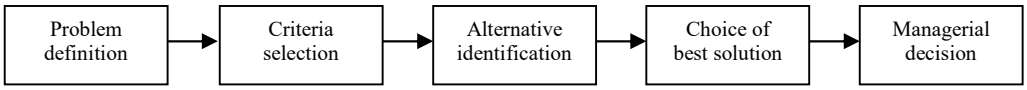
CHAPTER 1
INTRODUCTION TO MODELING AND DECISION ANALYSIS

1. Decision-making

   . As shown in the following diagram, decision-making is a process of selecting the best course of action that involves five steps:



   . While experience, judgment, intuition, hunch, rule of thumb, and even "flying by the seat of one's pants" might all be helpful in managing an organization, systematic and rational methods are called for to make sound decisions consistently especially when the manager is faced with a complex problem.

2. Modeling

   . In the fourth step of the decision-making process, choice of best solution, the modeling approach is often taken to decide which of the alternatives being considered is the best based on the decision criterion. Specifically, the business problem associated with each alternative is formulated as a mathematical model and solved optimally. The one with the best optimal solution (e.g., the highest profit or the lowest cost) is then selected.

   . A model is a simplified representation of a system, entity, phenomenon, or process of interest. Models may be classified as follows:

      (1) Physical (or scale) model - It is made of tangible components to represent a system.

      (2) Abstract model - It is a conceptual representation of a system that does not have a concrete existence. Abstract models can be further divided into two categories:

         (i) Logical model - It describes the logical relationships between the components of a system.

         (ii) Mathematical model - It describes the mathematical relationships between the components of a system.

3. Mathematical Models

   . In general, a mathematical model may be represented by the function $y = f(x_1, x_2, \ldots, x_n)$, where $x_1, x_2, \ldots, x_n$ are the independent (or input) variables and y is the dependent (or output) variable.

   . There are three types of mathematical models:

      (1) Descriptive model - The solution shows what y will be given $x_1, x_2, \ldots, x_n$ when the functional relationship f(.) is known.

      (2) Predictive model - The functional relationship between $x_1, x_2, \ldots, x_n$ and y is unknown and the solution is an estimation of f(.) so that one can predict what y will be given $x_1, x_2, \ldots, x_n$.

      (3) Prescriptive model - The solution indicates what $x_1, x_2, \ldots, x_n$ should be in order to optimize (maximize or minimize) y when the functional relationship f(.) is known.

4. Prescriptive Analytics vs. Business Analytics

   . Analytics is concerned with the discovery, interpretation, and communication of meaningful patterns in data (especially big data).

   . Business analytics (BA) is a new, fast growing area of study that involves the use of mathematical models, statistical techniques, and computer technologies to identify patterns and relationships in massive data for the purpose of making better business decisions.

   . Prescriptive analytics is an integral part of BA that deals with modeling and optimization of business problems. It is the focal point of this course.

5. Applications of Prescriptive Analytics

   . What follows is a table showing a wide range of industries and areas where prescriptive analytics has been successfully applied:

Finance	**Production**	**Human resource management**
Pension fund investment	Line balancing	Work shift scheduling
Cash management	Facility location	Labor/management negotiation
Portfolio management	Plant layout	Personnel evaluation
Cash flow analysis	Product mix	Recruitment and promotion
Education	**Health care**	**International business**
Teaching assignment	Nurse scheduling	Global financing
Curriculum design	Diagnosis and therapy	Multinational joint ventures
Course timetabling	Blood distribution	Global manufacturing
Capital budget planning	Ambulance dispatching	International logistics
Urban-social issues	**Military operations**	**Purchasing**
Municipal zoning	Space vehicle reliability	Material management
City planning	Satellite queuing	Vendor selection
Highway traffic control	Missile defense strategy	Order allocation
Police beat design	Search and rescue efforts	Competitive bidding
Marketing	**Environmental concerns**	**Miscellaneous**
Advertising management	Natural resource planning	Agricultural feed mix
New product analysis	Solid waste disposal	Casino design
Retail promotion strategy	Pollution control	Airline flight scheduling
Market mix analysis	Obnoxious facility siting	Energy policy analysis