

# ***Operational Research***

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# ***Textbook***

***Quantitative Analysis for Management,  
Eleventh Edition,  
by Render, Stair, and Hanna***

# ***Learning Objectives***

**After completing this course, students will be able to:**

- 1. Tackle a wide variety of problems by OR.**
- 2. Understand the steps of conducting mathematical analysis.**
- 3. Explain the advantages and disadvantages of OR.**
- 4. Understand alternative Methods for Operational Research packages available.**

# ***Assessment***

Assessment	Weight
Midterm	30%
Section	10%
Final Exam	60%

**Bonus**

# *What is OR*



- ***Operations***
- **The activities carried out in an organization.**
- ***Research:* The process of observation and testing characterized by the scientific method. Situation, problem statement, model construction, validation, experimentation, candidate solutions.**

# *Operations Research* is an Art and Science

- Primary applications areas of Operations Research include
- forecasting,
- production scheduling,
- inventory control,
- capital budgeting,
- and transportation



# Operations Research



- is the scientific approach to execute decision making, which consists of:
  - The art of *mathematical modeling* of complex situations
  - The science of the development of *solution techniques* used to solve these models
  - The ability to effectively *communicate* the results to the decision maker

# ***Importance of OR in Decision making***



- Undoubtedly, decisions hold immense significance in an organization.
- For enhanced decision-making and problem solving, operation research is pivotal. A decision can be made after analyzing all the relevant information, facts and data. This is where operation research proves utilitarian.
- Operation Research is considered to be the most supportive means in management because it can help in resolving any **uncertain** or **complex problem** easily.



# ***Importance of OR in Decision making Cont.***

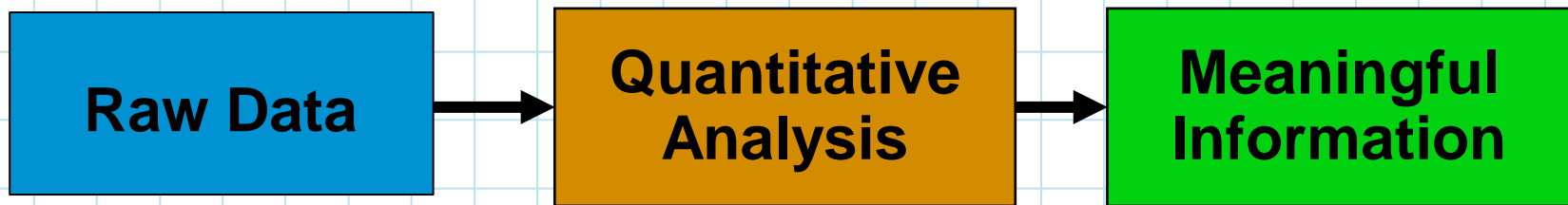
- Different methods such as simulation, queuing theory, game theory, which are part of operation research are considered as major helpers in the decision-making process.



# ***What is Quantitative Analysis?***



***Quantitative analysis*** is a scientific approach to managerial decision making in which raw data are processed and manipulated to produce meaningful information.





In solving a problem, managers must  
consider both qualitative and  
quantitative factors

# ***Quantitative Verses Qualitative factors***



## ■ ***Quantitative factors***

- **are data that can be accurately calculated.**

**Examples include:**

- **Different investment alternatives**
- **Interest rates**
- **Inventory levels**
- **Demand**
- **Labor cost**

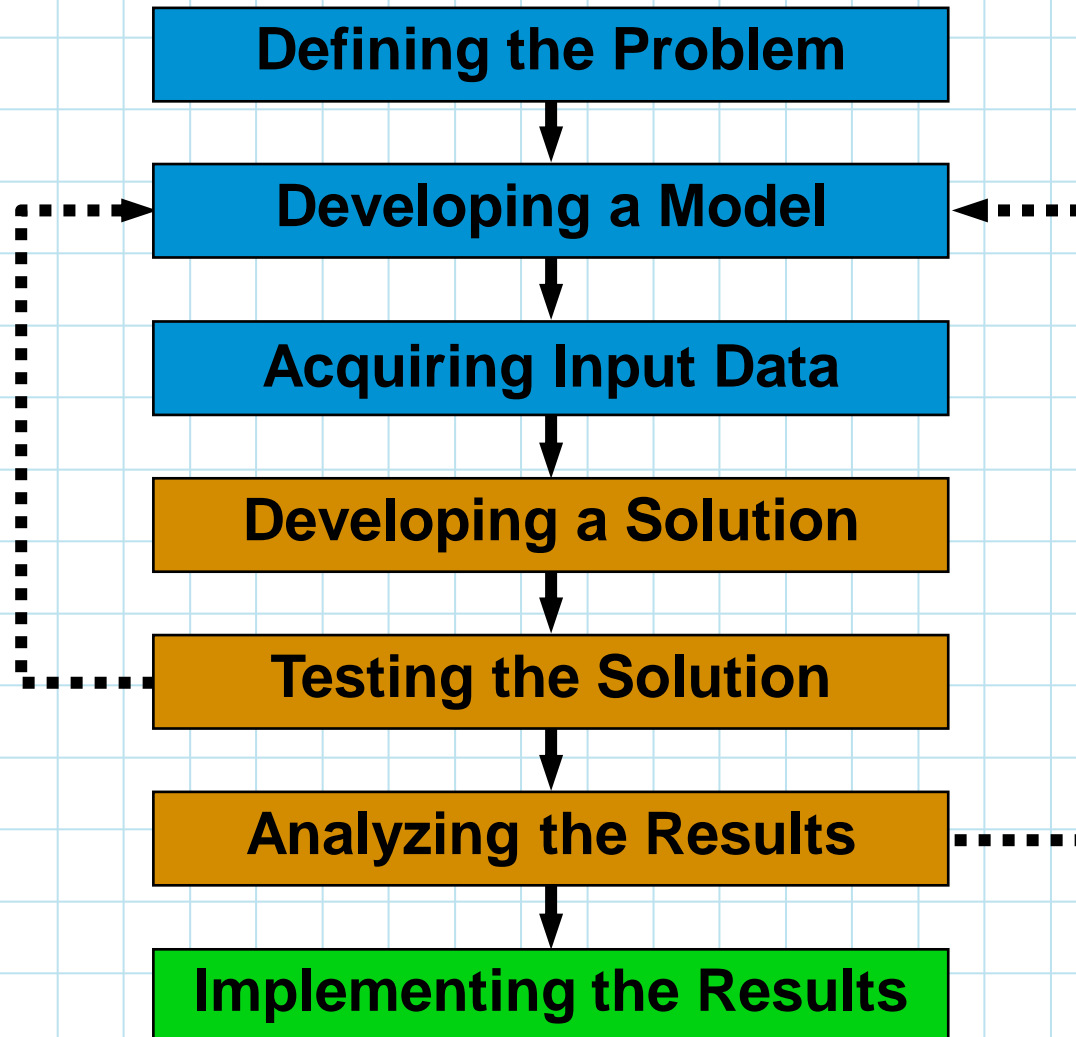
## ■ ***Qualitative factors***

- **are more difficult to quantify but affect the decision process. Examples include:**

- **The weather**
- **State of laws**
- **Technological breakthroughs.**



# ***The Quantitative Analysis Approach***



**Figure 1.1**

# ***Defining the Problem***



**Develop a clear and concise statement that gives direction and meaning to subsequent steps.**

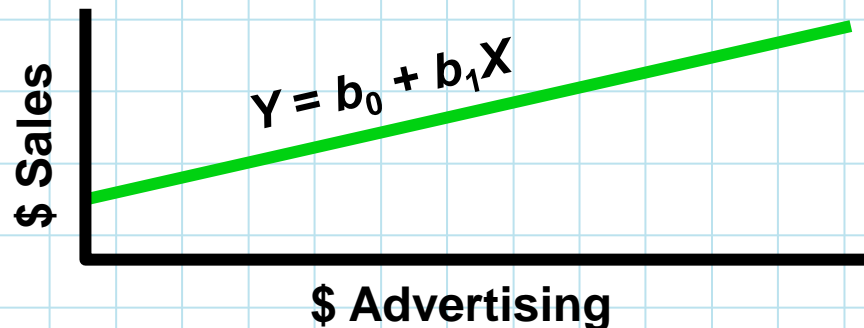
- **This may be the most important and difficult step.**
- **It is essential to go beyond symptoms and identify true causes.**
- **It may be necessary to concentrate on only a few of the problems – selecting the right problems is very important**
- **Specific and measurable objectives may have to be developed.**



# ***Developing a Model***



**Quantitative analysis models are realistic, solvable, and understandable mathematical representations of a situation.**

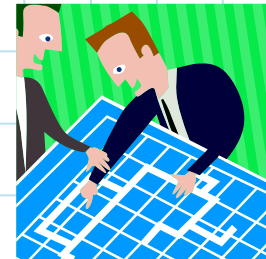


**There are different types of models:**

**Scale  
models**



**Schematic  
models**



# ***Developing a Model***



**Models generally contain variables (controllable and uncontrollable) and parameters.**



- **Controllable variables are the decision variables and are generally unknown.**
  - **How many items should be ordered for inventory?**
- **Uncontrollable variables are unknown variables that I cannot control.**
- **Parameters are known quantities that are a part of the model.**
  - **What is the holding cost of the inventory?**

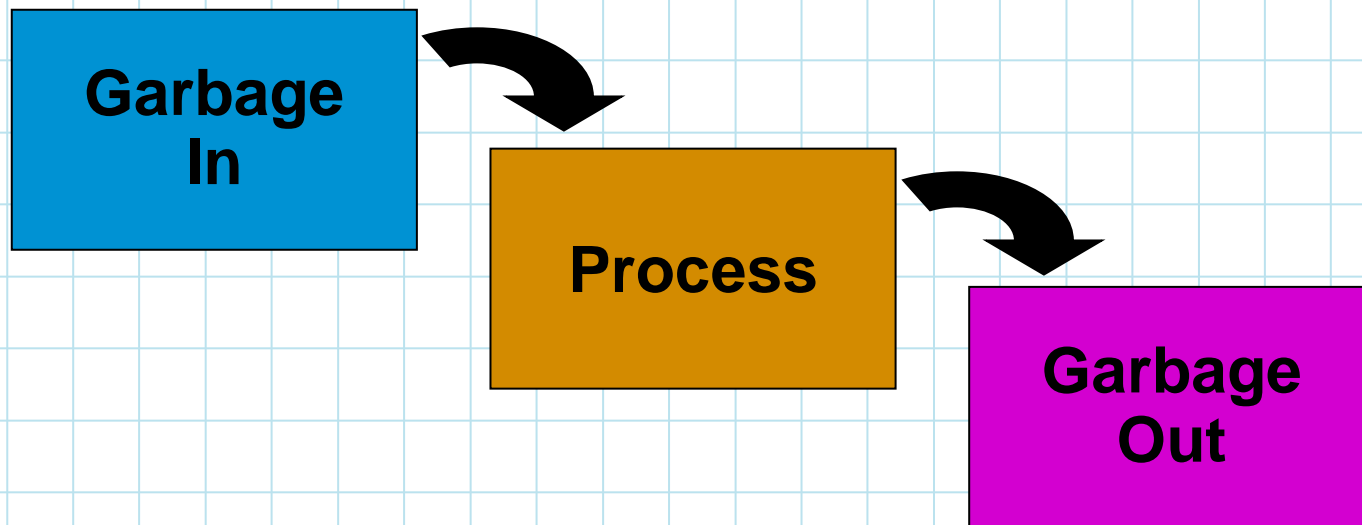




# ***Acquiring Input Data***



**Input data must be accurate – GIGO rule:**



**Data may come from a variety of sources such as company reports, company documents, interviews, on-site direct measurement, or statistical sampling.**

# ***Developing a Solution***



**The best (optimal) solution to a problem is found by manipulating the model variables until a solution is found that is practical and can be implemented.**

**Common techniques are**

- ***Solving*** equations.
- ***Trial and error*** – trying various approaches and picking the best result.
- ***Complete enumeration*** – trying all possible values.
- Using an ***algorithm*** – a series of repeating steps to reach a solution.

# ***Testing the Solution***



**Both input data and the model should be tested for accuracy before analysis and implementation.**

- **New data can be collected to test the model.**
- **Results should be logical, consistent, and represent the real situation.**

# ***Analyzing the Results***



**Determine the implications of the solution:**

- **Implementing results often requires change in an organization.**
- **The impact of actions or changes needs to be studied and understood before implementation.**

***Sensitivity analysis*** determines how much the results will change if the model or input data changes.

- **Sensitive models should be very thoroughly tested.**

# ***Implementing the Results***



**Implementation incorporates the solution into the company.**

- **Implementation can be very difficult.**
- **People may be resistant to changes.**
- **Many quantitative analysis efforts have failed because a good, workable solution was not properly implemented.**

**Changes occur over time, so even successful implementations must be monitored to determine if modifications are necessary.**

# ***Advantages of Mathematical Modeling***



- 1. Models can accurately represent reality.**
- 2. Models can help a decision maker formulate problems.**
- 3. Models can give us insight and information.**
- 4. Models can save time and money in decision making and problem solving.**
- 5. A model may be the only way to solve large or complex problems in a timely fashion.**
- 6. A model can be used to communicate problems and solutions to others.**

# ***Possible Problems in the Quantitative Analysis Approach***

## **Defining the problem**

- Problems may not be easily identified.
- There may be conflicting viewpoints
- There may be an impact on other departments.
- Beginning assumptions may lead to a particular conclusion.
- The solution may be outdated.



## **Developing a model**

- Manager's perception may not fit a textbook model.
- There is a trade-off between complexity and ease of understanding.

# ***Possible Problems in the Quantitative Analysis Approach***



## **Acquiring accurate input data**

- Accounting data may not be collected for quantitative problems.
- The validity of the data may be suspect.

## **Developing an appropriate solution**

- The mathematics may be hard to understand.
- Having only one answer may be limiting.

## **Testing the solution for validity**

## **Analyzing the results in terms of the whole organization**



# ***Implementation – Not Just the Final Step***



**There may be an institutional lack of commitment and resistance to change.**

- **Management may fear the use of formal analysis processes will reduce their decision-making power.**
- **Action-oriented managers may want “quick and dirty” techniques.**
- **Management support and user involvement are important.**