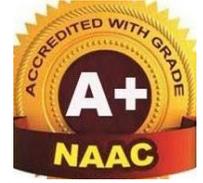




# **ROHINI COLLEGE OF ENGINEERING & TECHNOLOGY**

## **DEPARTMENT OF MATHEMATICS**



### **INTRODUCTION TO LINEAR PROGRAMMING**

Relevance of quantitative techniques in management decision making. Linear Programming - formulation, solution by graphical and simplex methods (Primal - Penalty, Two Phase), Special cases. Sensitivity Analysis.

#### **Introduction to Operations Research**

Operation Research is a relatively new discipline. The Operation Research starts when mathematical and quantitative techniques are used to substantiate the decision being taken. The main activity of a manager is the decision making. In our daily life we make the decisions even without noticing them. The decisions are taken simply by common sense, judgment and expertise without using any mathematical or any other model in simple situations. Operation Research is a scientific method of providing executive departments with a quantitative basis for decisions regarding operations under their control. The stages of development of Operation Research are as follows:

##### **Step I: Observe the problem environment:**

The first step in the process of Operation Research development is the problem environment observation. This step includes different activities; they are conferences, site visit, research, observations etc. These activities provide sufficient information to the Operation Research specialists to formulate the problem.

##### **Step II: Analyze and define the problem**

This step is analyzing and defining the problem. In this step in addition to the problem definition the objectives, uses and limitations of Operation Research study of the problem also defined. The outputs of this step are clear grasp of need for a solution and its nature understanding.

### **Step III: Develop a model**

This step develops a model; a model is a representation of some abstract or real situation. The models are basically mathematical models, which describes systems, processes in the form of equations, formula/relationships. The different activities in this step are variables definition, formulating equations etc. The model is tested in the field under different environmental constraints and modified in order to work. Sometimes the model is modified to satisfy the management with the results.

### **Step IV: Select appropriate data input**

A model works appropriately when there is appropriate data input. Hence, selecting appropriate input data is important step in the O.R. development stage or process. The activities in this step include internal/external data analysis, fact analysis, and collection of opinions and use of computer data banks. The objective of this step is to provide sufficient data input to operate and test the model developed in Step\_III.

### **Step V: Provide a solution and test its reasonableness**

This step is to get a solution with the help of model and input data. This solution is not implemented immediately, instead the solution is used to test the model and to find there is any limitations. Suppose if the solution is not reasonable or the behaviour of the model is not proper, the model is updated and modified at this stage. The output of this stage is the solution(s) that supports the current organizational objectives.

### **Operation Research Tools and Techniques:**

Operations Research uses any suitable tools or techniques available. The common frequently used tools/techniques are mathematical procedures, cost analysis, electronic computation. However, operations researchers given special importance to the development and the use of techniques like linear programming, game theory, decision theory, queuing theory, inventory models and simulation.

### **Linear Programming:**

This is a constrained optimization technique, which optimize some criterion within some constraints. In Linear programming the objective function (profit, loss or return on investment) and constraints are linear. There are different methods available to solve linear programming.

**Game Theory:**

This is used for making decisions under conflicting situations where there are one or more players/opponents. In this the motive of the players are dichotomized. The success of one player tends to be at the cost of other players and hence they are in conflict.

**Decision Theory:**

Decision theory is concerned with making decisions under conditions of complete certainty about the future outcomes and under conditions such that we can make some probability about what will happen in future.

**Queuing Theory:**

This is used in situations where the queue is formed (for example customers waiting for service, aircraft waiting for landing, jobs waiting for processing in the computer system, etc). The objective here is minimizing the cost of waiting without increasing the cost of servicing.

**Inventory Models:**

Inventory model make a decisions that minimize total inventory cost. This model successfully reduces the total cost of purchasing, carrying, and out of stock inventory.

**Simulation:**

Simulation is a procedure that studies a problem by creating a model of the process involved in the problem and then through a series of organized trials and error solutions attempt to determine the best solution. Sometimes this is a difficult/time consuming procedure. Simulation is used when actual experimentation is not feasible or solution of model is not possible.

**Non-linear Programming:**

This is used when the objective function and the constraints are not linear in nature. Linear relationships may be applied to approximate non-linear constraints but limited to some range, because approximation becomes poorer as the range is extended. Thus, the non-linear programming is used to determine the approximation in which a solution lies and then the solution is obtained using linear methods.

**Dynamic Programming:**

Dynamic programming is a method of analyzing multistage decision processes. In this each elementary decision depends on those preceding decisions and as well as external factors.

### **Integer Programming:**

If one or more variables of the problem take integral values only then dynamic programming method is used. For example number of motor in an organization, number of passenger in an aircraft, number of generators in a power generating plant, etc.

### **Markov Process:**

Markov process permits to predict changes over time information about the behavior of a system is known. This is used in decision making in situations where the various states are defined. The probability from one state to another state is known and depends on the current state and is independent of how we have arrived at that particular state.

### **Network Scheduling:**

This technique is used extensively to plan, schedule, and monitor large projects (for example computer system installation, R & D design, construction, maintenance, etc.). The aim of this technique is minimize trouble spots (such as delays, interruption, production bottlenecks, etc.) by identifying the critical factors. The different activities and their relationships of the entire project are represented diagrammatically with the help of networks and arrows, which is used for identifying critical activities and path. There are two main types of technique in network scheduling, they are:

Program Evaluation and Review Technique (PERT) – is used when activities time is not known accurately/ only probabilistic estimate of time is available.

Critical Path Method (CPM) – is used when activities time is know accurately.

### **Information Theory:**

This analytical process is transferred from the electrical communication field to O.R. field. The objective of this theory is to evaluate the effectiveness of flow of information with a given system. This is used mainly in communication networks but also has indirect influence in simulating the examination of business organizational structure with a view of enhancing flow of information.

### **Applications of Operations Research**

Today, almost all fields of business and government utilizing the benefits of Operations

Research. There are voluminous applications of Operations Research. Although it is not feasible to cover all applications of Operations Research in brief. The following are the abbreviated set of typical operations research applications to show how widely these techniques are used today:

**Marketing:** Selection of product mix; Location of plants, warehouses and retail outlets; Advertising decisions; Competitive strategies.

**Production:** Production planning; Production scheduling; Sequencing of jobs; Assignment of jobs to machines; Purchase and inventory management; Maintenance policies.

**Finance:** Capital expenditure, replacement decisions.

**HR:** Recruitment, assignment of jobs.

**Other industry applications:** Resource allocation; Implementation of projects; Planning of service facilities.

**Other applications:** Banking, Hospitals, Traffic control, Agriculture, Defence, Government.

### **Limitations of Operations Research**

Operations Research has number of applications; similarly it also has certain limitations.

These limitations are mostly related to the model building and money and time factors problems involved in its application. Some of them are as given below:

- i) Distance between O.R. specialist and Manager
- ii) Magnitude of Calculations
- iii) Money and Time Costs
- iv) Non-quantifiable Factors
- v) Implementation