Introduction

15 January 2021 18:23

'Optimum' - Finding the best from the given set of alternatives.

- Involves decision making at management and technological level.
- Decision goals are
  (i) Minimize effort
  (ii) Maximize benefit
- 'effort or benefit' can be expressed as a function of certain decision / design variables
- 'Optimization' is the process of finding the maximum or minimum value of a function under certain conditions
  ↓
  Constraints
- Optimum seeking methods are known as Mathematical Programming Techniques.
- Mathematical programming technique is a part of Operations Research (OR).
- OR is a branch of Mathematics concerned with the application of

> Scientific methods and techniques to decision making problems in order to find optimum solution.

- OR Methods

Mathematical Programming Techniques	Stochastic process Techniques	Statistical Methods
- Linear	- Queuing	- Regression
- Non linear	- Simulation	- Cluster Analysis
- Dynamic	- Reliability	
- Integer		

- Existence of OR is due to the following Mathematicians

- Lagrange, - Bernoulli, - Euler, - Cauchy	Calculus
- Bellman	Dynamic programming
- Dantzig	Simplex Method
- Kuhn Tucker	Non Linear Programming

Applications

- Design of Aircraft
- Civil Engineering Structure

- Water resource system
- Design of Mechanical Components
- Shortest path
- Control system etc.

Statement of Optimization Problem

An optimization or Mathematical programming problem can be stated as follows.

Find $X = \begin{Bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{Bmatrix}$ which minimizes $f(X)$.

Subject to the Constraints

$$g_i(X) \leq 0 \quad i = 1, 2, \ldots m$$

$$l_j(X) = 0 \quad j = 1, 2, \ldots P$$

where

X - is an 'n' dimensional vector called as design vector (or decision)

$f(X)$ - objective function

$g_i(X)$ - Inequality Constraints

$l_j(X)$ - Equality Constraints

Components of Optimization Problem

1) Objective function

- Expresses main aim (ie) Minimize or maximize

2) Design or Decision Variables

- A set of Variables which control the Value of the objective function.
(eg. amount of different resources used)

3) Constraints

- Allow the Variables to take only Certain Values.