1) $\min \; -2x_1 - x_2$

$x_1 - x_2 \leq 2$
$x_1 + x_2 \leq 6$
$x_1, x_2 \geq 0$

a) Forma estándar y $x_1, x_2 = 0,0$

$\min \; -2x_1 - x_2$

$x_1, x_2 = 0,0$ $\quad 0 - 0 + S_1 = 2 \Rightarrow S_1 = 2$
$0 + 0 + S_2 = 6 \Rightarrow S_2 = 6$

$x_1 - x_2 + S_1 = 2$
$x_1 + x_2 + S_2 = 6$
$x_1, x_2, S_1, S_2 \geq 0$

$B = \{0,0,2,6\}$

b) Método simplex comenzando con $B = \{0,0,2,6\}$

| | $x_1$ | $x_2$ | $S_1$ | $S_2$ | b |
|---|---|---|---|---|---|
| $S_1$ | 1 | -1 | 1 | 0 | 2 |
| $S_2$ | 1 | 1 | 0 | 1 | 6 |
| $f(x)$ | -2 | -1 | 0 | 0 | 0 |

-2 es el más negativo, entra $x_1$

$\frac{2}{1} < \frac{6}{1}$ ($S_1$, $S_2$) sale $S_1$

pivoteo en $a_{11}$

$R_{S_2} = R_{S_2} - R_{S_1}$
$R_f = R_f + 2R_{S_1}$

| | $x_1$ | $x_2$ | $S_1$ | $S_2$ | b |
|---|---|---|---|---|---|
| $x_1$ | 1 | -1 | 1 | 0 | 2 |
| $S_2$ | 0 | 2 | -1 | 1 | 4 |
| $f(x)$ | 0 | -3 | 2 | 0 | 4 |

-3 es el más negativo, entra $x_2$

$\frac{2}{-1}$ No cuenta $\quad \frac{4}{2} = 2$ sale $S_2$

pivoteo en $a_{22}$

$R_{x_2} = 1/2 \, R_{S_2}$

| | $x_1$ | $x_2$ | $S_1$ | $S_2$ | b |
|---|---|---|---|---|---|
| $x_1$ | 1 | 0 | 1/2 | 1/2 | 4 |
| $x_2$ | 0 | 1 | -1/2 | 1/2 | 2 |
| $f(x)$ | 0 | 0 | 1/2 | 3/2 | 10 |

No hay coeficientes negativos en $f(x)$, por lo que la solución es óptima

$R_{x_1} = R_{x_1} + R_{x_2}$
$R_f = R_f + 3R_{x_2}$

$x_1 = 4$
$x_2 = 2$

$f = -2(4) - 2 = -10$

2) a) $\max\limits_{x_1, x_2, x_3} \; z$

$$1.75\,x_1 + 0.25x_2 - 5x_3 \geq z$$

$$-1.5x_1 + 8x_3 \geq z$$

$$-0.125x_2 + 8x_3 \geq z$$

$$x_1 + x_2 + x_3 = 1$$

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

b) $\max z \rightarrow \min -z$

$$-1.75x_1 - 0.25x_2 + 5x_3 + z + S_1 = 0$$

$$1.5x_1 - 8x_3 + z + S_2 = 0$$

$$0.125x_2 - 8x_3 + z + S_3 = 0$$

$$x_1 + x_2 + x_3 + a_1 = 1 \qquad x_1, x_2, x_3, z, S_1, S_2, S_3, a_1 \geq 0$$

Base inicial $\{S_1, S_2, S_3, a_1\} = \{0, 0, 0, 1\}$

| | $x_1$ | $x_2$ | $x_3$ | $z$ | $S_1$ | $S_2$ | $S_3$ | $a_1$ | $b$ |
|---|---|---|---|---|---|---|---|---|---|
| $S_1$ | $-7/4$ | $-1/4$ | 5 | 1 | 1 | 0 | 0 | 0 | 0 |
| $S_2$ | $3/2$ | 0 | $-8$ | 1 | 0 | 1 | 0 | 0 | 0 |
| $S_3$ | 0 | $1/8$ | $-8$ | 1 | 0 | 0 | 1 | 0 | 0 |
| $a_1$ | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |

entra $x_1$, Sale $S_2$ cero y coef $S_1 < 0$

$R_{S_2} = 2/3 R_{S_2}$

$R_{S_1} = R_{S_1} + 7/4 R_{S_2}$

$R_{a_1} = R_{a_1} - R_{S_2}$

$R_w = R_w - R_{S_2}$

| | $x_1$ | $x_2$ | $x_3$ | $z$ | $S_1$ | $S_2$ | $S_3$ | $a_1$ | $b$ |
|---|---|---|---|---|---|---|---|---|---|
| $S_1$ | 0 | $-1/4$ | $-13/3$ | $13/6$ | 1 | $7/6$ | 0 | 0 | 0 |
| $x_1$ | 1 | 0 | $-16/3$ | $2/3$ | 0 | $2/3$ | 0 | 0 | 0 |
| $S_3$ | 0 | $1/8$ | $-8$ | 1 | 0 | 0 | 1 | 0 | 0 |
| $a_1$ | 0 | 1 | $19/3$ | $-2/3$ | 0 | $-2/3$ | 0 | 1 | 1 |
| $w$ | 0 | 1 | $19/3$ | $-2/3$ | 0 | $-2/3$ | 0 | 0 | 1 |

entra $x_3$, sale $a_1$

$R_{a_1} = 3/19 R_{a_1}$

$R_{S_1} = R_{S_1} + 13/3 R_{a_1}$

$R_{x_1} = R_{x_1} + 16/3 R_{a_1}$

$R_{S_3} = R_{S_3} + 8 R_{a_1}$

$R_w = R_w - 19/3 R_{a_1}$

| | $x_1$ | $x_2$ | $x_3$ | $z$ | $S_1$ | $S_2$ | $S_3$ | $a_1$ | $b$ |
|---|---|---|---|---|---|---|---|---|---|
| $S_1$ | 0 | 0 | 0 | $701/422$ | 1 | $411/422$ | $-66/211$ | $61/211$ | $61/211$ |
| $x_1$ | 1 | 0 | 0 | $2/211$ | 0 | $130/211$ | $-128/211$ | $16/211$ | $16/211$ |
| $S_3$ | 0 | 0 | 0 | $24/211$ | 0 | $-128/211$ | $152/211$ | $192/211$ | $192/211$ |
| $x_3$ | 0 | $3/19$ | 1 | $-2/19$ | 0 | $-2/19$ | 0 | $3/19$ | $3/19$ |
| $w$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $-1$ | 0 |

$w = 0$ Solución básica factible

Se quita la fila $w$

Se crea la fila $Z \to Z - z = 0$

Se quita la columna $a_1$

| | $x_1$ | $x_2$ | $x_3$ | $z$ | $S_1$ | $S_2$ | $S_3$ | $b$ |
|---|---|---|---|---|---|---|---|---|
| $S_1$ | 0 | 0 | 0 | $701/422$ | 1 | $411/422$ | $-66/211$ | $61/211$ |
| $x_1$ | 1 | 0 | 0 | $2/211$ | 0 | $130/211$ | $-128/211$ | $16/211$ |
| $S_3$ | 0 | 0 | 0 | $24/211$ | 0 | $-128/211$ | $152/211$ | $192/211$ |
| $x_3$ | 0 | $3/19$ | 1 | $-2/19$ | 0 | $-2/19$ | 0 | $3/19$ |
| $Z$ | 0 | 0 | 0 | $-1$ | 0 | 0 | 0 | 0 |

El más negativo es $z$, entra

y sale $S_1$ $\quad \dfrac{61/211}{701/422} = \dfrac{122}{701}$ es la menor

$R_{S_1} = 422/701\, R_{S_1}$

$R_{x_1} = R_{x_1} - 2/211\, R_{S_1}$

$R_{S_3} = R_{S_3} - 24/211\, R_{S_1}$

$R_{x_3} = R_{x_3} + 2/19\, R_{S_1}$

$R_Z = R_Z + R_{S_1}$

| | $x_1$ | $x_2$ | $x_3$ | $z$ | $S_1$ | $S_2$ | $S_3$ | $b$ |
|---|---|---|---|---|---|---|---|---|
| $z$ | 0 | 0 | 0 | 1 | $422/701$ | $411/701$ | $-132/701$ | $122/701$ |
| $x_1$ | 1 | 0 | 0 | 0 | $-4/701$ | $428/701$ | $-424/701$ | $52/701$ |
| $S_3$ | 0 | 0 | 0 | 0 | $-48/701$ | $-472/701$ | $520/701$ | $624/701$ |
| $x_3$ | 0 | $3/19$ | 1 | 0 | $4/65$ | $-4/65$ | $-264/13319$ | $1/5$ |
| $Z$ | 0 | 0 | 0 | 0 | $422/705$ | $411/701$ | $-132/701$ | $122/701$ |

$R_{S_3} = 701/520\, R_{S_3}$

$R_z = R_z + 132/701\, R_{S_3}$

$R_{x_1} = R_{x_1} + 424/701\, R_{S_3}$

$R_{x_3} = R_{x_3} + 264/13319\, R_{S_3}$

$R_Z = R_Z + 132/701\, R_{S_3}$

| | $x_1$ | $x_2$ | $x_3$ | $z$ | $S_1$ | $S_2$ | $S_3$ | $b$ |
|---|---|---|---|---|---|---|---|---|
| $z$ | 0 | 0 | 0 | 1 | $38/65$ | $27/65$ | 0 | $2/5$ |
| $x_1$ | 1 | 0 | 0 | 0 | $-4/65$ | $4/65$ | 0 | $4/5$ |
| $S_3$ | 0 | 0 | 0 | 0 | $-6/65$ | $-59/65$ | 1 | $6/5$ |
| $x_3$ | 0 | $3/19$ | 1 | 0 | $4/65$ | $-4/65$ | 0 | $1/5$ |
| $Z$ | 0 | 0 | 0 | 0 | $38/65$ | $27/65$ | 0 | $2/5$ |

En la fila $z$ no hay coeficientes $< 0$, entonces es óptimo

$x_1 = \dfrac{4}{5} = 0.8 \qquad x_2 = 0 \qquad x_3 = \dfrac{1}{5} = 0.2$

$Z = \dfrac{2}{5} = 0.4$

# 3) Matriz

| | Jn | Jrg | San | Dav | Jmy |
|---|---|---|---|---|---|
| E | 37.7 | 32.9 | 33.8 | 37.0 | 35.4 |
| P | 43.3 | 33.1 | 42.2 | 34.7 | 41.8 |
| M | 33.3 | 28.5 | 38.9 | 30.4 | 33.6 |
| L | 29.2 | 26.4 | 29.6 | 28.5 | 31.1 |
| D | 0 | 0 | 0 | 0 | 0 |

Se crea una columna virtual para hacer la matriz cuadrada

Se resta el mínimo de cada fila

| | Jn | Jrg | San | Dav | Jmy |
|---|---|---|---|---|---|
| E | 4.8 | 0 | 0.9 | 4.1 | 2.5 |
| P | 10.2 | 0 | 9.1 | 1.6 | 8.7 |
| M | 4.8 | 0 | 10.4 | 1.9 | 5.1 |
| L | 2.8 | 0 | 3.2 | 2.1 | 4.7 |
| D | 0 | 0 | 0 | 0 | 0 |

Toda la columna de jorge son 0

El mínimo no cubierto es 0.9
Se resta 0.9 a todos los no cubiertos
Se suma 0.9 a la intersección

| | Jn | Jrg | San | Dav | Jmy |
|---|---|---|---|---|---|
| E | 3.9 | 0 | 0 | 3.2 | 1.6 |
| P | 9.3 | 0 | 8.2 | 0.7 | 7.8 |
| M | 3.9 | 0 | 9.5 | 1.0 | 4.2 |
| L | 1.9 | 0 | 2.3 | 1.2 | 3.8 |
| D | 0 | 0.9 | 0 | 0 | 0 |

Espalda → Sam

Eliminar E y Sam

| | Jn | Jrg | Dav | Jmy |
|---|---|---|---|---|
| P | 9.3 | 0 | 0.7 | 7.8 |
| M | 3.9 | 0 | 1.0 | 4.2 |
| L | 1.9 | 0 | 1.2 | 3.8 |
| D | 0 | 0.9 | 0 | 0 |

Mariposa → Jorge

Eliminar Jrg y M

| | Jn | Dav | Jmy |
|---|---|---|---|
| P | 9.3 | 0.7 | 7.8 |
| L | 1.9 | 1.2 | 3.8 |
| D | 0 | 0 | 0 |

restar 0.7 a todos

$28.5 + 33.8 + 34.7 + 29.2 = 126.2$

| | Jn | Dav | Jmy |
|---|---|---|---|
| P | 8.6 | 0 | 7.1 |
| L | 1.2 | 0.5 | 3.1 |
| D | 0 | 0 | 0 |

Pecho → David

| | Jn | Jmy |
|---|---|---|
| L | 1.2 | 3.1 |
| D | 0 | 0 |

Libre → Juan