**<u>Example equation (MINIMIZATION):</u>**
**$C = 5x + 4y + 3z$**
**$x \leq 200$ (Mixture X constraint)**
**$y \geq 300$ (Mixture Y constraint)**
**$z \leq 400$ (Mixture Z constraint)**
**$x + y + z = 1000$ (Total Mixture constraint)**
**$x, y, z \geq 0$**

**Simplex Method in LPP:**

1. First of all, you must have all the equations needed to start simplex method
   a. Decision Variables
   b. Objective function
   c. Constraints
2. Now, you need to convert inequalities into equalities by adding slack, surplus or artificial variables.
   a. For less than equals to <=
      - Adding a slack variable
   b. For greater than equals to >=
      - Subtracting surplus variable
      - Adding artificial variable
   c. For equals to sign =
      - Adding artificial variable
   d. Eg:
      - $x + S_1 = 200$ (LTE so <u>slack</u> variable)
      - $y - S_2 + A_1 = 300$ (GTE so <u>surplus and artificial</u> variables)
      - $z + S_3 = 400$ (LTE so <u>slack</u> variable)
      - $x + y + z + A_2 = 1000$ (Equals to so <u>artificial</u> variable)
3. Now, convert all these equalities and objective function into standard equation
   a. Standard equation must have all the variables on left hand side and constants on right hand side.
   b. For objective function, moving all the variables on left side,
      - $C - 5x - 4y - 3z = 0$
      - Now convert it into standard equation by showing all the variables – even that does not contain in the equation
      - *<u>Note</u>: For artificial variables they must have coefficients 10/100/... and positive/negative sign depending on the question*
      - For, maximization problem Coeff. is positive and for minimization problem Coeff. Is negative.
      - *<u>Note:</u> For the value of Coeff. Of artificial variable we must check the maximum Coeff. In the main objective equation which is 5 in this case. As, the is max. <u>Coeff. is a single</u>*

*digit the Coeff. of artificial variable will be 10, if it was 2 digit it would have been 100.*

- Eg: $1\,C - 5\,x - 4\,y - 3\,z + 0\,S_1 + 0\,S_2 - 10\,A_1 - 10\,A_2 = 0$

4. Now, change all the other equations to standard equations
    a. $0C + 1x + 0y + 0z + 1S_1 + 0S_2 + 0S_3 + 0A_1 + 0A_2 = 200$
    b. $0C + 0x + 1y + 0z + 0S_1 - 1S_2 + 0S_3 + 1A_1 + 0A_2 = 300$
    c. $0C + 0x + 0y + 1z + 0S_1 + 0S_2 + 1S_3 + 0A_1 + 0A_2 = 400$ (LTE so slack variable)
    d. $0C + 1x + 1y + 1z + 0S_1 + 0S_2 + 0S_3 + 0A_1 + 1A_2 = 1000$
5. Make the table

**Simplex table 1**

| | Z' | x | y | z | $S_1$ | $S_2$ | $S_3$ | $A_1$ | $A_2$ | Const. |
|---|---|---|---|---|---|---|---|---|---|---|
| $R_0$ | 1 | -5 | -4 | -3 | 0 | 0 | 0 | -10 | -10 | 0 |
| $R_1$ | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 200 |
| $R_2$ | 0 | 0 | 1 | 0 | 0 | -1 | 0 | 1 | 0 | 300 |
| $R_3$ | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 400 |
| $R_4$ | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1000 |

First of all, as the value of $A_1$ and $A_2$ in $R_0$ is not 0 so first of all we adjust this row to 0

To make that 0 we need to change $R_0$ to, $R_0 + 10 * (R_1 + R_2 + R_3 + R_4)$

6. After doing so – we need to adjust the rows by finding the key column, key row and key element.
    a. Key Column ---
        - Maximization: Check for the value in $R_0$ with the highest negative
        - Minimization: Check for the value in $R_0$ with the highest positive
    b. Key Row –
        - Check the ratios Ratio = Constant / Value in Key Column
        - The Minimum Positive Ratio will be the key row.
    c. Key element
        - The element which is both in key row and key column
7. Adjust the rows
    a. Key row: old value / Key Element
    b. Other rows: Lets take an element with Row = RR and Column = CC
        - Old Value from RR – (Value of Key Column in RR) * (Adjusted value of Key Row in column CC)

8. Check if R <= 0, as this is a minimization problem. And Check

   If not then again start from step 6

   Work on this process by adjusting the values until you reach the optimal solution which is when $R_0$ <= 0 for minimization problem (*$R_0$ >= 0 for maximization problem*).

9. When the optimal solution is reached check for the values in the column of variables – x,y,z.
   a. If there is only one '1' and all the other elements '0' then the optimal solution value of x is in the Constant column and the Row which has '1' in the column of x

      | X | Constant |
      |---|---|
      | 0 | 200 |
      | 1 | 300 |
      | 0 | 100 |

      - Here the value of x = 300
   b. If the above condition is not fulfilled then the optimal solution of X will be 0.

      | X | Constant |
      |---|---|
      | 34 | 200 |
      | 20 | 300 |
      | -10 | 100 |

      - Here the value of x = 0

**Thank You**
**If you have any queries then please let me know.**