$Minz = 5x_1 + 6x_2 + 3x_3$

$5x_1 + 5x_2 + 3_x3 \geq 50$

$x_1 + x_2 - x_3 \geq 20$

$7x_1 + 6x_2 - 9x_3 \geq 30$

$5x_1 + 5x_2 + 5x_3 \geq 35$

$2x_1 + 4x_2 - 15x_3 \geq 10$

$12x_1 + 10x_2 + 0x_3 \geq 90$

$0x_1 + x_2 - 10x_3 \geq 20$

$x_1, x_2, x_3 \geq 0$

Modelo dual

$Maxw = 50y_1 + 20y_2 + 30y_3 + 35y_4 + 10y_5 + 90y_6 + 20y_7$

$5y_1 + y_2 + 7y_3 + 5y_4 + 2y_5 + 12y_6 \leq 5$

$5y_1 + y_2 + 6y_3 + 5y_4 + 4y_5 + 10y_6 + 1y_7 \leq 6$

$3y_1 - 1y_2 - 9y_3 + 5y_4 - 15y_5 - 10y_7 \leq 3$

$y_1, y_2, y_3, y_4, y_5, y_6, y_7 \geq 0$

Simplex

Ecuaciones

$w - 50y_1 - 20y_2 - 30y_3 - 35y_4 - 10y_5 - 90y_6 - 20y_7 = 0$

$5y_1 + y_2 + 7y_3 + 5y_4 + 2y_5 + 12y_6 + s_1 = 5$

$5y_1 + y_2 + 6y_3 + 5y_4 + 4y_5 + 10y_6 + 1y_7 + s_2 = 6$

$3y_1 - 1y_2 - 9y_3 + 5y_4 - 15y_5 - 10y_7 + s_3 = 3$

$y_1, y_2, y_3, y_4, y_5, y_6, y_7 \geq 0$

Tabla inicial

V_B	w	y_1	y_2	y_3	y_4	y_5	y_6	y_7	s_1	s_2	s
w	1	-50	-20	-30	-35	-10	-90	-20	0	0	0
s_1	0	5	1	7	5	2	12	0	1	0	0
s_2	0	5	1	6	5	4	10	1	0	1	0
s_3	0	3	-1	-9	5	-15	0	-10	0	0	1

Primera iteración

V_E y V_P

$V_E = y_6$

V_B	Columna V_E	Columna $Solución$	Relación mínima	Válida
s_1	12	5	$\frac{5}{12}$	Sí
s_2	10	6	$\frac{6}{10} = \frac{3}{5}$	Sí
s_3	0	3	$\frac{3}{0} = \infty$	No

$V_P = s_1$

Actualizar fila V_P

V_B	w	y_1	y_2	y_3	y_4	y_5	y_6	y_7	s_1	s_2
s_1	0	5	1	7	5	2	12	0	1	0
$s_1 \to y_6$	0	$\frac{5}{12}$	$\frac{1}{12}$	$\frac{7}{12}$	$\frac{5}{12}$	$\frac{2}{12}$	$\frac{12}{12} = 1$	0	$\frac{1}{12}$	0

V_B	w	y_1	y_2	y_3	y_4	y_5	y_6	y_7	s_1	s_2	s
w	1	-50	-20	-30	-35	-10	-90	-20	0	0	0
y_6	0	$\frac{5}{12}$	$\frac{1}{12}$	$\frac{7}{12}$	$\frac{5}{12}$	$\frac{2}{12}$	1	0	$\frac{1}{12}$	0	0
s_2	0	5	1	6	5	4	10	1	0	1	0
s_3	0	3	-1	-9	5	-15	0	-10	0	0	1

Actualizar filas respecto a la fila V_P

Actualizar w

V_B	w	y_1	y_2	y_3	y_4	y_5	y_6	y_7	s_1	s
w	1	-50	-20	-30	-35	-10	-90	-20	0	0
y_6	0	$\frac{5}{12}$	$\frac{1}{12}$	$\frac{7}{12}$	$\frac{5}{12}$	$\frac{2}{12}$	1	0	$\frac{1}{12}$	0
$90y_6$	0	$\frac{75}{2}$	$\frac{15}{2}$	$\frac{105}{2}$	$\frac{75}{2}$	15	90	0	$\frac{15}{2}$	0
$w = w + 90y_6$	1	$-\frac{25}{2}$	$-\frac{25}{2}$	$\frac{45}{2}$	$\frac{5}{2}$	5	0	-20	$\frac{15}{2}$	0

Actualizar s_2

V_B	w	y_1	y_2	y_3	y_4	y_5	y_6	y_7	s_1	s
s_2	0	5	1	6	5	4	10	1	0	1
y_6	0	$\frac{5}{12}$	$\frac{1}{12}$	$\frac{7}{12}$	$\frac{5}{12}$	$\frac{2}{12}$	1	0	$\frac{1}{12}$	0
$-10y_6$	0	$-\frac{25}{6}$	$-\frac{5}{6}$	$-\frac{35}{6}$	$-\frac{25}{6}$	$-\frac{5}{3}$	-10	0	$-\frac{5}{6}$	0
$s_2 = s_2 - 10y_6$	0	$\frac{5}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{5}{6}$	$\frac{7}{3}$	0	1	$-\frac{5}{6}$	1

Actualizar s_3

V_B	w	y_1	y_2	y_3	y_4	y_5	y_6	y_7	s_1	s_2
s_3	0	3	-1	-9	5	-15	0	-10	0	0
y_6	0	$\frac{5}{12}$	$\frac{1}{12}$	$\frac{7}{12}$	$\frac{5}{12}$	$\frac{2}{12}$	1	0	$\frac{1}{12}$	0

V_B	w	y_1	y_2	y_3	y_4	y_5	y_6	y_7	s_1	s_2
$0y_6$	0	0	0	0	0	0	0	0	0	0
$s_3 = s_3 - 0y_6$	0	3	-1	-9	5	-15	0	-10	0	0

Actualizar tabla con filas actualizadas

V_B	w	y_1	y_2	y_3	y_4	y_5	y_6	y_7	s_1	s_2	s
w	1	$-\frac{25}{2}$	$-\frac{25}{2}$	$\frac{45}{2}$	$\frac{5}{2}$	5	0	-20	$\frac{15}{2}$	0	0
y_6	0	$\frac{5}{12}$	$\frac{1}{12}$	$\frac{7}{12}$	$\frac{5}{12}$	$\frac{2}{12}$	1	0	$\frac{1}{12}$	0	0
s_2	0	$\frac{5}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{5}{6}$	$\frac{7}{3}$	0	1	$-\frac{5}{6}$	1	0
s_3	0	3	-1	-9	5	-15	0	-10	0	0	1

Segunda iteración

V_E y V_P

$V_E = y_7$

V_B	Columna V_E	Columna $Solución$	Relación mínima	Válida
y_6	0	$\frac{5}{12}$	$\frac{\frac{5}{12}}{0} = \infty$	No
s_2	1	$\frac{11}{6}$	$\frac{\frac{11}{6}}{1} = \frac{11}{6}$	Sí
s_3	-10	3	$\frac{3}{-10}$	No

$V_P = s_2$

Actualizar fila V_P

V_B	w	y_1	y_2	y_3	y_4	y_5	y_6	y_7	s_1	s_2
s_2	0	$\frac{5}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{5}{6}$	$\frac{7}{3}$	0	1	$-\frac{5}{6}$	1
$s_2 \to y_7$	0	$\frac{5}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{5}{6}$	$\frac{7}{3}$	0	1	$-\frac{5}{6}$	1

V_B	w	y_1	y_2	y_3	y_4	y_5	y_6	y_7	s_1	s_2	s
w	1	$-\frac{25}{2}$	$-\frac{25}{2}$	$\frac{45}{2}$	$\frac{5}{2}$	5	0	-20	$\frac{15}{2}$	0	0
y_6	0	$\frac{5}{12}$	$\frac{1}{12}$	$\frac{7}{12}$	$\frac{5}{12}$	$\frac{2}{12}$	1	0	$\frac{1}{12}$	0	0
y_7	0	$\frac{5}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{5}{6}$	$\frac{7}{3}$	0	1	$-\frac{5}{6}$	1	0
s_3	0	3	-1	-9	5	-15	0	-10	0	0	1

Actualizar filas respecto a la fila V_P

Actualizar w

V_B	w	y_1	y_2	y_3	y_4	y_5	y_6	y_7	s_1	s
w	1	$-\frac{25}{2}$	$-\frac{25}{2}$	$\frac{45}{2}$	$\frac{5}{2}$	5	0	-20	$\frac{15}{2}$	0
y_7	0	$\frac{5}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{5}{6}$	$\frac{7}{3}$	0	1	$-\frac{5}{6}$	1
$20y_7$	0	$\frac{50}{3}$	$\frac{10}{3}$	$\frac{10}{3}$	$\frac{50}{3}$	$\frac{140}{3}$	0	20	$-\frac{50}{3}$	2
$w = w + 20y_7$	1	$\frac{25}{6}$	$-\frac{55}{6}$	$\frac{155}{6}$	$\frac{115}{6}$	$\frac{155}{3}$	0	0	$-\frac{55}{6}$	2

Actualizar y_6

V_B	w	y_1	y_2	y_3	y_4	y_5	y_6	y_7	s_1	s_2
y_6	0	$\frac{5}{12}$	$\frac{1}{12}$	$\frac{7}{12}$	$\frac{5}{12}$	$\frac{2}{12}$	1	0	$\frac{1}{12}$	0
y_7	0	$\frac{5}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{5}{6}$	$\frac{7}{3}$	0	1	$-\frac{5}{6}$	1
$0y_7$	0	0	0	0	0	0	0	0	0	0
$y_6 = y_6 + 0y_7$	0	$\frac{5}{12}$	$\frac{1}{12}$	$\frac{7}{12}$	$\frac{5}{12}$	$\frac{2}{12}$	1	0	$\frac{1}{12}$	0

Actualizar s_3

V_B	w	y_1	y_2	y_3	y_4	y_5	y_6	y_7	s_1	s
s_3	0	3	-1	-9	5	-15	0	-10	0	0
y_7	0	$\frac{5}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{5}{6}$	$\frac{7}{3}$	0	1	$-\frac{5}{6}$	1

V_B	w	y_1	y_2	y_3	y_4	y_5	y_6	y_7	s_1	s
$10y_7$	0	$\frac{25}{3}$	$\frac{5}{3}$	$\frac{5}{3}$	$\frac{25}{3}$	$\frac{70}{3}$	0	10	$-\frac{25}{3}$	1
$s_3 = s_3 + 10y_7$	0	$\frac{34}{3}$	$\frac{2}{3}$	$-\frac{22}{3}$	$\frac{40}{3}$	$\frac{25}{3}$	0	0	$-\frac{25}{3}$	1

Actualizar tabla con filas actualizadas

V_B	w	y_1	y_2	y_3	y_4	y_5	y_6	y_7	s_1	s_2	s
w	1	$\frac{25}{6}$	$-\frac{55}{6}$	$\frac{155}{6}$	$\frac{115}{6}$	$\frac{155}{3}$	0	0	$-\frac{55}{6}$	20	0
y_6	0	$\frac{5}{12}$	$\frac{1}{12}$	$\frac{7}{12}$	$\frac{5}{12}$	$\frac{2}{12}$	1	0	$\frac{1}{12}$	0	0
y_7	0	$\frac{5}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{5}{6}$	$\frac{7}{3}$	0	1	$-\frac{5}{6}$	1	0
s_3	0	$\frac{34}{3}$	$\frac{2}{3}$	$-\frac{22}{3}$	$\frac{40}{3}$	$\frac{25}{3}$	0	0	$-\frac{25}{3}$	10	1

Tercera iteración

V_E y V_P

$V_E = y_2$

V_B	Columna V_E	Columna $Solución$	Relación mínima	Válida
y_6	$\frac{1}{12}$	$\frac{5}{12}$	$\frac{\frac{5}{12}}{\frac{1}{12}} = 5$	Si
y_7	$\frac{1}{6}$	$\frac{11}{6}$	$\frac{\frac{11}{6}}{\frac{1}{6}} = 11$	Si
s_3	$\frac{2}{3}$	$\frac{64}{3}$	$\frac{\frac{64}{3}}{\frac{2}{3}} = 32$	Si

$V_P = y_6$

Actualizar fila V_P

V_B	w	y_1	y_2	y_3	y_4	y_5	y_6	y_7	s_1	s_2
y_6	0	$\frac{5}{12}$	$\frac{1}{12}$	$\frac{7}{12}$	$\frac{5}{12}$	$\frac{2}{12}$	1	0	$\frac{1}{12}$	0

V_B	w	y_1	y_2	y_3	y_4	y_5	y_6	y_7	s_1	s_2
$y_6 \to y_2$	0	5	1	7	5	2	12	0	1	0

V_B	w	y_1	y_2	y_3	y_4	y_5	y_6	y_7	s_1	s_2	s
w	1	$\frac{25}{6}$	$-\frac{55}{6}$	$\frac{155}{6}$	$\frac{115}{6}$	$\frac{155}{3}$	0	0	$-\frac{55}{6}$	20	0
y_2	0	5	1	7	5	2	12	0	1	0	0
y_7	0	$\frac{5}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{5}{6}$	$\frac{7}{3}$	0	1	$-\frac{5}{6}$	1	0
s_3	0	$\frac{34}{3}$	$\frac{2}{3}$	$-\frac{22}{3}$	$\frac{40}{3}$	$\frac{25}{3}$	0	0	$-\frac{25}{3}$	10	1

Actualizar filas respecto a la fila V_P

Actualizar w

V_B	w	y_1	y_2	y_3	y_4	y_5	y_6	y_7	s_1	s_2
w	1	$\frac{25}{6}$	$-\frac{55}{6}$	$\frac{155}{6}$	$\frac{115}{6}$	$\frac{155}{3}$	0	0	$-\frac{55}{6}$	20
y_2	0	5	1	7	5	2	12	0	1	0
$\frac{55}{6}y_2$	0	$\frac{275}{6}$	$\frac{55}{6}$	$\frac{385}{6}$	$\frac{275}{6}$	$\frac{110}{6}$	110	0	$\frac{55}{6}$	0
$w = w + \frac{15}{2}$	1	50	0	90	65	70	110	0	0	20

Actualizar y_7

V_B	w	y_1	y_2	y_3	y_4	y_5	y_6	y_7	s_1	s
y_7	0	$\frac{5}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{5}{6}$	$\frac{7}{3}$	0	1	$-\frac{5}{6}$	1
y_2	0	5	1	7	5	2	12	0	1	0
$-\frac{1}{6}y_2$	0	$-\frac{5}{6}$	$-\frac{1}{6}$	$-\frac{7}{6}$	$-\frac{5}{6}$	$-\frac{2}{6}$	-2	0	$-\frac{1}{6}$	0
$y_7 = y_7 - \frac{1}{6}y_2$	0	0	0	-1	0	2	-2	1	-1	1

Actualizar s_3

V_B	w	y_1	y_2	y_3	y_4	y_5	y_6	y_7	s_1	s
s_3	0	$\frac{34}{3}$	$\frac{2}{3}$	$-\frac{22}{3}$	$\frac{40}{3}$	$\frac{25}{3}$	0	0	$-\frac{25}{3}$	1
y_2	0	5	1	7	5	2	12	0	1	0
$-\frac{2}{3}y_2$	0	$-\frac{10}{3}$	$-\frac{2}{3}$	$-\frac{14}{3}$	$-\frac{10}{3}$	$-\frac{4}{3}$	-8	0	$-\frac{2}{3}$	0
$s_3 = s_3 - \frac{2}{3}y_2$	0	8	0	-12	10	7	-8	0	-9	1

Actualizar tabla con filas actualizadas

V_B	w	y_1	y_2	y_3	y_4	y_5	y_6	y_7	s_1	s_2	s
w	1	50	0	90	65	70	110	0	0	20	0
y_2	0	5	1	7	5	2	12	0	1	0	0
y_7	0	0	0	-1	0	2	-2	1	-1	1	0
s_3	0	8	0	-12	10	7	-8	0	-9	10	1

Esta es la solución del modelo dual. De aqui podemos interpretar lo siguiente.

Las restricciones primales correspondientes a y_2 y y_7 son las relevantes para nuestra solución óptima.

El resto de restricciones no forman parte de la solución óptima primal, por lo que se evaluarían en 0.

La ventaja de resolver el problema dual en lugar del primal, es que la cantidad de variables básicas se ve reducida debido a que la cantidad
e variables es menor a la cantidad de restricciones.