Q1)

Max z = - X1 + 2 X2

3 X1 + 4 X2 = 12
2 X1 - X2 ≤ 12
and X1,X2≥0;

-->Part-1<--

The problem is converted to canonical form by adding slack, surplus and artificial variables as appropriate
1. As the constraint-1 is of type '=' we should add artificial variable A1
2. As the constraint-2 is of type '≤' we should add slack variable S1

After introducing slack, artificial variables

Max z = -X1 + 2X2 +0A1 +0S1
subject to
3X1+4X2+A1 + 0S1 =12
2X1- X2 + 0A1 +S1 =12
and X1,X2,S1,A1≥0

$BV = \{X_1, S_1\}$

$$\Rightarrow C_{BV} = \begin{bmatrix} -1 \\ 0 \end{bmatrix}, \quad B = \begin{bmatrix} 3 & 0 \\ 2 & 1 \end{bmatrix} \xRightarrow{ERO} B^{-1} = \begin{bmatrix} 1/3 & 0 \\ -2/3 & 1 \end{bmatrix}$$

Iteration 0	Z	X_1	X_2	A_1	S_2	RHS	minimum Ratio
$Z = \bar{z}$	1	0	$\boxed{\bar{c}_2}$	$\boxed{\bar{c}_3}$	0	$\boxed{\bar{z}}$	
→ X_1	0	1	$\bar{a}_2$	$\bar{a}_3$	0	$\bar{b}$	$4 \div 4/3 = 3$
S_1	0	0			1		X

$$* \quad \bar{a}_2 = B^{-1} \cdot a_2 = \begin{bmatrix} 1/3 & 0 \\ -2/3 & 1 \end{bmatrix} \begin{bmatrix} 4 \\ -1 \end{bmatrix} = \begin{bmatrix} 4/3 \\ -11/3 \end{bmatrix}$$

Intering element

$$** \quad \bar{a}_3 = '' \cdot a_3 = '' \cdot \begin{bmatrix} 1 \\ 0 \end{bmatrix} = \begin{bmatrix} 1/3 \\ -2/3 \end{bmatrix}$$

$$\bar{c}_2 = C_{BV}^T (B^{-1} a_2) - c_2 = [-1, 0] \cdot * - 2 = -4/3 - 2 = \boxed{\frac{-10}{3}}$$

$$\bar{c}_3 = C_{BV}^T (B^{-1} a_3) - c_3 = [-1, 0] \cdot ** - 0 = -1/3 - 0 = -1/3$$

$$\bar{b} = B^{-1} b = [\quad] \begin{bmatrix} 12 \\ 12 \end{bmatrix} = \begin{bmatrix} 4 \\ 4 \end{bmatrix}$$

$$\bar{z} = C_{BV}^T \cdot B^{-1} b = [-1 \;\; 0] \begin{bmatrix} 4 \\ 4 \end{bmatrix} = -4$$

-->Part-2<--

Iteration-1		Cj	-1	2	0	
B	**CB**	**XB**	**X1**	**X2**	**S1**	**MinRatio**
X2	2	3	3/4	1	0	
S1	0	1/5	11/4	0	1	
z=6		**Zj**	**3/2**	**2**	**0**	
		Zj-Cj	5/2	0	0	

Since all Zj-Cj≥0
Hence, optimal solution is arrived with value of variables as :

X1*=0 , X2*=3 ,z*=6

Q2) objective function for first phase is in this form :
Min W = A1 + … + An
such that Ai is an artificial variable.
If we satisfied The optimal condition in last iteration of the first phase, It means z row has not any positive number. And the reduce cost coefficient of all artificial variables must be non_positive.
But for stronger result we can use “Simplex algebraic formula ” and show Ai = -1 ,(1 =< i <=n).

و روابط زیر را به کار می‌بریم:

$\bar{a}_j = B^{-1}a_j$
$\bar{b} = B^{-1}b$
$\bar{c}_j = c_{BV}^T B^{-1} a_j - c_j$
$\bar{z} = c_{BV}^T B^{-1} b$

$$\bar{C}_{a_j} = \underbrace{\cancel{C_{Bv}^T \cdot B^{-1} \cdot a_{a_j}}}_{0} - \overset{1}{\overset{\shortparallel}{C_{a_j}}} = -1$$

Q3)
part A)

- b>=0
- c<=0
- a1 element of R
- a2 element 0f R

Part B)

- b>=0
- c <0
- a1 element of R
- a2 element of R

or

- b=0
- c =0
- a1 element of R
- a2 > 0

Part C)

- b >= 0
- c > 0
- a1 <=0
- a2 <=0

Thank You.
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