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Introduction and Related Terminology To Linear Programming Problems

SUBJECT : Mathematics
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What we expect to learn?

- Learn about representing the linear programming problems in mathematical formulation.
- Learn about the graphical solution of the linear programming problems when feasible region is bounded.
- Learn about the graphical solution of the linear programming problems when feasible region is unbounded.
- Able to apply solution methods for linear programming models.

Introduction

In Mathematics, linear programming is a method of optimising operations with some constraints. The main objective of linear programming is to maximize or minimize the numerical value. It consists of linear functions which are subjected to the constraints in the form of linear equations or in the form of inequalities. Linear programming is considered an important technique that is used to find the optimum resource utilization. The term “linear programming” consists of two words as linear and programming. The word “linear” defines the relationship between multiple variables with degree one. The word “programming” defines the process of selecting the best solution from various alternatives.

Linear Programming is widely used in Mathematics and some other fields such as economics, business, telecommunication, and manufacturing fields. In this chapter, let us discuss the definition of linear programming, its components, and different methods to solve linear programming problems.

Some Related Terminology

Optimization Problems

To find the minimum or maximum values, based on some conditions are known as Optimization Problems.

For example:

Maximise the profit, if the Number of hours worked < 10, etc.

Some Related Terminology

Linear Programming

Linear programming is an optimization technique for a system of linear constraints and a linear objective function. For obtaining the maximum or minimum values as required of a linear expression to satisfy a certain number of given linear restrictions.

Linear programming deals with that class of problems for which all relations among the variables are linear.

Some Related Terminology

Linear Programming Problem (LPP)

The linear programming problem in general calls for optimizing a linear function of variables called the objective function subject to a set of linear equations and/or linear inequations called the constraints or restrictions.

Objective Function

The function which is to be optimized (maximized/minimized) is called an objective function.

$e.g.$ Maximum $Z = 250\,x + 120\,y$

Some Related Terminology

Constraints

The system of linear inequations (or equations) under which the objective function is to be optimized is called constraints.

$$e.g. -2x + 5y \geq 10, \qquad 5x - y \geq 0$$

Non-negative Restrictions

All the variables considered for making decisions assume non-negative values.

Mathematical Description of a General Linear Programming Problem

A general LPP can be stated as (Max/Min)$Z = c_1x_1 + c_2x_2 + \cdots + c_nx_n$ (Objective function) subject to constraints

$$\left.\begin{array}{l} a_{11}x_1 + a_{12}x_2 + \ldots + a_{1n}x_n (\leq = \geq)\ b_1 \\ a_{21}x_1 + a_{22}x_2 + \ldots + a_{2n}x_n\ (\leq = \geq)\ b_2 \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \end{array}\right\}$$

$$a_{m_1}x_1 + a_{m_2}x_2 + \ldots + a_{m_n}x_n\ (\leq = \geq)\ b_m$$

and the non-negative restrictions $x_1, x_2, \ldots\ldots, x_n \geq 0$

where all $a_{11}, a_{12}, \ldots\ldots, a_{mn}$; $bl, b_2, \ldots\ldots, bm$ are constants; $c_l, c_2, \ldots\ldots, c_n$ are constants known as cost coefficients and $x_1, x_2, \ldots\ldots, x_n$ are known as decision variables.

Different Type of Linear Programming Problems

The various types of problems in linear programming problems are included.

They are

- **Manufacturing problem-** Here we maximize the profit with the help of minimum utilization of the resource.
- **Diet Problem-** We determine the number of different nutrients in a diet to minimize the cost of manufacturing **resource**
- **Transportation problem-** Here we determine the schedule to find the cheapest way of transporting a product at minimum time.
- **Assignment Problem –**It deals with the allocation of the various resources to the various activities on one to one basis.

Assignments

Fill in the blanks:

1. In LPP, the function is to be optimized is called _____.
2. The objective function of an LPP is a _____.
3. The system of linear inequations under which the objective function is to be optimized is called as _____.

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