***Simplex method for solving linear programming problems MAX***

Introduction:

From the foregoing, it is clear to us that the graphic solution of the linear programming model, although it is characterized by its ease of application, and is useful in understanding the characteristics of the composition and solution of the linear programming model, but it is only valid in the case of two variables, and it is difficult to use this graphic method in the case of the presence of three decision variables ,〖x\_1〗\_,x\_2,x\_3), as this requires three dimensions on the graph, and it is impossible to use it if the number of decision variables exceeds three.

Thus, it emerged that there is a method "" to facilitate finding a solution for linear models that are difficult to solve by the graphic method, as we saw in this method the optimal solution in one of the corners of the possible solutions area, and the simplex method examines these corners in an organized way to reach that optimal solution.

1- Definition of the simplex method in solving linear programming problems: Most of the methods used in solving linear programming problems are originally attributed to "George Danzig" and his deductions in the forties of the twentieth century. There have been many changes in the origin of this method. In the field of our analysis, we will focus on the “Primal Simplex Method” (Sayyid Abdel Maqsoud and Nasser Noureddine, 2008, pg. 303).

The optimal solution is obtained according to this method by following the following steps: (Ibrahim, 2006, pages 34-35)

Converting all constraints into equations by adding the positive difference variable to each constraint;

- Choosing the initial solution is basic and permissible, and in most cases the point of origin is chosen as the initial solution, where the complementary variables added are the basic variables; That is, non-zero while the decision variables are non-basic; that is, zero, and the value of the objective function is equal to zero in this case;

- At each stage of the solution, the objective function is written, as well as the constraints in terms of the basic variables, and then the optimization of the solution that we have is tested. If it is the optimal solution, the process ends, and if it is not, we move to another solution that is better than it.

This step is repeated until we reach the end of the optimal solution.

2- Steps to solve linear programming problems using the simplex method in case of maximizing “Max”:

MaxZ=∑\_(j=1)^n▒〖C\_i X\_i 〗

∑\_(j=1)^n▒a\_ij x\_j≤b\_i

x\_j≥0,b\_i≥0

i=1,……………….,m

For any linear model whose technical constraints are all less than or equal to (≤) the following steps must be followed: (Ali, 2015, pp. 51-56)

The first step: converting the constraints of the linear model from the form of inequalities (inequalities) to the form of equations (equality). ".

If the left side of the technical constraint is less than or equal to (≤) the right side, which is ∑\_(j=1)^n▒a\_ij x\_j≤b\_i, then in order for the two sides to become equal, we need to add to the left side the difference variable “S\_i”, i.e. ∑\_(j=1)^n▒a\_ij x\_j=b\_i So the linear model is of the form:

MaxZ=∑\_(j=1)^n▒〖C\_i X\_i 〗

∑\_(j=1)^n▒a\_ij x\_j≤b\_i

x\_j≥0,b\_i≥

i=1,……………….,m

becomes MaxZ=∑\_(j=1)^n▒〖C\_i X\_i 〗

∑\_(j=1)^n▒a\_ij x\_j=b\_i

x\_j≥0,b\_i≥0,S\_i≥0 ;

i=1,……………….,m

In order for all variables to be represented in all equations of the linear mathematical model, we add the difference with a coefficient of zero to the objective function. These variables do not add anything to the objective function, and therefore their coefficients are equal to zero, because these variables are not originally represented in the objective function.

And the objective function becomes:

MaxZ=∑\_(j=1)^n▒〖C\_i X\_i 〗+0S\_1+0S\_2+...…0S\_n

Dealing with equations is much better than dealing with relations of inequalities. The previous set of equations is called: "the standard formula for the linear programming problem" which consists of "m" of constraints and "n" of decision variables (Sayed and Latif, 2008, p. 315) .

The second step: it represents all the information of the linear model in the following table:

Solution b\_i Difference variables Fundamental variables (decision variables) Objective function

s\_1,s\_2,…s\_m x\_1,x\_2,…x\_n Objective function variables

0,0,…0 c\_1,c\_2,…c\_m Parameters of the variables of the objective function

solution base variables

b\_1 1,0,0,…0 a\_11,c\_12,…c\_1n Parameters of the technical constraints variables S\_1

b\_2 1,0,0,…0 a\_21, c\_22,…c\_2n S\_2

…………………………………………………………………

b\_m 0,0,0,…1 a\_m1,c\_m2,…c\_mn S\_n

The table can be simplified in symbols as follows:

b\_i/a\_ij b\_i ………………c\_n c\_2j c\_1 c\_j

……………………x\_n x\_2 x\_1 v\_b c\_j

∙ b\_1 ⋯…………a\_1n a\_12 a\_11 s\_1 ∙

∙ b\_2 ⋯…………a\_2n a\_22 a\_21 s\_2 ∙

∙ ⋯…

∙ b\_n ä………………a\_mn a\_m2 a\_m1 s\_n ∙

z\_n z\_2 z\_1 z\_i

〖...…………c〗\_n-z\_n c\_2-z\_2 c\_1-z\_1 c\_j-z\_i

where:

 c\_j : coefficients of variables in the objective function;

a\_ij: coefficients of variables in constraints

b\_i : constraints (resources) right end

v\_b: difference variables (written in the simplex table according to their order in the constraints)

The third step: It is represented in the stage of the initial solution or the search for the rule from which we proceed in the search for the optimal solution. For economic activity, it means that stage in which the economic enterprise has prepared all the means of production required to carry out its activity, but it has not yet started to practice this activity. If the institution has not yet started its activity, this means that the indicators of this activity (decision indicators) are at zero level x\_1=0,x\_2=0,…x\_n=0; That is, we make the activity counter at the zero level, so if the decision indicators in the objective function are equal to zero and the difference variables have zero coefficients, then the objective function in this case is equal to zero and it is proportional to the stage before the start of the activity.

With regard to technical constraints, if the decision variables are equal to zero, then when multiplied by their coefficients, the result will be all zero and the difference variables will remain, which are (s