UNIT – I

Introduction

Quantitative Techniques for Managers is a relatively new discipline. The contents and the boundaries of the OR are not yet fixed. Therefore, to give a formal definition of the term Quantitative Techniques for Managers is a difficult task. The OR 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.

But the decision we are concerned here with are complex and heavily responsible. Examples are public transportation network planning in a city having its own layout of factories, residential blocks or finding the appropriate product mix when there exists a large number of products with different profit contributions and production requirement etc. Quantitative Techniques for Managers tools are not from any one discipline.

Quantitative Techniques for Managers takes tools from different discipline such as mathematics, statistics, economics, psychology, engineering etc. and combines these tools to make a new set of knowledge for decision making.

Today, O.R. became a professional discipline which deals with the application of scientific methods for making decision, and especially to the allocation of scarce resources. The main purpose of O.R. is to provide a rational basis for decisions making in the absence of complete information, because the systems composed of human, machine, and procedures may do not have complete information. Quantitative Techniques for Managers can also be treated as science in the sense it describing, understanding and predicting the systems behaviour, especially man-machine system.

Thus O.R. specialists are involved in three classical aspect of science, they are as follows:

    i)   Determining the systems behaviour
    ii)   Analyzing the systems behaviour by developing appropriate models
    iii)   Predict the future behaviour using these models

Definitions

According to Saaty, "O.R. as tool of improving quality of answers. O.R. is the art of giving bad answers to problems which otherwise have worse answers".

According to Miller and Starr state, "O.R. is applied decision theory, which uses any scientific, mathematical or logical means to attempt to cope with the problems that confront the executive, when he tries to achieve a thorough-going rationality in dealing with his decision problem".

According to Morse and Kimball, "O.R. is a quantitative approach and described it as " a scientific method of providing executive departments with a quantitative basis for decisions regarding the operations under their control".

Scope of Quantitative Techniques for Managers

1. Observe the problem environment.
2. Analyze and define the problem.
3. Develop a model.
4. Select appropriate data input.
5. Provide a solution and test its reasonableness.
6. Implement the solution.

Tools and Techniques of Quantitative Techniques for Managers

Quantitative Techniques for Managers uses any suitable tools or techniques available. The common frequently used tools/techniques are mathematical procedures, cost analysis, electronic computation.

However, Quantitative Techniques for Managersers given special importance to the development and the use of techniques like linear programming, game theory, decision theory, queuing theory, inventory models and simulation. In addition to the above techniques, some other common tools are non-linear programming, integer programming, dynamic programming, sequencing theory, Markov process, network scheduling (PERT/CPM), symbolic Model, information theory, and value theory. There is many other Quantitative Techniques for Managers tools/techniques also exists. The brief explanations of some of the above techniques/tools are as follows:

1. **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.
2. **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.
3. **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.
4. **Queuing Theory:** Choose the solution to be used. 'Sell' the decision to operating managers; get their understanding and cooperation. This is used in situations where the queue is formed (for example customers waiting for service, aircrafts 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.
5. **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.

6. **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.

7. **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.

8. **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.

9. **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: -
   i)   **Program Evaluation and Review Technique (PERT) –** is used when activities time is not known accurately/ only probabilistic estimate of time is available.
   ii)   **Critical Path Method (CPM) –** is used when activities time is know accurately.

10. **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 Quantitative Techniques for Managers

Almost all fields of business and government utilizing the benefits of Quantitative Techniques for Managers. There are voluminous of applications of Quantitative Techniques for Managers. Although it is not feasible to cover all applications of O.R. in brief. The following are the abbreviated set of typical Quantitative Techniques for Managers applications to show how widely these techniques are used today:

1. **Accounting:**
   Assigning audit teams effectively
   Credit policy analysis
   Cash flow planning

Developing standard costs
Establishing costs for byproducts
Planning of delinquent account strategy

2. **Construction:**
   Project scheduling, monitoring and control
   Determination of proper work force
   Deployment of work force
   Allocation of resources to projects

3. **Facilities Planning:**
   Factory location and size decision
   Estimation of number of facilities required
   Hospital planning
   International logistic system design
   Transportation loading and unloading
   Warehouse location decision

4. **Finance:**
   Building cash management models
   Allocating capital among various alternatives
   Building financial planning models
   Investment analysis
   Portfolio analysis
   Dividend policy making

5. **Manufacturing:**
   Inventory control
   Marketing balance projection
   Production scheduling
   Production smoothing

6. **Marketing:**
   Advertising budget allocation
   Product introduction timing
   Selection of Product mix
   Deciding most effective packaging alternative

7. **Organizational Behavior / Human Resources:**
   Personnel planning
   Recruitment of employees
   Skill balancing
   Training program scheduling
   Designing organizational structure more effectively

8. **Purchasing:**
   Optimal buying
   Optimal reordering

Materials transfer
9. **Research and Development:**
   R & D Projects control
   R & D Budget allocation
   Planning of Product introduction

Limitations of Quantitative Techniques for Managers

Quantitative Techniques for Managers 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: -** Quantitative Techniques for Managersers job needs a mathematician or statistician, who might not be aware of the business problems. Similarly, a manager is unable to understand the complex nature of Quantitative Techniques for Managers. Thus there is a big gap between the two personnel.

ii) **Magnitude of Calculations: -** The aim of the O.R. is to find out optimal solution taking into consideration all the factors. In this modern world these factors are enormous and expressing them in quantitative model and establishing relationships among these require voluminous calculations, which can be handled only by machines.

iii) **Money and Time Costs: -** The basic data are subjected to frequent changes, incorporating these changes into the Quantitative Techniques for Managers models is very expensive. However, a fairly good solution at present may be more desirable than a perfect Quantitative Techniques for Managers solution available in future or after some time.

iv) **Non-quantifiable Factors: -** When all the factors related to a problem can be quantifiable only then Quantitative Techniques for Managers provides solution otherwise not. The non-quantifiable factors are not incorporated in O.R. models. Importantly O.R. models do not take into account emotional factors or qualitative factors.

v) **Implementation: -** Once the decision has been taken it should be implemented. The implementation of decisions is a delicate task. This task must take into account the complexities of human relations and behavior and in some times only the psychological factors.