DECISION SUPPORT SYSTEMS

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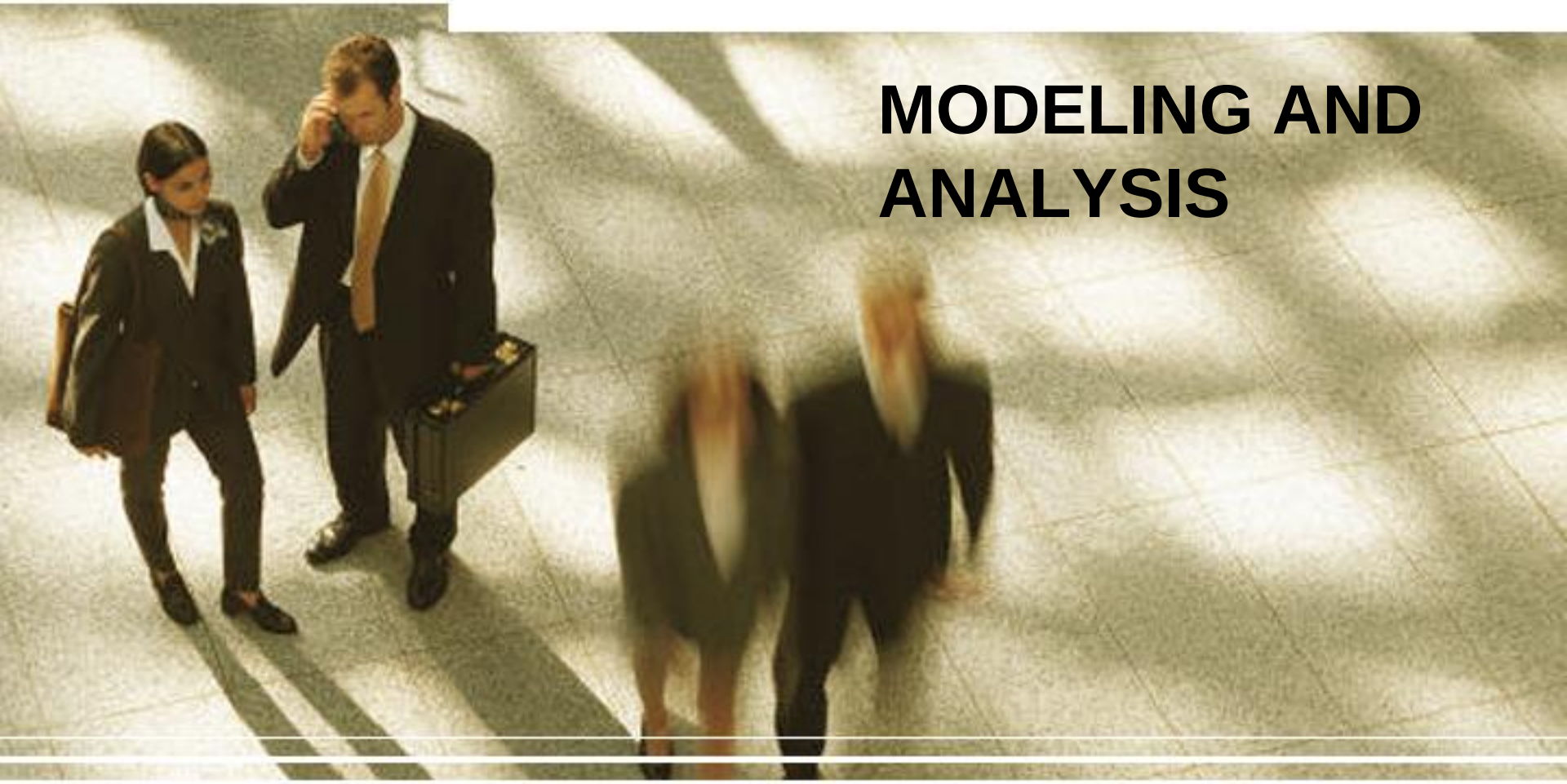
CENTRAL UNIVERSITY

FAITH • INTEGRITY • EXCELLENCE

Chapter 4



MODELING AND ANALYSIS

MSS Modeling

- Current modeling issues
  - Variable identification
  - **Forecasting**

  Predicting the future
  - *Predictive analytics* systems attempt to predict the most profitable customers, the worst customers, and focus on identifying products and services at appropriate prices to appeal to them
  - Multiple models: A DSS can include several models, each of which represents a different part of the decision-making problem

MSS Modeling

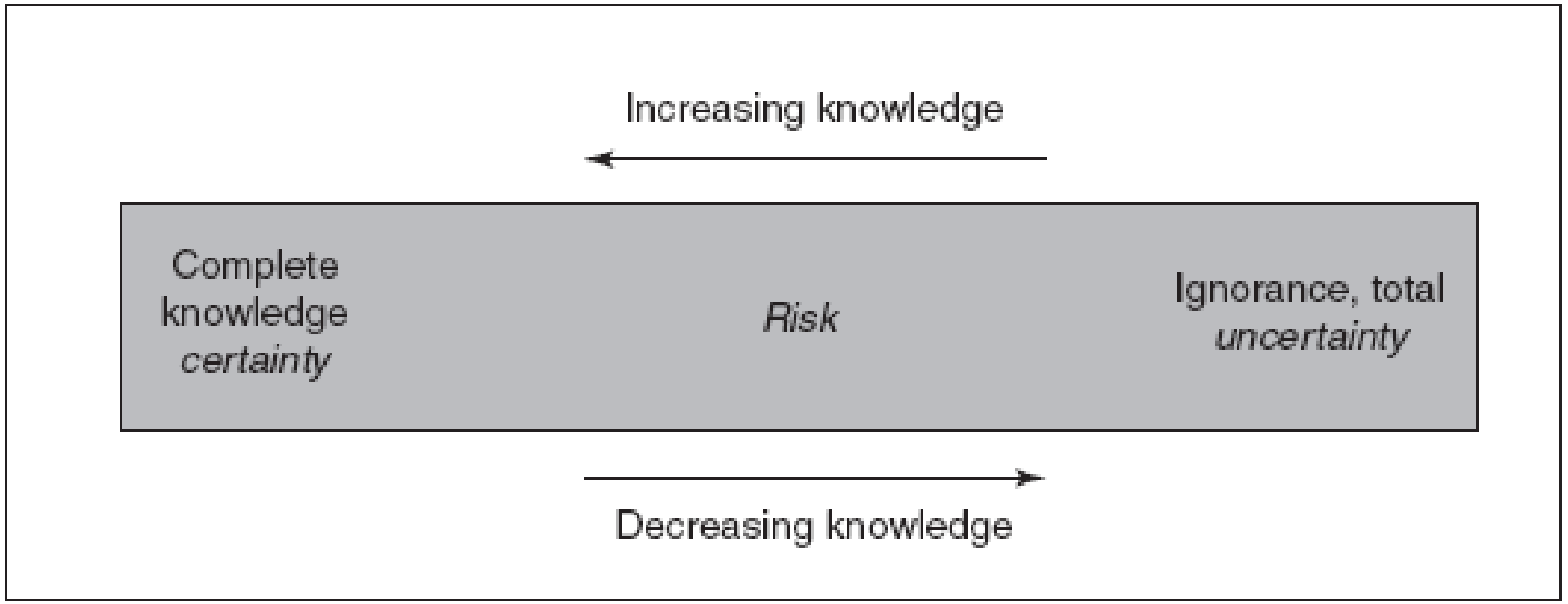
- Current trends
  - **Multidimensional analysis (modeling)**

    A modeling method that involves data analysis in several dimensions
  - **Influence diagram**

    A diagram that shows the various types of variables in a problem (e.g., decision, independent, result) and how they are related to each other

Certainty, Uncertainty, and Risk

FIGURE 4.1 The Zones of Decision Making



Certainty, Uncertainty, and Risk

- **Certainty**

  A condition under which it is assumed that future values are known for sure and only one result is associated with an action

- **Uncertainty**

  In expert systems, a value that cannot be determined during a consultation. Many expert systems can accommodate uncertainty; that is, they allow the user to indicate whether he or she does not know the answer

- **Risk**

  A probabilistic or stochastic decision situation

- **Risk analysis**

  A decision-making method that analyzes the risk (based on assumed known probabilities) associated with different alternatives. Also known as calculated risk

MSS Modeling with Spreadsheets

- Models can be developed and implemented in a variety of programming languages and systems
- The spreadsheet is clearly the most popular *end-user modeling tool* because it incorporates many powerful financial, statistical, mathematical, and other functions
- Other important spreadsheet features include what-if analysis, goal seeking, data management, and programmability

MSS Modeling with Spreadsheets

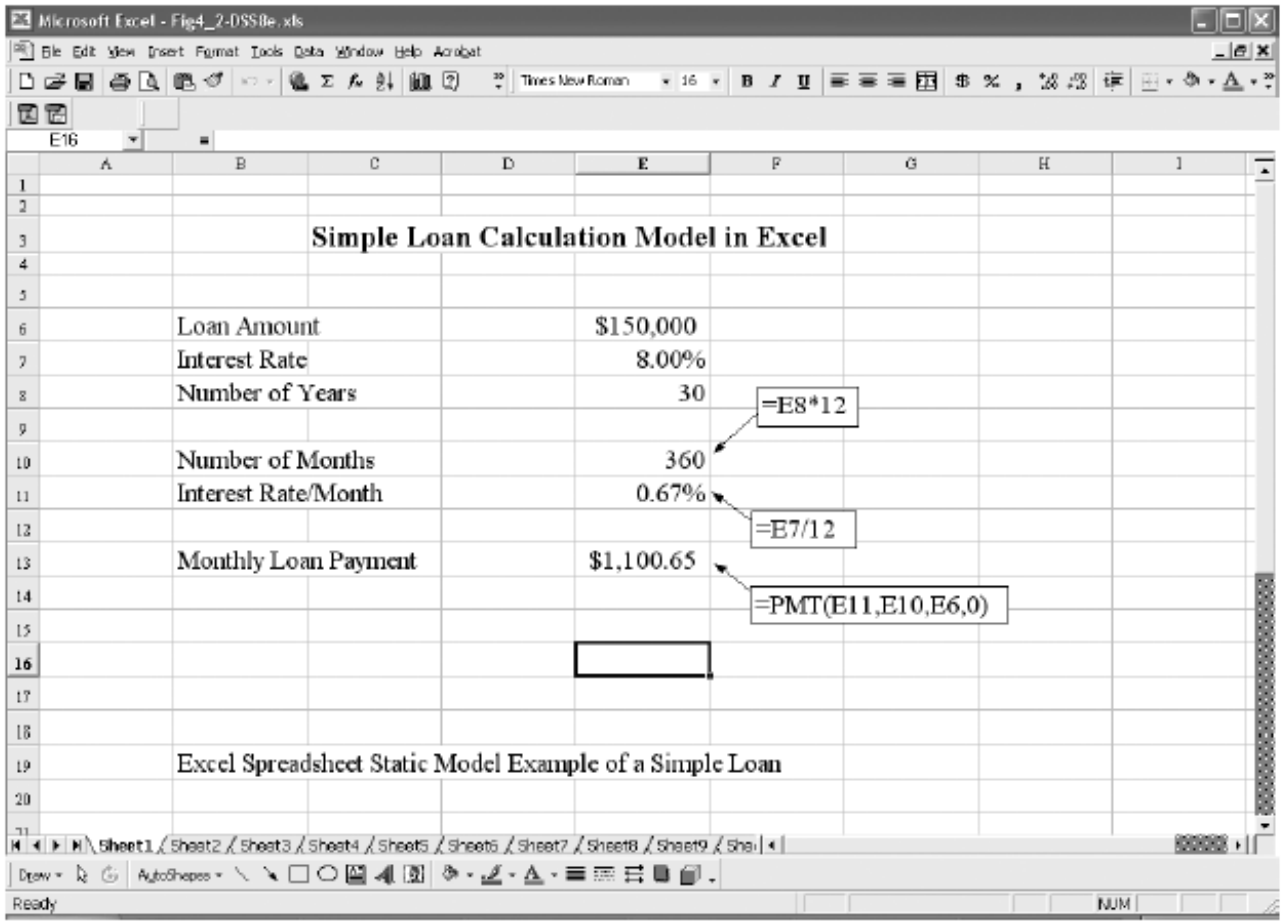


FIGURE 4.2 Excel Spreadsheet Static Model Example of a Simple Loan Calculation of Monthly Payments

MSS Modeling with Spreadsheets

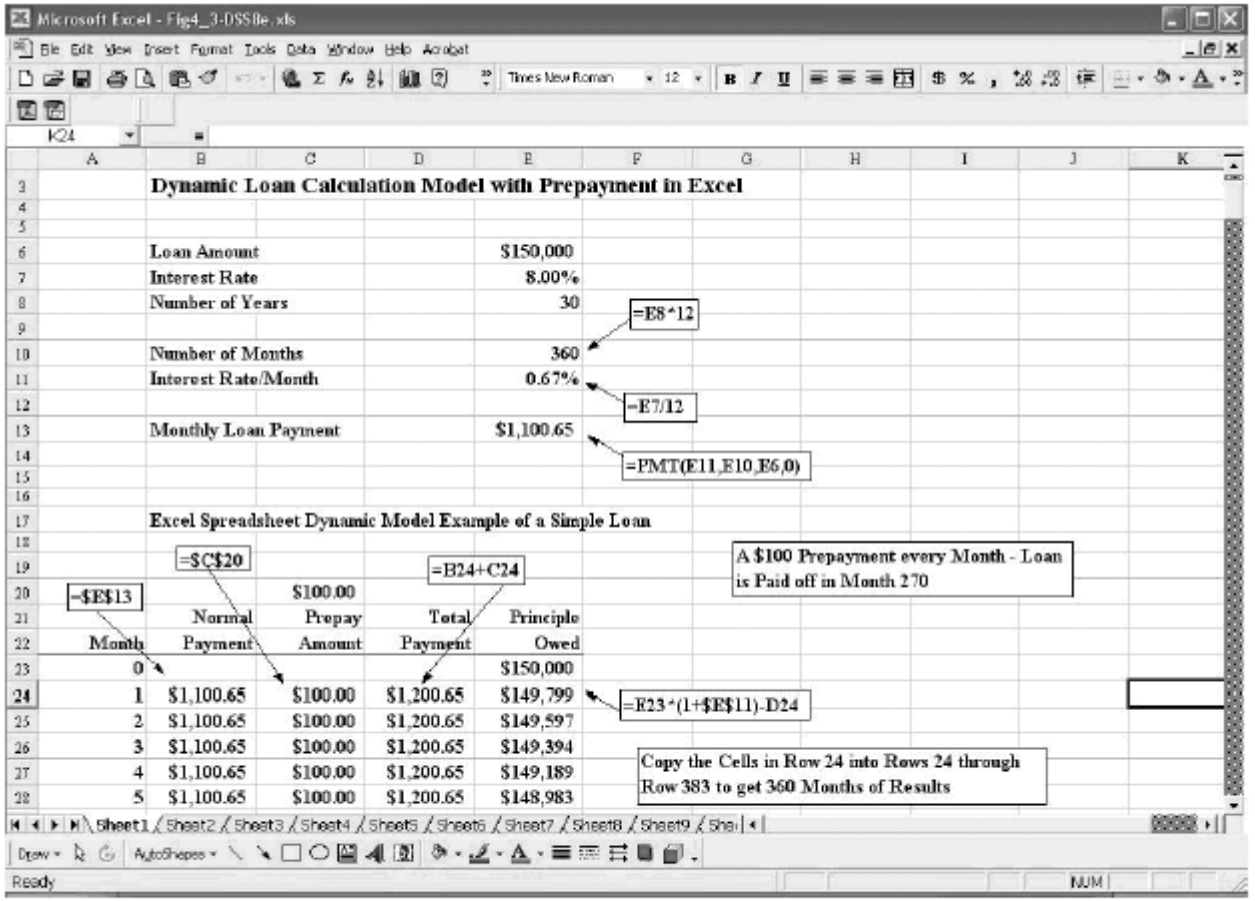


FIGURE 4.3 Excel Spreadsheet Dynamic Model Example of a Simple Loan Calculation of Monthly Payments and the Effects of Prepayment

Decision Analysis with Decision Tables and Decision Trees

- **Decision analysis**

  Methods for determining the solution to a problem, typically when it is inappropriate to use iterative algorithms

- **Decision table**

  A table used to represent knowledge and prepare it for analysis in:

  - Treating uncertainty
  - Treating risk

Decision Tables

Can summarize complex decision logic better than structured English

Incorporate logic into the table structure to make descriptions more readable

YTD purchases > $250	YES						NO					
Number of Items (N)	N≤3			N≥4			N≤3			N≥4		
Delivery Day	Next	2nd	7th	Next	2nd	7th	Next	2nd	7th	Next	2nd	7th
Shipping Charge ($)	25	10	N*1.50	N*6.00	N*2.50	Free	35	15	10	N*7.50	N*3.50	N*2.50

Decision Analysis with Decision Tables and Decision Trees

- **Decision tree**

  A graphical presentation of a sequence of interrelated decisions to be made under assumed risk

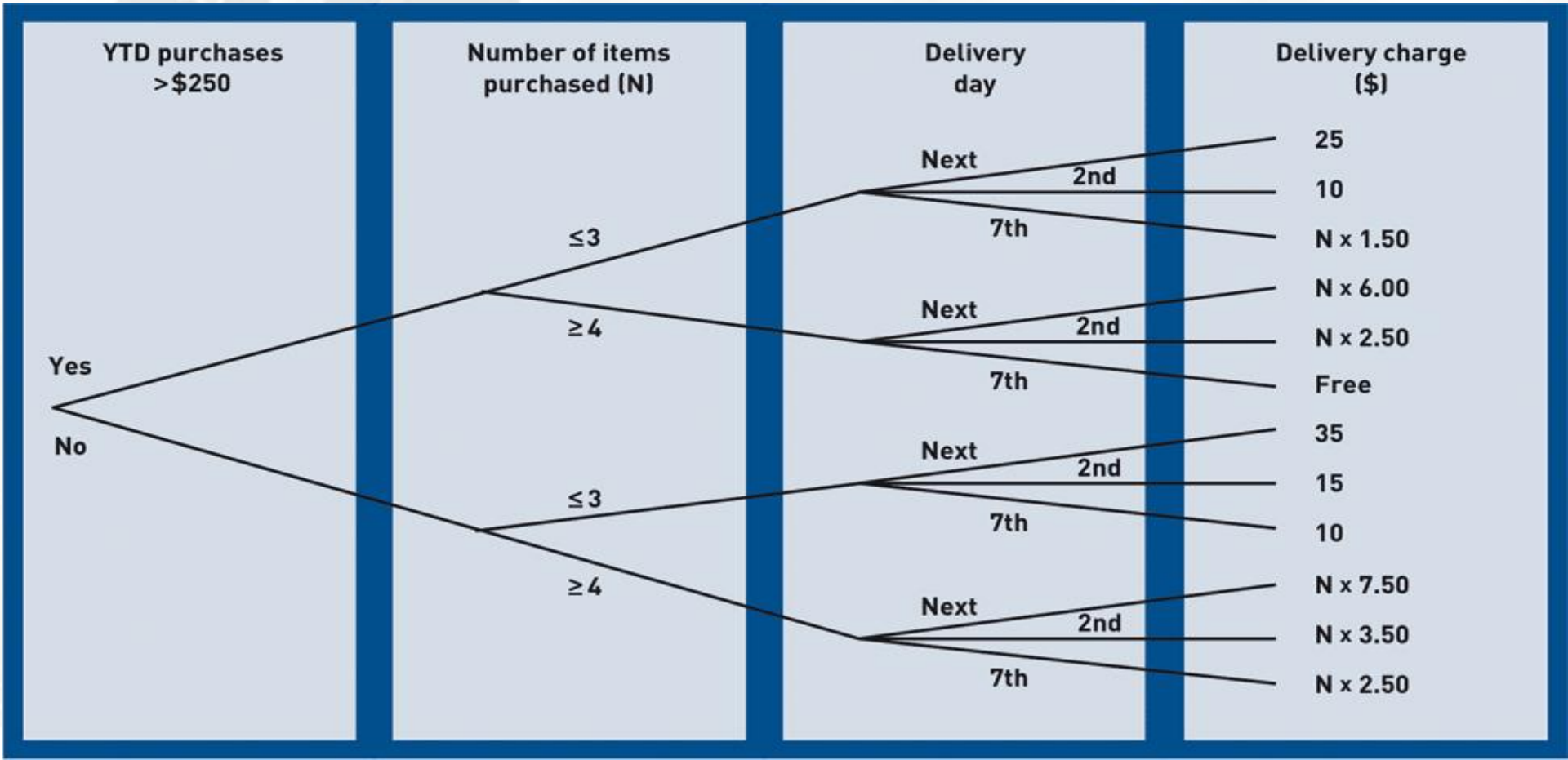
- **Multiple goals**

  Refers to a decision situation in which alternatives are evaluated with several, sometimes conflicting, goals

Decision Tree for Calculating Shipping Charges

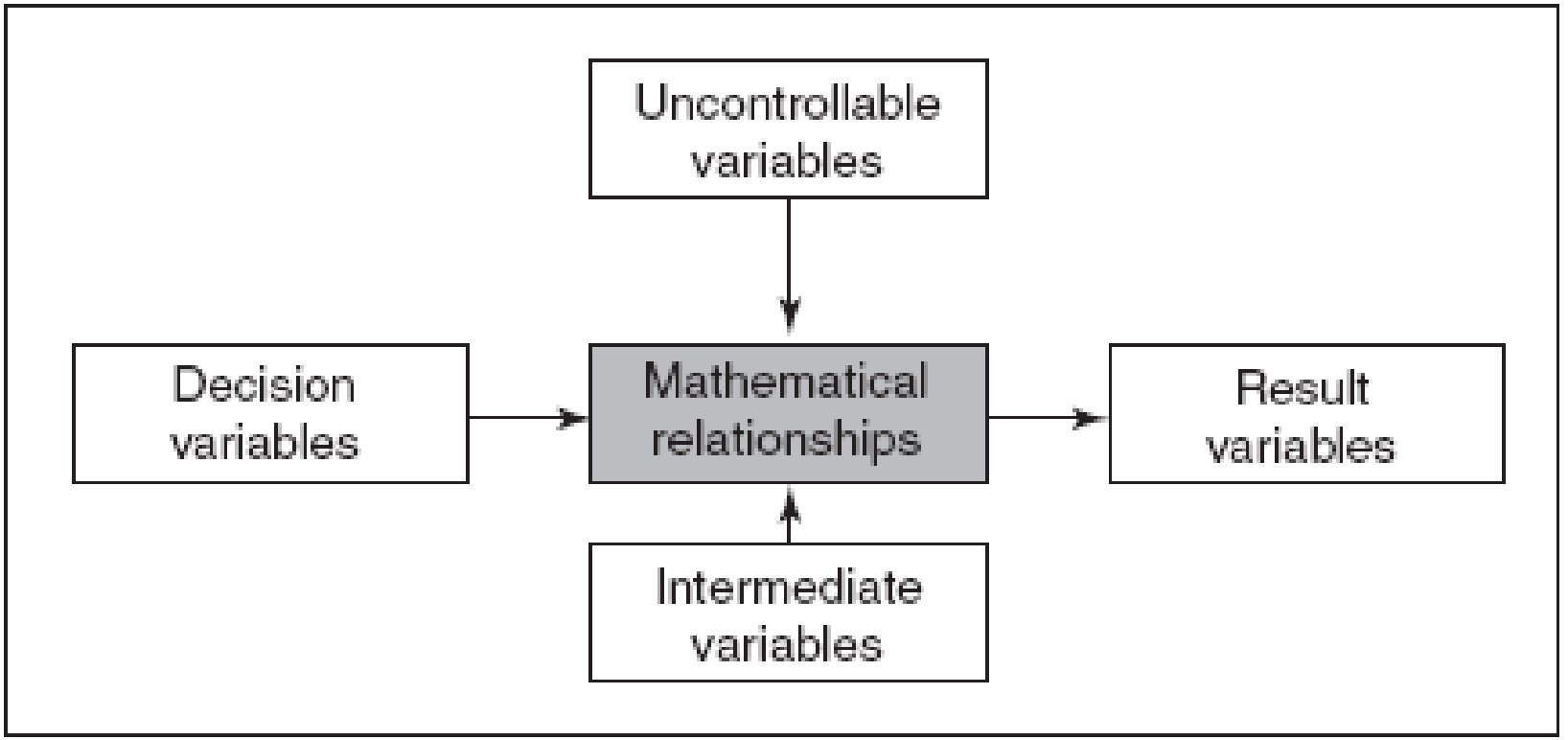
Can summarize complex decision logic better than structured English

Incorporate logic into the tree structure to make descriptions more readable



The Structure of Mathematical Models for Decision Support

FIGURE 4.4 The General Structure of a Quantitative Model



The Structure of Mathematical Models for Decision Support

- Components of decision support mathematical models
  - **Result (outcome) variable**

    A variable that expresses the result of a decision (e.g., one concerning profit), usually one of the goals of a decision-making problem
  - **Decision variable**

    A variable of a model that can be changed and manipulated by a decision maker. The decision variables correspond to the decisions to be made, such as quantity to produce and amounts of resources to allocate

The Structure of Mathematical Models for Decision Support

- **Uncontrollable variable (parameter)**

  A factor that affects the result of a decision but is not under the control of the decision maker. These variables can be internal (e.g., related to technology or to policies) or external (e.g., related to legal issues or to climate)

- **Intermediate result variable**

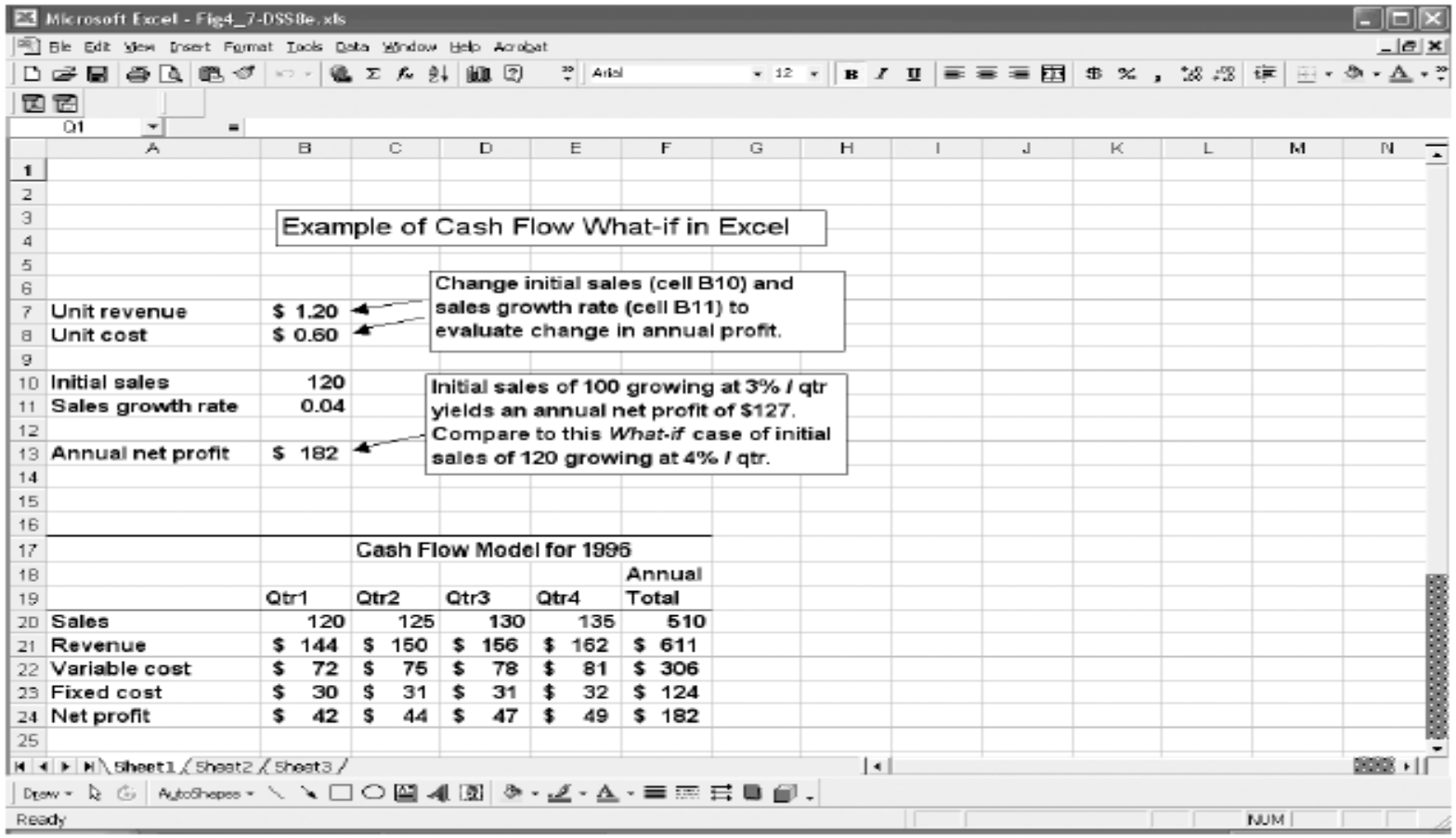
  A variable that contains the values of intermediate outcomes in mathematical models

What-If Analysis, and Goal Seeking

- **What-If Analysis**

A process that involves asking a computer what the effect of changing some of the input data or parameters would be

FIGURE 4.7 Example of a What-If Analysis Done in an Excel Worksheet

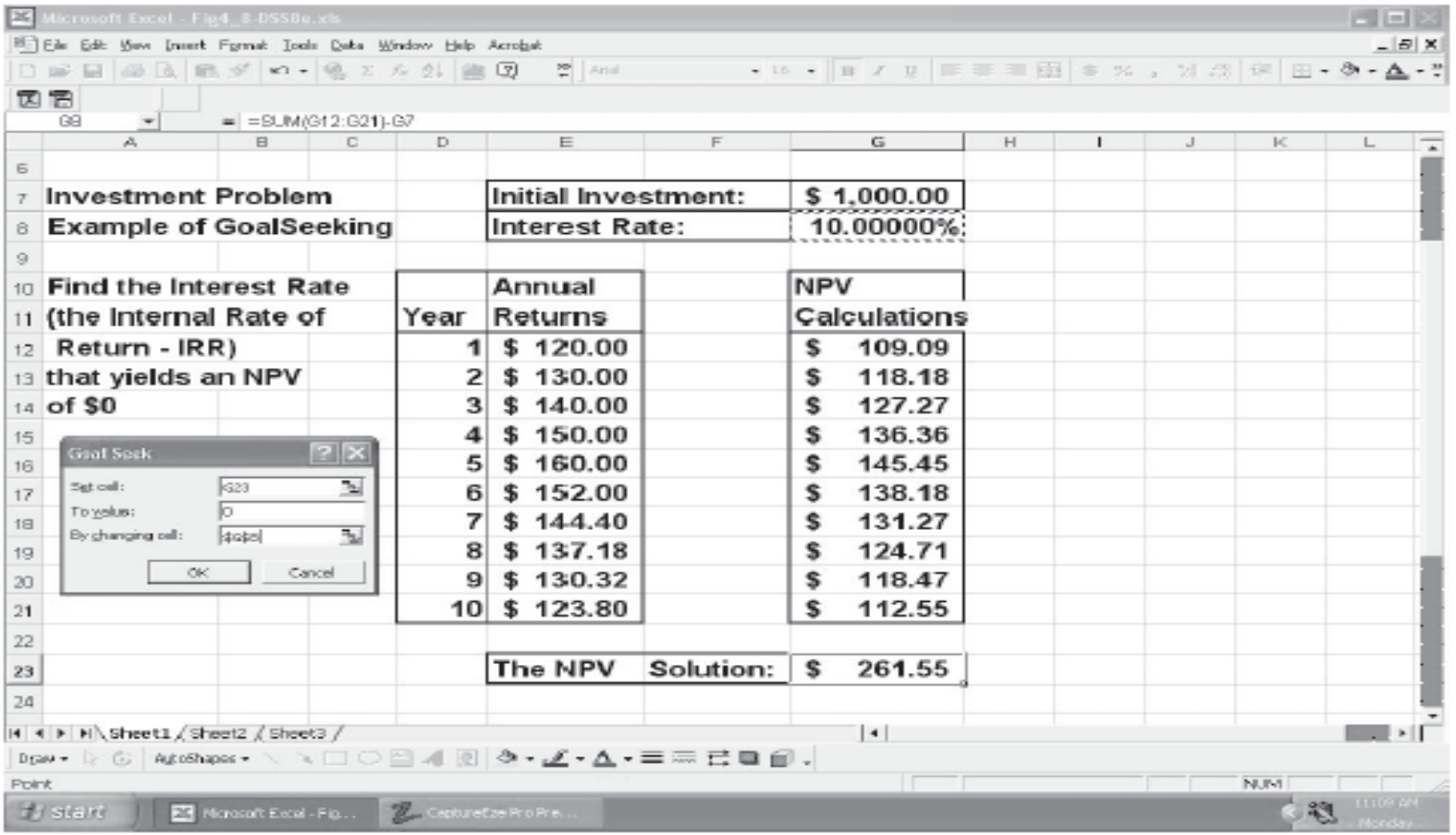


What-If Analysis, and Goal Seeking

- **Goal seeking**

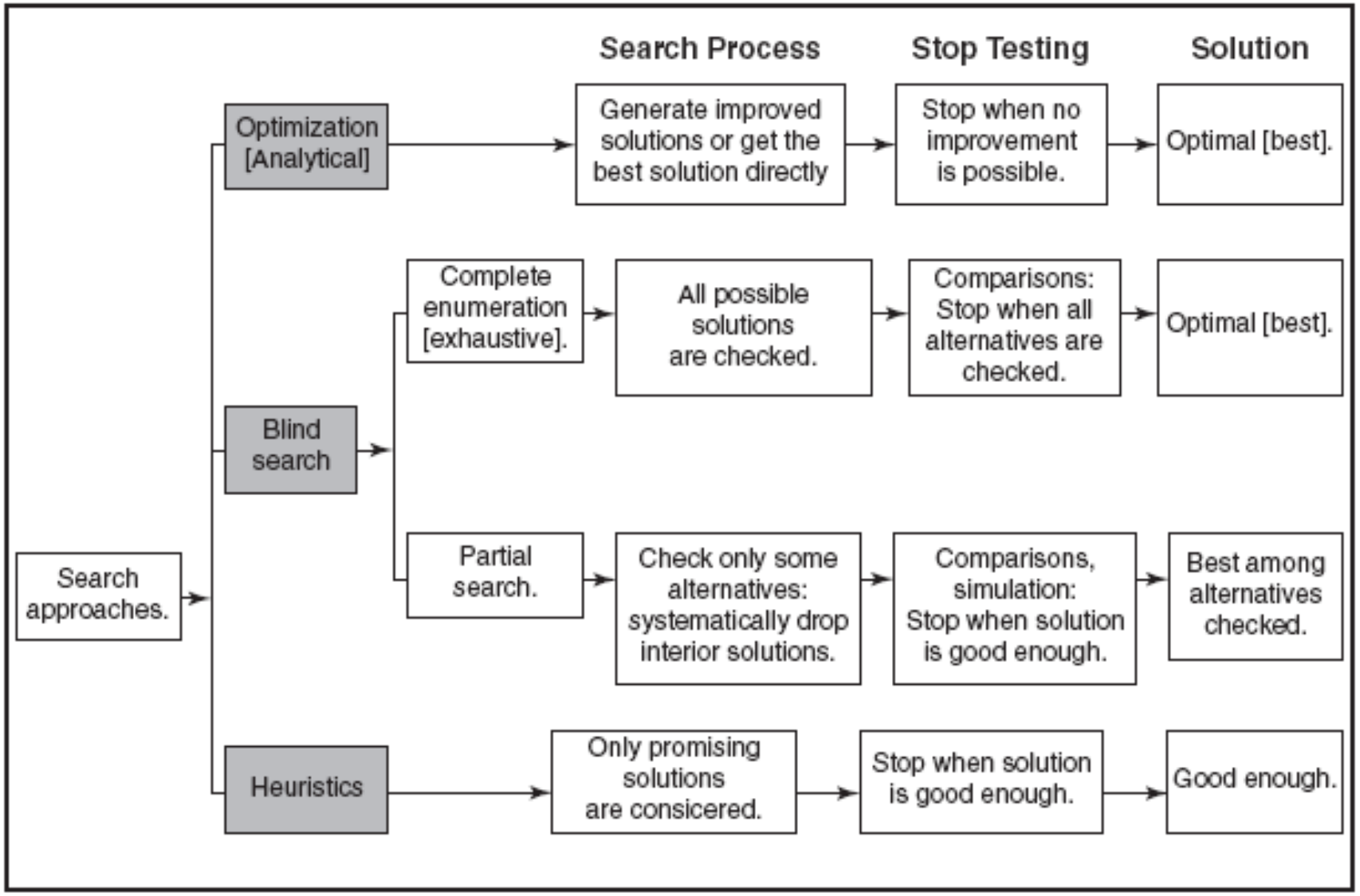
Asking a computer what values certain variables must have in order to attain desired goals

FIGURE 4.8 Goal Seeking Analysis



Problem-Solving Search Methods

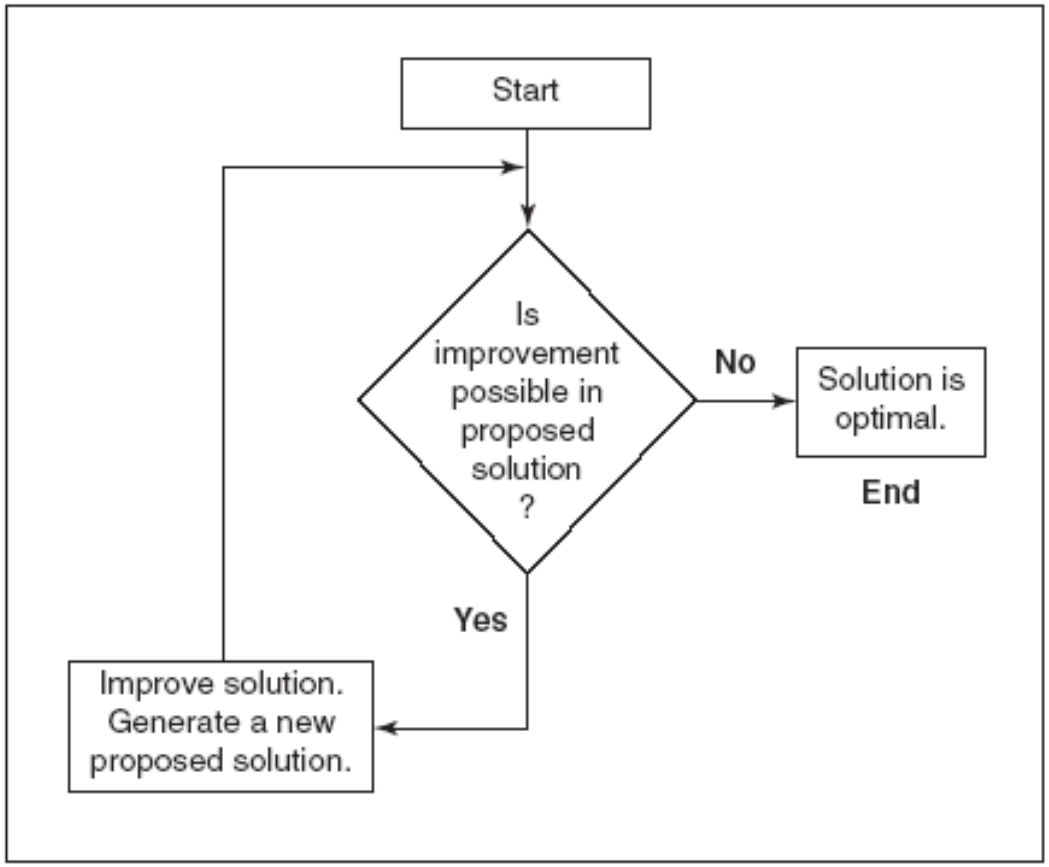
FIGURE 4.9 Formal Search Approaches



Problem-Solving Search Methods

- Analytical techniques use mathematical formulas to derive an optimal solution directly or to predict a certain result
- An algorithm is a step-by-step search process for obtaining an optimal solution

FIGURE 4.10 The Process of Using an Algorithm



Problem-Solving Search Methods

- A *goal* is a description of a desired solution to a problem
- The *search steps* are a set of possible steps leading from initial conditions to the goal
- Problem solving is done by searching through the possible solutions
- *Blind search* techniques are arbitrary search approaches that are not guided

Simulation

- **Simulation**

  An imitation of reality
- **Major characteristics of simulation**
  - Simulation is a technique for *conducting experiments*
  - Simulation is a *descriptive* rather than a *normative* method
  - Simulation is normally used only when a problem is too complex to be treated using numerical optimization techniques

Simulation

- **Complexity**

  A measure of how difficult a problem is in terms of its formulation for optimization, its required optimization effort, or its stochastic nature

Simulation

- Advantages of simulation
  - The theory is fairly straightforward.
  - A great amount of *time compression* can be attained
  - A manager can experiment with different alternatives
  - The MSS builder must constantly interact with the manager
  - The model is built from the manager's perspective.
  - The simulation model is built for one particular problem

Simulation

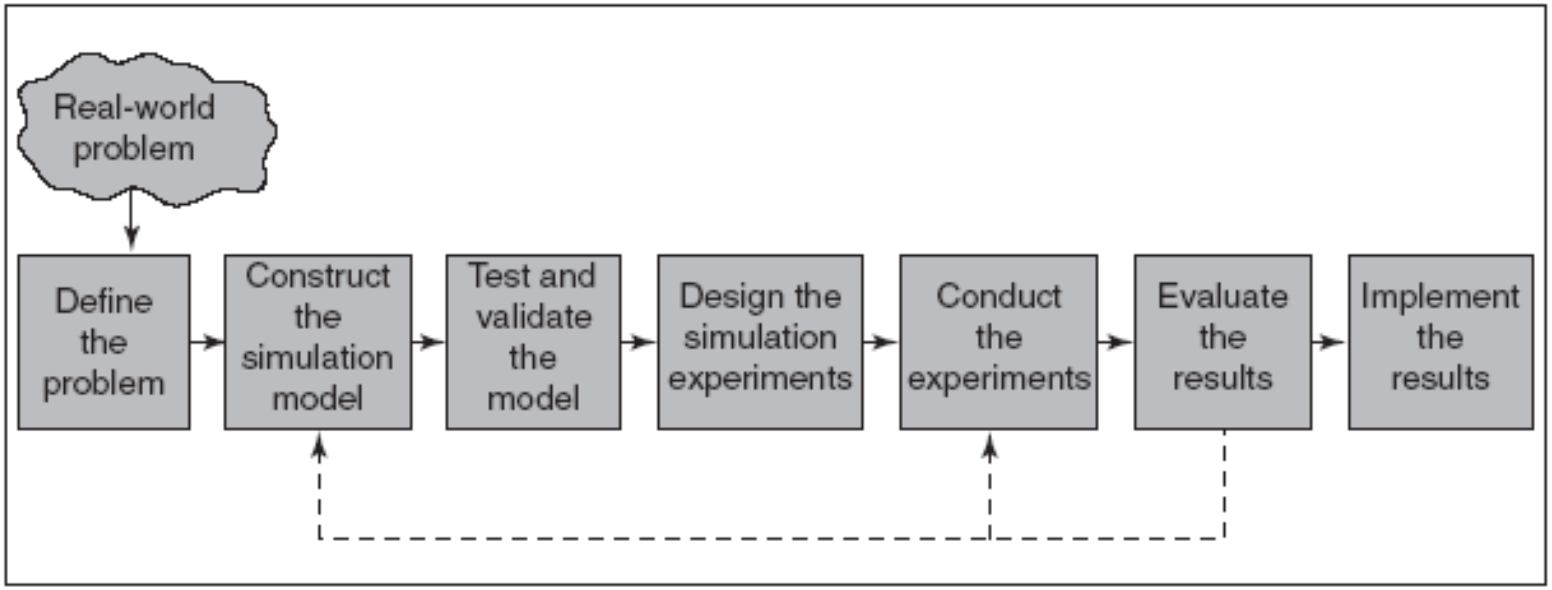
- Advantages of simulation
  - Simulation can handle an extremely wide variety of problem types
  - Simulation can include the real complexities of problems
  - Simulation automatically produces many important performance measures
  - Simulation can readily handle relatively unstructured problems
  - There are easy-to-use simulation packages

Simulation

- Disadvantages of simulation
  - An optimal solution cannot be guaranteed
  - Simulation model construction can be a slow and costly process
  - Solutions and inferences from a simulation study are usually not transferable to other problems
  - Simulation is sometimes so easy to explain to managers that analytic methods are often overlooked
  - Simulation software sometimes requires special skills

Simulation

FIGURE 4.11 The Process of Simulation



Simulation

- Methodology of simulation
  1. Define the problem
  2. Construct the simulation model
  3. Test and validate the model
  4. Design the experiment
  5. Conduct the experiment
  6. Evaluate the results
  7. Implement the results

Summary Note

- Decision Support Systems never take decision for you, however, you have to rely on the results for a good decision making.

- Thank you