

# Introduction to Operations Research

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# Introduction

**OPERATIONS RESEARCH** is a branch of mathematics - specially applied mathematics, used to provide a scientific base for management to take timely and effective decisions to their problems.

Management is the multidimensional and dynamic concept. It is multidimensional, because management problems and their solutions have consequences in several dimensions, such as human, economic social and political fields. As the manager operates his system in an environment, which will never remain static, hence is dynamic in nature.

Operations research analyst list out alternative solutions and their consequences to ease manager's work of decision making. Operations research gives rationality to decision-making with clear view of possible consequences.



# Definitions

A **decision** is the conclusion of a process designed to weigh the relative uses or utilities of a set of alternatives on hand, so that decision maker selects the best alternative which is best to his problem.

**Decision Making** involves all activities and thinking that are necessary to identify the most optimal or preferred choice among the available alternatives. The basic requirements of decision-making are (i) A set of goals or objectives, (ii) Methods of evaluating alternatives in an objective manner, (iii) A system of choice criteria and a method of projecting the repercussions of alternative choices of courses of action.

In Operations Research, we are concerned with how to choose optimal strategy under specified set of assumptions, including all available strategies and their associated payoffs.

## OBJECTIVE OF OPERATIONS RESEARCH

The objective of Operations Research is to provide a scientific basis to the decision maker for solving the problems involving the interaction of various components of an organization by employing a team of scientists from various disciplines, all working together for finding a solution which is in the best interest of the organisation as a whole. The best solution thus obtained is known as optimal decision.

# Definition of Operations Research

- Operations Research uses Scientific Methods for making decisions.
- It is interdisciplinary approach for solving problems and it uses the knowledge and experience of experts in various fields.
- While analyzing the problems all aspects are considered and examined and analyzed scientifically for finding the optimal solution for the problem on hand.
- As operations research has scientific approach, it improves the quality of answers to the problems.
- Operations research provides scientific base for decision-making and provide scientific substitute for judgement and intuition.

# Characteristics of Operations Research

- Operations Research is an interdisciplinary team approach.
- Operations Research increases the creative ability of the decision maker
- Operations Research is a systems approach

# SCOPE OF OPERATIONS RESEARCH

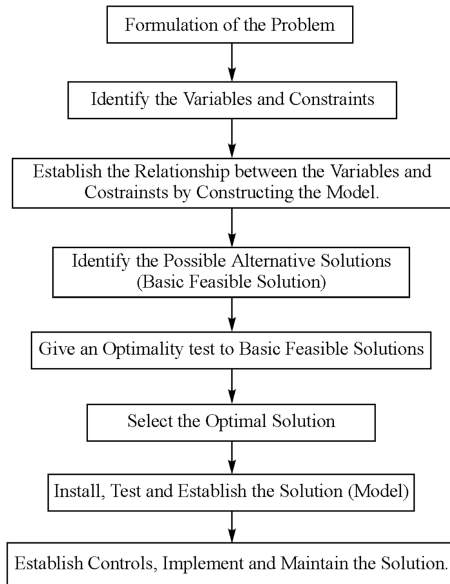
- Defense Operations - resource allocation model, transportation model  
Linear Programming, Game theory, and inventory models
- Industry - decision trees, inventory model, Linear Programming model, Transportation model, Sequencing model, Assignment model and replacement models are helpful to the managers to solve various problems, they face in their day to day work.
- Planning For Economic Growth - how many engineers, doctors, software people etc. are required in future and what should be their quality to face the then problems etc. can be easily solved.
- Agriculture - demand, yeild, selection of land amd time to sow
- Traffic control - proper timing of traffic signaling is necessary. queuing theory.
- Hospitals - queuing theory and allocation.





# Modeling an Operations Research Problem

# PHASES IN SOLVING OPERATIONS RESEARCH PROBLEMS



# Some of the Points to be Remembered while Building a Model

- When we can solve the situation with a simple model, do not try to build a complicated model.
- Build a model that can be easily fit in the techniques available. Do not try to search for a technique, which suit your model.
- In order to avoid complications while solving the problem, the fabrication stage of modeling must be conducted rigorously.
- Before implementing the model, it should be validated / tested properly.
- Use the model for which it is deduced. Do not use the model for the purpose for which it is not meant.

# Some of the Points to be Remembered while Building a Model

- Without having a clear idea for which the model is built do not use it. It is better before using the model; you consult an operations research analyst and take his guidance.
- Models cannot replace decision makers. It can guide them but it cannot make decisions. Do not be under the impression, that a model solves every type of problem.
- The model should be as accurate as possible.
- A model should be as simple as possible.
- Benefits of model are always associated with the process by which it is developed.

# Advantages of a Good Model

- A model provides logical and systematic approach to the problem.
- It provides the analyst a base for understanding the problem and think of methods of solving.
- The model will avoid the duplication work in solving the problem.
- Models fix the limitation and scope of an activity.
- Models help the analyst to find newer ways of solving the problem.
- Models saves resources like money, time etc.
- Model helps analyst to make complexities of a real environment simple. Risk of tampering the real object is reduced, when a model of the real system is subjected to experimental analysis.
- Models provide distilled economic descriptions and explanations of the operation of the system they represent.

# Limitations of a Model

- Models are constructed only to understand the problem and attempt to solve the problem; they are not to be considered as real problem or system.
- The validity of any model can be verified by conducting the experimental analysis and with relevant data characteristics.

# Characteristics of a Good Model

- The number of parameters considered in a model should be less to understand the problem easily.
- A good model should be flexible to accommodate any necessary information during the stages of building the model.
- A model must take less time to construct.
- A model may be accompanied by lower and upper bounds of parametric values.



## Some Models in Operations Research



# Linear Programming Model

This model is used for resource allocation when the resources are limited and there are number of competing candidates for the use of resources. The model may be used to maximise the returns or minimise the costs. Formulate a programme to distribute the commodity from factories to markets at minimum cost ( transportation model). Allocate the jobs or orders to the machines, so as to complete all the jobs in minimum time ( Assignment model).

# Sequencing Model

When a manufacturing firm has some job orders, which can be processed on two or three machines and the processing times of each job on each machine is known, then the problem of processing in a sequence to minimise the cost or time is known as Sequencing model.

# Queuing Model

A model used for solving a problem where certain service facilities have to provide service to its customers, so as to avoid lengthy waiting line or queue, so that customers will get satisfaction from effective service and idle time of service facilities are minimised is waiting line model or queuing model.

# Replacement Model

Any capital item, which is continuously used for providing service or for producing the product is subjected to wear and tear due to usage, and its efficiency goes on reducing. This reduction in efficiency can be predicted by the increasing number of breakdowns or reduced productivity. The worn out parts or components are to be replaced to bring the machine back to work. This action is known as maintenance. A time is reached when the maintenance cost becomes very high and the manager feels to replace the old machine by new one. This type of problems known as replacement problems and can be solved by replacement models.

# Inventory Model

Any manufacturing firm has to maintain stock of materials for its use. This stock of materials, which are maintained in stores, is known as inventory. Inventory is one form of capital or money. The company has to maintain inventory at optimal cost. There are different types of inventory problems, depending the availability and demand pattern of the materials. These can be solved by the application of inventory models.