$$\begin{cases} 6x_1 + 16x_2 + x_3 = 48000 \\ 12x_1 + 6x_2 + x_4 = 42000 \\ 9x_1 + 9x_2 + x_5 = 36000 \end{cases}$$

$$Z = 4x_1 + 3x_2 + 0x_3 + 0x_4 + 0x_5$$

| | | $c_j$ | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $c_k$ | $x_k$ | B | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $b_i/a_{ij}$ |
| | | | | | | | | |
| Z | | | | | | | | |

$$\begin{cases} 6x_1 + 16x_2 + x_3 = 48000 \\ 12x_1 + 6x_2 + x_4 = 42000 \\ 9x_1 + 9x_2 + x_5 = 36000 \end{cases}$$

$$Z = 4x_1 + 3x_2 + 0x_3 + 0x_4 + 0x_5$$

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $c_k$ | $x_k$ | B | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $b_i/a_{ij}$ |
| | | | | | | | | |
| Z | | | | | | | | |

$$\begin{cases} 6x_1 + 16x_2 + x_3 = 48000 \\ 12x_1 + 6x_2 + x_4 = 42000 \\ 9x_1 + 9x_2 + x_5 = 36000 \end{cases}$$

$$Z = 4x_1 + 3x_2 + 0x_3 + 0x_4 + 0x_5$$

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $c_k$ | $x_k$ | B | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $b_i/a_{ij}$ |
| | $x_3$<br>$x_4$<br>$x_5$ | | | | | | | |
| Z | | | | | | | | |

$$\begin{cases} 6x_1 + 16x_2 + x_3 = 48000 \\ 12x_1 + 6x_2 + x_4 = 42000 \\ 9x_1 + 9x_2 + x_5 = 36000 \end{cases}$$

$$Z = 4x_1 + 3x_2 + 0x_3 + 0x_4 + 0x_5$$

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $c_k$ | $x_k$ | B | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $b_i/a_{ij}$ |
| 0 | $x_3$ | 48.000 | | | | | | |
| 0 | $x_4$ | 42.000 | | | | | | |
| 0 | $x_5$ | 36.000 | | | | | | |
| Z | | | | | | | | |

$$\begin{cases} 6x_1 + 16x_2 + x_3 = 48000 \\ 12x_1 + 6x_2 + x_4 = 42000 \\ 9x_1 + 9x_2 + x_5 = 36000 \end{cases}$$

$$Z = 4x_1 + 3x_2 + 0x_3 + 0x_4 + 0x_5$$

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $c_k$ | $x_k$ | B | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $b_i/a_{ij}$ |
| 0 | $x_3$ | 48.000 | 6 | 16 | 1 | | | |
| 0 | $x_4$ | 42.000 | 12 | 6 | | 1 | | |
| 0 | $x_5$ | 36.000 | 9 | 9 | | | 1 | |
| Z | | | | | | | | |

$$\begin{cases} 6x_1 + 16x_2 + x_3 = 48000 \\ 12x_1 + 6x_2 + x_4 = 42000 \\ 9x_1 + 9x_2 + x_5 = 36000 \end{cases}$$

$$Z = 4x_1 + 3x_2 + 0x_3 + 0x_4 + 0x_5$$

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $c_k$ | $x_k$ | B | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $b_i/a_{ij}$ |
| 0 | $x_3$ | 48.000 | 6 | 16 | 1 | | | |
| 0 | $x_4$ | 42.000 | 12 | 6 | | 1 | | |
| 0 | $x_5$ | 36.000 | 9 | 9 | | | 1 | |
| Z = 0 | | | | | | | | |

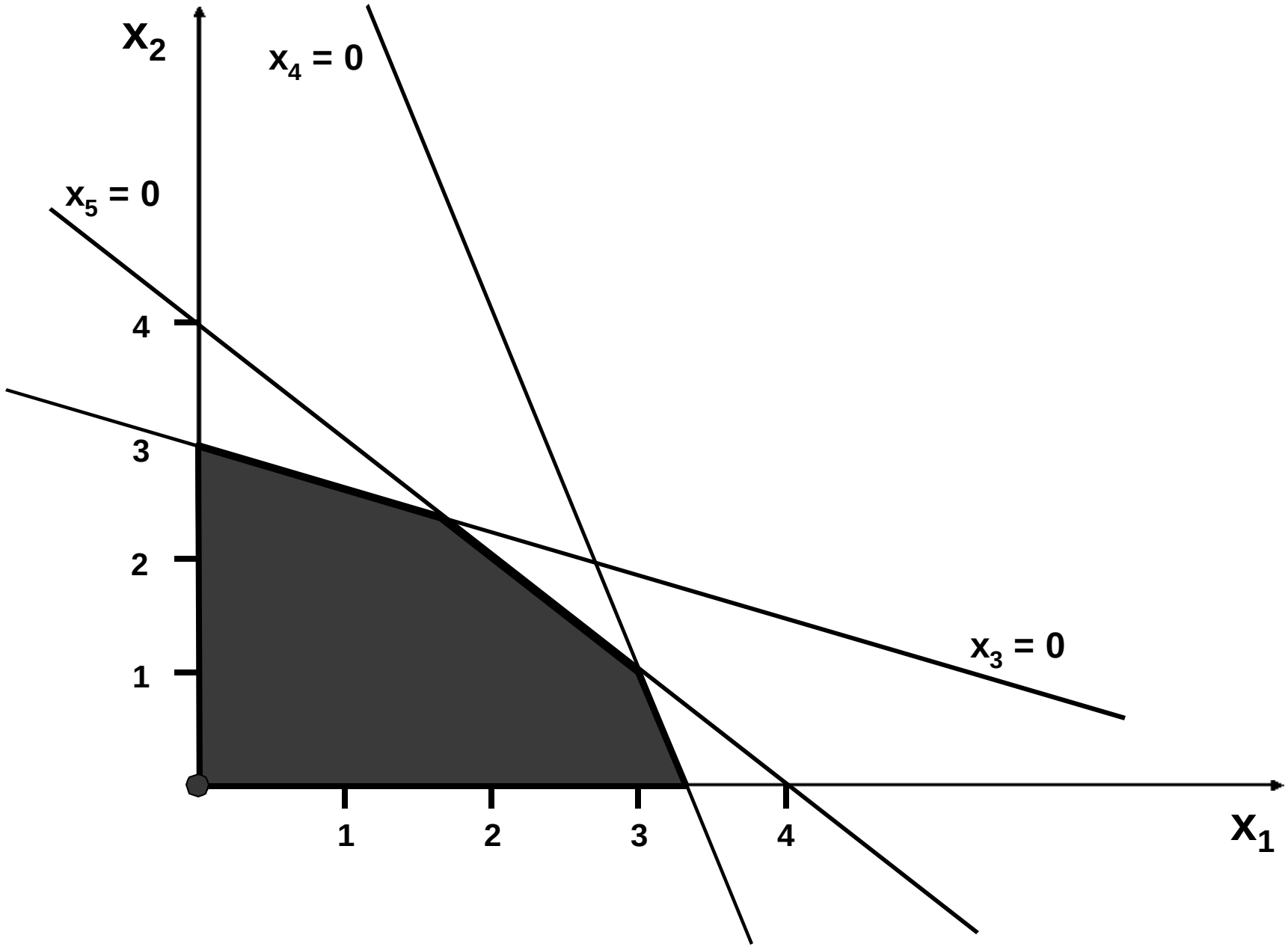
$$Z = \sum c_k \cdot x_k$$

$$\begin{cases} 6x_1 + 16x_2 + x_3 = 48000 \\ 12x_1 + 6x_2 + x_4 = 42000 \\ 9x_1 + 9x_2 + x_5 = 36000 \end{cases}$$

$$Z = 4x_1 + 3x_2 + 0x_3 + 0x_4 + 0x_5$$

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $c_k$ | $x_k$ | B | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $b_i/a_{ij}$ |
| 0 | $x_3$ | 48.000 | 6 | 16 | 1 | | | |
| 0 | $x_4$ | 42.000 | 12 | 6 | | 1 | | |
| 0 | $x_5$ | 36.000 | 9 | 9 | | | 1 | |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |

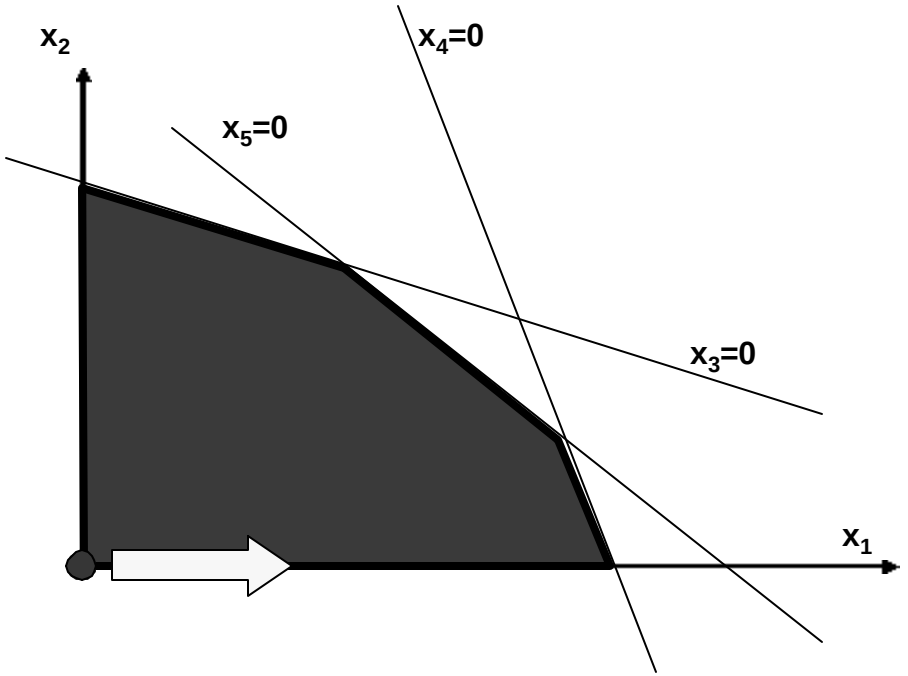
$$z_j - c_j = \sum c_k a_{ij} - c_j$$


x2
x4 = 0
x5 = 0
4
3
2
1
x3 = 0
1
2
3
4
x1

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $\mathbf{c_k}$ | $\mathbf{x_k}$ | **B** | $\mathbf{A_1}$ | $\mathbf{A_2}$ | $\mathbf{A_3}$ | $\mathbf{A_4}$ | $\mathbf{A_5}$ | $b_i/a_{ij}$ |
| 0 | $\mathbf{x_3}$ | 48.000 | 6 | 16 | 1 | | | |
| 0 | $\mathbf{x_4}$ | 42.000 | 12 | 6 | | 1 | | |
| 0 | $\mathbf{x_5}$ | 36.000 | 9 | 9 | | | 1 | |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $\mathbf{c_k}$ | $\mathbf{x_k}$ | **B** | $\mathbf{A_1}$ | $\mathbf{A_2}$ | $\mathbf{A_3}$ | $\mathbf{A_4}$ | $\mathbf{A_5}$ | $b_i/a_{ij}$ |
| 0 | $\mathbf{x_3}$ | 48.000 | 6 | 16 | 1 | | | |
| 0 | $\mathbf{x_4}$ | 42.000 | 12 | 6 | | 1 | | |
| 0 | $\mathbf{x_5}$ | 36.000 | 9 | 9 | | | 1 | |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $c_k$ | $x_k$ | B | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $b_i/a_{ij}$ |
| 0 | $x_3$ | 48.000 | 6 | 16 | 1 | | | |
| 0 | $x_4$ | 42.000 | 12 | 6 | | 1 | | |
| 0 | $x_5$ | 36.000 | 9 | 9 | | | 1 | |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |



| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $\mathbf{c_k}$ | $\mathbf{x_k}$ | **B** | $\mathbf{A_1}$ | $\mathbf{A_2}$ | $\mathbf{A_3}$ | $\mathbf{A_4}$ | $\mathbf{A_5}$ | $b_i/a_{ij}$ |
| 0 | $\mathbf{x_3}$ | 48.000 | 6 | 16 | 1 | | | 8.000 |
| 0 | $\mathbf{x_4}$ | 42.000 | 12 | 6 | | 1 | | 3.500 |
| 0 | $\mathbf{x_5}$ | 36.000 | 9 | 9 | | | 1 | 4.000 |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $c_k$ | $x_k$ | B | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $b_i/a_{ij}$ |
| 0 | $x_3$ | 48.000 | 6 | 16 | 1 | | | 8.000 |
| 0 | $x_4$ | 42.000 | 12 | 6 | | 1 | | 3.500 |
| 0 | $x_5$ | 36.000 | 9 | 9 | | | 1 | 4.000 |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |

$$\theta = \min \frac{b_i}{a_{ij}}$$

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $c_k$ | $x_k$ | **B** | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $b_i/a_{ij}$ |
| 0 | $x_3$ | 48.000 | 6 | 16 | 1 | | | 8.000 |
| 0 | $x_4$ | 42.000 | (12) | 6 | | 1 | | 3.500 |
| 0 | $x_5$ | 36.000 | 9 | 9 | | | 1 | 4.000 |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $c_k$ | $x_k$ | **B** | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $b_i/a_{ij}$ |
| 0 | $x_3$ | 48.000 | 6 | 16 | 1 | | | 8.000 |
| 0 | $x_4$ | 42.000 | (12) | 6 | | 1 | | 3.500 |
| 0 | $x_5$ | 36.000 | 9 | 9 | | | 1 | 4.000 |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | $x_3$ | | | | | | | |
| | $x_1$ | | | | | | | |
| | $x_5$ | | | | | | | |
| | | | | | | | | |

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $c_k$ | $x_k$ | B | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $b_i/a_{ij}$ |
| 0 | $x_3$ | 48.000 | 6 | 16 | 1 | | | 8.000 |
| 0 | $x_4$ | 42.000 | (12) | 6 | | 1 | | 3.500 |
| 0 | $x_5$ | 36.000 | 9 | 9 | | | 1 | 4.000 |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0 | $x_3$ | | | | | | | |
| 4 | $x_1$ | | | | | | | |
| 0 | $x_5$ | | | | | | | |
| | | | | | | | | |

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $c_k$ | $x_k$ | B | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $b_i/a_{ij}$ |
| 0 | $x_3$ | 48.000 | 6 | 16 | 1 | | | 8.000 |
| 0 | $x_4$ | 42.000 | (12) | 6 | | 1 | | 3.500 |
| 0 | $x_5$ | 36.000 | 9 | 9 | | | 1 | 4.000 |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0 | $x_3$ | | | | 1 | | | |
| 4 | $x_1$ | | 1 | | | | | |
| 0 | $x_5$ | | | | | | 1 | |
| | | | 0 | | 0 | | 0 | |

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $\mathbf{c_k}$ | $\mathbf{x_k}$ | **B** | $\mathbf{A_1}$ | $\mathbf{A_2}$ | $\mathbf{A_3}$ | $\mathbf{A_4}$ | $\mathbf{A_5}$ | $b_i/a_{ij}$ |
| 0 | $\mathbf{x_3}$ | 48.000 | 6 | 16 | 1 | | | 8.000 |
| 0 | $\mathbf{x_4}$ | 42.000 | (12) | 6 | | 1 | | 3.500 |
| 0 | $\mathbf{x_5}$ | 36.000 | 9 | 9 | | | 1 | 4.000 |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0 | $\mathbf{x_3}$ | | | | 1 | | | |
| 4 | $\mathbf{x_1}$ | 3.500 | 1 | 1/2 | | 1/12 | | |
| 0 | $\mathbf{x_5}$ | | | | | | 1 | |
| | | | 0 | | 0 | | 0 | |

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $c_k$ | $x_k$ | **B** | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $b_i/a_{ij}$ |
| 0 | $x_3$ | 48.000 | 6 | 16 | 1 | | | 8.000 |
| 0 | $x_4$ | 42.000 | (12) | 6 | | 1 | | 3.500 |
| 0 | $x_5$ | 36.000 | 9 | 9 | | | 1 | 4.000 |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0 | $x_3$ | 27.000 | | | 1 | | | |
| 4 | $x_1$ | 3.500 | 1 | 1/12 | | 1/12 | | |
| 0 | $x_5$ | | | | | | 1 | |
| | | | 0 | | 0 | | 0 | |

$$48.000 - \frac{6 \cdot 42.000}{12}$$

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $c_k$ | $x_k$ | **B** | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $b_i/a_{ij}$ |
| 0 | $x_3$ | 48.000 | 6 | 16 | 1 | | | 8.000 |
| 0 | $x_4$ | 42.000 | (12) | 6 | | 1 | | 3.500 |
| 0 | $x_5$ | 36.000 | 9 | 9 | | | 1 | 4.000 |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0 | $x_3$ | 27.000 | | 13 | 1 | | | |
| 4 | $x_1$ | 3.500 | 1 | 1/12 | | 1/12 | | |
| 0 | $x_5$ | | | | | | 1 | |
| | | | 0 | | 0 | | 0 | |

$$16 - \frac{6 \cdot 6}{12}$$

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $c_k$ | $x_k$ | **B** | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $b_i/a_{ij}$ |
| 0 | $x_3$ | 48.000 | 6 | 16 | 1 | | | 8.000 |
| 0 | $x_4$ | 42.000 | (12) | 6 | | 1 | | 3.500 |
| 0 | $x_5$ | 36.000 | 9 | 9 | | | 1 | 4.000 |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0 | $x_3$ | 27.000 | | 13 | 1 | -1/2 | | |
| 4 | $x_1$ | 3.500 | 1 | 1/12 | | 1/12 | | |
| 0 | $x_5$ | | | | | | 1 | |
| | | | 0 | | 0 | | 0 | |

$$0 \quad - \quad \frac{1 \cdot 6}{12}$$

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $c_k$ | $x_k$ | **B** | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $b_i/a_{ij}$ |
| 0 | $x_3$ | 48.000 | 6 | 16 | 1 | | | 8.000 |
| 0 | $x_4$ | 42.000 | (12) | 6 | | 1 | | 3.500 |
| 0 | $x_5$ | 36.000 | 9 | 9 | | | 1 | 4.000 |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0 | $x_3$ | 27.000 | | 13 | 1 | -1/2 | | |
| 4 | $x_1$ | 3.500 | 1 | 1/2 | | 1/12 | | |
| 0 | $x_5$ | 4.500 | | | | | 1 | |
| | | | 0 | | 0 | | 0 | |

$$36.000 - \frac{9 \cdot 42.000}{12}$$

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $c_k$ | $x_k$ | **B** | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $b_i/a_{ij}$ |
| 0 | $x_3$ | 48.000 | 6 | 16 | 1 | | | 8.000 |
| 0 | $x_4$ | 42.000 | (12) | 6 | | 1 | | 3.500 |
| 0 | $x_5$ | 36.000 | 9 | 9 | | | 1 | 4.000 |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0 | $x_3$ | 27.000 | | 13 | 1 | -1/2 | | |
| 4 | $x_1$ | 3.500 | 1 | 1/2 | | 1/12 | | |
| 0 | $x_5$ | 4.500 | | 9/2 | | | 1 | |
| | | | 0 | | 0 | | 0 | |

$$9 - \frac{6 \cdot 9}{12}$$

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $c_k$ | $x_k$ | **B** | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $b_i/a_{ij}$ |
| 0 | $x_3$ | 48.000 | 6 | 16 | 1 | | | 8.000 |
| 0 | $x_4$ | 42.000 | (12) | 6 | | 1 | | 3.500 |
| 0 | $x_5$ | 36.000 | 9 | 9 | | | 1 | 4.000 |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0 | $x_3$ | 27.000 | | 13 | 1 | -1/2 | | |
| 4 | $x_1$ | 3.500 | 1 | 1/2 | | 1/12 | | |
| 0 | $x_5$ | 4.500 | | 9/2 | | -3/4 | 1 | |
| | | | 0 | | 0 | | 0 | |

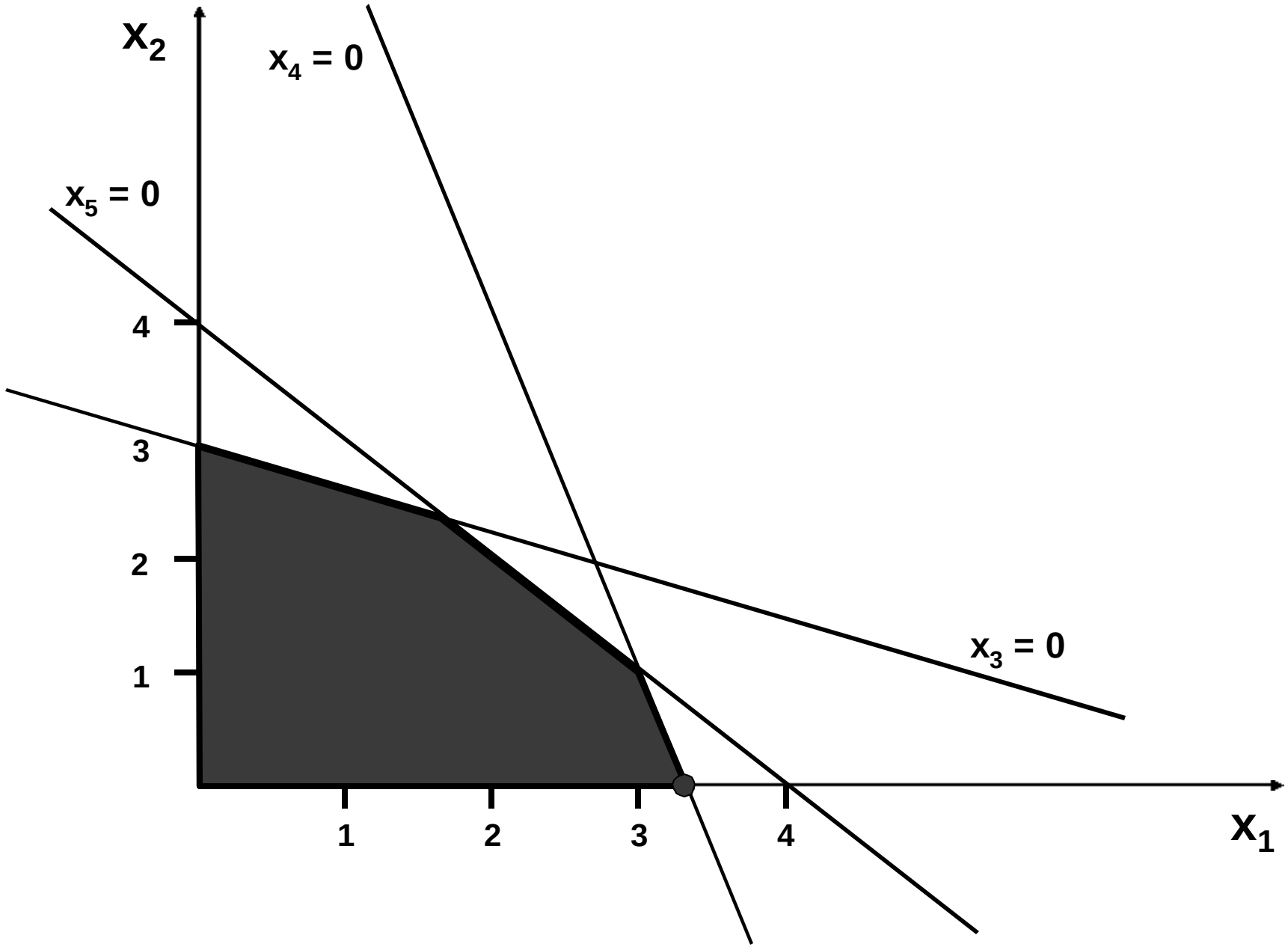
$$0 \quad - \quad \frac{1 \cdot 9}{12}$$

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $\mathbf{c_k}$ | $\mathbf{x_k}$ | **B** | $\mathbf{A_1}$ | $\mathbf{A_2}$ | $\mathbf{A_3}$ | $\mathbf{A_4}$ | $\mathbf{A_5}$ | $b_i/a_{ij}$ |
| 0 | $\mathbf{x_3}$ | 48.000 | 6 | 16 | 1 | | | 8.000 |
| 0 | $\mathbf{x_4}$ | 42.000 | 12 | 6 | | 1 | | 3.500 |
| 0 | $\mathbf{x_5}$ | 36.000 | 9 | 9 | | | 1 | 4.000 |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0 | $\mathbf{x_3}$ | 27.000 | | 13 | 1 | -1/2 | | |
| 4 | $\mathbf{x_1}$ | 3.500 | 1 | 1/2 | | 1/12 | | |
| 0 | $\mathbf{x_5}$ | 4.500 | | 9/2 | | -3/4 | 1 | |
| Z = 14.000 | | | 0 | | 0 | | 0 | |

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $\mathbf{c_k}$ | $\mathbf{x_k}$ | **B** | $\mathbf{A_1}$ | $\mathbf{A_2}$ | $\mathbf{A_3}$ | $\mathbf{A_4}$ | $\mathbf{A_5}$ | $b_i/a_{ij}$ |
| 0 | $\mathbf{x_3}$ | 48.000 | 6 | 16 | 1 | | | 8.000 |
| 0 | $\mathbf{x_4}$ | 42.000 | 12 | 6 | | 1 | | 3.500 |
| 0 | $\mathbf{x_5}$ | 36.000 | 9 | 9 | | | 1 | 4.000 |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0 | $\mathbf{x_3}$ | 27.000 | | 13 | 1 | -1/2 | | |
| 4 | $\mathbf{x_1}$ | 3.500 | 1 | 1/2 | | 1/12 | | |
| 0 | $\mathbf{x_5}$ | 4.500 | | 9/2 | | -3/4 | 1 | |
| Z = 14.000 | | | 0 | -1 | 0 | 1/3 | 0 | |

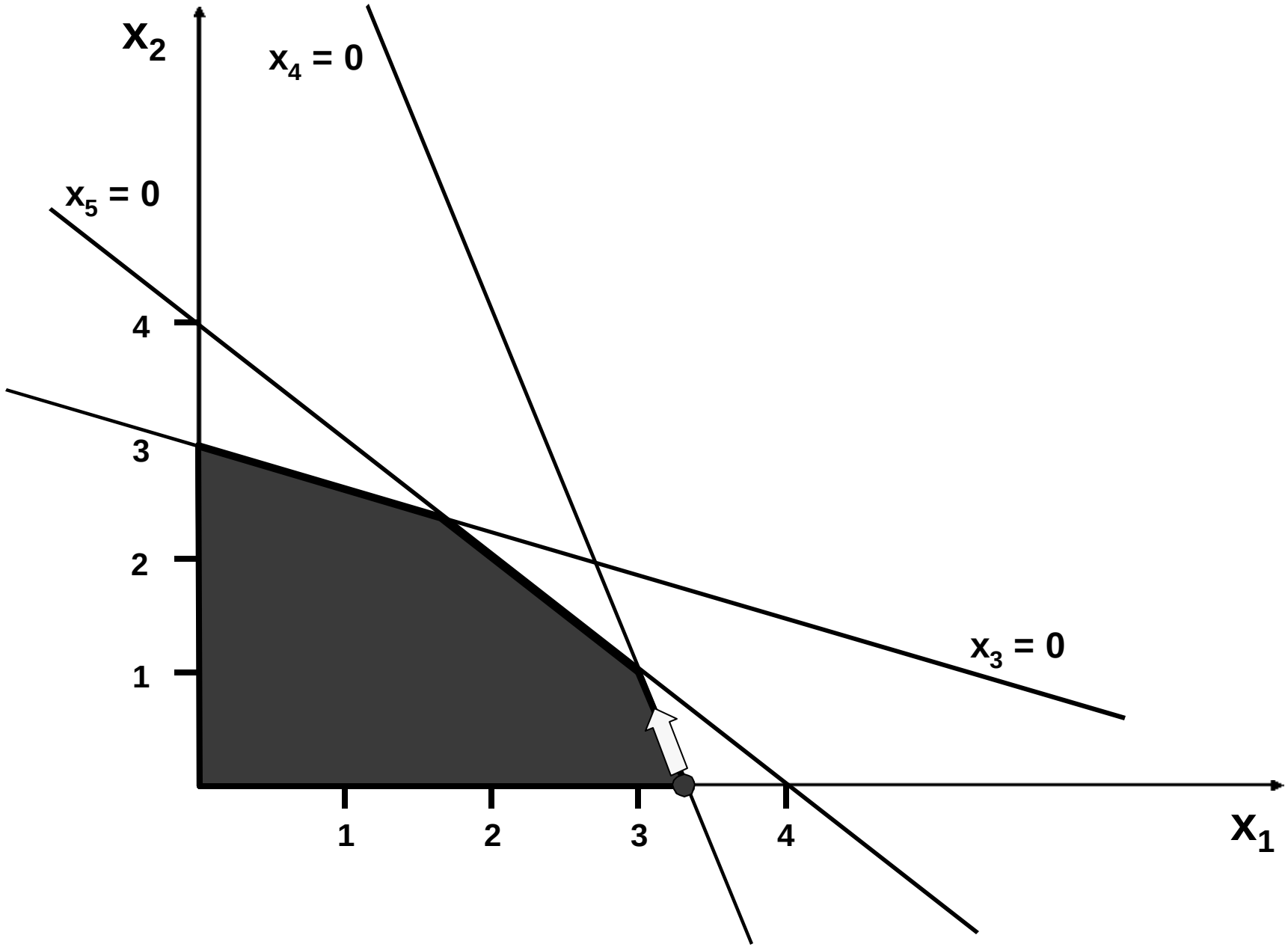

$x_2$
$x_4 = 0$
$x_5 = 0$
4
3
2
1
$x_3 = 0$
1
2
3
4
$x_1$

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $\mathbf{c_k}$ | $\mathbf{x_k}$ | **B** | $\mathbf{A_1}$ | $\mathbf{A_2}$ | $\mathbf{A_3}$ | $\mathbf{A_4}$ | $\mathbf{A_5}$ | $b_i/a_{ij}$ |
| 0 | $\mathbf{x_3}$ | 48.000 | 6 | 16 | 1 | | | 8.000 |
| 0 | $\mathbf{x_4}$ | 42.000 | 12 | 6 | | 1 | | 3.500 |
| 0 | $\mathbf{x_5}$ | 36.000 | 9 | 9 | | | 1 | 4.000 |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0 | $\mathbf{x_3}$ | 27.000 | | 13 | 1 | -1/2 | | |
| 4 | $\mathbf{x_1}$ | 3.500 | 1 | 1/2 | | 1/12 | | |
| 0 | $\mathbf{x_5}$ | 4.500 | | 9/2 | | -3/4 | 1 | |
| Z = 14.000 | | | 0 | -1 | 0 | 1/3 | 0 | |

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $c_k$ | $x_k$ | B | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $b_i/a_{ij}$ |
| 0 | $x_3$ | 48.000 | 6 | 16 | 1 | | | 8.000 |
| 0 | $x_4$ | 42.000 | 12 | 6 | | 1 | | 3.500 |
| 0 | $x_5$ | 36.000 | 9 | 9 | | | 1 | 4.000 |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0 | $x_3$ | 27.000 | | 13 | 1 | -1/2 | | |
| 4 | $x_1$ | 3.500 | 1 | 1/2 | | 1/12 | | |
| 0 | $x_5$ | 4.500 | | 9/2 | | -3/4 | 1 | |
| Z = 14.000 | | | 0 | -1 | 0 | 1/3 | 0 | |


$x_2$
$x_4 = 0$
$x_5 = 0$
4
3
2
1
$x_3 = 0$
1
2
3
4
$x_1$

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $\mathbf{c_k}$ | $\mathbf{x_k}$ | **B** | $\mathbf{A_1}$ | $\mathbf{A_2}$ | $\mathbf{A_3}$ | $\mathbf{A_4}$ | $\mathbf{A_5}$ | $b_i/a_{ij}$ |
| 0 | $\mathbf{x_3}$ | 48.000 | 6 | 16 | 1 | | | 8.000 |
| 0 | $\mathbf{x_4}$ | 42.000 | 12 | 6 | | 1 | | 3.500 |
| 0 | $\mathbf{x_5}$ | 36.000 | 9 | 9 | | | 1 | 4.000 |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0 | $\mathbf{x_3}$ | 27.000 | | 13 | 1 | -1/2 | | 2.077 |
| 4 | $\mathbf{x_1}$ | 3.500 | 1 | 1/2 | | 1/12 | | 7.000 |
| 0 | $\mathbf{x_5}$ | 4.500 | | 9/2 | | -3/4 | 1 | 1.000 |
| Z = 14.000 | | | 0 | -1 | 0 | 1/3 | 0 | |

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $c_k$ | $x_k$ | B | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $b_i/a_{ij}$ |
| 0 | $x_3$ | 48.000 | 6 | 16 | 1 | | | 8.000 |
| 0 | $x_4$ | 42.000 | 12 | 6 | | 1 | | 3.500 |
| 0 | $x_5$ | 36.000 | 9 | 9 | | | 1 | 4.000 |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |
| 0 | $x_3$ | 27.000 | | 13 | 1 | -1/2 | | 2.077 |
| 4 | $x_1$ | 3.500 | 1 | 1/2 | | 1/12 | | 7.000 |
| 0 | $x_5$ | 4.500 | | 9/2 | | -3/4 | 1 | 1.000 |
| Z = 14.000 | | | 0 | -1 | 0 | 1/3 | 0 | |

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $c_k$ | $x_k$ | B | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $b_i/a_{ij}$ |
| 0 | $x_3$ | 48.000 | 6 | 16 | 1 | | | 8.000 |
| 0 | $x_4$ | 42.000 | 12 | 6 | | 1 | | 3.500 |
| 0 | $x_5$ | 36.000 | 9 | 9 | | | 1 | 4.000 |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0 | $x_3$ | 27.000 | | 13 | 1 | -1/2 | | 2.077 |
| 4 | $x_1$ | 3.500 | 1 | 1/2 | | 1/12 | | 7.000 |
| 0 | $x_5$ | 4.500 | | 9/2 | | -3/4 | 1 | 1.000 |
| Z = 14.000 | | | 0 | -1 | 0 | 1/3 | 0 | |

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $\mathbf{c_k}$ | $\mathbf{x_k}$ | **B** | $\mathbf{A_1}$ | $\mathbf{A_2}$ | $\mathbf{A_3}$ | $\mathbf{A_4}$ | $\mathbf{A_5}$ | $b_i/a_{ij}$ |
| 0 | $\mathbf{x_3}$ | 48.000 | 6 | 16 | 1 | | | 8.000 |
| 0 | $\mathbf{x_4}$ | 42.000 | 12 | 6 | | 1 | | 3.500 |
| 0 | $\mathbf{x_5}$ | 36.000 | 9 | 9 | | | 1 | 4.000 |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0 | $\mathbf{x_3}$ | 27.000 | | 13 | 1 | -1/2 | | 2.077 |
| 4 | $\mathbf{x_1}$ | 3.500 | 1 | 1/2 | | 1/12 | | 7.000 |
| 0 | $\mathbf{x_5}$ | 4.500 | | 9/2 | | -3/4 | 1 | 1.000 |
| Z = 14.000 | | | 0 | -1 | 0 | 1/3 | 0 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | $\mathbf{x_3}$ | | | | 1 | | | |
| | $\mathbf{x_1}$ | | 1 | | | | | |
| | $\mathbf{x_2}$ | 1.000 | | 1 | | | | |
| Z | | | 0 | 0 | 0 | | | |

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $c_k$ | $x_k$ | B | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $b_i/a_{ij}$ |
| 0 | $x_3$ | 48.000 | 6 | 16 | 1 | | | 8.000 |
| 0 | $x_4$ | 42.000 | 12 | 6 | | 1 | | 3.500 |
| 0 | $x_5$ | 36.000 | 9 | 9 | | | 1 | 4.000 |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |
| 0 | $x_3$ | 27.000 | | 13 | 1 | -1/2 | | 2.077 |
| 4 | $x_1$ | 3.500 | 1 | 1/2 | | 1/12 | | 7.000 |
| 0 | $x_5$ | 4.500 | | 9/2 | | -3/4 | 1 | 1.000 |
| Z = 14.000 | | | 0 | -1 | 0 | 1/3 | 0 | |
| 0 | $x_3$ | | | | 1 | | | |
| 4 | $x_1$ | | 1 | | | | | |
| 3 | $x_2$ | 1.000 | | 1 | | -1/6 | 2/9 | |
| Z | | | 0 | 0 | 0 | | | |

| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $c_k$ | $x_k$ | B | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $b_i/a_{ij}$ |
| 0 | $x_3$ | 48.000 | 6 | 16 | 1 | | | 8.000 |
| 0 | $x_4$ | 42.000 | 12 | 6 | | 1 | | 3.500 |
| 0 | $x_5$ | 36.000 | 9 | 9 | | | 1 | 4.000 |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |

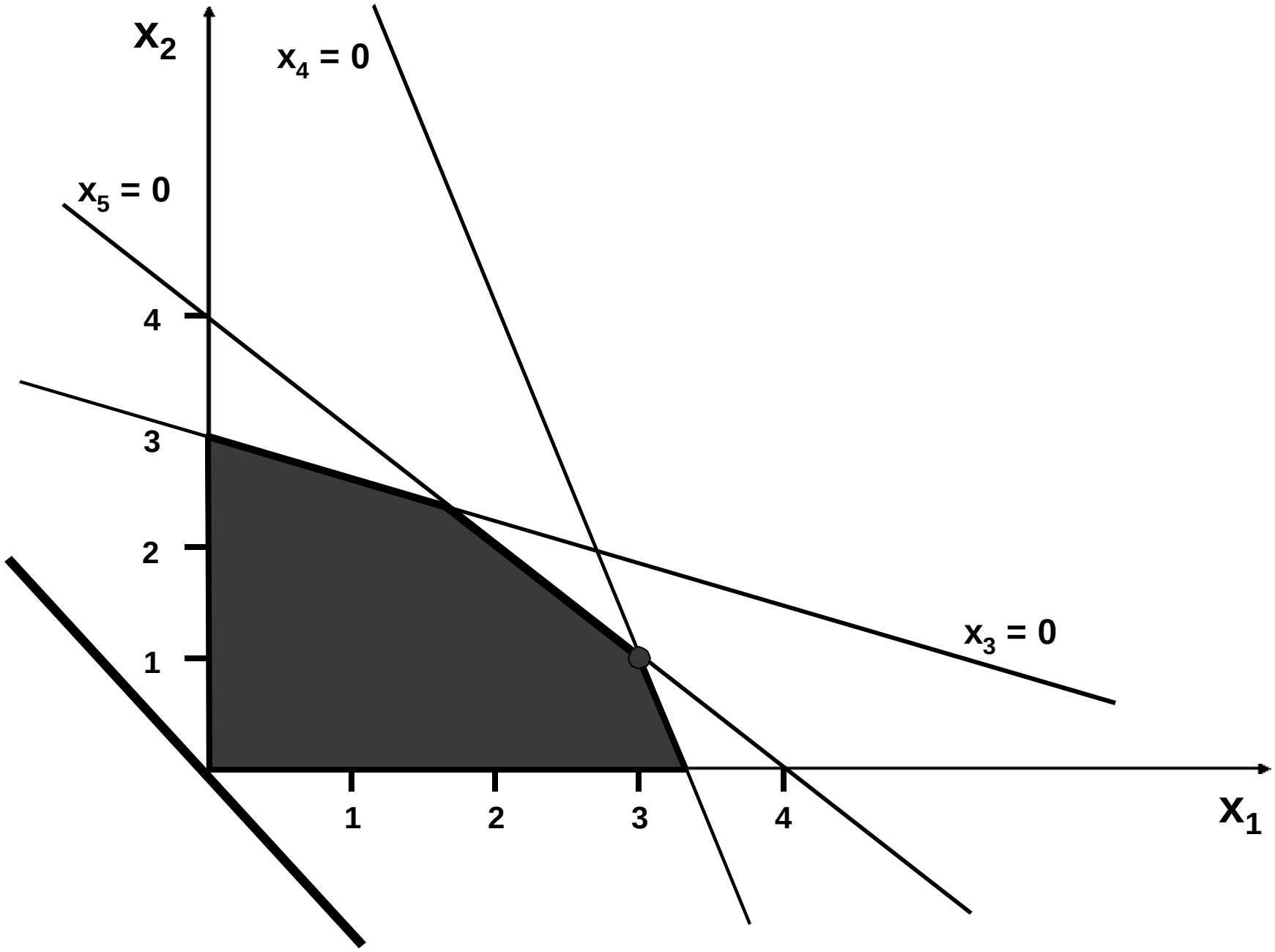
| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0 | $x_3$ | 27.000 | | 13 | 1 | -1/2 | | 2.077 |
| 4 | $x_1$ | 3.500 | 1 | 1/2 | | 1/12 | | 7.000 |
| 0 | $x_5$ | 4.500 | | 9/2 | | -3/4 | 1 | 1.000 |
| Z = 14.000 | | | 0 | -1 | 0 | 1/3 | 0 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 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 | | | 0 | 0 | 0 | | | |

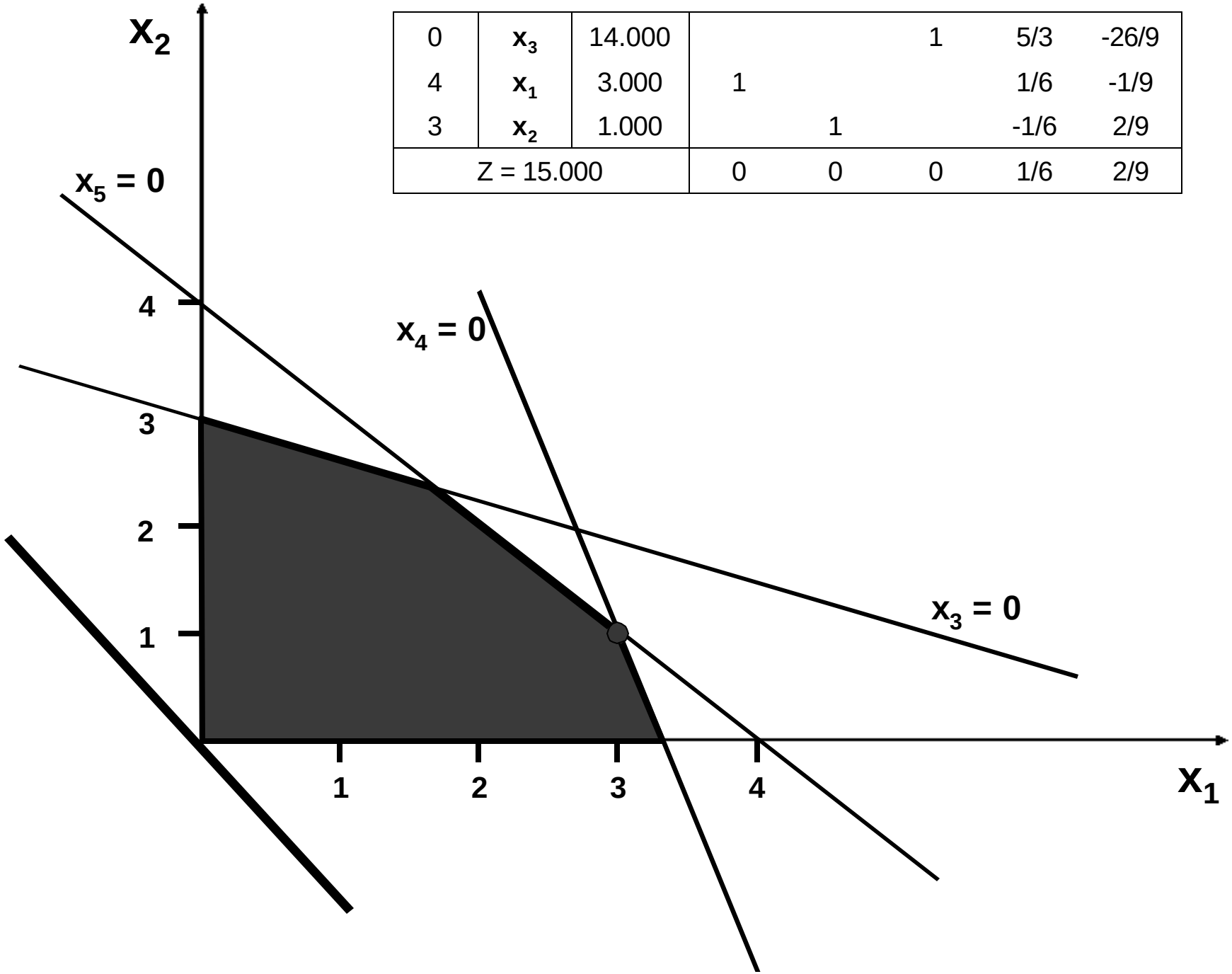
| | | $c_j$ | 4 | 3 | 0 | 0 | 0 | |
|---|---|---|---|---|---|---|---|---|
| $\mathbf{c_k}$ | $\mathbf{x_k}$ | **B** | $\mathbf{A_1}$ | $\mathbf{A_2}$ | $\mathbf{A_3}$ | $\mathbf{A_4}$ | $\mathbf{A_5}$ | $b_i/a_{ij}$ |
| 0 | $\mathbf{x_3}$ | 48.000 | 6 | 16 | 1 | | | 8.000 |
| 0 | $\mathbf{x_4}$ | 42.000 | 12 | 6 | | 1 | | 3.500 |
| 0 | $\mathbf{x_5}$ | 36.000 | 9 | 9 | | | 1 | 4.000 |
| Z = 0 | | | - 4 | - 3 | 0 | 0 | 0 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0 | $\mathbf{x_3}$ | 27.000 | | 13 | 1 | -1/2 | | 2.077 |
| 4 | $\mathbf{x_1}$ | 3.500 | 1 | 1/2 | | 1/12 | | 7.000 |
| 0 | $\mathbf{x_5}$ | 4.500 | | 9/2 | | -3/4 | 1 | 1.000 |
| Z = 14.000 | | | 0 | -1 | 0 | 1/3 | 0 | |

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

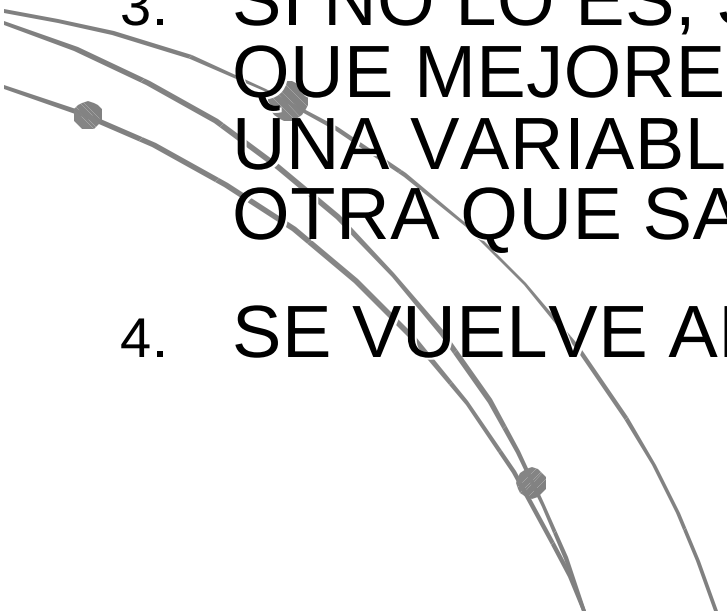

$x_2$
$x_4 = 0$
$x_5 = 0$
4
3
2
1
$x_3 = 0$
1
2
3
4
$x_1$

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 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 |

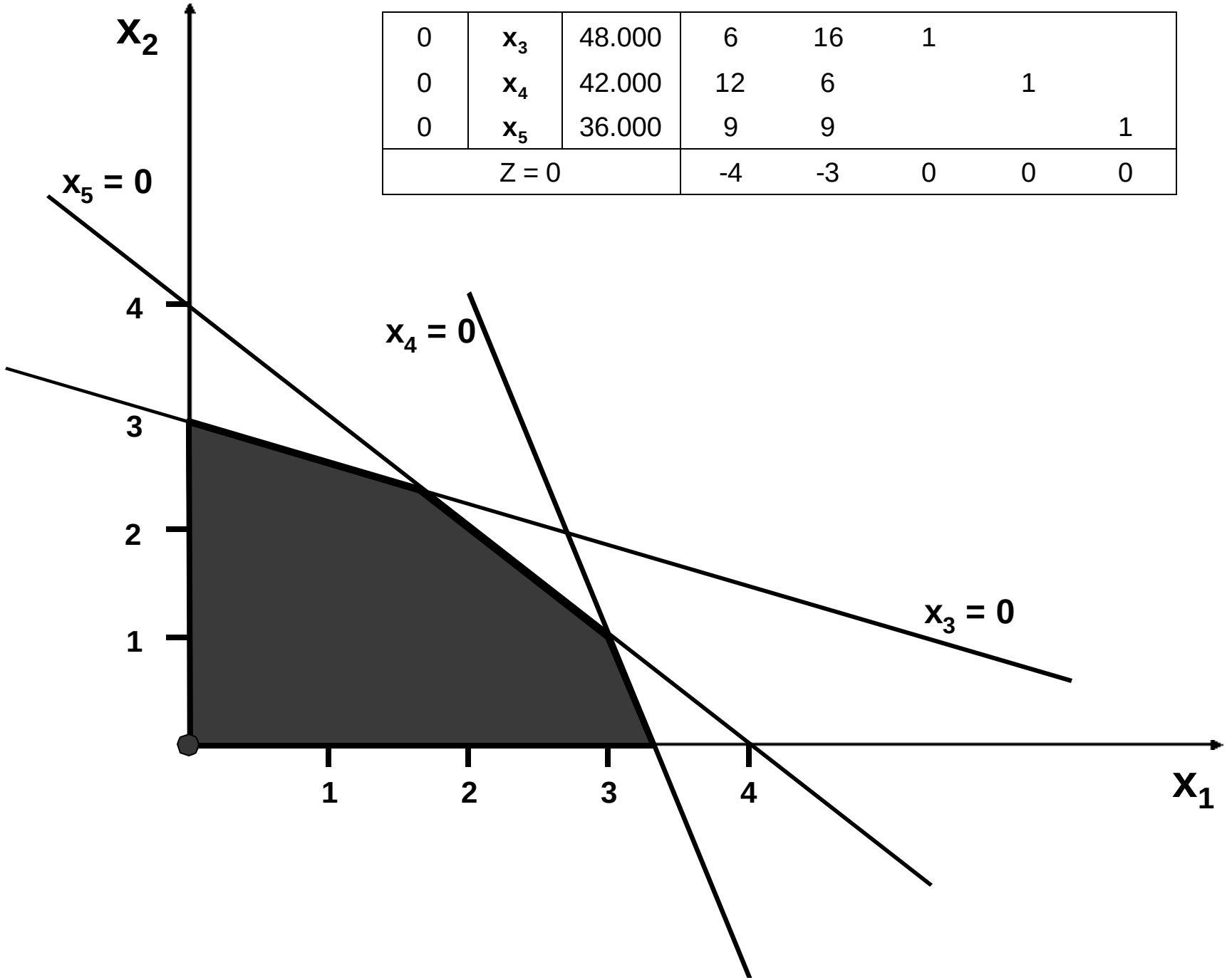


# PROCEDIMIENTO “SIMPLEX”

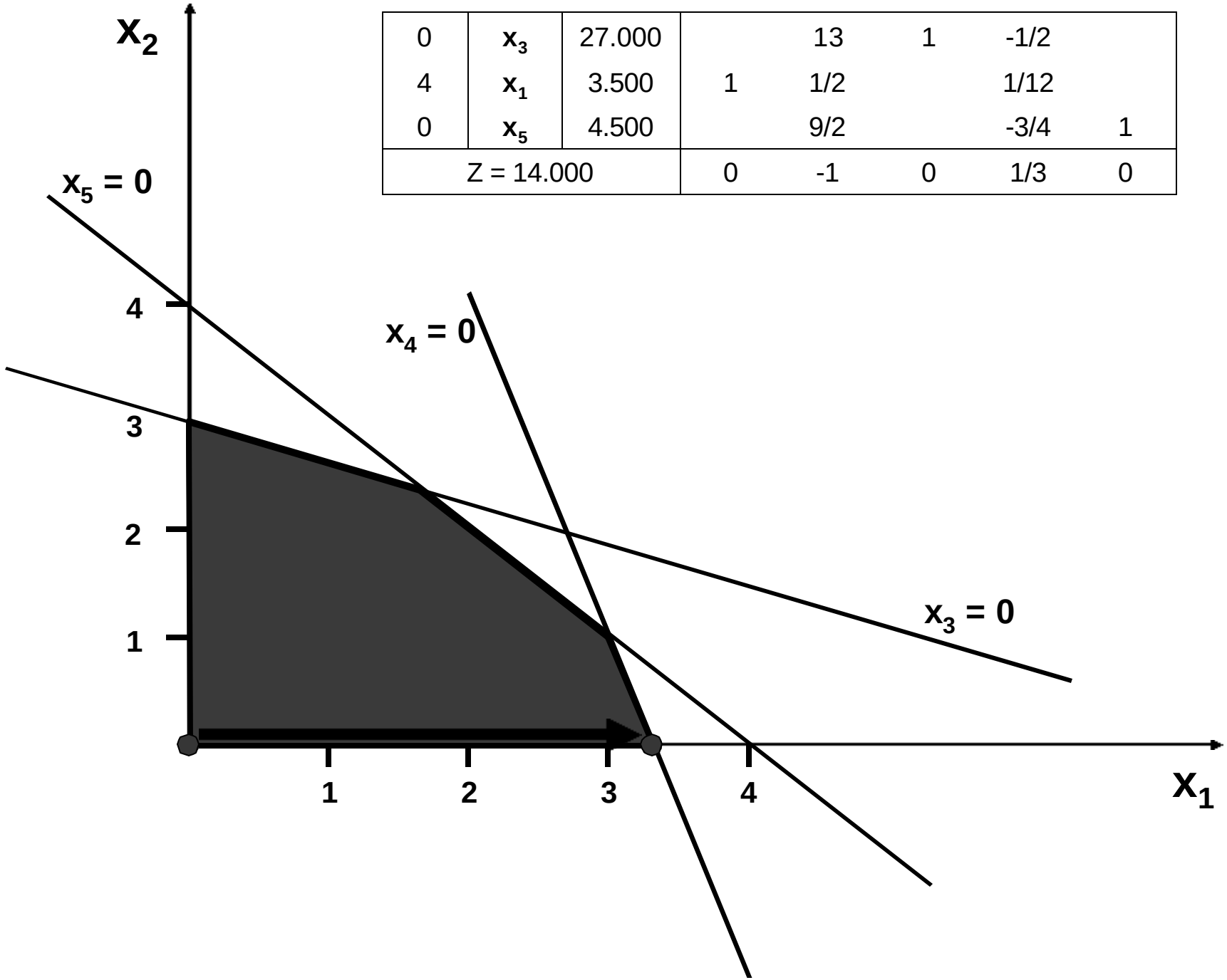
1. PARTE DE UNA BASE FACTIBLE, Y CALCULA EL Z
2. SE PREGUNTA SI LA SOLUCIÓN ES ÓPTIMA. SI LO ES SE TERMINA EL PROCEDIMIENTO.
3. SI NO LO ES, SE PASA A LA BASE VECINA QUE MEJORE MÁS A “Z”, SELECCIONANDO UNA VARIABLE QUE INGRESE A LA BASE Y OTRA QUE SALGA.
4. SE VUELVE AL PUNTO 2.



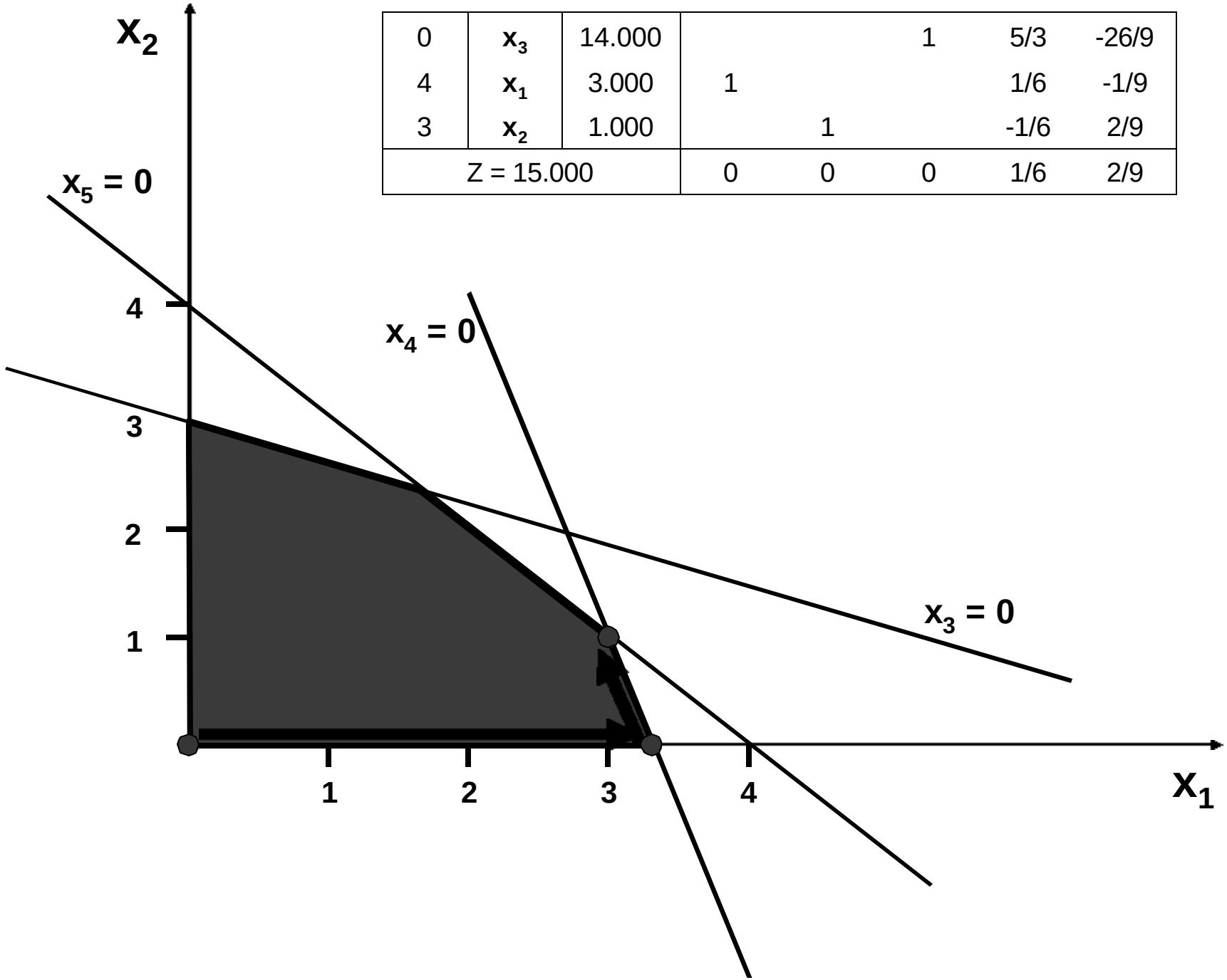
| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0 | $x_3$ | 48.000 | 6 | 16 | 1 | | | |
| 0 | $x_4$ | 42.000 | 12 | 6 | | 1 | | |
| 0 | $x_5$ | 36.000 | 9 | 9 | | | 1 | |
| Z = 0 | | | -4 | -3 | 0 | 0 | 0 | |

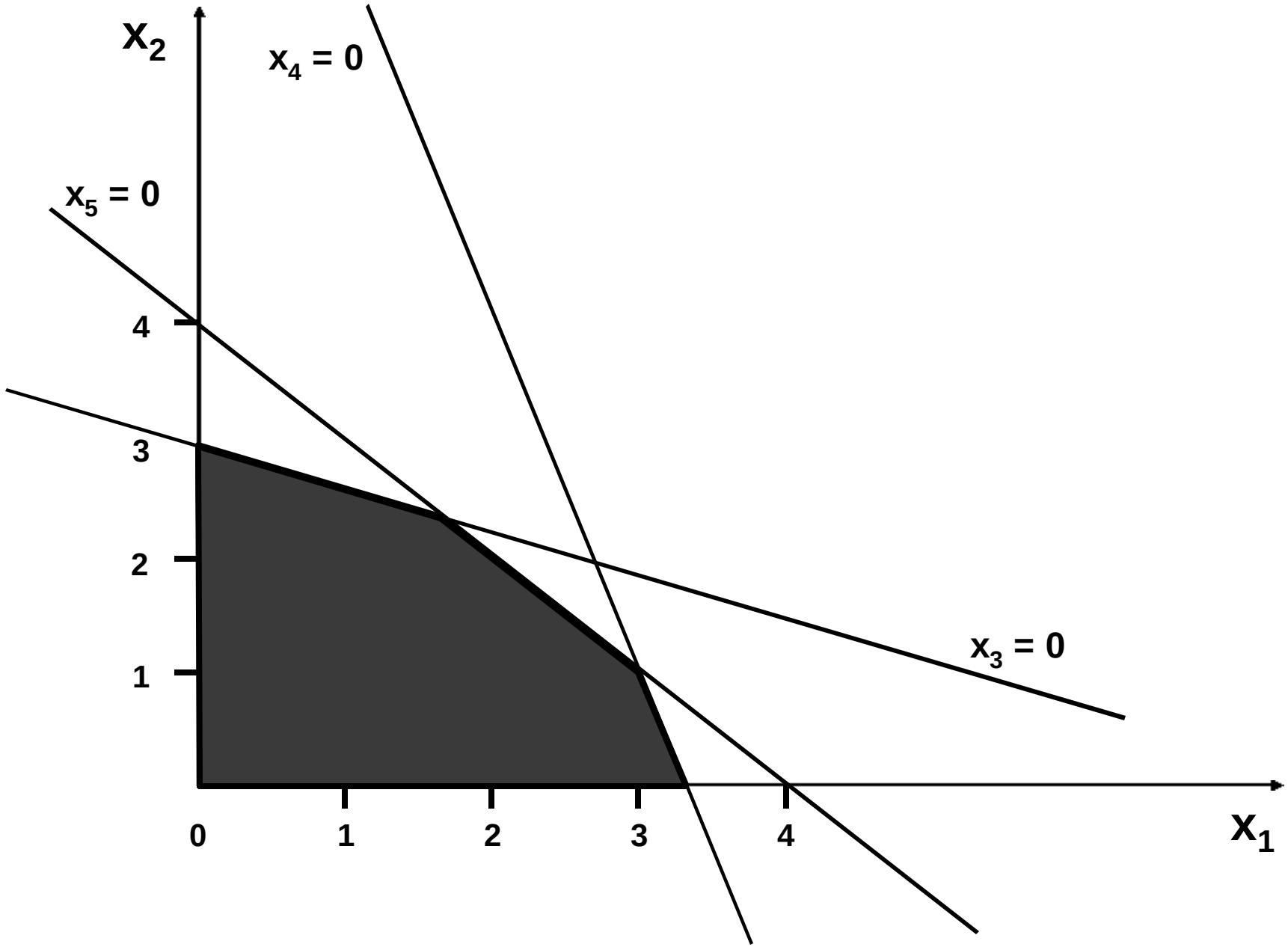


| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0 | $x_3$ | 27.000 | | 13 | 1 | -1/2 | |
| 4 | $x_1$ | 3.500 | 1 | 1/2 | | 1/12 | |
| 0 | $x_5$ | 4.500 | | 9/2 | | -3/4 | 1 |
| Z = 14.000 | | | 0 | -1 | 0 | 1/3 | 0 |



| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 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 |




x2
x4 = 0
x5 = 0
4
3
2
1
x3 = 0
0
1
2
3
4
x1

# SISTEMA DE INECUACIONES

$$\begin{cases} 6x_1 + 16x_2 \leq 48000 \\ 12x_1 + 6x_2 \leq 42000 \\ 9x_1 + 9x_2 \leq 36000 \end{cases}$$

$$Z = 4x_1 + 3x_2$$

# SISTEMA DE ECUACIONES

$$\begin{cases} 6x_1 + 16x_2 + x_3 = 48000 \\ 12x_1 + 6x_2 + x_4 = 42000 \\ 9x_1 + 9x_2 + x_5 = 36000 \end{cases}$$

$$Z = 4x_1 + 3x_2 + 0x_3 + 0x_4 + 0x_5$$

# FORMULACIÓN MATRICIAL DE LAS CONDICIONES DE VÍNCULO

$$\begin{cases} 6\,x_1 + 16\,x_2 + x_3 = 48.000 \\ 12\,x_1 + 6\,x_2 + x_4 = 42.000 \\ 9\,x_1 + 9\,x_2 + x_5 = 36.000 \end{cases}$$

$$Z = 4\,x_1 + 3\,x_2 + 0\,x_3 + 0\,x_4 + 0\,x_5$$

$$\begin{pmatrix} 6 & 16 & 1 & & \\ 12 & 6 & & 1 & \\ 9 & 9 & & & 1 \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{pmatrix} = \begin{pmatrix} 48.000 \\ 42.000 \\ 36.000 \end{pmatrix}$$

# FORMULACIÓN MATRICIAL DEL FUNCIONAL

$$\begin{cases} 6x_1 + 16x_2 + x_3 = 48.000 \\ 12x_1 + 6x_2 + x_4 = 42.000 \\ 9x_1 + 9x_2 + x_5 = 36.000 \end{cases}$$

$$Z = 4x_1 + 3x_2 + 0x_3 + 0x_4 + 0x_5$$

$$Z = \begin{pmatrix} 4 & 3 & 0 & 0 & 0 \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{pmatrix}$$

# DEFINICIÓN DE VECTORES

$$\begin{cases} 6x_1 + 16x_2 + x_3 = 48.000 \\ 12x_1 + 6x_2 + x_4 = 42.000 \\ 9x_1 + 9x_2 + x_5 = 36.000 \end{cases}$$

$$Z = 4x_1 + 3x_2 + 0x_3 + 0x_4 + 0x_5$$

$$A_1 = \begin{pmatrix} 6 \\ 12 \\ 9 \end{pmatrix} \quad A_2 = \begin{pmatrix} 16 \\ 6 \\ 9 \end{pmatrix} \quad A_3 = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} \quad A_4 = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} \quad A_5 = \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}$$

# FORMULACIÓN VECTORIAL

$$\begin{cases} 6x_1 + 16x_2 + x_3 = 48.000 \\ 12x_1 + 6x_2 + x_4 = 42.000 \\ 9x_1 + 9x_2 + x_5 = 36.000 \end{cases}$$

$$Z = 4x_1 + 3x_2 + 0x_3 + 0x_4 + 0x_5$$

$$\begin{pmatrix} 6 \\ 12 \\ 9 \end{pmatrix} \cdot x_1 + \begin{pmatrix} 16 \\ 6 \\ 9 \end{pmatrix} \cdot x_2 + \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} \cdot x_3 + \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} \cdot x_4 + \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix} \cdot x_5 = \begin{pmatrix} 48.000 \\ 42.000 \\ 36.000 \end{pmatrix}$$

# FORMULACIÓN VECTORIAL

$$\begin{cases} 6x_1 + 16x_2 + x_3 = 48.000 \\ 12x_1 + 6x_2 + x_4 = 42.000 \\ 9x_1 + 9x_2 + x_5 = 36.000 \end{cases}$$

$$Z = 4x_1 + 3x_2 + 0x_3 + 0x_4 + 0x_5$$

$$A_1 \cdot x_1 + A_2 \cdot x_2 + A_3 \cdot x_3 + A_4 \cdot x_4 + A_5 \cdot x_5 = \begin{pmatrix} 48.000 \\ 42.000 \\ 36.000 \end{pmatrix}$$

# FORMULACIÓN VECTORIAL

$$\begin{cases} 6x_1 + 16x_2 + x_3 = 48.000 \\ 12x_1 + 6x_2 + x_4 = 42.000 \\ 9x_1 + 9x_2 + x_5 = 36.000 \end{cases}$$

$$Z = 4x_1 + 3x_2 + 0x_3 + 0x_4 + 0x_5$$

$$\sum A_j \cdot x_j = B$$

$$\begin{cases} x_3 = b_1 \\ x_4 = b_2 \\ x_5 = b_3 \end{cases}$$

$$B = \begin{pmatrix} x_3 \\ x_4 \\ x_5 \end{pmatrix} = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} x_3 + \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} x_4 + \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix} x_5 = \begin{pmatrix} b_1 \\ b_2 \\ b_3 \end{pmatrix}$$

$$\boxed{B = \sum_{1}^{m} A_k x_k}$$

$$Z = c_1 x_1 + c_2 x_2 + c_3 x_3 + c_4 x_4 + c_5 x_5$$

$$Z^{(1)} = c_3\, x_3 + c_4\, x_4 + c_5 x_5$$

$$Z^{(1)} = \sum_{1}^{m} c_k x_k$$

$$A_1 = \begin{pmatrix} a_{11} \\ a_{21} \\ a_{31} \end{pmatrix} = a_{11}\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} + a_{21}\begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} + a_{31}\begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}$$

$$A_2 = \begin{pmatrix} a_{12} \\ a_{22} \\ a_{32} \end{pmatrix} = a_{12}\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} + a_{22}\begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} + a_{32}\begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}$$

$$A_j = \sum_{1}^{m} a_{ij} A_k$$

# Cambio de base

$$\begin{cases} a_{11}x_1 + x_3 = b_1 \\ a_{21}x_1 + x_4 = b_2 \\ a_{31}x_1 + x_5 = b_3 \end{cases}$$

$$\begin{cases} x_3 = b_1 - a_{11}x_1 \geq 0 \\ x_4 = b_2 - a_{21}x_1 \geq 0 \\ x_5 = b_3 - a_{31}x_1 \geq 0 \end{cases}$$

$$\begin{cases} x_1 \leq \dfrac{b_1}{a_{11}} \\ x_1 \leq \dfrac{b_2}{a_{21}} \\ x_1 \leq \dfrac{b_3}{a_{31}} \end{cases}$$

$$x_1 = \min \frac{b_i}{a_{ij}} = \theta$$

# Nueva base

$$\begin{cases} a_{11}\theta + x_3 = b_1 \\ a_{21}\theta + x_4 = b_2 \\ a_{31}\theta + x_5 = b_3 \end{cases}$$

$$A_j = \sum_1^m a_{ij} A_k \qquad \theta A_j = \theta \sum_1^m a_{ij} A_k$$

$$B = \sum_1^m A_k x_k \qquad B = \sum_1^m A_k x_k + \theta A_j - \theta \sum_1^m a_{ij} A_k$$

$$B = A_j \theta + \sum_1^m A_k (x_k - \theta a_{ij})$$

$$Z^{(2)} = c_j \theta + \sum_1^m c_k (x_k - \theta a_{ij})$$

$$Z^{(2)} = c_j\,\theta + \sum_{1}^{m} c_k (x_k - \theta\, a_{ij})$$

$$Z^{(2)} = c_j\,\theta + \sum_{1}^{m} c_k x_k - \sum_{1}^{m} \theta\, c_k a_{ij}$$

$$Z^{(2)} = c_j\,\theta + Z^{(1)} - \sum_{1}^{m} \theta\, c_k a_{ij}$$

$$Z^{(2)} = Z^{(1)} - \theta \left[ \sum_{1}^{m} c_k a_{ij} - c_j \right]$$

$$Z^{(2)} = Z^{(1)} - \theta \cdot \left( z_j - c_j \right)$$

$$Z^{(P+1)} = Z^{(P)} - \theta \cdot \left( z_j - c_j \right)$$