

# Introduction

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'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



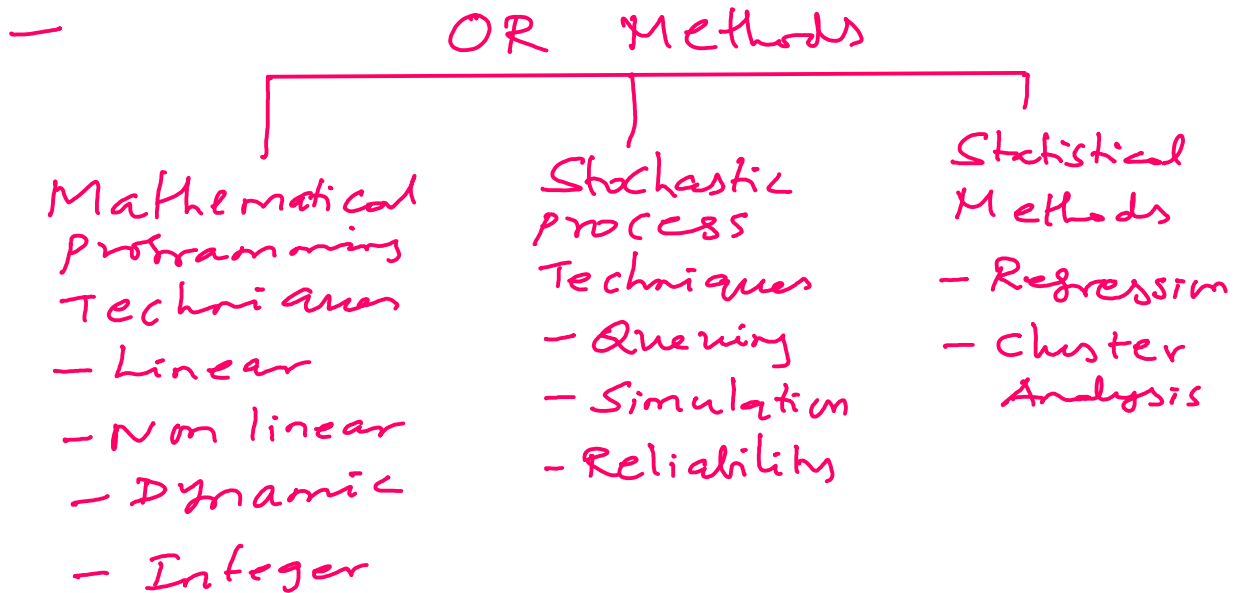
Constraints

- 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.



— 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.

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

Subject to the Constraints

$$g_i(x) \leq 0 \quad i=1,2,\dots,m$$

$$l_j(x) = 0 \quad j=1,2,\dots,p$$

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

# Component of Optimization Problem

## 1) Objective function

- Expresses main aim  
(e) 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.