***Use the graphical method to solve linear programming problems***

Preface:

There are several methods by which linear programming problems are solved, and the use of one of these methods depends solely on the nature and size of the problem in question, or the desire of the decision-making authority. The basis is that it is a set of equations of the first degree, and what draws this method is its inability to address large problems with variables or multiple constraints. As for the graph method, it is based on drawing the axes representing the variables, and then we draw the lines representing the constraints after identifying the represented points. For the variables on the axes, and then we define the area of possible solutions and identify and divide the points of this solution to choose the best one, and it is taken on this method that its analytical ability is limited, and that it is difficult to use if not impossible in cases where the number of variables is large, finally the simplified method that is considered more Methods are widespread, and the reason for this is due to their ability to address large and complex problems, and technical progress in the field of computer systems and programs related to this subject has helped to increase the capacity and effectiveness of this method.

1- Defining the graph method: The graph method is an easy and clear method in dealing with linear programming problems, especially those problems in which the number of variables does not exceed two, and which contains a small number of constraints. The graph method is useful as an introduction to studying other methods and methods. More complex in solving linear programming problems such as simplex. (Randa, 2016, p. 68).

2- Steps of the graphical solution method: To find a solution for each linear program that contains two variables using the graph, the following steps are followed (Khaled, 2018, pages 8-9):

- Converting inequality into equations, and this is done by changing the sign of the constraint from (≥) or (≤) to (=) without making any change in the constraint;

- find two coordinates for each entry; That is, specifying two points for each entry, where each point contains a value for: "x1" and a value for: "x2", "For the first entry, it is assumed that one of the two variables is non-existent, and therefore the other variable can be calculated, and the same thing is assumed that the second variable is non-existent In order to calculate the first variable, and thus we have two points from which the first constraint straight line is drawn.In the same way, the rest of the constraints lines are drawn, and by their intersection, the area of acceptable (possible) solutions is obtained, and the direction of the inequalities or constraints must be noted (Abdul Sattar Ahmed 2003, p. 27).

- Drawing the x-axis containing “x1” values, then the sampling axis containing “x2”;

- Drawing the constraints in a feature and defining the area of possible solutions: To draw the constraints in the feature, we choose the positive square, in application of the non-negative condition, as shown in the following figure:

The constraints in the linear program are drawn by defining the two points identified in the previous steps and connecting them with a straight line.

- defining the area of possible solutions for each constraint; According to the form of entry:

\* A constraint of the form (≤) (greater than or equal to): accepts the upper region as the region of possible solutions and rejects the lower region;

\* A constraint of the form (≥) (less than or equal to): accepts the lower region as a region of possible solutions and rejects the upper region;

\* A constraint of the form (=): rejects the upper region and the lower region, and the region of possible solutions is only the points on the constraint; The region common to all constraints is the region of possible solutions for the model;

- Finding the optimal solution: The optimal solution is one of the vertices of the possible solutions area, so we calculate the values of "x1" and "x2" at each vertex and calculate the value of each objective function. The optimal solution is determined according to the form of the objective function.

Example 01: A national institution for the furniture industry has information stating that it can use its surplus capacity to produce two new products (small desks and chairs), and that all of these two products will pass through two industrial workshops. The following table shows the needs of each product and all information related to the two products:

Products Products Available time (production capacity)

Chair desks

Carpentry 3 hours 5 hours 15 hours

Completion and assembly 5 hours 2 hours 10 hours

The unit profit is 5 DZD 3 DZD

Required:

- Find a mathematical model for the linear programming problem if the organization wants to maximize its profits?

Find the optimal solution using the graphical method.

\* Formulation of the mathematical model for the issue of linear programming:

Through the issue, we notice that the organization wants to produce two products, and thus the decision variables are as follows:

x\_1: number of office units;

x\_2: number of units of chairs;

Objective function: An objective function of maximization type that appears as follows:

MaxZ=c\_1 x\_1+c\_2 x\_2=5x\_1+3x\_2

\* Restrictions: From it, the restrictions appear as follows:

Carpentry workshop constraint: 3x\_1+5x\_2≤15

Completion and assembly workshop limit: 5x\_1+2x\_2≤10

Non-negative condition: x\_1,x\_2≥0

From it the form appears as follows:

MaxZ=c\_1 x\_1+c\_2 x\_2=5x\_1+3x\_2

3x\_1+5x\_2≤15

5x\_1+2x\_2≤10

x\_1,x\_2≥0

Finding the optimal solution using the graphical method:

Converting inequality into equations: by changing the sign of the constraint to the form (=)

\* For the first entry: 3x\_1+5x\_2≤15, we delete the constraint sign (≥) and replace it with a sign (=), so the constraint becomes in the form

3x\_1+5x\_2=15

\* For the second constraint: 5x\_1+2x\_2≤10, we delete the constraint sign (≥) and replace it with a sign (=), so the constraint becomes in the form

5x\_1+2x\_2=10

Finding two coordinates for each entry: As we mentioned earlier, the coordinate consists of a value for: "x1" and a value for: "x2". To facilitate the calculation, we assume that the value of "x1" is zero, and by substitution we get "x2". "x2" and substituting in we get the value of "x1".

First constraint: + 5 x 2 = 15 3 x 1

x1 = 0 ⇒ 5 x2 = 15 ⇒ x2 = 3 ⇒ (0 , 3)

x2 = 0 ⇒ 3 x1 = 15 ⇒ x1 = 5 ⇒ (5 , 0)

The second entry: x1 + 2 x2 = 10 5

x1 = 0 ⇒ 2