1) • Variáveis de decisão

$x_1 \to$ n° de dias publicidade a campanha no Prédio 1/ o mês de Abril

$x_2 \to$ " " " " " " " no Jornal " " "

$x_3 \to$ " " " " " " " no outdoors " " "

• Função objetivo

$Max\ Z = 10,000x_1 + 5,000x_2 + 1800x_3$

• Restrições

$x_3 \geq 10$ (obrigação de empresa outdoors)

$200x_1 + 60x_2 + 40x_3 \leq 9.200$ (orçamento mensal)

$x_2 \leq (x_1 + x_2 + x_3)/2$

$\left.\begin{array}{l} x_1 \leq 30 \\ x_2 \leq 30 \\ x_3 \leq 30 \end{array}\right\}$ (n° de dias de Abril)

$x_1 \geq 0.1(x_1 + x_2 + x_3)$

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

2)

a) $\operatorname{Min} Z = 2x_1 + 3x_2 + 7x_3$

S.a

$4x_1 - x_2 + x_3 \geq 14$ $\quad^{x-1}_{(=)}$

$2x_1 - 3x_2 + 2x_3 \geq 12$ $\quad^{x-1 \, (=)}_{(=)}$

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

$\operatorname{Max} Z' = -2x_1 - 3x_2 - 7x_3$

S.a

$-4x_1 + x_2 - x_3 \leq -14$

$-2x_1 + 3x_2 - 2x_3 \leq -12$

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

$-4x_1 + x_2 - x_3 + \boxed{x_4} = -14$ ← slacks

$-2x_1 + 3x_2 - 2x_3 + \boxed{x_5} = -12$

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

		-2	-3	-7	0	0		
		x_1	x_2	x_3	x_4	x_5	b	
← x_4	0	-4	1	-1	1	0	-14	(1)
x_5	0	-2	3	-2	0	1	-12	(2)
$z_j - y$		2	3	7	0	0	0	

$\dfrac{2}{|-4|} = 1/2 \qquad \dfrac{7}{|-1|} = 7$

		-2	-3	-7	0	0		
		x_1	x_2	x_3	x_4	x_5	b	
x_1	-2	1	$-1/4$	$1/4$	$-1/4$	0	$7/2$	$(1)' = -1/4 \,(1)$
x_5	0	0	$5/2$	$-3/2$	$-1/2$	1	-5	$(2) = (2) + 2(1)'$
$z_j - y$		0	$7/2$	$13/2$	$1/2$	0	-7	

$\dfrac{13/2}{|-3/2|} = 13/3 \qquad \dfrac{1/2}{|-1/2|} = 1/4$

	-2	-3	-7	0	0	
	x_1	x_2	x_3	x_4	x_5	b
$z_1\text{-}2$	1	$-3/2$	1	0	$-1/2$	6
$x_4\ 0$	0	-5	3	1	-2	10
z_j-y	0	6	9	0	1	-12

$(1)'' = (1) + 1/4(2)''$

$\underline{(2)''} = -2(2)'$

Quadro ótimo pois a coluna $b \geq 0$.

$x^* = (6,0,0,10,0) \rightsquigarrow z'^* = -2 \Rightarrow z^* = 12$

b) ||Primal|| ||Dual||

Min $z = 2x_1 + 3x_2 + 7x_3$
s.a
$4x_1 - x_2 + x_3 \geq 14 \ +u_1$
$2x_1 - 3x_2 + 2x_3 \geq 12 \ +u_2$
$x_1 \geq 0,\ x_2 \geq 0,\ x_3 \geq 0$

Max $zd = 14u_1 + 12u_2$
s.a
$4u_1 + 2u_2 \leq 2$
$-u_1 - 3u_2 \leq 3$
$u_1 + 2u_2 \leq 7$
$u_1 \geq 0,\ u_2 \geq 0$

c)

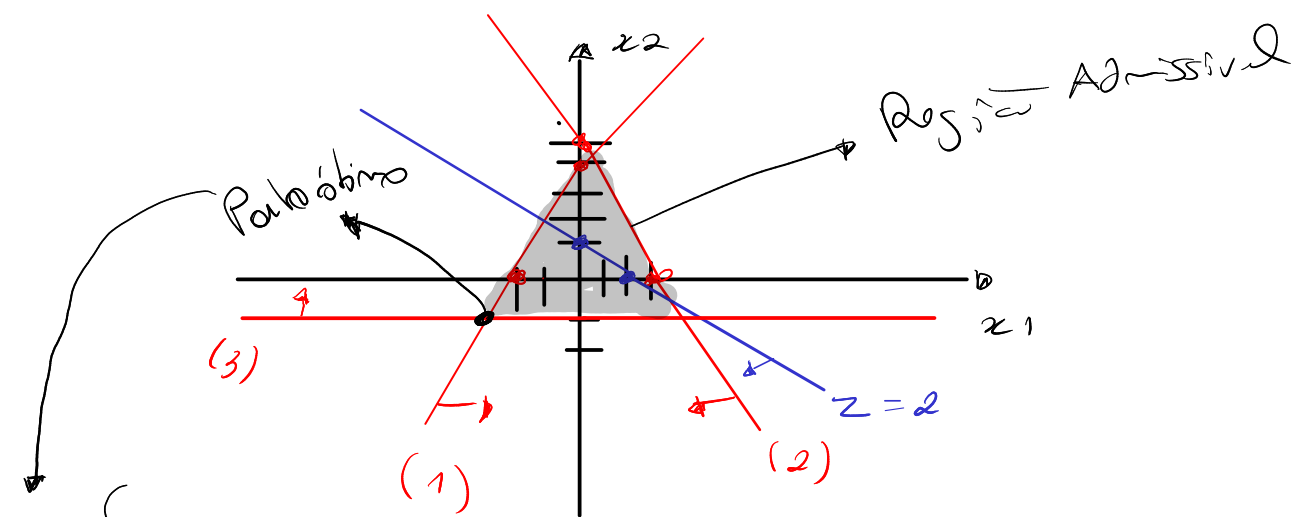|	-2	-3	-7	0	0	
	x_1	x_2	x_3	x_4	x_5	b
$z_1\text{-}2$	1	$-3/2$	1	0	$-1/2$	6
$x_4\ 0$	0	-5	3	1	-2	10
z_j-y	0	6	9	0	1	-12
	u_3^*	u_4^*	u_5^*	u_1^*	u_2^*	

$U^* = (0,1,0,6,9) \rightsquigarrow zd^* = 12$

3)

a) min $Z = x_1 + 2x_2 = 2$ (2,0) (0,1)

s.a

$-2x_1 + x_2 \leq 4$ (-2,0) (0,4) (1)

$5x_1 + 3x_2 \leq 15$ (3,0) (0,5) (2)

x_1 livre, $x_2 \geq -1$ (3)

Paraótimo

Região Admissível

(3)

(1)   (2)

$Z = 2$

$x^* = \begin{cases} x_2 = -1 \\ -2x_1 + x_2 = 4 \end{cases}$ (=)

$\begin{cases} x_2 = -1 \\ x_1 = -\frac{5}{2} \end{cases}$

$Z^* = -\frac{5}{2} + 2(-1) = -\frac{9}{2}$

b) Min $Z = x_1 + 2x_2$

s.a

$-2x_1 + x_2 \leq 4$

$5x_1 + 3x_2 \leq 15$

x_1 livre, $x_2 \geq -1$

___

$\boxed{x_1 = x_1^+ - x_1^-}$

$x_2 \geq -1$ (=) $\underline{x_2 + 1 \geq 0}$
x'_2

$x'_2 = x_2 + 1$, $x'_2 \geq 0$

$\boxed{x_2 = x'_2 - 1}$

Min $Z = (x_1^+ - x_1^-) + 2(x'_2 - 1)$

s.a

$-2(x_1^+ - x_1^-) + x'_2 - 1 \leq 4$

$5(x_1^+ - x_1^-) + 3(x'_2 - 1) \leq 15$

(=)

Min $Z = x_1^+ - x_1^- + 2x'_2 - 2$

s.a

$-2x_1^+ + 2x_1^- + x'_2 \leq 5$

$5x_1^+ - 5x_1^- + 3x'_2 \leq 18$

$x_1^+ \geq 0, x_1^- \geq 0, x'_2 \geq 0$