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APPLICATION OF L.P.P. TECHNIQUE IN ASSISTING SMALL BUSINESS DECISION MAKING.

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ABSTRACT

Decision making is an important phenomenon for any Individual or a firm, like for instance a dairy firm owner wants to know that how the milk should be produced in maximum quantity , while he has limited resources. A small snacks maker wants to know that how he can produce maximum quantity of snacks under the limited resources. An army commander always tries to find the ways to make his army in such a way so that the attacking capacity can be maximized while facing the limitations of the armed weapons and army personnel. Such problems occur in daily life regularly under which an individual has to find the optimal solution with the limitations of resources. The paper focuses on framing such problems mathematically and then solving them by using the techniques of LPP.

Key words: Linear Programming Problems, Simplex Method, Linear Inequalities, Surplus variable, Slack Variable, Graphical representation.

Introduction

In 1947 officers in USA Air force, George B. Dentzing, Marshal Wood and their peers have used linear programming and its techniques for optimally utilizing their resources. Since initially LLP was used only in War fields that's why initially it was called as Operation research, but in current time it is known as Linear programming more popularly. Due to its importance and usefulness this method is utilized more frequently in the field of Business and Industries, where one has to work under lot of different types of restrictions and limitations.

The most challenging thing for an organization is to make the most effective use of its resources like machinery, time, labor, money, raw material, industry specific limited material, warehouse space etc. LP is a mathematical modeling technique which helps the managers in planning and decision-making.

Description of L.P.P.

1. **Objective function:** The objective function describes the primary purpose of the formulation of a linear programming problem and it is always non-negative. In business applications, the profit function which is to be maximized or the cost function which is to be minimized is called the objective function.
   If $c_1,c_2,c_3,\ldots\ldots\ldots c_n$ are the constants and $x_1,x_2,x_3,\ldots\ldots x_n$ are variables, then the linear function $Z= c_1\ x_1 + c_2\ x_2 +c_3\ x_3 +\ldots\ldots.+ c_n\ x_n$ is called the objective function. If the problem is of Maximization then we write it as Maximize $Z= c_1\ x_1 + c_2\ x_2 +c_3\ x_3 +\ldots\ldots.+ c_n\ x_n$ and if the problem is of Minimization then it is written as Minimize $Z= c_1\ x_1 + c_2\ x_2 +c_3\ x_3 +\ldots\ldots.+ c_n\ x_n$.
2. **Constraints:** Since the objective to achieve maximum profit or minimum cost always faced with the challenges of limited resources, so the limitations under which the problem is to be dealt with are called constraints. These are the inequations or equations in the variables of a LPP which describe the conditions under which the optimization is to be accomplished are called constraints. Any one of the tree signs ($\leq$, $\geq$, $=$) can be used, depending on the type of constraint.
3. **Non-Negativity Restrictions:** The variables under L.P.P. are always positive or equal to zero i.e. variables can never be negative.

Mathematical Model of L.P.P.

To understand the mathematical model of L.P.P. we can take an example of a furniture company which produces tables and chairs. The production process is same for both tables and chairs. Each table requires 8 hours of carpentry and 4 hours of painting and varnishing. Each chair requires 6 hours of carpentry and 2 hours of painting and varnishing. The firm is working under the restrictions of availability of hours of carpentry and hours of varnishing & painting. Total available hours of Carpentry is 480 hours and total available hours of Varnishing and painting is 200 hours. Profit on each table is Rs. 1400 and profit on each chair is Rs. 1000. The company needs to determine the optimal combination of tables and chairs to be manufactured to get the maximum profit.

Formulation of L.P.P. Now we will formulate the L.P.P. of the above case. Let the number of chairs to be produced be "C" and Number of tables to be produced be "T"

Objective function: Since the profit per chair is Rs. 1000, so total profit on "C" number of chairs will be 1000C and profit per table is Rs. 1400, so total profit on "T" number of tables will be 1400T. Objective is to maximize the total profit i.e. 1000C + 1400T which can be represented as

Maximize $Z = 1000C + 1400T$

Subject to Constraints

Constraint 1: Availability of Carpentry hours.

Since each chair requires 6 hours and each table requires 8 hours of carpentry so total requirement of carpentry in case of C chairs and T tables will be 6C + 8T and it can never be greater than the total availability of carpentry hours i.e. 480 hours. So first constraint can be represented as

$6C + 8T \leq 480$

Constraint 2: Availability of Painting and Varnishing hours.

Since each chair requires 2 hours and each table requires 4 hours of painting and varnishing so total requirement of painting and varnishing in case of C chairs and T tables will be 2C + 4T and it can never be greater than the total availability of painting and varnishing hours i.e. 200 hours. So second constraint can be represented as

$2C + 4T \leq 200$

Finally the L.P.P. for the above case will be

Maximize $Z = 1000C + 1400T$

Subject to constraints

$6C + 8T \leq 480$

$2C + 4T \leq 200$ Where $C \geq 0$ and $T \geq 0$

Solving L.P.P.

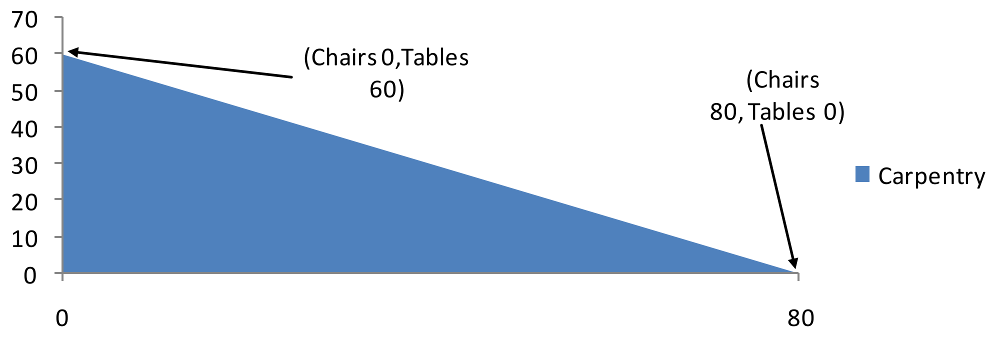
After formulation of L.P.P., the major task is to solve it and find the optimal solution. L.P.P. can be solved by using either of the following two methods:

1. Graphical Method
2. Simplex Method

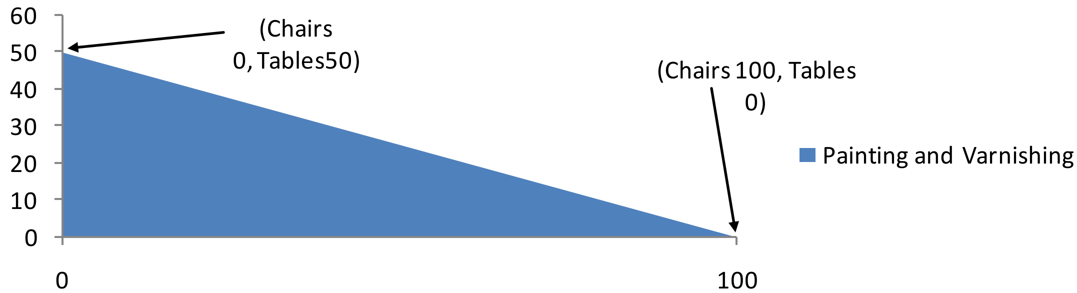
Graphical method works under the limitation of 2 variables as the three dimensional graph cannot be drawn manually. Simplex method can be utilized for n ($n \geq 2$) number of variables. To understand the application part of both the method, we will solve the above furniture company's L.P.P. by using both the methods.

Solution of the L.P.P. by using Graphical Method

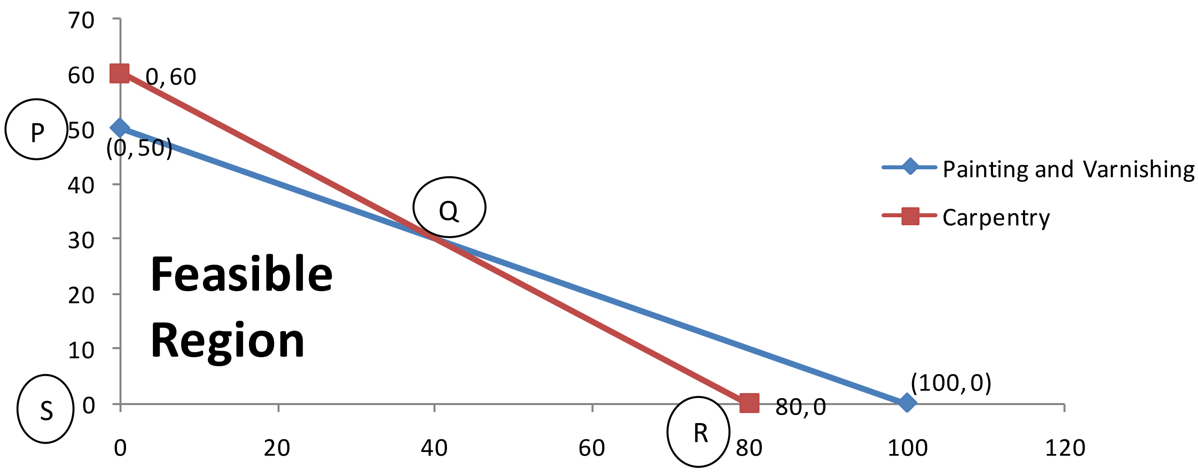
Graphical representation of Constraint 1



Graphical representation of Constraint 2



Finding the Feasible region:



As it is evident from the above three graphs that the basic feasible region is the area PQRS. This area is called as basic feasible area because it is the common are for both the constraints carpentry hours as well as painting and varnishing hours.

Points under this area will give the feasible solutions to the L.P.P. But in order to find the optimal solution we will follow the Corner point solution method.

By observing the boundary of the feasible region, we find that there are three corner points P(0,50), S(0,0), R(80,0) and one intersection point Q. Since Q is the intersection point of the two constraint inequations, co-ordinates of point Q can be find out by solving the two equations (by using elimination or substitution method).

By solving $6C + 8T \leq 480$ and $2C + 4T \leq 200$ we find that coordinates of Q are (40,30) Now the final step is to find the value of Z at each corner point. And the maximum value will give us the maximum profit that can be earned by producing optimum quantity of chairs and tables.

Corner	Number of Chairs (C)	Number of Tables (T)	Z= 1000C +1400 T
P(0,50)	0	50	70000
Q (40, 30)	**40**	**30**	**82000**
R(80,0)	80	0	80000
S(0,0)	0	0	0

Hence the maximum value of Z is at corner Q(40, 30) So The it can be concluded that in order to get the maximum profit the company should produce 40 number of chairs and 30 number of Tables and the maximum profit will be of Rs. 82000.

Limitations of the study

The study was limited to only two variables L.P.P. with less than or equal to constraints. Demand was assumed to be constant and fully satisfied.

Future scope of the study

The study can be extended to solve the more complex L.P.P. with more than two variables in objective function and more constraints including all the three symbols ($\leq$, $\geq$, =).

Conclusion

It can be concluded that by utilizing L.P.P. technique an individual or a firm can take a better decision as to how much to be produced to get the maximum profit under resources constraints.

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