APPLICATIOIN OF LINEAR PROGRAMMING BY GRAPHICAL METHOD - WITH REFERENCED TO A FURNITURE MANUFACTURING COMPANY

Dr. D.VISHNU PRIYA,

Reader & HOD of Commerce (P.G.)
B.T.College, Madanapalle, Chittoor Dist.

***Abstract*: The central theme of Economic theory and Management Science is to optimize the use of scarce resources which include machine, labour, capital and organization. There are several theoretical tools to accomplish this purpose in both fields. But, such tools are not adequate for solving a complex economic problems with many limitations.**

It is for tackling such problem that the use of "Linear Programming" has been found to be most useful technique. It was first invented by "L.V.Kantorowich" and later, developed by "George Simplex" in 1945.

NEED FOR THE STUDY:

Basically, LPP can be solved by using Graphical Method and Simplex Method. Simplex Method is an Algorithm or a set of Mathematical instructions which seeks to examine corner points with the help of various Mathematical tables (simplex tables). Since, the construction of various business organizations usually adopt Graphical Method of Linear Programming to optimize their available resources.

Hence, there is a need to study the Graphical Method of LPP with simple steps.

OBJECTIVE OF THE STUDY

The main objective of this article is to understand how Graphical Method can be applied in a simple way for a furniture manufacturing company so as to optimize their objective (Profit maximization or cost minimization) function.

Key words : LPP, Shaded Area, Corner Points, Optimum solution.

INTRODUCTION:

Linear Programming was the first mathematical programming method to be used by army personnel during Second World War and later for civilian purposes. It became very popular method from 1950 onwards. Today it is standard model that is used to minimize the cost and maximize the profits for the big organizations and also to moderate to smell organization alive.

Linear programming is a technique of determining an optimum program of independent activities in view of available resources.

"It is a technique of allocating limited resources in an optimum manner so as to satisfy the Laws of Demand and Supply of products".

In general, LPP is a Mathematical technique for the analysis of optimum decisions subject to certain restrictions in the form of Linear Inequalities.

In LPP, the term 'Linear' indicates that function should be maximized (or) minimized is of degree '1' and the corresponding restrictions are represented by a system of uniform inequalities.

The term "programming" means, the planning of activities in a manner that leads to some optimum solution.

Thus, Linear programming may be defined as "a mathematical technique for determining optimum allocation of resources for obtaining a particular objective of profit maximization (or) cost minimization".

❖ **Assumptions of LPP :**

LPP can be applied based on some assumptions such as -

(i) The decision making can be done with under some restrictions.
(ii) It assumes a limited number of alternative activities
(iii) It assumes technology will be constant
(iv) Input and prices are also constant.

❖ **Applications of LPP :**

1) Production Management
2) Human Resource Management
3) Inventory Management
4) Financial Management

PRACTICAL APPLICATION OF GRAPHICAL METHOD OF LPP

Graphical technique is used when there are only two decision variables to be determined. This method provides pictorial representation of solution and helps to get insight into basic concepts used in LPP. These concepts are -

a) Optimum solution :
Any feasible solution which optimizes the "objective function" of LPP is called optimum solution.

b) Feasible solution :
Any solution to a general LPP which satisfied "non-negative restrictions" of given problem is called feasible solution.

With the understanding of these two basic concepts, LPP can be done by adopting the following steps.

Step - 1: Frame objective function :

It may be "Profit Maximisation" (or) 'Cost Minimisation' It is denoted by "Z".
Eg: $Z = 30x, +40x_2$

Note:
Since, it is the Graphic Method, we get two axes 'X' and 'Y' taken as 'x_1' and 'x_2'.

Step - 2: Set up restrictions / Constraints / Inequalities

These restrictions may be less than (or) equal to "≤" to available resources (or) greater than (or) equal to "≥" to available resources.

Note:
1. For "Profit Maximization" restriction will be "≤"
2. For "Cost Minimisation" it is "≥"

Ex: 1. $x_1 + 2x_2 \leq 10$ Available resources
$2x_1 + x_2 \leq 20$

2. $x_1 + 2x_2 \geq 10$
$2x_1 + x_2 \geq 20$

Step - 3: Make Inequalities as equalities

So that, we get two equations
Ex: 1. $x_1 + 2x_2 = 10 \rightarrow (1)$
$2x_1 + x_2 = 20 \rightarrow (2)$

Step - 4: Put $x_1=0$, $x_2 = 0$ in all the equations.

So as to "get corner points"

Note :
Since, it is graphic method, LPP should be represented by way of "straight lines". To get straight lines, we require two points on each axis (or) equation. These points are known as corner points.

Step - 5: Represent all the corner points on graph. By connecting these corner points, we get the straight lines for given equations.

Identify the "optimum solution" which is also called "shaded area" in the graph. The shaded area will be "Lease of part of graph for profit maximization". It is largest part of graph for cost minimization.

Step -6 : After identifying the shaded area, then take the corner points of shaded area. These are known as "required corner points".

Finally, substitute all the required corner points into "objective function".

Then, take the "optimum solution" in the following manner.

- For "Profit maximization", it is the point where the value of 'z' is Maximum
- For "cost Minimization", it is the point where the value of 'z' is Minimum

PRACTICAL APPLICATION OF LPP WITH REFERENCE TO FURNITURE MANUFACTURING COMPANY

A furniture manufacturer, who is producing two products ; tables and chairs, wants to know the No. of tables and chairs to be produced in order to optimize the use of his available resources.

The available resources are : Type of Timber, Man Hours and time taken by the workers.

The data has been represented in the form of table.

Items	Table	Chair	Available resource
1st Type Board feet	4	2	1200
2nd Type Board feet	3	5	1050
Man Hours	4	2	800

He estimated a profit of Rs.10 on table and Rs.5 on chair.

Now, let us apply LPP by Graphical Method, so as to reach his objective. (Profit Maximizing) by taking table as 'x_1' & chair as 'x_2'.

Step 1 : $Z = 10x_1 + 5x_2$

Step 2 : Restrictions / Constraints

$4x_1 + 2x_2 \leq 1200$
$3x_1 + 5x_2 \leq 1050$
$4x_1 + 2x_2 \leq 800$

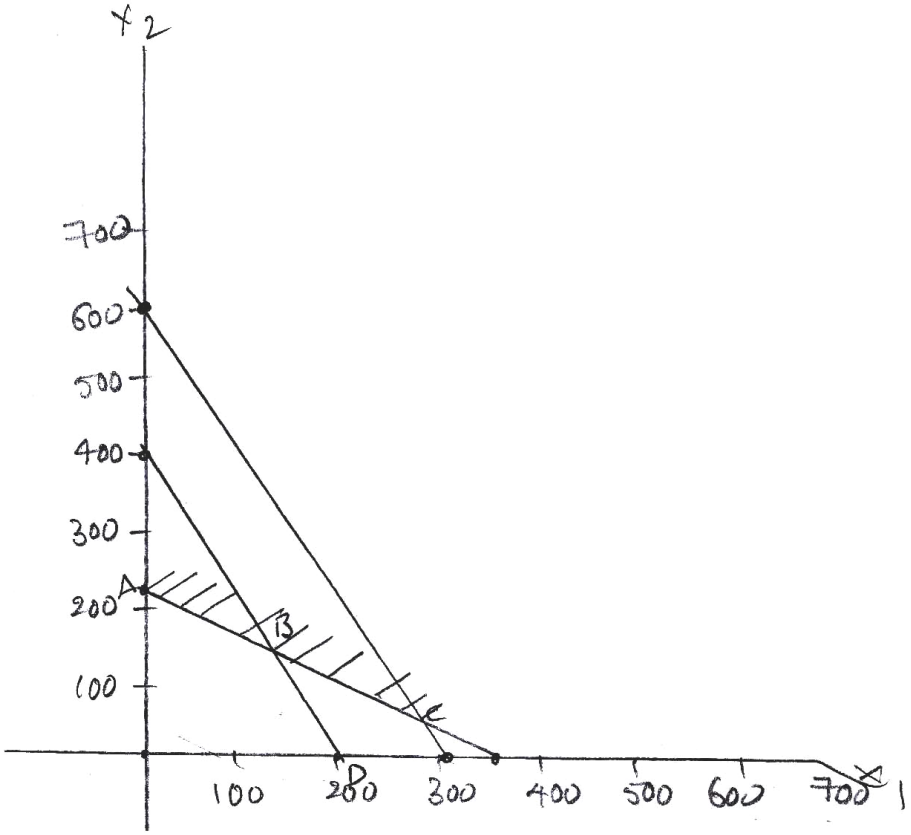
Step 3 : Making inequalities as equalities

$4x_1 + 2x_2 = 1200 \rightarrow 1$
$3x_1 + 5x_2 = 1050 \rightarrow 2$
$4x_1 + 2x_2 = 800 \rightarrow 3$

Step 4 : Getting "Corner Points" on Graph by putting $x_1 = 0$, $x_2 = 0$ in all the equations. Usually we get 2 corner points on each equation.

Now, the corner points on 1st equation are : (0,600), (300,0)
corner points on 2nd equation are : (0.210), (350,0)
corner points on 3rd equation are : (0.400), (200,0)

Step 5 : By representing the corner points on graph we get shaded area or feasible area.



It is observed from the Graph, that the regions (shaded) which are over lapping can be considered as "feasible solution". To get optimum solution, one of points of shaded area will be maximum. It can be seen from the following.

In the graph feasible solution is represented by the corner points 'A,B,C,D'. Here A = (0,210), B = (135,129), (intersecting points of 2nd and 3rd equations), C = (279,43) (intersecting points of 1st and 3rd equations), D = (200,0).

Then the values of objective function on Shaded area will be …

Z = 10 (0) + 5 (210) = 0 + 1050 = 1050
Z = 10 (135) + 5 (129) = 1350 + 645 = 1995
Z = 10 (279) + 5 (43) = 2790 + 215 = 3005
Z = 10 (200) + 5 (0) = 2000 + 0 = 2000

From the above results, it is observed that the company's optimum solution is to make 275 tables and 43 chairs, where we can obtain maximum profit of Rs.3005/-.

CONCLUSION :

LPP is a powerful technique for solving the problem of allocating resources among competing activities as well as other problems having a similar mathematical nature. Through practical application of LPP we can conclude that Graphical model Techniques used in business organizations may rationally optimize the resources to maximize the profits or to minimize the cost.

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