5	36.000	9	9			1	18
$Z = 0$			- 4	- 3	0	0	0	

0	x_3	14.000			1	5/3	-26/9	1
4	x_1	3.000	1			1/6	-1/9	1
3	x_2	1.000		1		-1/6	2/9	1
$Z = 15.000$			0	0	0	1/6	2/9	-0,5



		c_j	4	3	0	0	0	7,5
c_k	x_k	B	A_1	A_2	A_3	A_4	A_5	A_6
0	x_3	13.000		-1	1	11/6	-28/4	
4	x_1	2.000	1	-1		1/3	-1/3	
7,5	x_6	1.000		1		-1/6	2/9	1
Z = 15.500			0	1/2	0	1/12	1/3	0



AGREGADO DE UNA NUEVA RESTRICCIÓN

$$\text{MAX: } Z = 4 x_1 + 3 x_2$$

$$\left\{ \begin{array}{l} 6 x_1 + 16 x_2 \text{ £ } 48.000 \\ 12 x_1 + 6 x_2 \text{ £ } 42.000 \\ 9 x_1 + 9 x_2 \text{ £ } 36.000 \\ 2 x_1 + x_2 \text{ £ } 6.000 \end{array} \right.$$

SOLUCIÓN ÓPTIMA ANTERIOR: $x_1 = 3.000$ $x_2 = 1.000$

$$2 \cdot x_1 + x_2 = 2 \cdot 3.000 + 1.000 = 7.000 \not\leq 6.000$$

		C_j	48.000	42.000	36.000	0	0	6.000
C'_k	y_k	B'	A'_1	A'_2	A'_3	A'_4	A'_5	A'_6
0	y_4	4	6	12	9	-1		2
0	y_5	3	16	6	9		-1	1

C'_k	y_k	B'	A'_1	A'_2	A'_3	A'_4	A'_5	A'_6
42.000	y_2	1/6	-5/3	1		-1/6	1/6	
36.000	y_3	2/9	26/9		1	1/9	-2/9	
$Z = 15.000$			-14.000	0	0	-3.000	-1.000	

$$\begin{vmatrix} 1/6 & -1/6 \\ -1/9 & 2/9 \end{vmatrix} \cdot \begin{vmatrix} 2 \\ 1 \end{vmatrix} = \begin{vmatrix} 1/6 \\ 0 \end{vmatrix}$$

		C_j	48.000	42.000	36.000	0	0	6.000
C'_k	y_k	B'	A'_1	A'_2	A'_3	A'_4	A'_5	A'_6
0	y_4	4	6	12	9	-1		2
0	y_5	3	16	6	9		-1	1

C'_k	y_k	B'	A'_1	A'_2	A'_3	A'_4	A'_5	A'_6
42.000	y_2	1/6	-5/3	1		-1/6	1/6	1/6
36.000	y_3	2/9	26/9		1	1/9	-2/9	0
$Z = 15.000$			-14.000	0	0	-3.000	-1.000	1.000



		C_j	48.000	42.000	36.000	0	0	6.000
C'_k	y_k	B'	A'_1	A'_2	A'_3	A'_4	A'_5	A'_6
6.000	y_6	1	-10	6		-1	1	1
36.000	y_3	2/9	25/9		1	1/9	-2/9	
$Z = 14.000$			-4.000	-6.000	0	-2.000	-2000	0

VARIABLES BÁSICAS

C_k	x_k	B	A_j			
C_i	x_i	b_i				
				a_{ij}		
Z			$z_j - C_j$			

VARIABLES BÁSICAS

C_k	x_k	B	A_j			
C_i	x_i	b_i				
				a_{ij}		
Z		$Máx$	$z_j - C_j$			

$$\Delta c_+ \cdot a_{ij} = - (z_j - c_j)_+$$

LÍMITE SUPERIOR: $\Delta c = c_{\text{sup}} - c_j$

VARIABLES BÁSICAS

a_{ij}	MAX	MIN
SUP.	—	
INF.		

VARIABLES BÁSICAS

C_k	x_k	B	A_j			
C_i	x_i	b_i				
				a_{ij}		
Z		$Máx$	$z_j - C_j$			

$$\Delta C \cdot a_{ij} = - (z_j - C_j)_+$$

LÍMITE INFERIOR: $\Delta C = C_{INF} - C_j$

VARIABLES BÁSICAS

a_{ij}	MAX	MIN
SUP.	-	
INF.	+	

VARIABLES BÁSICAS

C_k	x_k	B	A_j			
C_i	x_i	b_i				
				a_{ij}		
Z		$Mín$	$z_j - C_j$			

$$\Delta c_+ \cdot a_{ij} \leq - (z_j - c_j)_-$$

LÍMITE SUPERIOR: $\Delta c = c_{\text{sup}} - c_j$

VARIABLES BÁSICAS

a_{ij}	MAX	MIN
SUP.	-	+
INF.	+	

VARIABLES BÁSICAS

C_k	x_k	B	A_j			
C_i	x_i	b_i				
				a_{ij}		
Z		$Mín$	$z_j - C_j$			

$$\Delta c_{\cdot} \cdot a_{ij} = - (z_j - c_j)$$

LÍMITE INFERIOR: $\Delta c = c_{INF} - c_j$

VARIABLES BÁSICAS

a_{ij}	MAX	MIN
SUP.	-	+
INF.	+	-

$$\Delta c \cdot a_{ij} = - (z_j - c_j)$$

$$(c_{j \text{ LIM}} - c_j) \cdot a_{ij} = - (z_j - c_j)$$

$$c_{j \text{ LIM}} = c_j \pm \frac{z_j - c_j}{a_{ij}}$$

$$C_{jLIM} = C_j \pm \left| \frac{Z_j - C_j}{a_{ij}} \right|_{MIN}$$

a_{ij}	MAX	MIN
SUP.	-	+
INF.	+	-

VARIABLES NO BÁSICAS

		c_j	c_j			
c_k	x_k	B	A_j			
Z Máx			$z_j - c_j$			

LÍMITE SUPERIOR

$$(z_j - c_j)_+ - \Delta c_+ = 0$$

VARIABLES NO BÁSICAS

		C_j	C_j			
C_k	X_k	B	A_j			
$Z \quad Máx$			$z_j - C_j$			

LÍMITE SUPERIOR

$$C_j \text{ sup} = (z_j - C_j)_+ + C_j$$

VARIABLES NO BÁSICAS

		c_j	c_j			
c_k	x_k	B	A_j			
				a_{ij}		
Z	$Máx$		$z_j - c_j$			

$$(z_j - c_j)_+ - \Delta c_- = 0$$

LÍMITE INFERIOR NO EXISTE

VARIABLES NO BÁSICAS

		c_j	c_j			
c_k	x_k	B	A_j			
				a_{ij}		
Z Mín		$z_j - c_j$				

LÍMITE SUPERIOR
NO EXISTE

$$(z_j - c_j)_- - \Delta c_+ = 0$$

VARIABLES NO BÁSICAS

		c_j	c_j			
c_k	x_k	B	A_j			
				a_{ij}		
Z Mín			$z_j - c_j$			

$$(z_j - c_j)_{-} - \Delta c_{-} = 0$$

LÍMITE INFERIOR

VARIABLES NO BÁSICAS

		C_j	C_j			
C_k	X_k	B	A_j			
				a_{ij}		
Z Mín		$Z_j - C_j$				

LÍMITE INFERIOR

$$C_j \text{ INF} = - (Z_j - C_j) + C_j$$

VARIABLES NO BÁSICAS

C_j LIM	MAX	MIN
SUP.	$C_j + (Z_j - C_j)$	$\exists$
INF.	$\exists$	$C_j - (Z_j - C_j)$

RANGO DE c_1

c_k	x_k	B	A_1	A_2	A_3	A_4	A_5
0	x_3	14.000	1		1	5/3	-26/9
4	x_1	3.000				1/6	-1/9
3	x_2	1.000			1	-1/6	2/9
Z = 15.000 (Máx)			0	0	0	1/6	2/9

$$c_{1\text{SUP}} = c_j + \frac{z_j - c_j}{a_{ij}}$$

a_{ij}	MAX	MIN
SUP.	-	+
INF.	+	-

RANGO DE c_1

c_k	x_k	B	A_1	A_2	A_3	A_4	A_5
0	x_3	14.000	1		1	5/3	-26/9
6 4	x_1	3.000				1/6	-1/9
3	x_2	1.000				-1/6	2/9
Z = 15.000 (Máx)			0	0	0	1/6	2/9
Z = 16.000 (Máx)			0	0	0	1/2	0*

$$c_{1\text{SUP}} = 4 + \frac{2/9}{1/9} = 6$$

RANGO DE c_1

c_k	x_k	B	A_1	A_2	A_3	A_4	A_5
0	x_3	14.000	1		1	5/3	-26/9
4	x_1	3.000				1/6	-1/9
3	x_2	1.000			1	-1/6	2/9
Z = 15.000 (Máx)			0	0	0	1/6	2/9

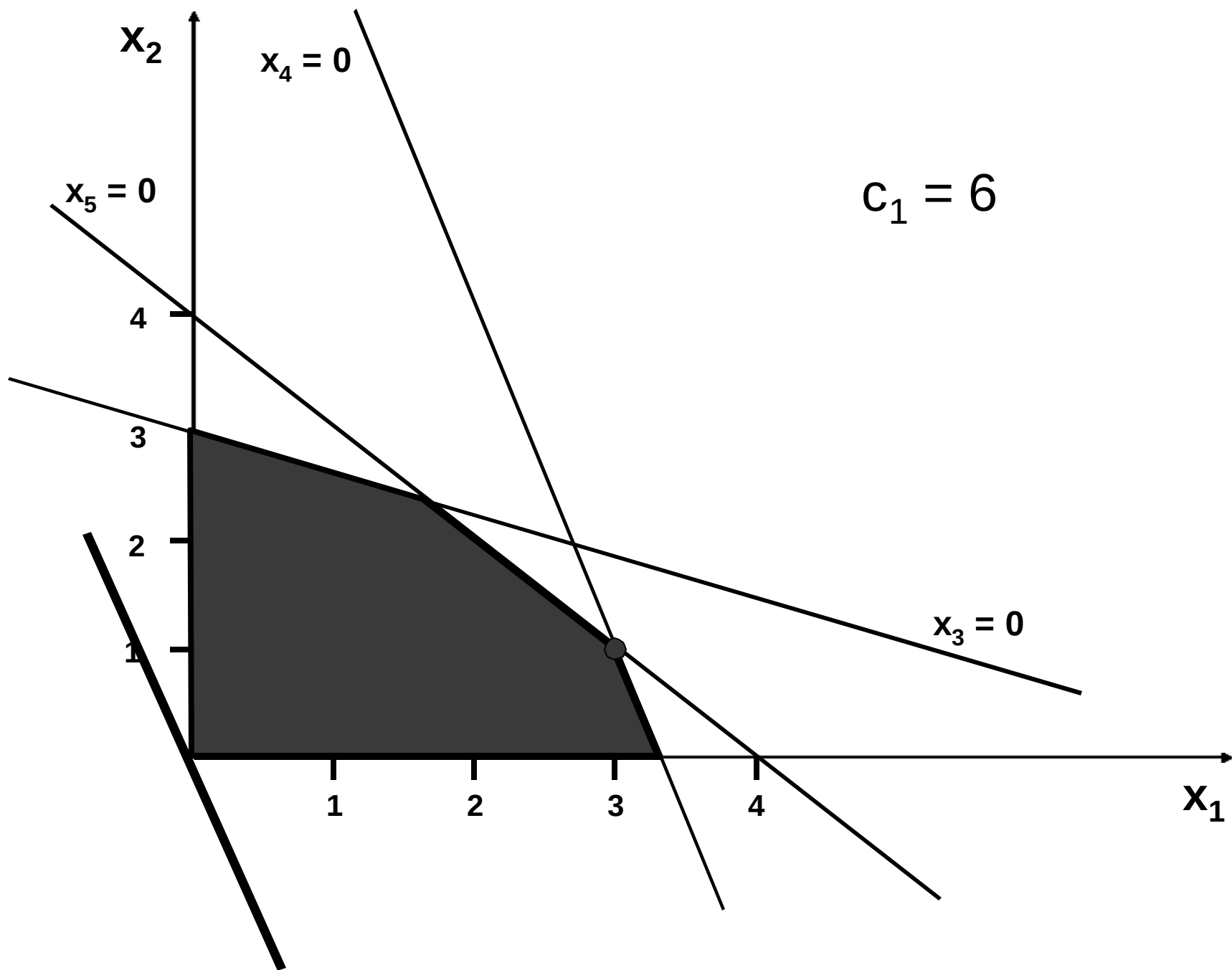
$$c_{1\text{ INF}} = c_j - \frac{Z_j - c_j}{a_{ij}}$$

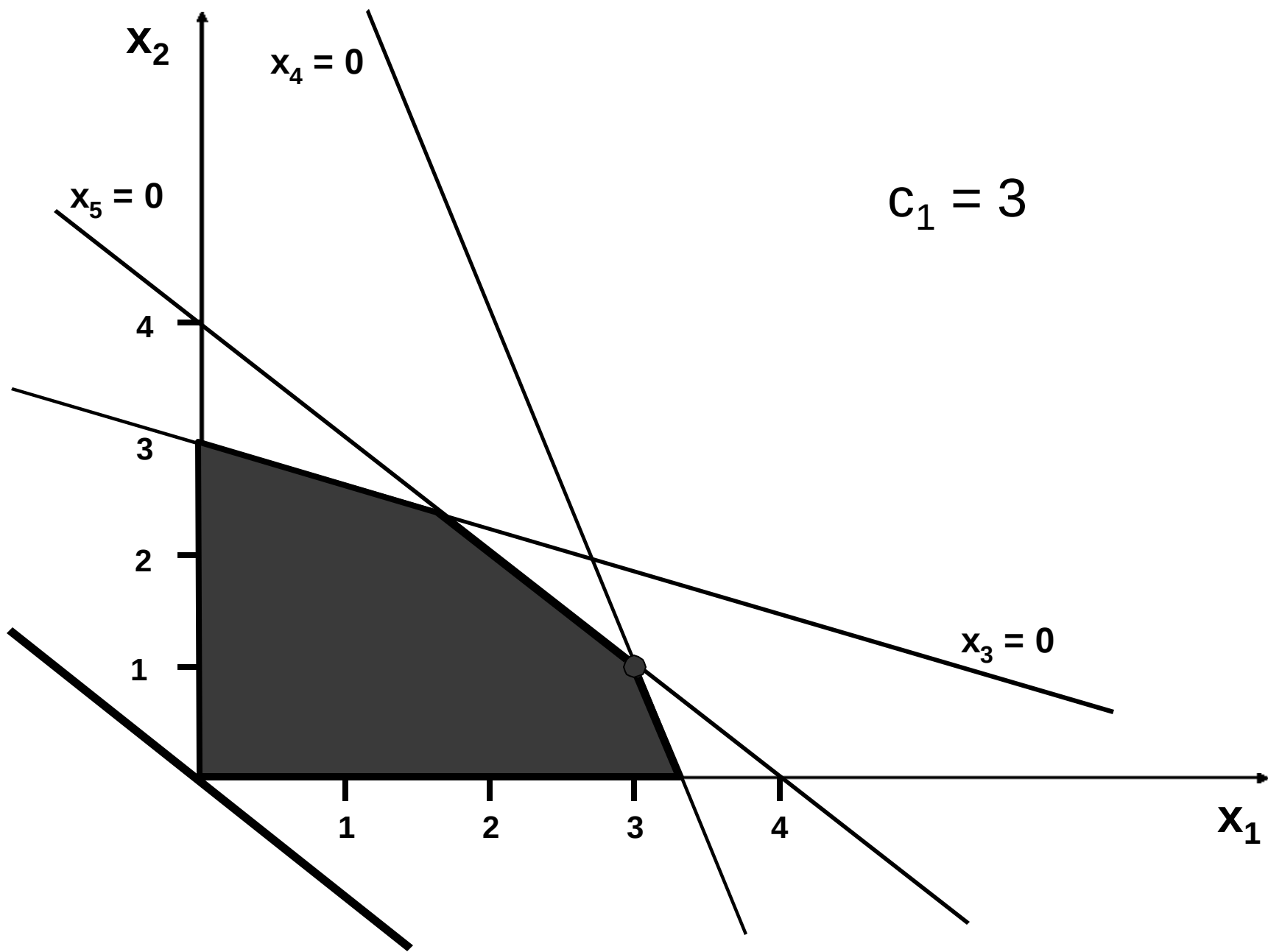
a_{ij}	MAX	MIN
SUP.	-	+
INF.	+	-

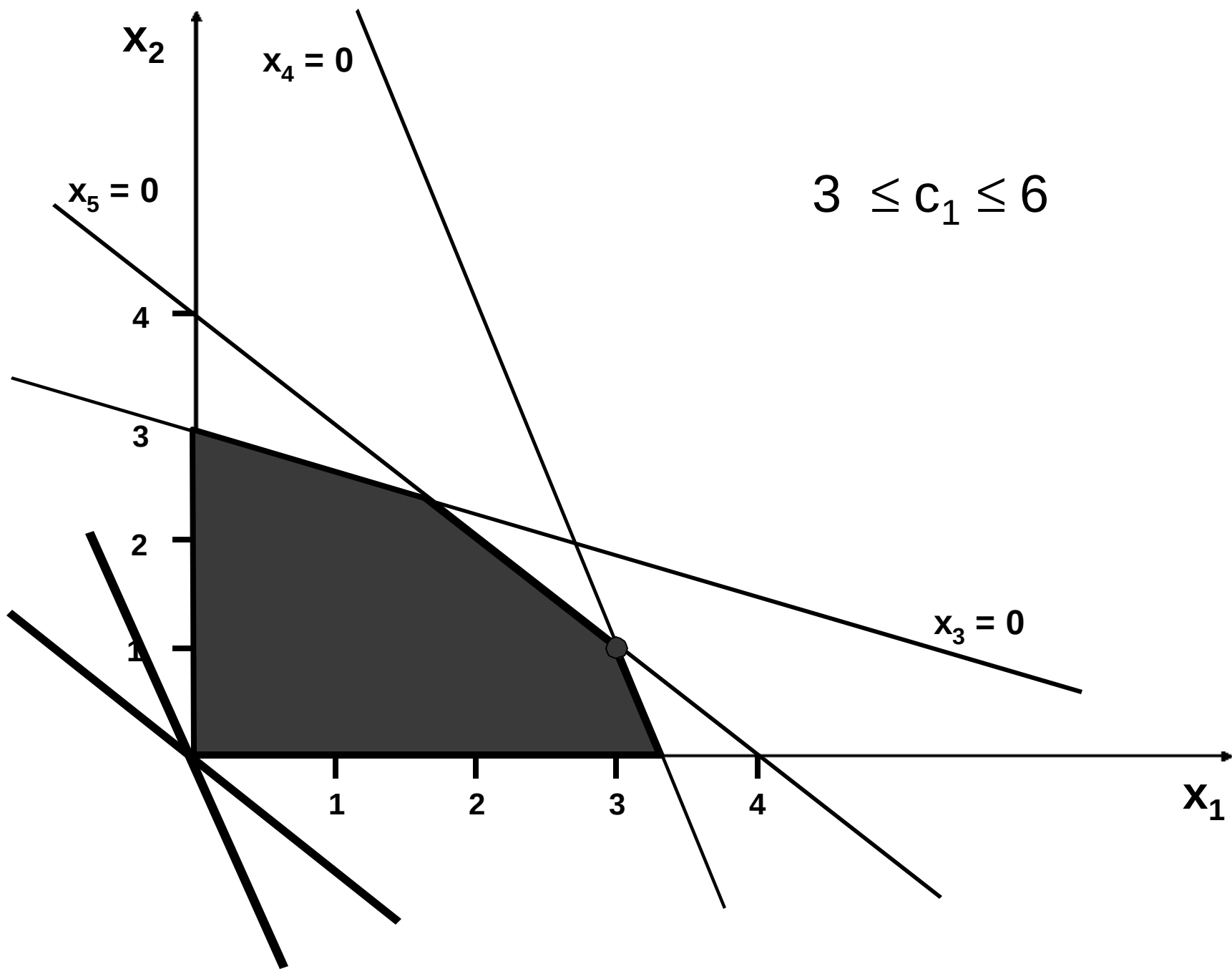
RANGO DE c_1

c_k	x_k	B	A_1	A_2	A_3	A_4	A_5
0	x_3	14.000	1		1	5/3	-26/9
3 4	x_1	3.000				1/6	-1/9
3	x_2	1.000			1	-1/6	2/9
Z = 15.000 (Máx)			0	0	0	1/6	2/9
Z = 12.000 (Máx)			0	0	0	0*	1/3

$$c_{1\text{INF}} = 4 - \frac{1/6}{1/6} = 3$$







RANGO DE c_2

c_k	x_k	B	A_1	A_2	A_3	A_4	A_5
0	x_3	14.000	1	1	1	5/3	-26/9
4	x_1	3.000				1/6	-1/9
3	x_2	1.000				-1/6	2/9
Z = 15.000 (Máx)			0	0	0	1/6	2/9

$$c_{2\text{ SUP}} = c_j + \frac{z_j - c_j}{a_{ij}}$$

a_{ij}	MAX	MIN
SUP.	-	+
INF.	+	-

RANGO DE c_2

c_k	x_k	B	A_1	A_2	A_3	A_4	A_5
0	x_3	14.000			1	5/3	-26/9
4	x_1	3.000	1			1/6	-1/9
3 4	x_2	1.000			1	-1/6	2/9
Z = 15.000 (Máx)			0	0	0	1/6	2/9
Z = 16.000 (Máx)			0	0	0	0*	4/9

$$c_{2\text{ SUP}} = 3 + \frac{1/6}{1/6} = 4$$

RANGO DE c_2

c_k	x_k	B	A_1	A_2	A_3	A_4	A_5
0	x_3	14.000	1	1	1	5/3	-26/9
4	x_1	3.000				1/6	-1/9
3	x_2	1.000				-1/6	2/9
Z = 15.000 (Máx)			0	0	0	1/6	2/9

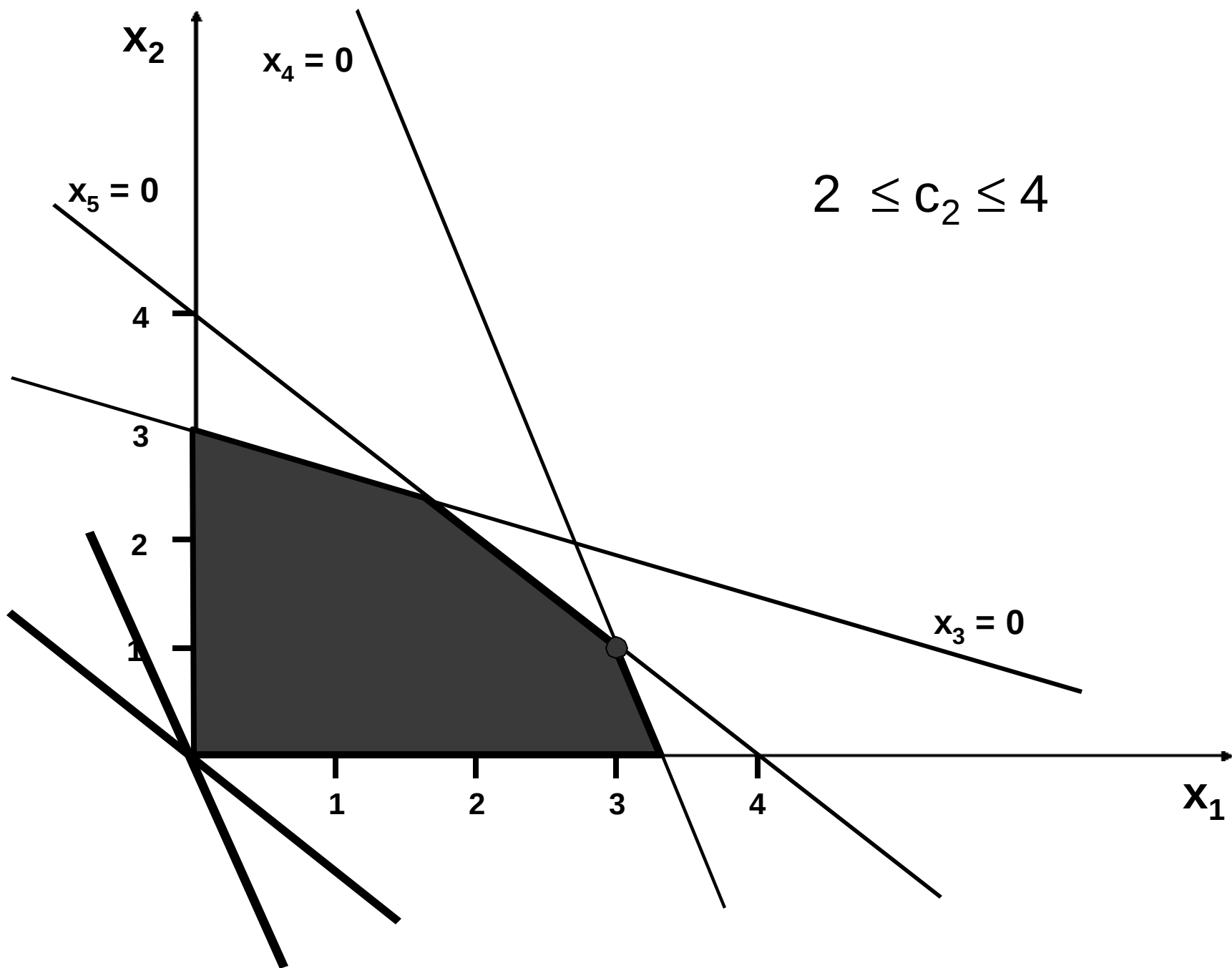
$$c_{2\text{ INF}} = c_j - \frac{z_j - c_j}{a_{ij}}$$

a_{ij}	MAX	MIN
SUP.	-	+
INF.	+	-

RANGO DE c_2

c_k	x_k	B	A_1	A_2	A_3	A_4	A_5
0	x_3	14.000	1		1	5/3	-26/9
4	x_1	3.000				1/6	-1/9
2 3	x_2	1.000			1	-1/6	2/9
Z = 15.000 (Máx)			0	0	0	1/6	2/9
Z = 14.000 (Máx)			0	0	0	1/3	0*

$$c_{2 \text{ INF}} = 3 - \frac{2/9}{2/9} = 2$$



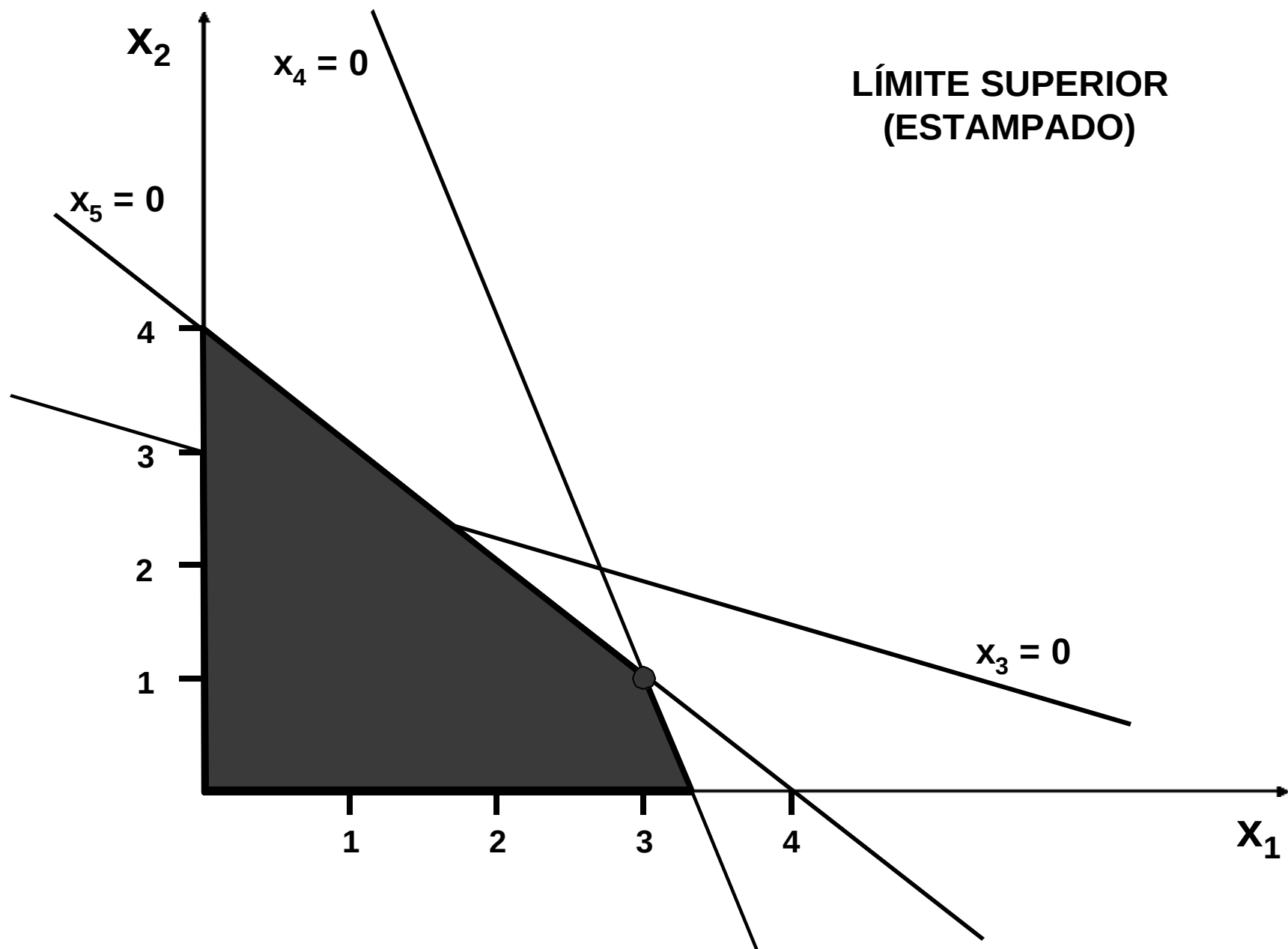
RANGO DE b_1 (EST)

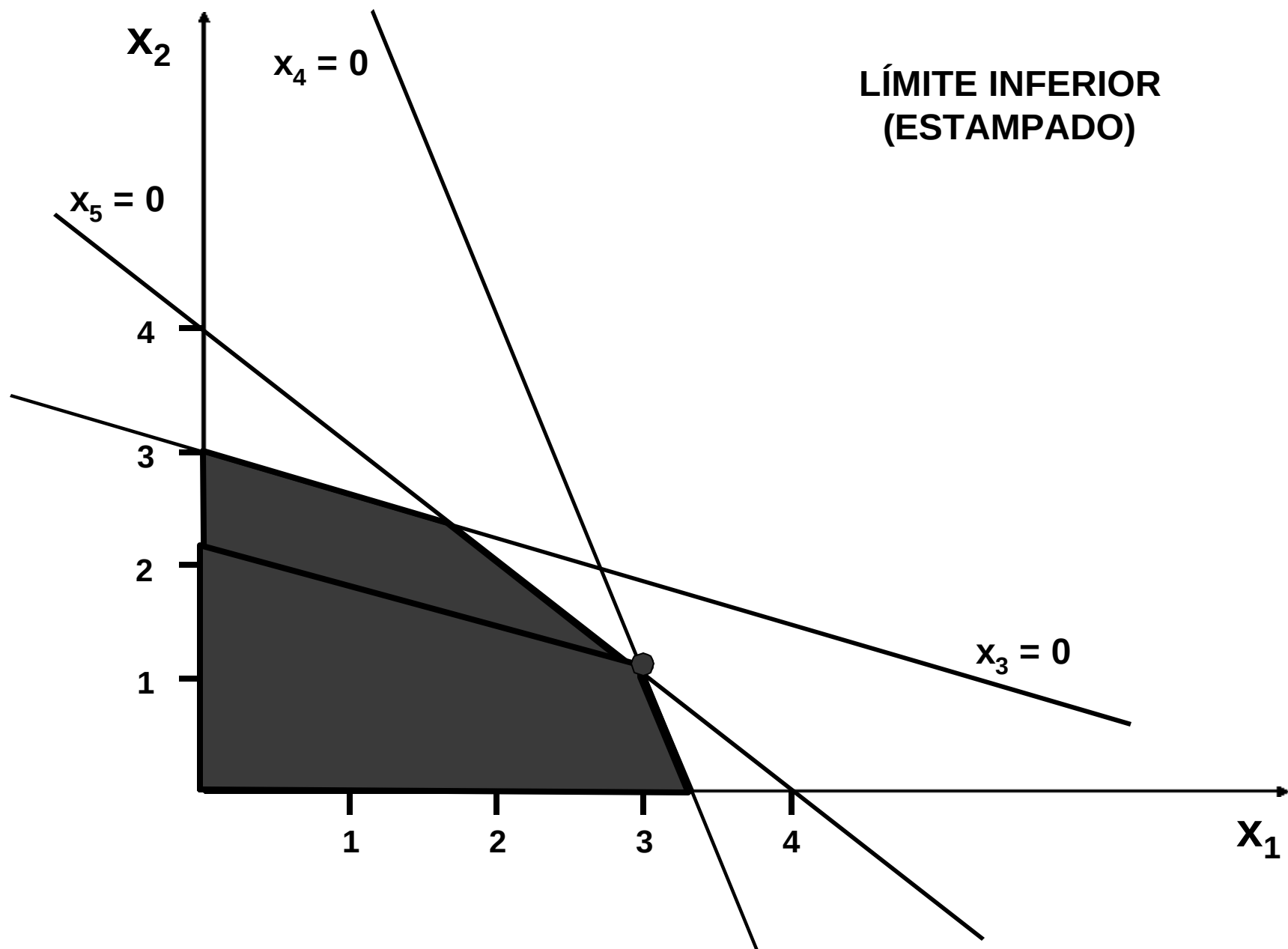
		C_j	48.000 34.000	42.000	36.000	0	0
C'_k	y_k	B'	A'_1	A'_2	A'_3	A'_4	A'_5
42.000	y_2	1/6	-5/3	1		-1/6	1/6
36.000	y_3	2/9	26/9		1	1/9	-2/9
$Z = 15.000$ (Mín)			-14.000	0	0	-3.000	-1.000
$Z = 15.000$ (Mín)			0*	0	0	-3.000	-1.000

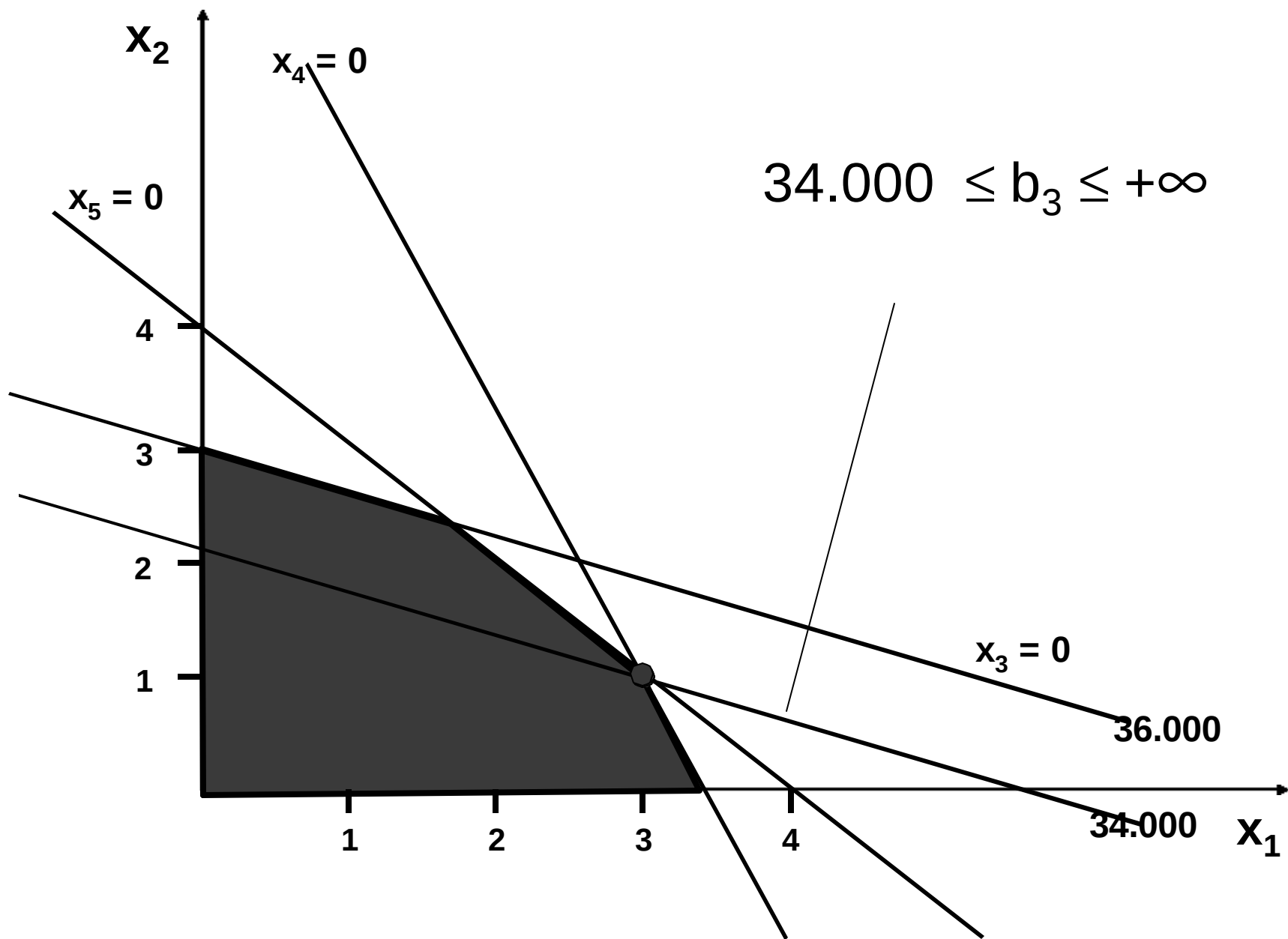
$$b_1 \text{ SUP} = \infty$$

$$b_1 \text{ INF} = 48.000 - 14.000 = 34.000$$

$C_j \text{ LIM}$	MAX	MIN
SUP.	$C_j + (Z_j - C_j)$	∞
INF.	$-\infty$	$C_j - (Z_j - C_j)$







RANGO DE b_2 (SOL)

			C_j	48.000	42.000	36.000	0	0
	C'_k	y_k	B'	A'_1	A'_2	A'_3	A'_4	A'_5
48.000	42.000	y_2	1/6	-5/3	1		-1/6	1/6
	36.000	y_3	2/9	26/9		1	1/9	-2/9
Z = 15.000 (Mín)				-14.000	0	0	-3.000	-1.000
Z = 16.000 (Mín)				-24.000	0	0	-4.000	0*

$$b_{2SUP} = C_j + \frac{Z_j - C_j}{a_{ij}}$$

$$b_{2SUP} = 42.000 + \frac{1.000}{1/6} = 48.000$$

a_{ij}	MAX	MIN
SUP.	-	+
INF.	+	-

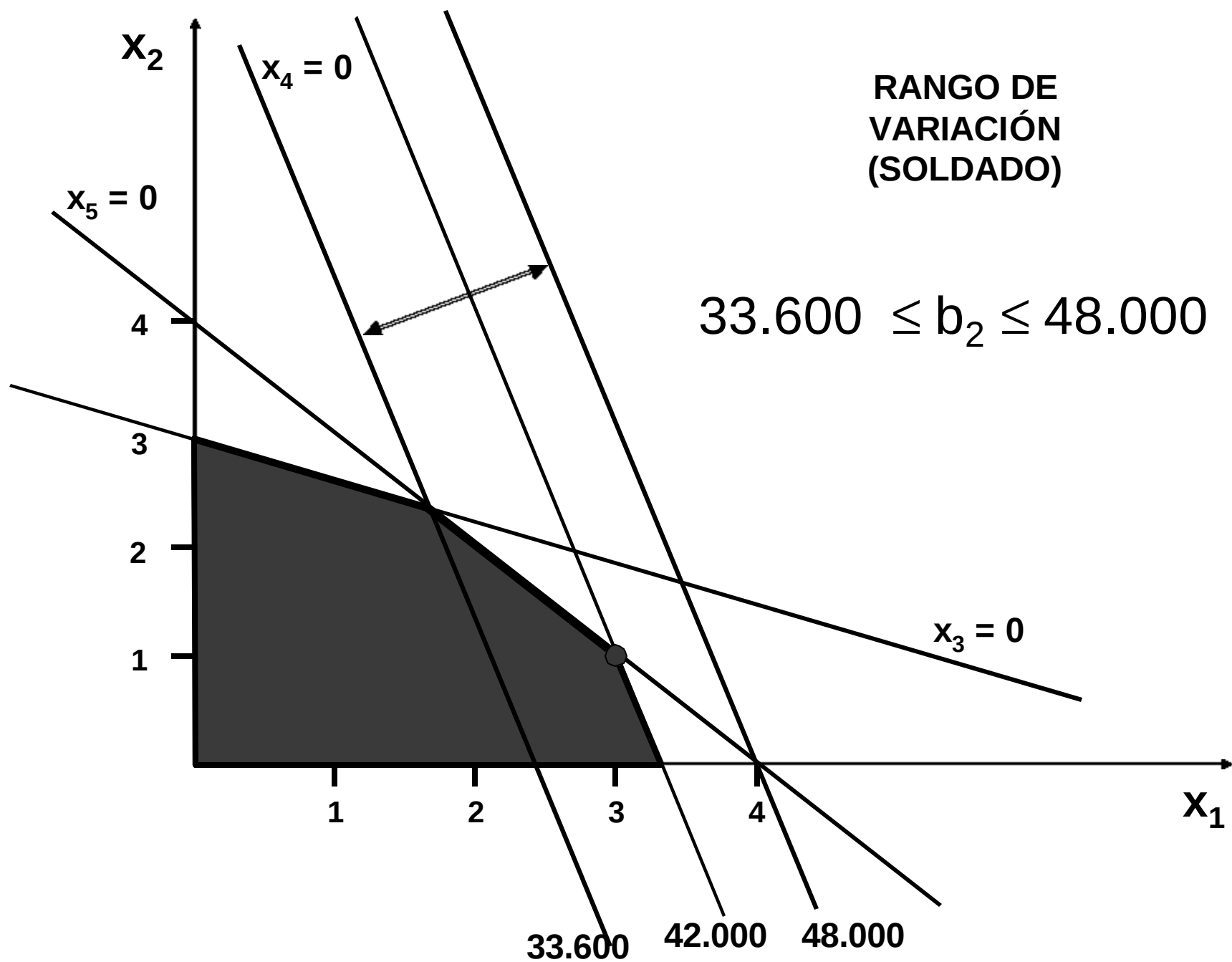
RANGO DE b_2 (SOL)

			C_j	48.000	42.000 33.600	36.000	0	0
	C'_k	y_k	B'	A'_1	A'_2	A'_3	A'_4	A'_5
33.600	42.000	y_2	1/6	-5/3	1		-1/6	1/6
	36.000	y_3	2/9	26/9		1	1/9	-2/9
Z = 15.000 (Mín)				-14.000	0	0	-3.000	-1.000
Z = 13.600 (Mín)				0*	0	0	-1.600	-2.400

$$b_{2\text{ INF}} = C_j - \left| \frac{Z_j - C_j}{a_{ij}} \right|_{\text{MIN}}$$

$$b_{2\text{ INF}} = 42.000 - \frac{14.000}{5/3} = 33.600$$

a_{ij}	MAX	MIN
SUP.	-	+
INF.	+	-



RANGO DE b_3 (PIN)

40.846,15

		C_j	48.000	42.000	36.000	0	0
	C'_k	B'	A'_1	A'_2	A'_3	A'_4	A'_5
	42.000	y_2	1/6	-5/3	1	-1/6	1/6
40.846,15	36.000	y_3	2/9	26/9	1	1/9	-2/9
	$Z = 15.000$ (Mín)		-14.000	0	0	-3.000	-1.000
	$Z = 16.077$ (Mín)		0*	0	0	-2.461,5	-2.076,9

$$b_{3\text{SUP}} = C_j + \frac{Z_j - C_j}{a_{ij}}$$

$$b_{3\text{SUP}} = 36.000 + \frac{14.000}{26/9} = 40.846,15$$

a_{ij}	MAX	MIN
SUP.	-	+
INF.	+	-

RANGO DE b_3 (PIN)

31.500

		C_j	48.000	42.000	36.000	0	0
	C'_k	B'	A'_1	A'_2	A'_3	A'_4	A'_5
	42.000	y_2	1/6	-5/3	1	-1/6	1/6
31.500	36.000	y_3	2/9	26/9	1	1/9	-2/9
	$Z = 15.000$ (Mín)		-14.000	0	0	-3.000	-1.000
	$Z = 14.000$ (Mín)		-27.000	0	0	-3.500	0*

$$b_{3\text{INF}} = C_j - \frac{Z_j - C_j}{a_{ij}}$$

$$b_{3\text{INF}} = 36.000 - \frac{1.000}{2/9} = 31.500$$

a_{ij}	MAX	MIN
SUP.	-	+
INF.	+	-

