**UNIT 1**

**What is OR?**

* Analytical method
* Focuses on objectives (cost, profit)
* Involves strong understanding of the underlying system

**Characteristics of OR**

* Find optimum solution by using scientific methods to reach it
* Inter-disciplinary approach
* Optimize total output (maximizing profit, minimizing cost)

**Phases of OR (Methodology)**

1. Identification of problem
2. Formulation of problem
3. Constructing a model (physical, symbolic, deterministic, probabilistic)
4. Data collection
5. Substitution of data in model
6. Establishing control
7. Implementation

**Applications of OR**

* Marketing
* Finance
* Organization Behaviour
* Allocation and Distribution in Projects
* Research and Development
* Production and Facilities Planning

**Tools of OR**

* Linear programming
* Integer programming
* Assignment problems
* Transportation problems

**Advantages of OR**

**Structured approach to problems**

* A substantial amount of time and effort can be saved in developing and solving OR models if a logical and consistent approach is followed.
* This implies that the decision maker has to be careful while defining variables, availability of resources, and functional relationships among variables in the objective function and constraints.
* This also reduces the chances of conceptual and computational errors. Any such error can also be detected easily and corrected at an early stage.

**Critical approach to problem solving**

* The decision maker will come to understand various components of the problem and accordingly select a mathematical model for solving the given problem.
* He will become aware of the explicit and implicit assumptions and limitations of such models.
* Problem solutions are examined critically and the effect of any change and error in the problem data can be studied through sensitivity analysis techniques.

**Disadvantages of OR**

* Marketing

**Interdisciplinary Approach of OR**

* OR utilizes a planned approach following a scientific method and an interdisciplinary team, in order to represent complex functional relationships as mathematical models.
* For solving any managerial decision problem, often interdisciplinary teamwork is essential.
* This is because while attempting to solve a complex management problem, one person may not have the complete knowledge of all its aspects such as economic, social, political, psychological, engineering, etc.
* Therefore, a team of various functional areas of management should be organized so that each aspect of the problem can be analyzed to arrive at a solution acceptable to all solutions of the organization.
* *“This new decision-making field has been characterized by the use of scientific knowledge through interdisciplinary team efforts for the purpose of determining the best utilization of limited resources”* – H A Taha (1976)

**Applications of OR**

* Marketing

**UNIT 4**

**Bisection Method**

* The bisection method is used to find the roots of a polynomial equation.
* It separates the interval and subdivides the interval in which the root lies.
* It works by reducing the gap between positive and negative intervals, until it corrects to the closest answer (root).
* Bisection method is based on the intermediate value theorem, which states that

*“If f(x) is a continuous function in* [*a, b*]*, and q is any number between f(a) and f(b), then there exists a number c such that f(q) = c”*

* If *f(a)* and *f(b)* are of opposite signs, there must be a number *q* in between *a* and *b*, such that *f(q) = 0*, meaning *q* is the solution of the equation.
* Steps

1. Find the interval where there exists a root, i.e., find *a* and *b*, such that *f(a)* and *f(b)* have opposite signs, then the root lies in [*a, b*]  
   (do this by trial and error using consecutive integers)
2. Compute *x*1 = *(a + b)/2* and then find *f(x*1*)*If original opposite signs were - + and *f(x*1*)* is positive, then root lies in [*a, x*1]If original opposite signs were - + and *f(x*1*)* is negative, then root lies in [*x*1*, b*]   
   If original opposite signs were + - and *f(x*1*)* is positive, then root lies in [*x*1*, b*]  
   If original opposite signs were + - and *f(x*1*)* is negative, then root lies in [*a, x*1]
3. Compute *x2 = (a + x*1*)/2 or (x*1 *+ b)/2*
4. Repeat steps 2 and 3 until the intervals rounded to 5 decimal digits are equal, or *f(xi)* rounded to 5 decimal digits is 0.

**Regula Falsi Method (False Position)**

* Steps

1. To find the interval, substitute *x* values from 0 to *m* in *f(x)*
2. Stop as soon as you get consecutive opposite signs for the value of *f(x)*
3. Compute
4. Repeat the process until two *xi* values or *f(xi)* values approximate to 0.

**Newton Raphson Method**

* Steps

1. Find *f(x)* for all *i = 0,….,n*, and select the interval based on consecutive opposite signs.
2. Select a seed point, it can be one of the ends of the interval, or any random value between the ends of the interval.
3. Find the derivative of *f(x)*, i.e., calculate *f’(x)*
4. Compute *x*i+1 *= f(xi) / f’(xi)*
5. Repeat the process till *xi* and *x*i+1 are approximately equal.

**Newton’s Forward Interpolation**

* Used to predict a data point, when the value is given or suitable data is assumed.
* Steps

1. Let h = length of interval