Eredu Linealak eta Ebazpide Grafikoa. Soluzioak

Eredu Linealak

1. Marmeladen problema.

   Erabaki-aldagaiak:

   x_i= ekoitziko den i motako marmelada kg kopurua, $i = 1$ (sagarra), 2 (arana), 3 (mertxika).

   y_i= ekoitziko den bi zaporezko i marmelada kg kopurua, $i = 1$ (sagar+aran), 2 (sagar+mertxika).

   Eredu lineala:

$$
\begin{aligned}
\max\ z = {} & (2-0.4)x_1 + (2-0.6)x_2 + (2-0.8)x_3 + \\
& +(2.5-0.4)\frac{1}{2}(y_1+y_2) + (2.5-0.6)\frac{1}{2}y_1 + (2.5-0.8)\frac{1}{2}y_2 \\
& \text{hauen mende} \\
& x_1 \geq 175 \\
& x_2 \geq 160 \\
& x_3 \geq 150 \\
& x_1 + \frac{1}{2}y_1 + \frac{1}{2}y_2 \leq 1000 \\
& x_2 + \frac{1}{2}y_1 \leq 600 \\
& x_3 + \frac{1}{2}y_2 \leq 800 \\
& x_1, x_2, x_3, y_1, y_2 \geq 0
\end{aligned}
$$

2. Mazedonien problema.

Erabaki-aldagaiak:

x_i= i frutaren kantitatea kg bat mazedonia normalean, $i = 1$ (gerezia), 2 (sandia), 3 (mangoa), 4 (laranja), 5 (meloia), 6 (banana).

y_i= i frutaren kantitatea kaloriatan baxua den kg bat mazedonian, $i = 1$ (gerezia), 2 (sandia), 3 (mangoa), 4 (laranja), 5 (meloia), 6 (banana).

Eredu lineala:

$$\begin{aligned}
\min\ z = {} & 7(x_1+y_1)+0.9(x_2+y_2)+4(x_3+y_3)+ \\
& +1.6(x_4+y_4)+1.4(x_5+y_5)+1.5(x_6+y_6)
\end{aligned}$$

hauen mende

$$\begin{aligned}
250x_1+100x_2+150x_3+400x_4+140x_5+90x_6 &\geq 150 \\
200x_1+90x_2+220x_3+200x_4+160x_5+280x_6 &\geq 200 \\
120x_1+60x_2+50x_3+550x_4+300x_5+100x_6 &\geq 200 \\
700y_1+300y_2+580y_3+490y_4+300y_5+900y_6 &\leq 400 \\
200y_1+90y_2+220y_3+200y_4+160y_5+280y_6 &\geq 100 \\
120y_1+60y_2+50y_3+550y_4+300y_5+100y_6 &\geq 250 \\
x_1+x_2 \geq 0.1(x_1+x_2+x_3+x_4+x_5+x_6)& \\
y_1+y_2 \geq 0.1(y_1+y_2+y_3+y_4+y_5+y_6)& \\
x_3+x_4 \geq 0.3(x_1+x_2+x_3+x_4+x_5+x_6)& \\
y_3+y_4 \geq 0.3(y_1+y_2+y_3+y_4+y_5+y_6)& \\
x_5+x_6 \geq 0.2(x_1+x_2+x_3+x_4+x_5+x_6)& \\
y_5+y_6 \geq 0.2(y_1+y_2+y_3+y_4+y_5+y_6)& \\
x_1+x_2+x_3+x_4+x_5+x_6 &= 1 \\
y_1+y_2+y_3+y_4+y_5+y_6 &= 1 \\
x_i, y_i \geq 0, \quad i &= 1,2,3,4,5,6
\end{aligned}$$

3. Udalekuen problema.

Erabaki-aldagaiak:

x_{ij}= ama-hizkuntza i duen zenbat neska joango den j udalekura,

$i = e$ (euskara), g (gaztelera), $j = 1, 2$.

y_{ij}= ama-hizkuntza i duen zenbat mutil joango den j udalekura,

$i = e$ (euskara), g (gaztelera), $j = 1, 2$.

Eredu lineala:

$$
\begin{aligned}
\min\ z = 8x_{e1} + 8y_{e1} + 8x_{g1} + 8y_{g1} + 26x_{e2} + 26y_{e2} + 26x_{g2} + 26y_{g2} \\
\text{hauen mende} \\
x_{e1} + x_{e2} = 650 \\
y_{e1} + y_{e2} = 600 \\
x_{g1} + x_{g2} = 475 \\
y_{g1} + y_{g2} = 475 \\
x_{e1} + y_{e1} + x_{g1} + y_{g1} <= 800 \\
x_{e1} + y_{e1} \geq 0.5(x_{e1} + y_{e1} + x_{g1} + y_{g1}) \\
x_{e2} + y_{e2} \geq 0.5(x_{e2} + y_{e2} + x_{g2} + y_{g2}) \\
x_{e1} + x_{g1} \geq 0.5(x_{e1} + y_{e1} + x_{g1} + y_{g1}) \\
x_{e2} + x_{g2} \geq 0.5(x_{e2} + y_{e2} + x_{g2} + y_{g2}) \\
x_{e1}, x_{e2}, x_{g1}, x_{g2} \geq 0 \quad \text{eta osoak} \\
y_{e1}, y_{e2}, y_{g1}, y_{g2} \geq 0 \quad \text{eta osoak}
\end{aligned}
$$

4. Lan-jantzien problema.

Erabaki-aldagaiak:

x_{ij}= i hilabetean ekoitziko den j motako lan-jantzi kopurua, $i = 1, \ldots, 6, \quad j = 1$ (ehun berriaz egindakoa), 2 (birziklatutako ehunezkoa).

y_{ij}= i hilabetean biltegiratuko den j motako lan-jantzi kopurua, $i = 1, \ldots, 5, \quad j = 1$ (ehun berriaz egindakoa), 2 (birziklatutako ehunezkoa).

Eredu lineala:

$$\begin{aligned} \min\ z = {} & 70(x_{11} + x_{21} + x_{31} + x_{41} + x_{51} + x_{61}) + 60(x_{12} + x_{22} + x_{32} + x_{42} + \\ & + x_{52} + x_{62}) + y_{11} + y_{21} + y_{31} + y_{41} + y_{51} + y_{12} + y_{22} + y_{32} + y_{42} + y_{52} \end{aligned}$$

hauen mende

$$\begin{aligned} x_{11} &= 100 + y_{11}, & x_{12} &= 100 + y_{12} \\ x_{21} + y_{11} &= 300 + y_{21}, & x_{22} + y_{12} &= 150 + y_{22} \\ x_{31} + y_{21} &= 500 + y_{31}, & x_{32} + y_{22} &= 300 + y_{32} \\ x_{41} + y_{31} &= 600 + y_{41}, & x_{42} + y_{32} &= 200 + y_{42} \\ x_{51} + y_{41} &= 200 + y_{51}, & x_{52} + y_{42} &= 100 + y_{52} \\ x_{61} + y_{51} &= 450, & x_{62} + y_{52} &= 300 \end{aligned}$$

$$\begin{aligned} x_{11} &\leq 400, & x_{12} &\leq 200 \\ x_{21} &\leq 400, & x_{22} &\leq 200 \\ x_{31} &\leq 400, & x_{32} &\leq 200 \\ x_{41} &\leq 400, & x_{42} &\leq 200 \\ x_{51} &\leq 400, & x_{52} &\leq 200 \\ x_{61} &\leq 400, & x_{62} &\leq 200 \end{aligned}$$

$$x_{ij} \geq 0 \text{ eta osoak }, \ i = 1, \ldots, 6, \ j = 1, 2$$

$$y_{ij} \geq 0 \text{ eta osoak }, \ i = 1, \ldots, 5, \ j = 1, 2$$

5. Lehiaketaren problema.

Erabaki-aldagaiak:

$$x_i = \begin{cases} 1 & \text{baldin } i \text{ haurra taldeko partaide izango bada,} \quad i = 1, \ldots, 20. \\ 0 & \text{kontrako kasuan.} \end{cases}$$

Eredu lineala:

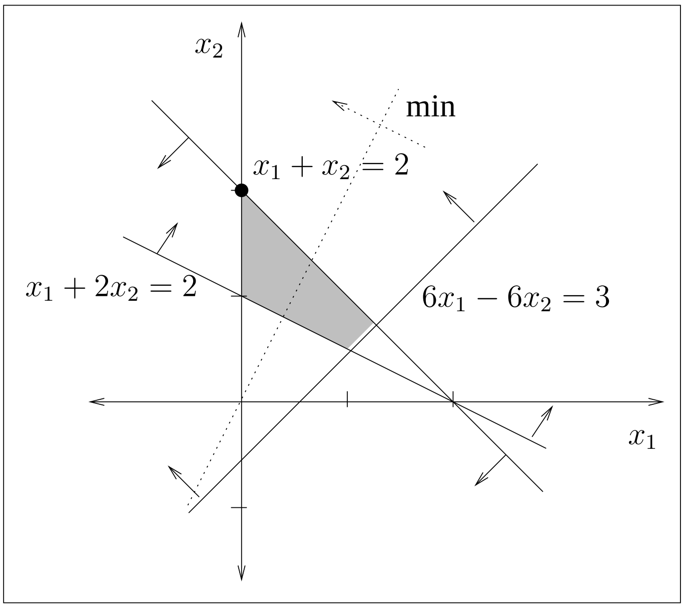
$$\begin{aligned}
\min\ z = {} & x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10} + \\
& + x_{11} + x_{12} + x_{13} + x_{14} + x_{15} + x_{16} + x_{17} + x_{18} + x_{19} + x_{20}
\end{aligned}$$

hauen mende

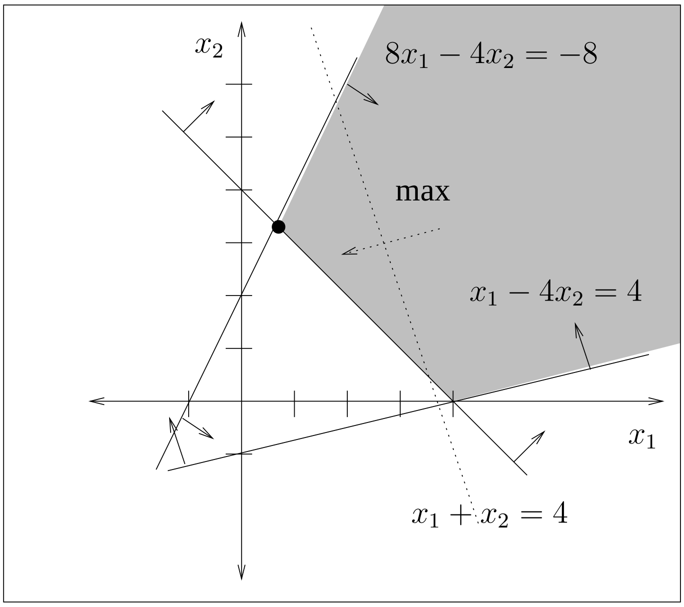
$$\begin{aligned}
x_2 + x_6 + x_7 + x_{12} + x_{19} &\geq 1 \\
x_5 + x_{13} + x_{14} &\geq 1 \\
x_9 + x_{15} + x_{18} &\geq 1 \\
x_1 + x_4 + x_9 + x_{10} + x_{20} &\geq 1 \\
x_{13} + x_{17} &\geq 1 \\
x_3 + x_8 + x_{11} + x_{12} + x_{16} &\geq 1 \\
x_1 + x_2 + \cdots + x_{20} &\geq 3 \\
x_i = 0, 1, \quad i = 1, \ldots, &20
\end{aligned}$$

Ebazpide Grafikoa

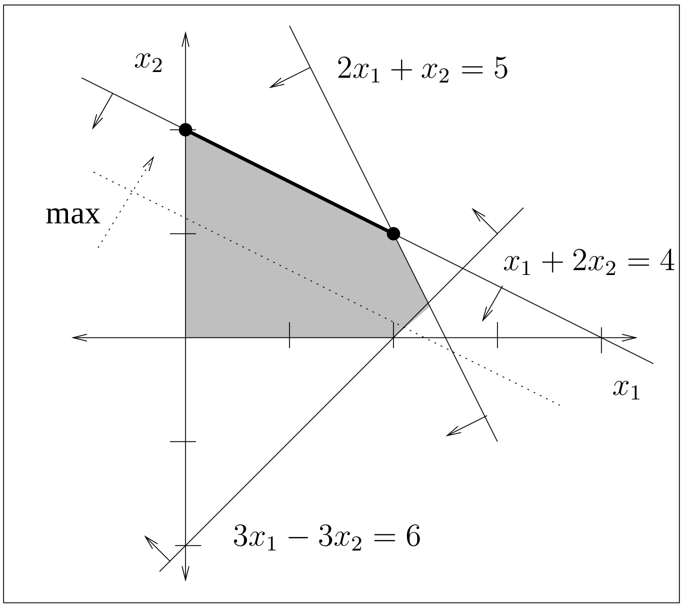
1. Soluzio optimo bakarra: $x_1^* = 0$, $x_2^* = 2$, $z^* = -2$.



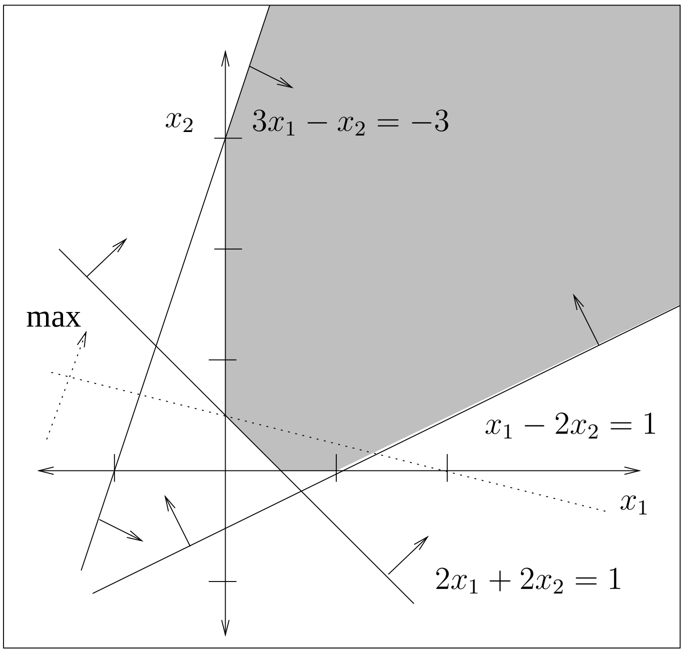
2. Soluzio optimo bakarra: $x_1^* = \frac{2}{3}$, $x_2^* = \frac{10}{3}$, $z^* = -\frac{32}{3}$.



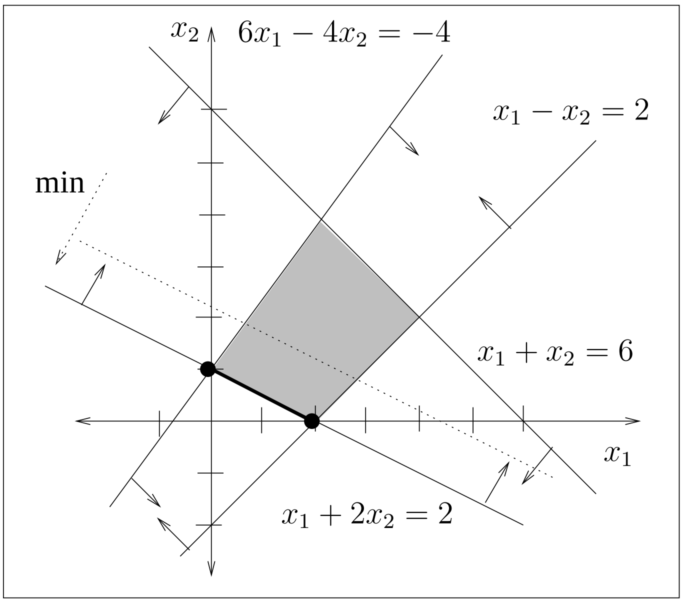
3. Soluzio optimo anizkoitza: $x_1^* = 0$, $x_2^* = 2$ mutur-puntua, $x_1^* = 2$, $x_2^* = 1$ mutur-puntua, eta bi mutur-puntuak lotzen dituen segmentuan dauden infinitu soluzioak optimo dira. $z^* = 8$.



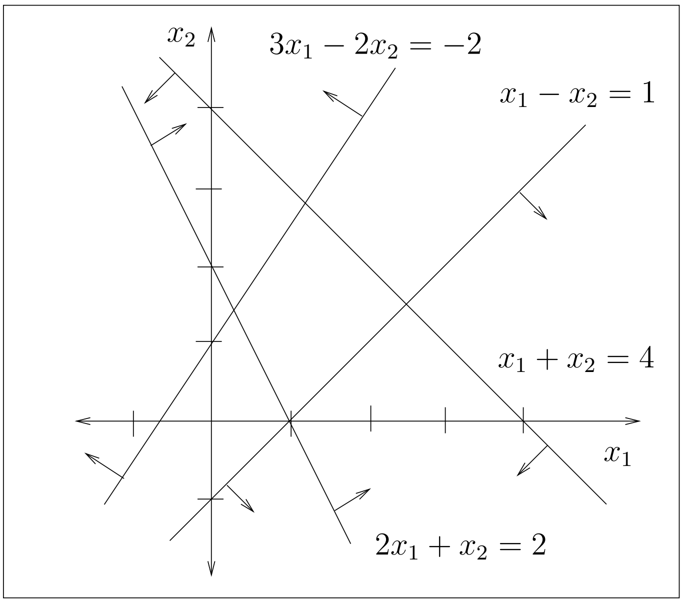
4. Soluzio bornegabea.



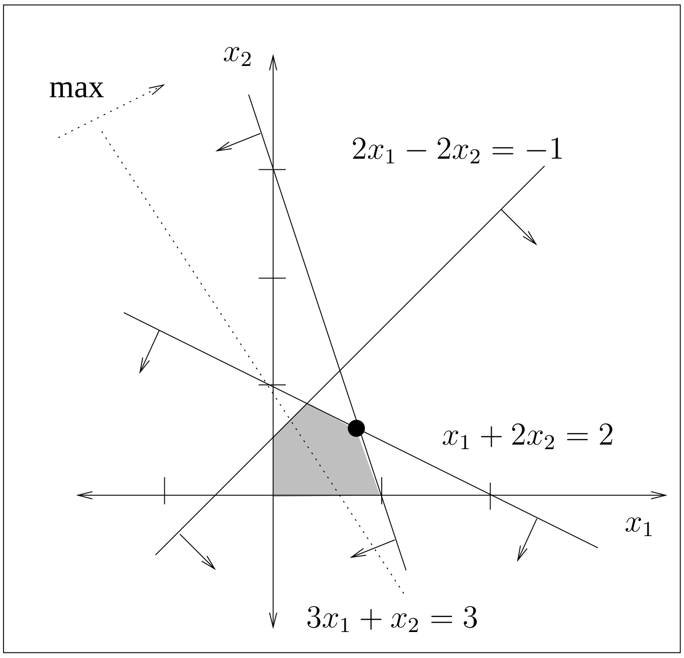
5. Soluzio optimo anizkoitza: $x_1^* = 0$, $x_2^* = 1$ mutur-puntua, $x_1^* = 2$, $x_2^* = 0$ mutur-puntua, eta bi mutur-puntuak lotzen dituen segmentuan dauden infinitu soluzioak optimo dira. $z^* = 2$.



6. Problema bideraezina.



7. Soluzio optimo bakarra: $x_1^* = \frac{4}{5}$, $x_2^* = \frac{3}{5}$. $z^* = \frac{36}{5}$.



8. Soluzio bornegabea.