CHAPTER 1

THE USE OF MODELS IN MARKETING

Introduction

The personal computer has affected the entire world of model building. Just a few years ago we were visiting with a mid-level marketing manager marketing models. He told us of his experience with marketing models, then added, "Models are used only by the megabuck consumer-products companies that can afford the high risk and costs of model development, data collection, and analysis."

His was a widely-held view in those days before personal computers, and was supported in the history of mainframe-based marketing models. What are the reasons why?

First, in some cases model development costs have been outrageous, with no payback whatever. In the early 1970's, LaButz of Canada spent over $50,000 to develop a model which would determine the effects of advertising and sales force expenses on market share, but it was never used. A few years earlier, Amstutz's Sprinter Mod II market simulation had cost over $200,000 to develop and it was never used. Today, many large corporations contract for large research projects that do not answer the right question, and are not even directed at the right problem.

Second, the development time for a model was often too long for it to be useful. Many mainframe models have taken years of development to simulate market conditions which had changed long before the model was finished.

Third, costs of collecting data to be used as input to a model have frequently been huge. In 1999, IBM spent nearly $2,000,000 to model world wide sales potential on a country by country basis.

And finally but probably most important, many of those mainframe models were almost incomprehensible to anyone but their developer. Amstutz's model was staggeringly complex, having more than 500 equations. Another well-publicized 1960's model was so large and complex that running it took more than $75,000 in computer time.

The personal computer changed all this. It has encouraged the development of models that are smaller, cheaper to develop and cheaper to run. These models are more understandable, appeal to a larger audience and, if not always "friendly," are at least more companionable than the impersonal, and even intimidating, mainframe models of a decade ago.

Model development software, such as Excel, is also becoming plentiful. These programs, or executable versions may ultimately standardize much model building. This standardization will help non-model-builders feel more comfortable interacting directly with the model themselves, instead of relying on their operations research people to do it for them. Undoubtedly, this interaction will increase management's comfort zone for models. This is likely to increase the use, confidence in, and understanding of the models.

What is a Model?

A model is simply a representation. A map, which represents the countryside, is a model, and so is a graph which represents a company's sales over time. In this sense, all our perceptions of reality are "models" since they are only perceptions and not reality itself. Our language is a model, since words are only representations of objects or ideas. Similarly, our numbering system is a model by which quantities of objects or ideas can be represented. These are trivial, but real, distinctions between models and reality.

Models characterize either what currently exists in fact, or what might exist in the future. Marketing models might depict such operations as an existing product

distribution system; a consumer's value structure, consumer preference modeling for product choices, or the effects of advertising on consumer awareness, knowledge, attitudes, or intention to purchase.

The purpose of a model is typically to provide the manager with a guide for evaluating the effect of a set of input variables. For example, a design engineer for General Motors might model the aerodynamics of a different body design features to determine their impact on airflow and fuel economy. Or a civil or hydraulics engineer designing a dam to hold back a reservoir 200 feet deep might use a model to determine the concrete density and materials necessary to withstand the water pressure at each depth level.

Model builders in the applied or physical sciences often use readily measurable and quantifiable input data. But marketing model builders typically often have only very loose and imprecise inputs. These inputs are often estimates of such unknowns as new product demand, advertising effectiveness, advertising efficiency, optimal sales force allocation, results of a product positioning option, or estimates of pricing strategy.

Marketing Decision Making

Modeling is simply a means of depicting, examining, specifying, or operationalizing relationships. This suggests, then, that management decision making is inherently a modeling process, in which the manager models the environment and competitive strategy.

Companies, in their evolution toward becoming "model-building" firms, will usually include four processes or stages in marketing decision making. Most are stuck in the first or second stage. These processes are:

1. Making decisions through managerial experience, where the years of integrative executive experience guides managers to the proper course of action.

2. Using market data or other facts derived from marketing research along with the above, where marketing research may describe the attitudes, perceptions, preferences, product usage by market segments, or product use scenarios. Often data is collected to examine relationships, such as the relationship between use situation and usage rate, but the underlying assumptions of a consumer behavior model are not readily recognized.

3. Developing accepted organizational standards for decision making, where the organization explicitly recognizes acceptable alternatives in planning and implementing marketing strategy.

4. Conducting explicit model building, where model building objectives, constructs (variables), and relationships between constructs are specified in detail. The relationships between the constructs are specified in detail using theory and management judgement, and the evaluation of the model is based on a conceptual framework.

An obvious question to be asked is, "Why don't more managers do explicit model building?" MIT professor John Little helped answer this by identifying several reasons why management science models are not used more often in marketing decision making. The reasons why models are not used in marketing include:

1. Parameterization of variables is difficult

2. Managers do not have time or desire to spend the effort to become knowledgeable in the area

3. Models are technologically and mathematically too complex

4. Managers do not have the input data for the models

5. Most models are not well defined

To overcome these problems, Little gave thought to what characterizes "good" models -- models that will be used by management. These characteristics provide a litmus test for evaluating the "goodness", or managerial acceptability of all model building efforts within the social sciences. These are:

1. The model must be simple to use and understand,

2. It must be robust -- its results must not vary wildly with small changes to the input data,

3. It must be easy to communicate with,

4. It must be easy to control,

5. It must be adaptable to other products or situations, and

6. It must be complete on important details.

It is easy to appreciate the complexity of the marketing decision making process when the difficulties of creating and parameterizing the models are understood.

Total market effort is the mixture of activities the firm undertakes to meet its objectives (sales, profitability, donations, or whatever). Marketing activities

include, of course, marketing mix variables such as the types and levels of pricing, promotional activities, distribution strategies, and product development strategies. Interactions are known to exist between these functions, but the duration, relevant range, and extent is unknown.

In practice, the mathematical, and even directional, relationships between the marketing mix variables and market response are not usually known. Consider the "Be a Pepper" advertisements aired by Dr. Pepper. Their upbeat music and image resulted in high advertising awareness, but Dr. Pepper market share steadily declined. Although it is generally thought that the campaign was unsuccessful because it provided no product benefit focus, little is actually known as to why (or even "whether") the campaign was unsuccessful in selling the product.

Contributing to this complexity are many other factors that can influence the implementation or interpretation of the marketing effort. Specifically, these variables may include:

Market segments which differ in their response to the marketing mix. Segments may be defined according to geographic areas, attitudes held, benefits sought, characteristic life styles, demographic characteristics and so on.

Multiple products which exist or are offered to the consumer. The allocation of resources, such as sales effort, to one product may influence sales of other products within the line.

Conflicting objectives which present difficulties when setting goals and developing implementations for product offerings.

Functional Areas Interaction. For example, inventory management objectives of limited stock may conflict with sales management objectives of no waiting time and abundant stock. Pricing and advertising strategies may influence inventory,

employee scheduling, cash flows, production scheduling, and financial management.

Competitive Effects. The nature and impact of competitive actions is typically unknown.

Delayed Response To Marketing Efforts. The effects of advertising campaigns or selling efforts may carry over substantial periods of time and even last for years.

In spite of the complexities of model building, models offer significant benefits. Perhaps most important is the sensitization process they help develop. Managers must gather and enter the input data, then evaluate the model's outputs. They re-evaluate the input data, modify it, and watch the effect on the model's outputs. By using models in this way, managers become sensitized to recognize and evaluate the elements that are important to making an appropriate decision.

Modeling activities also force both the manager and the researcher to be critical (and parsimonious) in evaluating the impact of variables that could explain the process. They begin to question assumptions about supposedly influential variables, and begin to discover important new variables.

Finally, the manager is forced, as part of the variable selection process, to consider the relationships between variables. He or she begins to be aware of interactions between them, and they may begin to recognize that a symbiotic, synergistic, relationship exists between many marketing activities and effects.

AN INTRODUCTION TO MODELING CONCEPTS

Model Purpose and Form

Models are usually developed to increase our understanding, prediction, and control of real world events. They can further be described as being either descriptive, predictive, or normative. This distinction between model types is

important since it delineates the purpose or use of the model in management decision making.

Descriptive Models. Some models are intended merely to describe a real-world process. These descriptive models provide a characterization of the nature and workings of the modeled process. For example, a simple accounting model of,

Profit = Revenue - Costs,

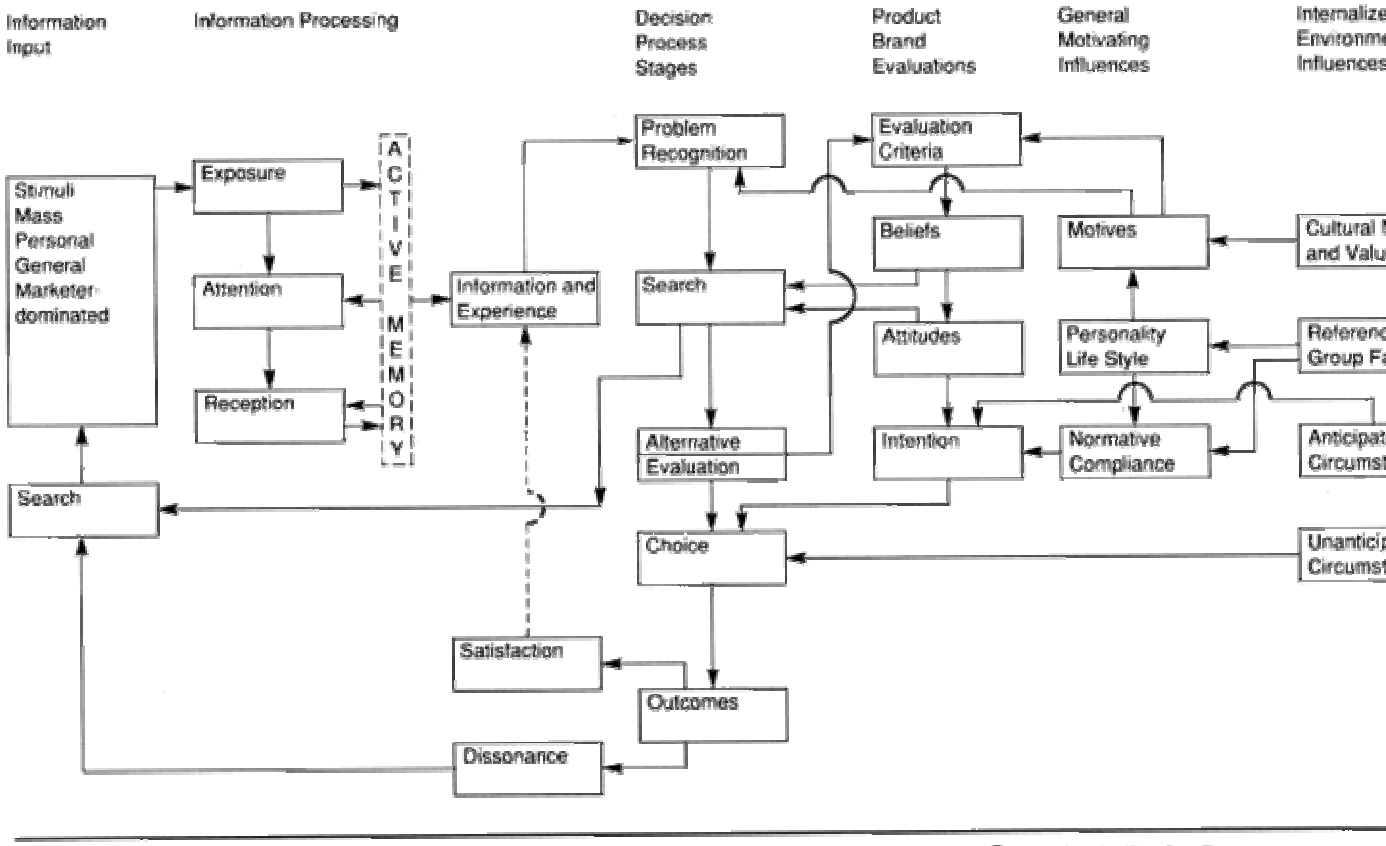
describes a large number of events, including sales, purchases of materials, expenditures for labor and overhead, and so on. In marketing, descriptive models show market information in a way that identifies the components of a market or system. In consumer research, this system might be the consumer information search process that occurs within the overall process of consumer behavior. Descriptive models make statements that certain phenomena are produced by other factors. For example, we might predict sales with the factors,

Factor 1 = size of the customer's business
Factor 2 = number of salespersons
.
.
.
Factor k = Overall health of the economy

Descriptive models are often used to depict large systems, because the large number of variables and interactions make other types of models impractical. The Engel, Blackwell, and Kollat model provides one example (Figure 1-1). In addition to providing graphic detail, descriptive models also serve to develop descriptive structural hypothesis that specify the causal relationships between variables. This specification may provide for better measurement of variable relationships. Descriptive models provide a structured basis for discussion, analysis and understanding of a problem.

FIGURE 1-1

Engel, Blackwell, Kollat Model A Comprehensive Model of Consumer Behavior



Source: Consumer Behavior, 3/e, by James F. Engle, Rodger D. Blackwell and David T. Kollat. Copyright © 1978 by the Dryden Press. Reprinted by permission of Holt, Rinehart and Winston, Inc.

.

Predictive Models. Predictive models are usually more complex than descriptive ones. Besides describing objectives and events, they are designed to predict future events. A sales forecasting model, for example, is designed to predict the result of the purchase decisions by a firm's customers.

As another example, we might develop a time-series regression model to predict the impact of advertising reach and frequency on advertising effectiveness. Predictive models make inferences about the underlying structure of variables that govern a phenomenon. Understanding the predictive relationships between sets of variables is beneficial because these relationships can be used to forecast future events, making them invaluable in planning and control. Predictive

models can be useful in validating descriptive models and in determining sensitivity of predictions to variables in the model.

Extending our sales example from above, predictive models provide a more precise explanation by specifying how factors 1...k interact in manner *x1...xk* to predict sales.

Normative Models. Normative (or, control) models are the most difficult models to construct since these models not only describe and predict, but provide direction about the proper course of action. If our sales forecasting model includes the prices we can charge for our products, we might be able to make a decision about which price we should charge in the future. The normative models tell us what should be done. They assess the implications of decisions and provide solutions to problems.

Once again using our sales example, normative models extend to provide the reasons for the predictive relationship, and may be expressed as: "Factors 1...k interact in manner *x1...xk* for reasons *w1...wk* to predict sales."

Iconic and Symbolic Models. Management science models may assume a variety of forms, as shown by Zaltman, Pinson and Anglemar (1970), who identify two basic types of models: iconic and symbolic.

Iconic (which means "image") models are like reality in the sense that they look like reality. Photographs, maps, architectural miniatures, and rough layouts of advertisements are all iconic models.

In contrast to iconic models, symbolic models do not look like reality, but emulate reality in other ways. They include either (a) verbal, (b) schematic, or (c) mathematical forms that describe a specific process. For example, consider several simple models of these types which describe the relationship between consumer attitudes and intention to purchase a brand:

Verbal: To discover consumers' purchase intention for a brand, measure their evaluation of each of its attributes and then add these evaluations together.

Schematic:

Purchase Intention = Evaluation of Attitude 1 + Evaluation of Attitude 2 + Evaluation of Attitude 3

Mathematical:

$PI = b_0 + b_1A_1 + b_2A_2 + b_3A_3$

where,

b_0, b_1, b_2 and b_3 are importance weights, and

A1, A2 and A3 are measured attitudes evaluating brand

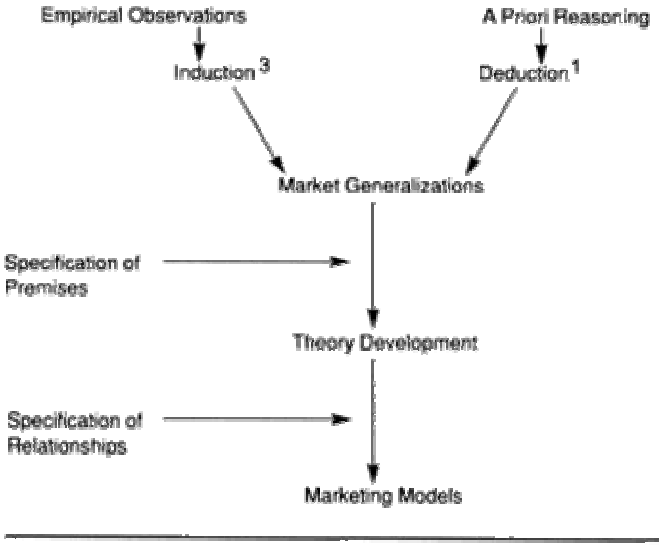
attributes 1, 2 and 3, and PI is purchase intention.

DEVELOPING MARKETING MODELS

Marketing models, like all management science models, are developed through either inductive or deductive logic which leads to generalization about market behavior. From these generalizations, sets of premises or theories are developed. These lead to sets of relationships which constitute marketing models. This process is depicted graphically in Figure 1-2.

FIGURE 1-2

Process of Marketing Model Building



[4] Induction moves from the particular to the general—using particular observations to build a general model. Deduction moves from the general to the particular—using inference to establish the particulars from a general model.

1. Induction moves from the particular to the general--using particular observations to build a general model. Deduction moves from the general to the particular--using inference to establish the particulars from a general model.

PROCESS OF MARKETING MODEL BUILDING

Model Development Objectives

Since models are intended to represent reality, a fundamental issue is the convergence between the model and the reality it is designed to represent. We might hope that a model would confidently represent reality on all significant issues.

Model builders should measure the quality of their models against the criteria of validity and utility. Validity refers to the accuracy of the model in describing and predicting reality. A sales forecasting model which does not forecast sales with reasonable accuracy is probably worse than no sales forecasting model at all.

Yet, a major obstacle to the adoption of early marketing models was not caused by their being *incomplete*, but because they were *too complete*. Their developers, in trying achieve validity, were led to include so many variables (with correspondingly difficult data collection problems) that the basic structure of the model was buried, input data costs were escalated, and confidence in them was lost. The models may have been reasonably valid, but they had little utility because they slowed down the decision making and increased its cost.

The completeness and validity required in a model depends on the accuracy required in the results. Model users should not expect a model to make their decisions for them. The output from a model should typically be taken as one additional piece of information to help the managers make their own decisions.

Given this perspective, models can be excused from not representing reality perfectly and, in fact, will probably benefit from it if they are simple enough for the managers to understand and deal with. Clearly, though, models used to help make hundred-million-dollar decisions should be more complete than those used to make hundred-dollar decisions.

Too, the model to be used depends on the model's purpose. A simplified model does not preclude its user from considering other factors not included in it. We measure the value of a model on the basis of its efficiency in helping us arrive at a decision. If we arrive at better decisions more easily without the model, then the model is inefficient. In fact, models should be used only if they can help us arrive at results faster, with less expense, or with more validity.

Building Blocks for Models

The building blocks for models are concepts, constructs, variables, operational definitions, and propositions. Let us take a brief look at each of these.

Concepts and Constructs. A concept is an abstraction formed by generalization about particulars. "Mass", "strength", and "love" are all concepts, as well as "advertising effectiveness", "consumer attitude", and "price elasticity." Constructs are also concepts, but they are the conscious inventions of researchers to be used for a special research purpose. When we refer to "consumer attitude" as a *construct*, we are suggesting not only that it exists as a concept, but that it can be observed and measured, and is related to other constructs.

Variables. Model builders loosely call the constructs they study "variables." Variables are constructs that can be measured and quantified. A variable takes on different values (a variable varies). Treated as a variable, "consumer attitudes" suggests a some form of measurement which has produced data that represents consumer attitudes.

Cause and Effect. Relationships between variables usually involve cause and effect. For example, if we turn up the heat under a pan of water, the water will boil. We conclude that the heat caused the water to boil. Or if we increase our advertising expenditures we might see our sales increase. We can conclude that the advertising caused the sales to increase.

Or can we? A model builder would argue that we can not. To establish a cause-effect relationship, three conditions must be met:

1. Concommitant variation is necessary. If variable X has an effect upon variable Y, movement of the two variables must be associated with each other. Increasing X should increase (or decrease, or otherwise change) Y.

2. Proper time order of effects. If we want to believe that variable X has a causal effect on variable Y, then X should precede Y in time. If an increase in advertising expenditures is causing a sales increase, then the advertising

increase should precede the sales increase. (Have you ever noticed ... the more firefighters, the larger the fire?)

3. Absence of competing explanations. To be convinced that X is causing Y, we must be convinced that other variables are not responsible for the change in Y. If these are not controlled, we may ultimately discover that X is be causing Z, and Z is causing Y, or that both X and Y are caused by Z, etc. For example, our increase in advertising might have coincided with a price increase in our competitor's product and it was this price change that increased our sales.

Using the above three points to establish that the advertising increase caused the sales increase, we might argue that movement of those two variables is associated, and even that they have the proper time order of events. But we might be hard pressed to establish that no other variables are accountable for the sales increase. Those variables must be controlled, or at least monitored, before we could comfortably draw such a conclusion.

Operational Definitions. We can talk about "consumer attitudes" as if we know what it means, but the term makes no sense at all until we define it in a specific, measurable way. An operational definition assigns meaning to a variable by specifying how it is to be measured. It is a set of instructions about how we are going to treat a variable. For example, the variable "height" could be operationally defined in a number of different ways:

--as measured, in inches, with a precision ruler, with the person wearing shoes,

--as above, but without shoes,

--as measured by an altimeter or barometer,

--as measured by the number of "hands",

--etc.

As another example, suppose we were interested in "purchase intentions" for Brand X window cleaner. We might operationally define the variable as the answer to the following question:

Please indicate your intention to purchase Brand X window cleaner the next time you purchase a window cleaning product:

I definitely will purchase Brand X _____
I probably will purchase Brand X _____
I probably will not purchase Brand X _____
I definitely will not purchase Brand X _____

We could have chosen to operationally define "purchase intention" in other ways. For example, we could have used the concepts of "attitudes" and "beliefs," which have been shown to predict purchase intention, and used a simple mathematical model:

$$P = PI = A_i * B_i$$

P = Purchase behavior toward window cleaners	PI = Purchase Intention for window cleaners	A_i * Attitudes about window cleaners	B_i Beliefs about Window Cleaner Brand X

Propositions. A proposition is a statement of the relationships between variables. Propositions require an explicit statement of the relationship between variables, including both the variables influencing the relationship and the form of the relationship. It is not enough to simply state that the concept "sales" is a function

of the concept "advertising." More appropriately, any intervening variables must be specified, along with the relevant ranges for the effect, including saturation and threshold effects, and the symbolic form of the relationship.

A proposition is quite close, you can see, to a model. It is produced by linking propositions together in a way that gives us a meaningful explanation for a system or process.

EVALUATING MODELS

As we discussed above, the modeling process is helpful to managers because it sensitizes them to variables that are important in explaining a process. Modeling forces both managers and researchers to scrutinize and select appropriate variables, and to consider the relationships between them.

A checklist to serve as a guide in evaluating this model-building process can be helpful. Some important questions to be asked (and answered) are:

[ ] Are concepts and propositions specified in the model?

[ ] Are the concepts relevant to solving the problem at hand?

[ ] Are the principle components of the concept clearly defined?

[ ] Is there concensus as to which concepts are relevant in explaining the problem?

[ ] Are the concepts properly defined and labeled?

[ ] Is the concept specific enough to be operationalized reliably and with validity?

[ ] Are assumptions made in the model clear?

[ ] Are the limitations of the model stated?

[ ] Does the model predict?

[ ] Does the model explain?

[ ] Are normative guidelines given for model use?

[ ] Can the model be readily quantified?

[ ] Are the outcomes of the model supported by common sense?

If the model does not meet the relevant criteria, it should probably be revised. Concept definitions may be made more precise, variables may be added or deleted, operational definitions may be tested for validity, mathematical forms may be revised, and assumptions may be strengthened or weakened.

Summary

In this chapter we have reviewed some of the fundamental concepts behind models. In the next few chapters we will get much more focused and help you with an understanding of specific building blocks to be able to construct your own models.

Chapter Questions

1. What are models and how do they help in making marketing decisions?

2. Why don't managers do explicit model building?

3. According to Little, what are the characteristics of a good model?

4. What extraneous variables may iconic implementation or interpretation of marketing models?

5. Compare and contrast: descriptive, predictive and normative models.

6. Identify three types of iconic models.

7. Symbolic models include verbal, schematic, or mathematical terms that describe a specific process. Identify the verbal, schematic, and mathematical forms of two different processes.

8. Compare and contrast induction and deduction.

9. Define completeness and validity as they apply to model building and identify the relationship between the two criteria for measuring quality of models.

10. Compare and contrast a concept and a construct.

11. Identify the relationship between a variable, the operational definition of a variable, and a proposition.

12. As a manager, how would you evaluate the "goodness" of a model?

CHAPTER 2

A SPREADSHEET PRIMER

Excel provides the building blocks for an imaginative and exciting array of decision-making tools. It acts only on data and procedures entered by its users. But once those data and procedures are entered into Excel, it can process this data in a veritable garden of ways. It can treat the data as an electronic spreadsheet, or as a database, and it can plot or graph that data.

These functions enable us to quickly solve business problems traditionally solved with paper and pencil, a ledger, calculator, and drafting tools. Excel's primary function provides a combination spreadsheet and calculator which facilitates easy problem layout and calculation. Its database function is used to manipulate the numbers, formulas, or phrases stored in the spreadsheet. And with its graphics function, users can create graphs of spreadsheet data on the screen or on a printer or plotter. Excel's advanced capabilities include Solver, which can solve problems that have multiple interdependent variables; Goal Seek, a simplified version of Solver, uses a single changing variable; and Visual Basic for Applications, which is the Excel Macro language.

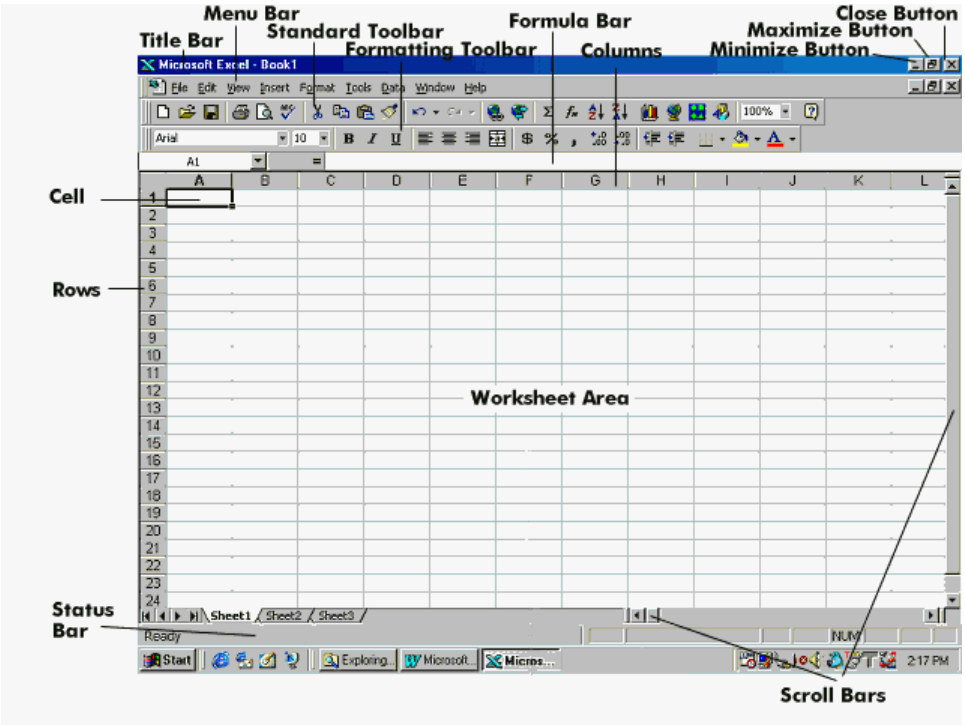
Excel magnifies our ability to analyze and solve business problems. In particular, repetitive and even dynamic problems needing new solutions for different input values are quickly, easily, and automatically solved. Too, we can save these spreadsheet "models" (also called "worksheets" or "templates") for use or modification in other applications.

In this chapter we begin a journey through the specific features Excel that make it appropriate for model building. Our objective in this chapter, and in the two which follow it, is to increase our familiarity with Excel, toward becoming comfortable using it for your own model building efforts.

GETTING STARTED WITH EXCEL

Spreadsheet Elements

After starting Excel, the display brings you immediately to the spreadsheet. In Excel, the spreadsheet is composed of individual worksheets or pages. The spreadsheet requires that you enter labels, data, formulas, and even define specific functions to be performed on the data. The spreadsheet contains several menus, which are identified in Figure 2.1 as the Menu bar, the Standard toolbar, the Formatting toolbar, Status bar, and the Formula bar. By using the Menu bar to select View Toolbars, all toolbars options are displayed and may be selected or customized. Most often, the Menu bar, Standard toolbar, Formatting toolbar, and Status bar are used.



Selecting

The Menu bar items can be selected in four ways: (1) selecting the menu item with the mouse and clicking with the left mouse button , (2) pressing the alt key, using the arrow keys to move the highlighted box along the Menu bar, and then

pressing enter to select a menu item, (3) pressing the alt key and pressing the underlined letter associated with the desired menu item, or (4) by pressing the / key.

Title bar The Title bar is at the top of the Excel spreadsheet window and shows the name of the file currently open.

Menu bar Clicking any item in the Menu bar displays the options that are controlled. Menu bar items include File, Edit, View, Insert, Format, Tools, Data, Window and Help. Because Microsoft keeps the same look and feel across software programs, users of Word or Powerpoint will find similarities in Menu bar functionality.

Standard Toolbar The standard toolbar displays icons for frequently used file, spreadsheet, and database operations, including functions and charting.

Formula Toolbar Is found on the right side of the toolbar and is used for entering, editing, or viewing data or formulas into a cell of the spreadsheet. On the left side of the toolbar is the Name Box. Whenever the pointer is positioned on a cell, the contents of that cell will be shown in the Name Box.

Formatting Toolbar contains icons for formatting the text or data in the spreadsheet cell(s).

SPREADSHEET FEATURES

The spreadsheet has many control features and prompts, most of which may be selected from the Menu bar.

Columns, Rows, and Cells

The spreadsheet is a table or matrix with 230 columns and 65,536 rows. The screen shows only a fraction of the spreadsheet at a time, much like a window that admits only a bit of a panoramic landscape. But you can move the window around so that you are able to see the entire spreadsheet, though a bit at a time.

The spreadsheet columns are labeled A through Z, then AA through AZ, BA through BZ and so on to column IV. The standard column width is 8.43 spaces (but this can be varied from 1 to 255 spaces to permit longer text areas). Rows are numbered 1 through 65,536. Depending on your monitor resolution and size, most monitors display 20+ rows at a time.

Spreadsheet "cells" are formed by the intersection of columns and rows. Every cell has a specific address or coordinate that corresponds to its particular column heading and row number. For example, the cell located at the upper left corner of the spreadsheet (in column A and row 1) has coordinate A1, and the cell found at the lower right corner of the spreadsheet has coordinate IV65,536. Cell addresses are used in specifying relationships in the formulas.

Into each cell you can enter numeric values, formulas or characters. While numbers of nearly any length can be entered into cells of any width, the screen will not display the number unless the column width is wider than the number. For example, to display a number with 6 digits the column must be at least 7 spaces wide. The column must be wider when a negative number, or special formats are used. A numeric value with more digits than the screen can display will usually be shown as a row of asterisks, or in scientific notation. Only the screen display is affected here; the number itself will reside in the cell whether or not we can view it.

Less important are the space limitations for labels. Even though each cell can hold up to 240 characters, the column width limits the display. Label displays are limited to the smaller of either the screen width (72 spaces) or one cell width plus the width of any empty cells to its right.

POINTER CONTROL AND SELECTING CELLS IN THE SPREADSHEET

Within the spreadsheet is a cell which is highlighted. This might be considered to be Excel's version of a cursor. In a new spreadsheet, the cell A1 is always highlighted. The pointer location is displayed in the left position of the top line on the control panel. Although it ordinarily highlights only one cell, the pointer can be expanded to identify a range of cells for input or manipulation.

Moving the pointer

You can move the pointer in many different ways:

← → ↓ The four arrow keys on the numeric keypad move the pointer one cell in the direction of the arrow.

Ctrl+← Moves to the left edge of the current region of the worksheet

Ctrl+ Moves to the top edge of the current region of the worksheet

Ctrl+→ Moves to the right edge of the current region of the worksheet

Ctrl+↓ Moves to the bottom edge of the current region of the worksheet

Home The Home key, located on the numeric keyboard, moves the pointer to the first cell in the row of the spreadsheet.

Ctrl+Home Moves the pointer to the upper left extreme of the worksheet, usually cell A1.

PgUp PgDn The page up and the page down keys move the entire screen (and the pointer) up or down one "screen" (about 20 lines).

Ctrl+PgUp To the previous worksheet

Ctrl+PgDn To the next worksheet

Alt+PgUp Right one screen

Alt+PgDn Left one screen

End If you press the End key then an arrow key in sequence, the pointer will move as follows:

a) If the pointer begins on a non-blank cell, it will move in the direction of the arrow to the last non-blank cell it encounters. If there is no blank cell it moves to the edge of the worksheet.
b) If the pointer begins on a blank cell, it will move in the direction of the arrow to the next non-blank cell. If it doesn't meet a blank cell, it will move to the edge of the worksheet.

Tab, Shift Tab The tab keys [|<--], [-->|] move the pointer one cell to the left or

right. (The left tab key is accessed by pressing the tab key, while holding down the shift key).

F5, Ctrl+G These keys invoke the Go To command. When pressed, the Go To dialogue box appears and a cell address or name may be entered into the "Reference bar". Just type in the worksheet coordinates you want the pointer to move to and then press [Ok]. The pointer will move to the specified position.

Selecting Cells, Row, Column or the Worksheet

The easiest way to select an item is to click on it. Click the left mouse button on an individual cell, click on a cell and hold the left mouse button down and drag it over a range of cells. Move the cursor to the column labels on the top of the worksheet and click on a column or drag to include a group of columns (a,b,c). Do the same with a row or range of rows. Select the entire worksheet by clicking on the button in the upper left corner of the worksheet where the column and row labels meet.

ENTERING DATA, EDITING, AND FORMATTING THE SPREADSHEET

Entries made into a spreadsheet are either labels, values, or formulas.

Labels are strings of alphanumeric characters such as titles, headings and comments. They can be made of alphabetic

characters, numbers, spaces, and the keyboard's special symbols. Labels can never be used in calculations, even if they contain numbers.

Values are numeric data and can be used in calculations.

Formulas are entered to specify the relationship between cells or ranges of cells. For example, the formula =sum(a1.c1) and =(a1+b1+c1) both produce the same result, though the first is shorter and uses the Excel Sum function in the formula. Note that when you enter a formula into a cell, the Formula bar shows the function and the cell displays the numerical result of the formula, even though the cell actually contains the formula itself.

Entering Labels Whenever the first character being typed into the formula bar is other than a slash, number or one of six special characters (= + - . @ /), interprets the entry as a "label." When a label is entered, the text is positioned within the cell to the right. You can change do this by selecting the justification option on the Formatting bar.

Entering Values and Operators. Excel interprets an entry as being a "value" the first character entered is a number, a decimal point, or one of the following special characters: = + - (@ . All other characters, except the slash (/), are interpreted as a label. It is helpful to keep a few rules in mind when entering values:

1. Values and formulas must always begin with either a number or a numerical indicator such as 0,1,2,3,4,5,6,7,8,9,0,+ , . , (, @, =
2. Do not use commas, spaces, dollar or percent signs when entering a number. Excel will insert these symbols or commas as needed.
3. Use only one decimal point.
4. A % sign after a number indicates percentage and causes the number entered to be divided by 100.

5. Mathematical operators may be used in formulas to perform mathematical and logical operations. These operators work in order of algebraic precedence, as described below.

   If all operators have the same precedence in a formula, they are performed left to right. The order of precedence can be changed by using parentheses, because operations within parentheses are always performed first.

   Operator Description

   ^ Exponentiation

   + Positive

   - Negative

   * Multiplication

   / Division

   + Addition

   - Subtraction

   = Equal

   < Less Than

   <= Less Than or Equal

   > Greater Than

   >= Greater Than or Equal

   <> Not Equal

1. Formulas may contain actual values or values that are designated by referencing another cell (or cells) that contains the value. For example, entering the formula +A1+A2+A3 into any cell will place into that cell the sum of values contained in cells A1, A2, and A3.
2. If you wish to begin a cell entry with a cell coordinate, start the entry with either an = (or + character, or will interpret the entry as a label rather than a value. For example, instead of entering "A1", enter "(A1)" or "=A1".

Editing The Spreadsheet

Excel provides you with five methods for correcting a spreadsheet entry:

1. Use the backspace [← BkSp] key

2. Use the [Del] delete key
3. If entering data into a cell, cancel the entry with the escape [Esc] key.
4. Replace cell contents by typing over the current cell.
5. Erase cell contents (by using Edit Clear).
6. Edit cell contents using the [F2] key, which invokes the edit mode.

If you want to change data that has been entered into the Formatting bar, but not yet saved into the cell, it is easiest to use the backspace key or the escape key.

Backspacing. At the upper right of the keyboard is the backspace [← BkSp] key. The backspace key always moves the curser to the left, in the direction of the arrow, deleting all characters as it moves. The right or left arrow keys on the numeric keypad cannot delete characters. Pressing these arrow keys enters data shown on the Formatting bar into the cell.

Canceling Cell Contents. Often is it more efficient to delete all of the characters stored in the Formatting bar rather than backspacing. By pressing the [Esc] key, the entire entry can be erased. Note that this feature only erases data from the Formatting bar . Once data has been transferred from the Formatting bar into a cell, you must either replace or erase the cell contents to change them.

Replacing Cell Contents. Replacing cell contents is easily done by positioning the pointer on a cell, entering the new data into the Formatting bar , and pressing [Enter] or an arrow key. The old cell contents will then be replaced with the new data . While you can use the space bar to replace or erase a cell, this causes Excel to store "spaces" in the cell, which inefficiently uses the computer's memory.

Erasing Cell Contents or the Worksheet. The contents of a cell can be erased by moving the pointer to a cell and using the Menu bar to select the Edit Clear command, or by using the / key to invoke the menu and selecting the letters associated with the clear option:

/[Edit] [cleAr] [All]

You can use this command to erase any rectangular group of cells. Simply place the pointer on one of the corners of the rectangle and enter the following command:

/[Edit] [cleAr] [All]

Use the arrow keys to expand the pointer in any direction desired. Selecting [All] option will erase the entire highlighted rectangle.

Sometimes it is preferable to start over with a new, clean spreadsheet. Do this with the [File] [New] option:

/[File] [New] [OK]

Editing Instead of replacing the contents of a cell, the [EDIT] mode may be selected to edit cell contents. Editing a cell requires that a four step procedure be followed.

1. Move the pointer to the cell you want to edit.
2. Press the [F2] (edit) key. This copies the cell contents to the Formatting bar.
3. Edit the data displayed on the Formatting bar line by moving the cursor with the left or right arrow keys, by typing in new characters, or by using the [Del] or [← BkSp] keys to delete selected characters.
4. After editing is complete, press the [Enter] key to transfer the contents of the Formatting bar back to the cell.

Specifying A Range

Many commands require you to specify a "range." A range is any continuous collection of cells. Ranges can include a single cell, a row or column, or a rectangular group of cells. Single cell "ranges" are called by their cell address, such as B5 or A1. Multiple cell ranges are identified by the opposite corner addresses of the rectangle: (i.e., B1..D3). The first coordinate (B1) is the upper left corner of the range, while the second coordinate (D3) is the lower right corner of the range.

The range is required for, but is not limited to, the following Menu bar commands:

1. /[Insert] to insert or delete rows and columns.
2. /[Format] to set the format for the cell displays.

3. /[Edit] [Clear] to erase ranges of cells.
4. /[Edit] [Delete] to delete ranges of cells, rows, or columns

   (deletion of cells removes the cells and shifts the neighboring cells to take their place). Alternatively, you can specify a range of cells and press the [Del] key.

5. /[Insert] [Name] [Create] to name the range.
6. /[Edit][Copy] to copy the contents of one range into another range location.
7. /[Edit][Move] to move a range within the spreadsheet.
8. /[File][Print Area] to designate ranges of cells or be printed.
9. /[Insert][Chart] to identify ranges of cells used to make a chart or graph.

How To Specify A Range

There are four ways to specify a range:

1. Pointing to a range involves using the arrow keys to expand the pointer. First, lock the upper left-hand corner of the range by pressing the [Shift] key. Second, expand the pointer (the range) as far as desired by repeatedly pressing an arrow key. When the desired dimension is reached, use an arrow key to expand the range in a second direction if a rectangle is desired. Finally, select the menu options using the mouse or / key.
2. Typing the Range is the second alternative for specifying a range. For example, typing A1.B2 or A1:B2 will define a range composed of cells A1, A2, B1, and B2.
3. Naming the Range: /[Insert] [Name] [Define] assigns a name to a specified range. Once the range is defined and named, the name may be referenced instead of typing the cell address or pointing to the cell. First, select the range to be named. Next, the /[Insert][Name] [Define] command causes the menu box to appear and prompt you for the name.
4. The /[Insert][Function] command is used to specify special functions that apply to specific cells or ranges that serve as an argument for the function. For example, the statistical function AVERAGE is entered as: =AVERAGE(B1.B10) and computes the average of the range B1 to B10. The @ or = symbol specifies a function, followed by the function name and parentheses containing the range to be operated on. Ranges are required for the math & Trig, Statistical, Logical, Text, Database, Lookup and Reference, date and time, and Information functions.

Formatting Entries

Cells, rows, columns, or worksheets may be displayed according to various formats. These formats are invoked using the /[Format] option from the Menu bar to access [Format] and the associated submenu. The [Format] submenu appears in Figure 2.3 where the main submenu choices include the formatting of cells, rows, column, and the entire worksheet.

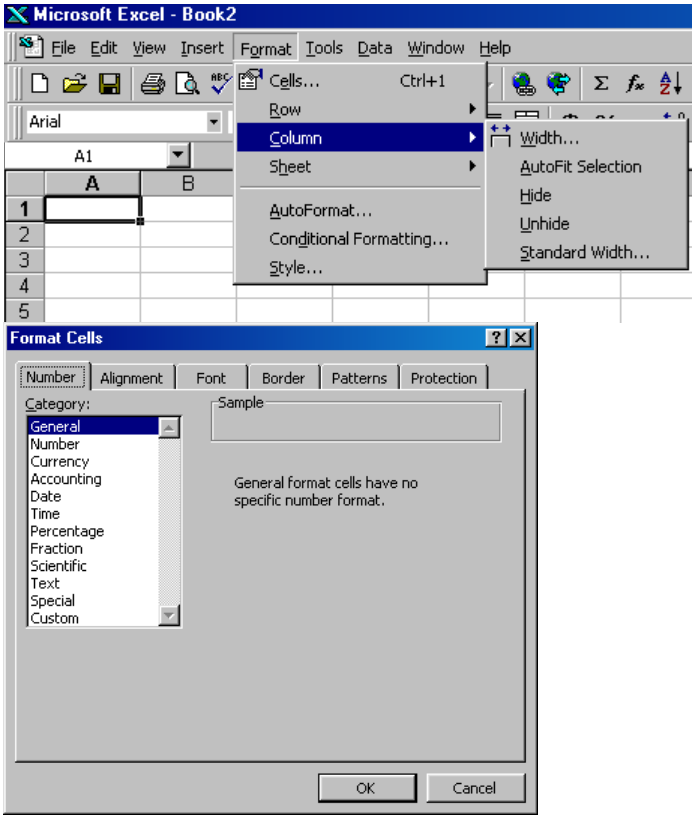


Figure 2.3 The Cell and Column Formatting Menus

Cell formatting allows you to modify the actual formatting of the data displayed in the cell or range of cells (display the number, the number with a defined number of decimals, as currency, in accounting format, use fractions and percentages, or to use scientific notation. In addition, you may format date, time, and text data.

Formatting extends beyond the actual number itself to include alignment, the font displayed, the use of borders around the cell or range of cells, use patterns as backgrounds, and to set protections so that the data and formulas cannot be changed. Within the [Format][Column] or [Format][Row] options, columns and rows may be formatted to be of variable width or to be hidden (width=0). A conditional formatting wizard is also available, that guides you specification of a changing format that varies depending on the value that is present in the cell.

[General] Resets the format to the default format, which is the same as the global format.
[Number] Sets the number of decimal places to be used in number and formula displays.
[Currency] Causes numerical and formula entries to be preceded by a $. Negative values will be displayed in parentheses, and commas will be inserted between thousands. The number of decimal places may be designated. Decimal points are aligned
[Accounting] Causes numerical and formula

entries to be preceded by a $. Negative values will be displayed in parentheses, and commas will be inserted between thousands. The number of decimal places may be designated. Currency values are aligned

[Scientific] Displays numbers and formulas as exponential notation.

[Percentage] Displays the value entered multiplied times 100. The number of decimals may be designated.

[Fraction] Displays the decimal portion of the value as a fraction. 1,2,3 digit fractions, as well as halves, quarters, eighths, sixteenths and tenths may be displayed.

[Date] Provides multiple format options for displaying a date:

[Text] Displays numbers in general format and formulas exactly as entered rather than as calculated values.

Absolute Vs. Relative Cell Addressing

Absolute versus Relative Cell Addressing permits the copying of formulas in just the same way that numerals and labels are copied. Formulas, when copied, will automatically change to reflect a new set of cells that have the same relative address positions to the cell copied...unless addresses are made "absolute". Formulas with relative cell addressing use data relative to the cell where the formula is located. If the formula location is changed, the cells identified in the formula as the source of the data also change. For example, if cell A2 contains the formula (A1+B1), the data is taken from the cell directly above the formula and the cell located one row up and one column to the right. When the formula is copied from cell A2 to cell B2, the formula would automatically change to read (B1+C1), again taking the data from the cell directly above the formula and the cell located one row up and one column to the right.

At times, when copying formulas, we desire that the same cells be used, thereby avoiding this relative formula change. This requires use of "absolute" cell addressing. Absolute cell addressing would result in the formula inputs being held constant. The dollar sign ($) in the cell address may be used to anchor either the row or column number, or both of the coordinates. All coordinates without the $ anchor remain relative.

Consider the following three examples:

Cell A2 Formula Result When Copied to B3 Explanation

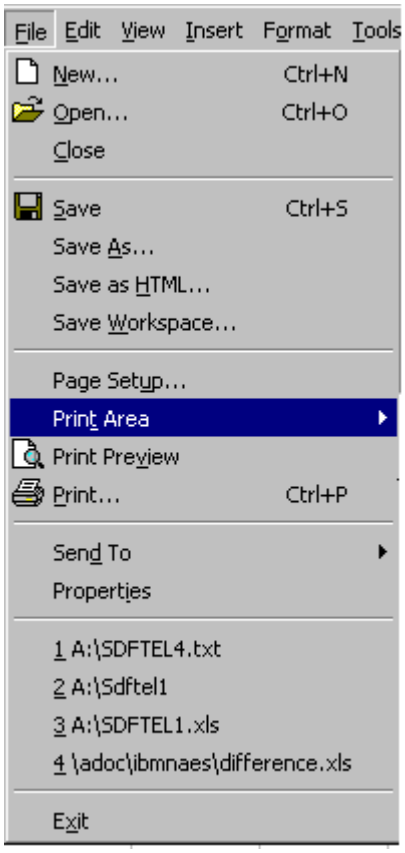
=$A$1+B1 =$A$1+C2 The Column A and Row 1 are anchored

=$A1+B1 =$A2+C2 Only Column A is anchored, leaving the Row to change

=A$1+B1 =B$1+C2 Only Row 1 is anchored, leaving the Column to change

THE MENU BAR: FREQUENTLY PERFORMED TASKS

FILE OPTIONS



The File option controls the overall spreadsheet formatting and file functions. New files may be created, existing files opened, and opened files closed.

Open allows files from other formats to be opened and defined for import, including text, Quattro Pro, Lotus 1-2-3, and Microsoft Works.

Close simply closes the open spreadsheet and allows you to save it when closing.

Save allows for saving the spreadsheet. If the spreadsheet has been saved previously, selecting the save option automatically saves the sheet under the default name.

Save As allows for saving the spreadsheet under a new name or new format. Formats include text, database, and many versions of Excel and non-Excel spreadsheets.

Save as HTML saves the spreadsheet as HTML for publishing in web documents.

Save Workspace Saves changes to the individual worksheets. This command is used in conjunction with saving a workspace file, which saves information about all open workbooks, such as their locations, window sizes, and screen positions. When you open a workspace file by using the Open command (File menu), Excel opens each workbook saved in the workspace.

Page Setup controls the formatting for the entire spreadsheet and includes settings for page orientation (landscape and portrait) and scaling, margins, headers and footers, and sheet print areas and page orders within the spreadsheet.

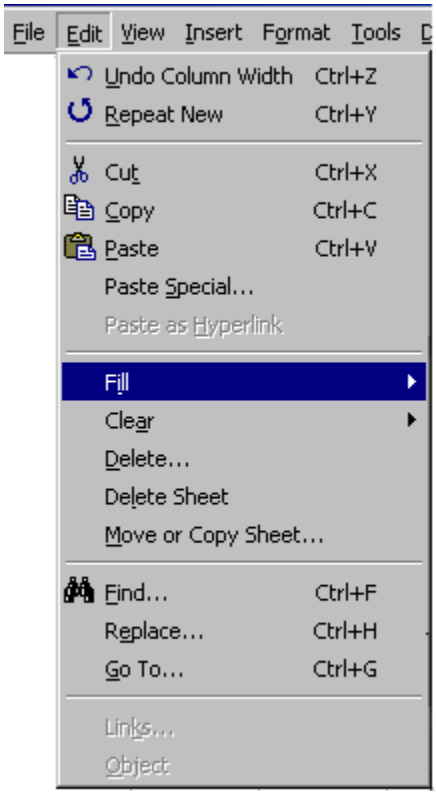
Print Area, Print Preview, Print Excel will print defined ranges of a spreadsheet. The amount of print contained on a given page is limited by the size of the character font used to print the page. When the width of the range to be printed exceeds the physical page width, blocks of columns will be printed until the entire spreadsheet is completed.

Print Area allows for the selecting of a specific range of the worksheet that is to be printed.

Print Preview allows for viewing the document to be printed prior to actual printing.

Print beings up the print dialog box that specifies the printer, whether the whole or selected area are printed, and gives the final command to print.

Send To is a useful command if you have an Internet mail connection. The spreadsheet can be attached to an E-mail and forwarded to a designated e-mail address.



EDIT MENU OPTIONS

Edit menu options contain the undo and repeat commands options, and the standard cut, copy, paste commands common to all windows programs.

Paste Special command has some features important in preparing an Excel spreadsheet. In Excel, values are often computed using formulas. If areas of the spreadsheet are copied, the formulas are copied with the areas. When the areas are pasted using the paste command, the relative addresses change and the values computed when the formulas are pasted back into the spreadsheet often become nonsense. The Paste Special command allows the copied values and their associated formulas to be pasted as copied, or to paste only the formulas, values, formats, comments, or without the borders. Additionally, the Paste Special command will allow the data to be transposed (a row of data to be converted automatically into a column).

Fill allows for the filling of a range in the spreadsheet with a given number or with a series of numbers. We would use the following steps to create a range of numbers from 1 to 10 in cells A1 to A10. First, enter the value 1 in cell A1. Next highlight the range A1 to A10 using the mouse. Finally, select [Edit][Fill][Series]

on the Menu bar. Once in the series dialog box, make sure that the following are selected: Series in Columns, Linear and Step value of 1. Click [OK] and the series will be created. It is a quick and easy way to enter a long series of values.

Clear is used to clear comments, formats, or all values and labels from a cell, range of cells, or the entire worksheet if it is selected.

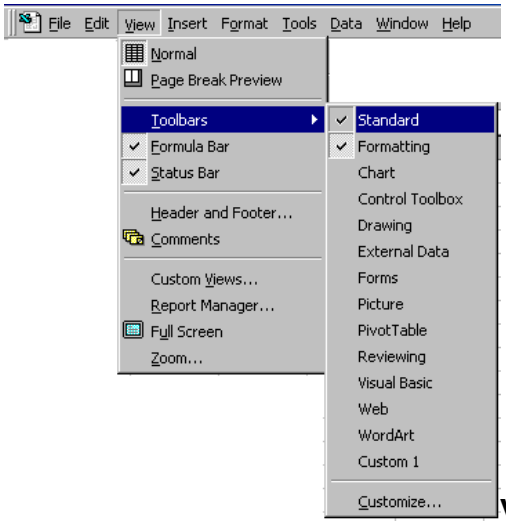
Delete removes the cells selected and moves the adjacent cells up or over to take their place.

Delete Sheet removes the entire worksheet contents and removes the worksheet from the workbook.

Move or Copy Sheet copies or moves the entire worksheet.

Find, Replace invokes the search and search/replace function for Excel.

Go To moves to a specified cell or named cell within the spreadsheet.



VIEW MENU OPTIONS

The view options control the toolbar options viewed on Excel. As explained earlier, the Formula bar, Status bar, and Standard and Formatting toolbars are most often viewed. Specialty and custom developed toolbars for charts, drawing, or other special features of Excel may be brought to the desktop.

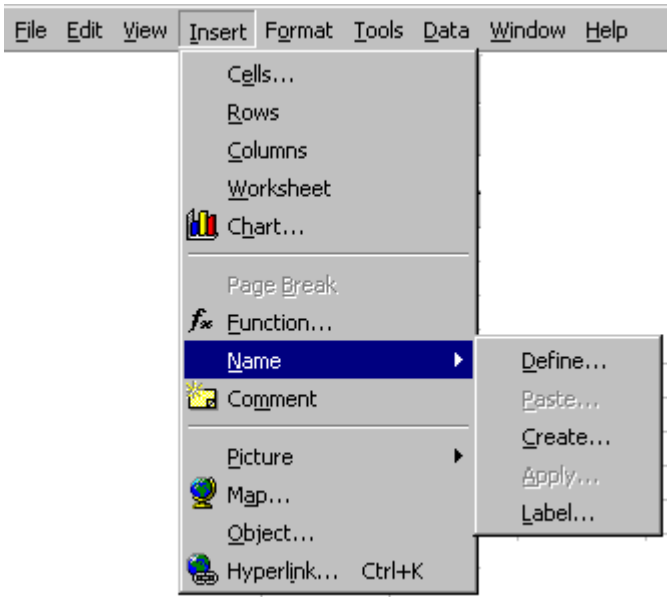
The view option menu also permits insertion of headers and footers, and the viewing of comments that have been inserted with the Insert Menu Options.

INSERT MENU OPTIONS

Cells, Rows, and Columns

The insert menu controls the insertion of all worksheets, rows, columns, and cells when the spreadsheet is modified to accommodate new data, labels, or formulas.

Figure 2.4 The VIEW MENU



Inserting Columns or Rows

Inserting rows and columns requires precise positioning of the pointer. Column insertion occurs directly to the left of the pointer. Row insertion occurs directly above the pointer. To insert columns, place the pointer directly to the right of where the columns are to be inserted and select [Insert] [Column]

Similarly, to insert a row, place the pointer on the row(s) directly below where the row is to be entered, and select [Insert] [Row]

For example, if two new columns were

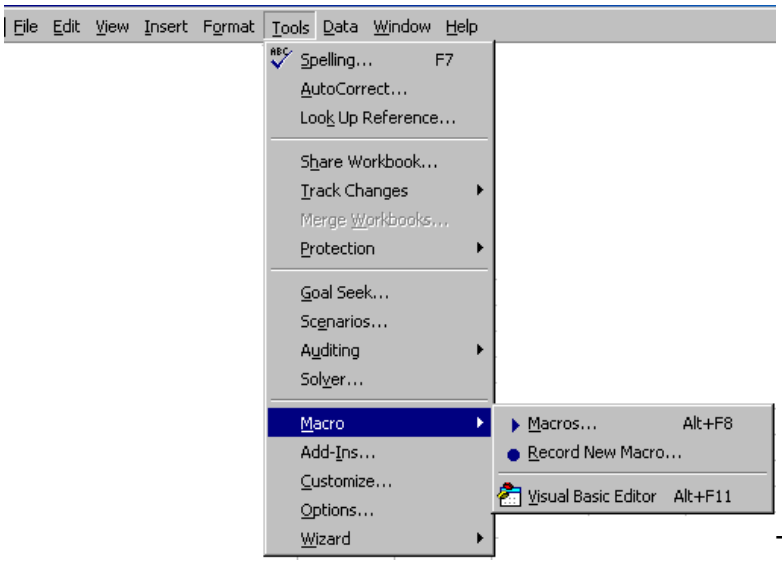
were to be added, we would simply select the point for insertion

on the column labels, hold down the left mouse key, drag to cover two columns and then select [Insert][Columns] and the task is completed.

Deleting columns or rows is not part of the insert menu, but part of the [Edit] menu. It is mentioned here simply for association with Insertion. Deletion occurs by highlighting the columns or rows to be deleted and then pressing the [Del] key on the keyboard, or by highlighting and then entering the [Edit][Delete] menu command sequence.

Inserting cells requires that the area of insertion be highlighted, [Insert][Cells] be selected, and then you are asked which way the adjacent cells should be shifted.
Chart insertions require that the data to be charted be highlighted and the [Insert][Chart] command be selected. At this point, the chart wizard dialogue box appears and guides you through the chart setup procedure. The chart will be inserted into the worksheet.
Functions are inserted using the [Insert][Function] option. Functions include Math & Trig, Statistical, Logical, Text, Database, Lookup and Reference, date and time, and Information functions.
For example, the statistical function AVERAGE may be selected from the statistical functions using the function wizard. The function, when entered might appear as: =AVERAGE(B1:B10) assuming that we are computing the average of the range B1 to B10.
Name The name command assigns a name to a cell or range of cells in the worksheet. Names, once defined, can be referenced in formulas and logical statements, and provide absolute addresses to the cell even when the range is moved.
Comment Comments may be inserted as overlay dialogue boxes to draw attention or provide explanation for information contained in the cells.
Pictures and Graphics may be inserted into the worksheet in the form of clip art, organizational charts, maps, graphics files and word art.
Hyperlink Cells, pictures, or graphics in the worksheet may be linked to the World Wide Web or to files on your local computer through the [Insert][Hyperlinks] command. After links are created, clicking on the value in the cell or on the graphic will move you to the hyperlinked file or internet address.

TOOLS MENU OPTIONS



The tools menu provides a broad variety of tools to the Excel user. Tools range from the standard spelling checker to protection options, to sophisticated linear programming models for solving for constrained solutions. Changes can be tracked, workbooks shared, and of course new programs developed with Excel's Visual Basic Macro Command Language.

Most of these tools are problem-application specific and will be addressed in the context of specific marketing problems within the chapters of the text. Many of these chapters will focus on the development and use of Macros to solve marketing problems.

This completes the basic primer for Excel. It is worth repeating that this is basic primer designed to start the user, but does not cover much of the detail available in other Excel command options. Consulting the Excel help will provide descriptions of the additional program capabilities. Chapters Three and Four build upon this introduction to by presenting "Advanced Commands: Graphics and Database", and "Macros: A Model Development Tool". These chapters acquaint you with the specific tools needed for model development using Excel.

CHAPTER PROBLEMS

ABC Corporation

Excel Exercise 2-1

ABC Corp. has assigned Bill Cohen and Michael Rubens to the sales accounts in the New England region of the United States. The table below shows their monthly sales results. As a sales manager, your task is to recreate the table using Excel. You may use the steps outlined below.

SALESPERSON RESULTS

MONTH	BILL	MICHAEL	DIFFERENCE
JANUARY	$10,567	$11,453	($886)
FEBRUARY	$9,457	$10,476	($1,019)
MARCH	$8,654	$7,453	$1,201
APRIL	$7,983	$6,497	$1,486
MAY	$7,540	$6,298	$1,242
JUNE	$7,329	$6,165	$1,164
JULY	$7,180	$5,390	$1,790
AUGUST	$8,328	$7,946	$382
SEPTEMBER	$9,436	$9,854	($418)
OCTOBER	$10,967	$11,739	($772)
NOVEMBER	$12,857	$13,856	($999)
DECEMBER	$11,438	$12,864	($1,426)
TOTAL	$111,736	$109,991	$1,745
AVERAGE	$9,311	$9,166	$145

A guide to setting up the worksheet:

1. Set the worksheet column width to 12.
2. Set the format of the worksheet to currency with zero decimal spaces.
3. Starting in row 2 column C, enter "Salesperson Results" as the table label.
4. In row 3 starting with column B, center the column titles.
5. Underline the column titles using border controls.

6. Enter the data in the table, right justify the months of the year and enter the sales data for each salesperson.
7. In the first row of the "difference" column enter formula that subtracts Michael's sales from Bill's sales. Copy the formula into the other cells.
8. At the bottom of each column, calculate the total sales and average sales and the total difference and the average difference using the sum and average functions.
9. Save and name the worksheet.
10. Print the worksheet.
11. Erase the worksheet. (You have already saved it.)

XYZ Food Stores, Inc.
Excel Case 2-2

Ralph Johnson, the regional manager for XYZ Food Stores Inc., has given you the first quarter sales information for the grocery stores in your region:

Store 1: Sales in the meat department were $10,134, in the produce department they were $5645, and total store sales were $106,756.

Store 2: Meat department sales of $7567, produce department sales of $4589, total sales of $97,508.

Store 3: Meat department sales of $6732, produce department sales of $7849, total sales of $102,397.

Mr. Johnson wants you, his assistant, to prepare a report that presents the first quarter regional sales results by store and department. Create an Excel spreadsheet to present the data in an easy to read and understand format. The spreadsheet should look like the one shown below.

FIRST QUARTER REGIONAL SALES RESULTS, XYZ STORES INC.

	STORE 1	STORE 2	STORE 3	TOTAL	AVERAGE
MEAT DEPT	$10,134	$7,567	$6,732	$24,433	$8,144
PRODUCE DEPT	$5,645	$4,589	$7,849	$18,083	$6,028
TOTAL SALES	$106,756	$97,508	$102,397	$306,661	$102,220
MEAT % TOT	9.49%	7.76%	6.57%	7.97%	

SALES				
PROD % TOT SALES	5.29%	4.71%	7.67%	5.90%
STORE AS % TOTAL	34.81%	31.80%	33.39%	

Steps to set up the worksheet:

1. In cell B1 type the title
   First Quarter Regional Sales Results, XYZ Stores Inc.
2. Change the worksheet column width to 11 spaces.
3. Set the format of the worksheet to currency with zero decimal places.
4. In row 3 put the following titles in consecutive columns starting in column B: STORE 1, STORE 2, STORE 3, TOTAL, AVERAGE.
5. In column A beginning with row 4 and moving down the rows enter the following titles: MEAT DEPT, PRODUCT DEPT, TOTAL SALES, MEAT % TOT SALES, PROD % TOT SALES, STORE SALES %, TOTAL SALES. (Leave a space between the TOTAL SALES and the MEAT % TOT SALES row titles. Also split the last title into two rows in column A.)
6. Adjust the column width for column A so that the titles fit into column A.
7. Enter the store sales data in the appropriate cells.

   Perform the Calculations:
8. In the column labeled TOTAL, use the sum function to sum the meat department sales. Copy the formula to the TOTAL PRODUCE and TOTAL SALES cells.
9. In the column labeled AVERAGE use the average function to calculate average sales for the meat and produce departments and for total sales.

   Percentages:
10. The cells with percent calculations need to be percent formatted, therefore, use the range format command to format the cells as a percentage with one decimal place.
11. For Store 1, compute the meat department sales as a percentage of TOTAL STORE SALES. (Divide the meat sales in Store 1 by the total sales in Store 1.) Copy the formula into Store 2, Store 3, and total columns.
12. Perform the same operation for the produce department.
13. Compute the store sales as a % of regional sales by dividing the total store sales by the total regional sales. Use an absolute cell address for the total regional sales and copy the formula into the other two store columns.
14. Save the worksheet.
15. Print the worksheet.
16. Erase the worksheet.

CHAPTER 3

ADVANCED EXCEL COMMANDS: CHARTS AND DATABASE

INTRODUCTION

The major reason for the popularity of computers in business is their ability to help us manipulate words, numbers and formulas. As we have seen in the previous chapter, software such as Excel helps us do these things.

Computer-based marketing, finance, or statistical models can perform an unlimited number of unique tasks. However, many recurring problems confront people that design programs, manipulate data, or prepare data for final presentation. Here, too, spreadsheets can help solve these recurring problems with their companion features:

its charts capability to display the data and,

its database capability to manipulate the values and labels contained in the spreadsheet.

These features can help you in your own development of models with Excel. In this effort, we believe you will find a good understanding of them helpful. This chapter discusses these features.

CHARTS

Users of marketing models eventually face the problem of how to present their results in a manner that communicates clearly and is attractive. These tasks are greatly simplified with the help of the Excel [Chart] function.

Charts Terminology and Procedures

Excel charts begins with the identification of several ranges of data. Ranges are most conveniently accessed when the data is in what can be called "database format." Although this format is not required, it does provide a consistent format for setting up a spreadsheet that is easily accessible by the database as well as the spreadsheet and graphs.

In the database format, each row of the database is called a *record*, and each column in the database is called a *field*. The first row of the spreadsheet will contain the field name(s). The second and successive rows contain the data.

The sample database shown in Figure 3-1 identifies quarterly sales of 12 products. Total purchases may be summed within and across the quarters. The database has six fields and 12 records.

FIGURE 3-1

EXAMPLE DATABASE OF PRODUCT SALES

A	B	C	D	E	F
PRODUCTNAME	#	Q 1	Q 2	Q 3	Q 4
PRODUCT A	1	30	13	48	78
PRODUCT B	2	26	14	46	72
PRODUCT C	3	13	20	50	63
PRODUCT D	4	17	35	48	65
PRODUCT E	5	23	46	52	75
PRODUCT F	6	24	48	52	76
PRODUCT G	7	29	38	46	75
PRODUCT H	8	29	52	52	81
PRODUCT I	9	26	44	48	74
PRODUCT J	10	30	54	59	84
PRODUCT K	11	29	50	62	79
PRODUCT L	12	25	50	58	75

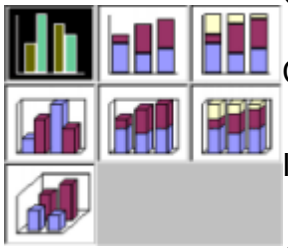
Defining the Chart

The Excel Chart function asks you to decide on the type of graph, the ranges for the sets of data to be graphed, the labels for the axes, and the scaling of the axes.

Standard Chart Types and Variants

Excel Charts can prepare many different types of charts including both standard and custom charts. The standard chart types are identified below:

Column Uses: Comparison across categories. Variations over time (X axis):

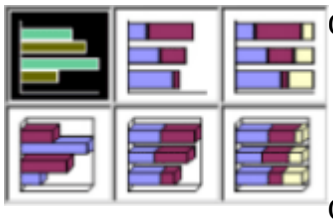


Clustered, Stacked, 100% Stacked

In 3D

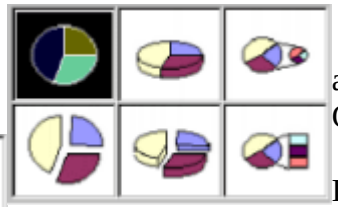
Column Comparisons

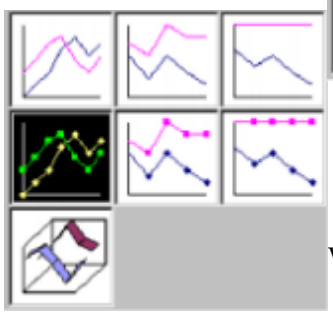
Bar Uses: Comparisons across categories.



Clustered, Stacked, 100% Stacked in 2D

Clustered, Stacked, 100% Stacked in 3D

Line Uses: Changes  across categories and across time. Continuous X axis.



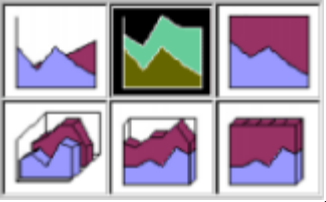
Line, Stacked Line, 100% Stacked

with markers,

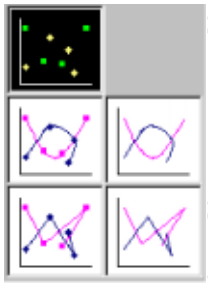
in 3D

Pie Uses: Showing Percentages as a whole for a single data series.

2-D, 3-D, Pie of Pie,


Exploded 2D, Exploded 3D, Bar of Pie

XY Uses: Showing Correlations between the X and Y variables.


Scatter with markers

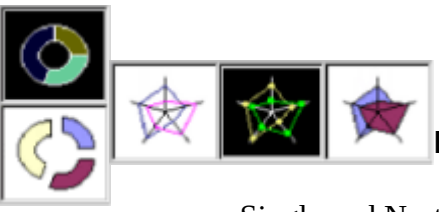
Scatter With Smoothed Lines With and without markers

Scatter With Sharp Lines With and without markers

Area Uses: Changes over time for all series combined

Area, Stacked Area in 2D

Area, Stacked Area in 3D

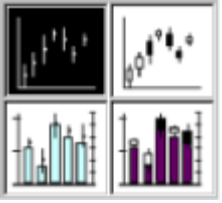

Doughnut Uses: Percentage comparisons of equivalent series (pie charts)

Single and Nested Donuts

Single and Nested Donuts exploded

Radar Uses: Showing multiple categorical variables by wrapping the scale to the beginning

Lines, Data Markers, and Filled



Surface Uses: Interaction of three independent variables (X,Y,Z) in 3-D

Surface in filled and wireframe

Contour in filled and wireframe

Bubble Uses: Like 3 dimensional scatter charts, but the bubble is the size of the third dimension

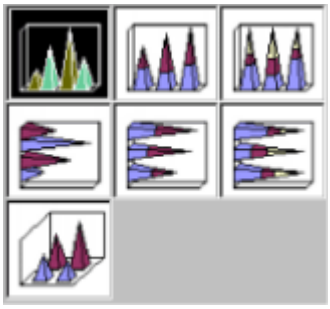
Bubble area, width and scaling controls

Stock Uses: Charting Stock Activity

High-Low-Close; Open-High-Low-Close

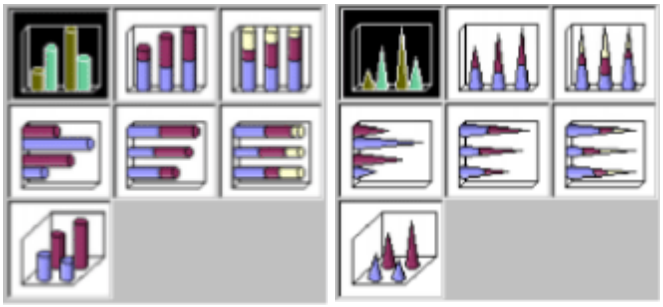
Volume-High-Low-Close; Volume-Open-High-Low-Close

Cylinder, Cone, Pyramid Uses: Same as Column and Bar Chart



Clustered, Stacked, 100% Stacked

Horizonal



Column Comparisons

Example: Preparing A Column Chart

A bar chart of 12 products using data from Figure 3-1, may be prepared showing the total dollar sales on the Y axis and bars for each of the 12 products on the X axis. Each of the four quarterly sales amounts for each product forms a separate vertical bar plotting that purchase amount. To create this chart in Excel, we will use the chart wizard that is selected by either pressing the chart button on the Standard Toolbar, or by selecting [Insert][Chart] on the Menu Bar.

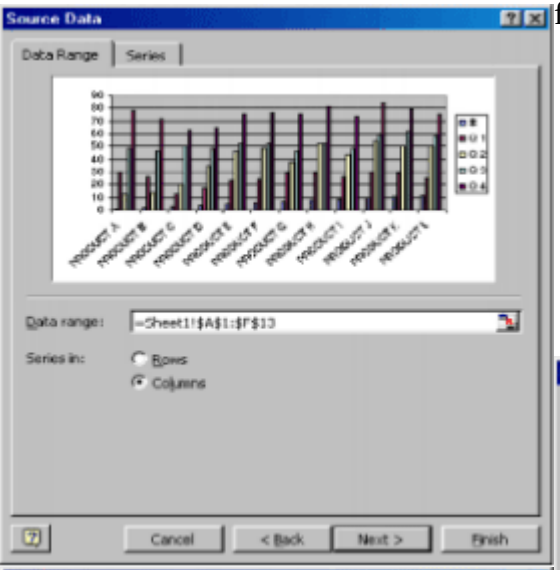
Step 1: Select the Chart Type

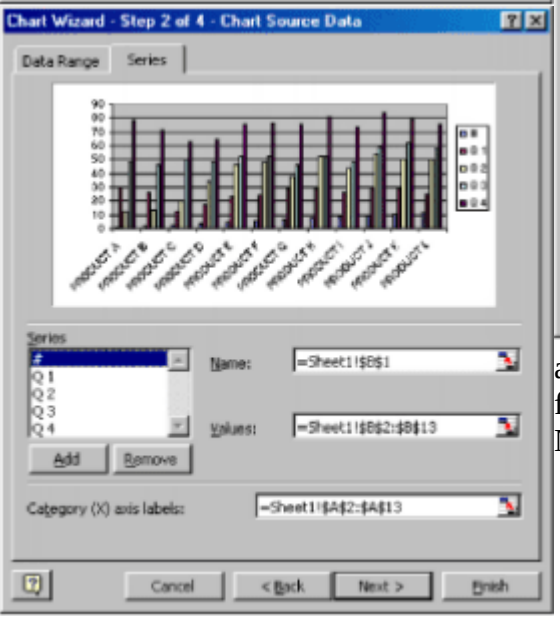
To prepare a column chart, we select "Column" as the chart type and Clustered Column as the upper left corner Chart sub-type. Press Next.

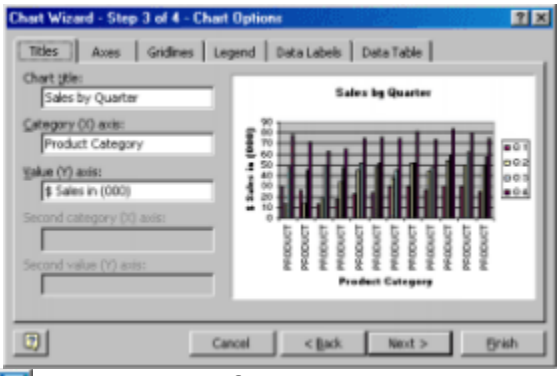
Step 2A: Highlight the Data Range to be Charted

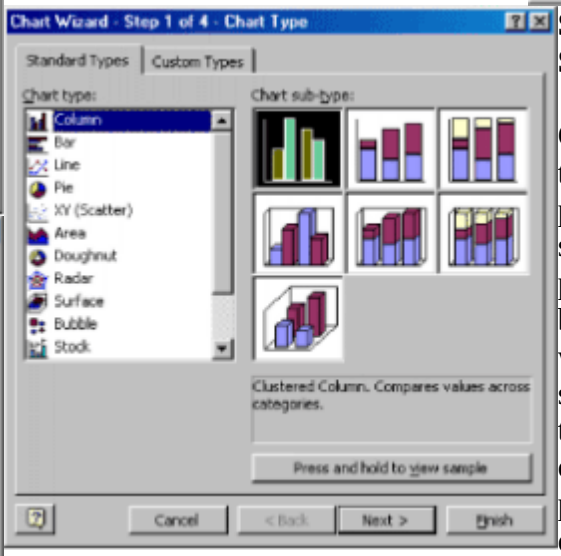
The second step in charting is to highlight the data to be included in the chart. In the sample database, we use the

mouse to highlight the range $A$1:$F$13. Note that this range includes both the row and column labels plus column B, labeled #, a column of sequential numbers for the products. We do not want column B to be included and it must remove it from the chart.









Step 2B: Specify the Series

Clicking on the series tab on the source data page takes you to the series specification page. In the series box on the lower left, we highlight the # series (Column B of the database) and click remove. At this point, we click on any of the series (Q1-Q4) and we will see and verify the range for the name, and the range for the Values for the appropriate series. For Q1, we see the Name is contained in $C$1 and the Values are in $C2:$C13.

Step 3: Chart Options

Chart options include the titles for the chart, legends for the X and Y axes, and details for the appearance of the chart. Enter the Chart title and the X and Y axis titles. They will appear in the Vignette as they are entered.

AXES define which fields are to be designated as the X and Y variables.

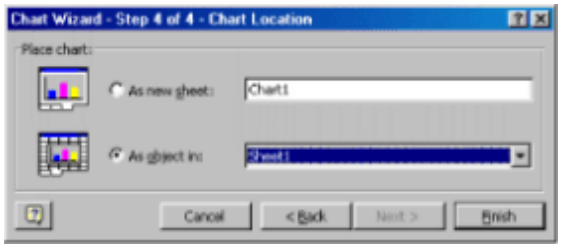
GRIDLINES specify the use of major and minor gridlines to help read the graph.

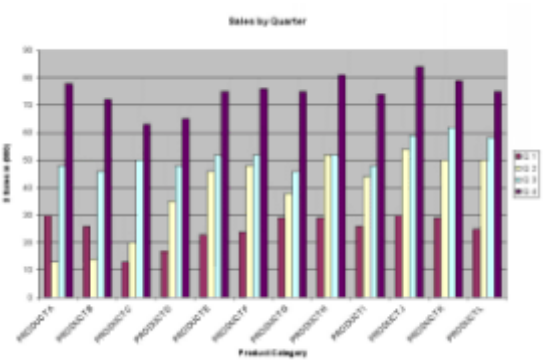
LEGEND refers to the legend for the four quarters used in the graph. The legend can be positioned to the bottom, top, left, right, or in the corner.

DATA LABELS places the label values on the graph next to the bars.

DATA TABLE places the actual data table below graph.

Step 4: Chart Location specifies the location of the chart as either an object in the sheet, or as a separate chart sheet.





GRAPHICAL APPLICATIONS IN MARKETING

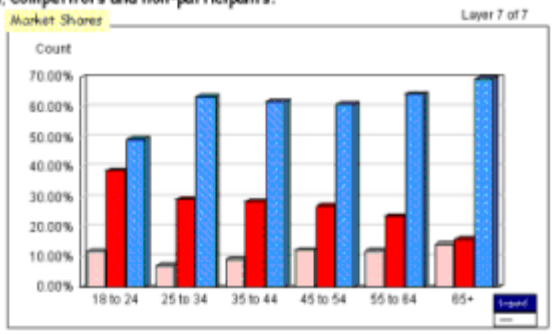
Given the basics of creating charts and graphs, the most fundamental of questions must be raised when making presentations: (1) Are the questions being answered interesting in the sense that they address the fundamental problems being addressed by the study, and (2) Is the information being displayed in a meaningful manner.

Certain types of questions are fundamental to marketing. With each of these questions are certain fundamental types of presentations. Completing this Question-Analysis-Presentation sequence in a precise, rigorous, and understandable manner is critical to effective management problem solving.

Below are 12 charts that address very specific questions that are critical in managing the business.

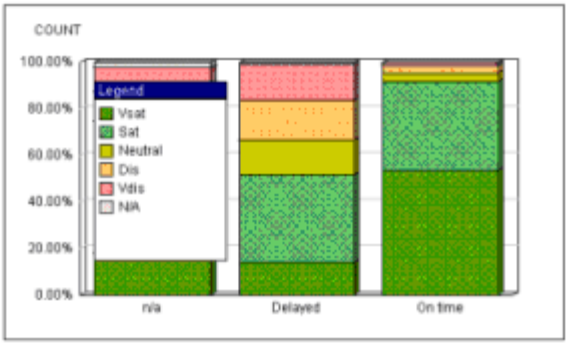
Competitive Market Analysis

The most effective surveys are those which track the entire market: customers, competitors and non-participants.



Speed of Service is Number One

On-Time Service Delivery is highly correlated with Satisfaction. The #1 determinant of a satisfied Customer is Quick Service

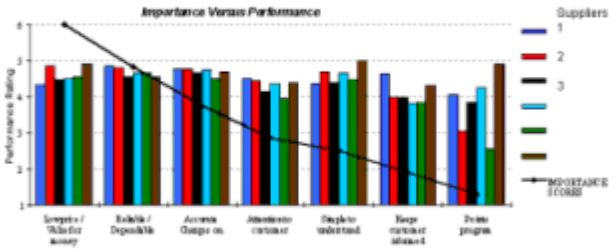


Upon what basis do we compete in the market place, and how well do we compete? To answer these questions, we first identify the key variables that are responsible for creating customer satisfaction. We must know what we need to do best to compete in the market. Secondly, how are we doing in the market place itself? Who is our Love Group (Our Customers)? Who is our Hate Group (Those who buy from our competitors) and Who is in the Swing Group (those not currently in the market)? Do these market groups differ by any particular characteristics such as age? Do we have a stronger hold in the younger market, or in the older market? Why? And what can we do to target the specific segments?

Logistic Regression Analysis of Results

The survey can determine the relative importance of demographics and customer satisfaction in establishing a brand's position

Important Attributes by Supplier



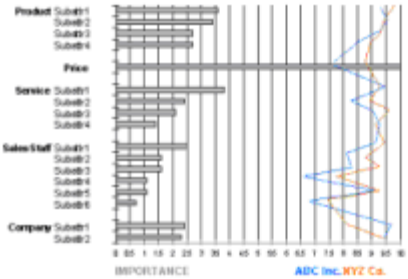
The survey can track the relative performance customers experience on different dimensions of service for each supplier.

Given the overall market picture, how do we stack up against our competitors? Competitive positioning is a key perspective in understanding our share in the market place. If we know what the market wants, the next step is to understand how we deliver relative to our competitors. Burger King may provide it our way, but do the gourmet burgers at Burgers Supreme provide faster service (less than 30 seconds), more consistent quality (the bun is not dry)? This competitive analysis must eventually focus on the overall value proposition that each market segment receives. Remember that marketing is an exchange process. Does each market segment receive the same value?

Customer Value Perception Map

Combining the perceived price and value of service, and weighting it by importance determines each company's position on the perceived value map for each line of business.

Customer Perceived Quality Gap Analysis (TQM)

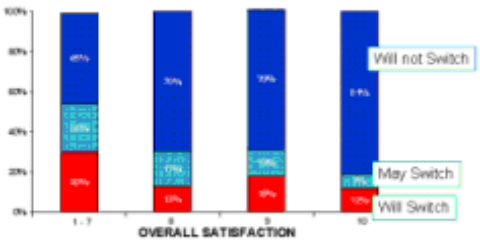


The relative perceived performance of each competitor in the market can be measured for key products and services in relation to the attributes most important to customers

Gap analysis focuses on the differences in perceived quality of product or service delivery. The delivery process is often considered to have three components that include the product or service, the delivery process itself, and the people that deliver the product or service. Gap analysis can be based on a competitive analysis comparing your company with competition, or perceived vs. ideal analysis that focuses on what the customer really desires.

The bottom line of the GAP analysis is that perceived differences exist between our products and competitors products and between our products and the customer's ideal product. But are these differences critical in our gaining or losing market share. Satisfaction and the liklihood of switching to another company, product or service are critical predictors of the future of our company. When tracked over time, we can find the weaknesses of our competition in the market place. When loyalty is on a down swing, it is prime time for taking market share. When have customers had enough, and what does it take to get them to switch to our products or services.

Satisfaction and Motivation to Switch

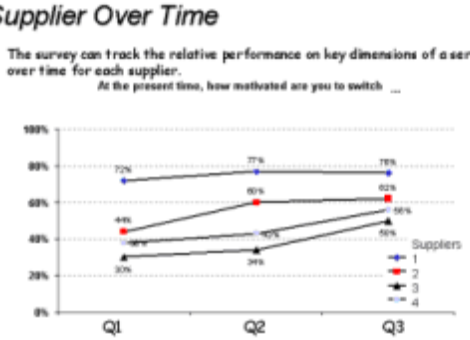


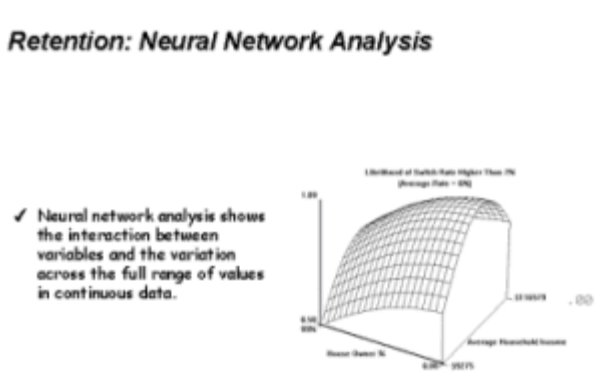
The survey can determine the relationship between various measures of satisfaction and loyalty.

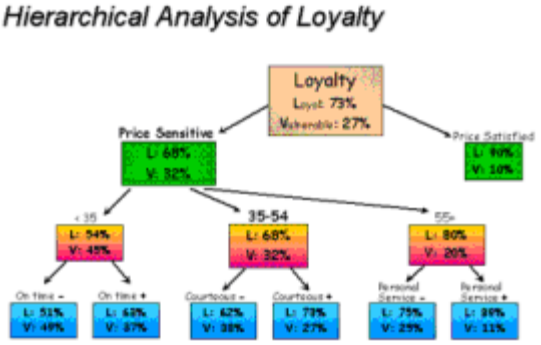
Switching (shifts in brand loyalty patterns) often follows a demand curve function. When the proper variable can be identified as most important to the customer and we can gain an advantage over the competition on this variable, we can gain an increase in switching and thereby increase share of the market. The analysis of these key variables supports corporate planning efforts for retaining customers and developing effective marketing strategies.

Tracking Loyalty for Each Supplier Over Time

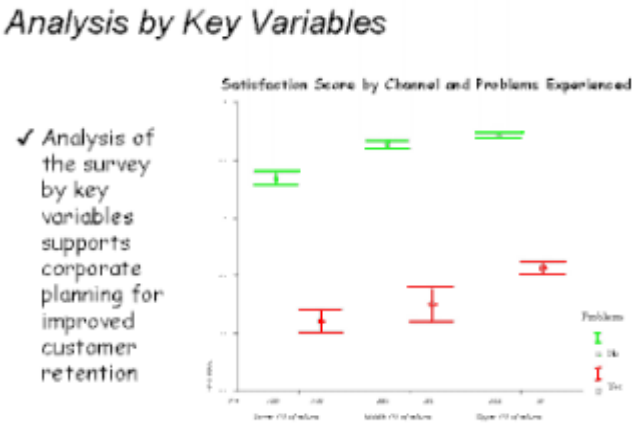
The survey can track the relative performance on key dimensions of a service over time for each supplier.







Econ
omists teach us that the analysis of marginal returns is critical if we are to maximize our marketing efforts. Our current target market may be producing diminished marginal returns from our advertising, pricing and distribution efforts. How do we define the next most profitable segment and how do we maximize their loyalty by targeting our products and services to provide exactly what they want? Multiple segments exist and ideally, we would track each segment on a daily basis, measuring the changes in the market and identifying who we should target, what we should sell to them, and where we should find them. We maximize our offering to the prime market segments to receive the best return for our marketing investment



DATABASE MANAGEMENT

Database manipulates or analyzes the data entered into the spreadsheet using specific command and data manipulation procedures. Excel offers many data manipulation procedures that expand the functionality of Excel to be both a programming language and a dynamic interface for web based databases. In the

next chapter, we will discuss using the Visual Basic Language Editor. In this chapter, we will discuss several of the basic database procedures that do not require programming and may be performed as options within the [Tools] and [Data] submenus. With these five procedures, we are able to perform basic database manipulation and analysis:

1. Sorting records (alphabetically, numerically, or by date),

2. Searching for and manipulating data records,

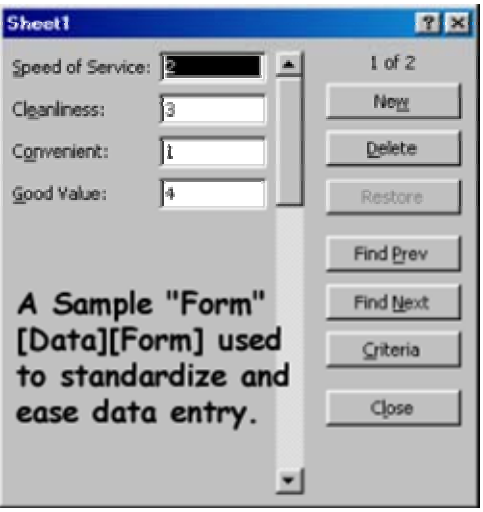
3. Constructing data output tables,

4. Producing frequency distributions, and

5. Performing statistical analysis.

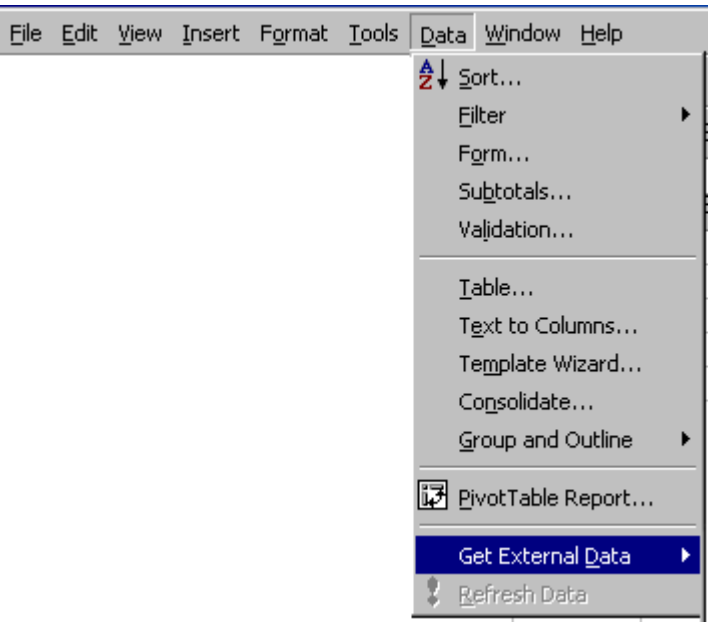
Database Terminology and Procedures

A database consists of values or labels entered into the spreadsheet. A database is an information set having one or more spreadsheet columns and at least two spreadsheet rows. The first row of a database contains the "field" name(s) for the database, while the second and subsequent rows contain the database itself. Each row of the database is called a "record". Each column in the database is called a "field".



A flat database is a rows by column two dimensional database that may be displayed on a single screen. This database is the type you create with any spreadsheet program.

A relational database is a 3 dimensional database that adds one or more tables to the flat database by having a shared variables



Entering Data The procedure for entering database values and labels is about the same as for the spreadsheet, although if a permanent database is being constructed that will be used or updated by several individuals, you may want to create a template for data entry using the [Data][Form] option. The [Data][Form] option requires that you have a row containing the data field names and a sample row of data. Once the data for these two rows are entered, highlight the two rows and then select [Data][Form]. The above form will appear and you can select "New" to enter a new row of data in your database. The following information will help you in planning your database.

The database is limited to 65,536 rows (2^{16}) and is further limited by the amount of memory (RAM) in your computer. If larger databases are required, you should consider moving to an Access database which utilizes hard drive space for storing and manipulating the database.

Setting up your database requires setting up a data structure. This structure establishes the fields (columns) and rows for the database. The following guidelines will prove to be very valuable in setting up any database.

- Use the first row in each field to enter the field name. This field name is a unique identifier for the data in the column and is used in Excel to specify field manipulation options.
- Determine the layout of the columns in terms of which field comes first, second, and so forth. Be sure to include a field as a row or record identifier. This is important so that you can re-order your records if you desire.
- Set up a separate column for each field or piece of data within each record. Don't leave blank fields between the data fields, but adjust the database by modifying column widths, typefaces, alignment, and other formatting variables to modify the appearance of the database.

DATA MENU OPTIONS

The Data menu allows for data manipulation of fields data in the spreadsheet. Databases may cleaned, parsed, organized, and presented as professional looking reports. The first five data menu options allow the database to be sorted, filtered to show a subset of the data that meets the conditions specified by logic or boolean operators, subtotaled, and validated by screening the data for specific values that are to be deleted from the database.

Table is a tool for constructing one or two way tables from a column and row input values and from a formula. Given input values, the cells of the table are computed. As the input values are changed or updated, the values of the table will change automatically.

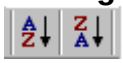
Text to Columns is a parsing tool for converting a text file to fixed length database fields.

Template Wizard helps you create a template you can use to enter data in a database that you link to the template. The database can be constucted in Microsoft Excel, Microsoft Access, Microsoft FoxPro, dBASE, or a Paradox database. When a new workbook is created based on the template, the information entered in the workbook can be saved as a new record in the database.

Consolidate provides

In the next chapter, the advanced Excel commands for graphics and database will be discussed.

Sorting Data



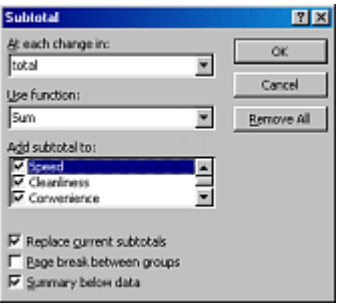
Once your database has been constructed, you can quickly sort items in any field within the database. The database may be sorted in two ways. First, the sort keys from the standard toolbar will quickly sort the entire database by the single field you select. The sort may be completed alphabetically or numerically in ascending (A to Z) or descending order (Z to A).

A more sophisticated sort may be performed that will sort up to three fields at a time using the [Data][Sort] command from the menu bar. To sort using the data sort command, position the cursor within the database, select [Data][Sort], and

then use the pull down menus to select the sequence of the variables to be sorted and whether the sort is ascending or descending.

When specific fields are selected (by selecting the column headings), the data sort will operate only on those fields selected rather than on the entire database. This option should be used with caution, as sorting on a select group of fields will effectively randomize the relationship between rows of the database. For example, if the rows represent a customer's data, sorting by a selected field only rather than the entire database will assign another customer's data to that field within the customer's row. Caution and keeping a backup to your database file is the rule.

Subtotaling



Data within the database can be subtotaled to form tables using the [Data][Subtotal] command. In the example below, the worksheet was formatted using the standard [Format][Autoformat] Accounting1 table format, and then was highlighted and subtotaled. The Subtotal menu box on the right shows that each row in the table was summed and subtotaled at the bottom of the table. Subtotals were specified for the Speed, Cleanliness, Convenience, and Value variables. Subtotals are simply a function with three parameters that specify the function to be selected, the start and end of the range to be subtotaled.

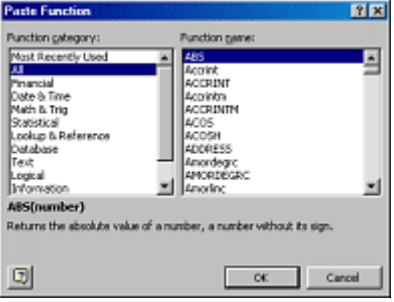
Speed	*Cleanliness*	*Convenience*	*Value*	*Total*
9.0	6.0	9.0	8.0	
9.0	8.0	7.0	6.0	
78.0	6.0	5.0	3.0	
8.0	5.0	4.0	3.0	
3.0	4.0	4.0	5.0	
5.0	4.0	3.0	2.0	
1.0	2.0	3.0	4.0	
2.0	2.0	2.0	2.0	
5.0	2.0	2.0	5.0	
120.0	39.0	39.0	38.0	Grand Total

Subtotal functions include

Sum: Returns the sum of the numbers in a field

Count: Returns the frequency count of the numbers in the field

Average: Returns the average value of the numbers in the field



Maximum: Returns the maximum value of the numbers in the field

Minimum: Returns the minimum value of the numbers in the field

Product: Returns the product of all values in a specified group in the field

Count Nums: Returns a count of all cells in the field that have a value

StdDev. Returns the standard deviation (Square root of the variance from the average)

StdDevp. Returns the standard deviation adjusted for the population size

Variance Returns the variance of the numbers in the field

Varp Returns the variance of the numbers in the field adjusted for population size

Functions

Functions allow you to analyze ranges of data and fields of your database. In addition, functions may be used to perform logical, financial and statistical analyses.

Functions are identified in the [Insert][Function] menu to include a variety of general categories of operators: Financial, Date and Time, Math and Trig, Statistical, Lookup and Reference, Database, Text, Logical, Information, and Engineering.

Because we are discussing features of the database, let us consider the database functions first, and then the other functions that may be inserted into the worksheet.

DAVERAGE Average of all values in a field that meet the designated criteria

DCOUNT Frequency count of all values in a field that meet the designated criteria

DCOUNTA Frequency count of all non blank cells in a field that meet the designated criteria

DGET Returns a single item that meets the criteria. Multiple resulting items produce an error

DMAX The maximum value of the values in the field that meet the criteria

DMIN The minimum value of the values in the field that meet the criteria

`DPRODUCT Returns the product of all values in a field that meet the criteria

DSTDEV The standard deviation based on a sample from the database.
DSTDEVP Returns the standard deviation of the entire population (entire database)
DSUM The sum of all values in the field that meet the criteria
DVAR The variance from the average of a sample from the database
DVARP The variance from the average based on the entire population (entire database)
GETPIVOTDATA Returns data stored within a pivot table
Details of Financial, Logical and Statistical databases are contained in the Appendix to Chapter three.

Constructing Data Tables

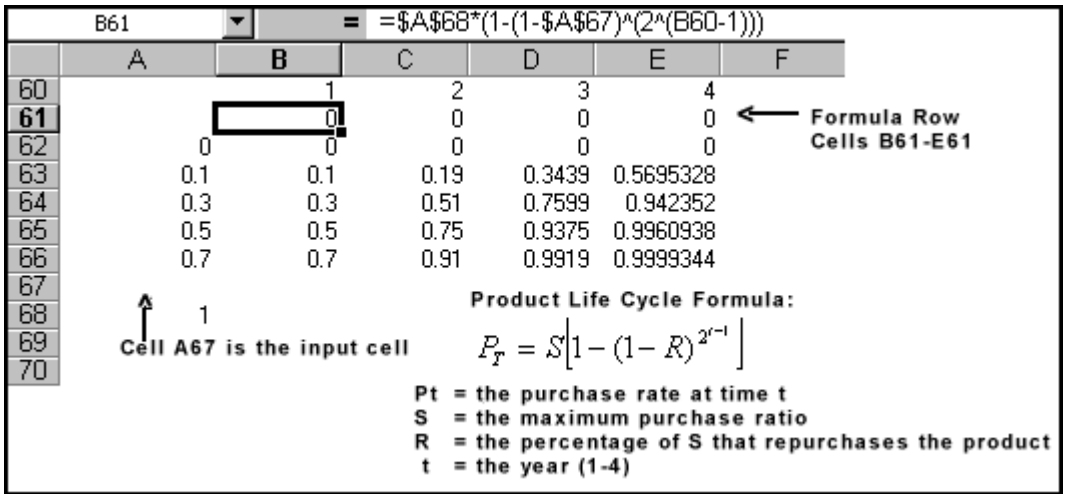
Data tables are a simple, easy to use method of automatically computing table values from tables with one or two variables that change along the rows or columns of the worksheet. In the example we will show here, we compute an s-shaped function that depicts the traditional form of the product life cycle. This function, written $P_T = S\left[1-(1-R)^{2^{t-1}}\right]$, where P_t is the purchase rate for time period t; S is the maximum purchase ratio; R is the percentage of S that repurchases the product; and t is the time period (year 1-4). As we can determine from the formula, we have (Total Market - (Non-Repurchasers raised to some exponent that becomes smaller with time)). As the repurchase rate increases, the cumulative sales of the product will increase over time, but decrease at an exponential growth rate. Setting up formula shows clearly what happens when we increase product quality or value to increase the repurchase rate, or conversely decrease our marketing efforts.

One Variable Data Tables

The one variable data table is formed by entering the variables for the table in either a row or column. In the example, the repurchase rates R, are entered into the column at cells A62:A66. The column input cell (the data is in the column, so the input cell is a column input cell) is located in cell A67. The formula must be

entered into the cell one row above the first value and one column to the right (in this case, cell B61). If several columns of data are to be computed, as in this case, you may copy the formula into multiple cells as in the example: =$A$68*(1-(1-$A$67)^(2^(B60-1))) In the example, the formula is copied into cells C61, D61, and E61.

To populate the cells of the table, we simply highlight the cells containing the formulas, values and the cells to be populated (A61:E66), select [Data][Tables], specify the column input variable (A67) and press enter. The values for the cells of the table will be computed and entered.

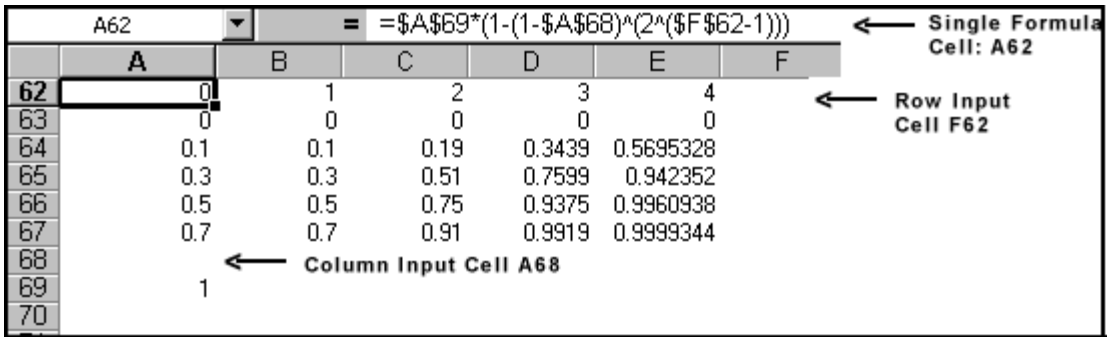


	A	B	C	D	E	F
60		1	2	3	4	
61		0	0	0	0	
62	0	0	0	0	0	
63	0.1	0.1	0.19	0.3439	0.5695328	
64	0.3	0.3	0.51	0.7599	0.942352	
65	0.5	0.5	0.75	0.9375	0.9960938	
66	0.7	0.7	0.91	0.9919	0.9999344	
67						
68	1					
69						
70						

Two Variable Data Tables

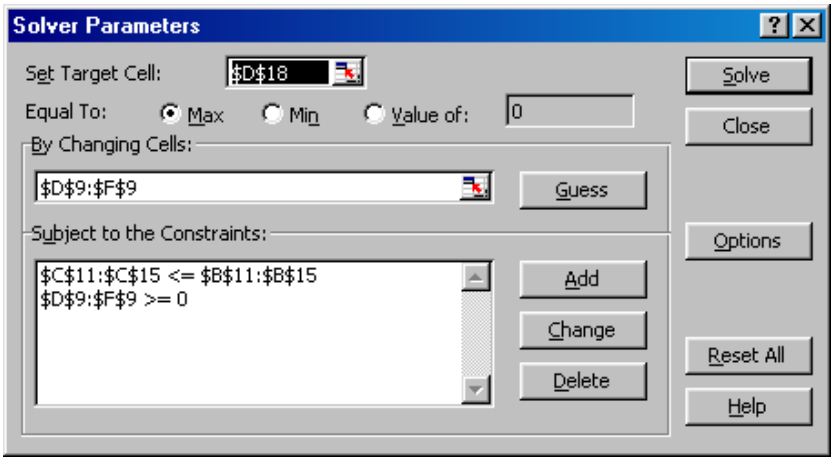
The two variable data tables operate in basically the same way as the one way table, except that the Two-variable data tables use only one formula (A62) with two lists of input values. The formula must refer to two different input cells (F62 and A68), both of which are referred to in the formula.

To populate the cells of the table, we simply highlight the cells containing the formulas, values and the cells to be populated (A62:E67), select [Data][Tables], specify the column input variable (A68) and the row input variable (F62) and press enter. The values for the cells of the table will be computed and entered.



	A	B	C	D	E	F
62	0	1	2	3	4	
63	0	0	0	0	0	
64	0.1	0.1	0.19	0.3439	0.5695328	
65	0.3	0.3	0.51	0.7599	0.942352	
66	0.5	0.5	0.75	0.9375	0.9960938	
67	0.7	0.7	0.91	0.9919	0.9999344	
68						
69	1					
70						

SOLVER



Solver is an Excel Add-in that can solve problems with multiple interdependent variables. Solver uses linear algebra techniques to optimize problem solutions. Solver appears in the [Tools][Solver] menu option. If it is not present, you will need to (1) use the Add-ins dialog box, or if not shown in this dialog box, (2) use the Excel install option to Add/Remove program options to add the Solver Add-in. The Excel installation CD-ROM also contains a number of Solver examples in the file SOLVSAMP.XLS. This Excel file contains multiple worksheet files of which one is an example of product manufacturing planning. Load the Product Mix example for optimizing product manufacturing alternatives where costs and profits vary depending on what we are willing to manufacture.

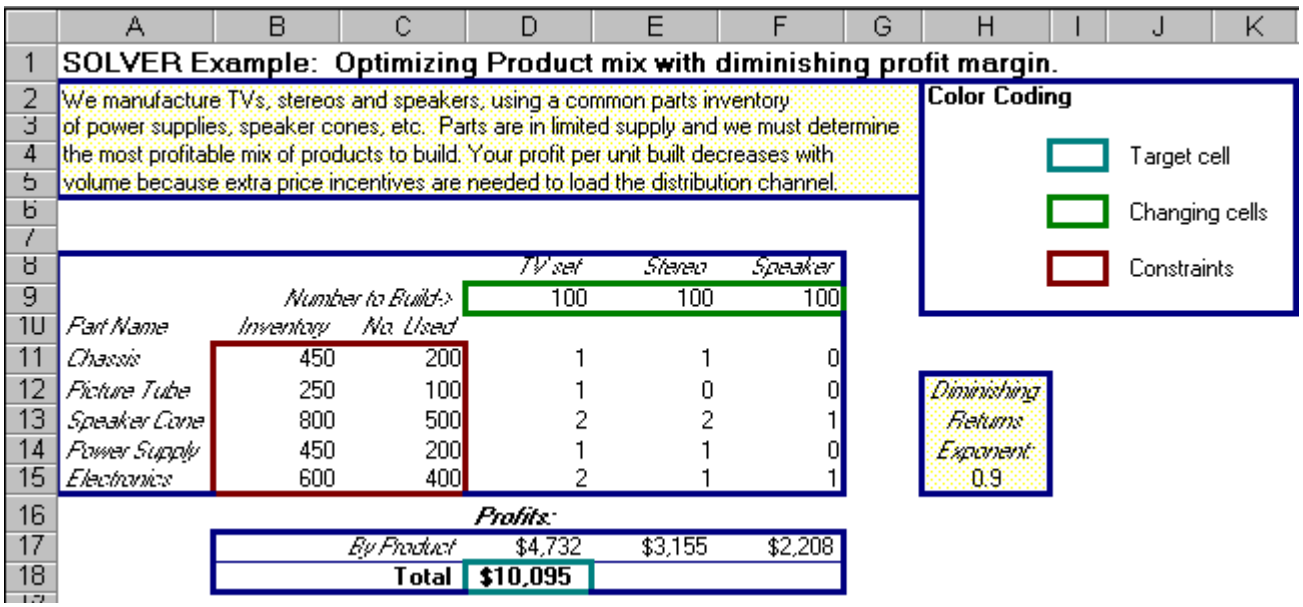
After loading the SOLVSAMP.XLS workbook and the Product Mix workpage, we may select the [Tools][Solver] menu command to invoke the Solver Parameter dialogue box. The dialog box identifies

1. the Target cell ($D$18)
2. the maximization option
3. the cells to change ($D$9:$F$9)

TV set	Stereo	Speaker
160	200	80

4. the constraints $C$11:$C$15 <= $B$11:$B$15 and $D$9:$F$9 => 0 that is, we may not use more parts in any given category than we have in inventory, and we cannot have a negative number of products built in any given category.

Selecting the Solve option from the dialog box optimizes the function and produces a result of $14,917 profits by building 160 TV sets, 200 Stereos, and 80 speakers.



Solver Dialogue Box Options (from the Excel Help file)

The Options button in the Solver Dialogue Box contains the advanced control features for the solution process, loading or saving problem definitions, and defining parameters for both linear and nonlinear problems. The default settings are present for each option are appropriate for most problems.

Max time Limits the time taken by the solution process. While you can enter a value as high as 32,767, the default value of 100 (seconds) is adequate for most small problems.

Iterations Limits the time taken by the solution process by limiting the number of interim calculations. While you can enter a value as high as 32,767, the default value of 100 is adequate for most small problems.

Precision Controls the precision of solutions by using the number you enter to determine whether the value of a constraint cell meets a target or satisfies a lower or upper bound. Precision must be indicated by a fractional number between 0 (zero) and 1. Higher precision is indicated when the number you enter has more decimal places 3/4 for example, 0.0001 is higher precision than 0.01. The higher the precision, the more time it takes to reach a solution.

Tolerance The percentage by which the target cell of a solution satisfying the integer constraints can differ from the true optimal value and still be considered acceptable. This option applies only to problems with integer constraints. A higher tolerance tends to speed up the solution process.

Convergence When the relative change in the target cell value is less than the number in the Convergence box for the last five iterations, Solver stops. Convergence applies only to nonlinear problems and must be indicated by a fractional number between 0 (zero) and 1. A smaller convergence is indicated when the number you enter has more decimal places 3/4 for example, 0.0001 is less relative change than 0.01. The smaller the convergence value, the more time Solver takes to reach a solution.

Assume Linear Model Select to speed the solution process when all relationships in the model are linear and you want to solve either a linear optimization problem or a linear approximation to a nonlinear problem.

Show Iteration Results Select to have Solver pause to show the results of each iteration.

Use Automatic Scaling Select to use automatic scaling when inputs and outputs have large differences in magnitude 3/4 for example, when maximizing the percentage of profit based on million-dollar investments.

Assume Non-Negative Causes Solver to assume a lower limit of 0 (zero) for all adjustable cells for which you have not set a lower limit in the Constraint box in the Add Constraint dialog box.

Estimates Specifies the approach for initial estimates of the basic variables in each one-dimensional search.

Tangent Uses linear extrapolation from a tangent vector.

Quadratic Uses quadratic extrapolation, which can improve the results on highly nonlinear problems.

Derivatives Specifies the differencing used to estimate partial derivatives of the objective and constraint functions.

Forward Use for most problems, in which the constraint values change relatively slowly.

Central Use for problems in which the constraints change rapidly, especially near the limits. Although this option requires more calculations, it might help when Solver returns a message that it could not improve the solution.

Search Specifies the algorithm used at each iteration to determine the direction to search.

Newton Uses a quasi-Newton method that typically requires more memory but fewer iterations than the Conjugate gradient method.

Conjugate Requires less memory than the Newton method but typically needs more iterations to reach a particular level of accuracy. Use this option when you have a large problem and memory usage is a concern, or when stepping through iterations reveals slow progress.

Load Model Displays the Load Model dialog box, where you can specify the reference for the model you want to load.

Save Model Displays the Save Model dialog box, where you can specify where to save the model. Click only when you want to save more than one model with a worksheet 3/4 the first model is automatically saved.

SOLVER REPORTS

The Answer, Sensitivity, and Limits reports show the optimized answer, the calculation of the relative sensitivity of each variable, and the effects of the constraints on SOLVER. Reports are accessed from the Solver Results Dialogue box that appears after the problem is solved.

	A	B
44	amt	13572.065
45	term	48
46	int	7%
47	pmt	($325.00)

GOAL SEEK

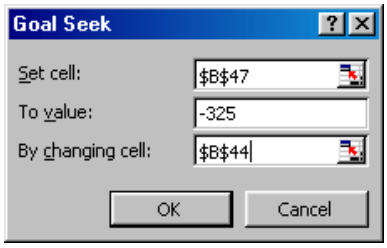
Goal Seek is a single input variable problem solver that is much simpler to use and faster than Solver. Goal Seek does not have the capability to solve problems where there are multiple input cells and constraints on the solution. Goal Seek operates to solve for a given parameter value required by a given financial, statistical, math and trig, or engineering function. In the following example, we will use goal seek to identify how much we can spend on an automobile given current interest rates, a 48 month loan package, and our family budget that allows $325 to be spent on the car per month.

Using GOAL SEEK:

The spreadsheet must be setup to solve for the given function we desire. In the current example, we would use the PMT function to identify the payment amount. PMT requires three parameters: Number of months, interest rate per month, and the total value of the purchase:

PMT Calculates the payment for a loan based on constant payments and a constant interest rate

Syntax: PMT(rate,nper,pv,fv,type)



In this example, the function is expressed as:

=PMT(B46/12,B45,B44)

The [Tools][Goal Seek] menu option will invoke the Goal Seek dialog box, which is setup to solve for a value of cell $B$44 by constraining the payment (cell $B$47) to $325.00.

Summary

The Graphics and database functions in Excel offer powerful tools to the manager, whether the focus is on creating a database, presenting charts to explain the results, or solving problems. This chapter showed the basics of charting with Excel, with a focus on 12 charts for market segmentation, tracking and analysis. In the database section, we examined the basic process for design and layout of a database, and the use of a variety of functions for the database and the worksheet in general. We concluded by examining specialty tools for problem solving: Tables, Solver, and Goal Seek.

In the next chapter, we focus on Excel macros to solve new types of problems...those that require programming in Visual Basic for applications.

CHAPTER PROBLEMS
DATA BASE MANAGEMENT AND CHARTS

Do all of the following problem sets on the same worksheet.

Problem Set 1: Database
Wally Widget Corporation

Your manager, Erin Shearson, is the national sales manager for the Wally Widget Corporation, and has just receivedthe regional sales results for the three products that you manufacture and market. Ms. Shearson has asked you to tabulate the data and determine which regions sell the most of each product. Table 1 shows what she expects to see.

1. Format the entire worksheet to currency with zero decimal places. Range format the cells that do not need thecurrency format.
2. Put the region numbers in the region column, and recreate Table 1. Include the table and column titles shown below.
3. Use the Sum function to calculate the total sales for each product.

TABLE 1

NATIONAL SALES STATISTICS BROKEN DOWN BY REGION (2001)

REGION	PRODUCT 1	PRODUCT 2	PRODUCT 3
1	$70,765	$25,528	$41,744
2	$81,563	$29,124	$43,258
3	$75,760	$37,354	$44,964
4	$89,877	$38,004	$37,124
5	$80,986	$28,156	$42,642
6	$86,682	$27,956	$39,528
TOTAL	$485,633	$186,122	$249,260

1. Copy Table 1 excluding the Total Sales line to a blank position on the spreadsheet below Table 1.
2. Change the titles of the newly copied table to: "TABLE 2" and "PRODUCT 1 - HIGHEST TO LOWEST REGIONAL SALES."
3. Sort regional sales from highest to lowest on Product 1. The new table should look like Table 2, shown below.

TABLE 2

PRODUCT 1 - HIGHEST TO LOWEST REGIONAL SALES

REGION	PRODUCT 1	PRODUCT 2	PRODUCT 3
4	$89,877	$38,004	$37,124
6	$86,682	$27,956	$39,528
2	$81,563	$29,124	$43,258
5	$80,986	$28,156	$42,642

3	$75,760	$37,354	$44,964
1	$70,765	$25,528	$41,744

Create Tables 3 and 4 shown below by copying Table 1 two times to blank parts of the spreadsheet (exclude the TotalSales line). Change the titles, and sort the tables according to sales of product 2 and 3 respectively.

Save the worksheet because the tables will be used in the following problem sets.

TABLE 3

PRODUCT 2 - HIGHEST TO LOWEST REGIONAL SALES

REGION	PRODUCT 1	PRODUCT 2	PRODUCT 3
4	$89,877	$38,004	$37,124
3	$75,760	$37,354	$44,964
2	$81,563	$29,124	$43,258
5	$80,986	$28,156	$42,642
6	$86,682	$27,956	$39,528
1	$70,765	$25,528	$41,744

TABLE 4

PRODUCT 3 - HIGHEST TO LOWEST REGIONAL SALES

REGION	PRODUCT 1	PRODUCT 2	PRODUCT 3
3	$75,760	$37,354	$44,964
2	$81,563	$29,124	$43,258

5	$80,986	$28,156	$42,642
1	$70,765	$25,528	$41,744
6	$86,682	$27,956	$39,528
4	$89,877	$38,004	$37,124

Problem Set 2: Database
XYZ Corporation

You have forecasted the annual sales growth rates for the next five years for each of the three products marketed by XYZ Corp. The growth for the products are as follows: rate for PRODUCT 1 is 2.0%, for PRODUCT 2, 25%, and for PRODUCT 3, 10%. You want to make a table that shows the forecasted sales for each product for the next five years. The total sales for the current year, 2001, were calculated in Problem 1. Recreate the table shown below on the same spreadsheet used for problem set 1.

PRODUCT SALES FORECAST		
ESTIMATED		
2001 SALES GROWTH RATE		
PRODUCT 1	$485,633	2.0%
PRODUCT 2	$186,122	25.0%
PRODUCT 3	$249,260	10.0%

YEAR	0 (2001)	1	2	3	4	5
	-----	-----	-----	-----	-----	-----
PRODUCT 1	$485,633	$495,346	$505,253	$515,358	$525,665	$536,178
PRODUC	$186,122	$232,653	$290,816	$363,520	$454,399	$567,999

T 2						
PRODUCT 3	$249,260	$274,186	$301,605	$331,765	$364,942	$401,436

1. In both locations of the table that list the current year's (2001) sales use a relative cell address formula to address the total sales calculated in Table 1 of the previous problem.
2. Use the Fill handle to number the columns from 0 to 5 in the year row.
3. Calculate the sales forecast for each year using a formula that addresses the cell which contains the estimatedpercent growth rate and the cell which contains the previous year's sales. (Hint: forecasted sales = previous year sales * (1 + growth rate percent). You will want to use both relative and absolute cell address in the formula.)
4. Save the worksheet for use in Problem Set 3.

Problem Set 3: Charts

Ms. Shearson needs graphs of this year's sales data and the sales forecast data. The graphs will be used in a presentation to top management. She has asked you to prepare "Professional Looking Graphs".

1. GRAPH 1: Make the pie chart shown below using the data from Problem Set 1, Table 1.
2. GRAPH 2: Make the bar chart shown below using the data in Table 1.
3. GRAPH 3: Make the multiple bar chart shown below using the data in Table 1.
4. GRAPH 4: Stacked Bar: The multiple bar graph can be easily made into a stacked bar graph by changing the graph type from bar to stacked bar.
5. GRAPH 5: Make the Line graph shown below using the sales forecast data in the table created in Problem Set 2.

Chapter 4

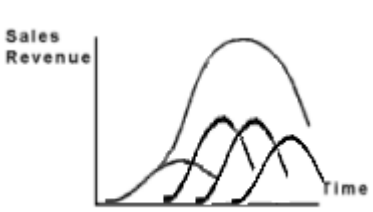
Modeling Marketing Phenomenon

In chapter 2 we introduced the basic concepts of a marketing model, different types of models, and the building blocks there were used for modeling. These building blocks were identified as concepts, constructs, variables, and propositions. Recall that a proposition specifies the nature and form of the relationships between the variables. We might list the variables influenced and influencing the relationship and the specific mathematical form of that relationship. It is not enough to state that sales are a function of advertising. Modeling requires that intervening variables be specified, the relevant ranges for which they have an effect be specified, and that we identify the symbolic or mathematical form of the relationship. Propositions are the glue that link concepts together. Furthermore propositions, when linked together, form models. These linkages provide meaningful explanations for a system or process.

In this chapter we will focus upon descriptive and predictive models. In each example, the model will be described in multiple fashion:

1. verbally to provide a layman's explanation of the relationships,
2. schematically to identify the directions and flows of the variables,
3. mathematically to operationalize the predictive model, and
4. graphically to provide a reality check of the value of the results.
5. Models are also statistically tested where appropriate.

We know that in model building relationships will often involve cause and effect. In building a house, we connect wires from the main power supply to the switch in the wall and finally up to the light fixture in the ceiling. As an occupant of the home, we have little interest in the model that when followed allows the switch to break the flow of power to the light thus turning the light off. And when the circuit is unbroken, the light is on. All we know is that every evening we flip the light switch and the light works. Likewise, every morning we turn the faucet and receive hot water. We turn on the radio and music begins to play.
Marketing is likewise a cause and effect relationship, where the objective is to maximize the return for a given market input.
Basic market relationships
Relationships between marketing variables are typically defined either at the consumer level or at the market level. At the consumer level, we're concerned with the individual's decision process (awareness, attitudes, intention to purchase, the evaluation of the product or service in the decision process, the purchase process, the evaluation of the customer service they received, their post purchase attitudes, overall satisfaction, repurchase activity, and loyalty). At the broader market level we are concerned with the impact of marketing variables on segments of the market or on the market as a whole (the impact of advertising, sales, promotion, distribution, price, and competitive activities on

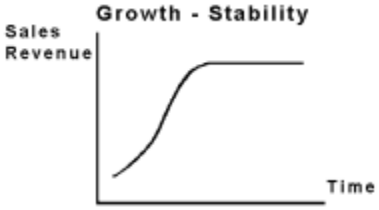


sales, market share, market growth, and profitability by product or service, by the category of product or service, or for the total market.)

Market level models focus upon the relationships between the marketing variables input and total market demand. While the appeal of specific advertising or promotional campaigns may be researched at the individual consumer level, the roll-up of sales per marketing dollar invested is tracked for the total market level. It is evaluated in terms of the uplift that occurs at the levels of market aggregation/segmentation that are of interest to management (demographic segments, geographic markets, or by campaign.

The Product Life Cycle: Sales over time

The Modeling of sales over time has traditionally included a discussion of what we call the classical product life cycle with its associated introduction, growth, maturity, and decline stages. This descriptive model conforms to a bell shaped curve on the left three-quarters and ends with an incomplete right tail. The assumption is that numerous market segments sequentially enter the marketplace ready to purchase. Those segments that enter the market first are termed innovators, and are followed by early adopters, the early majority, the late majority, and laggards. This theory of sequential adoption of purchases across the market segments creates an adoption/diffusion curve that tracks segment purchases over time. This theory of diffusion does much to explain the growth rate and height of the product life cycle, but does little to emphasize the nature of marketing plans that are directed at the individual market segments. Effective marketing requires selection of those market segments that are most ready to purchase the product with the least amount of cost to the company.



The actual life cycle for a product often bears little resemblance to the classical depiction of the product life cycle. If we take a quick look at the form of the classical product life-cycle, and then reflect on a list of brands that were number one in their category 75 years ago (noting that many are the same in 1999), it is easy to conclude that life cycles conform to a variety of forms.

We may observe relationships that are linear, models that conform to threshold levels, maturity models that demonstrate decreasing returns to scale, saturation models that shows stable maturity. S shaped models produce increased returns to scale followed by decreasing returns to scale. A variety of other patterns may show anything from rapid penetration followed by rapid decline (as in a fad) to a maturing life-cycle that is revitalized by innovative changes to the product and in the marketing variables.

Let us consider some of these models by identifying the phenomena being modeled and the nature of the variables that are being used to predict the phenomena.

Linear Model:

The linear model of the form $Y= a_0 + b_iX_i$ is linear in parameters and in variables, meaning that all relationships, when graphed, form straight line.

Verbal Description: The linear model is described as a relationship between two variables. When the first variable is equal to zero, there may be a positive, negative or zero value of the second variable. However when the value of the first variable increases, there is a constant and sustained increase in the second. For each measured unit of increase in the first variable we always observe the same measured unit of change in the second variable.

Graphical Description: The linear model may be graphed as a straight line of any direction and slope that intersect the Y axis of an X-Y coordinate system. In this case, the point of intersection is designated as a0 and the slope of the line is designated as b1, where the angle of the slope is the change in y divided by the change in x1.

Mathematical description: The most basic mathematical description of a two variable linear model is the equation $Y= a_0 + b_1X_1$, where X_1 is the input variable and Y is the output variable.

The most basic assumption of a model that is linear in form is that of a constant slope, return to scale, or elasticity such that y/x = b1. In reality, this assumed form rarely occurs. Most marketing relationships between marketing variables are characterized by threshold and saturation effects... that is, there must be a certain amount of advertising that is aired before any appreciable change in sales will be observed. Likewise, the relationship between advertising and sales is not infinite. There are saturation points at which further advertising produces less of an effect, or even a negative effect. Indeed, it is likely that viewers may tire or even reject advertising if it becomes too repetitive and is annoying.

A second assumption is that changes in demand are unrelated to other marketing variables. This lack of relationship is the same as saying that there are no interactions between variables, or that sales are related to variables other than advertising, such as the number of sales people, competition, or the economy.

As we can see, the linear model has very limited ability to explain marketing processes. For example, if the slope of the line is greater than one, the line is inelastic. This means that if we increase our X variable, advertising, that the sales would increase more. If this were truly a linear relationship, we could increase advertising infinitely and enjoy an infinite increase in sales. This would never be the case.

However, the linear model provides a powerful means of fitting relationships that have occurred in the past. The straight line, when fit properly through data, lies on the average of the data and minimizes the average deviation between the points and the line.

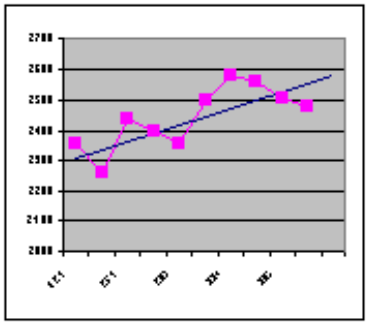
$$a = \bar{Y} - \left(b * \bar{X} \right)$$

$$b = \frac{\sum XY - \left(\bar{X} * \sum Y \right)}{\sum X^2 - \left(\bar{X} * \sum X \right)}$$

We can develop a linear model from scratch using an Excel formula that expresses the mathematical form for the slope and intercept:
When converted to Excel formulas, the equations appears as
b = (F$13-(D$14*E$13))/(G$13-(D$14*D$13))
a = E$14-B$16*D$14

Once the values of the slope and intercept have been computed, it is a simple matter to estimate values for future periods by using the formula y=a+bX where x is the value of the new data (see cells b13.b15).

	A	B	C	D	E	F	G	H
1	**Years**		**Market**	**Income**	**Sales**			
2				**X**	**Y**	**X*Y**	**X Squared**	**Est. Y**
3	1989			121	2360	285560	14641	2318.643
4	1990			118	2260	266680	13924	2315.424
5	1991			271	2440	661240	73441	2479.585
6	1992			190	2400	456000	36100	2392.676
7	1993			203	2360	479080	41209	2406.625
8	1994			263	2500	657500	69169	2471.002
9	1995			334	2580	861720	111556	2547.181
10	1996			368	2560	942080	135424	2583.662
11	1997			305	2505	764025	93025	2516.066
12	1998			210	2480	520800	44100	2414.135
13	Est. 1999	310	2521.431	**2383**	**24445**	**5894685**	**632589**	**Sum**
14	Est. 2000	321	2533.233	**238.3**	**2444.5**	**589468.5**	**63258.9**	**Average**
15	Est. 2001	330	2542.89	**X**	**Y**	**X*Y**	**X Squared**	
16	**Value of b=**	**1.07**	**Value of b = (F$13-(D$14*E$13))/(G$13-(D$14*D$13))**					
17	**Value of a=**	**2188.82**	**Value of a = E$14-B$16*D$14**					

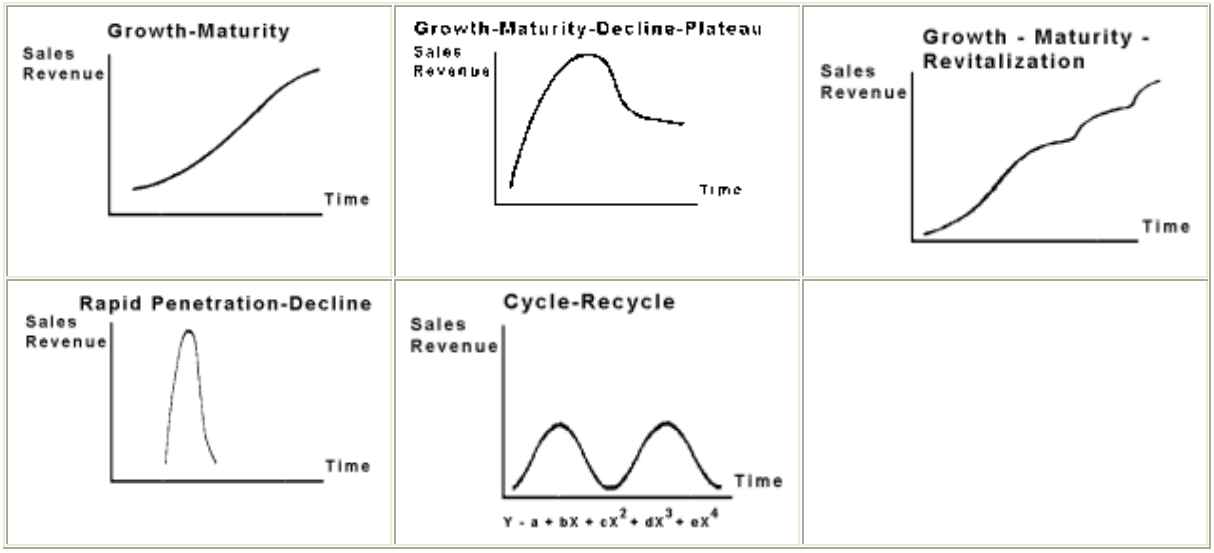


An alternative to making your own two variable regression is to select [Tools][Data Analysis][Regression] and the values for the slope and intercept, along with statistical information and tests will be produced. Excel also includes a linear estimation function that will produce the value of the slope, and a chart capability that permits adding a trend line to a chart (first click on a completed chart and then select [chart][add trendline][linear]).

SUMMARY OUTPUT		ANOVA	*df*	*SS*	*MS*	*F*
Regression Statistics						
Multiple R	0.90975399	Regression	1	74507.34	74507.33	38.4178
R Square	0.82765232	Residual	8	15515.16	1939.396	*Prob..00026*
Adjusted R Sq	0.80610886	Total	9	90022.50		
Standard Error	44.0385752					
Observations	10					
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	2188.81576	43.53860279	50.27299	2.71E-11	2088.415499	2289.216
X Variable 1	1.07295106	0.173106617	6.198209	0.00026	0.673766228	1.4721359

Increasing Model Complexity by Decreasing Returns to Scale

The linear model above provides a robust predictor for many marketing relationships. Robustness in a modeling sense means that the model fits well even though the assumptions of the model are not met, or the individual variables being measured are not well represented. In other words the model does a reasonably good job even though it isn't designed to do what we ask it to do. In the following pages we will systematically investigate other models that add to our understanding of marketing phenomenon and allow us to predict the effects of marketing variables.



Power Series Model

The power series model is characterized by linear parameter but variables that are nonlinear. We are interested in the power series model because it is a basic deviation from a linear model that introduces the concept of decreasing returns to scale. All marketing activities will eventually produce decreasing returns to scale as more and more additional resources are poured into these activities. The power series model is a relatively simple form, being only a slight extension of the linear model. This model is expressed as

$$Q = a_0 + a_1 x_1 + a_2 x_2^2$$

The decreasing returns to scale occur when a_2 is negative and is less than a_1. We might employ this type of model in a situation where profits are defined as unit sales times the contribution margin per unit less expenses:
Profits = unit sales * contribution margin per unit - expenses.
In this simple equation, the power series model would estimate the profit.

$$P = a_0 + b_1 x_1 + b_2 x_2^2)M - E$$

We take the derivative of Z to solve for x and x = 1-a_1 M / 2a_2M
The maximum is reached if $a_1 > 1$ and $a_2 < 0$

Fractional Root Model

The fractional root model will also handle decreasing returns to scale. The fractional root model is of the form

$$Z = a_0 + b_1 x_1^B$$

where $0 < B < 1$
As we observe, this model becomes linear as B equals one, produces the square root model when B equals 1/2, and produces extreme decreasing returns to scale as B approaches zero.

We have thus created models that offered decreasing returns to scale but are ill behaved and predict sales that approach infinity as marketing expenditures are increased. Thus our need is to define a model that saturates as marketing expenditures increase and also provides the decreasing rate of return. By slightly modifying the fractional root model we may obtain this desired result.

$$Z = a_0 + b_1 x_1^{-B} for B > 0$$

In this situation a_0 represents the total market potential. The larger the value of B, the faster we reach saturation. The threshold at which the marketing variable begins to have an effect is also defined as

$$Z = (a_1 / a_0)^{1/B}$$

When B = 1, we observe that the threshold is equal to a_1 / a_0.

The S Shaped Curve Models

While this simple model has considerable appeal because it offers the threshold, saturation and decreasing returns, in most marketing situations we'd desire more. We want increasing returns to scale followed by decreasing returns to scale. In other words, we want a simple S shaped curve. Most often this type of model requires the use of nonlinear variables. Each of the above models we've described were linear or were capable of being transformed into linear form. The following models increase, decrease, and have constant return to scale regions. They are therefore also capable of exhibiting threshold and saturation effects.

Logistic Curve Model:

The logistic model is one of the most commonly used S shaped models. The general form of the Logistic curve is:

$$Q = \frac{\overline{Q}}{1 + e^{(a_0 + a_1 X_1 + \ldots + a_k x_k}}$$

$$Q = \frac{\overline{Q}}{1 + e^{a_0}}$$

The starting value occurs where x = 0,

$$Q = \frac{\overline{Q}}{1 + e^{-(a_0 + a_1 X_1}}$$

and then rises to Q bar when x is large and at that point:

Gompertz Model

A second S shaped model is the Gompertz model which appears

$$Q = a_0 a_1^{a_2^x}$$

In this model, when x is large, Q approaches a_0. When x = 0, Q = $a_0 a_1$. Taking the log of the model, lnQ = lna_0 + a_2^x lna_1

a_0 is interpreted as market potential. We may estimate separately by Q* = lna_0 - lnQ = - a_2^x lna_1

or taking logs, $\ln Q^* = \ln(\ln a_0 - \ln Q) = x\ln a_2 + \ln(-\ln a_1)$
Characteristics of this model are that the growth increments of the logs are declining by a constant proportion a_2. Gompertz functions for most often used to model demand as a function of market efforts. It is further used where the demand function grows over time. Gompertz and Log curve functions have the lower bound or threshold, and upper bound or saturation level, and the function is increased at decreasing rates of growth. The logistic curve increases at a constant ratio of successive first differences in the value of 1 / Q, while the Gompertz curve increases at a constant ratio of successive first differences of the value of Log Q.
In Chapter three, we examined a simple two-way table that produced an S curve. It provides the a simple model that tracks cumulative purchases as they develop as a function of repurchase purchase rate percentages as they accumulate over time. This example is reproduced below.

Creating an S-Shaped Curve Using a Two Way Table

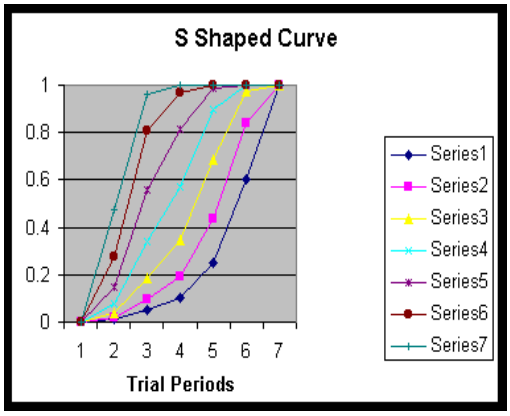
This function, is written $P_T = S\left[1-(1-R)^{2^{t-1}}\right]$, where P_t is the purchase rate for time period t; S is the maximum purchase ratio; R is the percentage of S that repurchases the product; and t is the time period (time periods 1-7). Recall that the two variable data tables use two lists of input values to feed the single formula that populates the table. In this example, the two-variable data table uses formula (A62) with two lists of input values. The formula must refer to two different input cells (F62 and A68), and both are referred to in the formula.
To populate the cells of the table, we simply highlight the cells containing the formulas, values and the cells to be populated (A62:E67), select [Data][Tables], specify the column input variable (A68) and the row input variable (F62) and press enter. The values for the cells of the table will be computed and entered.

A62 = =$A$69*(1-(1-$A$68)^(2^($F$62-1))) ← Single Formula Cell: A62

	A	B	C	D	E	F
62	0	1	2	3	4	← Row Input Cell F62
63	0	0	0	0	0	
64	0.1	0.1	0.19	0.3439	0.5695328	
65	0.3	0.3	0.51	0.7599	0.942352	
66	0.5	0.5	0.75	0.9375	0.9960938	
67	0.7	0.7	0.91	0.9919	0.9999344	
68		← Column Input Cell A68				
69	1					
70						

An Expanded S Curve (7 time periods, 7 B values)

0	1	2	3	4	5	6	7
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00							
0.01	0.01	0.02	0.04	0.08	0.15	0.28	0.47
0.05	0.05	0.10	0.19	0.34	0.56	0.81	0.96
0.10	0.10	0.19	0.34	0.57	0.81	0.97	1.00
0.25	0.25	0.44	0.68	0.90	0.99	1.00	1.00
0.60	0.60	0.84	0.97	1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00



Summary

A simple tool such as an Excel worksheet, when used with simple mathematical models, provides a virtually unlimited tool for examining the structure and sensitivity of marketing models.

In this chapter we have shown that models can be described verbally to provide a layman's explanation of the relationships, schematically to identify the directions and flows of the variables, mathematically to operationalize the predictive model, and graphically to provide a reality check of the value of the results.

Models are also statistically tested where appropriate. At the end of this testing process, the question that remains is whether we retain the model because it fits theoretically, or because it best fits the data. Such questions as this are constantly with those investigating how best predict and how to predict normative models.

ASSIGNMENTS

MATHEMATICAL MODELS

1. In Chapter 3, a two variable table was demonstrated for the Product Life Cycle. This example performed a sensitivity analysis using a range of values. Use Excel to construct a product life cycle yourself.
2. Construct a similar tables using mathematical models of the form:

   linear: $y = a_0 + b_1X_1 + b_2X_2$
   power series: $y = a_0 + b_1X_1 + b_2X_2^2$
   fractional root: $y = a_0 + b_1X_1^b$ where $0<b<1$

   Gompertz function: $y = a_0 a_1^{a2^x}$ (a1 is raised to the a2 power, and a2 is raised to the x power)
3. A single variable power function (Nonlinear, but linearizable): $y = a_0 x_1^{a1}$

   where $a_1<0$, $a_1>1$, $0< a_1<1$, $a_1=1$, and $a_1=0$

Chapter Five
Market Segmentation Concepts and Models

Market segmentation is the process of finding homogeneous groups of purchasers by either aggregating or dis-aggregating the market. Stated very

simply, market segmentation focuses on differences between customers that are responsible for differences in market demand.

Market segmentation focuses on improving our understanding of the customer and why he or she buys. Successful marketing management requires that we understand the product, the purchase process, and the associated service required to fulfill customer expectations. Market opportunities lie in discovering consumer needs that are either not identified or under fulfilled.

Segmentation also strengthens management's ability to meet customer demands. Strategic planning based on segmentation, should match company and product strengths and weaknesses to the needs of the market.

Three Propositions for Market segmentation
Effective market segmentation is based on three propositions, that if fulfilled, will

Proposition One: Not all Customers are the same
Market segments may be identified using many different types of variables including

demographics (age, income, occupation, family life-cycle, social class, race, religion, nationality, and generation), psycho-graphics (activities, interest, and opinions), behavioral activities, technical knowledge, usage and purchase situations, benefits sought from the product, usage rates, and even geographic area of residence. Customers do exhibit differences and these differences are often related to purchase behavior.

Proposition Two: Customers must be identifiable and accessible
Customer segments must be able to be identified using some descriptive variable that shows who they are and their demand for the product. Furthermore the marketer must be able to reach them once they are identified. From a marketing perspective this means the we're able reach them an inefficient and cost-effective manner.

Proposition Three: Customer segments have varying levels of demand
This proposition entails two factors: Ability to Purchase and Differential Response. Almost all college seniors would like to have a new Porsche or Corvette, but few have the ability to purchase such an expensive two seat sports car. Ability to purchase is key, but in addition, the market segment must be willing to respond. Premier market segments produce a high rate of response when introduced to the product offering. Market segments may be identified by product usage rates, and the likelihood of purchasing the product or service.

Market segmentation models also make it possible to evaluate the company's strengths and weaknesses within each market segment. Planning efficient

allocation of marketing resources, targeting, and setting performance goals by segment are critical to realizing the benefits of effective market segmentation.

Customer Characteristics and Market Segmentation
In the above discussion it has been hinted that market segments may be identified in two ways: the analysis of consumer characteristics, and analysis of consumer demand.

Customer characteristics are those descriptors that are related to purchase behavior. Customers are often categorized by demographic (age, income, occupation, family life-cycle, social class, race, religion, nationality, and generation), psycho-graphic (activities, interest, and opinions), behavioral activities, technical knowledge, different use and purchase situations, benefits sought from the product, and even geographic area of residence. Each of these segmentation variables is a descriptor that can be used to classify the customers. They focus on who uses the product and how the product is used, but not on how much is used.

Demand Analysis and Market Segmentation
Customer demand analysis focuses on the questions of purchase and use characteristics that include differences in customer behavior that may be related to actual purchase behavior. For example, we may identify users of the product by usage rate and classify them into heavy user, light to moderate user, and non-user groups. Almost all segmentation studies include this type of classification. We may find that 87% of all dog food is consumed in only 17% of the households. Why? We find the answer in examining the customer characteristics related to the number and size of dogs in the household. We may find that 67% of the households consume no Beer. Why? It may be a preference for other beverages, or even a gender, age, socio-economic, life style, or religion based decision.

Demand analysis also identifies such variables as stated preferences, choices expressing preference between products, intention to purchase, anticipation of purchase: more - about the same - or less in some future time period, and reports of actual purchase amounts.

Marketers desire to know both the level, variability, and trends in demand functions for the individual consumer, for market segments, and for the total market. Furthermore, these demand functions are investigated as a function of marketing mix variables and market characteristics.

Problems in Modeling Market Segments
The actual results from a market segmentation study are often a far cry from the precise model building used to identify market segments. Market segmentation is an appealing concept that promises knowledge of who the market is, what they

want, and how to target differences in demand. Reality is that fundamental problems exist in this discovery process:

1. Mutually exclusive market segments are difficult to define.
2. Market responds differences as measured by differences in elasticity of demand is difficult to identify on a segment by segment basis.
3. Consumer characteristics are poor predictor's of market responds.
4. Market access is limited, especially when we consider the many alternative forms of the marketing mix that may be used as entrees to stimulate market demand.

Market segmentation is used to increase profitability by maximizing response to broad market appeals. But as more market segments are identified, we approach the point where the costs of targeting the needs of the next marginal segment exceed the profits generated from that segment. Market fragmentation occurs when we're no longer able to serve the needs of small segments of the market. This delicate balance between aggregation in dis-aggregation produces three conditions of misuse of market segmentation.

Over segmentation, sometimes called fragmentation, is a result of more specialization than the market requires. The detergent market includes powder, liquid, solid, scented, non-scented, whitening, brightening, with bleach, without bleach, with non-bleach whiteners , gentle, heavy-duty, concentrated, super concentrated, single use packs, five gallon tubs, national brands, private brands, hot water, cold water, all temperature, and many other product categories. The result of this fragmentation is that that no single brand dominates the market.

Over concentration results when industries concentrate on a specific market segment characterized by heavy levels of consumption. The marketing of caller I D products was once thought to be concentrated in the single women's market that everyone focused on. Other segments were excluded such as teenagers (who perceived product as a substitute for an answering machine), and older segments (who used to devise to record who called and return the calls when more convenient).

Pointing to the wrong segment occurs when marketing efforts are redirected into new segments. Many beverage manufacturers have different products appealing to diverse market segments. Occasionally however, a brand may be repositioned unsuccessfully. The product may alienate the original market and not be well received by the new targeted market.

Keys for Selecting Market Segments

It is a difficult task to selecting market segments and developing a strategy that successfully reaches the segments. Whether faced with the decision of adding a "Rosy O’Donnell" Barbie doll concept to the product line, adding a new Yoplait yogurt flavor or style, the wants, size and potential of the market segments must be considered. The key issues that should be considered in developing segmentation based strategies include:

1. Size of the Market: The easiest way to make a lot of money is to sell a product to a large market were everyone wants the product. How large is the market when the market is sliced diced and otherwise defined.
2. Stage in the Product Life Cycle: What are the characteristics of the product in terms of the product life-cycle. Can segments be identified at this stage. Would product differentiation or targeting strategies be better applied rather than segmentation?
3. Product Type: The product type has considerable influence on market strategy. Industrial products differ from consumer goods products, from commodities, and from specialty products. How easily can the product be differentiated from products offered by the competition?
4. Competition: Competitor strategies, competitor resources, and competitor knowledge and experience are critical in identifying appropriate market strategies.
5. Customer Response: How receptive is the customer in the segment to the elements of the marketing offering? Is there a special use or feature set that are of particular value to the segment, and can we target advertising, sales promotions, or coupons with great effect in that segment?

Market Segmentation, Product Differentiation, and Product Positioning

Thus far our chapter discussion has focused on the basic elements of market segmentation. From a product marketing perspective two other concepts are closely aligned with market segmentation: product differentiation and product positioning. The relationship between these concepts is best explained by viewing a graph of the classical product life-cycle. Market segmentation is most effective in the introductory stage of the product life cycle were great economies of scale are achieved by identifying the different market segments at which the marketing appeals may be directed.

As the life-cycle for the product category matures and moves into the growth stage, market segmentation becomes less and less effective because the targeted segments are increasingly dissatisfied within a product that is not differentiated to meet their specific needs. The growth stage in the PLC typically brings an increase in new competitors and a host of new product formulations into the marketplace. The most effective strategy for these products is to achieve differentiation from competitors. Thus in the growth stage of the product life-cycle we find that product differentiation strategies produce the greatest sales increases. Product differentiation continues into the maturity stage of the product life-cycle at which point this differentiation has produced both customer recognition and understanding of the product and its features. As consumers of automobiles, we recognize the luxury of the Toyota Land Cruiser, the solid dependability of the Ford Explorer, and the value of the Isuzu rodeo. In the beverage market we recognize diet and non-diet, Cola and uncola, caffeine and noncaffeine, and softdrinks and fruit drinks, and then, you could have had a V8. Product differentiation defines the market space within which products and services compete.

The maturity stage of the product life cycle is characterized by well defined markets in terms of the customers perceptions of the product attributes space. Competition at this phase of the product lives cycle is difficult. It is much easier to grow market share when the market is growing than take market share when the market is mature. Product positioning is the key to making inroads at this stage of the PLC.
Product positioning reflects both the attributes that define the product or service, and the competing products that are recognized as the leaders in their market space. Effective positioning is the single largest influence on buyer behavior at this stage of the product life-cycle. Positioning means focusing on the single one or two attributes that are most critical in deciding to purchase a product or service. Positioning is long-lasting. Positioning includes both perceptions of product characteristics and the associated benefits and values that are achieved by association and purchase of the product.
Vehicles that are from the heartland of America and are built like a rock are of course Chevrolet. Tough trucks are built by Ford. Taste great and less filling? Which airline offers friendliness and which offers success in your business travel? Which credit card offers so much security that you won't leave home without it? The long-lasting effect of positioning on key features and benefits makes customers highly resistant to changes in perceptions. Strong positioning within a market is the key to building strong brand loyalty.

Modeling Customers and Markets
Market analysis focuses most heavily on three basic questions:

Who are the customers that purchase our products and services (and what are they like)?
What features, benefits and values do they desire?
How do we perform relative to our competition?

These questions are largely the same for segmentation, differentiation and positioning analyses. It is the competitive environment, the mindset of the customer, and the decision process of the customer that changes as the market develops and we move along the product life cycle. In response to these changes in the competitive and customer environment, we demand and employ newer and more sophisticated marketing models. At this point, we begin our exploration of models by focusing on the development of models for the individual customer.

Who Purchases Our Products and Services And What Are They Like?
Modeling individual customers is an interesting challenge because of the diversity of customers in the market place and because of the wealth of knowledge that is found in the customer. Traditional research methods for profiling the customer have generally involved preparing volumes of cross-tabulations that compare groups of customers defined as high-moderate-lite-non users (using purchase frequency or purchase amount (dollar or volume)) with

standard demographic variables. This methodology is simple, relatively inexpensive and produces inches of paper in a nice binder that can be placed on the manager's desk and touted as "the study" that has been completed. While this understanding is necessary, these simple descriptive analyses do little to enhance development of advertising appeals or help us to really understand the motivations behind purchase behavior. It is one thing to paint a picture of the customer and quite another to understand what the customer is thinking.

Cross-Tabulation of Age by Customer
XYZ Customers Vs Competing Products

Age	Customers	Customers %	Competing Products	Competing Products %
< 36	727	28.52%	1,788	21.44%
36 - 49	1,206	47.31%	4,188	50.21%
50 - 64	411	16.12%	1,500	17.98%
65 +	59	2.31%	358	4.29%
Unknown	146	5.73%	507	6.08%
Total	2,549	100.00%	8,341	100.00%

An alternative methodology that is gaining favor among practitioners is the means-end chain analysis.

Means-End Mapping of Consumer Decision-Making

The means-end chain views consumer decision making as a problem solving process. As consumers, we select a course of action or means to reach an objective or end. By understanding the nature of this decision process directed towards the goal, we understand why customers are interested in purchasing our product and what they want or are trying to achieve through it's adoption. This type of description is often followed by a cross-tabulation analysis to find any demographic relationships that may exist. Thus we find the motivations as well as the demographics that might be associated.

A means-end analysis produces a map that arranges means and ends into a decision network. This network begins with product or service attributes (features) and links them to the physical and emotional consequences of the purchase (benefits) and then to the higher order personal values or life goals that often direct the overall lifestyle or goal of consumption. This type of analysis is extremely valuable in the area of communications strategy and copy development in advertising. The premise of this analysis is that advertising is most relevant and compelling when a strong link is made between the right set of attributes, consequences, and values. What's in it for me? Buy our product that has these features and you will receive this set of benefits that will move you further toward your life values.

Additional Materials:

Cougar Visa: Developing a Means-End Chain for a Credit Card

WHAT IS A MEANS-END CHAIN?

Excerpts from "Applying Laddering Data to Communications Strategy and Advertising Practice" by Tom Reynolds and David Whitlark. *Journal of, Advertising Research* - July/August 1995

Means-End Mapping of Consumer Decision-Making

One way to understand a means-end chain is to think of consumer decision making as a problem solving process. In making decisions consumers select a course of action or means to reach an objective or end. While a means can be an end, an end can also be a means. Using the map shown below as an example, "on-time delivery," an end, is obtained through the "reliability" provided by an express mail delivery service, a means. However, "on-time delivery" itself is a

means to reach other ends, such as "less worry about on-the-job unknowns," "feeling more personal control," and "peace of mind."

A means-end map arranges means and ends into a network of attributes, physical and emotional consequences, and personal values or life goals. The means-end framework for viewing consumer decision making leads to a means-end theory of communications strategy. Generally speaking, the theory posits that communications are the most personally relevant and compelling when they make a strong link between the right set of attributes, consequences, and values.

Means-End Chains and Laddering

Laddering refers to an interviewing technique that can be used to elicit means-end connections and attribute-consequence-value networks people use when making decisions about what brand to buy, what store to shop at, what issue to support, or even who to vote for.

Consider, for example, a consumer that says an important distinction between express delivery services is that one service has "package tracking software" and another service does not. The researcher would then ladder the key distinction by asking what the respondent receives by having package tracking software" (means) i.e., why is it important to the respondent. Then the respondent is asked about the consequence "makes me look good" (end) i.e., why it is important to the respondent and so forth until the attribute-consequence-value chain is exhausted.

The laddering interview reveals the linkages between attributes, consequences, and values used by respondents to justify their beliefs and/or behavior.

LEARNING ABOUT LADDERING

Excerpts from "Advancements in Laddering" by Tom Reynolds, Clay Dethloff, and Steve Westberg.

The Laddering Interview

A laddering interview is an in-depth, one-on-one structured dialog that draws out the connections people make between product attributes, the consequences of those attributes, and the human values linked with those consequences (means-end chain). Interviews last between forty-five minutes to two hours and generally recorded so that interviewers do not lose the detail of what is said.

Getting respondents to reveal their true beliefs, feelings, and goals requires warm-up questions to put the respondent at ease with the interviewer and to help them start thinking about the product of interest. Laddering differs from other types of qualitative research in that it aims to uncover personally motivating reasons behind brand choice and link them to product attributes and their consequences.

Laddering begins by identifying the most important distinguishing characteristics of the brand for a given usage situation and then moving up and down the means-end chain to get a complete picture of attribute-consequence-value identities and linkages. Moving up and down the means-end chain is done by asking a form of the question: *why is that important to you?*

Attitudes toward a product do not often predict choice behavior, but attitudes toward choice behavior concerning a product typically will. Laddering asks questions regarding the reasons people have for making the choices they do. It requires respondents to justify their buying behavior by explaining the distinctions they make between choice alternatives.

Eliciting Product Distinctions

Laddering research is designed to uncover the reasons underlying purchase decisions. Both the positive reasons for choosing a brand and the negative reasons for rejecting a brand should be determined. Simply asking what is good about a brand or product is not enough. The marketer needs to understand how a brand is believed to be better than others, or conversely how a brand is

believed to be worse than others.

There are several methods for eliciting distinctions between brands. These methods are (1) top-of-mind imaging, (2) grouping similar brands, (3) contextual environment, (4) preference, usage, and preference-usage differences, (5) timing of purchase or consumption, (6) usage trends, (7) product or brand substitution, and (8) alternative usage occasions.

Top-of-mind imaging. The respondent is asked to give one or more first-thought associations for each of several brands or product types. Polarity (positive or negative) for each association is also determined. Then, the respondent is asked why the characteristic is -a positive or -a negative and the responses are further probed to uncover the ladder. Top-of-mind imaging identifies the most conspicuous characteristics of a brand, but not always the characteristics that differentiate it from a close competitor.

Grouping similar brands. This method uncovers the way respondents group products together and the reasons they use for forming product groups. Respondents are asked to group brands and/or products into like categories. Then the primary reason for group membership, either a positive or negative characteristic, can be elicited and laddered. Additionally, the respondent can be asked to identify the brand or product that best represents the group. Important traits and trait performance for the most representative brand can be identified and laddered as well.

Contextual environment. the contextual environment includes predetermined physical or need-state occasions of brand purchase or use. Physical occasions are generally described by time, place, and people when usage occurs. A need-state occasion is a mental need or inner desire that can span many physical occasions. For example, need-states include occasions such as relaxing,

rejuvenating, building relationships, feeling powerful, reducing stress, and getting organized. The method asks respondents to associate a product or brand with a context such as "those times when you want to relax," or "after you have just completed a tough job or accomplished something that is important to you."

Preference, usage-e. and preference-usage differences. Comparing brand preference and brand usage is one of the most direct and commonly used methods for eliciting brand distinctions. Brands can be ranked with respect to (1) preference and (2) frequency of use. Then, brands can be directly compared against each other based on these rankings using such questions as, "why did you rank Brand A higher than Brand X," and/or "why do you use Brand B more often than Brand A." Also, the interviewer may ask why a brand ranks lower on preference than on usage. Often, respondents use price as the key reason for ranking one brand over another. Avoid the problem by selecting brands to compare that are price competitive.

Timing of purchase or consumption. Timing issues can influence product choice and usage. For example, a respondent might be asked to break a sickness such as the common cold into several stages like onset, full-blown, and on-the-mend. Then the respondent would relate which brands were preferred for each time-related stage. It is also common for consumers to use one brand of product during the day (Coca-Cola) and a different brand in the evening (sprite).

Usage trends. Respondents are asked to quantify their beliefs about past and future usage of a brand. For example, an interviewer might ask, "over the next five years, do you expect to use this brand more often, less often, or about the same as you have in the past?" Then, reasons for increased, decreased, or unchanged usage are elicited.

Product or brand substitution. Distinctions between brands can be directly

assessed based on the ability of one brand to be substituted for another. The brand to be substituted can be a brand currently used by the respondent if a goal of the research is to increase use (identify what-attribute or consequence needs to be added or removed) or it can be a brand not currently used if a goal is to increase trial (identify what attributes or consequences need to be promoted).

For an unfamiliar brand, the respondent first can sample or be given a description of the brand. Follow-on questions might include, "how likely would you be to substitute this new brand for your current brand for this occasion -- why is that?"

Alternative usage occasions. Another method is to alter or add new usage occasions for the respondent to consider. Alternative occasions can be either predetermined or provided by the respondent. For example, one might ask, "think of a new situation or occasion in which you might use Brand A, but that you currently don't -- why would you consider using Brand A for this occasion -- what is keeping you from using Brand A for this occasion now?" Both positive reasons why a brand fits a new occasion and negative reasons why it does not fit can be elicited and laddered.

In practice, several different elicitation techniques are used in a laddering study to capture a full range of meaningful distinctions between a brand and its competitors. For example, a laddering interview might start with "top-of-mind imaging" to understand general product-category beliefs, then increase in brand-related specificity through using "contextual environment" and "alternative usage occasions."

Getting the Ladders

Once distinctions are elicited, they must be laddered to move the respondent up and down the means-end chain to uncover salient attributes, consequences, and values together with their linkages.

Salient attributes are uncovered by asking questions such as, "what is it about the brand that makes it that way," "what is it about the brand that gives you that benefit," "how can the brand deliver that benefit," "what is the brand missing to give it that defect." Attributes are linked to higher level constructs (consequences and values) by asking questions such as "why is that important to you," "how does that help you out," "what do you get from that," "why do you want that," and "what happens to you as a result of that." Higher level psycho social consequences and values are most often feelings or personal beliefs, so asking "how does that make you feel" is an appropriate question.

Negative ladders begin, of course, in negative terms. At the consequence levels, the interviewer may want to ask, "why do you want to avoid that." This effectively turns the discussion from negative to positive. Most respondents are better able to discuss feelings about obtaining a value rather than avoiding one, so laddering is facilitated by talking in positive terms before reaching the value level. More examples of negative questioning are, "why is that negative to you..... how does that interfere with what you are doing," "what's wrong with that."
Often the respondent cannot answer a question or will not move to a higher level on the means-end chain. In the circumstances, one can try one of the following techniques to help the respondent move on.

Reiteration of occasion. The interviewer can remind the respondent of the occasion basis for the ladder when the respondent appears to have forgotten or lost track. It may help to have the respondent provide further information about the occasion. For example, "you were with whom, doing what, where, etc."

Alternate scenario. The interviewer can ask the respondent to think of another situation or scenario similar to the one currently being discussed in which the brand is used in a similar way for similar reasons.

Absence of product. The interviewer can ask the respondent for his or her feelings, responses, and the potential consequences if the brand were unavailable for the occasion.

Abstraction form product. Occasionally, respondents will not be able to leave the brand at the attribute level and will wonder how the brand itself can "make me feel good about myself" or can "improve my relationship with my spouse." The interviewer can ask the respondent to ignore the brand and only consider the last consequence that was mentioned.

Negative laddering. Negative laddering seeks the respondent's reasons why they do not want to do certain things or feet certain ways. The interviewer can ask the respondent what would happen if they were not able to achieve a certain positive consequence.

Age regression contrast. The age regression contrast forces the respondent to compare usage or consumption in a previous time period with now. For example, the interviewer may ask the respondent if he or she used the product five years ago then why or why not. This technique is similar to the "usage trend" method of eliciting distinctions, but is used during the actual ladder to overcome a mental block.

Third person probe. This method places the respondent in another person's shoes. The interviewer asks the respondent how others might feel in similar circumstances. The approach is useful when the respondent feels threatened or uncomfortable discussing their personal reasons underlying their behavior.

Silence. Silence and patient attention will signal to the respondent that the interviewer is waiting for a more detailed response. The respondent often will elaborate on a vague or incomplete answer.

Reiteration of "a-c-v" means-end chain. To help the respondent maintain a complete train of thought during the ladder, the interviewer can reiterate the answers given up to the point of the mental block. The complete ladder should be repeated back to the respondent after a value has been reached allowing the

respondent the opportunity to verify his chain of thought. In addition, the interviewer can use the technique to refocus a rambling respondent.

Laddering Pitfalls In the course of a laddering interview, the respondent will not always provide responses that are whole or complete. The interviewer must be able to identify incomplete responses so that additional probes can draw out useful information.

Generic statements. Respondents often provide generic answers that have no specific meaning. For example, "satisfied" can be either physical (feeling full after a meal) or psychological (feeling content with oneself. Likewise, "happy" can have multiple meanings, including feeling happy about something accomplished and feeling happy for another person, and it can have varying intensity. Slang words like "cool" and "bad" in particular need to be clarified because they can hold different meanings for different people. Often, these situations can be resolved by simple asking, "what do you mean" or "could you describe that feeling."

Not brand specific. Differentiating characteristics should be brand specific and unambiguous. Distinctions that apply to many brands equally well or even to the entire category are not useful.

Multiple responses. Respondents may give more than one answer when providing distinctions or during laddering probes. In these cases, the interviewer must ask which characteristic or idea is most important for the given situation and then continue probing from there. It is possible to ladder multiple "branches" although this can confound the analysis.

Chutes and ladders. Distinctions are most often product attributes, but respondents may sometimes mention an upper level element as a basis for differentiating one brand from another. The interviewer can "chute down" by

asking, "what is it about the brand that makes it that way?" Occasionally, a respondent might ladder directly from an attribute to a value or appear to leave an important element out. Again, the interviewer can ask, "I'm not sure how (lower level element) leads to (upper level element) -- is there something about the brand that makes you feel that way?"

Habit. Respondents tend to say "it's a habit" or "I've always done it that way" when they cannot think of a more rational reason for their usage or consumption behavior. The interviewer should try to uncover when and how the habit started, and what brand they would substitute if they could no longer get their favorite brand, then ladder the resulting distinctions.

I like it. Although similar to a generic statement, this phrase occurs frequently in laddering and can almost always be handled the same way. For example, the interviewer -can ask,-"could -you describe that feeling for me" or "what is it about the brand that you like."

This review has covered the most common practices, difficulties, and remedies associated with laddering interviews. A final rule of thumb for interviewers is to ask themselves, "do I understand all of the personal reasons why the respondent chooses and uses the brand?"

The following comments are found in the article: "A Motivational Perspective on Means-End Chains " by Joel B. Cohen, University of Florida and Luk Warlop ,Catholic University of Leuven http://www.econ.kuleuven.ac.be/tew/academic/market/members/member/courses\meansend.htm

The underlying assumption is that by making these terminal values more salient (e.g., through advertising) greater importance will be given to designated product

characteristics and resulting consequences, producing the desired effect on behavior. While this is a theoretically viable approach, its success hinges on the importance of that higher order value in the consumer's choice among competing alternatives. Thus, not only must the value be a potent driving force, but distinguishing characteristics of the product and/or the consequences of owning and using it must be seen as consistent with, or furthering, the valued state.

This would appear to be a tall order for most products! "Just" determining which goals and values are especially potent and/or salient in a person's life is itself a challenging endeavor. This often involves consideration of perceived discrepancies between ideal/desired states and an assessment of one's current situation, since higher order values that are judged to be important in the abstract are not necessarily active, driving forces on a daily basis. Cantor, Marcus, Niedenthal, and Nurius (1986) hypothesize that a "working self-concept" (i.e., the subset of self-knowledge that is made salient and dominant by contextual factors) -- rather than a few generally important self-related values -- is likely to guide behavior. Context-recruited self-perceptions (i.e., the working self-concept) help identify intermediate goal regions and influence the means chosen to attain them. Walker and Olson (1991) recently expressed a similar view; that "central aspects of self" should be related to behavior only when the situation activates these aspects, and that the "particular values that influence behavior may be completely different in different situations."

Inherent Limitations of Laddering

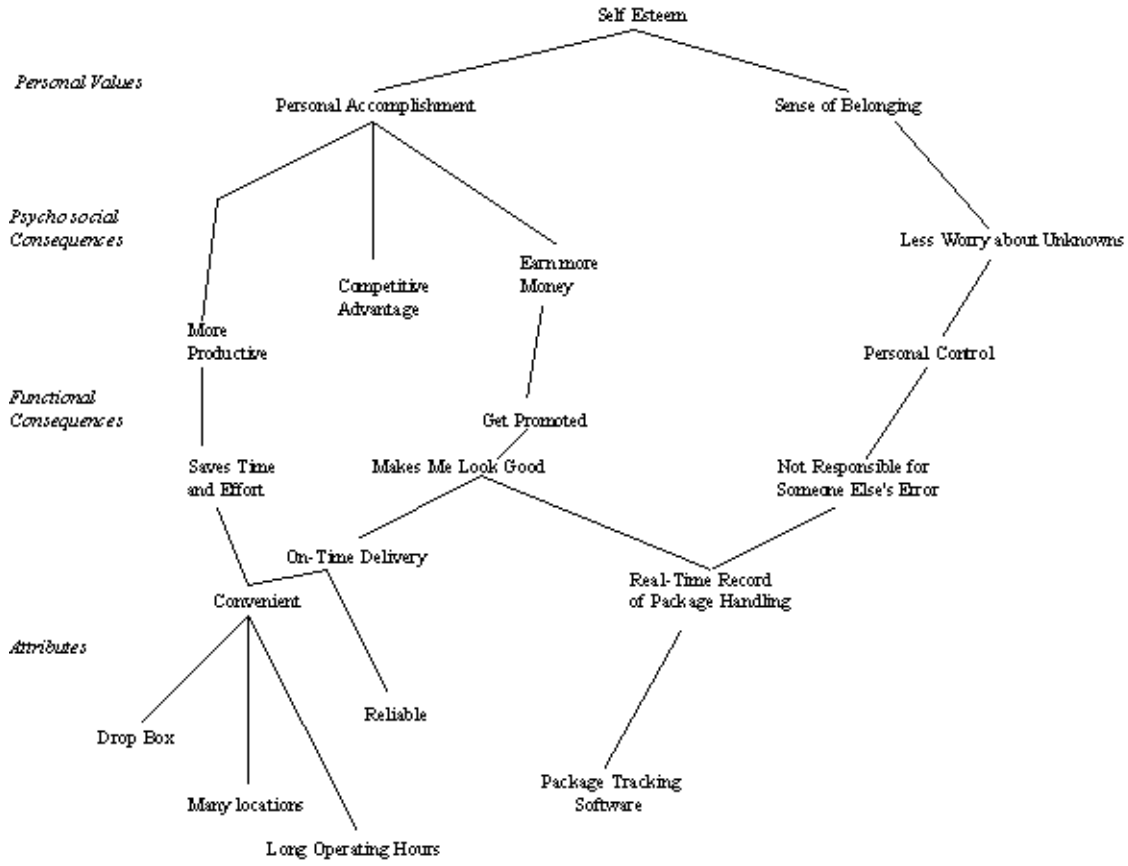
One reason for means-end chain advocates' enthusiasm about the use of the approach to represent cognitive structures seems to be the face validity of a relatively unstructured elicitation task rather than the use of pre-specified cognitive categories. However, laddering is far from neutral in the types of responses it elicits (i.e., reasons underlying preferences). Laddering systematically probes for successively higher level goals and values, and

therefore cannot be said to reflect how consumers think about products or brands. It is quite likely, for example, that there are many important associations at a given level in the hierarchy -- particularly at the attribute/benefit level -- that are ignored because of this hierarchical emphasis. In addition, in striving for useful and representative means-end chains, individuals' responses are interpreted, coded, and aggregated, thus necessarily sacrificing a certain degree of accuracy for parsimony. While such procedures may be sound as a way of focusing on predominant motivational chains, different tradeoffs would be needed if the goal were, in fact, to map consumers' cognitive structures.

A second major issue in the use of laddering to discover how consumers think about products is the leading nature of the procedure. Participants are literally "pushed up" an attribute- consequence-goal-value hierarchy in an effort to discover which of these seem to be linked hierarchically. Whether such a hierarchical arrangement exists (in any form) in the consumer's mind is not investigated; it is assumed.

Aside from respondents answering that there was no particular reason why they desired a certain attribute or felt that a certain outcome was beneficial -- and risking looking rather foolish -- laddering will produce reasons for preferences. That is what the technique is designed to do. Unfortunately, it has characteristic features of a problem-solving exercise. In a sense, riddles are posed and solved, proceeding from the shared belief that preferences must have reasons. One can only imagine the thought processes that respondents go through when they realize they have never thought about why a certain outcome is desirable! However, there is ample reason to believe that they will search for a plausible explanation, and one that speaks well of themselves (Schlenker and Weigold 1992).

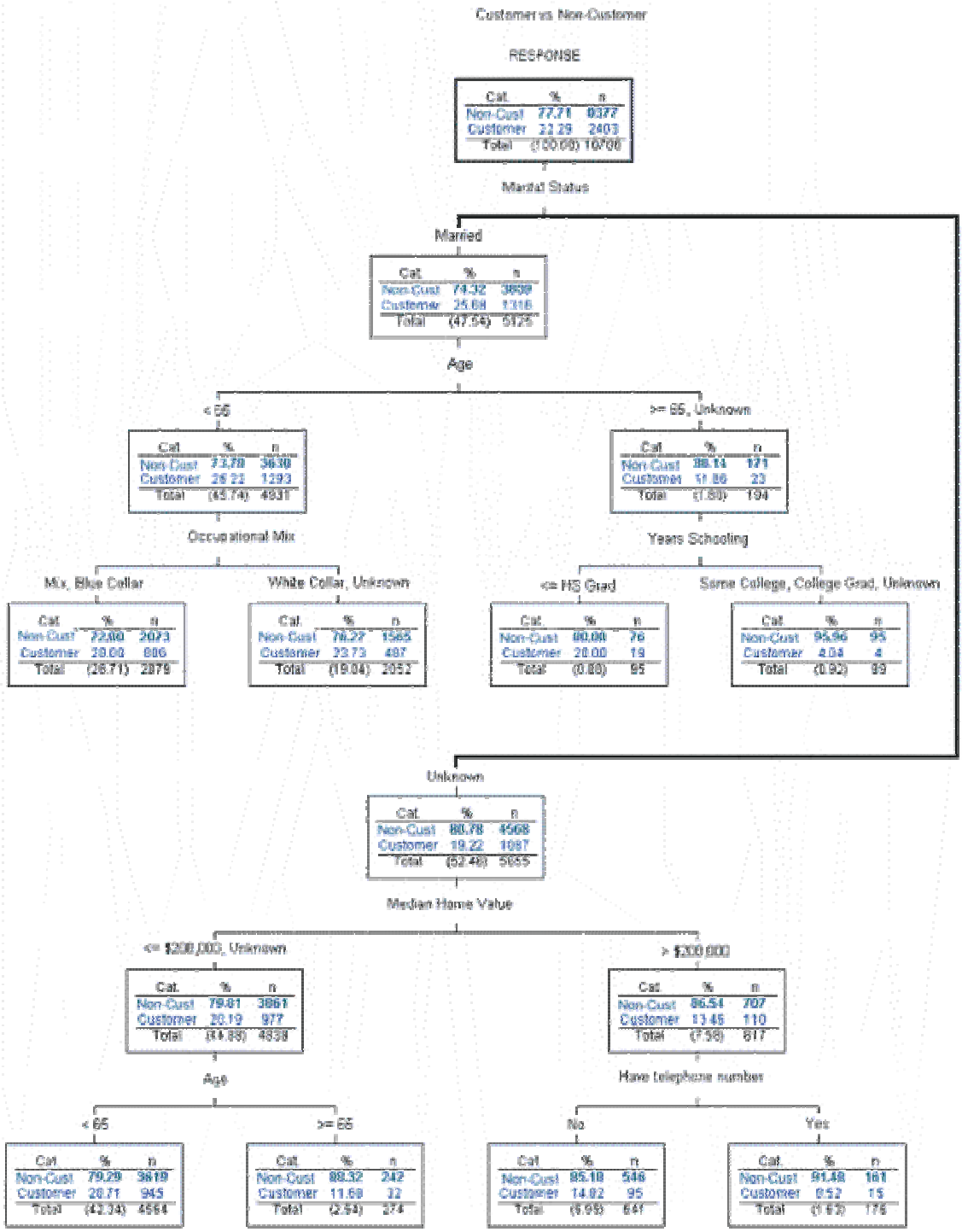
Consumer Decision-Making Map: Express Mail Delivery



CHAID Models for Determining Who Is the Customer

CHAID, **Ch**i-square **A**utomatic **I**nteraction **D**etection, is a technique that groups data to maximize differences between segments. For example purposes, assume we identify two segments of the market, say those who were heavy purchasers and those who were light purchasers. We desire to determine how they are described demographically. CHAID would take the heavy purchasers and break them into two or more sub-groups based on the single demographic variable that best (most statistically significant) predict heavy usage. Next, each of the newly

created sub-groups are divided into two or more groups based on the best predictor variable that hasn't previously been previously used as splitting criteria. This splitting process continues until no statistically significant predictor variables remain. The process is halted once each of the sub-groups is as homogenous as possible. A decision tree diagram is then constructed, which displays the splits as well as the resulting sub-groups or segments. By tracing down the tree, we observe that we can describe the nature of the heavy users, with the variables most important in the description being at the top of the tree and the least important being at the bottom of the tree. CHAID provides an excellent model for managing segmentation problems where we have large databases consisting of many customers that have been surveyed. Large samples are important because as we continue down the tree, the sub-samples become smaller and smaller, eventually testing the limits of sample size for these analyses.



Chapter Exercise

Create a Means-End Map

Means-end chain analysis is conducted for the purpose of understanding motivation and benefits to be received from a specific action. In this case, we might be concerned about identifying the features, benefits and motivations for purchasing the specific product or service that you will be using for a term project.

Find three consumers to whom you can talk with (one-on-one interviews) for about 15 minutes each. Try to find a quiet place where you won't be interrupted.

A. Begin the interview by stating…"assume that you are in the market for ...[your product or service] What do you consider when you are deciding on a brand of _____ to buy for yourself?

Then ask…"What two factors are most important to you in making your decision?"

B. The for each factor, do the means-end analysis by probing for relationships with questions like…

"Why is [FACTOR] important to you?"
"Why is [FACTOR] important?"
"What does [FACTOR] mean or give you?"
"Why does [FACTOR] matter to you?"
"How would you feel if [FACTOR] was not part of brand _____?"
Continue this process for each factor until the consumer cannot go on.
Draw out a means end chain for those you interviewed.

C. Identify Perceived-Risk criteria:

"Sometimes we think about the positive aspects of products we are considering buying … the "good" things the product will give us. In other situations, we think about the negative aspects of products … the unpleasant consequences the product might have. Are there any of these considerations [show the person his /her list of criteria] that you think of in terms of avoiding potentially negative consequences? What aspect (or level) of [CRITERIA] are you trying to avoid?

D. Probing for risk meanings: [For each negative/risk decision criteria, ask:] "Why is it important that you avoid [CRITERIA]? Or "What events or situations does [CRITERIA] lead to?" or "What are the consequences of [CRITERIA]?"
Continue the means-end analysis to probe the chain of negative connections.
Include this in your means-end chain in your written report.

E. Exploring risk handling strategies:

"Most consumers develop ways of handling the possibly negative consequences of their purchases. What things do you do to handle the potentially negative consequences of buying [PRODUCT]? Probe to gain a complete understanding.

F. Next, develop an attribute by brand matrix of product evaluation scores. In the rows of the matrix identify the relevant attributes used in evaluating brands. The columns of the matrix are the major competing brands. Have the person you are

interviewing complete the matrix, giving a 1-10 score for each brand on each attribute, according to how well the brand scores on the attribute or characteristic.

G. After completing the interview, summarize what you have learned about these consumers' product knowledge. What implications does your analysis have for developing marketing strategies.

H. After completing all interviews, identify a new product or brand as a final column in the matrix. Identify how it should perform on each of the characteristics to meet the needs of a specific market segment. Identify in detail, the characteristics of the market segment to which the new brand appeals.

CHAPTER 6
PRODUCT PLANNING MODELS

This chapter examines a garden of interesting and useful product planning models. Included are the Boston Consulting Group's product portfolio model, two diffusion models for new products, and a multidimensional scaling routine. These programs can be richly rewarding because of the increasing dilemma which decision-makers face in product planning.

Developing and marketing successful products continues to get more difficult, for four reasons. First, most new product ideas never reach the market. On average, one successful new product about 60 new product ideas. Second, of the products that are introduced to the market, most fail. The first-year failure rate for products is between 40 and 90 percent (depending on the industry). Third, successful new products have declining life cycles. Due to increasingly sophisticated competition and discriminating consumers, today's new products have life spans that are half of those ten years ago. Finally, the costs of new product development are mushrooming. Fragmented markets, competition, skyrocketing research and development costs, and capital shortages all contribute to these development costs.

Product Strategy and Allocation of Resources

Despite this product development dilemma, since all products have limited life spans, and therefore firms must develop new products or ultimately fail. These companies must manage their product strategy to reduce their risk of failure. In this context, risk is comprised of two basic dimensions: probability of loss, and size of investment. A firm can reduce risk by reducing its likelihood of loss, or the size of its investment.

Although this risk-reduction strategy may protect the firm in the short run, it can lead to hazards in the long run. Development of breakthrough products is often expensive. Using cost-minimization strategies will redirect innovative thinking into existing products rather than into dynamic new products. For example, a

consumer foods company might have the technology to develop a breakthrough product like no cholesterol butter, but chooses instead to develop a "new" lemon-lime cake mix. Despite the fact that the potential returns could be incomparably greater for butter product, management develops the cake mix instead because the risk -- both the probability of loss and the investment in R&D and market development -- are far lower.

The traditional (yet more risky) approach to new product development, particularly for consumer products, is to shift development costs forward by moving as quickly as possible through idea generation, concept testing, R & D, and small-scale production into test marketing. On the basis of test market results a decision is made to introduce the product nationally, revise the product or its strategy, or abandon it. The expenditures for each alternative are enormous, but greatest is the cost of introducing a product that fails. With these large investments comes correspondingly large risk.

By spending more time and money earlier in the new product development process, however, the firm can reduce its ultimate risk of failure. Although larger investments generally mean larger risk, this is not always so. Money spent for guidance information can readily be saved many times over through its power to help avoid mis-spending later. It can provide information of great utility to a management wishing predict the corporate value of the product before major investments in marketing and production are made.

Decisions about new products are often made during a six-stage process, as indicated below.

1. Idea Generation
2. Idea/Concept Screening
3. Concept/Product Development and Analysis
4. Development of an Evaluation
5. System to Monitor Product Performance
6. Product Strategy Implementation

The first stage is one of idea expansion -- to enlarge upon the number of new product ideas. Subsequent stages are those of idea contraction -- to reduce that number to the few which have real promise. The process includes the generation of new product ideas, screening the ideas to identify the best ones, conducting a detailed analysis of those few, and implementing the finest of them. Added to this is a monitoring system that tracks the performance in the marketplace.

At each stage in the new product development process, the decision for a particular product or idea can be "go" -- to proceed to the next stage of development, "no go" -- to cease development and abandon the project or, "on" -- to conduct a deeper investigation in that stage. This iterative process increases the supply of management information about the viability of the product or idea, before major capital is spent. Management thus keeps tighter reign on investment spending while simultaneously reducing the probability of loss.

The following sections briefly discuss each stage of this process and summarize the quantitative modeling contributions made in this stage.

Idea Generation

While product idea generation is a qualitative process best suited to qualitative procedures, a few modeling efforts are noteworthy. Analysis of industrial markets by vonHippel suggests that three sources for new ideas are important: traditional marketing research, customer surveillance (he notes that users of innovative products are good sources for new product ideas), and R & D. Assuming no interactions between these, vonHippel proposes that the firm should find an X_1, X_2, and X_3 to maximize,

$Z = a_1f_1(X_1) + a_2f_2(X_2) + a_3f_3(X_3)$ with the condition that,

$X_1 + X_2 + X_3 \leq$ Annual Budget where,

X_1 = annual spending in marketing research,

X_2 = annual spending for customer surveillance,

X_3 = annual spending on R&D for unmet but known needs,

$f_i(X_i)$ = expected annual number of successful products from investment level X_i in activity i, and

a_i = relative profitability of a success from i.

In short, in its search for new product ideas, the firm should weight its spending by the expected returns. This framework formalizes the normally informal decision process of industrial firms.

One modeling effort directed at simulating the "rate of return" for new product ideas was developed by Edward Pessemier. Input data for this model includes the acceptable rate-of-return, search areas and strategies to be considered, and estimates of the response to each search area and strategy. The model uses Monte Carlo simulation to produce a distribution of return-on-investment for each search policy and within each search area. The final output is an optimum search and evaluation policy for the firm, given the model's inputs. Although an interesting method, it requires that management make time-consuming estimates, the validity of which might be questioned.

Large contributions to product-idea searches have been made using multivariate analytical approaches. For instance, multidimensional scaling (also called "perceptual mapping") is a popular graphics based set of techniques that identifies marketplace "gaps" where customer demand exists for as-yet undeveloped products.

Consumer choice models can also assist the firm to prioritize the importance of new product benefits or attributes. Among these is conjoint analysis, a method capable of identifying measures of consumer value for each potential product attribute, and provide management with the ability to configure a product that will optimize consumer preference.

Cluster analysis methods are yet another tool that can help clarify the market structure by showing logical groupings of products or customers. Examining the characteristics, including benefits valued in possible new products, of these customer clusters can give the firm good direction for new product development.

Regardless of the search methods used, it is clear that expenditures for new product ideas face a diminishing rate of return.

Idea/Concept Screening

Screening is typically a qualitative "paper-and-pencil" step. Modeling procedures can include a simple product profile analysis, in which knowledgeable managers are asked to rate the importance of various dimensions of product characteristics and to then evaluate each product idea on its expected performance for the dimensions. A composite score for each idea is calculated from this, and judgements can be made about which ideas have the most potential.

For example, suppose a manufacturer of floor care products was considering marketing Shinex, a "non-yellowing spray-on" floor shine. Using a five point scale (with 5 representing high potential or importance), a manager might rate the product idea as follows:

Dimension	Importance of Dimension	Evaluation of Shinex
Marketability:		
Merchandisability	4	5
Price/Quality Relationship	2	1
Channel Compatibility	4	5
Effect on Present Products	3	2
Life Cycle:		
Stability Over Time	3	1
Non-Seasonal	2	3
Exclusivity of Design	2	4
Size of Market	5	2
Match with Production Resources:	4	2

Match with Equipment Match with Expertise Match with Materials	4 3	3 3
Growth Potential: Market Acceptance Competitive Reaction	5 3	2 5

A composite score for Shinex is calculated by multiplying the importance rating and the evaluation rating for each item and summing across items.

$$IdeaValue = \sum_{i=1}^{n} (I_i * e_{ij})$$

where, I_i = importance of attribute I and e_{ij} = evaluation of product j on item i

In our example of Shinex, the composite "idea value" score is 129, which would then be compared with the composites for alternative new product ideas.

While this simple and appealing approach it is not without its problems, it is an enormous improvement over typical unstructured overall judgements.

Estimates of profitability are usually the next step. For this, break-even analysis is a simple yet invaluable tool to force decision-makers to think about probable fixed and variable costs, necessary production levels, pricing and profitability.

Product Development and Analysis

If a product idea survives the first two stages it deserves careful (and sometimes costly) consideration for product development and analysis. This stage consists of two steps. The first is a detailed re-analysis of the strategic issues related to projected revenues, costs and profits.

1. Examination of demand factors, including analysis of
a. product life cycle and growth potential,
b. product parameters,
c. appropriate promotional efforts,
d. pricing structure, and
e. distribution strategy,
2. Evaluation of match with company resources, including
a. production,
b. marketing (both markets and physical distribution),
c. materials, and
d. management expertise.
3. Development of costing information, including
a. investment in plant and equipment,
b. interdependencies with other products,
c. material and labor costs,
4. Development of profit calculations, including a. demand estimates,
b. revenue flows,
c. constraints on profit.
5. "Decision" factors, including
a. profit, and
b. risk.

Coordinated with this detailed analysis is product R & D and the development of small-scale production lines. Next, a limited-scale market test is started that includes consumer and dealer surveys, respondent concept/placement (product use) tests, panel tests, and test marketing. Each of these data-collection tasks, is intended to generate information that reduces, or at least gives understanding to the risk of investing in and entering a market. Lest you think we have forgotten about marketing models, this prelim>

---

to modeling efforts and is the focus of a number of decision models of varying complexity.

Some of these models use preliminary research and test market data as input. Among these are early models by Fourt and Woodlock, and Parfitt and Collins (both discussed in detail in this chapter). They have been selected for detailed treatment in this book because they have good face validity, are simple conceptually and in parameterization, and are appealing. Both are diffusion models -- they predict the rate of acceptance of the new product, given preliminary test market acceptance rates.

Other models also use preliminary market data. Several use test market data to predict awareness, trial, repeat purchase, and brand share. SPRINTER (particularly its third version, MOD III) is a one of the most complex simulation models ever designed, having over 500 equations. It uses input from store audits, panels, surveys, sales force reports, and so on to provide comprehensive diagnostic information, marketing strategy, and sales guidance. Some models use no market data, but rely on management's subjective judgments. A model developed by the N. W. Ayer advertising agency, for example, uses multiple regression techniques to accommodate estimates of 14 "critical factors" to predict awareness, trial, and repeat purchase three months after product introduction. And DEMON, the grandfather of new product models, uses simulation techniques on three sets of estimates (management policies, product category descriptors, and market performance ratios) to provide output including advertising budget, reach, number of impressions, awareness, and sales.

Implementation

Each of the models surveyed above attempts in some way to minimize management's market-entry risk by providing preliminary

estimates of the success of a new product idea. Also, each can help management refine and optimize its entry strategy. When a model is used to "try out" a number of alternative strategies, the model, rather than the market, can show the effects each strategy will produce, and many costly and irrevocable mistakes can be avoided.

While many modeling efforts have been undertaken in the area of product strategy, it is still an area that deserves a great deal more attention. We need useful models early in the development process, before heavy expenditures have been made. (Most of the screening models require actual products to generate their input data ... an expensive step to undertake.) We need models to help management recognize the differences between customers -- using segmentation strategies -- rather than treating all consumers alike. We need more attention to competitive reactions in models, and we need models that are appropriate for products other than frequently purchased consumer goods.

The following sections focus on spreadsheet models provided at the website that accompanies this text.

The Parfitt & Collins Model

Structure of the Model.

Parfitt and Collins conceptualized a simple model that has a great deal of intuitive appeal and has greatly influenced the structure and development of other product models. It predicts ultimate market share for new repeat-purchase consumer products using input data from consumer panels. Although the model requires actual market data (which is expensive since it presumes that the new product is at least in a test market), its ability to predict national share prior to national distribution can help management avoid future losses.

Cumulative penetration (the total number trying the brand, over time) and repeat purchasing rates over *time from the time each buyer first bought the product* (along with a buying-level index) form the basis for predictions of future share. Trial and repeat purchase rate data is typified in Figures 6-1 and 6-2 for a hypothetical new brand.

Parfitt and Collins represent the ultimate brand share as a composite of these three dimensions: Share = T x R x B where,

T = Projected percentage of triers of the new brand,

R = Projected percentage of those who tried and will repurchase the brand, and

B = Buying-level index of repeat purchase of the new brand, compared with an index of 1.0 for the product class average.

To illustrate, suppose we had developed a new lemon-lime cake mix and introduced it in test market. As consumers buy it, the number of triers of our product accumulate, growing in number, but at a diminishing rate. A few months after introduction the shape of this growth curve should become fairly well defined, and a (freehand or computer-aided) extrapolation can be made to the ultimate penetration level (illustrated by the dotted line in Figure 6-1). Similarly, the repeat purchase rate for the brand can be examined.

For example, assume that Figures 6-1 and 6-2 represent the cake mix penetration and repeat, and that average repeat level for our product is equal to the product category. Then our ultimate share is projected to be,

$$\text{Share} = (0.34)(0.25)(1.0) = 0.085$$

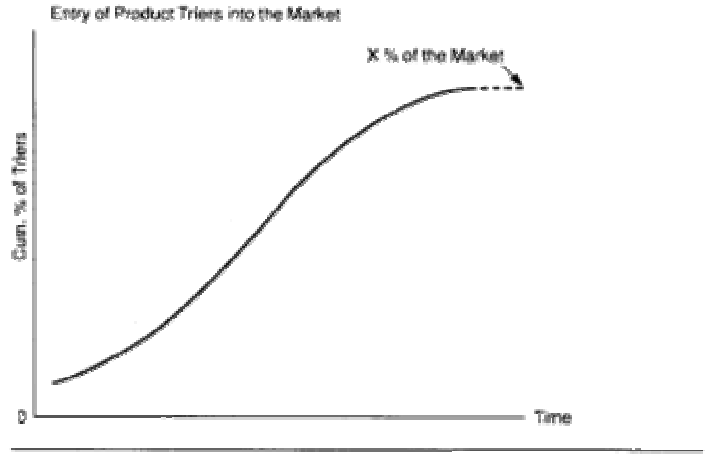
That is, if 34 percent of the potential market tries this new product and 25 percent of the triers repurchase it, and they buy neither

more nor less than other brands in the product class, the share for the new product will settle at 8.5 percent.

An appealing feature of this model is that the predicted share can be estimated well before stable shares have been reached, and even while the company is in test market with the product. Too, the diagnostic value of the model should not be ignored. Share estimates below expectation may suggest to management that a change in promotional strategy is necessary to increase penetration (trial) rates, or that a change in product strategy is necessary to increase repurchase rates.

FIGURE 8-1

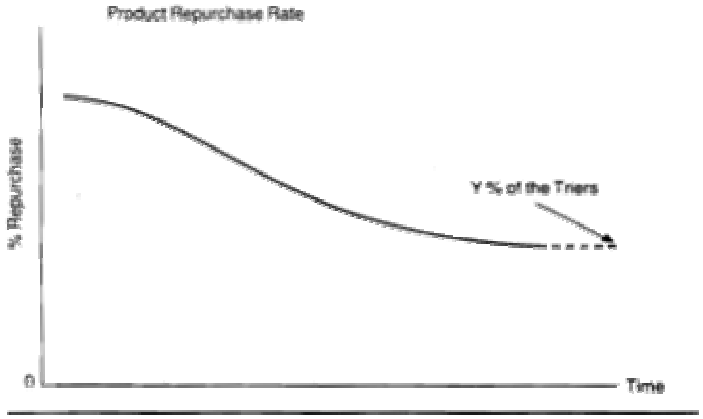
Penetration Rate



THE PARFITT AND COLLINS MODEL

FIGURE 8-2

Repurchase Rate



Running the Parfitt and Collins Worksheet

The Fourt & Woodlock Model
Structure of the Model

Intuitively, we can see that repeat purchase behavior is influenced by the relationships (ratios) between the following:

A low awareness-to-trial ratio (i.e., of those aware of the product, few are trying it) suggests, as a starting point, discovering problems in the promotional campaign, positioning, or media; or problems with the pricing or distribution of the product. Each of these problems could be corrected. But a low trial-to-repeat (or repeat-to-repeat) ratio suggests problems with the product itself. This is a more difficult problem to correct since the product may be failing to satisfy the buyer. If the number of consumers at each step did not diminish (a ratio of 1.0), the product would be a remarkable success. But because each step is a necessary condition for the succeeding step, the number of consumers ordinarily does diminish at each step.

This framework is fundamental to both the Fourt & Woodlock and Parfitt & Collins models; both are new product adoption models for frequently purchased products. The

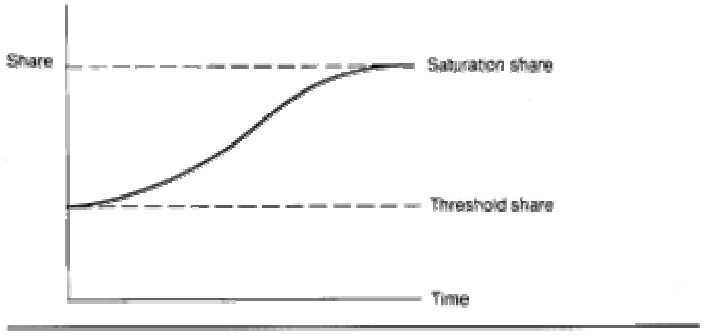
Fourt & Woodlock model is one of the earliest, best-known, and useful market penetration models.

Their model consists of two procedures: a prediction for first-purchase penetration and a prediction for repeat purchase. In developing the first-purchase penetration procedure Fourt and Woodlock, like many model-builders, observed that, as market penetration of a new product accumulates, diminishing returns cause sales to approach but not reach a "ceiling" or saturation level (Figure 6-5). As they stated, "the increments in penetration for

equal time periods are proportional to the remaining distance to the limiting 'ceiling' penetration."

FIGURE 8-5

Saturation of Share



[13]See Fourt and Woodlock, "Early Prediction of Market Success for New Grocery Products," *Journal of Marketing* (October 1960), pp. 31–38.

They define the additional penetration for any period as,

$Q_t = r\,P\,(1-r)^{t-1}$

where, Q_t = the increase in sales at time t, as a proportion of potential sales,
r = the rate of penetration of unrealized potential sales (a constant),
P = the potential sales as a proportion of all buyers, and
t = time period.

Only two values are necessary for the equation: r and P. For example, suppose we believed that our new product would eventually be tried by 50 percent all households (P = 0.5), and that in each period 30 percent of the remaining potential buyers will actually buy (r = 0.3). Using Fourt & Woodlock's equation, the new-buyer penetration of this market for the first period is, $Q_1 = r\,P(1-r)^{1-1} = r\,P = (0.3)(0.5) = 0.15$

or, 15 percent of the market. For the second period, the increment in new-buyer penetration is,

$Q_2 = rP(1-r)^{2-1} = r\,P(1-r) = (0.3)(0.5)(1-0.3) = 0.105$,

or, 10.5 percent of the remaining market. Subsequent periods would continue to penetrate the market at declining rates. For period three:

$Q_3 = rP(1-r)^{3-1} = r\,P(1-r)^2 = (0.3)(0.5)(1-0.3)^2 = .0735$

Naturally, when the product is actually introduced or test-marketed we can watch penetration during the first few periods and update our estimates of r and P.

Fourt and Woodlock's repeat-purchase procedures build on the above. They examined penetration rates for several new products and observed a curious trend. While the absolute number of consumers at each successive step grew smaller, the ratios between steps grew larger. Typical findings (Table 6-1) include 48.5 percent of the new buyers making repeat purchases, a larger percentage (55.9 percent) of those continuing on to buy once again, and so on. These data are calculated from consumer panel data for the new product.

TABLE 6-1

Ratios Over Repeat Purchase

New Buyers	Repeat Ratio
1st Repeat	.485
2nd Repeat	.559
3rd Repeat	.645
4th Repeat	.593
5th Repeat	.797

Fourt and Woodlock used this to predict product sales. First they used results from their first-purchase procedure (discussed above) to predict estimated new-buyer sales. (For example, if 100,000 potential buyers comprise the market for a new product, and 15

percent of these are expected to buy in the first period, we would have 15,000 first-period sales.) If the values of Table 6-1 were observed for our product, we would take the product of 15,000 and the first-repeat ratio of .485 to predict 7275 repeat sales for the first period. Second-repeat sales would be the product of 7275 and .559, or 4067, third-repeat would be 2623 (4067 multiplied by .645), and so on for each level of repeat and then for each period.
Running the Fourt and Woodlock Worksheet

The BCG Strategic Portfolio Model

Structure of the Model. The Boston Consulting Group (BCG) was founded in the 1960s by Bruce Henderson on the basis of a single idea that the technological learning curve, (which suggests that with practice, people learn to complete repetitive tasks more quickly) applies to company and product marketing. Henderson coined the phrase "experience curve" and suggested that total company costs decline as production experience increases. Specifically, every time company output doubles, total unit costs decline by a constant percentage (usually around 20 to 30 percent). Thus the market leader (largest share, greatest production experience) can be in the enviable position of having lower costs and higher profits than its competitors.

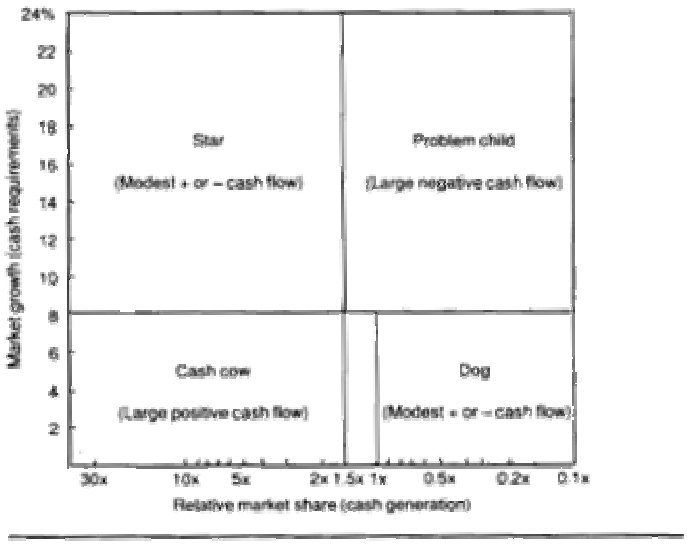
BCG used the concept of the experience curve to develop an approach to strategic analysis: the BCG Market Share/Market Growth Matrix. This is a model based on market growth and market share that represents expected outcomes for a particular marketing strategy in a particular environment. It is a popular and stimulating approach that has intrigued managers for years. (It is, however, not without its critics.)

Using the BCG Growth Matrix, each of the firm's products is identified as falling into one of four quadrants (see Figure 6-9).

Each quadrant also suggests something about the cash flows of products. The names associated with each quadrant indicate the attractiveness of each position. BCG defined the following:

FIGURE 8-9

BCG Growth Matrix



1. **Cash Cows**. Products that generate more cash than they need to maintain market share. Their role is to provide cash to cover overhead, and to finance growth of other brands, and to pay dividends.
2. **Stars**. Products which need cash to maintain growth. Their objective should be to maintain a dominant market share. While they often generate their own cash needs, the firm is cultivating them to become cash cows.
3. **Problem Children**. These do not generate enough cash to cover their own needs because their low shares produce low profits. Their market growth makes them attractive, however.
4. **Dogs**. While these products usually cover their own cash needs, their low share in a slow-growing market hinders them from ever generating much cash.

The BCG Growth Matrix has several implications. Market leaders are capable of continuing to push their costs down and broaden their market base. And they should do so. Also, depending on the position of the firm's products in the matrix, cash needs vary. Given

these varying opportunities, management must decide on strategies that will give the best total corporate performance. Henry Claycamp provided this description of portfolio strategy:

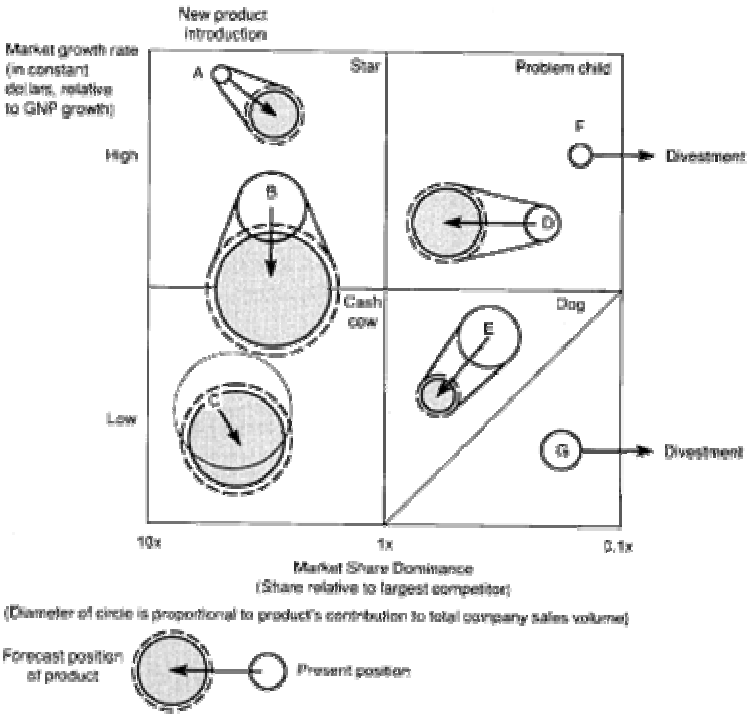
> *For example, businesses classified in the low-growth, high-share category should produce high profitability. And, since they require little reinvestment to keep up with market growth, they should produce a high cash flow, which the corporation can put to use elsewhere...*
>
> *On the other hand, businesses in the high-growth, high-share category usually require substantial investments to support growth during their expansion phase and to protect their share from competitors so that they will become the cash cows of the future. Such businesses are usually called the "stars" and are top-priority candidates for the allocation of scarce capital resources.*
>
> *Businesses with low competitive strength (or market share) are the most troublesome for the corporate strategists . . . if the low share is accompanied by high growth, the business is bound to be a heavy cash drain on the company. The best strategic advice is "don't procrastinate" -- either gain competitive strength and profitability or get out.*
>
> *The low-growth, low-strength businesses are appropriately called "cash traps" [dogs]. They rarely provide a net cash contribution to the corporation and are the leading candidates for either quick liquidation or slower harvesting to free up funds that can be used to grow the stars of tomorrow....*

A company uses the BCG model to develop product strategies. The current position of each product is defined by the relative share and market growth. A future position can be estimated either from a linear forecast of the present situation, or a forecast of the results of a change in strategy. In fact, management should do both and then compare the results. Figure 6-10 shows several strategic decisions made by the company:

- Aggressively support product A, newly introduced, to gain dominance,
- Continue present strategies on products B and C to maintain market share,
- Invest in acquisitions for product D to gain market share,
- Engage in a focused segmentation strategy for product E, and
- Divest products F and G.

FIGURE 8-10

Strategic Decisions Using BCG Growth Matrix



Source: Reprinted from the *Journal of Marketing*, published by the American Marketing Association. Exhibit from "Diagnosing the Product Portfolio," by George S. Day, vol. 41, August 1977, p. 34.

FIGURE 6-10

STRATEGIC DECISIONS USING BCG GROWTH MATRIX

Building the BCG Worksheet

FIGURE 8-20

BCG Analysis— Data and Computation Sections

	A	B	C	D	E	F	G	H	I	J	K	L	M
1													
2		Number of Brands:		5									
3													
4				Brand 1		Brand 2		Brand 3		Brand 4		Brand 5	
5		Input Items											
6													
7		Mkt. Growth %		8		10		12		14		16	
8		Total Mkt. Sales($'M)		13500		11500		9500		7500		5500	
9		Sales Largest Co($LC)		1300		1100		900		700		500	
10		Own Brand Sales:($OB)		1000		1200		1400		1600		1800	
11													
12													
13													
		Computations:											
14		Circle Area											
		CA = ($OB/$TM)*100		(D10/D8) *100		(F10/F8) *100		(H10/H8) *100		(J10/J8) *100		(L10/L8) *100	
15		Circle Center Point:											
16		X Axis = OBS/$LC		(1+@LOG (@+D$14/ ((D9/D8) *100)))		(1+@LOG (@+F$14/ ((F9/F8) *100)))		(1+@LOG (@+H$14/ ((H9/H8) *100)))		(1+@LOG (@+J$14/ ((J9/J8) *100)))		(1+@LOG (@+L$14/ ((L9/L8) *100)))	
17		Y Axis = (Mkt Growth %)		(D7)		(F7)		(H7)		(J7)		(L7)	
18		Circle Radius CR = (CA/@PI)^.5		(D14/@P I)^.5)		(F14/@P I)^.5)		(H14/@P I)^.5)		(J14/@P I)^.5)		(L14/@P I)^.5)	
19													
20		Scale Increment: (Circle Radius/6)		(D18/6)		(F18/6)		(H18/6)		(J18/6)		(L18/6)	

Non-metric Multidimensional Preference Analysis (MDS) Structure of the Procedure

Multidimensional preference analysis refers to a group of procedures for changing one-dimensional measures of relationships into multidimensional measures. This is a remarkable set of techniques that represents products or concepts in geometric space to distinguish between them. It can transform ordinal input data into metric output data. Our discussion will be limited to a

single type: scaling of preference data, based on perceived similarities between products.

Preference analysis is intended to show the relationships that underlay the one-dimensional measures, and illustrates two aspects of the relationships: (1) a spatial representation of the relationships, and (2) the "goodness of fit" of the spatial model with the original input data.

In marketing, the input data for MDS models can either be evaluations of the brands on a set of attributes, or customer perceptions of similarity (or differences) between pairs of brands or products.

Any product (or any phenomenon, for that matter) can be thought of as having both perceived dimensions and objective dimensions, and these do not necessarily coincide. A distribution manager for toothpaste, for example, might see the product as a green fluoridated gel, packed in a plastic tube. Toothpaste consumers, however, might see it as a decay fighter that reduces the family dental bills. Another consumer might see it as a product that sweetens breath and brightens teeth, thereby making them more attractive and acceptable when on a date. Preference scaling techniques allow the researcher to represent the consumers' perceptions spatially by creating "spatial maps," (see Figure 6-13) which can help the researcher better understand consumers' perceptual reality.

Although a single map can be used to represent the perceptions of many people, different people (even those whose perceptions are captured in a single map) may perceive the product quite differently. Too, they might attach different levels of importance to the product’s characteristics. For example, one person might evaluate a toothpaste in terms of its tooth-whitening and breath-

freshening benefits, while another thinks only of its decay prevention powers.

One input data method for preference analysis is collected by presenting consumers (as respondents) with a set of attributes that describe the brand category. Next, each brand to be included in the map is evaluated on each attribute. The ratings scores are averaged over each of the respondents to produce an [attribute x brand] matrix, the values of which are arithmetic means. This process works with any product or brand category where there are differences between brands. For example we could conduct a preference analysis as a taste test for 7 donuts.

Iced cake donut with rainbow sprinkles

Apple fritter

Old fashioned donut iced

White cake donut with icing

Chocolate cake donut with chocolate icing

Maple bar

Regular raised donut

Preference for each of the donuts could be evaluated on several attributes or dimensions:

	Don't Like at All	Somewhat Dislike	Neither Like nor Dislike	Somewhat Like	Strongly Like
Sweetness					
Flavorful					
Texture					
Fun to Eat					

Good for Snack					
Good for Breakfast					
Nutrition					

Other forms of preference analysis rely on evaluating all possible pairs of at least seven or eight products. They are then asked to indicate the relative similarity (or dissimilarity) of each pair (using either rank-ordering or scaling methods), from the most similar pair to the least similar pair. The respondents are ordinarily free to use any criteria they want in making these similarity judgments, although it is possible for the researcher to specify criteria. While consumers could possibly evaluate a product on dozens of attributes, it is believed that they actually use only a few. Preference analysis software converts these judgments into measures of geometric distance for each brand along an attribute vector such that the preference ordering of the original data is preserved. See the software download for the text to download a copy of MDPREF and the donut data. (mdpref.exe, mdpref.out) Interpretation of the spatial map can be problematic, as can the determination of the appropriate number of dimensions for it. The amount of variance explained by each dimension is useful here, too, when plotted against the number of dimensions. As a practical matter, maps beyond two or three dimensions create significant problems in presentation and understandability because the output is graphically oriented.

One multidimensional scaling program that is particularly useful is the MDPREF program developed at Bell Laboratories by Doug

Carroll and G.G. Chang. The MDPREF method of multidimensional scaling uses brand attribute evaluations to map the positions on the attributes that describe the brands.

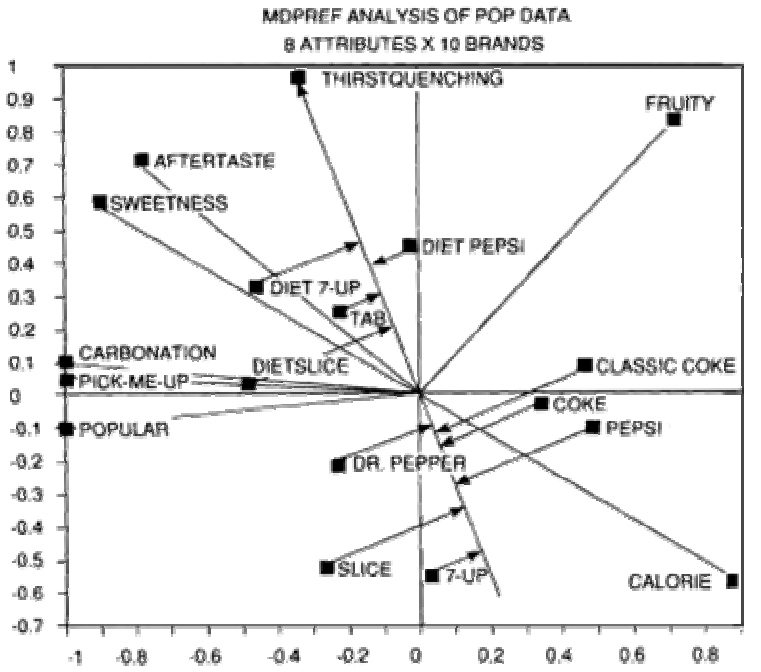
The brand evaluations may be collected for an individual, but more often are reported as average preferences that are summarized for groups of individuals, such as a market segment.

MDPREF produces perceptual maps similar to that shown in Figure 6-14. In this example, the points represent soft drinks that were evaluated on a set of attributes that include popularity, sweetness, thirst-quenching ability, calories, carbonation, and so on.

MDPREF is a "point-vector model." That is, the products, (represented by the points in Figure 6-14) are interpreted with respect to the attribute vectors. MDPREF permits the perceptual points to be readily interpreted as having more or less of a particular attribute, but does not allow the interpretation of the relative positions between the brand points. The ability to make point-point interpretation is reserved for other multidimensional scaling models. Figure 8-14 shows a sample output for MDPREF in the analysis of a set of soft drinks.

FIGURE 8-14

Sample Output from MDPREF



Running the MDPREF Worksheet

Summary

In this chapter we have examined several important product strategy models. This is a critical area for model building, since so much money is invested into this very risky strategic area. And yet, without this investment, the firm would soon fail.

While much has been done in this area, more attention should be given to product models which can be used early in the product development process, before substantial development funds have been invested -- to search for new product ideas, to screen them, to analyze them for potential. Too, product models are needed to identify segmentation strategies more completely. They need to make better use of available input data: behavioral inputs and competitive reactions, in particular. And, most of the modeling for product strategy has been based on frequently purchased

consumer non-durables; more attention needs to be given to durables, and to industrial goods.

CHAPTER 7

SALES MANAGEMENT MODELS

INTRODUCTION

Most firms spend more on personal selling than any other form of marketing communication. A sales force does far more than sell. Allocation of selling effort to customers, to territories, and to developing new business is a key strategic area for firms. In this chapter we examine a way to address some of these problems with a sales call allocation worksheet model.

For many customers, the salesperson is the firm. Consequently, everything the salesperson does reflects on the firm's interest (or lack of interest) in the customer. Aside from the obvious selling tasks, key responsibilities of sales people include establishing accounts, maintaining appropriate and timely customer service, and communicating with the customer about new products and service. Often, sales people also are expected to actively help customers become more successful, and to provide market intelligence for the firm, and to make decisions about customer allocation of scarce products. This chapter discusses a worksheet model called Sales Plan, designed to help sales management allocate those resources better.

THE PERSONAL SELLING EFFORT

A major resource for the sales force in is time. That time is impressively valuable. As long ago as 1980, the typical industrial sales force costs per sales call ranged from a low of $50.40 (in the hospitality industry) to $228.78 (in the transportation industry). Costs to close a sale for these industries were $191.52 and $$1,121.02, respectively. Salespeople must effectively allocate their time to call on accounts, perform necessary administrative functions, and to improve product knowledge and selling skills.

The purpose of sales force allocation models is to improve the effectiveness of the salesperson's time in calling on accounts. Models in this area focus on differences in accounts by allocating different levels of selling effort in order to maximize long-term sales.

The "Sales Plan" model identifies differences in the salesperson's set of accounts. Individual accounts may vary in their need for our products, their loyalty or propensity to buy, and their service requirements. If a salesperson fails to recognize these differences, the firm ignores the potential for a sale or the relative worth of calling on one account over another.

Many accounts will purchase enough to possibly cover the cost of the sales call, but in the long run do not generate enough sales to merit the number of sales calls made to them. Salesperson time would be more efficiently spent by calling on new accounts to add to the customer base, or to key accounts that are the primary source of the company's profit.

The Sales Force Allocation Problem.

Companies developing sales call plans have used several approaches. A simple classification approach might assign all accounts into several categories (A, B, C, or D), based on a single criterion such as the sales potential of the account. The salesperson decides on a specific number of sales calls for each category, and all accounts in each category receive the same number of sales calls. A complex classification approach might model the relationship between the various quantitative and qualitative aspects of a sales call and sales. Sales calls are then allocated using the mathematical function to assign sales calls to accounts in a way that maximizes total sales.

Each approach has its advantages and disadvantages. The simple classification approach is easy for the salesperson to apply. But any improvement in the long

run sales over the unmanaged approach may be limited. The complex mathematical decision model approach will probably result in a much better plan for sales call allocation, but may be hard or even intimidating for the salesperson to use.

Illustration of a Sales Force Allocation Model: Sales Plan

The Sales Plan model categorizes accounts and allocates sales calls based upon the attractiveness of investing in alternative sales resources. The model considers each attractiveness category independently and develops a specific call plan strategy for that category. Sales call allocation to an individual account within an attractiveness category is based upon its level of attractiveness (i.e., the anticipated level of sales) relative to other accounts in that category.

The attractiveness of an account includes two primary dimensions -- account opportunity and strength of position. "Account opportunity" refers to the accounts' need for our product type and the likelihood of the firm purchasing our product within a particular time period. Account opportunity then, is a measure of market potential.

"Strength of position," assesses the advantages or competencies that our company or salesperson might have with the account. Strength of position could be viewed as a probability assessment; given that the account will purchase the product during the next time period, it is a measure of the probability that the account will purchase from us. Strength of position focuses on the strength of the relationship between the account and our company.

The Sales Plan model identifies four distinct account categories, segments, or portfolios, as indicated in Figure 7-1. Each quadrant in the Figure represents accounts of different attractiveness, and each should have its own sales call

allocation plan. The call plan is based upon the characteristics of the accounts in each of the categories.

Figure 7-1

Model of Account Attractiveness

Account Strength	Account Opportunity	
	High	**Low**
High	Segment 1 (Grid 1)	Segment 3 (Grid 3)
Low	Segment 2 (Grid 2)	Segment 4 (Grid 4)

Portfolio segment 1. Segment (grid) 1, with accounts of high opportunity and high strength tends to include the key accounts for the company. Generally, the primary contribution to the company's profit comes from these accounts. Because of their importance to the selling company, high levels of sales calls should be allocated to this segment.

Portfolio segment 2. Segment 2 contains accounts with high opportunity but whose strength of position is low. Interpretation of this category depends upon the nature of the market in which the selling company operates. Generally, in an expanding or growth market, these accounts represent the new prospects that the company is cultivating. The opportunity for sales is there, however, due to the newness of the account, or to the lack of awareness of the benefits offered by the selling company's product, the selling company has yet to make the account a major client. Investment of sales calls to these accounts is an investment in the future. Sales per call will probably be low, but should not be evaluated as

negatively as in other segments. Failure to allocate sales calls to these accounts results in higher short term profits at the expense of long run profitability.

In a mature, stable market, segment 2 accounts reflect more the nature of competition than their being prospects or new accounts. In such a market, any increase in our sales is primarily a result of increase in overall market share rather than an increase in new accounts. In fact, in a stable market, companies in segment two can well be the major source of increased sales and profit for the selling firm. This is the case in an example presented later. The company sells salt, a product well into the mature stage of the product life cycle with little growth in total demand or sales.

Portfolio segment 3. Segment 3, comprised of accounts with low opportunity and high strength, might be referred to as the old friends of the company. Often these are companies that used to be the key accounts of the firm. As their needs or capability to purchase the product have changed, however, they no longer represent our major source of profit. Still, these are companies with which we have long term relationship. It is difficult for the individual salesperson to avoid the temptation to call on these accounts. Generally, they will purchase enough to make the call worthwhile, but the same call could be allocated much more effectively to a segment one or two account.

Portfolio segment 4. Accounts in this segment are marginal accounts. Not only is the probability of a sale is low, but market potential low for the product even if they were to purchase from us. Segment 4 accounts are generally unprofitable when more than a very limited number of sales calls are allocated to them. These accounts are serious candidates for less costly forms of promotion (such as telephone sales), or even for elimination from the portfolio.

Developing the Model. The Sales Plan sales force portfolio allocation model is organized around six sequential steps:

1) Determine the time period of analysis,

2) Identify the variables to be used to assess account opportunity and strength of position,

3) Measure the account opportunity and strength of position variables,

4) Develop the actual grid or portfolio,

5) Analyze the results, and

6) Plan strategies for future periods.

The time period of the analysis depends upon the planning cycle of the selling company and characteristics of the selling situation. One-year periods of analysis usually are appropriate for most firms. If the sales cycle of the firm is unusually long, as with capital equipment for instance, the time period the time period should be adjusted to reflect the situation.

Account opportunity variables should be chosen to reflect the purchasing power of the account and the potential for that account to purchase in the defined time horizon. Variables such as past and expected future sales to the account, growth rate, and financial position of the account would be appropriate. Strength of position variables should assess such matters as the relationship the firm has with the account, and the competitive environment.

Measures of the variables can be obtained using secondary data from our company files, or by surveying our salespeople directly. The advantage of company data, of course, is that it tends to be more accurate and free from individual salesperson bias. The advantage of surveying our sales personnel is that responses can be directly tabulated to generate overall indices for opportunity, and can be indexed across salespeople to adjust for different scales

of measurement. The indices are not as easy to interpret, however, as the raw data from the salesperson survey.

Determining the actual segments requires that each index be divided into high and low categories. Once the indices have been calculated and the category break points have been assigned, each account can be categorized into one of the four categories. Summary statistics by category, such as average sales, number of sales calls and sales per call can be generated. These results can be analyzed in comparison with category strategies felt appropriate by management.

Several types of analyses can be performed. Each individual account can be analyzed based on the portfolio results to get a better understanding of its value to the selling firm. The number of accounts in each segment can be analyzed to assess the performance of the salesperson. For example, too many accounts in segment 3 and too few accounts in segment 2 might require counseling about seeking new prospects for future growth. Summary statistics such as average sales calls and sales by segment can be analyzed to evaluate the appropriateness of sales call allocation by the salesperson. Finally, at the district or management level, managers can evaluate appropriateness of territory allocation by considering the categorization of accounts across territories.

The Sales Plan Model

The Sales Plan portfolio analysis model is available from the http://marketing.byu.edu web site as an Excel worksheet and includes data to analyze the sales accounts of SaltFlats, Inc., a salt producing company of modest size. In the paragraphs below we discuss the SaltFlats situation, but have simplified it by using only 20 accounts from each of two salespeople.

Three files are used to analyze SaltFlats' sales call performance (STEMP1.XLS, STEMP2.XLS, and SALESPLN.XLS). Only the SALESPLAN.XLS is accessed directly, however. The other two are data files for salespersons #1 and #2,

respectively, and are accessed through a normal menu command within the SALESPLN.XLS file. (These two files can be used as templates for developing additional salesperson data files, if you wish.)

SALESPLN.XLS is the file containing summary statistics from the individual files as well as global averages across the salespeople, which are needed to categorize the individual accounts into their respective segments.

It is possible to categorize the accounts into segments based on sales averages within the sales territory. However, doing this would preclude any analysis of differences across territories. Including the global averages file allows the database to be three-dimensional. The first two dimensions can be presented on the screen in a spreadsheet format. The third dimension is created by accessing the global file which contains information across the individual salesperson files. Thus, the global file is dependent upon the two individual salesperson files. In turn, when performing sales allocations, each individual file must have a copy of the global averages, so they are dependent upon the global file as well.

Throughout our analysis of the sales accounts for SaltFlats, keep in mind that they have segmented their sales accounts into the segments discussed above. These segments are called "grids" in the model, as indicated in Figure 7-1.

Running the Worksheet Model. Load Excel, with a backup of the worksheet files on your hard drive. When Excel appears on your computer screen, continue with the commands to Open the File SALESPLN.XLS

The Sales Plan model will be loaded into your computer, and will display its main command in a pop-up menu box:

SUMMARY
GRID

IMPORT
RETREIVE
UPDATE
PRINT
QUIT

The commands are invoked by selecting the desired option with the mouse button and then clicking on OK. For example, if you wanted to enter see summary statistics as a percent of all Grids (segments), you would highlight "SUMMARY" and press the OK button. Once you press a menu function a secondary menu appears or the selected feature is initiated. You can initiate another command function by simply selecting another option from the command menu.

Unlike the other models, the "sample" data in the Sales Plan worksheet is not intended to be replaced with new user data. Instead, the data already within the model is permits an analysis of the sales planning appropriate for SaltFlats, Inc. But as with the other models, each function in the command menu invokes a predefined macro sequence which performs a series of operations. Below we briefly discuss each function. Then we will "walk through" an analysis of SaltFlats' sales performance to diagnose areas which need improvement.

SUMMARY

Invoking "SUMMARY" displays summary statistics for all four grids (segments). This is also the default screen when the worksheet is first loaded. The

percentage distribution of accounts, sales calls, and total sales is displayed, across Grid segments. See Figure 7-2.

FIGURE 7-2

SALESPLN: SUMMARY SCREEN

	A	B	C	D	E	F	G	H
1								
2				SALES GRID - SALES CALL COVERAGE				
3								

4	SLSPERSON	CALLS	SALES	OP1	OP2	OP3
5						
6	COUNT	1	20	20	20	20	20
7	SUM	1	253	380182	894500	51200	61
8	SUM OF SQUARES	1	11661	3.5E+10	2.2E+11	4.9E+08	189
9							
10	COUNT	2	20	20	20	20	20
11	SUM	2	100	104109	163543	15110	49
12	SUM OF SQUARES	2	1268	2.7E+09	4.8E+09	17723224	133
13							
14	COUNT	ALL	40	40	40	40	40
15	SUM	ALL	353	484291	1058043	66310	110
16	SUM OF SQUARES	ALL	12929	3.8E+10	2.3E+11	5.1E+08	322
17							
18	AVERAGE		8.825	12107.27	26451.07	1657.75	2.75
19	STANDARD DEVIATION		15.66347	28365.39	71003.98	3171.091	0.698212
20	SPREADSHEET DEVELOPED BY DR. CLIFFORD YOUNG, OKLAHOMA STATE UNIVERSITY						

GRID

Choosing the "GRID" command displays the original, unsummarized, data behind the information in the "SUMMARY" screen. See Figure 7-3.

FIGURE 7-3

PORTFOLIO SUMMARY STATISTICS FOR ALL SALESPEOPLE

A	B	C	D	E	F	G	H
47							
48							
49	GRID SUMMARY STATISTICS FOR ALL SALESPEOPLE						
50			GRID	GRID	GRID	GRID	TOTAL
51	GRID		1	2	3	4	
52	COUNT		12	6	14	8	40
53	TOTAL SALES CALLS		222	49	48	34	353
54	TOTAL SALES		297357	135212	31491	20231	484291
55	AVERAGE SALES CALLS		18.5	8.16	3.43	4.25	8.825
56	AVERAGE SALES		24779.75	22535.33	2249.36	2528.86	12107.27
57	TOTAL REC. CALLS		144	60	84	48	256
58							
59							
60	STATISTICS AS A PERCENT OF ALL GRIDS						
61							
62			GRID 1	GRID 2	GRID 3	GRID 4	
63	ACCOUNTS		30.00	15.00	35.00	20.00	
64	CALLS		62.89	13.88	13.60	9.63	
65	TOTAL SALES		61.40	27.92	6.50	4.18	
66							

IMPORT

Invoking "IMPORT" updates the overall summary statistics portion of this file by merging the individual salesperson files (STEMP1 and STEMP2). This command, and "UPDATE" are only necessary if you have modified the salesperson files (through the "RETRIEVE" command, discussed below).

RETRIEVE

"RETRIEVE" accesses the individual salesperson files. After invoking this command, you will be given a choice of which file you wish to load. To stay in the SALESPLN model, choose either STEMP1 or STEMP2. Doing so will load and display performance data for either salesperson #1 or #2, respectively, and will display a new screen and a secondary command menu. If you choose STEMP1, the screen will appear as shown in Figure 7-4. The first two columns are just the account number and an arbitrary account name. The next two columns contain total account sales and number of sales calls made during the past year.

The next six columns (use the "QUIT" function to examine those beyond the right edge of the screen) contain data used in calculating the opportunity and strength scores. OP1 is the normal (dollar) demand for salt from the account. OP2 is the account's normal salt inventory. OP3 is an expected growth value for the account (on a 1 to 5 scale, where 5 indicates high growth expectations).

ST1 is a strength measure calculated as 4, less the number of firms selling salt to the account. That is, an ST1 value of 3 indicates that SaltFlats is the sole salt supplier

to the account. ST2 is SaltFlats' market share (percent) with the account, and ST3 is the number of years SaltFlats has dealt with the account. SERVIC represents the level of service required by the account (on a 1 to 10 scale, where 10 indicates high service needs).

OPP and STR are opportunity and strength indices for the account, and GRID indicates the grid segment to which the account has been assigned on the basis of these indices. OPP is calculated as a standard score (a Z-score, having a mean of 0 and a standard deviation of 1) of OP1, OP2, and OP3. Similarly, STR is a standard score of ST1, ST2, and ST3.

ATT is the account's attractiveness, calculated as a slightly modified product of OPP and STR. REC.CALL is the recommended call level, which is calculated as a function of ATT, the GRID, and management judgment about the number of calls appropriate for the account (which is entered manually into the "RECOMMENDED CALLS" row in the "VIEW" screen.

FIGURE 7-4

PORTFOLIO SUMMARY STATISTICS FOR SALESPERSON #1

	A	B	C	D	E	F	G	H
1			SALESPERSON #1 DATA FILE					
2			TYPE ALT[M] TO RE-ENTER MENU					
3								
4	ACCT#	CLIENT NAM	CALLS	SALES	OP1	OP2	OP3	ST1
5	18725	AAJ	96	144687	350000	20000	4	1
6	32530	AAT	35	29992	30000	3000	3	3
7	28414	AAM	24	111341	300000	5000	3	1
8	18676	AAI	10	6278	100000	6000	3	2
9	12795	AAF	10	12801	12000	2000	3	3
10	90	AAE	6	24949	25000	1000	3	3
11	31475	AAN	6	3873	5000	1000	3	2
12	25297	AAL	6	2722	6000	1000	4	3
13	31575	AAO	6	8375	8000	1500	3	3
14	32150	AAR	6	2285	6000	1000	3	2
15	31625	AAP	6	5586	6000	1500	3	2
16	223	AAB	6	1475	3000	200	3	3
17	2350	AAC	6	429	2000	500	2	3
18	32466	AAS	6	8737	10000	1500	3	2
19	14670	AAG	6	834	1000	350	3	3
20	32050	AAQ	6	1459	2000	500	3	3

The secondary command menu has these options:

DBASE VIEW IMPORT PRINT RETURN QUIT

Choosing "DBASE" switches to yet another menu:

SORT EDIT MAIN

"SORT" permits you to sort the salesperson data, choosing any of several sorting variables. On choosing this option, the worksheet will automatically set up the data range, then will present you with the 1-2-3 Data Sort menu:

Data-Range Primary-Key Secondary-Key Reset Go Quit

At this point, you typically will want to select "Primary-Key" then, using the cursor movement keys, move the cursor to the column on which you wish to sort. For example, if you wanted the accounts sorted by sales levels, you would move the cursor to column C (anywhere in the column will do) and hit <ENTER>. Next you will be prompted to indicated whether you want the sort A (for ascending in value) or D (for descending in value). If you want descending order, just hit <ENTER>. Finally, select "GO", and the sort will be executed.

After the sort, invoke the SALESPLN command menu by selecting "Quit" (from the Data-Sort menu) and typing <ALT>-<M> simultaneously.

"EDIT" is essentially a "quit" command, which allows you to change or update any of the salesperson data. After editing, you may reinvoke the SALESPLN command menu as above by simultaneously typing <ALT>-<M>.

"MAIN" returns you to the previous command menu.

"VIEW" lets you look at the salesperson's summary statistics, similar to that which you examined in the "GRID" selection, discussed above.

"IMPORT" merges the global averages (from the SALESPLN file) into this salesperson's data base.

"PRINT" prints the salesperson data base. Be sure your printer is turned on and is on-line before invoking this function.

"RETURN" saves the salesperson database and returns you to the SALESPLN worksheet. From there, you can select another salesperson database, or perform other functions.

"QUIT" exits you from the command menu and returns you to the 1-2-3 ready mode, where you can explore the macros. Again, you can re-enter the SALESPLN menu at any time by typing <ALT>-<M>.

UPDATE

Invoking "UPDATE" updates the grid summary statistics portion of this file by merging the individual salesperson files.

PRINT

This command prints the summary statistics, as in Figure 7-5. Be sure your printer is on, and on-line before invoking this function.

QUIT

"QUIT" exits from the command menu and permits you to explore the model and its macros. Once again, you can re-enter the SALESPLN model by simultaneously typing <ALT>-<M>.

FIGURE 7-5

SALESPLAN: OUTPUT

SALES GRID - SALES CALL COVERAGE

SLSPERSON		CALLS	SALES	OP1	OP2	OP3
COUNT	1	20	20	20	20	20
SUM	1	253	380182	894500	51200	61
SUM OF SQUARES	1	11661	3.5E+10	2.2E+11	4.9E+08	189
COUNT	2	20	20	20	20	20
SUM	2	100	104109	163543	15110	49
SUM OF SQUARES	2	1268	2.7E+09	4.8E+09	17723224	133
COUNT	ALL	40	40	40	40	40

SUM	ALL	353	484291	1058043	66310	110
SUM OF SQUARES	ALL	12929	3.8E+10	2.3E+11	5.1E+08	322
AVERAGE		8.825	12107.27	26451.07	1657.75	2.75
STANDARD DEVIATION		15.66347	28365.39	71003.98	3171.091	0.698212

ST1	ST2	ST3	SERVICE	OPP	STR
20	20	20	20	-0.494	-1.364
50	1595	222	98	20.670	3.522
134	146225	4102	514		
20	20	20	20	-0.651	-1.469
52	1635	86	115	0.809	0.420
142	150725	524	695		
40	40	40	40		
102	3230	308	213		
276	296950	4626	1209		
2.55	80.75	7.7	5.325	-0.65098	-1.46891
0.630476	30.05307	7.507329	1.367250	20.66967	3.522140

FIGURE 7-5
SALESPLAN: OUTPUT (continued)

SALES GRID Summary Statistics (Date)

GRID SUMMARY STATISTICS FOR SALESPERSON #1

	GRID	GRID	GRID	GRID	TOTAL
GRID	1	2	3	4	
COUNT	2	3	10	5	20
TOTAL SALES CALLS	41	130	54	28	253
TOTAL SALES	32714	262306	64218	20944	380182
AVERAGE SALES CALLS	20.50	43.33	5.40	5.60	12.65
AVERAGE SALES	16357	87435.33	6421.8	4188.8	19009.1
ATTRACTIVENESS TOTALS	12.58	19.41	48.46	15.25	
RECOMMENDED CALL LEVELS	12	10	6	4	
TOTAL REC. CALLS	24	30	60	20	134

GRID SUMMARY STATISTICS FOR SALESPERSON #2

	GRID	GRID	GRID	GRID	TOTAL
GRID	1	2	3	4	
COUNT	2	1	10	7	20
TOTAL SALES CALLS	39	3	30	28	100
TOTAL SALES	50077	6800	28476	18756	104109
AVERAGE SALES CALLS	19.50	3.00	3.00	4.00	5.00
AVERAGE SALES	25038.5	6800	2847.6	2679.428	5205.45
ATTRACTIVENESS TOTALS	12.85	2.73	31.16	15.05	
RECOMMENDED CALL LEVELS	12	10	6	4	
TOTAL REC. CALLS	24	10	60	28	122

GRID SUMMARY STATISTICS FOR ALL SALESPEOPLE

	GRID	GRID	GRID	GRID	TOTAL
GRID	1	2	3	4	
COUNT	4	4	20	12	40
TOTAL SALES CALLS	80	133	84	56	353

TOTAL SALES	82791	269106	92694	39700	484291
AVERAGE SALES CALLS	20	33.25	4.2	4.666666	8.825
AVERAGE SALES	20697.75	67276.5	4634.7	3308.333	12107.27
TOTAL REC. CALLS	48	40	120		

Conclusion

In this chapter we have reviewed sales planning models. Sales planning models can include those to help the sales force in goal setting, to establish an optimum sales force size, and to allocate sales force effort. We have focused on the latter, with the Sales Plan model. Too, sales planning could be helped with models which deal with organizational aspects of personal selling: recruitment and selection of sales people, the span of control of sales offices, compensation schemes, assignment of sales people to customers/territories, sales control, training, etc.

CHAPTER 8

DISTRIBUTION AND PRODUCTION MODELS

INTRODUCTION

Although distribution and production models are used in different contexts, they often use similar modeling approaches. Both represent allocation problems. With distribution models, the problem typically deals with allocation to territories, sales outlets, and segments. With production models, the allocation deals with products, machines, and time. This short chapter deals with both areas and with the presentation of an EOQ worksheet model

Physical distribution is one of the key marketing strategy variables. Distribution decisions involve determining the most effective way of placing a firm's products and services within reach of target customers. They encompass not only the actual physical distribution of the product, but also salesperson efforts to provide information and product support.

Decisions about physical distribution are both frustrating and intriguing because of conflicts between economic control and control of channel power. Naturally, firms want to minimize their distribution costs (economic criterion). But they also want to maximize their power over their market, including controlling what dealers charge for their product, and how they sell, inventory, display, and service it (power criterion).

Distribution decisions thus require a careful balance between the pitfalls of spending too little and spending too much. With too little spending, firms will lose control over how intermediaries treat their products; with too much, they will lose control over their costs and profits.

Formulating a good distribution strategy can be an interesting and challenging task, requiring careful attention to many details. Hutt and Speh suggested that the formulation of distribution strategy be approached in several steps, which are fundamental to the identification of a distribution system that gets products to the desired markets. Most of these steps are adaptable to quantitative modeling, yet little modeling has been done on them. They are:

1. *Analyze the Distribution Channel Objectives*

Distribution channel objectives must be coordinated with the overall corporate mission, and objectives, and with the marketing plan.

2. *Analyze Market and Channel Attributes*

The appeal of a market can be evaluated looking at several dimensions that define the competitive environment. This is an area rich in modeling opportunities. Dimensions, which could be included in a model, include:

a. Market Dimensions, including

- Market size, growth rate, diversity of segments within the market, size of the firm;
- Stage in the product life cycle;
- Sensitivity of market segments to promotion, price, product and/or service availability;
- Demand pattern for the product: replacement rates, time of consumption, and search time; and
- Bargaining power of manufacturers and retailers.

b. Competitive Dimensions, including

- Variety of competition;
- Strength of competition;
- History of competitive failure, success, and growth; and
- Technological and integrative growth.

c. Economic Dimensions, including

- Capacity utilization;
- Economies of scale and experience in production;
- Barriers to entry and/or exit;
- Size of the average order;
- Purchase frequency; and
- Gross profit margin.

d. Technological Dimensions, including

- -Degree of standardization;
- -Complexity of the distributor/manufacturer technology;
- -Technical service complexity;
- -Stability of technological change; and
- -Type and depth of technical skills required.

e. Legal-Political Dimensions, including

- Laws and Regulations; and
- Government, union, and special interest group positions and trends.

3. *Specify Channel Goals*

Channel goals must be specified to identify the specific activities that are to be performed by the prospective channel. A modeling effort that includes measured or managerial judgment of the effectiveness of various channels in meeting company goals could facilitate this step.

4. *Specify Channel Structure Alternatives*

Channel structure strategy must also be specified. Channel structure refers to the number of intermediaries that may operate within the distribution channel, moving goods from the manufacturer to the purchaser. Channel structure strategy involves specification of the number of different channels to use, and the number and type of intermediaries to use in each of the different channels. This is an area highly adaptable to an optimization modeling procedure.

5. Ev*aluate Channels and Make a Selection:*

Finally, the selection of a channel structure strategy is made by carefully synthesizing thee components of the strategic planning process:

a. The evaluation of the competitive environment,

b. The evaluation of company strengths and weaknesses, and

c. The evaluation of channel structure alternatives.

While firms undoubtedly use informal evaluation procedures for these areas, these structural aspects of a distribution strategy could readily be incorporated in a formal evaluation and determination model.

LOGISTICAL DISTRIBUTION MODELS

One key area in distribution modeling is distribution logistics -- that is, (1) the selection of the market, (2) the identification of the optimal number of outlets, and (3) the selection of site locations for the outlets. Logistical models for physical distribution provide managers with assistance in these three major areas. Because each area influences the efficiency of the distribution channel, they are discussed below.

Market Selection

Market selection is the process of choosing markets most appropriate for products, and is most often based on a simple estimate of market potential. Sometimes the market potential is determined for the total market and sometimes for geographic sub-markets (territories) within the total market. Many measures of market potential are found in the literature, including those of competitive structure, profit potential, net present value, and market opportunity.

Estimates of the *total market potential* are often calculated using "market breakdown" methods, in which the total market is broken into its component parts. Fundamentally, examining the average purchase quantity per buyer and the number of buyers does this. This relationship is usually expressed as:

Dollar Sales = N X P X Q

where:

N = Number of buyers in the market

P = Price of an average unit
Q = Average quantity purchased per buyer

The difficulty in estimating total market potential lies in making an estimate of N -- the total number of buyers in the market. A different formulation sidesteps this problem, but decreases the accuracy of the estimate:
Dollar Sales = N' X P' X Q'
where:
N' =Population of the market (buyers and non-buyers)
P' = Price of an average unit
Q' = Average purchase per member of the population
This formulation is not sensitive to variations in the number of buyers or to variations in purchase quantities within purchaser/ non-purchaser segments, or other segments of the total market.
Instead of using these market breakdown methods, more precise estimates of market potential can be made by using the "market-buildup" method. This approach estimates sales potential for each targeted territory within the total market. The potential for targeted territories is then summed to produce an estimate of sales potential for the total market.
While the above method is most useful for consumer markets, for industrial markets market buildup methods may be applied by using geographic market information reported by Standard Industrial Classification (SIC) codes. One application of the market buildup method uses SIC codes to estimate market potential within a given geographic area.
IPR, a Boston based company, currently provides country specific estimates of worldwide computer and software sales for companies like IBM, Microsoft and Compaq. IPR's economists model the process using both break-down and build-up approaches to reach a common market estimate. The differences between the two approaches are reconciled to obtain what is believed to be a more accurate estimate.
Closely related to the market-buildup method is the market indexing method employed in *Sales and Marketing Management* magazine's

"Survey of Buying Power". The survey of buying power estimates the relative buying power of a total area by weighting characteristics of consumer markets. While the "Survey of Buying Power" reports an expected buying power for each metropolitan region in the United States, it also encourages firms to develop customized indices for their particular products. Thus a firm marketing Digital Cameras might use multiple regression analysis to develop an index such as,

$BP = .5Y_1 + .3R_1 + .2P_1$

where:

BP = Percentage of national buying power
Y_1 = Percentage of national population in area 1
R_1 = Percentage of effective buying income in area 1
P_1 = Percentage of national retail sales from area 1

For example, if San Diego has 0.86 percent of the population in the United States, 0.94 percent of the nation's income, and 1.20 percent of the nation's retail sales, San Diego would have a Digital Camera buying-power index of:

BP = .5*.86 + .3*.94 + .2*1.2 = .952

This indicates that 0.952 percent of Digital Camera sales in the United States might be expected to come from San Diego. The "Survey of Buying Power" employs a multiple-factor indexing system that is based on three independent variables. Multiple factor indexing systems are predictive formulas developed as additive linear model using multiple regression analysis. In this case, the weights used in the buying power index are simply the regression coefficients previously determined to predict buying power.

Number of Outlets

Once the potential of markets is determined, the number and location of wholesale and retail outlets to be used in the channel must be considered. But this consideration is only relevant when changing the number of outlets will make a difference to the firm. Hartung and Fisher and Lilien and Rao have shown that differential advantage of adding an outlet is not

linear with the number of outlets. Like many relationships in marketing, the relationship between the number of outlets and market share is S-shaped. Hartung and Fisher modeled purchases as though a single customer made them. Their model focused on the notion that a buyer could either "purchase our brand" or "purchase another brand". For example, using their model to assist in strategy development for Shinex (our spray-on floor wax), would result in the following market share prediction:

$$\text{Mkt Share} = \frac{P(Sx|\text{Not } Sx) * \text{Outlet Shr}}{(1-\text{Outlet Shr}) + (1 + P(Sx|\text{Not } Sx) - P(Sx|Sx)) * \text{Outlet Shr}}$$

where

Sx represents the brand, Shinex
P(Sx|Not Sx) = The probability that the customer purchased Shinex this time period, but did not purchase Shinex last time period
P(Sx|Sx) = The probability that the customer purchased Shinex both this time period and last time period
Outlet Shr = The outlet share

Hartung and Fisher have reported that the constants which estimate purchase probabilities in a linear model sense (P(Sx|Not Sx) and P(Sx|Sx)) are 4.44 and .64, respectively, across products they have studied. When these constants are multiplied by the outlet share and input to the formula $(1 + C_2 - C_1)$, an index number is produced to show if more outlets should be added.

That the relationship between the number of outlets and market share is non-linear, this suggests that market efficiencies exist. But the main problem of determining an optimum number of outlets is still not solved. This problem is a classification issue that is solved by a statistical technique called cluster analysis.

The classification problem of determining how many outlets should serve a market has a variety of solutions. But at present we lack a way to optimize any of these solutions. That is, we can not be confident that the recommended number of outlets (or number of clusters of customers around a specified number of outlets) is in reality the best number.

The two conflicting objectives of classification analysis are (1) determine locations that are maximally distinct from one another, or (2) to determine locations which concentrate on customers that are maximally similar. Defining the problem in this way can result in the curious conclusion that different numbers of outlets may be equally satisfactory. However, we know that the most correct solution requires determining which solution is most appropriate for a specific problem. The best number of locations depends on a combination of market, economic, competitive, technical and legal-political factors.

Optimal Site Location

Once the product's market potential and the appropriate *number* of outlets for it have been determined, the next step is selecting the locations for prospective outlets. This, too, can be modeled. Model builders find it a struggle, however, to keep good location models simple. Let us consider some of the simple classical models.

Huff created a model in 1962 that is regarded as the starting point of modern work. But this model was quite limited in its assumptions about patronage motives. It predicted patronage to be a function of two factors: the size of the outlet and the "economic distance" of competing outlets for the customer. This undoubtedly oversimplifies the issues. It ignores a range of patronage motives, including store attributes (image, reputation, product assortment, price, etc.), and customer characteristics (demographic, life style, and socioeconomic variables). However, we will first consider the Huff model and then a more current model explaining retail patronage.

The Huff model is based on the assumption that the probability of a consumer using a given outlet or site is equal to that site's share of the consumer's total utility (the sum of the utilities for using each of the possible sites). The model can be expressed in terms of the attractiveness of a retail outlet at location *j* for a consumer located in market area *i*. The attractiveness of a site is directly proportional to the size of the retail

center and inversely proportional to the customer's distance from the center. That is,

$$P(C_{ij}) = \frac{S_j / T_{ij}^{\lambda}}{\sum_{j=1}^{n} S_j / T_{ij}^{\lambda}}$$

where

$P(C)_{ij}$ = The probability that a customer in market area i chooses to shop at retail location j,
S_j = The size of the retail outlet at location j,
T_{ij} = The distance between customer market location i and retail center j,
λ = A parameter representing the sensitivity of distance and types of purchase need. λ is developed using the formula:
E_{ij}, the expected number of customers originating from market area i and shopping in retail center j, is $P(C)_{ij}$ x (λ)(C_i), where C_i is the total number of customers located in market area i, and
n_i = The set of retail locations for a customer located in area i.

The Huff model was developed to represent geographic areas within the Midwestern United States, where cities are geographically separate, with distance between them. More modern applications of this model have been directed at refining customer motivation variables and incorporating them into the model.

One such model suggests that most site location solutions are inadequate because they focus on cost minimization rather than long run profit maximization. This model, called the Beaumont, is summarized in the technical appendix at the end of this chapter. Its solution to the location problem has two important benefits. First, it uses Euclidean distance measures to represent cost structures.

Second, it parameterizes some qualitative consumer evaluations that influence demand. The most important limitation of this model is the coarseness of the consumer evaluation variable. As noted by Gautchi,

there is a variety of consumer motivators which must be included to improve the predictive validity of models.

INVENTORY MANAGEMENT DISTRIBUTION MODELS

A second major area for distribution modeling is inventory management, naturally also important in production modeling. The management of physical inventory revolves around meeting some management-approved level of customer service, while minimizing inventory cost. Once again, conflicts occur between economic criteria and other criteria.

Economic order quantity (EOQ) formulas exist to determine ordering practices that minimize the overall cost of inventory. The problem in balancing inventory costs and service levels focuses on the difficulty of predicting demand and avoiding an out-of-stock condition. A stockout results in immediate lost sales and possible long-term decline of the customer base.

EOQ Models

You will find two EQQ models at the web site for this text, a basic (and traditional) EOQ model, and a discrete time period EOQ model.

The traditional EOQ model requires the balancing of ordering costs and carrying costs. Ordering costs include all expenses involved in placing an order. Total order costs increase with the total number of orders. Carrying costs increase with the average level of inventory. Lower levels of inventory result in lower carrying costs, but in higher order costs due to the larger number of orders that must be placed.

A number of formulations for EOQ may be used to minimize the total inventory carrying/ordering cost function. The most basic model is,

$$EOQ = \sqrt{\frac{(2AS)}{i}}$$

Where

a = Ordering cost for an average order
s = Annual Sales in units
i = Carrying cost per unit per year (usually equal to the interest rate)

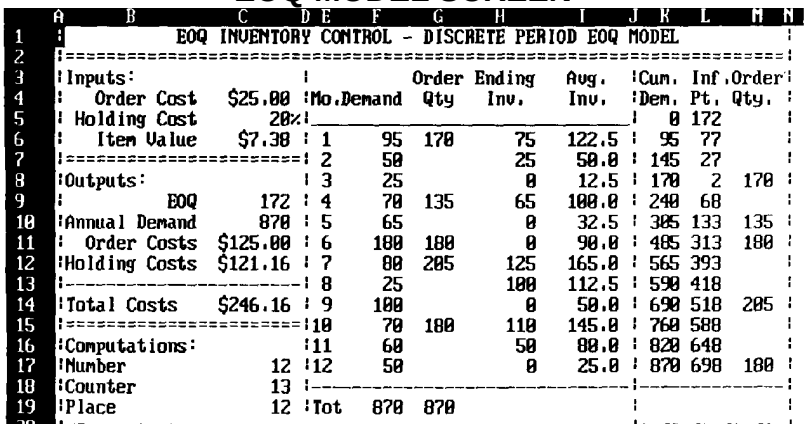
The basic EOQ model may be expanded to include levels of safety stock and base stock. Safety stock is the additional units of inventory that must be stocked to serve peak demand fluctuations, and base stock is the minimum amount of inventory necessary to serve typical demand levels. Let us look at a simple EOQ model that also considers demand over time. The discrete-time-period EOQ model is the second EOQ model found at the web site
http://marketing.byu.edu. This model treats the time periods as discrete opportunities for placing orders. (For a discussion of the Excel macro that drives this model, see the more detailed discussion in the technical appendix at the end of this chapter).

This model adapts the standard EOQ model (for constant demand) to a variable demand situation. It requires the calculation of an optimum EOQ, which is based on an assumption of constant demand, and tracks demand as it accumulates to the point that optimal EOQ is reached. The model then adjusts order size to be as close as possible to the calculated EOQ amount, which is exactly equal to the total amount demanded for several time periods. The discrete time period EOQ model gives a good approximation of the optimal order schedule as long as demand is relatively constant over time.

Figure 6-1 shows a screen appropriate to the above explanation, from the discrete period EOQ 1-2-3 model on the web site. Because the model requires that the quantity ordered be as close to the EOQ amount as possible, 170 units are purchased at the start of month 1, thus providing the beginning inventory that meets the optimal EOQ. As a result of monthly demand of 95, 50, and then 25 units, the 170 units of beginning inventory is depleted in month 3. This process continues as further orders are made in months 4, 6, 7, and 10.

FIGURE 6-1

EOQ MODEL SCREEN



EOQ INVENTORY CONTROL - DISCRETE PERIOD EOQ MODEL

Inputs:		Mo.	Demand	Order Qty	Ending Inv.	Avg. Inv.	Cum. Dem.	Inf. Pt.	Order Qty.
Order Cost	$25.00						0	172	
Holding Cost	20%	1	95	170	75	122.5	95	77	
Item Value	$7.38	2	50		25	50.0	145	27	
Outputs:		3	25		0	12.5	170	2	170
EOQ	172	4	70	135	65	100.0	240	68	
Annual Demand	870	5	65		0	32.5	305	133	135
Order Costs	$125.00	6	100	100	0	90.0	405	313	100
Holding Costs	$121.16	7	80	205	125	165.0	565	393	
		8	25		100	112.5	590	418	
Total Costs	$246.16	9	100		0	50.0	690	518	205
		10	70	100	110	145.0	760	588	
Computations:		11	60		50	80.0	820	648	
Number	12	12	50		0	25.0	870	698	100
Counter	13								
Place	12	Tot	870	870					

Inventory control is a key element in physical distribution. The elements of physical distribution models considered in this chapter bring into consideration the geographic and time related questions relevant in responding to the market. Market evaluation and physical facility evaluation models, as well as inventory models are planning models are planning models critical in adapting to changes in market structure.

Running the EOQ Worksheet Model.

Load Excel, with a backup copy of your template on the hard drive of your computer. When the blank worksheet appears on your computer screen, use the File Open command to open the EOQ file.

After a moment, the EOQ analysis template will load into your computer, and will display the first of its two command menus on the screen:

SIMPLE INPUT EXECUTE PRINT QUIT

These EOQ worksheet commands are invoked by selecting the desired option and clicking on OK. If you wanted to go into the "SIMPLE" EOQ model, you would select "SIMPLE" and that EOQ model sequence would be invoked, with the alternate command menu being displayed. Each command in the command menu sequence invokes a predefined macro sequence that performs a specific set of functions.

The simple EOQ model command menu is:

DISCRETE INPUT EXECUTE PRINT QUIT

Each of the commands included in the primary command menu is discussed below.

SIMPLE

While the default model when the worksheet is first loaded is the discrete time period model, invoking "SIMPLE" switches to the simple EOQ model.

INPUT

Invoking "INPUT" accesses a secondary command menu:

DISCRETE SIMPLE QUIT

Within this secondary menu, invoking "DISCRETE" begins the prompts for entering data for the discrete time period model. You will be prompted to enter the annual unit demand, the order cost (the administrative costs of processing the order), the annual inventory holding or carrying costs (as a percentage of inventory value), and the product's dollar value (total unit costs). The new figures entered here will replace the sample data included in the worksheet. After completing this data entry, you will ordinarily want to "QUIT" to the previous menu.

"SIMPLE" permits you to enter the data for a simple EOQ model. You will be prompted to indicate whether you want the model to make a 1- or a 2-year forecast then, for each year, will be prompted for your estimates of annual product demand, the annual inventory holding or carrying costs (as a percentage of inventory value), the order cost (the administrative costs of processing the order), the product dollar cost (total unit cost of the product, in dollars), the production lead time necessary to fill the order, and the working days in a year. As above, the new figures entered here will replace the sample data included in the worksheet. After completing this data entry you will ordinarily "QUIT" to the previous menu.

EXECUTE

Invoking this command causes the model to process the input data and calculate new output data.

PRINT

For either model, this command will print the output data, as shown in Figures 6-1. (Before running this command, be sure your printer is loaded with paper and is on line.)

QUIT

Choosing "QUIT" from the main command menu exits the main menu of the EOQ model and allows you to explore the worksheet. Type <ALT>M to re-enter the EOQ menu, or /Q to exit Excel. If you have entered data into the model which you wish to save, be certain to save the model first, and be sure to use a file name other than "EOQ" to avoid overwriting the original "EOQ" file).

SUMMARY

The nature of distribution and EOQ models makes them particularly appealing for quantitative model development. Compared with other marketing areas, they are quite easily parameterized and their output, while suffering from some of the same validity questions that plague other models, is easy to interpret.

In this chapter we have reviewed a few popular approaches to modeling economic order quantity. In particular, we have examined both a simple EOQ model and a model over time. While both are useful as conceptual illustrations of determining economic order quantity, they are also potentially useful as freestanding models to do just what they contend to do: to model economic order quantity.

With respect to distribution decisions, we need more complete models, incorporating all aspects of distribution functions, including interactions with other marketing functions. We need models with emphasis on channels decisions (focused on the economic and power criteria discussed early in this chapter), on multi-product distribution decisions, on risk considerations.

Much work has been done in these areas, but much yet remains to be done.

CHAPTER 8 TECHNICAL NOTES

Classifying Data into Groups

Cluster Analysis. Cluster analysis is concerned with the classification, or grouping, of sets of similar items. In the case of our sales force example, our interest is in finding similar groups of accounts. The objective is to group these similar accounts, based on a set of descriptive variables, in such a way that we can understand the accounts better while still maintaining most of the distinctions between the accounts.

Cluster analysis attempts to deal with four distinct problems in determining a clustering solution:

1. How should similarity be measured, and should each measure of similarity be differentially weighted?
2. After inter-account similarities are obtained, how are the clusters to be formed?
3. After the categories are formed, what summary measures are useful in understanding the cluster?
4. Assuming that adequate descriptions of the clusters are obtained, can we draw statistical inferences about cluster differences?

Many alternative similarity measures exist, including distance (Euclidean, city block, or other Minkowski p-metric measure) and matching-type measures. Once a method of measuring similarity of the parts has been selected, the computational routine for clustering the accounts must be chosen. Several families of clustering methods exist, each of which uses a different approach to create groups:

- hierarchical agglomerative
- hierarchical divisive,
- factor analytic, and
- non-hierarchical.

While discussion of the specific algorithms is beyond the scope of this text, a brief discussion will be found in most advanced marketing research or analysis texts. 9

Once clusters are developed, the task of describing the clusters remains. One frequently used measure is the "centroid" (the average value for the accounts in the cluster of each of the variables defining the cluster). If clustering is performed on the original variables, this measure appears quite natural as a summary description.

Despite attempts to construct tests of statistical significance of clusters, current statistical tests are little more than rules of thumb, and are not defensible statistically. The researcher is in the uncomfortable statistical position of "testing" the significance between groups formed on the basis of the data itself.

Despite this limitation, cluster analysis is useful as a systematic procedure for grouping sets of data.

9See for example, J.F. Hair, Jr., R.E. Anderson, and R.L. Tatham, *Multivariate Data Analysis* (New York: Macmillan Publishing Company, 1987) or D.A. Aaker and G.S. Day, *Marketing Research* (New York: John Wiley and Sons, 1983).

Gravity Models

The Huff Model. The gravity model developed by Huff is useful for estimating the size of trading areas. The basic Huff model was developed to estimate probability of purchase, but has been modified to be equally applicable in estimating the number of customers, the available purchase potential (expenditure levels), and shopping frequency.

The mathematical expression for estimating the number of customers appears as a slight modification of the gravitational model discussed in this chapter:

$$E(C_{ij}) = \left[\frac{S_j / T_{ij}^{\lambda}}{\sum_{j=1}^{n} (S_j / T_{ij}^{\lambda})} \right] C_i$$

where

E(Cij) = Expected number of customers for each market area *i* that choose to shop at a particular retail location *j*

C*i* = The number of customers in market area *i*

$S_j / T\lambda_{ij}$ = Product draw coefficient, where

Sj = Square footage of space devoted to the sale of a particular product by retail center *j*

Tij = Distance between customer location *i* and retail center *j*

λ = A weighting parameter that is product and market specific, representing the sensitivity of distance and type of purchase needs.

This model simply adds the term C*i* that converts the probability of purchase to the number of purchases by multiplication by the number of consumers in the *i*th statistical unit.

An estimate of the purchasing potential available is achieved by including a new variable, the annual amount that consumers in the ith market locale spend on product class *k*. This formulation simply multiplies the number of consumers by their yearly expenditure:

$$E(E_{ij}) = \left[\frac{S_j / T_{ij}^{\lambda}}{\sum_{j=1}^{n} (S_j / T_{ij}^{\lambda})} \right] C_i B_{ik}$$

E(Eij) = Expected annual expenditure (sales potential) for retail center *j* and market location i

Bik = Yearly expenditure per customer for market i and product class k

An estimate of the purchase frequency is achieved by including a variable for the average number of times the product class is purchased during a specified time period:

$$E(F_{ijm}) = \left[\frac{S_j / T_{ij}^{\lambda}}{\sum_{j=1}^{n} (S_j / T_{ij}^{\lambda})}\right] C_i F_{im}$$

where

E(Fij,) = Expected number of shopping trips from market location i to retail center j during time period m to purchase the product class

Fim = Average frequency of product class purchase for the customer in market location i during time period m.

Let us consider an example to extend these estimates (of number of customers, purchase potential, and purchase frequency) one step further. In this example we will estimate the total market potential of the Hillsdale Shopping Center (Si) for purchases of French pastries. First, some data about the market:

S1 = 110, 000 square feet, *Tij1, = 2*
S2 = 200, 000 square feet, *Tjj2 = 3*
S3 = 300, 000 square feet, *Tij3 = 4*

We then find

$$E(C_{ij}) = \frac{110,000/2^2}{110,000/2^2 + 200,000/3^2 + 300,000/4^2} = \frac{2,750}{6,847} \simeq .40$$

Thus we see that there is a 40 percent probability that customers from market area 1 will travel to Hillsdale Shopping Center to buy French pastries.

If there are 2,000 households in market area i and they purchase an average of $8.00 in pastries each of the four times per month that they shop for them, then the expected frequency of shopping trips that are generated in a given month is 3,200:

E(FjjM) = (.40)(2,000)(4) = 3, 200

where

Ci = 2,000
S, =4

When the model is extended to estimate the expected average amount that customers would purchase in a month, we see that:

E(Dijm) = (.40)(2,000)(4)($8) = $40, 000

where

E(Dijm) = The expected dollar sales made at Hillside Shopping Center for an average month from customers residing in area *i*,

AV = $8 = Average customer sales per purchase.

The Beaumont Model. In a relatively complex equation, a truly optimal location would be one that maximizes market share by maximizing the demand of outlet location i given supply location j. Thus, the model seeks

$$\max_{x_j,\ y_j} \sum_{i=1}^{n} O_i \frac{A_j e^{-\beta c_{ij}}}{\sum_{j=1}^{m} A_j e^{-\beta c_{ij}}}$$

where

n = Number of customers demanding the product from location i
m = Number of competing suppliers at location *j*
xj, yj = Locational coordinates of the new location
Oi = Quantity demanded at location (xi, y)
Aj = Exponential transform of the mean utility at facility *j*
B = Elasticity parameter characterizing the trade-off between transportation costs (customer cost to access the goods), and qualitative non-transportation influences (customer evaluation of different supply locations and goods),
cij = Cost between demand point i and supply point *j (cij is* defined as a Euclidean distance)

EOQ Models

Basic EOQ Models. The basic EOQ model attempts to minimize the total inventory carrying/ordering cost relationship by the formula,

$$EOQ = \sqrt{\frac{2AS}{i}}$$

where

A = Ordering cost for an average order
S = Annual sales in units
i = Inventory carrying cost per year

For example, consider the following situation:

S = 100 units/year
A= *$10* i = 0.20 (20 percent of inventory value)
Safety stock = 20 units
Base stock = 30 units

Then,

$$EOQ = \sqrt{\frac{2(10)(100)}{0.2}} = 100 \text{units}$$

The basic EOQ model identifies the optimal purchase size, but does not identify the time period in which the order should take place, nor the amount to be ordered based on demand fluctuations.

The discrete-time-period model treats time periods as discrete opportunities for placing orders and permits the scheduling of order quantities and times based on anticipated demand schedule and the economic order quantity. The discrete-time-period model matches the EOQ amount as closely as possible, given the discrete demand amounts of the time periods.

EOQ Worksheet Macro. The EOQ worksheet macro controls program execution using two ranges that are designated as counters (counter and place), four range names (start, day, value, there), and six macro branching locations (loop, loop4, loop3, where, out, quit).

The model assumes that we start with a quantity as near the EOQ of merchandise as the sum of successive discrete time periods of demand will allow, without exceeding the EOQ. The model begins a loop that sequentially examines the difference between the EOQ and cumulative demand. When the ending inventory becomes negative, the model backs up to the first period after the previous zero stock condition, and recommends an order quantity. The order amount is the sum of the discrete time period demand since the last order was placed (when ending inventory was equal to zero). This process continues until merchandise is ordered for the 12 discrete time periods considered in the model.

CHAPTER 9

ADVERTISING MODELS

Introduction

This chapter examines two advertising models, each of which addresses a critical area of advertising decision-making. The first is conceptually similar to a model developed by John D. C. Little, and his colleague Leonard Lodish; it is called MEDIAC (Media Evaluation using Dynamic and Interactive Applications of Computers). MEDIAC is a linear programming model which helps management overcome the ordinarily enormous task of developing an optimum media schedule. The second model is ADBUDG (an Advertising Budgeting model), a decision calculus model developed by Little that provides intriguing guidance toward setting appropriate advertising budgets.

Contributions like these to advertising decision making should be welcomed, since expenditures for advertising are staggering. Annual U.S. spending for advertising is well over 100 billion dollars. But despite such huge expenditures, the potential contributions of management and behavioral science are just beginning to be tapped. It is safe to say that in no other field of business do so few people with so little knowledge spend so much money.

Advertising is an area filled with ironies and contrasts. It has the troublesome habit of posing questions whose answers serve only to revise the question, or of requiring solutions before the problem has even been articulated. This is so despite the fact that it has been a focus of intense study for at least 50 years. In harmony with the approach of other chapters, in this chapter we will first review this context in which ADBUDG and MEDIAC must function and the challenges which they might be able to overcome. Then each model will be briefly discussed.

Advertising Objectives

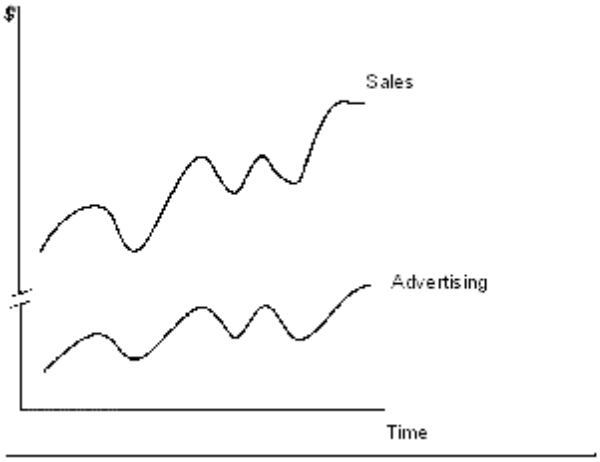
Advertising is expected to stimulate sales, increase profits, or otherwise help attain company goals. While this is clear to everyone, no one yet knows just how advertising works to accomplish these things. Let us consider a simple proposition that advertising works directly on sales (or other company goal). That is,

Sales = *f* (advertising)

This relationship could be modified to include logarithmic functions or lagged time effects for advertising, or other sophistications, but the relationship would still be a fundamental one. We would all like to believe in that kind of simplicity. For example, suppose we were shown a relationship between advertising and sales like that in Figure 9-1. We might look at their close relationship and conclude that advertising is doing just what it is supposed to -- causing sales. Or we might suspiciously wonder if the advertising levels are being set (as they often are) as a percentage of sales. Or perhaps we'll suggest that a relationship this close would be found only with direct marketing, in which the sales can only come from the direct-mail advertising and sales.

FIGURE 9-1

Traditional Expectations for Advertising-Sales Relationship



In fact, the first explanation is the least likely one for the simple reason that many variables other than advertising affect sales. That is,

Sales = f(advertising, pricing, distribution, the product, and other controllable variables; and competition, legislation, demand, the economy, and other uncontrollable variables)

This is a cumbersome set of concepts to model quantitatively, which have typically made the simpler assumption that advertising affects sales directly. But this has received a good deal of attention from behavioral scientists. Indeed, for more than 70 years advertisers have believed that the key effect of advertising is not on sales directly, but on factors that mediate or cause sales.

In the 1920s this idea was expressed as the "AIDA" model, which proposed that advertising first influenced an audience's Attention, then its Interest, then its Desire, and finally Action would follow. The AIDA model has been refined and modified in the intervening 60 years, including new forms of it which explain advertising effects when the audience is not involved with the product. But the fundamental premise of mediating effects is still accepted.

This modeling approach has been called a "hierarchy of effects"; each step is believed to be a necessary but insufficient condition for the succeeding step. Advertising was not perceived as having a direct influence on sales, but on factors that mediate sales.

It was natural for someone to suggest that advertisers should look directly to sales as a measure of advertising effectiveness. They should measure its effects on the mediating factors. This was tackled a 1961 report to the Association of National Advertisers, "Defining Advertising Goals for Measured Advertising Results" (DAGMAR). The DAGMAR report suggested a precise method for selecting and quantifying advertising goals. Most important, it proposed that

advertisers should collect feedback measures to determine if their advertising met those goals.

This was not a well-received suggestion. DAGMAR was in conflict over sales-oriented measurement approaches, for it made a careful distinction between sales goals and advertising goals, but it lit a controversy in the advertising community that still smolders. Among the popular recommendations which have followed from it, however, has been the concept of the "advertising decision sequence," which provides a framework for the rest of this chapter.

The Advertising Decision Sequence

As the term "advertising decision sequence" suggests, well-informed advertising decisions will usually result from a sequence of activities. Although the sequence has many variants, a popular one is illustrated in Figure 9-2.

FIGURE 9-2

ADVERTISING DECISION SEQUENCE

Before any advertising money is spent, some important homework must be completed. And even after the advertising has been placed, the advertiser's work is not through. Let's look briefly at each step to consider the model-building efforts there.

Situation Analysis

The question to be answered during the situation analysis stage is, "What should we communicate?" This is a paramount data collection, assimilation, and

correlation stage that has few of the boundaries desirable for model building. However, many firms are now using mainframe and personal computer database-management-systems to more efficiently serve the recurrent needs for data collected during the situation analysis stage.

In this step the parameters of the communication problem are examined, the problems faced by the advertiser are discovered, and likely approaches to solve them are identified. For example, suppose our client were "Instatune" -- a regional chain of quick car tune-up centers. Sales have been slipping recently and the client has asked for an advertising campaign to reverse the decline.

A preliminary situation analysis might reveal that the service departments of a number of automobile dealerships have added their own "fast tune-up" bays, bleeding off Instatune customers. The data suggest several possible solutions: increase the promotional budget, with no strategy change; temporarily reduce prices; add new services not now offered by the dealerships; or, a reposition the "product" offered by Instatune. We might conclude that the latter holds the most promise -- reposition the product offered by Instatune as an Engine Maintenance Agreement (EMA).

Setting Advertising Objectives.

While measurement of mediating factors might make more sense than measuring sales, there is plenty of evidence to suggest that advertising has a measurable impact on sales. A large body of research has used distributed lag models of advertising effect to show the short- and long-term effects of advertising on sales.

Advertising objectives most often are defined as sales objectives, but often also include others, such as audience awareness, beliefs and understanding, attitudes, purchase intentions, etc. These objectives are best set following research which establishes the "baseline" (pre-campaign) levels.

Traditionally, copy-testing services such as Starch, Gallup, Robinson, Burke Research, and others have focused on the power of an ad to generate *awareness*. In recent years, more attention has been given to the generation of *beliefs*, however.

For example, research for Instatune may lead to any or all of the following baselines and objectives whereby the objectives of an advertising campaign are clear, and its effectiveness can be clearly measured.

	Baselines	Objectives
Awareness of Instatune	53%	70%
Belief that Instatune ...		
does excellent work	35	40
does tuneups fast	38	40
protects your engine	30	55
offers an EMA	0	20
is reasonably priced	31	35
has friendly service	38	40
Preference for Instatune over competitors	22	30
Purchase intentions for Instatune	14	20
Revenues for Instatune	$5M	$6M

Message Strategy.

Message strategy is the most creative aspect of advertising. This is the creative execution, answering the questions, "What shall we say?" and "How shall we say it?" Decisions about the type of appeals (puffery or refutational, comparative or non-comparative, etc.) are made here, as well as actual copy content and format. Because of the qualitative nature of this area, quantitative modeling has

contributed little. However, the impact of management science is felt in providing input to and in evaluating advertising's creative quality and impact.

In recent years a number of widely used behavioral approaches and analytical techniques have stimulated better creative strategy by providing new ways to look at customers and their reactions to products and advertising. Among them are muliti-attribute attitude modeling, multidimensional scaling, and conjoint analysis. A number of studies have used regression techniques to make recommendations about desirable ad characteristics.

Some noteworthy work by Irwin Gross has led to recommendations about the number of ads that should be created and pre-tested. Most budgets for creating and pre-testing alternative campaigns represent three to five percent of the total advertising budget. By means of a stochastic modeling approach, Gross concluded that this was far too small a sum; that the optimum budget here is about 15 percent of the total budget. This larger investment would fund development and pre-testing of alternative creative executions, from which an advertisement having greater impact could be selected.

Media Plan.

The quantitative and iterative nature of media planning makes it an attractive area for computer-assisted decisions. In developing the media plan we answer the question, "Where, when, and how often shall we say it?" The complexity of media scheduling can take on impossible proportions. For example, a decision to use spot television advertising in any 20 of the top 100 television shows provides 4.29×10^{22} different ways to schedule the advertising. Because of its complexity, selection of media is usually made on the simple basis of cost-per-thousand exposures.

Three main exposure criteria affecting the media decision are total exposures, frequency, and reach (or, coverage). Total exposures is simply the number of times the target segments see or hear an advertisement in a given time period. An adjustment to this that reflects the potential of the segment is "weighted total exposures." (For example, compared with those seen by the working class, Instatune advertisements seen by up-scale people may have greater impact

because they have more money and inclination to use Instatune. "Frequency" refers to the average number of advertisements for the product that each target group member sees during a given period. And "reach" is defined as the total number of people exposed to at least one of the advertisements during a given time period.

The most comprehensive and detailed management science approach to analyzing media selection is micro-analytic simulation, in which audience members, or segments, are represented in probabilistic units, usually based on real-life response data. Media simulations can include factors of repeated exposure, forgetting, media type, cost discounts, duplication, and many other effects. A significant problem with this approach is that it does not develop an optimum media plan. It only evaluates submitted media schedules.

Linear programming approaches have been used in media scheduling, but most of these are constrained by some unrealistic assumptions. They typically assume that audience responses to advertising are linear, they assume that the number of media exposures is a continuous variable, they assume constant media costs (no quantity discounting), and they ignore time as a variable.

Optimization models, like MEDIAC, largely overcome these weaknesses. MEDIAC is unique in that the input data can be audience response functions. The input consists of media characteristics, market and segment characteristics, and market potential with any number of exposures up to a saturation level. Its output is a media schedule, including which media to use over time, the realized potential market response by segment. It has been frequently used by decision-makers, with reported improvements of 5-20 percent in starting schedules.

Final Budget Allocation

A preliminary budget must be established early in the advertising sequence to guide the choice of media and its scheduling. Revisions of both that budget and the media schedule will probably be made several times. That budget is finalized after all major strategy plans have been made - this is the final budget allocation step.

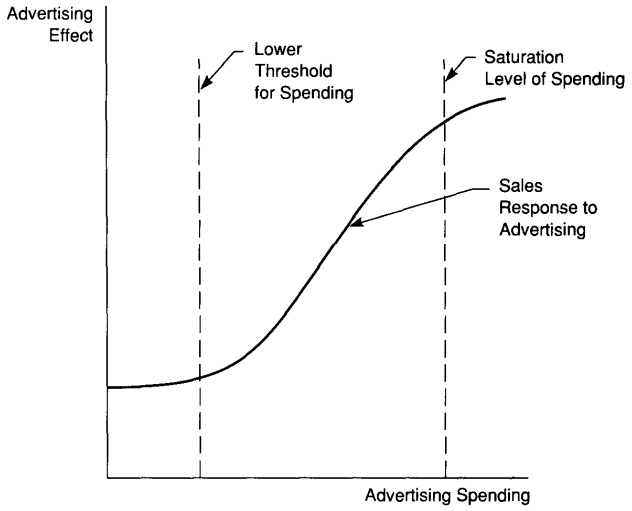
Ad budgeting is a critical area in which important modeling contributions have been made. Among them are competitive models under uncertainty, game theory models, decision theory models, stochastic models, and decision calculus models. Probably the most intuitive and easiest to parameterize are the decision calculus models, of which ADBUDG is the best known. ADBUDG uses a variety of readily available input data to provide, for each advertising budget, the brand market share, sales and profit contribution.

The impact of ad budget on advertising effects is influenced by floor and ceiling (saturation) effects. As advertising spending rises, its effects (e.g., audience awareness of the advertising) also rise to the point of diminishing returns and then until a ceiling or saturation point is reached. Spending more on advertising usually produces diminished audience effects and results in inefficiency.

Carryover effects also influence the impact of advertising spending. Consumers who have become new users because of advertising, or who have increased their usage because of it, will probably continue to do so after the advertising stops. Due to this carryover, reductions in ad spending will usually reduce audience response until a floor level of response is reached. At least in the short term, further reductions in spending will not reduce audience response below the floor level. A response function typical of this is shown in Figure 9-3.

FIGURE 9-3

Advertising Response Function



Several budget-setting approaches are popular. The "marginal economic approach" views advertising spending as an investment, and focuses on optimizing its rate of return. Although elegant and seemingly simple, it is not a practical method since it requires audience-response data of impossible precision.

The "percentage of sales" approach leads advertisers to set sales budgets at a particular percentage of a previous period's (or of expected) sales. This is an easy and popular though illogical approach. It makes advertising a function of sales, ignores the possibility that advertising will have an effect on future sales, and discourages thinking about what the firm wants its advertising to do.

The "competitive parity" approach is similar to the percentage of sales approach except that the percentage chosen is the average industry outlay.

The "affordable" and "historical spending" approaches suggest that firms should set advertising budgets based on what they can afford, or on the basis of what they have traditionally spent. The effect in both cases is to relegate advertising to the insignificant; its budget is what is left after other "more important" expenditures have been made.

Finally, the "objective and task" method sets advertising budgets at a level sufficient to permit it to reach its objectives, as discussed in the preceding "advertising objectives" section. Advertising targeted at increasing sales by 30 percent will need a different budget than that targeted at increasing sales by 10 percent. The objective and task method is both an appealing and popular approach to setting advertising budgets.

Implementation and Evaluation

Finally, the planned advertising must be implemented. It is created in finished form and scheduled with the planned media. Then the effectiveness of the advertising is monitored through internal data or consumer research on the variables established in the objectives-setting stage.

While much of advertising is wholly qualitative, in the sections that follow, we will discuss two quantitative models: one for assisting in media planning, and one for aiding advertising budget planning.

MEDIAC
Structure of the Model

MEDIAC is a media optimization model for frequently purchased consumer products. It uses a number of variables to search for the media schedule that will maximize total market advertising exposure. It is designed to be a straightforward model to use, following a premise established by one of its developers (John D. C. Little) for "decision calculus" models.

MEDIAC relies on a "leaky bucket" model of how advertising works. With the level of water in a bucket representing the mental state (e.g., awareness of the advertising) of the segment toward the advertising, advertising struggles to fill it while audience forgetting continues to empty it. The concept of diminishing returns is introduced by a function that links the audience's mental state -- a mediating variable -- with purchasing decisions.

The input data for MEDIAC include

--the media alternatives and their characteristics (e.g., the name of the advertising vehicles together with their cost per insertion, exposure probabilities, audience seasonality, etc.),
--the market characteristics for each segment (name, size, sales potential per person, seasonality, etc.),
--the media budget, and
--other data (audience forgetting constants, the audience potential with several exposure levels, etc.).

The model divides the population into segments and characterizes each segment by its sales potential and media habits. It models exposure decay (forgetting) and determines the pattern of exposure in each segment by media coverage and duplication (reaching the same segment with multiple media). Its output is a media schedule which recommends which media to use and when, and realized potential market response (exposures) by segment.

The worksheet model we call MEDIAC is an extensive modification of the model developed by Little. It uses similar input variables but, unlike the original, is not an optimization model and does not use linear programming to determine a

solution. The worksheet model operationalizes the value of a total campaign as a function of the maximum exposure response given insertion costs, the number of insertions, the exposure value of an individual advertisement, and the efficiency of the exposure (measured as the probability that the audience member is a member of the targeted market segment). This is expressed as,

$$MRF = \left(\frac{"MAXIMUM \quad SALES \quad RESPONSE}{(\#ins. \times \$per\_ins \times 1000)/(K_{ijt} \times E_{ij})} \right)^{MRC^{X_{jt}}}$$

where

MRF = marginal response function,

E_{ij} = exposure value of one exposure in media vehicle j to a person in market segment i,

MRC = a fractional exponent indicating the marginal return constant,

X_{jt} = the number of insertions in media vehicle j during time period t, and

$K_{ijt} = H_j G_{ij} N_i S_{ij}$, where

H_j = the probability of exposure to an ad in vehicle j, given that a person is in the audience for vehicle j,

G_{ij} = the fraction of people in market segment i who are in the audience of vehicle j,

N_i = the number of people in market segment i, and

S_{ij} = seasonal index of audience size for vehicle j (average = 1.00)

To restate, K_{ijt} is the exposure efficiency, or the expected number of exposures produced in market segment i by one insertion in media vehicle j during time t. And X_{jt} is the number of insertions in media vehicle j during time period t.

The MEDIAC problem is, then, to maximize total sales for the period through the purchase of the proper number of media insertions X_{jt}, for all media vehicles j during time period t. The solution of the model is subject to constraints in exposure value, use of specific media, and advertising budget.

A limitation of MEDIAC, and of the current worksheet model, is that exposures are treated in the aggregate, which could hide the fact that one person in a segment could get five exposures and another (in the same segment) gets none. But this approach has the advantage of being more efficient and more adaptable to available sources of data. MEDIAC fits best when the objective of the advertising is to maintain loyalty by "reminding" the segment of the product, rather than when introducing a new product or a new use for an old product. Used appropriately, MEDIAC is an excellent model which will both select media options and schedule them over time. The current model, which is based on the optimization of a simple objective function, is provided for illustrative purposes and may be less than ideal in actual usage situations.

The MEDIAC Worksheet Model

The MEDIAC worksheet is divided into three sections. We will look at each section in turn, examining it separately and in connection with the other sections, to provide an idea of how the three sections work together.

The highlighted sections of the worksheet indicate the areas where input is to be made by the user. Inputs for the first section include the maximum budget to spend, and those variables that influence media exposure efficiency. Media exposure efficiency is computed as the product of the four columns in the first section; this media efficiency shows the expected number of exposures produced in the market segment by one airing of the advertisement.

The second section of the worksheet reports the number of exposures purchased by the optimization model. Note that the number of exposures is not the same as the number of media inserts. User inputs include the value of exposure to an individual consumer, the maximum sales response, the average sales per capita, the number of exposures purchased for each media vehicle option, and the

media efficiency index computed in the first section of the worksheet. The simulation in the third section of the worksheet computes the optimal number of insertions. When the optimal number of insertions, the value of exposures, and media efficiency are multiplied together, the result is the number of individual exposures that are recommended for purchase.

The third section displays the model cost and the composite index that provides the evaluation components of the model. Given user input for the maximum number of insertions, cost per insertion, and the marginal return constant, the model cost is computed as the product of the cost per insertion and the optimal number of insertions reported in the second section. The composite index is analogous to a marginal return index, in that as each purchase of a media vehicle option is made, the composite index declines. Because the return is greatest for the media vehicle option with the highest composite index, it is this media vehicle option that is chosen for the next purchase.

Running the MEDIAC Worksheet

Load Excel with a backup of the worksheet on the hard drive. When the blank worksheet appears on your computer screen, continue with the File Open commands and specify the MEDIAC file.

After a few moments, the MEDIAC model will be loaded into your computer, and will display its command menu:

ENTER VIEW RUN PRINT QUIT

The MEDIAC commands are invoked by selecting the desired command and then pressing OK. Once you invoke a menu function a secondary menu appears or the selected feature is initiated. You can initiate another command function by simply selecting another option from the command menu.

Each function in the command menu invokes a predefined macro sequence which performs a series of operations. The purpose of each function is described below:

ENTER

Invoking "ENTER" is the typical starting point for MEDIAC. The "ENTER" command prompts you to enter new data into the worksheet model, which will

replace the sample data that has already been entered. "ENTER" starts a series of prompts, beginning with your entry of an advertising media budget, as shown in Figure 9-4. After entering the budget, the macros will run for several seconds before the next step appears, which is a secondary menu:

TIME NEWSWEEK TV GUIDE LIFE BUSINESS WK CONTINUE

This menu is a prompt for any changes you wish to make in data for each of several predefined media vehicles. See Figure 9-5. If you wish to change data for any magazine, invoke that magazine and then enter all data for that media option. For each vehicle you select, you will be prompted for new data.

VIEW

To view screens one, two, and three, select the "VIEW" option. A secondary menu appears, permitting you to examine each of the sections of the spreadsheet, each showing either entered or calculated data for the magazines being considered in the media schedule:

1 2 3 MAIN

FIGURE 9-4

MEDIAC ENTRY SCREEN

```
   A    B    C   D    E   F    G    H    I   J    K   L    M
1  |                    MEDIAC TYPE MODEL     Media Efficiency:  |
2  |INPUT MAXIMUM BUDGET:   $15,000              K = (N)*(H)*(G)*(S)|
3
|_____________________________________________________________________|
4  |  Media  |  N,s        |  H,j       |   G,sj          |   S,jt       | K,sjt  |
5  |  Option  |Population  | Prob. of   |% of Segment|Seasonality |  Media  |
6  | (Vehicle) |of Segment| Exposure |In Audience   |   Factor     |Efficiency|
7  |-----------|----------|----------|----------|----------|----------|
8  |LIFE       |  15,000  |    0.4   |      0.7     |      0.9     |   3,780 |
9  |TIME       |  35,000  |    0.7   |      0.6     |      0.9     |  13,230 |
```

10	NEWSWEEK	30,000	0.6	0.4	0.9	6,480
11	TV GUIDE	10,000	0.7	0.8	0.9	5,040
12	BUSINESS WK	20,000	0.5	0.5	0.9	4,500
13	AZ HIGHWAYS	25,000	0.2	0.2	0.9	900
14	SCHOOL PAPE	8,000	0.1	0.1	0.9	72
15	DAILY HERAL	8,500	0.2	0.1	0.9	153
16	SPORTS ILL.	9,500	0.4	0.1	0.9	342
17	FIELD&STREA	9,000	0.3	0.1	0.9	243
19	10	170,000				34,740

Invoking the first page (1) shows population, readership, seasonality, and media efficiency. The second page (2) shows exposure values, minimum and maximum numbers of insertions, media efficiency, and exposures purchased. And the third page (3) shows the forecasts: sales per capita, sales response, cost per insertion, marginal return constants, and a composite index of media efficiency. See Figures 9-6, 9-7, and 9-8 for samples of these three screens.

RUN

Invoking this command runs the model using either the data which you have entered (or, if you have entered none, it uses the sample data). This is a large model, and running it will takes several minutes, depending on the speed of your PC, typically, and more if the budget is very large or insertions are highly constrained. The greater the number of insertions to be evaluated, the longer the model will take to run.

PRINT

Invoking "PRINT" takes you to a secondary menu like that found in "VIEW", and permits you to print out any of the three pages ("1", "2", or "3"). Be sure your printer has paper and is on-line.

QUIT

Invoking this command quits the worksheet and returns to Excel spreadsheet, where you can explore the worksheet and its macros. If you wish to re-invoke

MEDIAC at this point, type <ALT><M>. If you made changes to the model that you wish to save, you may save them using the Excel File Save command. However, rename the file you save to avoid overwriting the original worksheet file.

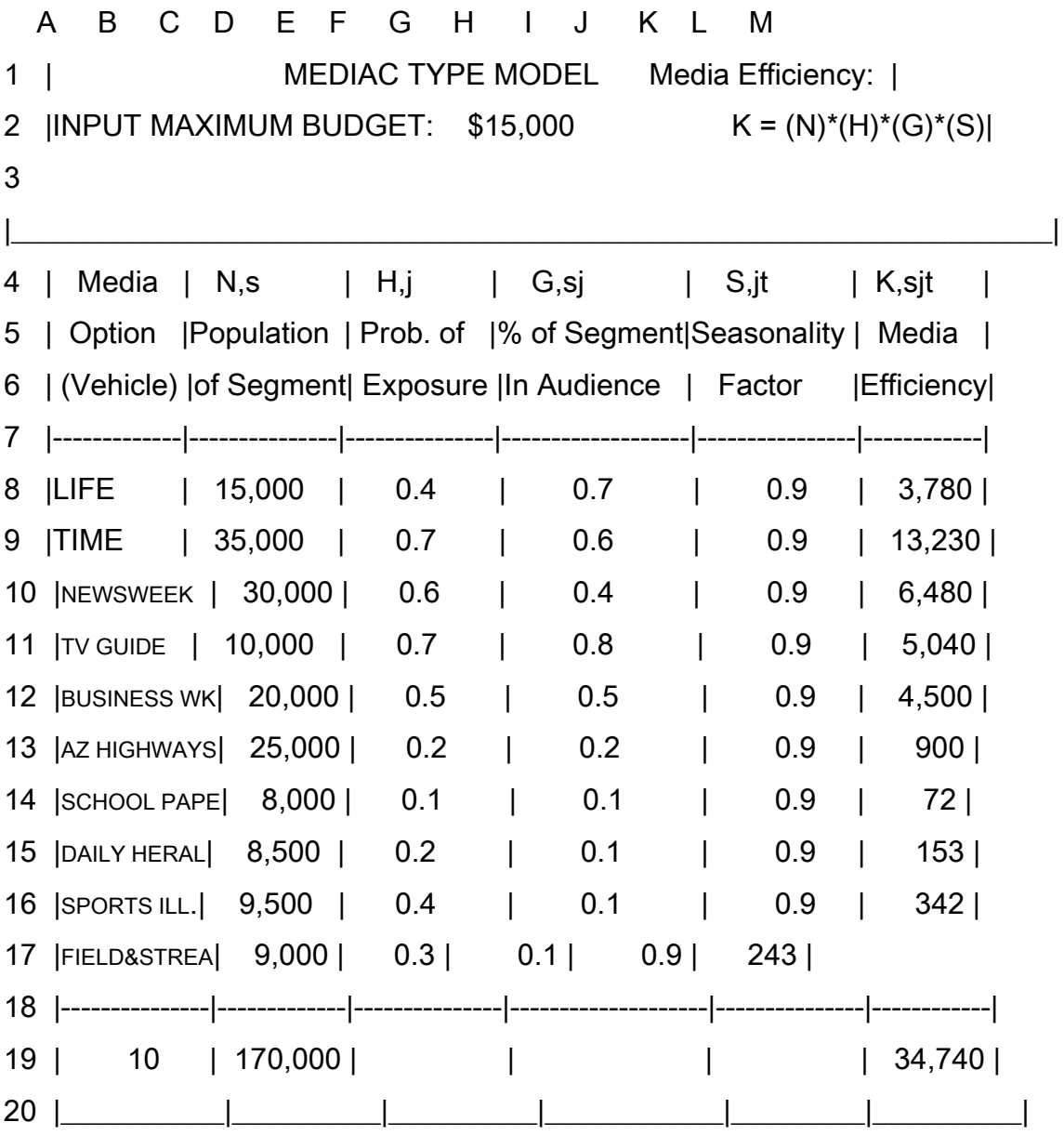
FIGURE 9-5
MEDIAC VEHICLE MODIFICATION SCREEN

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	|						MEDIAC TYPE MODEL				Media Efficiency:		|
2	|INPUT MAXIMUM BUDGET:				$15,000						K = (N)*(H)*(G)*(S)		|
3													

4	| Media	N,s	H,j	G,sj	S,jt	K,sjt |
5	| Option	Population	Prob. of	% of Segment	Seasonality	Media |
6	| (Vehicle)	of Segment	Exposure	In Audience	Factor	Efficiency |
7	|---	---	---	---	---	---
8	|LIFE	15,000	0.4	0.7	0.9	3,780 |
9	|TIME	35,000	0.7	0.6	0.9	13,230 |
10	|NEWSWEEK	30,000	0.6	0.4	0.9	6,480 |
11	|TV GUIDE	10,000	0.7	0.8	0.9	5,040 |
12	|BUSINESS WK	20,000	0.5	0.5	0.9	4,500 |
13	|AZ HIGHWAYS	25,000	0.2	0.2	0.9	900 |
14	|SCHOOL PAPE	8,000	0.1	0.1	0.9	72 |
15	|DAILY HERAL	8,500	0.2	0.1	0.9	153 |
16	|SPORTS ILL.	9,500	0.4	0.1	0.9	342 |
17	|FIELD&STREA	9,000 |	0.3 |	0.1 |	0.9 |	243 |
18	|---	---	---	---	---	---
19	| 10	170,000 |				34,740 |
20	|_____	_____	_____	_____	_____	_____	

FIGURE 9-6

MEDIAC SCREEN 1



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	|					MEDIAC TYPE MODEL					Media Efficiency:		|
2	|INPUT MAXIMUM BUDGET:				$15,000						K = (N)*(H)*(G)*(S)		|
3													
4	|	Media	|	N,s	|	H,j	|	G,sj	|	S,jt	|	K,sjt	|
5	|	Option	|Population		| Prob. of		|% of Segment|		Seasonality	|	Media	|
6	|	(Vehicle)	|of Segment|		Exposure		|In Audience		Factor		|	Efficiency|	
7	|												
8	|LIFE		|	15,000	|	0.4	|	0.7	|	0.9	|	3,780	|
9	|TIME		|	35,000	|	0.7	|	0.6	|	0.9	|	13,230	|
10	|NEWSWEEK		|	30,000	|	0.6	|	0.4	|	0.9	|	6,480	|
11	|TV GUIDE		|	10,000	|	0.7	|	0.8	|	0.9	|	5,040	|
12	|BUSINESS WK		|	20,000	|	0.5	|	0.5	|	0.9	|	4,500	|
13	|AZ HIGHWAYS		|	25,000	|	0.2	|	0.2	|	0.9	|	900	|
14	|SCHOOL PAPE		|	8,000	|	0.1	|	0.1	|	0.9	|	72	|
15	|DAILY HERAL		|	8,500	|	0.2	|	0.1	|	0.9	|	153	|
16	|SPORTS ILL.		|	9,500	|	0.4	|	0.1	|	0.9	|	342	|
17	|FIELD&STREA		|	9,000	|	0.3	|	0.1	|	0.9	|	243	|
18	|												
19	|	10	|	170,000	|		|		|		|	34,740	|
20	|												

FIGURE 9-7

MEDIAC SCREEN 2

	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	|												
2	|		Exposures Purchased Formula: (E,j)*(X,jt)*(K,sjt)										|
3													

4	| Media	E,j	Maximum	Average	K,sjt	Exposures |
5	| Option	Value of	Sales	Sales/	Media	Purchased |
6	| (Vehicle)	Exposures	Response	Capita	Efficiency	|
7	|---	---	---	---	---	---	
8	|LIFE	0.5	$75,000	$5.00	3,780	0 |
9	|TIME	0.6	$210,000	$6.00	13,230	15,876 |
10	|NEWSWEEK	0.5	$210,000	$7.00	6,480	6,480 |
11	|TV GUIDE	0.6	$90,000	$9.00	5,040	3,024 |
12	|BUSINESS WK	0.5	$40,000	$2.00	4,500	0 |
13	|AZ HIGHWAYS	0.4	$200,000	$8.00	900	0 |
14	|SCHOOL PAPER	0.2	$32,000	$4.00	72	0 |
15	|DAILY HERALD	0.3	$59,500	$7.00	153	0 |
16	|SPORTS ILL.	0.5	$28,500	$3.00	342	0 |
17	|FIELD&STREAM	0.4	$27,000	$3.00	243	0 |
18	|---	---	---	---	---	---	
19	| Totals		$972,000	$5.72	34,740	25,380 |
20	|___	___	___	___	___	___	

FIGURE 9-8

MEDIAC SCREEN "3"

```
   AA   AB   AC  AD  AE   AF    AG   AH   AI    AJ    AK AL  AM    AN     A
1  |Exposure Value    Formula:  Exposures / $Per Insertion            1 |
2  |Maximum Budget:     $15,000                                      0 |
3  |_____________________________________________________________     0 |
4  |  Media  |Optimal      | MAX X,jt   |  Cost    |Model Cost |Margin|      0 |
5  | Option  | # of        | Maximum    |   Per    |($/Insert)*  |Return| Composite |
6  |(Vehicle)|Inserts      |Insertions  |Insertion|(# Inserts)  |Const.|   Index   |
7  |---------|-------------|------------|---------|-------------|------|-----------|
8  |LIFE     |    0        |     20     | $1,000 |      $0     | 0.90 |   2679071 |
9  |TIME     |    2        |     15     | $5,000 |   $10,000   | 0.90 |   1028877 |
10 |NEWSWEEK |    2        |     10     | $1,000 |    $2,000   | 0.90 |    887319 |
11 |TV GUIDE |    1        |      6     | $3,000 |    $3,000   | 0.90 |    622954 |
12 |BUSINESS |    0        |     14     | $7,000 |      $0     | 0.90 |    289285 |
13 |AZ HIGHWA|    0        |     30     | $2,000 |      $0     | 0.90 |    129600 |
14 |SCHOOL PA|    0        |      1     |   $100 |      $0     | 0.90 |       664 |
15 |DAILY HER|    0        |      0     |   $900 |      $0     | 0.90 |         0 |
16 |SPORTS IL|    0        |      0     |   $600 |      $0     | 0.90 |         0 |
17 |FIELD&STR|    0        |      0     |   $400 |      $0     | 0.90 |         0 |
18 |---------|-------------------------------------------|------------|
19 | Totals  |    5        |     96     |        | $15,000 |          |           |
20 |_________|_____________|____________|________|_________|__________|___________|
```

ADBUDG

Structure of the Model

Like MEDIAC, ADBUDG is one of Little's decision calculus models. Unlike models that require parameterization from marketplace data, most decision calculus models are parameterized out of the manager's experience. Even so, they are often

capable of making much improved decisions over those of the unassisted decision-maker. Little's belief is that decision calculus models are also easy to understand (a noteworthy characteristic of ADBUDG), are resistant to giving bad answers, are easy to control, are adaptive to new information, and are complete on important issues.

ADBUDG is a model of sales response to advertising. Its inputs are essentially, managerial judgments about the effects of advertising, and an advertising budget. Its outputs are brand share, sales, and profits. Examining the effect of different ad budgets can help the manager choose a budget which best balances the budget with sales goals. The manager is asked to make four estimates:

1. The brand's share at the end of the period if advertising is reduced to zero.
2. The brand's share at the end of the period if advertising was at a saturation level.
3. The ad spending necessary to simply maintain current brand share throughout the period.
4. The brand share at the end of the period if advertising were increased by 50 percent (fifty) above the brand share maintenance level (3).

The relationships between these estimates are familiar, and are shown in Figures 9-9 and 9-10.

Figure 9-9
ADBUDG: Advertising Response Function

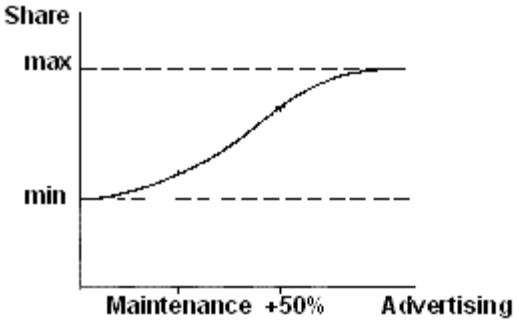
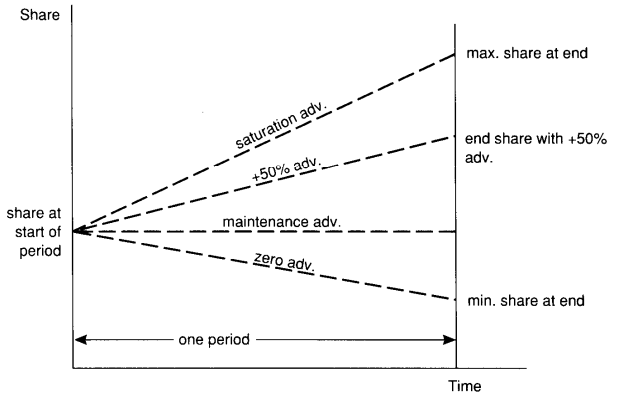


FIGURE 9-10
ADBUDG: Effect of Advertising on Share over One Period



The ADBUDG model computes brand share as (Nonadvertising Effect Index)*(Unadjusted Brand Share)

where the Unadjusted Brand Share (the function shown in Figure 9-10) is defined as

$$Share = \min + (\max - \min) \times \frac{adv^a}{d + adv^a}$$

where,

min = minimum share with no advertising,

max = maximum share with saturation advertising,

d = advertising response constant,

a = brand advertising response exponent, and

adv = media and copy efficiency index.

Min and max are the manager-supplied data, and d (the advertising response function denominator constant for the brand) and a (the brand advertising response function exponent) are estimated from the data. (Adv is discussed below.) While the plot in Figure 9-3 shows an S-shaped curve, it can take other shapes. If a > 1, then the curve will be S-shaped, and if a is between 0 and 1 it will be concave. The value of a depends on the input data. That is,

$$a = \left(\frac{1}{\log 1.5}\right) \times \log(d) \times \frac{50 - \min}{\max - 50}$$

where

$$d = \frac{\max - \text{starting share}}{\text{starting share} - \min}$$

So far, this discussion of ADBUDG has ignored any long-term effects. However, the model does assume that without any advertising, share will ultimately decay to a long-term minimum value (possibly zero). The one-period decay will be a constant exponential fraction of this. So, if "Persistence" *p* represents the fraction of the difference between current and long-term minimum share, then,

$$p = \frac{\min - \min \ long\ run\ share}{starting\ share - \min}$$

For period t,

$$Share(t) - long\ run \min = \frac{p * (share(t-1) - long\ run \min)}{1} + \frac{(\max - \min) * (adv}{(d + (adv(t)^a)}$$

Let us look now at the most important variable - advertising (adv). Marketing managers are concerned about ad spending as well as media and copy efficiency. Adv is defined to include all three. Media

and copy efficiencies are represented by time-varying indices, with both having reference (or, average efficiency) values of 1.0. The "delivered" advertising effect for period t then, is,

Adv(*t*) = [media efficiency(*t*)] X [copy efficiency(t)] X [adv $(t)]

The manager can estimate the media and copy efficiencies but other ways, like media research and copy testing, are usually better.

"Product class sales" are defined in terms of a relationship between reference class sales and a product class sales index. So, for period t,

Product class sales(*t*) = [reference product class sales] X [product class sales index(*t*)]

Brand advertising and time lags might also influence product class sales. These are treated similarly to brand share.

A number of other factors affect share, including promotions, competition, distribution, price, product changes, and package changes. These factors are all treated in a simple way by inputting effectiveness indices for each factor (with 1.0 representing a reference value), the product of which represents a "composite non-advertising effects index", as illustrated in Table 9-1. Brand share is the product of this index and the share developed from the advertising response relationship:

TABLE 9-1

Composite Index of Non-advertising Effects

	Period

Index of Effect on Share	1	2	3	4
Promotions	1.00	1.10	.98	1.00
Price	1.00	1.00	1.00	1.00
Package	1.00	1.05	1.05	1.05
Competitive Action	1.00	.98	.95	1.00
Other	1.00	1.00	1.00	1.00
Composite Index	1.00	1.13	.978	1.05

Brand share is the product of this index and the share developed from the advertising response relationship:

Brand share(t) = [non-adv effects index(t)]*[unadj share(t)]

This completes the specification of the ADBUDG model. Its structure permits consideration of the response of brand share to advertising, copy and media effectiveness, product class seasonality and trends, share dynamics, product class response to advertising, and several non-advertising effects.

The ADBUDG Worksheet Model

The ADBUDG worksheet is composed of four sections. Section one, the input section is located in cells A1 through C31, and contains the reference case and budget horizon conditions. Section two, the indexing section, receives input from the user about changes in product class sales, non-advertising time effect for the period, maintenance advertising, copy effectiveness, and brand advertising for each of the budget periods selected. Section three, the output table, reports for each period, the market share in percent, product and brand sales, the contribution

before and after advertising, and the cumulative profit contribution present at the end of the analysis periods. Section four, the computation and macro section is contained in the range P1 through AB100.

Running the ADBUDG Worksheet

Load Excel with a backup of the worksheet in the hard drive. When the blank worksheet appears on your computer screen, continue with the File Open command and specify the ADBUDG worksheet. After a few moments, the model will be loaded into your computer, and will display its command menu:

INPUT NEW_RUN RE_RUN OUTPUT GRAPH PRINT QUIT

The ADBUDG commands are invoked by selecting the desired command and then pressing the OK button. Once you invoke a menu function a secondary menu appears or the selected feature is initiated. You can initiate another command function by simply selecting another option from the command menu. Each function in the command menu invokes a predefined macro sequence which performs a series of operations. The purpose of each function is described below:

INPUT

"INPUT" is the default screen at the time ADBUDG is first loaded, and is the usual starting point for ADBUDG. When you are viewing other screens, this command returns you to the variable input table screen, to permit you to view the case conditions before (or after) running the model. See Figure 9-11.

NEW_RUN

The "NEW_RUN" command is a data entry module which clears the old values for the input variables by prompting you to enter new data, starting with a request for the number of periods you wish to forecast.

Except for media and copy efficiency indices, the requests for input are self-explanatory. Indices for media and copy efficiency reflect your perception of the effectiveness of your media plan and copy effectiveness. In the absence of information about them, or if you think that they are about equivalent to the product class average, enter a value of "1" for these variables. Enter higher or lower values to reflect higher or lower efficiencies, respectively. For example, if you felt your media buy was 20 percent more effective than the average in the product class, you would enter 1.2 as the media efficiency index. Similarly for copy efficiency.

"NEW_RUN" performs the data input function and runs the model using this data. Running the model with no changes in data is accomplished with the next step, "RE_RUN".

FIGURE 9-11

ADBUDG INPUT SCREEN

```
                    A                          B       C
1              ADBUDG:  ADVERTISING
BUDGETING  MODEL
```

2
==========
==========
3 | Number of periods (Max 10) =
4 |
4 | |
5 | REFERENCE CASE
CONDITIONS |
6 | Mkt share at start of period =
0.054 |
7 | Adv rate to maintain share ($M/period) =
1 |
8 | Mkt share at period end if adv is 0 =
0.0454 |
9 | Mkt share at period end if incr. to saturation =
0.063 |
10 | Mkt share at period end if adv increase 20% =
0.0554 |
11 | Mkt share in long run if adv is 0 =
0 |
12 | Index media efficiency =
1 |
13 | Index copy effectiveness =
1 |
14 | Contribution profit before adv exp. =
2.25 |
15 | Average brand price =
8.6 |
16 | Mkt share in previous period =
0.055 |

17 | Product sales rate at start of period =
22 |
18 | Average price for product category =
$8.60 |
19 | |
20 |MULTI-PERIOD BUDGET HORIZON
CONDITIONS (ENTER 1 IF YES, 0 IF NO) |

RE_RUN

Invoking this command runs (or re-runs) the ADBUDG model, using the data already entered (which can be reviewed in the "INPUT" screen). Period-by-period output will be calculated and displayed. Given the large number of calculations necessary for this model, computation time may take a minute or two.

The output takes the form of forecasts, given your input data (or the default sample data conditions if you have not entered new data), for unit market share, product category and brand sales (units and dollars), profit contributions, and advertising coefficient (slope). Positive slope values indicate positive cumulative net advertising effects.

VIEW

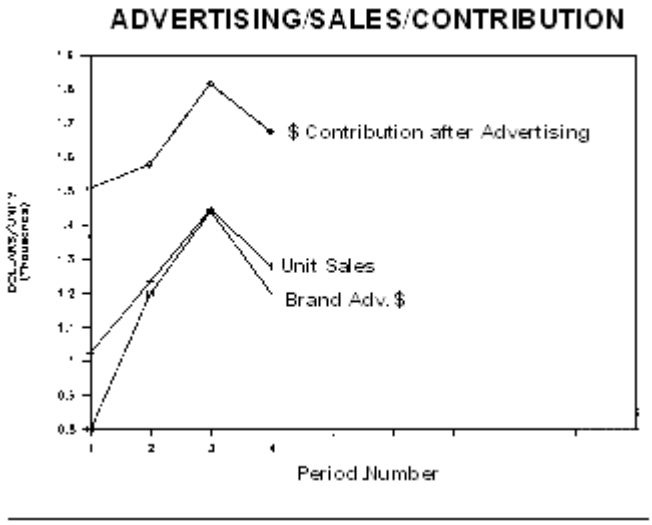
Invoking "VIEW" simply redisplays the output table created by either of the "RUN" commands.

GRAPH

This command will display a graph of the advertising response functions for brand advertising dollars, brand advertising units, and the contribution after advertising. See Figure 9-12.

FIGURE 9-12

ADBUDG Sample Graph Output



PRINT

Invoking "PRINT" will display a secondary menu:

INPUT RESULTS QUIT

Selecting "INPUT" will print the input "VIEW" screen (be sure your printer is loaded with paper and on-line). "RESULTS" will print the results table, and "QUIT" returns you to the main command menu.

QUIT

Invoking this command quits the ADBUDG program, returns control to Excel, and permits you to explore the worksheet and its macros. Any time you want to re-invoke the ADBUDG menu, just type <ALT><M>.

Conclusions

This chapter has reviewed modeling approaches useful for advertising. Advertising is probably the most qualitative of any marketing activity and, for the most part, efforts to quantify the development of creative advertising appeals have not been a great success. However, quantitative approaches can provide valid

input information to copywriters and art directors by giving precise guidance about the types of product features, appeals, and advertising formats which will improve the effectiveness of the advertising. And quantitative measurement approaches are routinely used to assess the audience impact of both rough and finished advertising executions.

While advertising -- particularly in its most visible aspect of designing message strategy -- is largely a qualitative art, some aspects of advertising are highly quantifiable. Media selection -- which can be a tremendously complex analytical task -- can be beautifully adapted to quantitative modeling, as we have illustrated with our adaptation of the MEDIAC model. And advertising budgeting is, by nature, a quantitative exercise which can be greatly assisted with computer modeling, as we have shown with the ADBUDG model.

In these and other advertising areas, nearly all modeling efforts are still relatively naive. Advertising models, and especially media models, need more attention to competition, better behavioral inputs about consumers, should be able to select from several copy approaches, and need to include media discounts. This is a fruitful area in which much work has been done, but much more remains to be done.