a)
- Variável de decisão X_{ij} . i = produção fabril .
j = mês do deposito

$$\text{Min } C = 5X_{11} + 10X_{12} + 2X_{13} + 3X_{21} + 7X_{22} + 5X_{23} + 6X_{31} + 8X_{32} + 4X_{33}$$

10)

Silveira	Depósito 1	2	3	Capacidade
A	R$ 5,00	10	2	100
B	3	7	5	25
C	6	8	4	75
Necessidade	80	30	90	

	1	2	3	
A	80	20	0	~~100~~ 20
B	0	10	15	~~25~~ 15
C	0	0	75	~~75~~ 0
Necessidade	~~80~~ 0	30	~~90~~ 15	

Solução: $X_{11}=80, X_{12}=20, X_{22}=10, X_{23}=15, X_{33}=75$

Custo:

$80.5 + 20.10 + 10.7 + 15.5 + 75.4 = 1045$

$U_i + V_j = C_{ij}$ $\quad U_1 = 0$

$X_{11} \Rightarrow U_1 + V_1 = 5 \rightarrow V_1 = 5$

$X_{12} \Rightarrow U_1 + V_2 = 10 \rightarrow V_2 = 10$

$X_{22} \Rightarrow U_2 + V_2 = 7 \rightarrow U_2 + 10 = 7 \Rightarrow U_2 = -3$

$X_{23} \Rightarrow U_2 + V_3 = 5 \rightarrow -3 + V_3 = 5 \Rightarrow V_3 = 8$

$X_{33} \Rightarrow U_3 + V_3 = 4 \rightarrow U_3 + 8 = 4 \Rightarrow U_3 = -4$

$U_i + V_j - C_{ij}$

$X_{13} \Rightarrow U_1 + V_3 - 2 = 0 + 8 - 2 = 6 \geq 0 \rightarrow X_{13}$ entra na base

$X_{21} \Rightarrow U_2 + V_1 - 3 = -3 + 5 - 3 = -1$

$X_{31} \Rightarrow U_3 + V_1 - 6 = -4 + 5 - 6 = -5$

$X_{32} \Rightarrow U_3 + V_2 - 8 = -4 + 10 - 8 = 0$

$X_{23} \rightarrow$ sai da base

	1	2	3	
A	80 (5)	-5 (10)	+15 (2)	100
B	0 (3)	25 (7)	0 (5)	25
C	0 (6)	+0 (8)	-75 (4)	75
	80	30	90	

Solução:

$X_{11}=80, X_{12}=5, X_{13}=15, X_{22}=25, X_{33}=75$

Custo

$80.5+5.10+15.2+25.7+75.4=955$

$U_i+V_j=C_{ij}$

$X_{11} \Rightarrow U_1+V_1=5$

$X_{12} \Rightarrow U_1+V_2=10$

$X_{13} \Rightarrow U_1+V_3=2$

$X_{22} \Rightarrow U_2+V_2=7$

$X_{33} \Rightarrow U_3+V_3=4$

$U_1=0$

$V_1=5$

$V_2=10$

$V_3=2$

$U_2=-3$

$U_3=2$

$U_i+V_j-C_{ij}$

$X_{21} \Rightarrow U_2+V_1-3=-3+5-3=-1$

$X_{23} \Rightarrow U_2+V_3-5=-3+2-5=-6$

$X_{31} \Rightarrow U_3+V_1-6=2+5-6=1$

$X_{32} \Rightarrow U_3+V_2-8=2+10-8=4 \geq 0 \Rightarrow$ [illegible]

$X_{22} \Rightarrow$ [illegible]

	1	2	3	
A	80	0	20	100
B	0	25	0	25
C	0	5	70	75
	80	30	90	

Solução

$X_{11} = 80, X_{13} = 20, X_{22} = 25, X_{32} = 5, X_{33} = 70$

Custo:

$80.5 + 20.2 + 25.7 + 5.8 + 70.4 = 935$

$U_i + V_j = C_{ij}$ $\quad U_1 = 0$

$X_{11} \Rightarrow U_1 + V_1 = 5 \quad V_1 = 5$

$X_{13} \Rightarrow U_1 + V_3 = 2 \quad V_3 = 2$

$X_{22} \Rightarrow U_2 + V_2 = 7 \quad U_2 = 1$

$X_{32} \Rightarrow U_3 + V_2 = 8 \quad V_2 = 6$

$X_{33} \Rightarrow U_3 + V_3 = 4 \quad U_3 = 2$

$U_i + V_j = C_{ij}$

$X_{12} = U_1 + V_2 - 10 = 0 + 6 - 10 = -4$

$X_{21} = U_2 + V_1 - 3 = 1 + 5 - 3 = 3 \geq 0 \rightarrow$ [illegible]

$X_{23} = U_2 + V_3 - 5 = 1 + 2 - 5 = -2$

$X_{31} = U_3 + V_1 - 6 = 2 + 5 - 6 = +1$

X_{22} [illegible]

25

	1	2	3	
A	55 (5)	0 (10)	45 (3)	100
B	25 (3)	0 (7)	0 (5)	25
C	0 (6)	30 (8)	45 (4)	75
	80	30	90	

Solução:

$X_{11}=55$, $X_{13}=45$, $X_{21}=25$, $X_{32}=30$, $X_{33}=45$

Custo

$55.5+45.2+25.3+30.8+45.4=860$

$U_i+V_i=C_{ij}$ $\quad U_1=0$

$X_{11} \Rightarrow U_1+V_1=5$ $\quad V_1=5$

$X_{13} \Rightarrow U_1+V_3=2$ $\quad V_3=2$

$X_{21} \Rightarrow U_2+V_1=3$ $\quad U_2=-2$

$X_{32} \Rightarrow U_3+V_2=8$ $\quad V_2=6$

$X_{33} \Rightarrow U_3+V_3=4$ $\quad U_3=2$

$U_i+V_j-C_{ij}$

$X_{12}=U_1+V_2-10=0+6-10=-4$

$X_{22}=U_2+V_2-7=-2+6-7=-3$

$X_{23}=U_2+V_3-5=-2+2-5=-5$

$X_{31}=U_3+V_1-6=2+5-6=1 \geq 0 \rightarrow$ [illegible]

$X_{33} \rightarrow$ [illegible]

45

	1	2	3	
A	10	0	90	100
B	25	0	0	25
C	45	30	0	75
	80	30	90	

Solução:

$X_{11}=10$, $X_{13}=90$, $X_{21}=25$, $X_{31}=45$, $X_{32}=30$

Custo

$10.5 + 90.2 + 25.3 + 45.6 + 30.8 = 815$

$U_i + V_i = C_{ij}$

$X_{11} \Rightarrow U_1 + V_1 = 5$ $\quad U_1 = 0$

$X_{13} \Rightarrow U_1 + V_3 = 2$ $\quad V_1 = 5$

$X_{21} \Rightarrow U_2 + V_1 = 3$ $\quad V_3 = 2$

$X_{31} \Rightarrow U_3 + V_1 = 6$ $\quad U_2 = -2$

$X_{32} \Rightarrow U_3 + V_2 = 8$ $\quad U_3 = 1$

$V_2 = 7$

$U_i + V_j - C_{ij}$

$X_{12} = U_1 + V_2 - 10 = 0 + 7 - 10 = -3$

$X_{22} = U_2 + V_2 - 7 = -2 + 7 - 7 = -2$

$X_{23} = U_2 + V_3 - 5 = -2 + 2 - 5 = -5$

$X_{33} = U_3 + V_3 - 4 = 1 + 2 - 4 = -3$

Como são todos negativos, tem uma solução ótima

	Custo por carga de caminhão		
	Armazéns		
Fábricas	1	2	3
1	5	10	2
2	3	7	5
3	6	8	4

min c	1045

Fábricas		Capacidade
1	100 <=	100
2	25 <=	25
3	75 <=	75

	Variáveis de Decisão (xij)		
	Armazéns		
Fábricas	1	2	3
1	80	20	0
2	0	10	15
3	0	0	75

Armazém		Necessidade
1	80 >=	80
2	30 >=	30
3	90 >=	90