

# **Linear Programming – Concept, Assumptions, Usage**

## **Meaning**

The technique of linear programming was formulated by a Russian mathematician L.V. Kantorovich. But the present version of simplex method was developed by George B. Dantzig in 1947. Linear programming (LP) is an important technique of operations research developed for optimum utilization of resources.

According to famous Economist Robbins, the resources (land, labor, capital, materials, machines, etc.) are always limited. But each resource has various alternative uses. The problem before any manager is to select only those alternatives which can maximize the profit or minimize the cost of production. The linear programming technique is used for selecting the best possible strategy from a number of alternatives.

Linear programming consists of two words:

‘Linear and programming’. The word linear stands for indicating the relationships between different variables of degree one whereas another word programming means planning and refers to the process of selecting best course of action from various alternatives.

Thus, linear programming is a mathematical technique for allocating limited resources in optimum manner. In the words of William M. Fox, “Linear programming is a planning technique that permits some objective function to be minimized or maximized within the framework of given situational restrictions.”

## **Assumptions of Linear Programming**

### **1. Conditions of Certainty.**

It means that numbers in the objective and constraints are known with certainty and do not change during the period being studied.

### **2. Linearity or Proportionality.**

We also assume that proportionality exists in the objective and constraints. This means that if production of 1 unit of product uses 6 hours, then making 10 units of that product uses 60 hours of the resources.

### **3. Additivity.**

It means that total of all activities equals the sum of each individual activity. In other words there is no interaction among all the activities of the resources.

#### **4. Divisibility.**

We make the divisibility assumption that solution need to be in whole numbers (integers). Instead, they are divisible and may take any fractional value, if product cannot be produced in fraction, and integer programming problem exists.

#### **5. Non-negative variable.**

In LP problems we assume that all answers or variables are non-negative. Negative values of physical quantities are an impossible situation. You simply cannot produce a negative number of cloth, furniture, computers etc.

#### **6. Finiteness.**

An optimal solution cannot compute in the situation where there is infinite number of alternative activities and resources restriction.

#### **7. Optimality.**

In linear programming problems of maximum profit solution or minimum costs solution always occurs at a corner point of the set of the feasible solution.

### **Advantages**

LP has been considered an important tool due to following reasons:

1. LP makes logical thinking and provides better insight into business problems.
2. Manager can select the best solution with the help of LP by evaluating the cost and profit of various alternatives.
3. LP provides an information base for optimum allocation of scarce resources.
4. LP assists in making adjustments according to changing conditions.
5. LP helps in solving multi-dimensional problems.

### **Limitations**

LP approach suffers from the following limitations also:

1. This technique could not solve the problems in which variables cannot be stated quantitatively.
2. In some cases, the results of LP give a confusing and misleading picture. For example, the result of this technique is for the purchase of 1.6 machines.

3. It is very difficult to decide whether to purchase one or two- machine because machine can be purchased in whole.
4. LP technique cannot solve the business problems of non-linear nature.
5. The factor of uncertainty is not considered in this technique.
6. This technique is highly mathematical and complicated.
7. If the numbers of variables or constrains involved in LP problems are quite large, then using costly electronic computers become essential, which can be operated, only by trained personnel.
8. Under this technique to explain clearly the objective function is difficult.

### **Administrative uses and applications:**

LP technique is applied to a variety of problems listed below:

1. Improving the product mix when the production line operates according to certain specifications;
2. Ensuring a less expensive set of inputs;
3. Selecting the factory site;
4. Determination of the transportation path;
5. Make use of storage and distribution centers;
6. Adequate scheduling of production and stock control;
7. (Solving blending problems;
8. Reducing raw materials waste;
9. Post a specialized staff.

The key feature in all of these cases is to find an ideal set of factors after assessing known limitations. LP provides a solution for business managers by understanding complex problems in a clear and sound way.

The primary problem for any manager is to determine how limited resources can be used to maximize profit and reduce costs. This needs the best allocation of limited resources - for this purpose linear programming can be usefully used.