

# Part I: The Basics

CHAPTER

1

## Introduction

In this chapter, we

- Define marketing engineering
- Identify the trends that make it important to learn about the emerging field of marketing engineering
- Indicate how marketing engineering facilitates decision making
- Highlight the benefits and challenges associated with the marketing engineering approach to decision making
- Summarize the philosophy and structure of the book
- Introduce the software provided with this book to support the marketing engineering concept

### **MARKETING ENGINEERING: FROM MENTAL MODELS TO DECISION MODELS**

#### Marketing and marketing management

Marketing is pervasive in market economies around the world. Many people associate marketing with its most manifest characteristics, namely, advertising and retailing, which represent only a small part of the functions and processes that make up marketing. Formally marketing is a *societal and managerial process* by which *exchanges* are brought about in an economy to satisfy the *needs and wants of individuals and organizations*. At the core of a market economy are the millions of voluntary exchanges that take place daily between consenting parties. An exchange occurs if two or more parties come together, each having something of value to offer to the other(s). We all engage in a number of exchanges every day. Whenever you go to a grocery store, make an airline reservation, order a book from Amazon.com, visit a hairdresser, bid in an eBay auction, or send out a résumé, you are participating in this exchange process.

In modern economies, both buyers and sellers take steps to initiate desirable exchanges and exchange relationships in the marketplace. Marketing management facilitates this exchange process and can be viewed as a management philosophy with

associated processes and activities that enable individuals and firms to proactively bring about desirable exchanges. As an example, let us consider how marketing management facilitates exchanges between a firm, Conglomerate, Inc., and its customers: Conglomerate uses marketing insights and techniques to choose who to sell to (to target a segment of the market) and who not to sell to, to design its physical product offerings, to set prices, to position its products relative to those of competitors, and to develop support services and the distribution mechanisms it needs to deliver its products to customers. The firm's goal is to maximize its returns, while at the same time providing value to customers through the exchange process. To effect the matching and exchange process, Conglomerate has to make targeted customers aware of its products (through advertising, promotion, and personal selling) and to ensure that its offerings provide more value than those of its competitors in the eyes of its current and potential customers. This entire marketing management process is founded on an intimate knowledge of what customers value, what they know about Conglomerate's (and competitive) offerings, and the process those customers go through in gathering information and effecting exchange (e.g., visiting the store, ordering by phone, or through personal negotiation).

At the heart of marketing management is the ability to understand customers and markets and to translate this understanding into decisions and actions that produce desirable exchanges in the marketplace. While marketing management begins and ends with customers, it serves the goals of the marketer.

## Marketing engineering

Marketing managers must make ongoing decisions about product features, prices, distribution options, sales compensation plans, and so forth. In making these decisions, managers choose from among alternative courses of action in a complex, uncertain world. Like all decisions involving people, marketing decision making involves judgment calls. A typical approach to systematic decision making is to develop a mental model of the decision situation that combines known facts with intuition, reasoning, and experience. For example, in deciding how much to spend on advertising, managers can use different approaches:

*Rely on experience:* Marketing managers often say that experience is the best teacher. By trying different advertising programs over the course of their careers, managers develop mental models of the levels of advertising that are appropriate under different conditions. To set the advertising budget, they may rely on this mental model or they may tap into the experience and wisdom (mental models) of colleagues and consultants.

*Use practice standards:* Companies that are successful often codify their decisions as practice standards, principles, or rules of thumb. These are essentially the collective mental models for the organization. Typically these rules are in the form of ratios (e.g., "advertising expenses to sales ratio should be 5 percent" or "30 percent of our advertising should be used for new products"). Using practice standards, managers might set the advertising budget as a fixed percentage of projected sales for the current year.

In many cases such mental models may be all that managers need to feel psychologically comfortable with their decisions. Yet mental models are prone to systematic errors. No one can deny the value of experience. But experience is unique to every person, and there is no objective way to choose between the best judgment based only on the experience of Mary versus Tom. Experience can also be confounded with a responsibility bias: sales managers might choose lower advertising budgets in favor of higher expenditures on personal selling, whereas advertising managers might prefer larger advertising budgets.

The use of practice standards can also lead to critical errors: they may be good on average, but they ignore idiosyncratic elements of a decision context. Suppose that a new competitor enters the market with an aggressive advertising program, which results in a decrease in the firm's sales. A fixed advertising-to-sales ratio would then prescribe a *decrease* in advertising, while other reasonable mental models would suggest some form of retaliation based on increased advertising. Rarely do practice standards provide the flexibility to act in changing marketing environments, where sound decisions are in fact most needed.

As an alternative approach to deciding advertising expenditures, managers might choose to build a spreadsheet decision model of how the market would respond to various expenditure levels. They could then use this model to explore the sales and profit consequences of alternative expenditure levels before making a decision.

This book is about the use of decision models for making marketing decisions. We use the term *marketing engineering* (ME) to refer to this approach. In contrast, relying solely on mental models may be referred to as *conceptual marketing*. Marketing engineering is not a substitute for conceptual marketing; rather, ME complements it, with the combination being greater than the sum of its parts.

To illustrate the marketing engineering approach and its potential value, we summarize below some real-world examples that we expand on in later chapters. The book includes software implementations of simple versions of these models.

*ABB Electric*, a manufacturer and distributor of power-generation equipment, wanted to increase its sales and market share in an industry that was facing a projected 50 percent drop in demand. By carefully analyzing and tracking customer preferences and actions, it determined which customers to focus its marketing efforts on and what features of its products were most important to those customers. Its managers used a marketing engineering tool called *choice modeling* to provide ongoing support for their segmentation and targeting decisions. The firm credits its modeling effort as being a major factor in its successful performance in a declining market.

*Marriott Corporation* was running out of good downtown locations for new full-service hotels. To maintain its growth, Marriott's management planned to locate hotels outside the downtown area that would appeal to both business travelers and weekend leisure travelers. The company designed and developed the highly successful Courtyard by Marriott chain using a marketing engineering tool called *conjoint analysis*.

*American Airlines* faces the ongoing problem of deciding what prices to charge for its various classes of service on its numerous routes and determining how many seats on each scheduled flight to allocate to each class of service. Too many seats sold at discount prices, overselling seats on a flight, or allowing too many seats to go empty leads to low revenues. Maximizing revenue in a competitive environment is crucial to the successful operation of the firm. It uses a marketing engineering tool called *yield management* to fill its planes with the right mix of passengers paying different fares.

*Syntex Laboratories* was concerned about the productivity of its salesforce. In particular, managers were unsure whether the size of the salesforce was right for the job it had to do and whether the firm was allocating its salesforce effort to the most profitable products and market segments. The company used a resource sizing and allocation tool that we call *Syngen* to evaluate the current performance of its salesforce and to develop salesforce deployment strategies that were in line with its long-term growth plans.

*Johnson's Wax* and many other firms in the packaged goods industry try to predict the likely success of their new products in a cost-effective manner and to

use this information to decide how best to proceed in developing a new product. Traditionally these firms relied on test marketing to get a reading on the likely success of the new product. However, test marketing is expensive, and it is also transparent to competitors. The company realized dramatic cost reductions in its new product testing program without harming decision effectiveness by implementing a marketing engineering tool called assessor, a pretest market measurement and modeling system.

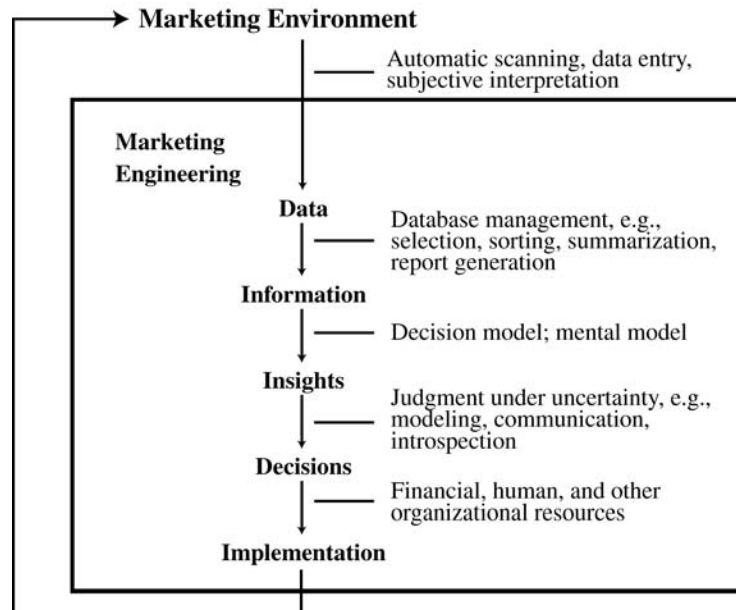
Exhibit 1.1 is an overview of the marketing engineering approach to decision making—using computer models to help transform objective and subjective data about the marketing environment into insights, decisions, and implementation of decisions.

*Data* are facts, beliefs, or observations used in making decisions. Thus numbers representing dollar sales in the previous month in various sales territories are data. So is the belief that the brand name *Coke* evokes a positive emotion, or the observation that a competitor has introduced a new product. A common misconception is that decision models require objective data. This is not the case. As we will show with several models in this book, the marketing engineering approach is useful even when one uses only beliefs (subjective data) as inputs to models.

*Information* refers to summarized or categorized data. For example, the average or the standard deviation of sales across all territories or the classification of sales as low or high constitutes information.

*Insights* provide meaning to the data or information, and they help the manager gain a better understanding of the decision situation. For example, insights offer us plausible explanations for why sales vary a lot between territories, or why some territories have consistently low sales performance. Information is a derived property of the data. On the other hand, managers gain insight as they mull over and process data and information (using either mental models or decision models) and as they incorporate information with their own internal knowledge.

A *decision* is a judgment favoring a particular insight as offering the most plausible explanation or favoring a particular course of action. For example, choosing to devote more effort in subsequent periods to territories with low sales constitutes a decision. Thus decisions provide purpose to information and insights.



#### EXHIBIT 1.1

The marketing engineering approach to decision making helps transform objective and subjective data about the marketing environment into decisions and decision implementations.

Finally, *implementation* is the set of actions the manager or the organization takes to commit resources toward physically realizing a decision. For example, a decision may require hiring and training more salespeople to work in poorly performing territories.

Although marketing engineering encompasses all the elements shown in Exhibit 1.1, we will focus mostly on ways to transform information and insights into decisions. Several cases in the book highlight key issues that arise in implementing model-based decisions within organizations.

In many ways computer models are simply tools that managers can use to explore the potential consequences of their decisions. The idea of using computer models to enhance decisions is not new. Researchers and practitioners have long developed and implemented powerful models that facilitate decision making in real-world marketing settings. (For case studies and examples, see Lilien, Kotler, and Moorthy (1992), Lilien and Rangaswamy (2001a,b), Little (1970), Rangaswamy (1993), and Wierenga and van Bruggen (2000).) Yet until recently much of the knowledge about marketing decision models resided in specialized academic journals or required considerable technical expertise to use. As a result, despite their potential value, these models have not seen the extent of managerial use indicated by their potential.

Recent advances in computer hardware and software now make it possible to put these models in the hands of every marketing manager. Several hundred commercially available canned software decision aids are of potential interest to marketers. At the same time, almost no associated teaching material is available to help marketing managers learn to be intelligent users and consumers of the available marketing models. We designed this book to serve this purpose.

## Why marketing engineering?

Many marketing managers succeed without relying on computer models. Conceptual marketing based on deep insights and years of experience may often be sufficient for making good decisions. Such tasks as identifying the market segments that are likely to be most attractive to a firm, positioning a product in a competitive setting, or anticipating customer response to a proposed marketing program can all be based on conceptual marketing. However, is conceptual marketing sufficient for the marketing managers of the future? Should you bet your future on relying only on intuitive methods when the marketing environment is undergoing major changes? The following trends are fundamentally changing the marketing manager's job.

**High-powered personal computers connected to networks are becoming ubiquitous:** Like other professionals, marketing managers are increasingly depending on computers to perform their jobs. Even managers in small firms use PCs. According to Dataquest ([www.dataquest.com](http://www.dataquest.com)), worldwide shipments of PCs are expected to exceed 130 million units in 2001; there were already over 500 million PC's in use worldwide at the end of the year 2000. Many marketing departments have more computing power today than entire firms did five years ago. A senior marketing executive told us recently, "Ten years ago in my department, we had lots of people and very little software. Today we have lots of software and very few people." These computers are being networked with other computers through local area networks (LANs) and, in some cases, connected to external computers and databases all over the world through wide area networks (WANs), such as the Internet. According to Nielsen-Netratings ([www.netratings.com](http://www.netratings.com)) about 430 million people globally had access to the Internet at the end of March 2001.

Although many managers currently use their PCs mainly for word processing and e-mail, sophisticated managers have begun to use their computers to access, combine, and process different types of information to improve their decisions. The most common analysis tools available to managers are spreadsheet programs, like Excel from Microsoft. According to a Microsoft official, about 245 million people worldwide use Microsoft Office products, of which Excel is a component. (Computerworld, June 4,

2001, p. 10). With the wider availability and use of these tools, computer-assisted decision making is becoming important in many firms.

**The volume of data is exploding:** The automatic electronic capture of data related to transactions with consumers is generating massive amounts of potentially useful information about the preferences and behavior of customers. For example, the typical brand manager in the packaged goods industry is inundated with 1000 times the volume of data (more frequently collected in finer detail) than was available five years ago. The growth of direct marketing and Internet shopping has led to similar data explosions in other industries as well. For example, an online company such as amazon.com collects over 30 gigabytes (30,000 megabytes) of data every day in its server logs. While available data has grown exponentially, the human brain has not advanced in a comparable manner to process and interpret these data. Managers need new concepts, methods, and technologies, such as marketing engineering, to make decisions in data-intensive environments.

**Firms are reengineering marketing:** The new corporate mantra seems to be “flatter organizations, ad hoc teams, outsourcing, and reduced cycle times.” In this environment, firms are reengineering marketing functions, processes, and activities for the information age. In the reengineered firm, centralized decision making, characteristic of traditional hierarchical organizations, is giving way to decentralized decision making that is characteristic of entrepreneurial organizations. As a consequence marketing managers are increasingly dealing directly with market information and using computers to do tasks that were once done by staff support people.

These changes are forcing an evolution in the marketing manager’s job from one based primarily on conceptual skills to one that is more akin to the way an engineer works—putting together data, models, analyses, and computer simulations to design an effective marketing program. As Peter Francese, president and founder of Marketing Tools puts it, “emerging corporations don’t have any need for classical marketing education. What they have a need for is understanding customers. What they want to know is how to analyze databases—supplier databases, demographic and geographic databases. . . . If you presented one of your students to me and asked me to hire him or her, I’d give that student a diskette and say, ‘Here are some of my customers. Tell me what I should do.’ There are no right answers. You either fail to create greater value and you’re out of a job, or you create more income for the company and you continue to be employed. It’s that simple. That’s the test, and it’s being applied to middle managers all over the country” (quoted in *Selections*, Spring 1996, published by the American Management Admission Council).

Marketing engineering is a way to capitalize on these trends. It is not, however, a panacea for coping with complex and uncertain decision environments. Markets are not controlled settings where careful observation or analysis will permit clear and unambiguous understanding. But neither are they so complex as to defy understanding. They fall somewhere between these two extremes. Marketing engineering enables us to capture the essence of marketing phenomena in well-specified models, and it improves our ability to make decisions that influence market outcomes.

## MARKETING DECISION MODELS

### Definition

Decision models are a special category of models that provide the foundation for marketing engineering, in much the same way that a skeleton provides the structure for the human body. We first define a generic model and then articulate what we mean by a decision model.

A model is a *stylized representation* of reality that is easier to deal with and explore for a *specific purpose* than reality itself. Let us explore key terms in this definition:

*Stylized:* Models do not capture reality fully but focus only on some aspects. They are simplified depictions, or analogies, of real-world phenomena and systems. For example, as a model a road map contains only some geographical aspects of the landscape such as main roads, rivers, and towns and ignores many other aspects, such as hills and valleys, vegetation, and buildings in an area. A map that is as large as the geography it represents adds little value.

*Representation:* A model is only a convenient analogy that may bear little resemblance to the physical characteristics of the reality it is trying to capture. For example, a map printed on paper has little physically in common with the terrain it represents. Most marketing models use verbal, graphical, or mathematical representations. The marketing decision models we describe in this book are often presented as mathematical equations embedded within a set of logical relationships, bearing no obvious physical resemblance to a marketplace of customers. In our view, the ability of a model to fully represent reality is less important than its ability to change people's minds. (Note that models can also represent artificial worlds, as in virtual reality simulations.)

*Specific purpose:* People develop models with a specific purpose in mind. Cartographers design road maps so that you can find a route from one location to another, estimate the time or distance between locations, or plan a long trip. They do not design them for settling property disputes or planning crop planting. Likewise, modelers design marketing decision models to highlight some aspects and ignore others. The purpose of a marketing model could be to understand or influence certain types of behavior in the marketplace (e.g., repeat purchase of the firm's products), to improve planning and prediction associated with a specific marketing issue (e.g., customer response to a new ad campaign), or to facilitate communication within the firm about a particular marketing problem.

This book is about a special category of models called *interactive decision models*. These are computer models (i.e., simplified representations of reality encoded as packaged software) that can be customized to a specific decision situation faced by a manager. They provide simulated learning environments where a manager can interactively explore the consequences of alternative actions while avoiding the expense, dangers, and irreversibility of the real world. Such models are tools for the mind, to help managers use objective and subjective data to support their decisions. The models serve the same purpose as flight simulators for training pilots or practice sessions for football players to prepare for a game. In some situations, decision models do not lead directly to decisions but enable managers to test and update their mental models of market behavior, perhaps leading to changes in future decisions.

## Characteristics of decision models

The decision models we describe in the book incorporate explicit statements of *purpose*, *assumptions*, *variables*, and *relationships* of interest.

A decision model has a well-defined *purpose*, which represents the reason for its construction and circumscribes its domain of applicability. For example, the adbudget model (Chapter 8) is designed primarily to help managers arrive at good advertising budgets. The clustering model (Chapter 3) is useful for identifying attractive market segments. A model could have several secondary purposes as well. For example, the adbudget model could be used to simulate the sales effect of different advertising spending levels; that is, as a forecasting tool.

*Assumptions* provide the context or framework for a model. For example, a model to evaluate the advertising budget for a product could include the following assumptions:

- Product sales are related to its advertising.
- Sales will go up if advertising is increased.
- There is a maximum level of sales for this product. No amount of advertising will make it possible for sales to exceed this maximum level.
- Increased advertising will decrease customers' sensitivity to the price of the product.

All models contain assumptions, either explicit or implicit, and unlike mental models, decision models require that these assumptions be made explicit. This explicitness also allows managers to more clearly evaluate the consequences of modifying their assumptions and provides them a means of communicating and sharing their assumptions with others in the organization.

*Variables* are those aspects of a marketing phenomenon that are not fixed. In a marketing system, many things can vary: the firm's sales, the likelihood that customers will purchase a new product, the calling patterns salespeople use, and the intensity of competition. We distinguish between three types of variables. *Controllable* variables are those that the firm controls, such as the level of advertising and the product features to be designed into a new product. *Noncontrollable* variables are those that are under the control of other players in the market, such as suppliers and competitors. Although a firm may try to influence a noncontrollable variable, it cannot manipulate it directly. *Environmental* variables are noncontrollable variables that are not under the control of any one player in the marketing system. These variables include general trends, such as the aging of the population, and variables whose values are determined by the actions of a number of different actors, such as new regulations or industry capacity. Together, controllable, noncontrollable, and environmental variables are referred to as *independent* or *input* variables. In contrast, *dependent* or *output* variables are those whose values are determined by a set of independent variables. For example, in many marketing models, product sales are driven by the level of advertising spending and the quality of the product. Although the distinction between independent and dependent variables may not always be precise, it is still a useful one.

*Relationships* between the variables, based on marketing theories and managerial insights, specify how changes in one variable affect another variable. For example, a change in *package design* can be hypothesized to increase *customer attention* at the point-of-purchase. Most marketing decision models use mathematical functions to represent how independent variables (e.g., advertising expenditures) affect dependent variables (e.g., sales). In Chapter 2 we provide details of the concepts, specification, calibration, and interpretation of the various types of relationships among marketing variables.

## Verbal, graphical, and mathematical models

One way to distinguish between decision models is on the basis of their structural characteristics: verbal, graphical, or mathematical.

*Verbal models* are described in words. For example, Lavidge and Steiner (1961) state that advertising moves consumers' mental states along the following chain:

awareness *to* knowledge *to* liking *to* preference *to* conviction *to* purchase.

This model specifies the variables influenced by advertising and the sequence in which this influence will take place. The model also suggests that an increase in advertising will lead to an increase in awareness, which will lead to an increase in knowledge, eventually leading to an increase in purchase. However, it does not specify the magnitude of increase in these variables for a given increase in advertising. This lack of quantification is a fundamental limitation of verbal models, especially when they are

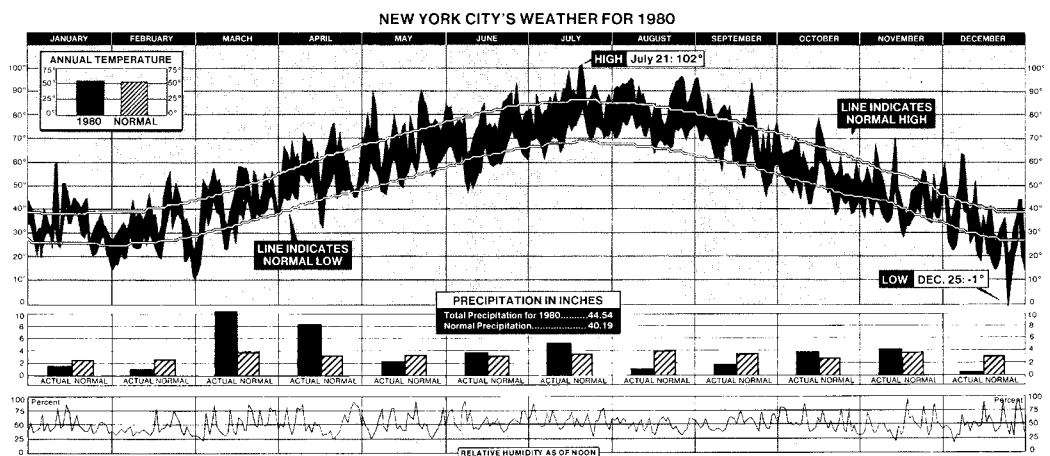
used for decision making. On the other hand, verbal models are easy to explain, are intuitively understandable, and in many cases are sufficient for the purpose at hand.

Almost all models start out as verbal models and are then refined into the other types. Some of the most important models of individual, social, and societal behavior, such as those of Freud, Marx, and Darwin, are verbal models. We all use verbal models all the time, even without being aware of it.

### EXAMPLE

Try this exercise. The next time you are feeling guilty about something (you were out later than you said you would be, and your partner or parent seems upset and asks for an explanation), check to see if you use a verbal model to “pretest” possible explanations before offering one. You consider saying, “I got a flat tire on the way home,” and you expect a sympathetic reaction, or alternatively, “I was out drinking with friends and lost track of time,” and you expect an angry reaction. If you go through this process, you are conducting a thought experiment, using a verbal model to forecast the reaction of your partner or parent. You then choose an explanation (suppose you really *were* out drinking), balancing the goal of getting sympathy instead of a reprimand against the moral cost of stretching the truth. If the reaction you get is the one you had expected, your model is confirmed, and you become more confident of your mental model; if you get an unexpected reaction, you will modify or abandon your verbal model.

*Graphical models* are represented in the form of pictures or charts. Examples include road maps, organizational charts, and flow diagrams. These models describe the overall nature of a phenomenon, stripped of nonessentials, so that the viewer can grasp the whole and select specific relationships for closer examination. We are all familiar with the notion that a picture is worth a thousand words. Graphical models



*New York Times*, January 11, 1981, p. 32.

### EXHIBIT 1.2

The graphical model of New York City weather for 1980 displays an amazing amount of information with great parsimony. *Source: New York Times*, January 11, 1981, p. 32.

are parsimonious compared with verbal models, and at the same time they are more explicit in representing relationships. To understand the power and parsimony of a graphical representation, look at Exhibit 1.2, which summarizes the weather records of New York City for an entire year.

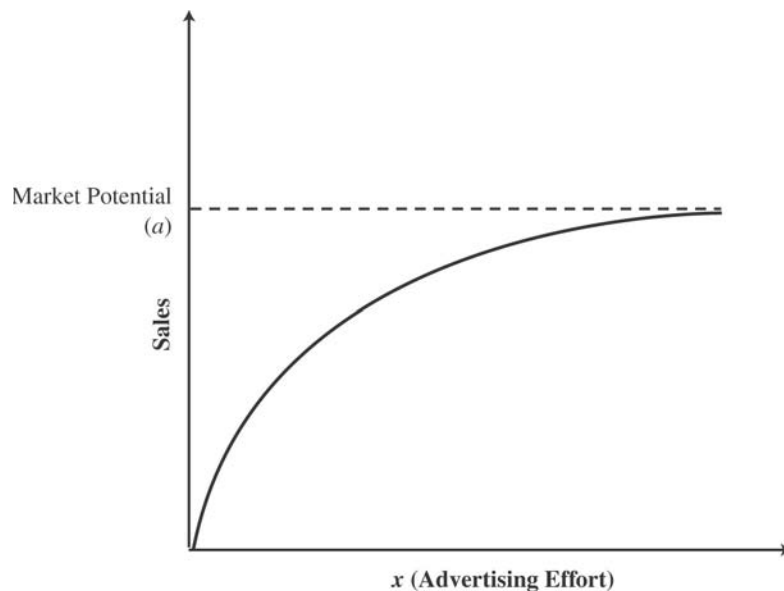
Graphical models help illuminate and identify key issues relevant to a phenomenon, aid communication about the phenomenon, and guide analysis. In addition graphical models provide a bridge between verbal models and the more formal mathematical models.

*Mathematical models* specify the relationships embodied in a model in the form of equations. For example, the relationship between advertising expenditure and sales often incorporates two important properties: saturation and diminishing returns (see Chapter 2). Saturation suggests that after some point, no amount of additional advertising will increase sales. Diminishing returns suggest that each incremental unit of advertising will lead to progressively decreasing increases in sales. These properties can be represented in the form of an equation:

$$\text{Sales} = a(1 - e^{-bx}) \quad (1.1)$$

where  $a$  is the market potential for the product (i.e., the maximum sales that would be achieved at infinite levels of advertising),  $e$  is the exponent,  $x$  is the proposed advertising expenditure, and  $b$  is a parameter that indicates that rate at which sales will approach the market potential as the level of advertising expenditure is increased. This equation can also be represented graphically as in Exhibit 1.3.

In a mathematical representation, both the nature and the magnitude of the relationships between variables must be specified. This quantification allows the manager to explore how variations in the level of an independent variable (e.g., advertising) influence both the direction and the level of the dependent variable of the model (e.g., sales). A disadvantage of mathematical models is that many managers are not comfortable dealing with mathematical representations. They think of them as mysterious “black boxes,” because they do not see intuitively how the models work. However,



### EXHIBIT 1.3

This is a graphical representation of a mathematical model— $\text{sales} = a(1 - e^{-bx})$ —showing the relationship between advertising effort and sales. This function incorporates the properties of saturation and diminishing returns.

advances in software and hardware are making it easier to provide graphical representations of equations and model outputs, as is the case with many of the software implementations of decision models in this book.

Widely available spreadsheet software, such as Excel, has also made it easier to work with mathematical representations such as Eq. (1.1). For example, marketing spreadsheets typically include planned marketing expenditures and the associated gross and net revenues. However, in most cases the model developer does not establish a relationship, within the spreadsheet, between marketing inputs (e.g., advertising) and sales revenues. Thus marketing inputs only affect net revenue as a cost item. We refer to such spreadsheets as “dumb” models. They make little sense because they are silent about the nature of the relationship between marketing inputs and outputs. For the spreadsheet to make sense, the model developer must define objectives and variables explicitly and specify the relationships among variables. In a “smart” model, an equation such as Eq. (1.1) will be embedded in the spreadsheet. The manager can then look at the effect of advertising on both sales and revenues to see if increases or decreases in advertising can be justified. This is precisely how we will approach the advertising expenditure decision in Chapter 8.

Each of the three types of models has its particular strengths and weaknesses. The same marketing phenomenon can be represented in verbal, graphical, or mathematical forms, depending on the purpose of the model and the level of knowledge about that phenomenon. Exhibit 1.4 contains verbal, graphical, and mathematical models that describe the trajectory of sales of a new product. The verbal model provides a starting point for developing the more refined graphical and mathematical models. The graphical representation adds finer details about the model, and finally the formal mathematical representation adds precision. The sequence from verbal to graphical to mathematical representations is the path by which many models are actually developed. For this phenomenon the mathematical model can make more specific numerical predictions (though not necessarily more accurate ones) of future sales of the new product than both the graphical and verbal models. In turn, the graphical model will have higher specificity of predictions than will the verbal model.

Today’s computer technologies enable us to develop models that combine verbal, graphical, and mathematical representations. For example, the user interface may be based on a verbal model, computations may be based on a mathematical model, and the results may be displayed graphically.

## Descriptive and normative decision models

Decision models can also be categorized according to the kinds of managerial question they address. We distinguish between two main types: those that are descriptive or predictive, and those that are normative. This book includes decision models of both types.

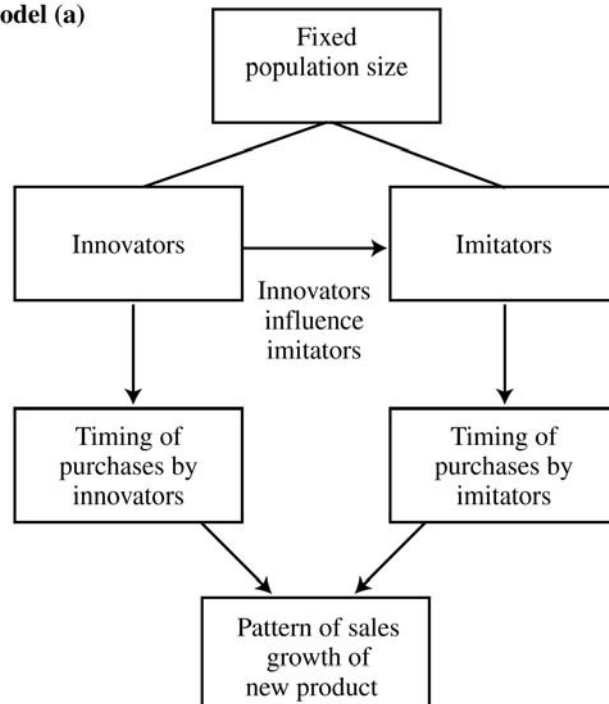
**Descriptive (predictive) decision models:** Descriptive models address the question, “What will happen if we do X?” For example, a manager’s decision about whether or not to introduce a new product might depend on the likely total sales for the product line if the new product is introduced; a decision to go ahead with a two-for-one promotional offer might depend on the incremental profit that might be generated by that promotion. Using descriptive models the manager conducts “simulations” to evaluate the consequences of marketing actions. Once we develop a descriptive model, we can use it equally well with numbers from the marketplace, or numbers we make up to explore alternative scenarios. For example, the manager might use a descriptive model to compute the likely sales of the product line under various scenarios, taking into account both the sales of the new product and the cannibalization of other products in the product line.

Descriptive models are useful for (1) exploring the impact of a set of alternative assumptions (scenarios), (2) finding explanations (diagnostics) for a phenomenon by identifying the specific variables and relationships that form causal links (e.g., poor

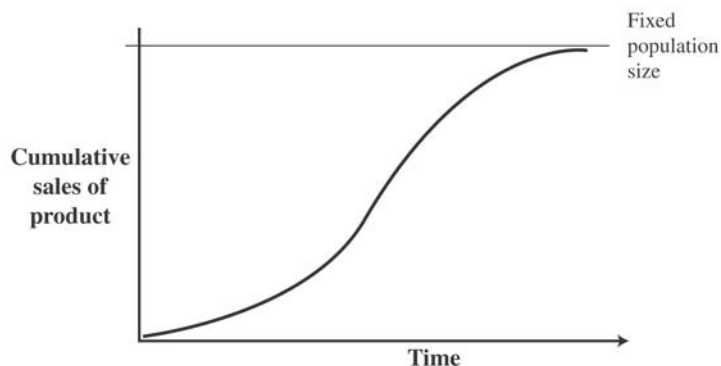
### Verbal Model

Sales of a new product often start slowly as “innovators” in the population adopt the product. The innovators influence “imitators,” leading to accelerated sales growth. As more people in the population purchase the product, total sales continue to increase but sales growth slows down.

### Graphical model (a)



### Graphical model (b)



### Mathematical model

$$\frac{dx_t}{dt} = (a + bx_t)(N - x_t)$$

$x_t$  = Total number of people who have adopted product by time  $t$

$N$  = Population size

$a, b$  = Constants to be determined. The actual path of the curve in graphical model (b) will depend on these constants.

### EXHIBIT 1.4

Sales of a new product can be represented in several ways: as a verbal model or description; as a graphical model (a) showing what factors influence the pattern of sales growth and (b) showing the pattern of cumulative sales; and as a mathematical model using a differential equation.

new product sales are due to low repeat purchase rates caused by poor product design) and (3) predicting possible outcome(s) when model inputs are extended to parameter regions other than those used for developing the model (e.g., what will sales be next month?). The ASSESSOR model (Chapter 7) is a successful descriptive and predictive model in marketing that helps managers decide whether to introduce a new product into the market.

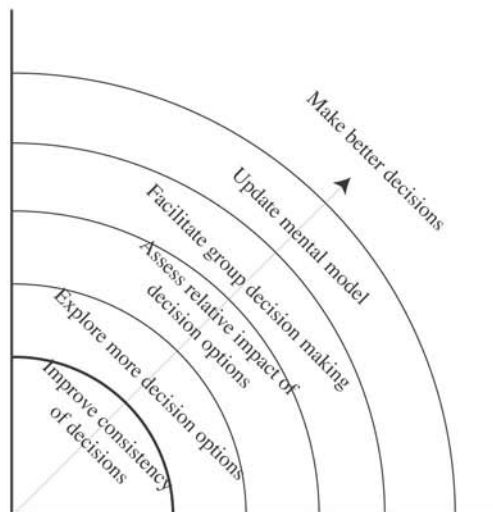
**Normative decision models:** Normative decision models address the question, “What is our best course of action in a given situation?” For example, a manager might want to determine the best location for a new store or the best level of advertising for a particular product. Normative models are designed to help managers to answer such questions by enabling them to explore the value of a decision option under different scenarios: The managerial question can be modeled as a *constrained optimization* problem where the *objective function* measures the value to the firm of a particular decision option and the constraints limit the range of allowed variation in the decision options. When the manager has only a few options, case studies or simulations using descriptive models may be adequate. When he or she is faced with many options to choose from, formal mathematical procedures are needed to identify good options (see the Appendix to Chapter 2).

Firms have used normative decision models in marketing to resolve such problems as allocating salesforce resources to products and markets (see Chapter 9), media planning, designing retail shelf space, and locating stores. Normative models are often referred to as *prescriptive models* because such models can prescribe effective courses of action from among numerous options available without being driven by an explicit optimization of an objective function (see, for example, the ADCAD model in Chapter 8).

Hybrid models combine descriptive and normative elements. For example, conjoint analysis models (Chapter 7) contain descriptive models to represent the utility functions of a sample of customers and normative models to identify the best new product to satisfy a target segment of customers.

## BENEFITS OF USING DECISION MODELS

The basic premise of marketing engineering is that the model-building process improves decisions. Let us look at some of the ways in which this comes about (Exhibit 1.5):



### EXHIBIT 1.5

Managers derive a spectrum of benefits from using decision models, leading ultimately to better decisions.

| Types of judgments experts had to make      | Mental Model* | Subjective Decision Model** | Objective Decision Model*** |
|---|---------------|-----------------------------|-----------------------------|
| Academic performance of graduate students   | .19           | .25                         | .54                         |
| Life expectancy of cancer patients          | -.01          | .13                         | .35                         |
| Changes in stock prices                     | .23           | .29                         | .80                         |
| Mental illness using personality tests      | .28           | .31                         | .46                         |
| Grades and attitudes in psychology course   | .48           | .56                         | .62                         |
| Business failures using financial ratios    | .50           | .53                         | .67                         |
| Students' ratings of teaching effectiveness | .35           | .56                         | .91                         |
| Performance of life insurance salesman      | .13           | .14                         | .43                         |
| IQ scores using Rorschach tests             | .47           | .51                         | .54                         |
| Mean (across many studies)                  | .33           | .39                         | .64                         |

\* Outcomes directly predicted by experts.

\*\* Subjective Decision Model: Outcomes predicted by subjective linear regression model, formalizing past predictions made by experts.

\*\*\* Objective Decision Model: Linear model developed directly from data.

### EXHIBIT 1.6

Degree of correlation with the true outcomes of three types of models, showing that even subjective decision models are superior to mental models, but that formal, objective models do far better. *Source: Russo and Schoemaker 1989, p. 137.*

| Applicant | Personal Essay | Selectivity of Undergraduate Institution | Undergraduate Major | College Grade Average | Work Experience | GMAT Verbal | GMAT Quantitative |
|-----------|----------------|--|---------------------|-----------------------|-----------------|-------------|-------------------|
| 1         | Poor           | Highest                                  | Science             | 2.50                  | 10              | 98%         | 60%               |
| 2         | Excellent      | Above avg                                | Business            | 3.82                  | 0               | 70%         | 80%               |
| 3         | Average        | Below avg                                | Other               | 2.96                  | 15              | 90%         | 80%               |
| ⋮         | ⋮              | ⋮  | ⋮                   | ⋮                     | ⋮               | ⋮           | ⋮                 |
| 117       | Weak           | Least                                    | Business            | 3.10                  | 100             | 98%         | 99%               |
| 118       | Strong         | Above avg                                | Other               | 3.44                  | 60              | 68%         | 67%               |
| 119       | Excellent      | Highest                                  | Science             | 2.16                  | 5               | 85%         | 25%               |
| 120       | Strong         | Not very                                 | Business            | 3.98                  | 12              | 30%         | 58%               |

### EXHIBIT 1.7

Input data for all three models—namely, mental model, subjective decision model, and objective decision model—used for predicting the performance of graduate students. See first row of Exhibit 1.6. *Source: Russo and Schoemaker 1989, p. 132.*

**Improve consistency of decisions:** One benefit of models is that they help managers to make more consistent decisions. Consistency is especially desirable in decisions that they make often. Several studies have shown the value of consistency in improving predictions (Exhibit 1.6).

Exhibit 1.7 lists variables experts often use to predict the academic performance of graduate business students (the first row of Exhibit 1.6). The formalized intuition of experts captured in a simple linear model outperforms the experts themselves! Accuracy here improved from 19 percent correlation with the actual student performance to 25 percent correlation. An explanation for this improvement is that the decision model more consistently applies the expertise of the experts to new cases.

The third column in Exhibit 1.6 lists the accuracy of an “objective” linear regression model. For the academic performance study the independent variables for the regression model were the same factors used by the experts, but the dependent variable was a known measure of the academic performance of the graduate students. The predictions in this case were based on a hold-out sample of data to which the objective model was applied. For this model the correlation of the predictions with the true outcomes was 54 percent. Exhibit 1.6 also shows the average correlations between predictions and true outcomes across several studies. We see that subjective decision models had an average correlation of 39 percent with true outcomes as compared with 33 percent for the intuitive mental models. For more details about these studies, see Camerer (1981), Goldberg (1970), and Russo and Schoemaker (1989).

In sum these results point to a few interesting conclusions: (1) When you can build an objective model based on actual data, you will generally make the best predictions. However, in many decision situations we do not have data that show the accuracy or the consequences of past decisions made in the same context. In such cases the next best option is to codify the mental model decision makers use into a formal decision model. The calibrating of response models using the decision calculus method (Chapter 2) is a way to formalize the mental models of decision makers. (2) Among these three types of models, the least accurate is the mental model. However, on average all three types of models had a positive correlation with the truth, whereas a model with random predictions would have zero correlation with the truth. (3) Managers should focus their attention on finding variables useful for prediction but should use decision models to combine the variables in a consistent fashion.

**Explore more decision options:** In some situations the number of options available to the decision makers is so large that it would be physically impossible for them to apply mental models to evaluate each option. For example, in allocating a firm’s sales effort across products and market segments, in deciding which media vehicles to use for an advertising campaign, or in pricing the various travel classes and routes of an airline, thousands of possible options are available to managers. The manager may develop decision heuristics that help cut down the number of options to be evaluated. The use of heuristics helps refine the mental model to incorporate additional considerations that narrow the number of decision options. But such pruning of decision options may lead to worse decisions than considering each of the available options more carefully. An alternative approach is to develop a computer decision model that facilitates the exploration of more options. By exploring more options, managers are more likely to move away from their prior dispositions (anchor points). A number of decision models of this type are available to marketing managers, and these have been shown to improve decisions. For example, several salesforce-allocation models have resulted in a 5 to 10 percent improvement in profitability with no additional investments (Fudge and Lodish 1977; Rangaswamy, Sinha, and Zoltners 1990; Sinha and Zoltners 2001).

**Assess the relative impact of variables:** In some situations, the decision options may be few, but the variables that might affect the decision may be numerous. For example, in test marketing a new product a manager may be considering only two decision options—withdraw the product or introduce it in selected markets—but many variables may influence this decision. Such variables as competitor and dealer reactions, consumer trial rates, competitive promotions, the brand equity associated with the brand name, and the availability of the product on the shelf all influence product sales. Here a decision model would provide the manager with a framework to more fully explore each decision option and to understand the impact of each of the variables on product sales. The model would also serve as a diagnostic tool in helping the manager assess the relative importance of the variables in influencing test market sales of the product. Models such as assessor (discussed in Chapter 7) have been successfully used in test marketing. Urban and Katz (1983) report that, on average, the use of the assessor model offers a 6:1 benefit:cost ratio.

**Facilitate group decision making:** Modeling provides focus and objectivity to group decision making by externalizing ideas and relationships that reside inside the minds of decision makers. In the same way that an explicit agenda helps direct meetings, the model or the results from a modeling effort can help a group deliberate and converge on a decision. For example, discussions on allocating resources tend to degenerate into turf battles, like congressional budget debates. However, if the entire group participates in a decision modeling exercise, then group discussions can be directed toward *why* someone prefers a particular allocation, rather than focusing simply on *what* allocation that person prefers. Likewise, if the members of a group agree on a modeling approach, then they may view the model results as unbiased and coming from an external source and therefore favor more rational (less emotional) decision options.

**Update mental models:** Marketing managers have mental models of how their markets operate. They develop these models through trial and error over years of experience, and these mental models serve as valuable guides in decision making. Yet in forming these mental models they may not take advantage of how managers in other industries have approached similar problems, or they may not incorporate academic research that addresses such problems. When managers are exposed to decision models, they update their own internal mental models in subtle but significant ways. Formal models require that key assumptions be made explicit, or their structure may require new ways of thinking about a familiar problem, resulting in learning that may affect future decisions. Although new learning is an indirect benefit of using models, in many cases it is the most important benefit. As a rough analogy, recall your first view of the sky through a telescope. It not only provided a clearer picture of familiar celestial objects but perhaps also altered your conception of the universe by revealing many new objects and providing more detail about the familiar objects.

Using decision models can produce all of these benefits. While managers can potentially realize one or more of these benefits in any decision situation, we must remember that the mere availability or use of a decision model does not guarantee better decisions or the realization of increased value for the firm.

Although models can produce significant benefits, many managers are reluctant to use models. This reluctance arises partly from the lack of simple-to-use computer software implementations of many marketing models. However, some managers may choose not to use a model even if they are familiar with it and the model is inexpensive, readily available, and provides quick results. Here are some of the reasons why:

*Mental models are often good enough:* Evolution has provided us with a brain that is an efficient processor of all kinds of information, particularly information that is visual in nature. However, managers mistakenly believe that because mental models do well most of the time, they will also suffice when decisions concern complex and dynamic market behavior. To understand this, look at the sketchy visual information in Exhibit 1.8 and the table of data from a marketing report in Exhibit 1.9. In the case of the picture the brain sorts out the pattern quickly even though the picture is fuzzy, whereas in the other case the pattern represented by the numbers is unclear, even though the numbers themselves are very precise. If you look at the picture in Exhibit 1.8 carefully, you may even be able to tell what kind of dog is shown in the picture. On the other hand, you will find it difficult to immediately see any “big picture” in the data of Exhibit 1.9.

Mental models, however, are not always effective, especially when the information does not form a familiar pattern. The pattern-matching ability of the human brain is helpful for making decisions when a new situation has a pattern similar to past situations, but not otherwise. Indeed, in an experimental study involving forecasting, Hoch and Schkade (1996) find that mental models perform much better in predictable decision environments than in unpredictable environments, where an overreliance on familiar patterns can lead to misleading insights.

**EXHIBIT 1.8**

Visual pattern of information, showing how you can “get the picture” even with sketchy visual information. *Source:* Morton Hunt 1982, p. 72.

*Models don't solve managerial problems, people do:* It is unrealistic to expect models to directly solve managerial problems, because by design, they are incomplete. Yet, this is precisely what many managers would like. Realistically, the relevant question is how should we use models to solve problems, not how models will solve problems. The former requires combining model-based analyses with managerial judgments, which often demands more effort, trained managers, motivation to use models, etc. If models are to be used in conjunction with a manager's judgments, some managers may legitimately argue, why not rely just on sound judgments? However, this is not a good argument. As Hogarth (1987, p. 199) notes, “When driving at night with your headlights on, you do not necessarily see too well. However, turning your headlights off will not improve the situation.” Indeed, as we have often heard said, “All models are wrong; some are useful.”

Decision models and mental models should be used in conjunction, so that each works to strengthen the areas where the other is weak. Mental models can incorporate idiosyncratic aspects of a decision situation, but they also overfit new cases to old patterns. On the other hand, well-designed decision models are consistent and unbiased, but they underweight idiosyncratic aspects. Managers also tend to evaluate decisions with successful outcomes more positively than the same decisions with unsuccessful outcomes. This is termed *outcome bias* and limits a manager's ability to objectively learn from the past decisions to further improve future outcomes (Baron and Hershey 1988). In a forecasting task, Blattberg and Hoch (1990) find that predictive accuracy can be improved by combining the forecasts generated by decision models with forecasts from mental models. Furthermore, they report that a 50-50 (equal weighting) combination of these two forecasts provides high predictive accuracy.

*Managers do not observe the opportunity costs of their decisions:* Managers observe only the consequences of decisions they have actually made and not the consequences of those they didn't. Therefore they are often unable to judge for themselves whether they could have made better decisions by using decision models. Without this ability to observe the value of systematic decision making, many managers continue

| Category: Frozen Dinner<br>Volume is expressed in pounds<br>Quarter ending Sept 1987<br>Including only brands<br>purchased by 0.5% or<br>more of all households | Data Reflect Grocery Store Purchases Only |                              |                               |                             |                             | Percent Volume with the Specified Deal |                        |                           |                             |                             |                              |                      | Avg.<br>%<br>off<br>on<br>price<br>deals |                    |
|---|---|------------------------------|-------------------------------|-----------------------------|-----------------------------|--|------------------------|---------------------------|-----------------------------|-----------------------------|------------------------------|----------------------|--|--------------------|
|   | Category<br>volume<br>share<br>%          | Type<br>volume<br>share<br>% | % of<br>hshlds<br>buying<br>% | Volume<br>per<br>purch<br>% | Purch.<br>per<br>buyer<br>% | Share<br>category<br>reqmts<br>%       | Price<br>per<br>volume | Any<br>trade<br>deal<br>% | Print<br>ad<br>feature<br>% | In<br>store<br>display<br>% | Shelf<br>price<br>reduc<br>% | Store<br>coupon<br>% |  | Mfr<br>coupon<br>% |
| <b>Category:</b><br><b>Frozen Dinners</b>   | 927.5+                                    | 100.0                        | 26.7                          | 1.5                         | 2.3                         | 100                                    | 2.80                   | 26                        | 12                          | 5                           | 23                           | 0                    | 8  | 21                 |
| <b>Type:</b><br><b>Frozen Dinner</b>  | 100.0                                     | 100.0                        | 26.7                          | 1.5                         | 2.3                         | 100                                    | 2.80                   | 26                        | 12                          | 5                           | 23                           | 0                    | 8  | 21                 |
| <i>All American Gourmet</i>   | 10.1                                      | 10.1                         | 5.3                           | 1.1                         | 1.6                         | 45                                     | 2.71                   | 34                        | 15                          | 8                           | 30                           | 0                    | 3  | 18                 |
| <i>The Budget Gourmet</i>   | 10.1                                      | 10.1                         | 5.3                           | 1.1                         | 1.6                         | 45                                     | 2.71                   | 34                        | 15                          | 8                           | 30                           | 0                    | 3  | 18                 |
| <i>Campbell Soup Co.</i>  | 34.9                                      | 34.9                         | 11.4                          | 1.4                         | 2.0                         | 61                                     | 3.22                   | 8                         | 3                           | 1                           | 7                            | 0                    | 6  | 18                 |
| <i>Le Menu Light Style</i>  | 2.4                                       | 2.4                          | 1.7                           | 0.9                         | 1.5                         | 24                                     | 4.44                   | 18                        | 8                           | 3                           | 15                           | 0                    | 27                                       | 20                 |
| <i>Swanson</i>  | 17.4                                      | 17.4                         | 6.3                           | 1.3                         | 2.0                         | 48                                     | 2.58                   | 9                         | 4                           | 1                           | 9                            | 0                    | 3  | 18                 |
| <i>Swanson Hungryman</i>  | 8.0                                       | 8.0                          | 2.8                           | 1.7                         | 1.6                         | 43                                     | 2.68                   | 3                         | 0                           | 0                           | 3                            | 0                    | 3  | 13                 |
| <i>Swanson Le Menu</i>  | 6.5                                       | 6.5                          | 3.1                           | 1.1                         | 1.8                         | 36                                     | 5.05                   | 6                         | 1                           | 0                           | 6                            | 0                    | 10                                       | 15                 |
| <i>Conagra</i>  | 38.7                                      | 38.7                         | 13.6                          | 1.5                         | 1.8                         | 59                                     | 2.32                   | 39                        | 19                          | 7                           | 36                           | 0                    | 7  | 22                 |
| <i>Banquet</i>  | 18.4                                      | 18.4                         | 6.2                           | 1.7                         | 1.7                         | 56                                     | 1.73                   | 47                        | 25                          | 10                          | 43                           | 0                    | 1  | 20                 |
| <i>Banquet Manpleaser</i>   | 2.2                                       | 2.2                          | 0.9                           | 1.8                         | 1.3                         | 38                                     | 1.75                   | 29                        | 12                          | 9                           | 24                           | 0                    | 1  | 13                 |
| <i>Classic Lite</i>   | 2.6                                       | 2.6                          | 1.9                           | 0.9                         | 1.4                         | 24                                     | 4.65                   | 24                        | 7                           | 1                           | 21                           | 0                    | 21                                       | 25                 |
| <i>Dinner Classics</i>  | 7.4                                       | 7.4                          | 4.0                           | 1.1                         | 1.6                         | 32                                     | 3.99                   | 27                        | 15                          | 6                           | 24                           | 0                    | 25                                       | 27                 |
| <i>Morton</i>   | 6.4                                       | 6.4                          | 2.5                           | 1.5                         | 1.6                         | 50                                     | 1.44                   | 31                        | 15                          | 3                           | 41                           | 0                    | 1  | 16                 |
| <i>Patio</i>  | 1.0                                       | 1.0                          | 0.6                           | 1.1                         | 1.5                         | 29                                     | 1.88                   | 51                        | 15                          | 0                           | 48                           | 0                    | 8  | 22                 |
| <i>General Foods</i>  | 2.2                                       | 2.2                          | 1.1                           | 1.2                         | 1.6                         | 42                                     | 3.68                   | 24                        | 8                           | 2                           | 24                           | 0                    | 54                                       | 38                 |
| <i>Birds Eye Fresh Creat.</i>   | 2.2                                       | 2.2                          | 1.1                           | 1.2                         | 1.6                         | 42                                     | 3.68                   | 24                        | 8                           | 2                           | 24                           | 0                    | 54                                       | 38                 |
| <i>Nestle Company</i>   | 1.9                                       | 1.9                          | 1.3                           | 1.1                         | 1.3                         | 26                                     | 4.68                   | 26                        | 10                          | 5                           | 16                           | 0                    | 35                                       | 23                 |
| <i>Stouffer Dinner Supreme</i>  | 1.8                                       | 1.8                          | 1.2                           | 1.1                         | 1.3                         | 26                                     | 4.69                   | 27                        | 10                          | 6                           | 16                           | 0                    | 36                                       | 23                 |
| <i>O'Donnell-USEN</i>   | 0.7                                       | 0.7                          | 0.6                           | 0.8                         | 1.3                         | 26                                     | 2.87                   | 31                        | 17                          | 7                           | 18                           | 1                    | 5  | 28                 |
| <i>Taste O Sea</i>  | 0.7                                       | 0.7                          | 0.6                           | 0.8                         | 1.3                         | 26                                     | 2.87                   | 31                        | 17                          | 7                           | 18                           | 1                    | 5  | 28                 |
| <i>Aggregated Vendors</i>   | 8.2                                       | 8.2                          | 4.3                           | 1.1                         | 1.6                         | 37                                     | 3.01                   | 24                        | 11                          | 4                           | 20                           | 0                    | 15                                       | 24                 |
| <i>Private Label</i>  | 1.8                                       | 1.8                          | 0.5                           | 1.9                         | 1.7                         | 47                                     | 1.62                   | 39                        | 16                          | 13                          | 39                           | 0                    | 0  | 14                 |

**EXHIBIT 1.9**

In this table from a marketing report, we are given a great deal of numerical information but may have difficulty seeing a pattern (do you see one?). In general we have far less ability to see a pattern in numerical information than we do in visual information (see Exhibit 1.8). Adapted from: The Marketing Fact Book, Information Resources, Inc., Chicago.

to do what is intuitively comfortable for them. In some industries, such as mutual funds, managers are rewarded based on their performance compared with that of managers of funds with similar risk portfolios. Here managers can observe indirectly the consequences of decisions they did not make. It is not surprising then that the financial services industry is one of the heaviest users of computer modeling to support decisions.

With the automatic capture of customer transaction data, marketing managers can now establish stronger links between their decisions and market outcomes. For example, in the packaged goods industry weekly data are available that include measures of in-store environment (e.g., special displays, price discounts) and consumer purchases for all brands in a product category. With these data we can track the performance of competing brands and the promotional strategies used by each of them. This ability to link managerial decisions with market performance has led to increased use of decision models in this industry.

*Models require precision:* Models require that assumptions be made explicit, that data sources be clearly specified, and so forth. Some managers perceive all this concreteness as a threat to their power base and a devaluation of their positions, particularly middle managers in hierarchical organizations. Using models is analogous to thinking aloud. Many people in traditional organizations may be uncomfortable revealing their thoughts. A typical role of middle managers in traditional organizations has been to gather information from the front lines and structure that information to facilitate top management decision making. However, as information management becomes more computerized and decentralized, middle managers need to focus more on the decision consequences of information. Rarely does information by itself lead to better decisions. Only when decision makers draw insights from information and use those insights as a basis for action does information translate into value for an organization.

*Models emphasize analysis:* Managers prefer action. Little (1970) noted this many years ago. In the past, managers could call on corporate support staff whenever they needed help with analysis, so that they could concentrate on what they liked to do best. In today's flatter organizations, support staff is increasingly a luxury that few firms can afford.

In sum, while there are many potential benefits of using decision models, there are also numerous barriers to actually realizing those benefits. Indeed, many empirical studies of decision support system (DSS) effectiveness report mixed findings (see reviews in Sharda, Barr, and McDonnell 1988; Lilien, Rangaswamy, Starke, and van Bruggen 2001). In a given context, the value of a model could come from a number of sources, including improved decision consistency, more decision options, reduced uncertainty associated with decisions, higher precision of forecasts, faster decision making, greater organizational involvement, and so forth. Some of these benefits are hard to quantify. We leave you with the following thought: the best decision models are those that help produce important and valuable decisions, especially decisions that could not be guessed a priori. See Sinha and Zoltners (2001) for compelling arguments and examples supporting this view.

## PHILOSOPHY AND STRUCTURE OF THE BOOK

### Philosophy

We designed this book for business school students and managers who wish to train themselves to function in marketing organizations in the information age. We hope to impart knowledge of the concepts and tools underlying decision models and of the skills needed to apply the models we describe for real-world marketing decision

making. This is an advanced book that requires you to be familiar with the basic concepts of marketing, as covered in an introductory course. You should also be familiar (though not necessarily proficient!) with basic business mathematics (algebra, statistics, and elementary calculus). The most important requirement is a *willingness* to approach problems in a systematic and logical manner.

The book straddles theory and practice, and we try to demonstrate how they reinforce each other. It will not take you long to learn how to run the software implementations of the various decision models we describe. However, you will need patience and diligence to learn and internalize the underlying principles of the modeling approaches in a way that will allow you to use them effectively in decision situations you will encounter in the future.

We based this book on two fundamental principles: *learning by doing and end-user modeling*.

**Learning by doing:** We believe that the best way to learn about marketing engineering is to put yourself in situations that require you to make decisions. Instead of focusing on modeling theory, we challenge you with practical exercises in marketing decision making. We hope that in making these decisions you will develop the ability to recognize a broad range of marketing decision problems, to structure problems to facilitate decision making, to carry out logical analyses, and to present the results of the modeling effort in a nontechnical manner to interested audiences.

As you use the models described in this book, you will have questions about their adequacy, their advantages, and their limitations, and you may want to know how to adapt the models to related problem areas. It is when you try to answer these questions in actual decision contexts that real learning takes place. To learn to ride a bike, you need to get on and try it. Merely learning about the laws of mechanics or watching other people ride bikes will not make you a bike rider. Learning by doing in the real world is expensive and error prone. This book and software simulate a safe and structured environment in which to explore and experiment with alternative courses of action.

**End-user modeling:** Decision models in marketing range from very sophisticated models that are developed by a team of experts (e.g., the Marriott conjoint study and the American Airlines yield management system mentioned earlier) to those that can be quickly put together by an individual (end user) with a basic knowledge of marketing and marketing engineering. In this book, we emphasize end-user models, which have the following key characteristics (Powell 1996):

- The modeling process is initiated and completed by an individual who has to deal with a business problem. The user is rarely a technical analyst or a modeling specialist. The objective of the modeling effort is to gain a better understanding of the specific decision problem and the alternative courses of action available to the user, i.e., the most important outcome of the modeling activity may be a better understanding of the user's goals and priorities.
- The modeling effort is nonmathematical in nature, although the underlying models themselves may be mathematical. The user relies on graphics, spreadsheets, and canned software to put together a model to reflect his or her understanding of the business problem.
- The user develops the model under budget and time constraints, and it has the characteristics of a good engineering solution—do as good a job as you can, cheaply, and with what you can obtain easily. The modeler uses whatever information is readily available along with a healthy dose of creativity. The model itself may be less thorough and scientific than models developed by academic researchers or by professional management scientists. Judgment plays a big role in generating inputs to the model and in interpreting the results.

|   | End-user models  | High-end models |
|---|------------------|-----------------|
| Scale of problem                            | Small to medium  | Small to large  |
| Time availability<br>(for setting up model) | Short            | Long            |
| Costs/benefits                              | Low to medium    | High            |
| User training                               | Moderate to high | Low to moderate |
| Technical skills for<br>setting up model    | Low to moderate  | High            |
| Recurrence of problem                       | Low              | Low or high*    |

\*Low for one-time studies (e.g., Marriott conjoint study) and high for models in continuous use (e.g., American Airlines yield management system).

### EXHIBIT 1.10

Two extremes of marketing decision models: end-user versus high-end models. Although the marketing engineering approach applies to both types of models, we focus on end-user models in this book. Source: Stephen G. Powell 1996.

- The models are often used for generating directional insights rather than for providing specific numerical guidelines. In contrast to full-blown decision support systems (e.g., a yield management system), end-user models produce outputs that are useful for the general patterns they reveal (e.g., the feasible range of prices) and not for their own sake.

Exhibit 1.10 summarizes these and other differences between end-user models and high-end models. Success with end-user models may provide the impetus for managers to develop organization-wide implementations of the models in the form of decision support systems that are linked to corporate databases.

## Objectives and structure of the book

Our primary objective is to get you to personally experience the value of the marketing engineering approach. We have been involved in conceptualizing and implementing many decision models, and we have experienced the opportunities, the challenges and frustrations, the excitement, and the “Aha!” moments associated with making models work in organizational settings. In many instances we have also seen that models offer considerable value to modern enterprises. We want to share with you our insights and experiences and those of others in academia and industry with similar experiences.

Although you will work hands-on with models, our objective here is *not* to train you to be an analyst or a modeler. Rather, our main goal is to help you to become an astute user of models and a knowledgeable consumer of modeling results generated by others. In particular, we hope that this book will enable you to recognize decision situations that could benefit from the marketing engineering approach and that it will help you focus the modeling effort and interpretation of results to facilitate the decision making process. Specifically we hope to accomplish the following objectives:

- Show how and why the marketing engineering approach *can* enhance marketing decisions
- Provide a basic understanding of the most successful marketing decision models, and offer examples showing why they are successful

- Help you improve your skills in understanding and formulating marketing processes and relationships analytically
- Give you hands-on experience applying decision models

We chose the models in the book to be both theoretically sound and practically useful. The models are either based on academic research that provides some justification for them, or they have been widely used in industry. Thus the models are robust and have been tested in field settings.

In Chapter 2 we focus on how to build models. In Chapters 3 through 6 we focus on strategic marketing issues, such as segmentation, positioning, portfolio analysis, and market measurement and strategic planning. In Chapters 7 through 10 we explore many tactical issues, such as product design, setting advertising budgets, salesforce deployment, store location, and yield management. Finally, in Chapter 11 we summarize the key points for you to take from the book and speculate on the future of marketing engineering. For each chapter we include examples, cases, and exercises to illustrate the concepts covered in the chapter and to gradually ease you into the underlying structure of the models.

There are mathematical descriptions of many models here. We recommend that if you have difficulty with mathematics, skip over the math as you read, do the case problems with the software, and use the mathematics to help deepen your understanding.

## Design criteria for the software

This book is best used in conjunction with the companion software tools. The book contains the conceptual material that you will need to understand the decision models embedded in the software. The software helps you learn to apply these concepts and models for making decisions in managerial settings. We used several criteria in designing the software to ensure that it is compatible with our objectives for the book:

*It runs under the Windows Operating System:* The software will run on IBM-compatible machines running Windows 98, ME, NT, 2000 and XP operating systems. This means you cannot run this software as a native application on Apple/Macintosh computers. We recommend that the software be installed only on PCs with the Intel Pentium chip or higher, with a minimum of 64 MB of RAM.

*It links to Microsoft Excel:* In addition to the Windows operating system, you should have the Microsoft Excel spreadsheet program, versions 97 or higher, to take full advantage of the software. Excel is required for running all the spreadsheet models in marketing engineering. In addition Excel may be used to set up the data for other models, such as cluster analysis (Chapter 3) and promotional analysis using the multinomial logit model (Chapter 10).

*It provides access to all software from a single menu:* A major benefit of this software package is that it allows you to access all the programs from a common window. However, all the programs may not work in the same way or have the same menu options. This is because each program is designed to address a specific problem area and, therefore, may contain idiosyncratic menu options. At the same time, we have tried to make similar programs have similar menu structures and look and feel the same. Thus, for example, all the spreadsheets are similar in many ways, although submenu options may be different.

*It covers the major areas of marketing decision making:* We have tried to include representative decision models from all major areas of marketing decision making. Naturally some areas are stronger than others, given our own interests and the availability of software that is compatible with the goals of this book.

*It runs on local area networks (LANs):* The software will also run on file-sharing networks that support the TCP/IP Protocol.

*It restricts commercial use:* All the software tools we provide are educational versions that have some built-in restrictions that limit their value in commercial applications. All the basic features however, remain intact. We have imposed such restrictions as limits on data size or the inability to save large-scale problems for later use, to ensure that most commercial-size applications cannot be executed with the educational version. You will be able to use a part of your data to evaluate whether it would be beneficial to attempt a full-scale application of the decision model to a particular problem.

You can access the software implementations of the models described in this book in one of three ways, described in the next section. For all three options, you will need access to Microsoft Excel 7 or higher to run models that are implemented as spreadsheets. Also the tutorials describing how to use each marketing engineering module are available both at [www.mktgeng.com/tutorials](http://www.mktgeng.com/tutorials) and on the CD-ROM.

Like other newly developed products, this software is subject to continuous improvement. Writing a book is quite different from putting together a complex piece of software, where even small errors can turn out to be critical. Please visit our Web site, [www.mktgeng.com](http://www.mktgeng.com) to obtain the latest updates and tips for using this software or to give us suggestions for improving the software.

## OVERVIEW OF THE SOFTWARE

In this section, we assume that you have some working knowledge of the Microsoft Windows operating system and the Microsoft Excel spreadsheet program.

### Software access options

With the purchase of this textbook, you get a one-year license to use the software. The license is for educational/training use of our software and includes access to various online resources available at our web site: [www.mktgeng.com](http://www.mktgeng.com). At the web site you will find the latest versions of the software and tutorials, FAQ, and technical help for software installation. If you did not purchase the book and want to access the software, or if you want a longer-term license, visit the following Web page: [www.mktgeng.com/purchase](http://www.mktgeng.com/purchase).

Currently, there are two options for installing marketing engineering.

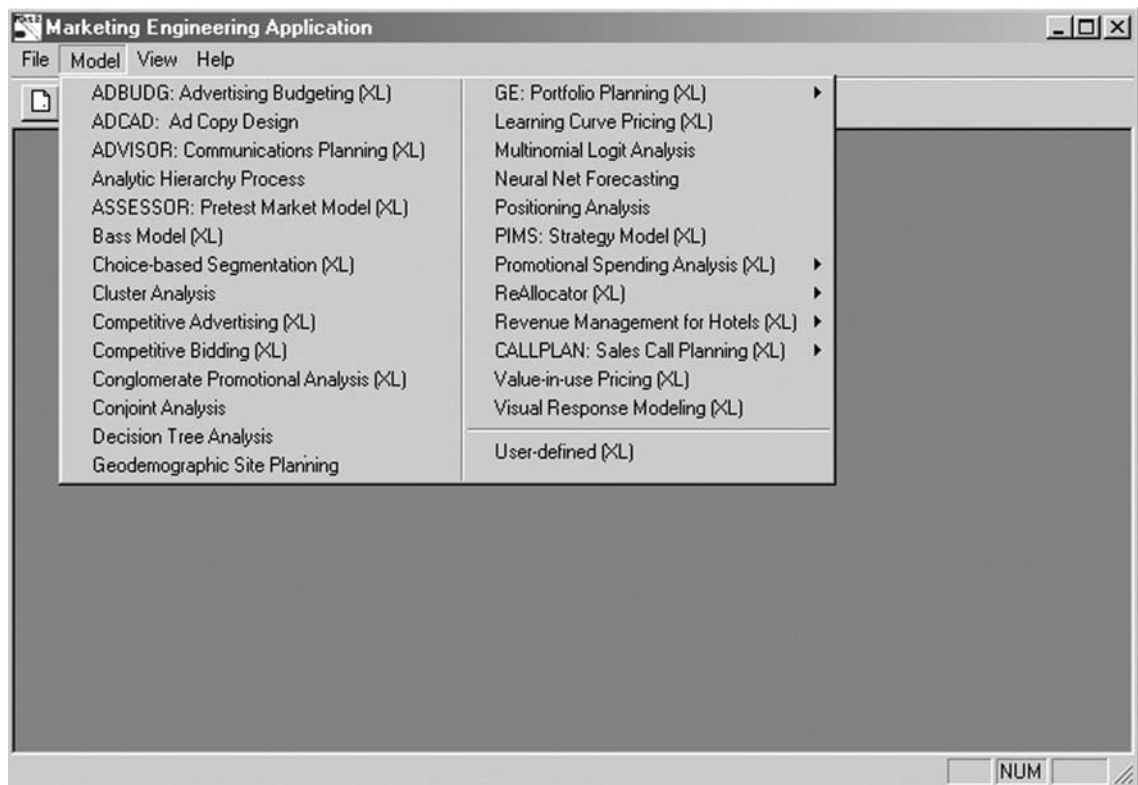
*Option 1: Single-user CD version:* With the textbook, we have included a CD containing the educational version of the software and an authentication code. Before installing the software, first visit our web page: [www.mktgeng.com/register](http://www.mktgeng.com/register) to authenticate your copy of the software. You will need the unique authentication code printed in the textbook to enter the registration section of the site. Once there, you will be asked to select a User Name and Password. Note down this information for your records. Next, install the CD on your PC. You must be connected to the Internet (a low bandwidth connection, such as 14.4k, is sufficient) when installing the software. If the CD does not automatically initiate the installation program after insertion into the CD-drive, use the Windows Run menu to execute the file, `setup.exe`. You will be guided through the rest of the installation by the on-screen instructions.

Once the program has been installed, you will be asked to provide the User Name and Password that you had registered earlier at our web site in the **Preferences** menu of the software. This will register your copy of the software at our web site. Now you should be ready to use the software. The **Preferences** menu also offers you several options to automatically update the software when new versions of our software or new versions of specific files are released. If you choose the automatic update option, we recommend that you have access to a high-bandwidth Internet connection.

Recommended Minimum System requirements: IBM-compatible Pentium PCs with a CD drive, minimum of 64 MB RAM, running Windows 98 or higher, and Excel 97, Excel 2000, or Excel XP.

If you lose the CD, you can download the software from our website as long as you have registered at our site and have a valid User Name and Password (i.e., your license has not yet expired). Note that the downloaded version does not support the Geodemographic Site Planning module.

*Option 2: Network version:* This version of the software can be installed on a Network and support multiple users. However, we recommend that only professional network administrators install the software on a network, such as those available in student labs. Further details about this version are available at: [www.mktgeng.com/network](http://www.mktgeng.com/network).



## Running Marketing Engineering

After you install Marketing Engineering on your computer (either the CD or Network version), you will see a marketing engineering shortcut on your Desktop. Click on the icon to start the program. This shortcut will run the shell, i.e., the main application controlling the full package of Marketing Engineering software (see screen below).

To run an application, click on that application in the **Model** menu. The models vary in terms of their underlying structures. Many of the models are in the form of Excel spreadsheets. Some of the spreadsheet models (e.g., GE planning matrix, CALLPLAN: Sales Call Planning model) accept data sets provided by the user. Other spreadsheet models (e.g., ADBUDG advertising budgeting, ASSESSOR pre-test market model) come with built-in data specific to a case and cannot easily be modified to accept new data sets. The shell will automatically open Excel if the application you are running is a spreadsheet model. The program also contains several non-Excel models, all of which accept new data provided by the user. Most of these models (except ADCAD and AHP) offer links to Excel, and also contain a built-in Excel-compatible spreadsheet facility. Exhibit 1.11 lists the modules available in the companion software and the cases or exercises that accompany a software module.

*Installing Solver module in Excel:* Several marketing engineering applications (e.g., CALLPLAN: Sales Call Planning model and the ADBUDG model) require the Solver optimization module. If you have not installed the Solver tool within Excel on your system, run the Excel or MSOffice setup program and add the Solver tool.

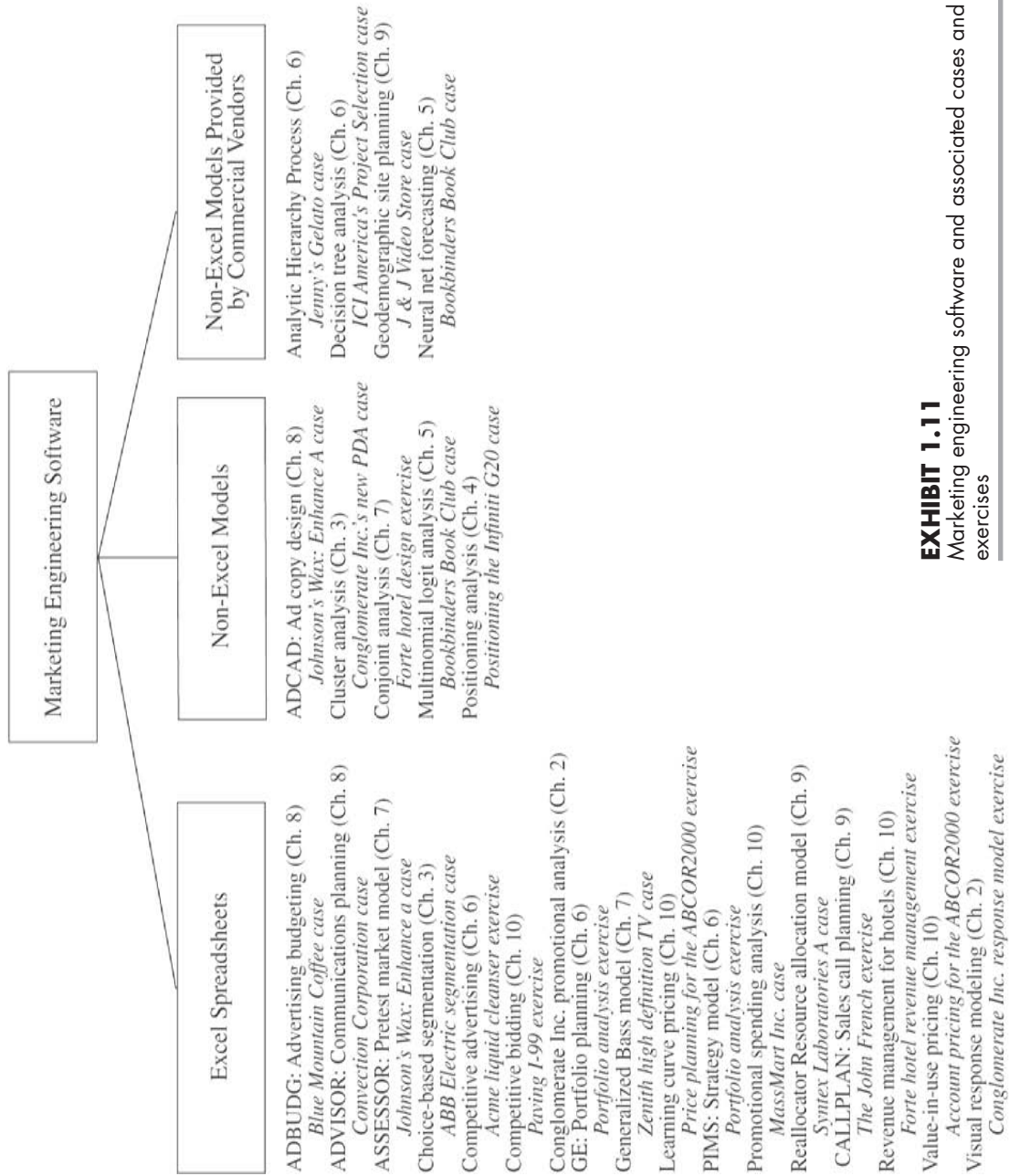
*Changing the default directories used by the Marketing Engineering program:* You can customize the directories where Marketing Engineering looks for data files and where it writes out temporary files. Select the **Help** menu and click on the **Preferences** option. Indicate your preferred locations for files. Note that the directory containing Excel spreadsheets must be one level below the directory where the Marketing Engineering program (mktgeng.exe) is installed.

*Learning to use the software:* To obtain details about the operation of any of the software modules, you should access the associated tutorial through the **Help** menu in the software or from our Web site. We strongly urge all users to follow the step-by-step illustration of software use included with each of the tutorials.

## SUMMARY

In this chapter our primary objective was to introduce the emerging field of marketing engineering—the use of interactive computer decision models to facilitate marketing decisions. More and more marketing managers are functioning in decision environments characterized by increasing amounts of data, information (summarized data), and computing resources. Yet few business schools currently offer courses to train marketing managers in the tools and concepts of marketing decision models, which we believe will help you succeed in such environments. We developed this book to provide in one package both the concepts and software tools that we hope will become a part of the marketing curriculum at business schools.

The marketing engineering approach is centered around interactive decision models, which are customizable computerized representations of marketing phenomena that enhance managerial decision making. We described the many potential benefits of using decision models, including improving the consistency of decisions, gaining the ability to evaluate more decision options, assessing the relative impact of different factors in influencing a decision, and updating one's own mental model

**EXHIBIT 1.11**

Marketing engineering software and associated cases and exercises

of market behavior. We also summarized several reasons that many managers do not currently use decision models in spite of their potential benefits.

We emphasize learning by doing. The more you apply the concepts and tools to real decision problems, the more you will learn about marketing engineering and its value. We also emphasize end-user models, that is, models that you can either develop or use directly without having to bring in technical experts. As a result we hope that you will use the software provided in the book to deal with problems you encounter in your jobs, at least as a starting point, before undertaking or authorizing more extensive modeling efforts.

Finally, we also provided an overview of the software that accompanies the book, focusing on the software design criteria and tips for installation and use. So get ready for marketing engineering!

## HOW MANY DRAFT COMMERCIALS EXERCISE<sup>1</sup>

Your boss directs TV advertising for a large corporation. Currently, the corporation's outside advertising agency creates a draft commercial and, after getting your boss' approval, completes production and arranges for it to be aired.

Your company's advertising budget is divided between creating and airing commercials. Your boss is considering increasing the proportion of the budget devoted to the first "creative" part of the process. He would do this by commissioning multiple ad agencies to each independently develop a draft commercial. He would then select the one for completion and airing that he determines would be most effective for promoting sales.

The standard technique for evaluating a draft commercial involves showing it to a trial audience and asking what they remembered about it later ("day after recall"). Both the effectiveness of a commercial and the exposure it receives will influence sales.

Your boss wants you to develop a marketing engineering approach for determining the "optimum" number of draft commercials to commission.

### EXERCISE

Assemble your marketing engineering team in a room. Identify one member of the group to serve as an observer/reporter. The selected observer is not permitted to say anything during the modeling session.

Your team must deliver a model capable of answering your boss' question. You do not have to answer the question; just develop a model that can be used to do so.

Use a combination of equations, words, diagrams, flowcharts, or graphs to express your model. Remember that someone else has to make sense of the model you develop.

In the class, each team will present its model and the observer for the team will then report on one admirable aspect of the team's process.

1. This exercise is adapted from an exercise developed by Professor Thomas R. Willemain of Rensselaer Polytechnic Institute for classroom use, and is used here with his permission. See O'Connor et al. (1996) and Gross (1972) for reference.