

**TECHNIQUES OF FINANCIAL ANALYSIS, MODELING,
AND FORECASTING**



Delta Publishing Company

Copyright © 2005 *by*

DELTA PUBLISHING COMPANY

P.O. Box 5332, Los Alamitos, CA 90721-5332

All rights reserved. No part of this course may be reproduced in any form or by any means, without permission in writing from the publisher.

PREFACE

Financial analysis is necessary in evaluating internal operations and activities to optimize profit and efficiency while at the same time reducing the risk. Problem areas must be identified so that corrective, timely action may be taken.

Break-even analysis determines what level of sales of a product line is necessary to cover costs. Contribution margin evaluation indicates what selling price to charge given a special order situation.

To determine where funds should be expended in the business, capital budgeting techniques are provided including present value, internal rate of return, and payback. Applications of various types of investment opportunities are addressed.

Analyzing the balance sheet, income statement, and overall financial structure shows you the company's financial strengths and deficiencies, and problem areas are noted for management attention. How the business is viewed financially by investors and creditors affects the firm's chances of financing, cost of capital, and the market price of its stock.

Knowing how to evaluate segmental performance is essential in recognizing the relative performance of divisions within the firm. Also, comparisons can be made to similar divisions in competing companies. Measures of performance include return on investment and residual income.

The management of current assets and liabilities positively affects the bottom-line and reduces risk. Some examples of this are accelerating cash inflow, delaying cash outflow, inventory planning, and investment portfolio management. By acquiring other companies, diversification and earning power may be enhanced. Selecting the right financing instrument to obtain funds is critical; it affects both cost of capital and restrictiveness of funds.

Financial planning models are used to generate pro-forma financial statements and financial ratios. These are the basic tools for budgeting and profit planning. There are user-oriented computer software systems specifically designed for corporate planners and executives. Due to technological advances in computers, such as networking and data base management systems, more companies are using modeling. A model is necessary for making day-to-day operational and strategic planning decisions. Financial planning models, which is one functional branch of a general corporate model, may be used for many purposes. Among these applications are

- Financial forecasting
- Budgeting
- Tax planning
- Profit planning
- Capital budgeting
- Risk analysis
- Cash management
- Merger and acquisition analysis
- New venture analysis

Supported by the expanded capabilities provided by models, many companies are increasingly successful in including long-term strategic considerations in their business plans, thus enabling them to investigate the possible impact of their current decisions on future profitability and cash flow. For example, companies are able to examine the effects of proposed mergers and acquisitions with much more certainty and to estimate with more confidence the potential profits from new markets. The applications of and benefits deriving from the use of well-designed and sophisticated planning models are unlimited. The model is, in short, a technique for “risk” analysis and “what-if” experiments. Modeling allows for strategic planning and for accomplishing operational and tactical decisions for immediate planning problems.

With the ever-increasing technology in the areas of spreadsheets, data base management systems, graphics, and the like, businesspeople will have no choice but to utilize financial models more effectively. Using the applications found throughout this course, you will be able to use modeling for analytical decisions without having to know programming.

The course shows you:

- How to develop a new model
- How to select the best user-oriented planning package to meet the specific needs and resources available
- How to use your spreadsheet program on a microcomputer for various modeling purposes
- How to tie the financial model to the overall management information system framework

This is your guide for more effective financial management. Use it often, to keep continuous tabs on your company’s financial health.

CONTENTS

What This course will Do for You

PART I

TOOLS AND TECHNIQUES FOR FINANCIAL ANALYSIS

1. BREAK-EVEN AND CONTRIBUTION MARGIN ANALYSIS

What Is Cost-Volume-Profit Analysis?

What Is Operating Leverage?

Sales Mix Analysis

Contribution Margin Analysis

Conclusion

2. UNDERSTANDING AND APPLYING THE TIME VALUE OF MONEY CONCEPT

Assumptions of Present Value and Future Value Techniques

Present Value Table

Future Value Table

Both Present Value and Future Value Tables

Perpetuities

Conclusion

3. HOW TO ASSESS CAPITAL EXPENDITURE PROPOSALS FOR STRATEGIC DECISION MAKING

Factors to Consider in Determining Capital Expenditure

Type of Capital Budgeting Decisions to Be Made

Capital Budgeting Methods

How to Select the Best Mix of Projects with a Limited Budget

How to Handle Mutually Exclusive Investments

Risk Analysis in Capital Budgeting

Conclusion

4. ANALYZING FINANCIAL STATEMENTS FOR FINANCIAL FITNESS

Who Uses Financial Analysis

Financial Statement Analysis

Ratio Analysis

Limitations of Ratio Analysis

5. ANALYZING QUALITY OF EARNINGS

- Quality of Earnings
- Analysis of Discretionary Costs
- Accounting Estimates
- Internal Control and Management Honesty
- Auditor Relations and Reports
- Conclusion

6. ANALYSIS OF VARIANCE ANALYSIS FOR COST CONTROL

- Responsibility Accounting and Responsibility Center
- Standard Costs and Variance Analysis
- General Model for Variance Analysis
- Flexible Budgets and Performance Reports
- Nonfinancial Performance Measures
- Conclusion

7. ANALYSIS OF SEGMENTAL PERFORMANCE AND PROFIT VARIANCE

- Segmental Reporting for Profit Centers
- Profit Variance Analysis
- Sales Mix Analysis
- Conclusion

PART II

MANAGING AND CONTROLLING FINANCIAL ASSETS, INVESTING, AND POTENTIAL ACQUISITIONS

8. EVALUATING DIVISIONAL PERFORMANCE

- Rate of Return on Investment (ROI)
- ROI and Profit Planning
- Residual Income (RI)
- Investment Decisions under ROI and RI
- Conclusion

9. ANALYZING WORKING CAPITAL

- Evaluating Working Capital
- Cash Management
- Management of Accounts Receivable

Inventory Planning and Control
Conclusion

10. CORPORATE INVESTMENTS

Accounting Aspects
Analytical Implications
Obtaining Information
Risk Versus Return
Financial Assets
Real Assets
Portfolio Analysis
Mutual Funds
Fundamental Analysis
Technical Analysis
Conclusion

11. OBTAINING FUNDS: SHORT-TERM AND LONG-TERM FINANCING

Financial Planning
Short-Term and Intermediate-Term Financing Sources
Comparing Short-Term to Long-Term Financing
Long-Term Financing
Cost of Capital
Conclusion

12. ANALYZING MERGERS AND ACQUISITIONS

Mergers
Deciding on Acquisition Terms
Acquisition of Another Business
Impact of Merger on Earnings per Share and Market Price per Share
Risk
Holding Company
Conclusion

13. FORECASTING AND FINANCIAL PLANNING

Who Uses Forecasts?
Forecasting Methods
Selection of Forecasting Method
The Qualitative Approach
Common Features and Assumptions Inherent in Forecasting

Steps in the Forecasting Process
Conclusion

14. FORECASTING METHODOLOGY

Naive Models
Smoothing Techniques
Forecasting Using Decomposition of Time Series
Conclusion

15. FORECASTING WITH REGRESSION AND MARKOV METHODS

The Least-Squares Method
Regression Statistics
Statistics to Look for in Multiple Regressions
Evaluation of Forecasts
Checklists—How to Choose the Best Forecasting Equation
Use of a Computer Statistical Package for Multiple Regression
Forecasting Sales with The Markov Model
Conclusion

16. FINANCIAL FORECASTING AND BUDGETING TOOLS

Forecasting External Financing Needs--The Percent-of-Sales Method
Budgeting and Financial Planning
How The Budget Works: An Example
Zero-Base Budgeting
The Certified Public Accountant's Involvement and Responsibility with Prospective Financial Statements
Conclusion

17. FORECASTING CASH FLOWS

Markov Approach
Lagged Regression Approach
Conclusion

PART IV BUILDING FINANCIAL MODELS FOR BUDGETING AND PLANNING

18. HOW TO USE CORPORATE PLANNING MODELS

Types of Analysis
Typical Questions Addressed via Corporate Modeling

Types of Models
Current Trends In Modeling
MIS, DSS, EIS, and Personal Computers
The Future of Corporate Planning Models
Conclusion

19. FINANCIAL MODELING FOR "WHAT-IF" ANALYSIS

A Financial Model
Applications and Uses of Financial Models
Putting Financial Modeling into Practice
Quantitative Techniques Used in Financial Models
Developing Financial Models
Model Specification
Comprehensive Financial Model
Conclusion

20. USING OPTIMIZATION TECHNIQUES TO BUILD OPTIMAL BUDGETS

Linear Programming
Goal Programming
Conclusion

21. USING SPREADSHEET AND FINANCIAL MODELING PACKAGES

Using Spreadsheet Programs
Forecasting Business Failures with Z Scores
Financial Modeling Languages
Conclusion

22. USING MANAGEMENT GAMES FOR EXECUTIVE TRAINING

Executive Management Games
Validating The Game
A New Role for Computerized Executive Games
Conclusion
References and Additional Readings

GLOSSARY

CHAPTER 1

BREAK-EVEN AND CONTRIBUTION MARGIN ANALYSIS

LEARNING OBJECTIVES

After studying the material in this chapter,

1. You will be able to define Cost-Volume-Profit (CVP) analysis.
2. You will be able to describe operating leverage.
3. You will be able to analyze sale mix.
4. You will be able to give examples of contribution margin analysis.

Before your business can realize "profit," you must first understand the concept of breaking even. To break even on your company's product lines and/or services, you must be able to calculate the sales volume needed to cover your costs and how to use this information to your advantage. You must also be familiar with how your costs react to changes in volume. Break-even analysis (cost-volume-profit analysis or CVP) allows you to answer many planning questions. Operating leverage is the degree to which fixed costs exist in a company's cost structure. Operating leverage measures operating risk arising from high fixed costs. Contribution margin analysis is useful in your decision making with respect to pricing strategy and which product lines to push.

WHAT IS COST-VOLUME-PROFIT ANALYSIS?

Cost-volume-profit (CVP) analysis relates to the way profit and costs change with a change in volume. CVP analysis examines the impact on earnings of changes in such factors as variable cost, fixed cost, selling price, volume, and product mix. CVP information helps you to predict the effect of any number of contemplated actions and to make better planning decisions. More specifically, CVP analysis tries to answer the following questions:

1. What sales volume is required to break even? How long will it take to reach that sales volume?
2. What sales volume is necessary to earn a desired profit?
3. What profit can be expected on a given sales volume?
4. How would changes in selling price, variable costs, fixed costs, and output affect profits?
5. How would a change in the mix of products sold affect the break-even and target volume and profit potential?

WHAT AND WHY OF BREAK-EVEN SALES

Break-even analysis, which is part of CVP analysis, is the process of calculating the sales needed to cover your costs so that there is zero profit or loss. The break-even point that is arrived at by such analysis is important to the profit planning process. Such knowledge allows managers to maintain and improve operating results. It is also important when introducing a new product or

service, modernizing facilities, starting a new business, or appraising production and administrative activities.

Break-even analysis can also be used as a screening device, such as the first attempt to determine the economic feasibility of an investment proposal.

Also, pricing may be aided by knowing the break-even point for a product. What other situations can you think of where break-even analysis is useful?

The assumptions of break-even analysis follow:

- Selling price is constant, which in turn requires the following assumptions:
- Demand elasticity is very high for selling price to remain the same when sales volume increases
- Selling price is stable over the income period
- *Tip:* In practice, neither assumption is likely to hold, making it difficult to forecast selling price
- There is only one product or a constant sales mix.
- Manufacturing efficiency is constant.
- Inventories do not significantly change from period to period.
- Variable cost per unit is constant.
- Fixed cost and variable cost are properly separated, identified, and quantified
- The only factor affecting variable cost is volume

Note: Cost-volume profit relationships that are curvilinear may be analyzed linearly by considering only a *relevant* range of volume.

The guidelines for breaking even are:

- An increase in selling price lowers break-even sales.
- An increase in variable cost increases break-even sales.
- An increase in fixed cost increases break-even sales.

Your objective of course is not just to break even, but to earn a profit. In deciding which products to push, continue, or discontinue, the break-even point is not the only important factor. Economic conditions, supply and demand, and the long-term impact on customer relations must also be considered. You can extend break-even analysis to concentrate on a desired profit objective.

The break-even sales can be determined using the graphic, equation, and formula approaches. Using the graphic approach (see Figure 1.1), revenue, total cost, and fixed cost are plotted on a vertical axis and volume is plotted on a horizontal axis. The break-even point occurs at the intersection of the revenue line and the total cost line. Figure 1.1 also depicts profit potentials over a wide range of activity. It shows how profits increase with increases in volume.

The equation approach uses the following equation:

$$\begin{aligned} S &= VC + FC \\ S - VC &= FC \end{aligned}$$

where S = sales, VC = variable cost, (S – VC) = contribution margin, and FC = fixed cost.

Note: At the breakeven point, the contribution margin equals total fixed cost.

This approach allows you to solve for break-even sales or for other unknowns as well. An example is selling price. If you want a desired before-tax profit, solve for P in the following equation:

$$S = VC + FC + P$$

EXAMPLE 1.1

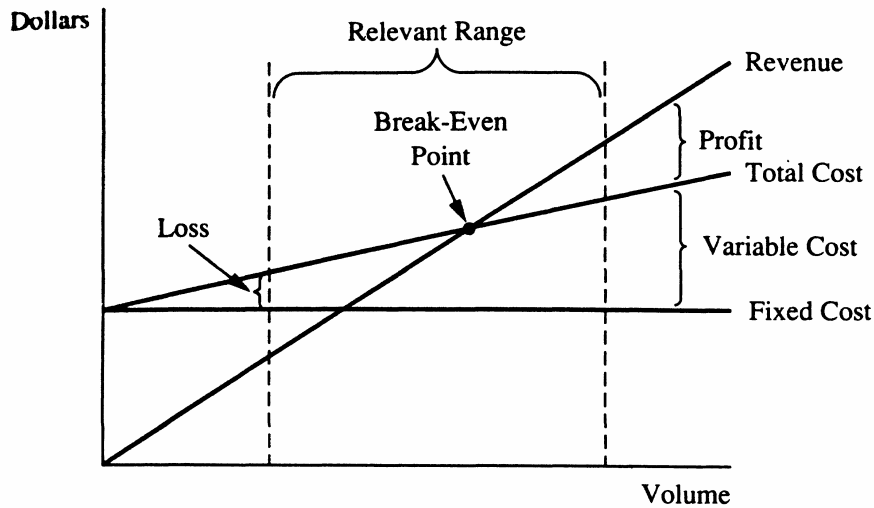
A product has a fixed cost of \$270,000 and a variable cost of 70% of sales. The point of break-even sales can be calculated as follows:

$$\begin{aligned} S &= FC + VC \\ 1S &= \$270,000 + .7S \\ 0.3S &= \$270,000 \\ S &= \$900,000 \end{aligned}$$

If the selling price per unit is \$100, break-even units are 9,000 (\$900,000/\$100). If desired profit is \$40,000, the sales needed to obtain that profit (P) can be calculated as follows:

$$\begin{aligned} S &= FC + VC + P \\ 1S &= \$270,000 + 0.7S + \$40,000 \\ 0.3S &= \$310,000 \\ S &= \$1,033,333 \end{aligned}$$

**FIGURE 1.1
BREAK-EVEN CHART**



EXAMPLE 1.2

If the selling price per unit is \$30, the variable cost per unit is \$20, and the fixed cost is \$400,000, the break-even units (U) can be calculated as follows:

$$\begin{array}{rclcl}
 S & = & FC & + & VC \\
 \$30U & = & \$400,000 & + & \$20U \\
 \$10U & = & \$400,000 & & \\
 U & = & 40,000 & &
 \end{array}$$

The break-even dollar amount is:

$$40,000 \text{ units} \times \$30 = \$1,200,000$$

EXAMPLE 1.3

You sell 800,000 units of an item. The variable cost is \$2.50 per unit. Fixed cost totals \$750,000. The selling price (SP) per unit should be \$3.44 to break even:

$$\begin{array}{rclcl}
 S & = & FC & + & VC \\
 800,000SP & = & \$750,000 & + & (\$2.50 \times 800,000) \\
 800,000SP & = & \$2,750,000 & & \\
 SP & = & \$3.44 & &
 \end{array}$$

EXAMPLE 1.4

Assume your selling price is \$40, your sales volume is 20,000 units, your variable cost is \$15 per unit, your fixed cost is \$120,000, your after-tax profit is \$60,000, and your tax rate is 40%. To determine how much you have available to spend on research (R), consider this equation:

$$\begin{aligned}
 S &= VC + FC + P + R \\
 (\$40 \times 20,000) &= (\$15 \times 20,000) + \$120,000 + \$100,000^* + R \\
 \\
 & \$280,000 = R
 \end{aligned}$$

$$* \text{ After-tax profit: } \$60,000 = 0.6 \times \text{before-tax profit}$$

$$\frac{\$60,000}{.6} = \text{before-tax profit}$$

$$\$100,000 = \text{before-tax profit}$$

EXAMPLE 1.5

Assume your selling price is \$40, your variable cost is \$24, your fixed cost is \$150,000, your after-tax profit is \$240,000, and your tax rate is 40%. To determine how many units you must sell to earn the after-tax profit, consider the following equation:

$$\begin{aligned}
 S &= FC + VC + P \\
 \$40 U &= \$150,000 + \$24 U + \$400,000^* \\
 \$16 U &= \$550,000 \\
 U &= 34,375
 \end{aligned}$$

$$*0.6 \times \text{before-tax profit} = \text{after-tax profit}$$

$$0.6 \times \text{before-tax profit} = \$240,000$$

$$\text{Before-tax profit} = \frac{\$240,000}{0.6} = \$400,000$$

EXAMPLE 1.6

Assume your selling price is \$50 per unit, your variable cost is \$30 per unit, your sales volume is 60,000 units, your fixed cost is \$150,000, and your tax rate 30%. To determine the after-tax profit, use the following equation:

$$\begin{aligned}
 S &= FC + VC + P \\
 (\$50 \times 60,000) &= 150,000 + (\$30 \times 60,000) + P
 \end{aligned}$$

$$1,050,000 = P$$

$$\text{After-tax profit} = \$1,050,000 \times 0.70 = \$735,000$$

EXAMPLE 1.7

You are considering making a product presently purchased outside for \$0.12 per unit. The fixed cost is \$10,000, and the variable cost per unit is \$0.08. Use the following equation to determine the number of units you must sell so that the annual cost of your machine equals the outside purchase cost.

$$\begin{array}{rclcl} \$0.12 \text{ U} & = & \$10,000 & + & \$0.08 \text{ U} \\ \$0.04 \text{ U} & = & \$10,000 & & \\ \text{U} & = & 250,000 & & \end{array}$$

THE FORMULA APPROACH

In order to compute the break-even point and perform various CVP analyses, note the following important concepts.

CONTRIBUTION MARGIN (CM). The contribution margin (CM) is the excess of sales (S) over the variable costs (VC) of the product or service. It is the amount of money available to cover fixed costs (FC) and to generate profit. Symbolically, $CM = S - VC$

UNIT CM. The unit CM is the excess of the unit selling price (p) less the unit variable cost (v). Symbolically, $\text{unit CM} = p - v$.

CM RATIO. The CM ratio is the contribution margin as a percentage of sales, i.e.,

$$\text{CM Ratio} = \frac{CM}{S} = \frac{(S - VC)}{S} = 1 - \frac{VC}{S}$$

Note: The CM ratio is 1 minus the variable cost ratio. For example, if variable costs are 70% of sales, then the variable cost ratio is 70% and the CM ratio is 30%

The three major formulas for break-even and CVP analysis are:

$$\text{Break-even sales in units (U)} = \frac{FC}{(p - v)} = \frac{\text{Fixed Costs}}{\text{Unit CM}}$$

$$\text{Break-even point in dollars (S)} = \frac{\text{Fixed Costs}}{\text{CM Ratio}}$$

$$\text{Target income sales volume} = \frac{\text{Fixed Costs} + \text{Target Income}}{\text{Unit CM (or CM ratio)}}$$

EXAMPLE 1.8

A product has a fixed cost of \$270,000 and a variable cost of 70% of sales. The CM ratio is then 30%. The break-even sales in dollars (S) can be calculated as follows:

$$\text{Break-even point in dollars (S)} = \frac{\text{Fixed Costs}}{\text{CM Ratio}} = \frac{\$270,000}{.3} = \$900,000$$

If target profit is \$40,000, the sales in dollars (S) needed to obtain that profit can be calculated as follows:

$$\frac{\$270,000 + \$40,000}{.3} = \frac{\$310,000}{.3} = \$1,033,333$$

WHAT IS MARGIN OF SAFETY?

The *margin of safety* is a risk indicator that stipulates the amount by which sales may decline before losses are experienced.

$$\text{Margin of safety} = \frac{\text{Budget sales} - \text{Break-even sales}}{\text{Budget sales}}$$

The lower the ratio, the greater the risk of reaching the break-even point.

EXAMPLE 1.9

If budget sales are \$40,000 and break-even sales are \$34,000, what is your margin of safety?

$$\text{Margin of safety} = \frac{\$40,000 - \$34,000}{\$40,000} = 15\%$$

CASH BREAK-EVEN POINT

If you have a minimum of available cash, or if the opportunity cost of holding excess cash is high, you may want to know the volume of sales that will cover all cash expenses during a period. This is known as the *cash break-even point*.

Not all fixed costs involve cash payments. For example, depreciation expense is a noncash charge. To find the cash break-even point, the noncash charges must be subtracted from total fixed costs. Therefore, the cash break-even point is lower than the usual break-even point. The cash break-even point equation is as follows:

$$S = VC + \text{FC (after deducting depreciation)}$$

EXAMPLE 1.10

If the selling price is \$25 per unit, the variable cost is \$15 per unit, and total fixed cost is \$50,000, which includes depreciation of \$2,000, the cash break-even point is:

$$\$25U = \$15U + \$48,000$$

$$\begin{array}{rcl} \$10U & = & \$48,000 \\ U & = & 4,800 \end{array}$$

You must sell 4,800 units at \$25 each to meet your break-even point.

WHAT IS OPERATING LEVERAGE?

Operating leverage is the degree to which fixed costs exist in your cost structure. It is the extent to which you commit yourself to high levels of fixed costs other than interest payments in order to leverage profits during good times. However, high operating leverage means risk because fixed costs cannot be decreased when revenue drops in the short run.

A high ratio of fixed cost to total cost over time may cause variability in profit. But a high ratio of variable cost to total cost indicates stability. It is easier to adjust variable cost than fixed cost when demand for your products decline.

EXAMPLE 1.11

Assume that fixed costs were \$40,000 in 20X0 and \$55,000 in 20X1, and that variable costs were \$25,000 in 20X0 and \$27,000 in 20X1. The operating leverage in 20X1 compared to 20X0 was higher, as indicated by the increase in the ratio of fixed costs to total costs. Hence, there is greater earnings instability.

$$\frac{\$55,000}{\$82,000} = 67.1 \% \text{ for 20X1}$$

$$\frac{\$40,000}{\$65,000} = 61.5\% \text{ for 20X0}$$

EXAMPLE 1.12

Assume that your selling price is \$30 per unit, your variable cost is \$18 per unit, your fixed cost is \$40,000, and your sales volume is 8,000 units. You can determine the extent of operating leverage as follows:

$$\begin{array}{rcl} \frac{(\text{Selling price} - \text{Variable cost}) (\text{Units})}{(\text{Selling price} - \text{Variable Cost}) (\text{Units}) - \text{Fixed cost}} & & \\ \frac{(\$30 - \$18)(8,000)}{(\$30 - \$18)(8,000) - \$40,000} & = & \frac{\$96,000}{\$56,000} = 1.71 \end{array}$$

This means that for every 1% increase in sales above the 8,000-unit volume, income will increase by 1.71 %. If sales increase by 10%, net income will rise by 17.1%.

EXAMPLE 1.13

You are evaluating operating leverage. Your selling price is \$2 per unit, your fixed cost is \$50,000, and your variable cost is \$1.10 per unit. The first example assumes a sales volume of 100,000 units; the second assumes a sales volume of 130,000 units.

Sales Volume (in dollars)	-	Fixed Cost	-	Variable Cost	=	Net Income
(100,000 x \$2)	-	\$50,000	-	\$110,000	=	\$40,000
(130,000 x \$2)	-	\$50,000	-	\$143,000	=	\$67,000

The ratio of the percentage change in net income to the percentage change in sales volume is as follows:

$$\frac{\frac{\text{Change in net income}}{\text{Net Income}}}{\frac{\text{Change in quantity}}{\text{Quantity}}} = \frac{\frac{\$67,000 - \$40,000}{\$40,000}}{\frac{130,000 - 100,000}{100,000}} = \frac{\frac{\$27,000}{\$40,000}}{\frac{30,000}{100,000}} = \frac{67.5\%}{30.0\%} = 2.25$$

If fixed cost remains the same, the 2.25 figure tells you that for every 1% increase in sales above the 100,000-unit volume there will be a 2.25% increase in net income. Thus, a 10% jump in sales will boost net income 22.5%. The same proportionate operating leverage develops regardless of the size of the sales increase above the 100,000-unit level.

The opportunity to magnify the increase in earnings that arises from any increase in sales suggests that you should use a high degree of operating leverage. Presumably, fixed operating costs should constitute a larger proportion of the total cost at a particular sales level so as to enhance the gains realized from any subsequent rise in sales. While a high degree of operating leverage is sometimes a desirable objective, there is the risk of financial damage caused by a drop in sales. It should also be noted that the more unpredictable sales volume is, the more desirable it is to have a high degree of operating leverage. *Remember:* Fixed costs magnify the gain or loss from any fluctuation in sales.

If you have a high degree of operating leverage, you should not simultaneously use a high degree of financial leverage (debt) because the combination makes the risk associated with your operations too severe for a volatile economic environment. Alternatively, if you have a low degree of operating leverage you can often take on a higher level of financial leverage. The lower risk of operating leverage balances the higher risk of financial leverage (debt position). The tradeoffs determine how much financial and operating leverage to use.

One example of an operating leverage question you may face is whether to buy buildings and equipment or rent them. If you buy them, you incur fixed costs even if volume declines. If there is a rental with a *short-term lease*, the annual cost is likely to be more, but it is easier to terminate the fixed cost in a business downturn. Another operating leverage decision involves whether to purchase plant and facilities and manufacture all components of the product or to subcontract the manufacturing and just do assembly. With subcontracting, contracts can be

terminated when demand declines. If plant and equipment is bought, the fixed cost remains even if demand declines.

Operating leverage is an issue that directly impacts line managers. The level of operating leverage selected should not be made without input from the production managers. In general, newer technology has a higher fixed cost and lower variable cost than older technology. Managers must determine whether the risks associated with higher fixed costs are worth the potential returns.

SALES MIX ANALYSIS

Break-even analysis requires some additional considerations when your company produces and sells more than one product. Different selling prices and different variable costs result in different unit contribution margins. As a result, break-even points vary with the relative proportions of the products sold, called the *sales mix*. In break-even analysis, it is necessary to predetermine the sales mix and then compute a weighted average contribution margin (CM). It is also necessary to assume that the sales mix does not change for a specified period.

The break-even formula for the company as a whole is:

$$\text{Break-even sales in units (or in dollars)} = \frac{\text{Fixed Costs}}{\text{Weighted Average Unit CM (or CM Ratio)}}$$

EXAMPLE 1.14

Your company has fixed costs of \$76,000 and two products with the following contribution margin data:

	<u>Product A</u>	<u>Product B</u>
Selling price	\$15	\$10
Less: Variable cost	<u>12</u>	<u>5</u>
Unit CM	<u>\$ 3</u>	<u>\$ 5</u>
Sales mix	60%	40%

The weighted average unit contribution margin is:

$$\$3(.6) + \$5(.4) = \$3.80$$

Your company's break-even point in units is:

$$\$76,000/\$3.80 = 20,000 \text{ units}$$

which is divided as follows:

Product A:	20,000 units	x	60%	=	12,000 units
Product B:	20,000 units	x	40%	=	8,000 units

EXAMPLE 1.15

Your company has total fixed costs of \$18,600 and produces and sells three products:

	<u>Product A</u>	<u>Product B</u>	<u>Product C</u>	<u>Total</u>
Sales	\$30,000	\$60,000	\$10,000	\$100,000
Less: Variable cost	<u>24,000</u>	<u>40,000</u>	<u>5,000</u>	<u>69,000</u>
Contribution margin	<u>\$6,000</u>	<u>\$20,000</u>	<u>\$ 5,000</u>	<u>\$ 31,000</u>
Contribution margin ratio	20%	33 $\frac{1}{3}$ %	50%	31%
Sales Mix	30%	60%	10%	100%

Since the contribution margin ratio for your company is 31%, the break-even point in dollars is:

$$\$18,600 / .31 = \$60,000$$

which will be split in the mix ratio of 3:6:1 to give us the following break-even points for the individual products A, B, and C:

Product A:	\$60,000	x	30%	=	\$18,000
Product B:	\$60,000	x	60%	=	\$36,000
Product C:	\$60,000	x	10%	=	<u>\$ 6,000</u>
					<u>\$60,000</u>

One important assumption in a multiproduct company is that the sales mix will not change during the planning period. If the sales mix does change, however, the break-even point will also change.

CONTRIBUTION MARGIN ANALYSIS

Contribution margin analysis is used to evaluate the performance of the manager and activity. Contribution margin equals sales less variable cost. The contribution margin income statement looks at cost behavior. It shows the relationship between variable cost and fixed cost, irrespective of the functions a given cost item is associated with. When analyzing the manufacturing and/or selling functions of your company, you are faced with the problem of choosing between alternative courses of action. Examples are:

- Whether to accept or reject a special order
- Whether to sell or process further
- Whether to make or buy
- Whether to add or drop a certain product line
- How to utilize scarce resources

Illustrative Contribution Margin Income Statement

Sales
Less variable cost of sales
Manufacturing contribution margin
Less variable selling and administrative expenses
Contribution margin
Less fixed cost
Net income

Advantages of Contribution Margin Income Statement

- Aids in decision making, such as whether to drop or push a product line
- Aids in deciding whether to ask a selling price that is below the normal price

Tip: When idle capacity exists, an order should be accepted at below the normal selling price as long as a contribution margin is earned, since fixed cost will not change.

Disadvantages of Contribution Margin Income Statement

- Not accepted for financial reporting or tax purposes
- Ignores fixed overhead as a product cost
- Difficult to segregate fixed cost and variable cost

ACCEPTING OR REJECTING A SPECIAL ORDER

You may receive a special order for your products at a lower price than usual. Normally, you may refuse such an order since it will not yield a satisfactory profit. However, if sales are slumping, such an order should be accepted if the incremental revenue obtained from it exceeds the incremental costs involved. The company should accept this price since it is better to receive some revenue than to receive nothing at all. A price that is lower than the regular price is called a *contribution price*. *This contribution approach to pricing* is most appropriate when: (1) there is a distressing operating situation where demand has fallen off, (2) there is idle capacity, or (3) there is sharp competition or a competitive bidding situation.

EXAMPLE 1.16

Your company has a 100,000-unit capacity. You are producing and selling only 90,000 units of a product each year at a regular price of \$2. If the variable cost per unit is \$1 and the annual fixed cost is \$45,000, the income statement follows:

	<u>Total</u>	<u>Per Unit</u>
Sales (90,000 units)	\$180,000	\$2.00
Less: Variable costs (90,000 units)	<u>90,000</u>	<u>1.00</u>
Contribution margin	\$90,000	\$1.00
Less: Fixed cost	<u>45,000</u>	<u>0.50</u>
Net income	<u>\$45,000</u>	<u>\$0.50</u>

The company received an order calling for 10,000 units at \$1.20 per unit, for a total of \$12,000. The buyer will pay the shipping expenses. Although the acceptance of this order will not affect regular sales, you are reluctant to accept it because the \$1.20 price is below the \$1.50 factory unit cost ($\$1.50 = \$1.00 + \0.50). You must consider, however, that you can add to total profits by accepting this special order even though the price offered is below the unit factory cost. At a price of \$1.20, the order will contribute \$0.20 per unit (contribution margin per unit = $\$1.20 - \$1.00 = \$0.20$) toward fixed cost, and profit will increase by \$2,000 (10,000 units x \$0.20). Using the contribution approach to pricing, the variable cost of \$1 will be a better guide than the full unit cost of \$1.50. Note that the fixed costs will not increase.

	<i>Per Unit</i>	<i>Without Special Order (90,000 Units)</i>	<i>With Special Order (100,000 Units)</i>	<i>Difference</i>
Sales	\$2.00	\$180,000	\$192,000	\$12,000
Less: Variable costs	<u>1.00</u>	<u>90,000</u>	<u>100,000</u>	<u>10,000</u>
Contribution margin	\$1.00	\$ 90,000	\$ 92,000	\$ 2,000
Less-. Fixed cost	<u>0.50</u>	<u>45,000</u>	<u>45,000</u>	
Net income	<u>\$0.50</u>	<u>\$45,000</u>	<u>\$47,000</u>	<u>\$2,000</u>

ANALYZING THE MAKE-OR-BUY DECISION

Deciding whether to produce a component part internally or to buy it from a supplier is called a *make-or-buy decision*. This decision involves both qualitative factors (e.g., product quality and long-term business relationships with subcontractors) and quantitative factors (e.g., cost). The quantitative effects of the make-or-buy decision are best seen through incremental analysis.

EXAMPLE 1.17

You have prepared the following cost estimates for manufacture of a subassembly component based on an annual product of 8,000 units:

	<i>Per Unit</i>	<i>Total</i>
Direct material	\$ 5	\$40,000
Direct labor	4	32,000
Variable factory overhead applied	4	32,000
Fixed factory overhead applied (150% of direct labor cost)	<u>6</u>	<u>\$48,000</u>
Total Cost	<u>\$19</u>	<u>\$152,000</u>

A supplier offers the subassembly at a price of \$16 each. Two-thirds of fixed factory overhead, which represent executive salaries, rent, depreciation, taxes, continue regardless of the decision. To determine whether to make or buy the product, you must evaluate the relevant costs that change between the alternatives. Assuming productive capacity will be idle if not used to produce the subassembly, the analysis is as follows:

	<u>Per Unit</u>		<u>Total of 8,000 Units</u>	
	<u>Make</u>	<u>Buy</u>	<u>Make</u>	<u>Buy</u>
Purchase price		16		128,000
Direct material	\$ 5		\$40,000	
Direct Labor	4		32,000	
Variable overhead	4		32,000	
Fixed overhead that can be avoided by not making	2		16,000	
Total relevant costs	<u>\$15</u>	<u>\$16</u>	<u>\$120,000</u>	<u>\$128,000</u>
Difference in favor of making	<u>\$ 1</u>		<u>\$ 8,000</u>	

The make-or-buy decision must be evaluated in the broader perspective of considering how best to utilize available facilities. The alternatives include:

1. Leaving facilities idle
2. Renting out idle facilities
3. Using idle facilities for other products

DETERMINING WHETHER TO SELL OR PROCESS FURTHER

When two or more products are produced simultaneously from the same input by a joint process, these products are called *joint products*. The term *joint costs* is used to describe all the manufacturing costs incurred prior to the point at which the joint products are identified as individual products that is, the *split-off point*. At the split-off point some of the joint products are in final form and can be sold to the consumer, whereas others require additional processing. In many cases, however, you might have an option: you can sell the goods at the split-off point or process them further in the hope of obtaining additional revenue. Joint costs are considered irrelevant to this sell-or-process-further decision, since the joint costs have already been incurred at the time of the decision and, therefore, represent sunk costs. The decision will rely exclusively on additional revenue compared to the additional costs incurred due to further processing.

EXAMPLE 1.18

Your company produces products A, B, and C from a joint process. Joint production costs for the year are \$120,000. Product A may be sold at the split-off point or processed further. The additional processing requires no special facilities, and all additional processing costs are variable. The sales value at the split-off point of 3,000 units is \$60,000. The sales value for 3,000 units after further processing is \$90,000 and the additional processing cost is \$25,000.

Incremental sales revenue	\$30,000
Incremental costs of additional processing	<u>25,000</u>
Incremental gain or CM of additional processing	<u>5,000</u>

It is profitable for product A to be processed further. Keep in mind that the joint production cost of \$120,000 is not included in the analysis, since it is a sunk cost and therefore, is irrelevant to the decision.

ADDING OR DROPPING A PRODUCT LINE

Deciding whether to drop an old product line or add a new one requires an evaluation of both qualitative and quantitative factors. However, any final decision should be based primarily on the impact on contribution margin or net income.

EXAMPLE 1.19

Your company has three major product lines: A, B, and C. You are considering dropping product line B because it is being sold at a loss. The income statement for these product lines follows:

	<u>Product A</u>	<u>Product B</u>	<u>Product C</u>	<u>Total</u>
Sales	\$10,000	\$15,000	\$25,000	\$50,000
Less: Variable costs	<u>6,000</u>	<u>8,000</u>	<u>12,000</u>	<u>26,000</u>
Contribution margin	<u>\$ 4,000</u>	<u>\$ 7,000</u>	<u>\$13,000</u>	<u>\$24,000</u>
Less: Fixed costs				
Direct	\$ 2,000	\$ 6,500	\$ 4,000	\$12,500
Allocated	<u>1,000</u>	<u>1,500</u>	<u>2,500</u>	<u>5,000</u>
Total	<u>\$ 3,000</u>	<u>\$ 8,000</u>	<u>\$ 6,500</u>	<u>\$17,500</u>
Net Income	<u>\$ 1,000</u>	<u>\$(1,000)</u>	<u>\$ 6,500</u>	<u>\$ 6,500</u>

Direct fixed cost are identified directly with each of the product lines, whereas allocated fixed costs are common fixed costs allocated to the product lines using some base (e.g., space occupied). Common fixed costs typically continue regardless of the decision and thus cannot be saved by dropping the product line to which they are distributed.

The following calculations show the effects on your company with and without product line B.

	<u>Keep</u>	<u>Drop</u>	
	<u>Product B</u>	<u>Product B</u>	<u>Difference</u>
Sales	\$50,000	\$35,000	\$(15,000)
Less: Variable cost	26,000	18,000	(8,000)
Contribution margin	<u>24,000</u>	<u>17,000</u>	<u>(7,000)</u>
Less: Fixed costs			
Direct	\$12,500	\$ 6,000	\$ (6,500)
Allocated	<u>5,000</u>	<u>5,000</u>	
Total	<u>\$17,500</u>	<u>\$11,000</u>	<u>\$ (6,500)</u>
Net Income	<u>\$ 6,500</u>	<u>\$ 6,000</u>	<u>\$ 500</u>

Alternatively, if product line B were dropped, the incremental approach would show the following:

Sales revenue lost	\$15,000
Gains:	

Variable cost avoided	\$8,000	
Directed fixed costs avoided	<u>6,000</u>	<u>14,500</u>
Increase (decrease) in net income		<u>\$ (500)</u>

Both methods demonstrate that by dropping product line B your company will lose an additional \$500. Therefore, product line B should be kept. One of the great dangers in allocating common fixed costs is that such allocations can make a product line look less profitable than it really is. Because of such an allocation, product line B showed a loss of \$1,000 but it actually contributes \$500 (\$7,000 - \$6,500) to the recovery of common fixed costs.

UTILIZING SCARCE RESOURCES

In general, the emphasis on products with higher contribution margins maximizes your company's net income. This is not true, however, when there are constraining factors or scarce resources. A *constraining factor* is the factor that restricts or limits the production or sale of a given product. It may be machine hours, labor hours, or cubic feet of warehouse space. In the presence of these constraining factors, maximizing profit depends on getting the highest contribution margin per unit of the *factor* (rather than the highest contribution margin per unit of *product output*).

EXAMPLE 1.20

Your company produces products A and B with the following contribution margins per unit and an annual fixed cost of \$42,000.

	<u>Product A</u>	<u>Product B</u>
Sales	\$8	\$24
Less: Variable costs	<u>6</u>	<u>20</u>
Contribution margin	<u>\$2</u>	<u>\$ 4</u>

As is indicated by the contribution margin, product B is more profitable than product A since it contributes more to your company's profits (\$4 versus \$2). But assume that your company has a limited capacity of 10,000 labor hours. Further, assume that product A requires 2 labor hours to produce and product B requires 5 labor hours. One way to express this limited capacity is to determine the contribution margin per labor hour.

	<u>Product A</u>	<u>Product B</u>
Contribution margin per unit	\$2.00	\$4.00
Labor hours required per unit	<u>2</u>	<u>5</u>
Contribution margin per labor hour	<u>\$1.00</u>	<u>\$0.80</u>

Since product A returns the higher contribution margin per labor hour, it should be produced and product B should be dropped.

Another way to look at the problem is to calculate the total contribution margin for each product.

	<u>Product A</u>	<u>Product B</u>
Maximum possible production	5,000 units*	2,000 units**
Contribution margin per unit	<u>x \$2</u>	<u>x \$4</u>
Total contribution margin	<u>\$10,000</u>	<u>\$8,000</u>
	*(10,000 hours/2 hours)	
	** (10,000 hours/5 hours)	

Again, product A should be produced since it contributes more than product B (\$10,000 versus \$8,000)

DON'T FORGET THE QUALITATIVE FACTORS

In addition to the quantitative factors highlighted by contribution margin analysis, qualitative factors must also be considered in the decision-making. They include:

1. Effect on employee morale, schedules and other internal factors
2. Relationships with and commitments to suppliers
3. Effect on present and future customers
4. Long-term future effect on profitability

In some decision-making situations, qualitative factors are more important than immediate financial benefit.

CONCLUSION

Break-even analysis assists you in making management decisions concerning the feasibility of introducing products or services. The impact of fixed costs in the cost structure has to be considered in evaluating corporate operational risk. Contribution margin analysis tells us whether to accept a below-normal selling price, which products to emphasize, how to optimize utilization of capacity, and how to formulate a bid price on a contract.

CHAPTER 2

UNDERSTANDING AND APPLYING THE TIME VALUE OF MONEY CONCEPT

LEARNING OBJECTIVES

After studying the material in this chapter, you will be able:

1. Understand the concept of future value.
2. Distinguish between future value and present value concepts.
3. Calculate the future value of a single payment and an annuity.
4. Calculate the present value of a single payment and an annuity.
5. Explain perpetuities

You cannot treat today's and tomorrow's dollars the same. This chapter looks at the relationship between present (discounted) and future (compound, amount of) values of money. Applications of present values and future values include loans, leases, bonds, sinking fund, growth rates, capital budgeting investment selection, and effect of inflation on the organization. You can solve for many different types of unknowns, such as interest rate, annual payment, number of periods, present amount, and future amount. Present value and future value calculations have many applications in accounting, financial, and investment decisions.

ASSUMPTIONS OF PRESENT VALUE AND FUTURE VALUE TECHNIQUES

- Present value and future value variables (e.g., interest rate, number of periods, annual cash flows) are known with certainty.
- The interest rate is constant.
- All amounts in a series are equal.

We will be using the following tables throughout this chapter.

Future Value of \$1	Table 2.1
Future Value of an Annuity of \$1	Table 2.2
Present Value of \$1	Table 2.3
Present Value of an Annuity of \$1	Table 2.4

Future value is sometimes called amount of, sum of, or compound value. Present value is sometimes called *discounted value*, year zero value, or current value.

Some rules for using the present and future value tables throughout this chapter follow.

PRESENT VALUE TABLE

- A present value table is used if you want to determine the *current* amount of receiving

future cash flows.

- The Present Value of \$1 table is used if you have unequal cash flows each period or a lump-sum cash flow.
- The Present Value of an Annuity of \$1 table is used if the cash flows each period are equal and occur at the end of the period.
- The Present Value of an Annuity Due (which requires modification of The Present Value of an Annuity table) is used if the cash flows each period are equal and occur at the beginning of the period.

FUTURE VALUE TABLE

- A Future Value table is used if you want to determine the future (later) amount of giving cash flows.
- The Future Value of \$1 table is used if you have unequal cash flows each period or a lump-sum cash flow.
- The Future Value of an Annuity of \$1 table is used if the cash flows each period are equal and occur at the end of the period.
- The Future Value of an Annuity Due (which requires modification of The Future Value of an Annuity table) is used if the cash flows each period are equal and occur at the beginning of each period.

BOTH PRESENT VALUE AND FUTURE VALUE TABLES

- If you want to determine a total dollar amount either in the present or future, you have a multiplication problem.
- If you want to calculate an annual payment, interest rate, or number of periods, you have a division problem. In such a case, what you put in the numerator of a fraction determines which table to use. For example, if you put in the numerator a future value that involves equal year-end payments, you have to use the Future Value of an Annuity table.
- If you are given a present value amount, it goes in the numerator of the fraction. On the other hand, if you are given a future value amount, that value goes in the numerator.
- If you are solving for an annual payment, you divide the numerator by the factor corresponding to the interest rate (i) and the number of periods (n).
- If you are solving for an interest rate, divide the numerator by the annual payment to get a factor. Then, to find the interest rate, find that factor on the table opposite the number of years. The interest rate will be indicated at the top of the column where the factor is located.
- If you are solving for the number of years, you divide the numerator by the annual payment to get the factor. Then find the factor in the appropriate interest rate column. The number of years will be indicated in the far left-hand column.

Now let us look at examples using the different tables.

FUTURE VALUE OF \$1 (TABLE 2.1)

EXAMPLE 2.1

You put \$400 in a savings account earning 10 percent interest compounded annually for six years. You will have accumulated

$$\$400 \times 1.7716 = \$708.64$$

EXAMPLE 2.2

You deposit \$10,000 in an account offering an annual interest rate of 20 percent. You will keep the money on deposit for five years. The interest rate is compounded quarterly. The accumulated amount at the end of the fifth year is

$$n = 5 \times 4 = 20$$

$$i = 20/4 = 5\%$$

$$\$10,000 \times 2.6533 = \$26,533$$

EXAMPLE 2.3

On 1/1/2001 you deposit \$10,000 to earn 10 percent compounded semiannually. Effective 1/1/2005 the interest rate is increased to 12 percent, and at that time you decide to double your balance. You want to determine how much will be accumulated in your account on 1/1/2011.

1/1/2001—1/1/2005:	n	=	4 x 2	=	8
	i	=	10% / 2	=	5%
			\$10,000 x 1.4775	=	\$14,775
1/1/2005:					
Double balance					<u>\$14,775</u>
1/1/2005:					
Total balance					\$29 550
1/1/2005-1/1/2011:	n	=	6 x 2	=	12
	i	=	12% / 2	=	6%
			\$29,550 x 2.0122		<u>\$59,460.51</u>

EXAMPLE 2.4

You want to have \$1,000,000 at the end of 15 years. The interest rate is 8 percent. You have to deposit today the following sum to accomplish your objective:

$$\frac{\$1,000,000}{3.1722} = \$315,238.63$$

EXAMPLE 2.5

At an interest rate of 12 percent, you want to know how long it will take for your money to double.

$$\frac{\$2}{\$1} = 2$$

n = 6 years (falls closer to 6 years)

EXAMPLE 2.6

You want to have \$250,000. Your initial deposit is \$30,000. The interest rate is 12 percent. The number of years it will take to reach your goal is

$$\frac{\$250,000}{\$30,000} = 8.3333$$

n = 18.5 years (approximately). Factor falls about midway between 18 and 19 years.

EXAMPLE 2.7

You agree to pay back \$3,000 in six years on a \$2,000 loan made today. You are being charged an interest rate of

$$\frac{\$3,000}{\$2,000} = 1.5$$

i=7%

EXAMPLE 2.8

Your earnings per share was \$1.20 in 20X1, and eight years later it was \$3.67. The compound annual growth rate is

$$\frac{\$3.67}{\$1.20} = 3.059$$

Growth rate = 15%

FUTURE VALUE OF AN ANNUITY OF \$1 (TABLE 2.2)

EXAMPLE 2.9

You plan to pay into a sinking fund \$20,000 year-end payments for the next 15 years. The fund earns an interest of 8 percent compounded once a year. The accumulated balance at the end of the fifteenth year is

$$\$20,000 \times 27.152 = \$543,040$$

EXAMPLE 2.10

You deposit \$30,000 semiannually into a fund for ten years. The annual interest rate is 8 percent. The amount accumulated at the end of the tenth year is calculated as follows:

$$n = 10 \times 2 = 20$$

$$i = 8\% / 2 = 4\%$$

$$\$30,000 \times 29.778 = \$893,340$$

EXAMPLE 2.11

You borrow \$300,000 for 20 years at 10 percent. At the end of the 20-year period, you will have to pay

$$\$300,000 \times 6.7275^* = \underline{\$2,018,250}$$

*Future Value of \$1 (Table 2.1)

The interest amount equals

\$2,018,250	Maturity value
<u>- 300,000</u>	Principal
<u>\$1,718,250</u>	Interest

EXAMPLE 2.12

You want to determine the annual year-end deposit needed to accumulate \$100,000 at the end of 15 years. The interest rate is 12 percent. The annual deposit is

$$\frac{\$100,000}{37.279} = \$2,682.48$$

EXAMPLE 2.13

You need a sinking fund for the retirement of a bond 30 years from now. The interest rate is 10 percent. The annual year-end contribution needed to accumulate \$1,000,000 is

$$\frac{\$1,000,000}{164.49} = \$6,079.40$$

EXAMPLE 2.14

You want to have \$600,000 accumulated in your fund. You make four deposits of \$100,000 per year. The interest rate you must earn is

$$\frac{\$600,000}{\$100,000} = 6$$

i = 28% (approximately)

EXAMPLE 2.15

You want to have \$500,000 accumulated in a pension plan after nine years. You deposit \$30,000 per year. The interest rate you must earn is

$$\frac{\$500,000}{\$30,000} = 16.667$$

i = 15% (approximately)

EXAMPLE 2.16

You want \$500,000 in the future. The interest rate is 10 percent. The annual payment is \$80,000. The number of years it will take to accomplish this objective is

$$\frac{\$500,000}{\$80,000} = 6.25$$

n = 5 years (approximately)

FUTURE VALUE OF AN ANNUITY DUE OF \$1 (TABLE 2.2. ADJUSTED)

Calculation of the future value of an annuity due of \$1 requires a minor adjustment to the Future Value of an Ordinary Annuity of \$1 table. To get the future value of an annuity due, add 1 to the number of years and then obtain the factor. Then subtract 1 from this factor.

EXAMPLE 2.17

You make \$25,000 payments at the beginning of the year into a sinking fund for 20 years. The interest rate is 12 percent. The accumulated value of the fund at the end of the twentieth year is

$$n = 20 + 1 = 21$$

Factor	81.698
	<u>1.000</u>
Adjusted	80.698

$$\$25,000 \times 80.698 = \$2,017,450$$

EXAMPLE 2.18

You want to accumulate \$600,000 in an account. You are going to make eight yearly deposits. The interest rate is 12 percent. The annual deposit is

$$n = 8 + 1 = 9$$

$$\frac{\$600,000}{14.775 - 1} = \frac{\$600,000}{13.775} = \$43,557.17$$

Table 2.1 Future Value of \$1

Number of Years	Interest Rate																			
	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	12%	14%	15%	16%	18%	20%	24%	28%	32%	36%
1	1.0100	1.0200	1.0300	1.0400	1.0500	1.0600	1.0700	1.0800	1.0900	1.1000	1.1200	1.1400	1.1500	1.1600	1.1800	1.2000	1.2400	1.2800	1.3200	1.3600
2	1.0201	1.0404	1.0609	1.0816	1.1025	1.1236	1.1449	1.1664	1.1881	1.2100	1.2544	1.2996	1.3225	1.3456	1.3692	1.4400	1.5376	1.6384	1.7424	1.8496
3	1.0303	1.0612	1.0927	1.1249	1.1576	1.1910	1.2250	1.2597	1.2950	1.3310	1.4049	1.4815	1.5209	1.5609	1.6030	1.7280	1.9066	2.0972	2.3000	2.5155
4	1.0406	1.0824	1.1255	1.1699	1.2155	1.2625	1.3108	1.3605	1.4116	1.4641	1.5735	1.6890	1.7490	1.8106	1.9388	2.0736	2.3642	2.6844	3.0360	3.4210
5	1.0510	1.1041	1.1593	1.2167	1.2763	1.3382	1.4026	1.4693	1.5386	1.6105	1.7623	1.9254	2.0144	2.1003	2.2878	2.4883	2.9316	3.4360	4.0075	4.6526
6	1.0615	1.1262	1.1941	1.2653	1.3401	1.4185	1.5007	1.5869	1.6771	1.7716	1.9738	2.1950	2.3131	2.4364	2.6966	2.9860	3.6352	4.3980	5.2899	6.3275
7	1.0721	1.1487	1.2299	1.3159	1.4071	1.5036	1.6058	1.7138	1.8280	1.9487	2.2107	2.5023	2.6600	2.8262	3.1855	3.5832	4.5077	5.6295	6.9826	8.6054
8	1.0829	1.1717	1.2668	1.3686	1.4775	1.5938	1.7182	1.8509	1.9926	2.1436	2.4760	2.8526	3.0590	3.2784	3.7589	4.2998	5.5895	7.2058	9.2170	11.703
9	1.0937	1.1951	1.3048	1.4233	1.5513	1.6895	1.8385	1.9990	2.1719	2.3579	2.7731	3.2519	3.5179	3.8030	4.4355	5.1598	6.9310	9.2234	12.166	15.916
10	1.1046	1.2190	1.3439	1.4802	1.6289	1.7908	1.9672	2.1589	2.3674	2.5937	3.1058	3.7072	4.0456	4.4114	5.2338	6.1917	8.5944	11.805	16.059	21.646
11	1.1157	1.2434	1.3842	1.5395	1.7103	1.8983	2.1049	2.3316	2.5804	2.8531	3.4785	4.2262	4.6524	5.1173	6.1759	7.4301	10.657	15.111	21.198	29.439
12	1.1268	1.2682	1.4258	1.6010	1.7959	2.0122	2.2522	2.5182	2.8127	3.1384	3.8960	4.8179	5.3502	5.9360	7.2876	8.9161	13.214	19.342	27.982	40.037
13	1.1381	1.2936	1.4685	1.6651	1.8856	2.1329	2.4098	2.7196	3.0658	3.4523	4.3635	5.4924	6.1528	6.8858	8.5994	10.699	16.386	24.748	36.937	54.451
14	1.1495	1.3195	1.5126	1.7317	1.9799	2.2609	2.5785	2.9372	3.3417	3.7975	4.8871	6.2613	7.0757	7.9875	10.147	12.839	20.319	31.691	48.756	74.053
15	1.1610	1.3459	1.5580	1.8009	2.0789	2.3966	2.7590	3.1722	3.6425	4.1772	5.4736	7.1379	8.1371	9.2655	11.973	15.407	25.195	40.564	53.358	100.71
16	1.1726	1.3728	1.6047	1.8730	2.1829	2.5404	2.9522	3.4259	3.9703	4.5950	6.1304	8.1372	9.3576	10.748	14.129	18.488	31.242	51.923	84.953	136.96
17	1.1834	1.4002	1.6528	1.9479	2.2920	2.6928	3.1588	3.7000	4.3276	5.0545	6.8660	9.2765	10.761	12.467	16.672	22.186	38.740	66.461	112.13	186.27
18	1.1961	1.4282	1.7024	2.0258	2.4066	2.8543	3.3799	3.9960	4.7171	5.5599	7.6900	10.575	12.375	14.462	19.673	26.623	48.038	85.070	148.02	253.33
19	1.2081	1.4568	1.7535	2.1068	2.5270	3.0256	3.6165	4.3157	5.1417	6.1159	8.6129	12.055	14.231	16.776	23.214	31.948	59.567	108.89	195.39	344.53
20	1.2202	1.4859	1.8061	2.1911	2.6533	3.2071	3.8697	4.6610	5.6044	6.7275	9.6463	13.743	16.366	19.460	27.393	38.337	73.864	139.37	257.91	468.57
21	1.2324	1.5157	1.8603	2.2788	2.7860	3.3996	4.1406	5.0338	6.0888	7.4002	10.803	15.667	18.821	22.574	32.323	46.005	91.591	178.40	340.44	637.26
22	1.2447	1.5460	1.9161	2.3699	2.9253	3.6035	4.4304	5.4365	6.6586	8.1403	12.100	17.861	21.644	26.186	38.142	55.206	113.57	228.35	449.39	866.67
23	1.2572	1.5769	1.9736	2.4647	3.0715	3.1897	4.7405	5.8715	7.2579	8.9543	13.552	20.361	24.891	30.376	45.007	66.247	140.83	292.30	593.19	1178.6
24	1.2697	1.6084	2.0328	2.5633	3.2251	4.0489	5.0724	6.3412	7.9111	9.8497	15.178	23.212	28.625	35.236	53.108	79.496	174.63	374.14	783.02	1602.9
25	1.2824	1.6406	2.0938	2.6658	3.3864	4.2919	5.2474	6.8485	8.6231	10.834	17.000	26.461	32.918	40.874	62.668	95.396	216.54	478.90	1033.5	2180.0
26	1.2953	1.6734	2.1566	2.7725	3.5557	4.5497	5.8074	7.3964	9.3992	11.918	19.040	30.166	37.856	47.414	73.948	114.47	268.51	612.99	1364.3	2964.9
27	1.3082	1.7069	2.2213	2.8834	3.7335	4.8223	6.2139	7.9881	10.245	13.110	21.324	34.389	43.535	55.000	87.259	137.37	332.95	784.63	1800.9	4032.2
28	1.3213	1.7410	2.2879	2.9987	3.9201	5.1117	6.6488	8.6271	11.167	14.421	23.883	39.204	50.065	63.800	102.96	164.84	412.86	1004.3	2377.2	5483.8
29	1.3345	1.7758	2.3566	3.1187	4.1161	5.4184	7.1143	9.3173	12.172	15.863	26.749	44.693	57.575	74.008	121.50	197.81	511.95	128.5	3137.9	7458.0
30	1.3478	1.8114	2.4273	3.2434	4.3219	5.7435	7.6123	10.062	13.267	17.449	29.959	50.950	66.211	85.849	143.37	237.37	634.81	1645.5	4142.0	10143.
40	1.4889	2.2080	3.2620	4.8010	7.0400	10.285	14.974	21.724	31.409	45.259	93.050	188.88	267.86	378.72	750.37	1469.7	5455.9	19426.	66520	*
50	1.6446	2.6916	4.3839	7.1067	11.467	18.420	29.457	46.901	74.357	117.39	289.00	700.23	1083.6	1670.7	3927.3	9100.4	46890.	*	*	*
60	1.8167	3.2810	5.8916	10.519	18.679	32.987	57.946	101.25	176.03	304.48	897.59	2595.9	4383.9	7370.1	20555	56347	*	*	*	*

Table 2.2 Future Value of an Annuity of \$1

Number of Years	Interest Rate																			
	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	12%	14%	15%	16%	18%	20%	24%	28%	32%	36%
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400	2.0500	2.0600	2.0700	2.0800	2.0900	2.1000	2.1200	2.1400	2.1500	2.1600	2.1800	2.2000	2.2400	2.2800	2.3200	2.3600
3	3.0301	3.0604	3.0909	3.1216	3.1525	3.1836	3.2149	3.2464	3.2781	3.3100	3.3744	3.4396	3.4725	3.5056	3.5724	3.6400	3.7776	3.9184	4.0624	4.2096
4	4.0604	4.1216	4.1836	4.2465	4.3101	4.3746	4.4399	4.5061	4.5731	4.6410	4.7793	4.9211	4.9934	5.0665	5.2154	5.3680	5.6842	6.0156	6.3624	6.7251
5	5.1010	5.2040	5.3091	5.4163	5.5256	5.6371	5.7507	5.8666	5.9847	6.1051	6.3528	6.6101	6.7424	6.8771	7.1542	7.4416	8.0484	8.6999	9.3983	10.146
6	6.1520	6.3081	6.4684	6.6330	6.8019	6.9753	7.1533	7.3359	7.5233	7.7156	8.1152	8.5355	8.7537	8.9775	9.4420	9.9299	10.980	12.135	13.405	14.798
7	7.2135	7.4343	7.6625	7.8983	8.1420	8.3938	8.6540	8.9228	9.2004	9.4872	10.089	10.730	11.066	11.413	12.141	12.915	14.615	16.533	18.695	21.126
8	8.2857	8.5830	8.8923	9.2142	9.5491	9.8975	10.259	10.636	11.028	11.435	12.299	13.232	13.726	14.240	15.327	16.499	19.122	22.163	25.678	29.731
9	9.3685	9.7546	10.159	10.582	11.026	11.491	11.978	12.487	13.021	13.579	14.775	16.085	16.785	17.518	19.085	20.798	24.712	29.369	34.895	41.435
10	10.462	10.949	11.463	12.006	12.577	13.180	13.816	14.486	15.192	15.937	17.548	19.337	20.303	21.321	23.521	25.958	31.643	38.592	47.061	57.351
11	11.566	12.168	12.807	13.486	14.206	14.971	15.783	16.645	17.560	18.531	20.654	23.044	24.349	25.732	28.755	32.150	40.237	50.398	63.121	78.998
12	12.682	13.412	14.192	15.025	15.917	16.869	17.888	18.977	20.140	21.384	24.133	27.270	29.001	30.850	34.931	39.580	50.894	65.510	84.320	108.43
13	13.809	14.680	15.617	16.626	17.713	18.882	20.140	21.495	22.953	24.522	28.029	32.088	34.351	36.786	42.218	48.496	64.109	84.852	112.30	148.47
14	14.947	15.973	17.086	18.291	19.598	21.015	22.550	24.214	26.019	27.975	32.392	37.581	40.504	43.672	50.818	59.195	80.496	109.61	149.23	202.92
15	16.096	17.293	18.598	20.023	21.578	23.276	25.129	27.152	29.360	31.772	37.279	43.842	47.580	51.659	60.965	72.035	100.81	141.30	197.99	276.97
16	17.257	18.639	20.156	21.824	23.657	25.672	27.888	30.324	33.003	35.949	42.753	50.980	55.717	60.925	72.939	87.442	126.01	181.86	262.35	377.69
17	18.430	20.012	21.761	23.697	25.840	28.212	30.840	33.750	36.973	40.544	48.883	59.117	65.075	71.673	87.068	105.93	157.25	233.79	347.30	514.66
18	19.614	21.412	23.414	25.645	28.132	30.905	33.99	37.450	41.301	45.599	55.749	68.394	75.836	84.140	103.74	128.11	195.99	300.25	459.44	700.93
19	20.810	22.840	25.116	27.671	30.539	33.760	37.379	41.446	46.018	51.159	63.439	78.969	88.211	98.603	123.41	154.74	244.03	385.32	607.47	954.27
20	22.019	24.297	26.870	29.778	33.066	36.785	40.995	45.762	51.160	57.275	72.052	91.024	102.44	115.37	146.62	186.68	303.60	494.21	802.86	1298.8
21	23.239	25.783	28.676	31.969	35.719	39.992	44.865	50.442	56.764	64.002	81.698	104.76	118.81	134.84	174.02	225.02	377.46	633.59	1060.7	1767.3
22	24.471	27.299	30.536	34.248	38.505	43.392	49.005	55.456	62.873	71.402	92.502	120.43	137.63	157.41	206.34	271.03	469.05	811.99	1401.2	2404.6
23	25.716	28.845	32.452	36.617	41.430	46.995	53.436	60.893	69.531	79.543	104.60	138.29	159.27	183.60	244.48	326.23	582.62	1040.3	1850.6	3271.3
24	26.973	30.421	34.426	39.082	44.502	50.815	58.176	66.764	76.789	88.497	118.15	158.65	184.16	213.97	289.49	392.48	723.46	1332.6	2443.8	4449.9
25	28.243	32.030	36.459	41.645	47.727	54.864	63.249	73.105	84.700	98.347	133.33	181.87	212.79	249.21	342.60	471.98	898.09	1706.8	3226.8	6052.9
26	29.525	33.670	38.553	44.311	51.113	59.156	68.676	79.954	93.323	109.18	150.33	208.33	245.71	290.08	405.27	567.37	1114.6	2185.7	4260.4	8233.0
27	30.820	35.344	40.709	47.084	54.669	63.705	74.483	87.350	102.72	121.09	169.37	238.49	283.56	337.50	479.22	681.85	1383.1	2798.7	5624.7	11197.9
28	32.129	37.051	42.930	49.967	58.402	68.528	80.697	95.338	112.96	134.20	190.69	272.88	327.10	392.50	566.48	819.22	1716.0	3583.3	7425.6	15230.2
29	33.450	38.792	45.218	52.966	62.322	73.689	87.346	103.96	124.13	148.63	214.58	312.09	377.16	456.30	669.44	984.06	2128.9	4587.6	9802.9	20714.1
30	34.784	40.568	47.576	56.084	66.438	79.058	94.460	113.28	136.30	164.49	241.33	356.78	434.74	530.31	790.94	1181.8	2640.9	5873.2	12940	28172.2
40	48.886	60.402	75.401	95.025	120.79	154.76	199.63	259.05	337.88	442.59	767.09	1342.0	1779.0	2360.7	4163.2	7343.8	22728	63977	.	.
50	64.473	84.579	112.79	152.66	209.34	290.33	406.52	573.76	815.08	1163.9	2400.0	4994.5	7217.7	10435	21813	45497	.	.	.	.
60	81.669	114.05	163.05	237.90	353.58	533.12	813.52	1253.2	1944.7	3034.8	7471.6	18535	29219	46057	.	.	.	.	.	.

PRESENT VALUE OF \$1 (TABLE 2.3)

The discount rate ordinarily used in present value calculations is called the *cost of capital*, which is the minimum required rate of return set by the firm.

EXAMPLE 2.19

You have an opportunity to receive \$30,000 four years from now. You earn 12 percent on your investment. The most you should pay for this investment is

$$\$30,000 \times 0.6355 = \$19,065$$

EXAMPLE 2.20

You are thinking of starting a new product line that initially costs \$30,000. The interest rate is 10 percent. Your annual net cash inflows are

Year 1	\$8,000
Year 2	15,000
Year 3	18,000

The net present value is positive, as indicated in the following calculations.

<i>Year</i>	<i>Calculation</i>	<i>Net Present Value</i>
0	-\$30,000 x 1	-\$30,000.00
1	8,000 x 0.9091	7,272.80
2	15,000 x 0.8264	12,396.00
3	18,000 x 0.7513	<u>13,523.40</u>
Net present value		<u>\$ 3,192.20</u>

You should undertake the new product line.

PRESENT VALUE OF AN ANNUITY OF \$1 (TABLE 2.4)

Annuities are often received from pension plans and insurance policies. The Present Value of \$1 table (Table 2.3) can be used to solve an annuity of equal payments by making separate calculations for each year's cash flow (multiplying the cash flow for the year by the present value of \$1 factor) and adding them all up over the length of the proposal's life. But the calculation can be done much faster using a Present Value of an Annuity of \$1 table (Table 2.4) All that is required is to multiply the annual cash payment by the factor in the table.

EXAMPLE 2.21

You are trying to determine the price you are willing to pay for a \$1,000, five-year U.S. bond paying \$50 interest semiannually, which is sold to yield 8 percent.

$$\begin{aligned} i &= 8\% / 2 = 4\% \\ n &= 5 \times 2 = 10 \end{aligned}$$

Present Value of \$1 (Table 2.3) for $n = 10$, $i = 4\%$:

$$\$1,000 \times 0.6756 = \$675.60$$

Present Value of an Annuity of \$1 (Table 2.4) for $n = 10$, $i = 4\%$:

$$\begin{aligned} \$50 \times 8.1109 & \quad \underline{405.55} \\ \text{Present value} & \quad \underline{\$1,081.15} \end{aligned}$$

EXAMPLE 2.22

You incur the following expenditures to lease an item:

Year 0	\$3,000
Year 1	4,000
Year 2	5,000
Years 3-10	12,000*

The interest rate is 10 percent.

For years 1 and 2, use the Present Value of \$1 table (Table 2.3).

*You are paying \$12,000 each from year 3 to year 10. While you can calculate it using the Present Value of \$1 table, it is significantly faster and more accurate to use the Present Value of an Annuity table (Table 2.4).

The net present value is

<i>Year</i>	<i>Calculation</i>	<i>Present Value</i>
0	$-\$3,000 \times 1$	$-\$3,000.00$
1	$-4,000 \times 0.9091$	$-3,636.40$
2	$-5,000 \times 0.8264$	$-4,132.00$
3—10	$-12,000 \times (6.1446 - 1.7355)^*$	$\underline{-52,909.20}$
Net present value		$\underline{\underline{\$63,677.60}}$

*Year 10 factor - year 2 factor.

Each loan payment comprises principal and interest. The breakdown is usually shown in a loan amortization table. The interest is higher in the early years than the later years because it is multiplied by a higher loan balance.

EXAMPLE 2.23

You borrow \$200,000 for five years at an interest rate of 14 percent. The annual year-end

payment on the loan is

$$\frac{\$200,000}{3.4331} = \$58,256.39$$

EXAMPLE 2.24

You take out a \$30,000 loan payable monthly over the next 40 months. The annual interest rate is 36 percent. The monthly payment is

$$n = 40$$

$$i = 36/12 = 3\%$$

From Table 2.4, 23.1148 for $n=40$ months and $i=3\%$ monthly

$$\frac{\$30,000}{23.1148} = \$1,297.87$$

EXAMPLE 2.25

You borrow \$300,000 payable \$70,000 a year. The interest rate is 14 percent. The number of years you have to pay off the loan is

$$\frac{\$300,000}{\$70,000} = 4.2857$$

$$n = 7 \text{ years (approximately)}$$

EXAMPLE 2.26

You borrow \$20,000 to be repaid in 12 monthly payments of \$2,131.04. The monthly interest rate is

$$\frac{\$20,000}{\$2,131.04} = 9.3851$$

Table 2.4 for $n=12$ months yields $i=4\%$

EXAMPLE 2.27

You borrow \$1,000,000 and agree to make payments of \$100,000 per year for 18 years. The interest rate you are paying is

$$\frac{\$1,000,000}{\$100,000} = 10$$

$$i = 7 \text{ percent (approximately)}$$

EXAMPLE 2.28

You buy a note for \$14,000. You will receive annual payments of \$2,000 on it for ten years. Your annual yield is

$$\frac{\$14,000}{\$2,000} = 7$$

$$i = 7\%$$

EXAMPLE 2.29

When you retire you want to receive an annuity of \$80,000 at the end of each year for ten years. The interest rate is 8 percent. The amount that must be in your retirement account at the date of retirement is calculated as follows.

Using the Present Value of an Annuity of \$1 table (Table 2.4):

$$\$80,000 \times 6.7101 = \$536,808$$

You also want to know how much you have to deposit into your pension plan at the end of each year to have \$536,808 if you are going to make 20 annual contributions. The interest rate is 6 percent.

Using the Future Value of an Annuity of \$1 table (Table 2.2):

$$\frac{\$536,808}{36.785} = \$14,593.12$$

PRESENT VALUE OF AN ANNUITY DUE OF \$1 (TABLE 2.4 ADJUSTED)

To get the present value of an annuity due, which refers to equal beginning-of-year payments, find the present value of an ordinary annuity of \$1 for one period less than the life of the annuity. Then add 1 to this number.

EXAMPLE 2.30

You will receive ten payments of \$5,000 at the beginning of each year. The interest rate is 14 percent. The present value of the cash receipts is

$$n = 10 - 1 = 9$$

Factor	4.9464
Add	<u>1.0000</u>
Adjusted factor	5.9464

$$\$5,000 \times 5.9464 = \$29,732$$

EXAMPLE 2.31

You owe \$800,000 and will make 15 beginning-of-year payments to pay it off. The interest rate is

n = 15 - 1 = 14	Factor	5.0081
	Add	<u>1.0000</u>
	Adjusted factor	6.0081

$$\frac{\$800,000}{6.0081} = \$133153.57$$

Table 2.3 Present Value of \$1

PERIODS	3%	4%	5%	6%	7%	8%	10%	12%	14%	16%	18%	20%	22%	24%	25%	26%	28%	30%	40%
1	.9709	.9615	.9524	.9434	.9346	.9259	.9091	.8929	.8772	.8621	.8475	.8333	.8197	.8065	.8000	.7937	.7813	.7692	.7143
2	.9426	.9246	.9070	.8900	.8734	.8573	.8264	.7972	.7695	.7432	.7182	.6944	.6719	.6504	.6400	.6299	.6104	.5917	.5102
3	.9151	.8890	.8638	.8396	.8163	.7938	.7513	.7118	.6750	.6407	.6086	.5787	.5507	.5245	.5120	.4999	.4768	.4552	.3644
4	.8885	.8548	.8227	.7921	.7629	.7350	.6830	.6355	.5921	.5523	.5158	.4823	.4514	.4230	.4096	.3968	.3725	.3501	.2603
5	.8626	.8219	.7835	.7473	.7130	.6806	.6209	.5674	.5194	.4761	.4371	.4019	.3700	.3411	.3277	.3149	.2910	.2693	.1859
6	.8375	.7903	.7462	.7050	.6663	.6302	.5645	.5066	.4556	.4104	.3704	.3349	.3033	.2751	.2621	.2499	.2274	.2072	.1328
7	.8131	.7599	.7107	.6651	.6227	.5835	.5132	.4523	.3996	.3538	.3139	.2791	.2486	.2218	.2097	.1983	.1776	.1594	.0949
8	.7894	.7307	.6768	.6274	.5820	.5403	.4665	.4039	.3506	.3050	.2660	.2326	.2038	.1789	.1678	.1574	.1388	.1226	.0678
9	.7664	.7026	.6446	.5919	.5439	.5002	.4241	.3606	.3075	.2630	.2255	.1938	.1670	.1443	.1342	.1249	.1084	.0943	.0484
10	.7441	.6756	.6139	.5584	.5083	.4632	.3855	.3220	.2697	.2267	.1911	.1615	.1369	.1164	.1074	.0992	.0847	.0725	.0346
11	.7224	.6496	.5847	.5268	.4751	.4289	.3505	.2875	.2366	.1954	.1619	.1346	.1122	.0938	.0859	.0787	.0662	.0558	.0247
12	.7014	.6246	.5568	.4970	.4440	.3971	.3186	.2567	.2076	.1685	.1372	.1122	.0920	.0757	.0687	.0625	.0517	.0429	.0176
13	.6810	.6006	.5303	.4688	.4150	.3677	.2897	.2292	.1821	.1452	.1163	.0935	.0754	.0610	.0550	.0496	.0404	.0330	.0126
14	.6611	.5775	.5051	.4423	.3878	.3405	.2633	.2046	.1597	.1252	.0985	.0779	.0618	.0492	.0440	.0393	.0316	.0254	.0090
15	.6419	.5553	.4810	.4173	.3624	.3152	.2394	.1827	.1401	.1079	.0835	.0649	.0507	.0397	.0352	.0312	.0247	.0195	.0064
16	.6232	.5339	.4581	.3936	.3387	.2919	.2176	.1631	.1229	.0930	.0708	.0541	.0415	.0320	.0281	.0248	.0193	.0150	.0046
17	.6050	.5134	.4363	.3714	.3166	.2703	.1978	.1456	.1078	.0802	.0600	.0451	.0340	.0258	.0225	.0197	.0150	.0116	.0033
18	.5874	.4936	.4155	.3503	.2959	.2502	.1799	.1300	.0946	.0691	.0508	.0376	.0279	.0208	.0180	.0156	.0118	.0089	.0023
19	.5703	.4746	.3957	.3305	.2765	.2317	.1635	.1161	.0829	.0596	.0431	.0313	.0229	.0168	.0144	.0124	.0092	.0068	.0017
20	.5537	.4564	.3769	.3118	.2584	.2145	.1486	.1037	.0728	.0514	.0365	.0261	.0187	.0135	.0115	.0098	.0072	.0053	.0012
21	.5375	.4388	.3589	.2942	.2415	.1987	.1351	.0926	.0638	.0443	.0309	.0217	.0154	.0109	.0092	.0078	.0056	.0040	.0009
22	.5219	.4220	.3418	.2775	.2257	.1839	.1228	.0826	.0560	.0382	.0262	.0181	.0126	.0088	.0074	.0062	.0044	.0031	.0006
23	.5067	.4057	.3256	.2618	.2109	.1703	.1117	.0738	.0491	.0329	.0222	.0151	.0103	.0071	.0059	.0049	.0034	.0024	.0004
24	.4919	.3901	.3101	.2470	.1971	.1577	.1015	.0659	.0431	.0284	.0188	.0126	.0085	.0057	.0047	.0039	.0027	.0018	.0003
25	.4776	.3751	.2953	.2330	.1842	.1460	.0923	.0588	.0378	.0245	.0160	.0105	.0069	.0046	.0038	.0031	.0021	.0014	.0002
26	.4637	.3607	.2812	.2198	.1722	.1352	.0839	.0525	.0331	.0211	.0135	.0087	.0057	.0037	.0030	.0025	.0016	.0011	.0002
27	.4502	.3468	.2678	.2074	.1609	.1252	.0763	.0469	.0291	.0182	.0115	.0073	.0047	.0030	.0024	.0019	.0013	.0008	.0001
28	.4371	.3335	.2551	.1956	.1504	.1159	.0693	.0419	.0255	.0157	.0097	.0061	.0038	.0024	.0019	.0015	.0010	.0006	.0001
29	.4243	.3207	.2429	.1846	.1406	.1073	.0630	.0374	.0224	.0135	.0082	.0051	.0031	.0020	.0015	.0012	.0008	.0005	.0001
30	.4120	.3083	.2314	.1741	.1314	.0994	.0573	.0334	.0196	.0116	.0070	.0042	.0026	.0016	.0012	.0010	.0006	.0004	.0000
40	.3066	.2083	.1420	.0972	.0668	.0460	.0221	.0107	.0053	.0026	.0013	.0007	.0004	.0002	.0001	.0001	.0001	.0000	.0000

Table 2.4 Present Value of an Annuity of \$1

Periods	3%	4%	5%	6%	7%	8%	10%	12%	14%	16%	18%	20%	22%	24%
1	.9709	.9615	.9524	.9434	.9346	.9259	.9091	.8929	.8772	.8621	.8475	.8333	.8197	.8065
2	1.9135	1.8861	1.8594	1.8334	1.8080	1.7833	1.7355	1.6901	1.6467	1.6052	1.5656	1.5278	1.4915	1.4568
3	2.8286	2.7751	2.7232	2.6730	2.6243	2.5771	2.4869	2.4018	2.3216	2.2459	2.1743	2.1065	2.0422	1.9813
4	3.7171	3.6299	3.5460	3.4651	3.3872	3.3121	3.1699	3.0373	2.9137	2.7982	2.6901	2.5887	2.4936	2.4043
5	4.5797	4.4518	4.3295	4.2124	4.1002	3.9927	3.7908	3.6048	3.4331	3.2743	3.1272	2.9906	2.8636	2.7454
6	5.4172	5.2421	5.0757	4.9173	4.7665	4.6229	4.3553	4.1114	3.8887	3.6847	3.4976	3.3255	3.1669	3.0205
7	6.2303	6.0021	5.7864	5.5824	5.3893	5.2064	4.8684	4.5638	4.2883	4.0386	3.8115	3.6046	3.4155	3.2423
8	7.0197	6.7327	6.4632	6.2098	5.9713	5.7466	5.3349	4.9676	4.6389	4.3436	4.0776	3.8372	3.6193	3.4212
9	7.7861	7.4353	7.1078	6.8017	6.5152	6.2469	5.7590	5.3282	4.9464	4.6065	4.3030	4.0310	3.7863	3.5655
10	8.5302	8.1109	7.7217	7.3601	7.0236	6.7101	6.1446	5.6502	5.2161	4.8332	4.4941	4.1925	3.9232	3.6819
11	9.2526	8.7605	8.3064	7.8869	7.4987	7.1390	6.4951	5.9377	5.4527	5.0286	4.6560	4.3271	4.0354	3.7757
12	9.9540	9.3851	8.8633	8.3838	7.9427	7.5361	6.8137	6.1944	5.6603	5.1971	4.7932	4.4392	4.1274	3.8514
13	10.6350	9.9856	9.3936	8.8527	8.3577	7.9038	7.1034	6.4235	5.8424	5.3423	4.9095	4.5327	4.2028	3.9124
14	11.2961	10.5631	9.8986	9.2950	8.7455	8.2442	7.3667	6.6282	6.0021	5.4675	5.0081	4.6106	4.2646	3.9616
15	11.9379	11.1184	10.3797	9.7122	9.1079	8.5595	7.6061	6.8109	6.1422	5.5755	5.0916	4.6755	4.3152	4.0013
16	12.5611	11.6523	10.8378	10.1059	9.4466	8.8514	7.8237	6.9740	6.2651	5.6685	5.1624	4.7296	4.3567	4.0333
17	13.1661	12.1657	11.2741	10.4773	9.7632	9.1216	8.0216	7.1196	6.3729	5.7487	5.2223	4.7746	4.3908	4.0591
18	13.7535	12.6593	11.6896	10.8276	10.0591	9.3719	8.2014	7.2497	6.4674	5.8178	5.2732	4.8122	4.4187	4.0799
19	14.3238	13.1339	12.0853	11.1581	10.3356	9.6036	8.3649	7.3658	6.5504	5.8775	5.3162	4.8435	4.4415	4.0967
20	14.8775	13.5903	12.4622	11.4699	10.5940	9.8181	8.5136	7.4694	6.6231	5.9288	5.3527	4.8696	4.4603	4.1103
21	15.4150	14.0292	12.8212	11.7641	10.8355	10.0168	8.6487	7.5620	6.6870	5.9731	5.3837	4.8913	4.4756	4.1212
22	15.9369	14.4511	13.1630	12.0416	11.0612	10.2007	8.7715	7.6446	6.7429	6.0113	5.4099	4.9094	4.4882	4.1300
23	16.4436	14.8568	13.4886	12.3034	11.2722	10.3711	8.8832	7.7184	6.7921	6.0442	5.4321	4.9245	4.4985	4.1371
24	16.9355	15.2470	13.7986	12.5504	11.4693	10.5288	8.9847	7.7843	6.8351	6.0726	5.4509	4.9371	4.5070	4.1428
25	17.4131	15.6221	14.0939	12.7834	11.6536	10.6748	9.0770	7.8431	6.8729	6.0971	5.4669	4.9476	4.5139	4.1474
26	17.8768	15.9828	14.3752	13.0032	11.8258	10.8100	9.1609	7.8957	6.9061	6.1182	5.4804	4.9563	4.5196	4.1511
27	18.3270	16.3296	14.6430	13.2105	11.9867	10.9352	9.2372	7.9426	6.9352	6.1364	5.4919	4.9636	4.5243	4.1542
28	18.7641	16.6631	14.8981	13.4062	12.1371	11.0511	9.3066	7.9844	6.9607	6.1520	5.5016	4.9697	4.5281	4.1566
29	19.1885	16.9837	15.1411	13.5907	12.2777	11.1584	9.3696	8.0218	6.9830	6.1656	5.5098	4.9747	4.5312	4.1585
30	19.6004	17.2920	15.3725	13.7648	12.4090	11.2578	9.4269	8.0552	7.0027	6.1772	5.5168	4.9789	4.5338	4.1601
40	23.1148	19.7928	17.1591	15.0463	13.3317	11.9246	9.7791	8.2438	7.1050	6.2335	5.5482	4.9966	4.5439	4.1659

PERPETUITIES

Annuities that go on indefinitely are referred to as perpetuities. An example is preferred stock having an indefinite constant dollar dividend.

$$\text{Present value of a perpetuity} = \frac{\text{Receipt}}{\text{Discount rate}}$$

EXAMPLE 2.32

A perpetual bond has a \$50 per year interest payment, and the discount rate is 8 percent. The present value of this perpetuity equals

$$\frac{\$50}{0.08} = \$625$$

CONCLUSION

The Present Value of \$1 table is used when you want to determine the current value of receiving unequal cash receipts. If the cash flows each year are equal, you use the Present Value of an Annuity of \$1 table. The Future Value of \$1 table is employed to find the compounded amount of making unequal deposits. If the cash deposits are equal each period, you use the Future Value of an Annuity of \$1 table. The present value and future value tables are used to solve for unknowns such as annual payment, interest rate, and the number of years. They can be used to solve many business-related problems.

CHAPTER 3

HOW TO ASSESS CAPITAL EXPENDITURE PROPOSALS FOR STRATEGIC DECISION MAKING

LEARNING OBJECTIVES

After studying the material in this chapter, you will be able to:

1. Describe the types and special features of capital budgeting decisions.
2. Calculate, interpret, and evaluate five capital budgeting techniques.
3. Select the best mix of projects with a limited capital spending budget.
4. Describe factors to consider in determining capital expenditure
5. Explain type of capital budgeting decisions to be made
6. Handle mutually exclusive investments
7. Discuss risk analysis in capital budgeting

Capital budgeting relates to planning for the best selection and financing of long-term investment proposals. Capital budgeting decisions are not equally essential to all companies; the relative importance of this essential function varies with company size, the nature of the industry, and the growth rate of the firm. As a business expands, problems regarding long-range investment proposals become more important. Strategic capital budgeting decisions can turn the tide for a company.

The types of scarce resources that may be committed to a project include cash, time of key personnel, machine hours, and floor space in a factory. When estimating costs for a proposed project, the allocation of the company's scarce resources must be converted in terms of money.

There are two broad categories of capital budgeting decisions, namely, screening decisions and preference decisions. Screening decisions relate to whether a proposed project satisfies some present acceptance standard. For instance, your company may have a policy of accepting cost reduction projects only if they provide a return of, say, 15 percent. On the other hand, preference decisions apply to selecting from competing course of action. For example, your company may be looking at four different machines to replace an existing one in the manufacture of a product. The selection of which of the four machines is best is referred to as a preference decision.

The basic types of investment decisions are selecting between proposed projects and replacement decisions. Selection requires judgments concerning future events of which you have no direct knowledge. You have to consider timing and risk. Your task is to minimize your chances of being wrong. To help you deal with uncertainty, you may use the risk-return trade-off method. Discounted cash flow methods are more realistic than are methods not taking into account the time value of money in appraising investments. Consideration of the time value of money becomes more essential in inflationary periods. Capital budgeting can be used in profit and nonprofit settings.

Planning for capital expenditures requires you to determine the "optimal" proposal, the number of dollars to be spent, and the amount of time required for completion. An appraisal is needed of current programs, evaluating new proposals, and coordinating interrelated proposals within the company. In planning a project, consideration should be given to time, cost, and quality, which all interact. For control, a comparison should be made between budgeted cost and time compared to actual cost and time. All future operating cash savings are considered as well as the tax effects on cash flows of future depreciation charges. The cash proceeds of future asset disposals are likewise a necessary consideration. Depreciation expense is a consideration only to the extent that it affects the cash flows for taxes. Otherwise, depreciation is excluded from the analysis because it is a noncash expense. *Note:* Accelerated depreciation results in greater depreciation in the early years of an asset's life compared with the straight-line method. Thus, accelerated depreciation results in lower income tax expense in the early years of a project and higher income tax expense in the later years. By effectively deferring taxes, the accelerated method increases the present value of the depreciation tax shield.

Capital budgeting decisions must conform to your cash position, financing strategy, and growth rate. Will the project provide a return exceeding the long-range expected return of the business? Projects must be tied into the company's long-range planning, taking into account corporate strengths and weaknesses. The objectives of the business and the degree to which they depend on economic variable (e.g., interest rate, inflation), production (e.g., technological changes), and market factors must be established. Also, the capital budget may have to be adjusted after considering financial, economic, and political concerns. But consideration should be given to "sunk" and "fixed" costs that are difficult to revise once the initial decision is made.

Recommendation: Use cost-benefit analysis. Is there excessive effort for the proposal? Can it be performed internally or must it be done externally (e.g., make or buy)? Is there a more efficient means and less costly way of accomplishing the end result? Further, problem areas must be identified. An example is when long-term borrowed funds are used to finance a project where sufficient cash inflows will not be able to meet debt at maturity.

Suggestion: Measure cash flows of a project using different possible assumed variation (e.g., change in selling price of a new product). By modifying the assumptions and appraising the results you can see the sensitivity of cash flows to applicable variables. An advantage is the appraisal of risk in proposals based on varying assumptions. An increase in risk should result in a higher return rate.

Taxes have to be considered in making capital budgeting decisions because a project that looks good on a before-tax basis may not be acceptable on an after-tax basis. Taxes have an effect on the amount and timing of cash flows.

What-if questions are often the most crucial and difficult with regard to the capital expenditure budget and informed estimates are needed of the major assumptions. Spreadsheets can be used to analyze the cash flow implications of acquiring fixed assets.

Once an investment proposal is approved, there has to be an implementation of controls over expenditures and a reporting system regarding the project's status. Expenditures should be traced to the project and controls in place assuring the expenditures are in conformity with the approved investment proposal. Continuous monitoring should be done of how well the project is doing relative to the original plan.

FACTORS TO CONSIDER IN DETERMINING CAPITAL EXPENDITURE

- * Rate of return
- * Budget ceiling
- * Probability of success
- * Competition
- * Tax rate
- * Dollar amounts
- * Time value of money
- * Risk
- * Liquidity
- * Long-term business strategy

TYPE OF CAPITAL BUDGETING DECISIONS TO BE MADE

- * Cost reduction program
- * Undertaking an advertising campaign
- * Replacing new facilities or expanding existing ones
- * Merger analysis
- * Refinancing an outstanding debt issue
- * New and existing product evaluation
- * No profit investments (e.g., health and safety).

This chapter discusses the various capital budgeting methods including payback, discounted payback, accounting rate of return, net present value, internal rate of return, and profitability index. Consideration is also given to capital rationing and risk analysis in capital budgeting.

CAPITAL BUDGETING METHODS

PAYBACK PERIOD

The payback period measures the length of time required to recover the amount of initial investment. It is computed by dividing the initial investment by the cash inflows through increased revenues or cost savings.

EXAMPLE 3.1

Assume:

Cost of investment	\$18,000
Annual after-tax cash savings	\$3,000

Then, the payback period is:

$$\text{Payback period} = \frac{\text{Initial investment}}{\text{Cost savings}} = \frac{\$18,000}{\$3,000} = 6 \text{ years}$$

Decision rule: Choose the project with the shorter payback period. The rationale behind this choice is: The shorter the payback period, the less risky the project, and the greater the liquidity.

EXAMPLE 3.2

Consider the two projects whose after-tax cash inflows are not even. Assume each project costs \$1,000.

<u>Cash Inflow</u>		
<u>Year</u>	<u>A(\$)</u>	<u>B(\$)</u>
1	100	500
2	200	400
3	300	300
4	400	100
5	500	
6	600	

When cash inflows are not even, the payback period has to be found by trial and error. The payback period of project A is (\$1,000 = \$100 + \$200 + \$300 + \$400) 4 years. The payback period of project B is \$1,000 = \$500 + \$400 + \$100):

$$2 \text{ years} + \frac{\$100}{\$300} = 2 \frac{1}{3} \text{ years}$$

Project B is the project of choice in this case, since it has the shorter payback period.

The advantages of using the payback period method of evaluating an investment project are that (1) it is simple to compute and easy to understand, and (2) it handles investment risk effectively.

The shortcomings of this method are that (1) it does not recognize the time value of money, and (2) it ignores the impact of cash inflows received after the payback period; essentially, cash flows after the payback period determine profitability of an investment.

DISCOUNTED PAYBACK PERIOD

You can take into account the time value of money by using the discounted payback period. The payback period will be longer using the discounted method since money is worth less over time.

Discounted payback is computed by adding the present value of each year's cash inflows until they equal the initial investment.

$$\text{Discounted payback} = \frac{\text{Initial cash outlays}}{\text{Discounted annual cash inflows}}$$

EXAMPLE 3.3

You invest \$40,000 and receive the following cash inflows. The interest rate is 10%. The discounted payback period is calculated as follows:

<u>Year</u>	<u>Cash inflows</u>	<u>T3 factor</u> <u>@ 10%</u>	<u>Present value</u>	<u>Accumulated</u> <u>Present value</u>
1	\$15,000	.909	\$13,635	\$13,635
2	20,000	.826	16,520	30,155
3	28,000	.751	21,028	51,183

Thus,

$$\begin{array}{rclclclcl} \$30,155 & + & \frac{\$40,000 - 30,155}{\$21,028} & = & 2 \text{ years} & + & .47 & = & 2.47 \text{ years} \end{array}$$

ACCOUNTING RATE OF RETURN

Accounting rate of return (ARR), also called *simple* or *unadjusted rate of return*, measures profitability from the conventional accounting standpoint by relating the required investment--or sometimes the average investment--to the future annual net income.

Decision rule: Under the ARR method, choose the project with the higher rate of return.

EXAMPLE 3.4

Consider the following investment:

Initial investment	\$6,500
Estimated life	20 years
Cash inflows per year	\$1,000

Depreciation per year (using straight line) \$325

The accounting rate of return for this project is:

$$\text{ARR} = \frac{\text{Net income}}{\text{Investment}} = \frac{\$1,000 - \$325}{\$6,500} = 10.4\%$$

If average investment (usually assumed to be one-half of the original investment) is used, then:

$$\text{ARR} = \frac{\$1,000 - \$325}{\$3,250} = 20.8\%$$

The advantages of this method are that it is easily understood, simple to compute, and recognizes the profitability factor.

The shortcomings of this method are that it fails to recognize the time value of money, and it uses accounting data instead of cash flow data.

NET PRESENT VALUE

Net present value (NPV) is the excess of the present value (PV) of cash inflows generated by the project over the amount of the initial investment (I):

$$\text{NPV} = \text{PV} - \text{I}$$

The present value of future cash flows is computed using the so-called cost of capital (or minimum required rate of return) as the discount rate. When cash inflows are uniform, the present value would be

$$\text{PV} = A \cdot T_4(i, n)$$

where A is the amount of the annuity. The value of T₄ is found in Table 2.4 of Chapter 2.

Decision rule: If NPV is positive, accept the project. Otherwise reject it.

EXAMPLE 3.5

Consider the following investment:

Initial investment	\$12,950
Estimated life	10 years
Annual cash inflows	\$3,000

Cost of capital (minimum required rate of return) 12%

Present value of the cash inflows is:

$$\begin{array}{rclcl}
 \text{PV} & = & A \cdot T_4(i,n) & & \\
 & = & \$3,000 \cdot T_4(12\%, 10 \text{ years}) & & \\
 & = & \$3,000 (5.650) & = & \$16,950 \\
 \text{Initial investment (I)} & & & & \underline{12,950} \\
 \text{Net present value (NPV = PV-I)} & & & & \underline{\$4,000}
 \end{array}$$

Since the NPV of the investment is positive, the investment should be accepted.

The advantages of the NPV method are that it obviously recognizes the time value of money and it is easy to compute whether the cash flows from an annuity or vary from period to period.

INTERNAL RATE OF RETURN

Internal rate of return (IRR), also called *time adjusted rate of return*, is defined as the rate of interest that equates I with the PV of future cash inflows.

In other words,

$$\text{at IRR } I = PV \text{ or } NPV = 0$$

Decision rule: Accept the project if the IRR exceeds the cost of capital. Otherwise, reject it.

EXAMPLE 3.6

Assume the same data given in Example 3.5, and set the following equality ($I = PV$):

$$\begin{array}{rclcl}
 \$12,950 & = & \$3,000 \cdot T_4(i, 10 \text{ years}) & & \\
 & & & & \\
 T_4(i, 10 \text{ years}) & = & \frac{\$12,950}{\$3,000} & = & 4.317
 \end{array}$$

which stands somewhere between 18 percent and 20 percent in the 10-year line of Table 2.4. The interpolation follows:

$$\begin{array}{c}
 \text{PV of An Annuity of \$1 Factor} \\
 \underline{T_4(i, 10 \text{ years})}
 \end{array}$$

18%	4.494	4.494
IRR	4.317	
20%		<u>4.192</u>
Difference	<u>0.177</u>	<u>0.302</u>

Therefore,

$$\begin{aligned} \text{IRR} &= 18\% + \frac{0.177}{0.302} = (20\% - 18\%) \\ &= 18\% + 0.586(2\%) = 18\% + 1.17\% = 19.17\% \end{aligned}$$

Since the IRR of the investment is greater than the cost of capital (12 percent), accept the project.

The advantage of using the IRR method is that it does consider the time value of money and, therefore, is more exact and realistic than the ARR method.

The shortcomings of this method are that (1) it is time-consuming to compute, especially when the cash inflows are not even, although most financial calculators and PCs have a key to calculate IRR, and (2) it fails to recognize the varying sizes of investment in competing projects.

Note: Spreadsheet programs can be used in making IRR calculations. For example, *Excel* has a function *IRR(values, guess)*. *Excel* considers negative numbers as cash outflows such as the initial investment, and positive numbers as cash inflows. Many financial calculators have similar features. As in Example 13, suppose you want to calculate the IRR of a \$12,950 investment (the value --12950 entered in year 0 that is followed by 10 monthly cash inflows of \$3,000). Using a guess of 12% (the value of 0.12), which is in effect the cost of capital, your formula would be *@IRR(values, 0.12)* and *Excel* would return 19.15%, as shown below.

<i>Year 0</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	<i>9</i>	<i>10</i>
\$ (12,950)	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
IRR = 19.15%										
NPV = \$4,000.67										

Note: The *Excel* formula for NPV is *NPV (discount rate, cash inflow values) + I*, where I is given as a negative number.

Note: The internal rate of return (IRR) or the net present value (NPV) method are collectively called discounted cash flow (DCF) analysis.

PROFITABILITY INDEX

The profitability index, also called *present value index*, is the ratio of the total PV of future cash inflows to the initial investment, that is, PV/I. This index is used as a means of ranking projects in descending order of attractiveness.

Decision rule: If the profitability index is greater than 1, then accept the project.

EXAMPLE 3.7

Using the data in Example 3.5, the profitability index is

$$\frac{\text{PV}}{\text{I}} = \frac{\$16,950}{\$12,950} = 1.31$$

Since this project generates \$1.31 for each dollar invested (i.e., its profitability index is greater than 1), accept the project.

The profitability index has the advantage of putting all projects on the same relative basis regardless of size.

HOW TO SELECT THE BEST MIX OF PROJECTS WITH A LIMITED BUDGET

Many firms specify a limit on the overall budget for capital spending. Capital rationing is concerned with the problem of selecting the mix of acceptable projects that provides the highest overall NPV. The profitability index is used widely in ranking projects competing for limited funds.

EXAMPLE 3.8

The Westmont Company has a fixed budget of \$250,000. It needs to select a mix of acceptable projects from the following:

<i>Projects</i>	<i>I(\$)</i>	<i>PV(\$)</i>	<i>NPV(\$)</i>	<i>Profitability Index</i>	<i>Ranking</i>
A	70,000	112,000	42,000	1.6	1
B	100,000	145,000	45,000	1.45	2
C	110,000	126,500	16,500	1.15	5
D	60,000	79,000	19,000	1.32	3
E	40,000	38,000	-2,000	0.95	6
F	80,000	95,000	15,000	1.19	4

The ranking resulting from the profitability index shows that the company should select projects A, B, and D.

	<u>I</u>	<u>PV</u>
A	\$70,000	\$112,000
B	100,000	145,000
D	<u>60,000</u>	<u>79,000</u>
	<u>\$230,000</u>	<u>\$336,000</u>

Therefore,

$$\text{NPV} = \$336,000 - \$230,000 = \$106,000$$

HOW TO HANDLE MUTUALLY EXCLUSIVE INVESTMENTS

A project is said to be mutually exclusive if the acceptance of one project automatically excludes the acceptance of one or more other projects. In the case where one must choose between mutually exclusive investments, the NPV and IRR methods may result in contradictory indications. The conditions under which contradictory rankings can occur are:

1. Projects that have different life expectancies.
2. Projects that have different sizes of investment.
3. Projects whose cash flows differ over time. For example, the cash flows of one project increase over time, while those of another decrease.

The contradictions result from different assumptions with respect to the reinvestment rate on cash flows from the projects.

1. The NPV method discounts all cash flows at the cost of capital, thus implicitly assuming that these cash flows can be reinvested at this rate.

2. The IRR method implies a reinvestment rate at IRR. Thus, the implied reinvestment rate will differ from project to project.

The NPV method generally gives correct ranking, since the cost of capital is a more realistic reinvestment rate.

EXAMPLE 3.9

Assume the following:

	<u>Cash Flows</u>					
	0	1	2	3	4	5
A	(1000)	1200				
B	(1000)					2011.40

Computing IRR and NPV at 10 percent gives the following different rankings:

	<u>IRR</u>	<u>NPV at 10%</u>
A	20%	90.08
B	15%	249.10

RISK ANALYSIS IN CAPITAL BUDGETING

Risk analysis is important in making capital investment decisions because of the large amount of capital involved and the long-term nature of the investments being considered. The higher the risk associated with a proposed project, the greater the rate of return that must be earned on the project to compensate for that risk.

Since different investment projects involve different risks, it is important to incorporate risk into the analysis of capital budgeting. There are several methods for incorporating risk, including:

1. Probability distributions
2. Risk-adjusted discount rate
3. Certainty equivalent
4. Simulation
5. Sensitivity analysis
6. Decision trees (or probability trees)

PROBABILITY DISTRIBUTIONS

Expected values of a probability distribution may be computed. Before any capital budgeting method is applied, compute the expected cash inflows, or in some cases, the expected life of the asset.

EXAMPLE 3.10

A firm is considering a \$30,000 investment in equipment that will generate cash savings from operating costs. The following estimates regarding cash savings and useful life, along with their respective probabilities of occurrence, have been made:

<i>Annual Cash Savings</i>	<i>Probability</i>	<i>Useful Life</i>	<i>Probability</i>
\$6,000	0.2	4 years	0.2
\$8,000	0.5	5 years	0.6
\$10,000	0.3	6 years	0.2

Then, the expected annual saving is:

$$\begin{array}{rcl}
\$6,000 (0.2) & = & \$1,200 \\
\$8,000 (0.5) & = & 4,000 \\
\$10,000 (0.3) & = & \underline{3,000} \\
& & \$8,200
\end{array}$$

The expected useful life is:

$$\begin{array}{rcl}
4 (0.2) & = & 0.8 \\
5 (0.6) & = & 3.0 \\
6 (0.2) & = & \underline{1.2} \\
& & 5
\end{array}$$

The expected NPV is computed as follows (assuming a 10 percent cost of capital):

$$\begin{array}{rclclcl}
\text{NPV} & = & \text{PV-I} & = & \$8,200 \text{ T4}(10\%,5) - \$30,000 \\
& & & = & \$8,200 (3.7908) - \$30,000 & = & \$31,085 - \$30,000 & = & \$1,085
\end{array}$$

The expected IRR is computed as follows: By definition, at IRR,

$$\begin{array}{rcl}
I & = & \text{PV} \\
\$30,000 & = & \$8,200 \text{ T4} (r,5) \\
& & \$30,000 \\
\text{T4}(r,5) & = & \frac{\text{-----}}{\$8,200} = 3.6585
\end{array}$$

which is about halfway between 10 percent and 12 percent in Table 2.4 in Chapter 2, so that we can estimate the rate to be about 11 percent. Therefore, the equipment should be purchased, since (1) NPV = \$1,085, which is positive, and/or (2) IRR = 11 percent, which is greater than the cost of capital of 10 percent.

RISK-ADJUSTED DISCOUNT RATE

This method of risk analysis adjusts the cost of capital (or discount rate) upward as projects become riskier, i.e., a risk-adjusted discount rate is the riskless rate plus a risk premium. Therefore, by increasing the discount rate from 10 percent to 15 percent, the expected cash flow from the investment must be relatively larger or the increased discount rate will generate a negative NPV, and the proposed acquisition/investment would be turned down. The expected cash flows are discounted at the risk-adjusted discount rate and then the usual capital budgeting criteria such as NPV and IRR are applied.

Note: The use of the risk-adjusted discount rate is based on the assumption that investors demand higher returns for riskier projects.

EXAMPLE 3.11

A firm is considering an investment project with an expected life of 3 years. It requires an initial investment of \$35,000. The firm estimates the following data in each of the next 4 years:

<u>After-Tax Cash Inflow</u>	<u>Probability</u>
-\$5,000	0.2
\$10,000	0.3
\$30,000	0.3
\$50,000	0.2

Assuming a risk-adjusted required rate of return (after taxes) of 20 percent is appropriate for the investment projects of this level or risk, compute the risk-adjusted NPV. First, the present value is:

$$\begin{aligned}
 PV &= -\$5,000(0.2) + \$10,000(0.3) + \$30,000(0.3) + \$50,000(0.2) = \$21,000 \\
 \text{The expected NPV} &= \$21,000 T_4(20\%, 3) - \$35,000 \\
 &= 21,000 (2.107) - \$35,000 = \$44,247 - \$35,000 = \$9,247
 \end{aligned}$$

CERTAINTY EQUIVALENT APPROACH

The certainty equivalent approach to risk analysis is to convert cash flows from individual projects into risk adjusted certainty equivalent cash flows. The approach is drawn directly from the concept of utility theory. This method forces the decision maker to specify at what point the firm is indifferent to the choice between a certain sum of money and the expected value of a risky sum.

Under this approach, first determine a *certainty equivalent adjustment factor*, α , as:

$$\alpha = \frac{\text{Certain sum}}{\text{Equivalent risky sum}}$$

Once α 's are obtained, they are multiplied by the original cash flow to obtain the equivalent certain cash flow. Then, the accept-or-reject decision is made, using the normal capital budgeting criteria. The risk-free rate of return is used as the discount rate under the NPV method and as the cutoff rate under the IRR method.

EXAMPLE 3.12

XYZ, Inc., with a 14 percent cost of capital after taxes is considering a project with an expected life of 4 years. The project requires an initial certain cash outlay of \$50,000. The expected cash inflows and certainty equivalent coefficients are as follows:

<u>Year</u>	<u>After-Tax Cash Flow</u>	<u>Certainty Equivalent Adjustment Factor</u>
1	\$10,000	0.95
2	15,000	0.80
3	20,000	0.70
4	25,000	0.60

Assuming that the risk-free rate of return is 5 percent, the NPV and IRR are computed as follows:
First, the equivalent certain cash inflows are obtained as follows:

<i>Year</i>	<i>After-Tax Cash Inflow</i>	<i>α</i>	<i>Equivalent Certain Cash Inflow</i>	<i>PV at 5%</i>	<i>PV</i>
1	10,000	0.95	\$9,500	0.9524	\$9,048
2	15,000	0.80	12,000	0.9070	10,884
3	20,000	0.70	14,000	0.8638	12,093
4	25,000	0.60	15,000	0.8227	<u>12,341</u>
					<u>44,366</u>

$$\text{NPV} = \$44,366 - \$50,000 = -\$5,634$$

By trial and error, we obtain 4 percent as the IRR. Therefore, the project should be rejected, since (1) NPV = -\$5,634, which is negative and/or (2) IRR = 4 percent is less than the risk-free rate of 5 percent.

SIMULATION

This risk analysis method is frequently called Monte Carlo simulation. It requires that a probability distribution be constructed for each of the important variables affecting the project's cash flows. Since a computer is used to generate many results using random numbers, project simulation is expensive.

SENSITIVITY ANALYSIS

Forecasts of many calculated NPVs under various alternative functions are compared to see how sensitive NPV is to changing conditions. It may be found that a certain variable or group of variables, once their assumptions are changed or relaxed, drastically alters the NPV. This results in a much riskier asset than was originally forecast.

DECISION TREES

Some firms use decision trees (probability trees) to evaluate the risk of capital budgeting proposals. A decision tree is a graphical method of showing the sequence of possible outcomes. A capital budgeting tree would show the cash flows and NPV of the project under different possible circumstances. The decision tree method has the following advantages: (1) It visually lays out all the possible outcomes of the proposed project and makes management aware of the adverse possibilities, and (2) the conditional nature of successive years' cash flows can be expressly depicted.

The disadvantages are: (1) most problems are too complex to permit year-by-year depiction and (2) it does not recognize risk.

EXAMPLE 3.13

Assume XYZ Corporation wishes to introduce one of two products to the market this year. The probabilities and present values (PV) of projected cash inflows are given below:

<u>Product</u>	<u>Initial investment</u>	<u>PV of cash inflows</u>	<u>Probabilities</u>
A	\$225,000		1.00
		\$450,000	0.40
		200,000	0.50
		-100,000	0.10
B	80,000		1.00
		320,000	0.20
		100,000	0.60
		-150,000	0.20

A decision tree analyzing the two products is given in Figure 3.1.

FIGURE 3.1

DECISION TREE

	Initial Investment (1)	Probability (2)	PV of Cash Inflows (3)	PV of Cash Inflows (2) X (3) = (4)
Choice A or B	Product A \$225,000	0.40	\$450,000	\$180,000
		0.50	\$200,000	100,000
		0.10	-\$100,000	-10,000
		Expected PV of Cash Inflows		<u>\$270,000</u>
	Product B \$80,000	0.20	\$320,000	\$64,000
		0.60	\$100,000	60,000
		0.20	-\$150,000	-30,000
		Expected PV of Cash Inflows		<u>\$ 94,000</u>

Expected net present value:

Product A	\$270,000 - \$225,000	=	\$45,000
Product B	\$ 94,000 - \$ 80,000	=	\$14,000

Based on the expected NPV, choose product A over product B.

CONCLUSION

Net present value, internal rate of return, and profitability index are equally effective in selecting economically sound, independent investment proposals. But the payback method is inadequate since it does not consider the time value of money. For mutually exclusive projects, net present value, internal rate of return, and profitability index methods are not always able to rank projects in the same order; it is possible to come up with different rankings under each method. Risk should be taken into account in the capital budgeting process, such as by using probabilities, simulation, and decision trees.

CHAPTER 4

ANALYZING FINANCIAL STATEMENTS FOR FINANCIAL FITNESS

LEARNING OBJECTIVES

After studying the material in this chapter, you will be able to:

1. Explain what financial statement analysis is and why it is important.
2. Compare horizontal analysis and vertical analysis.
3. List the basic components of ratio analysis.
4. Distinguish between trend analysis and industry comparison.
5. Calculate a comprehensive set of financial ratios and interpret them.
6. Explain the limitations of ratio analysis.

Accounting can be thought of as the art of creating scorecards for business operations. It translates raw data into a set of objective numbers integrated into financial statements that provide information about the firm's profits, performance, problems and future prospects. Financial analysis is the study of the relationships among these financial numbers; it helps users to identify the major strengths and weaknesses of a business enterprise.

WHO USES FINANCIAL ANALYSIS

The techniques of financial analysis are important to two groups: *internal management* and *external users*, such as investors and banks.

Internal Managers

Internal managers analyze the financial statements to determine whether the company is earning an adequate return on its assets. They also use financial ratios as “flags” to indicate potential areas of strength or weakness. Many financial analysts use rule-of-thumb measurements for key financial ratios. For example, most analysts feel that a current ratio (current assets divided by current liabilities) of two to one is acceptable for most businesses. However, while a company may meet or even surpass this ratio, the financial statements might indicate that an increasing proportion of the current assets consist of accounts receivable that have been outstanding for more than 30 days. Slow payments might require management to change its credit policy by shortening the credit period or by implementing a more effective cash-collection policy. Internal management also uses this “number-crunching” process to decide how much inventory is to be held at any one time or whether to merge with or acquire another company.

External Users

External uses include investors, creditors, unions, and prospective employees. Investors might use the financial statements to study whether there is an adequate profit margin or a favorable return on assets. The financial health of the company, as perceived by investors, will affect the market price of the company's stock, cost of financing, and bond rating. For creditors, financial

statements indicate a company's ability to repay a loan. A union will study the financial statements to evaluate their wage and pension demands when their old contract with management expires. Finally, students and other job seekers might analyze a company's financial statements to determine career opportunities.

Horizontal and Vertical Analysis

Financial statement analysis includes horizontal analysis (percentage change over the years) and vertical analysis (percentage relationship within one year). Sources of financial information include a company's annual financial report, SEC filings, financial reference books put out by such firms as Dun & Bradstreet, trade publications, and financial newspapers such as the *Wall Street Journal*.

An analyst also studies industry norms. This measurement indicates how a company is performing in comparison with other companies in the same industry. Unfortunately, there are limitations to the use of this method. First, one company in the same industry might be involved in manufacturing and selling a product in large quantities at the wholesale level, while another enterprise might only sell at the retail level to the public. Second, each enterprise might use a different accounting method for financial reporting purposes. For example, one company might value its ending inventory according to the FIFO method, while a competitor might use LIFO. In addition, the two companies might use a different accounting method for recording depreciation. The cumulative effect of the use of different accounting methods might make a comparison of net income and fixed-asset valuation of little importance.

FINANCIAL STATEMENT ANALYSIS

The financial community uses several methods for evaluating the financial health of an enterprise. These methods include trend analysis, horizontal and vertical analysis, and ratio analysis.

TREND ANALYSIS

Trend analysis indicates in which direction a company is headed. Trend percentages are computed by taking a base year and assigning its figures as a value of 100. Figures generated in subsequent years are expressed as percentages of base-year numbers.

EXAMPLE 4.1

The Hotspot Appliance Corporation showed the following figures for a five-year period:

	<u>20x5</u>	<u>20x4</u>	<u>20x3</u>	<u>20x2</u>	<u>20x1</u>
Net sales	\$910	\$875	\$830	\$760	\$775
Cost of goods sold	<u>573</u>	<u>510</u>	<u>483</u>	<u>441</u>	<u>460</u>
Gross profit	\$337	\$365	\$347	\$319	\$315

A schedule showing trend percentages is given below.

<u>20x5</u>	<u>20x4</u>	<u>20x3</u>	<u>20x2</u>	<u>20x1</u>
-------------	-------------	-------------	-------------	-------------

Net sales	117	113	107	98	100
Cost of goods sold	125	111	105	96	100
Gross profit	107	116	110	101	100

With 20x1 taken as the base year, its numbers are divided into those from subsequent years to yield comparative percentages. For example, net sales in 20x1 (\$775,000) is divided into 20x5's net-sales figure (\$910,000).

Net sales show an upward trend after a downturn in 20x2. Cost of goods sold shows a sharp increase between 20x4 and 20x5 after a small drop in costs between 20x1 and 20x2. There appears to be a substantial drop in gross profit between 20x4 and 20x5, which is attributable to the increased cost of goods sold.

Trend percentages show horizontally the degree of increase or decrease, but they do not indicate the reason for the changes. They do serve to indicate unfavorable developments that will require further investigation and analysis. A significant change may have been caused by a change in the application of an accounting principle or by controllable internal conditions, such as a decrease in operating efficiency.

HORIZONTAL ANALYSIS

Horizontal analysis improves an analyst's ability to use dollar amounts when evaluating financial statements. It is more useful to know that sales have increased 25% than to know that sales increased by \$50,000. Horizontal analysis requires that you: (1) compute the change in dollars from the earlier base year, and (2) divide the dollar amount of the change by the base period amount.

EXAMPLE 4. 2

The comparative income statement of the Ogel Supply Corporation as of December 31, 20x2, appears as follows:

	<u>20x2</u>	<u>20x1</u>
Net sales	\$990,000	\$884,000
Cost of goods sold	<u>574,000</u>	<u>503,000</u>
Gross profit	<u>\$416,000</u>	<u>\$381,000</u>
Operating expenses:		
Selling expenses	\$130,000	\$117,500
General expenses	<u>122,500</u>	<u>120,500</u>
Total operating expenses	<u>\$252,500</u>	<u>\$238,000</u>
Income from operations	163,500	143,000
Interest expense	<u>24,000</u>	<u>26,000</u>
Income before income taxes	\$139,500	\$117,000
Income tax expense	<u>36,360</u>	<u>28,030</u>
Net income	<u>\$103,140</u>	<u>\$ 88,970</u>

The following is a detailed horizontal analysis statement.

	<u>20x2</u>	<u>20x1</u>	Increase (Decrease) Amount	Percent
Net sales	\$990,000	\$884,000	\$106,000	12.0
Cost of goods sold	<u>574,000</u>	<u>503,000</u>	<u>71,000</u>	14.1
Gross profit	<u>416,000</u>	<u>381,000</u>	<u>35,000</u>	9.2
Operating expenses:				
Selling expenses	130,000	117,500	12,500	10.6
General expenses	<u>122,500</u>	<u>120,500</u>	<u>2,000</u>	1.7
Total operating expenses	<u>252,500</u>	<u>238,000</u>	<u>14,500</u>	6.1
Income from operations	163,500	143,000	20,500	14.3
Interest expense	<u>24,000</u>	<u>26,000</u>	<u>(2,000)</u>	(7.7)
Income before income taxes	139,500	117,000	22,500	19.2
Income tax expense	<u>36,360</u>	<u>28,030</u>	<u>8,330</u>	29.7
Net income	<u>\$103,140</u>	<u>\$ 88,970</u>	<u>\$ 14,170</u>	15.9

EXAMPLE 4.3

The comparative balance sheet of the Ogel Supply Corporation as of December 31, 20x2, appears as follows:

	<u>20x2</u>	<u>20x1</u>
ASSETS		
Current assets:		
Cash	\$ 60,000	\$ 30,000
Accounts receivable, net	113,000	79,000
Inventories	107,100	106,900
Prepaid expenses	<u>5,700</u>	<u>6,100</u>
Total currents assets	\$285,800	\$222,000
Property, plant & equipment, net	<u>660,000</u>	<u>650,000</u>
Total assets	<u>\$945,800</u>	<u>\$887,000</u>
LIABILITIES		
Current liabilities:		
Notes payable	\$ 40,000	\$ 33,000
Accounts payable	<u>100,600</u>	<u>57,500</u>
Total current liabilities	\$140,600	\$ 90,500
Long-term debt	<u>400,000</u>	<u>410,000</u>
Total liabilities	<u>\$540,600</u>	<u>\$500,500</u>
STOCKHOLDERS' EQUITY		
Common stock, no-par	\$200,000	\$200,000
Retained earnings	<u>205,200</u>	<u>186,500</u>
Total stockholders' equity	<u>\$405,200</u>	<u>\$386,500</u>
Total liabilities & stockholders' equity	<u>\$945,800</u>	<u>\$887,000</u>

The following is a detailed horizontal analysis statement.

	<u>20x2</u>	<u>20x1</u>	Increase (Decrease) Amount	Percent
ASSETS				
Current assets:				
Cash	\$ 60,000	\$ 30,000	\$ 30,000	100.0
Accounts receivable, net	113,000	79,000	34,000	43.0
Inventories	107,000	106,900	200	0.0
Prepaid expenses	<u>5,700</u>	<u>6,100</u>	<u>(400)</u>	<u>(7.0)</u>
Total current assets	\$285,800	\$222,000	\$ 58,000	28.7
Property, plant, & equipment, net	<u>660,000</u>	<u>665,000</u>	<u>(5,000)</u>	.1
Total assets	<u>\$945,800</u>	<u>\$887,000</u>	<u>\$ 58,800</u>	6.6
LIABILITIES				
Current liabilities:				
Note payable	\$ 40,000	\$ 33,000	\$ 7,000	21.2
Accounts payable	<u>100,600</u>	<u>57,500</u>	<u>43,100</u>	75.0
Total current liabilities	\$140,600	\$ 90,500	\$ 50,100	55.4
Long-term debt	<u>400,000</u>	<u>410,000</u>	<u>(10,000)</u>	(2.4)
Total liabilities	<u>\$540,600</u>	<u>\$500,500</u>	<u>\$ 40,100</u>	8.1
STOCKHOLDERS' EQUITY				
Common stock, no-par	200,000	\$200,000	\$	0.0
Retained earnings	<u>205,200</u>	<u>186,500</u>	<u>18,700</u>	10.0
Total stockholders' equity	<u>\$405,200</u>	<u>\$386,500</u>	<u>\$ 18,700</u>	5.0
Total liabilities & stockholders' equity	<u>\$945,800</u>	<u>\$887,000</u>	<u>\$ 58,800</u>	6.6

VERTICAL ANALYSIS

Vertical (common-size) analysis shows the percentage relationship of each item on the financial statement to a total figure representing 100 percent. Each income statement account is compared to net sales. For example, if net sales is \$100,000 and net income after taxes is \$8,000, then the company's net income is \$8,000 divided by \$100,000, or 8% of the net sales figure.

Vertical analysis also reveals the internal structure of the business. This means that if total assets are \$750,000 and cash shows a year-end balance, then cash represents 10% of the total assets of the business year-end. Vertical analysis shows the mix of assets that generate the income as well as the sources of capital provided by either current or noncurrent liabilities, or by the sale of preferred and common stock.

A company's vertical percentages should be compared to those of its competitors or to industry averages to determine the company's relative position in the marketplace. Like horizontal analysis, vertical analysis is not the end of the process. The analyst must be prepared to examine problem areas indicated by horizontal and vertical analysis.

EXAMPLE 4.4

The comparative income statement of the Ogel Supply Corporation at December 31, 20x2, appears as follows:

	<u>20x2</u>	<u>20x1</u>
Net sales	\$990,000	\$884,000
Cost of goods sold	<u>574,000</u>	<u>503,000</u>
Gross profit	\$416,000	\$381,000
Operating expenses:		
Selling expenses	\$130,000	\$117,500
General expenses	<u>122,500</u>	<u>120,500</u>
Total operating expenses	<u>\$252,500</u>	<u>\$238,000</u>
Income from operations	\$163,500	\$143,000
Interest expense	<u>24,000</u>	<u>26,000</u>
Income before income taxes	\$139,500	\$117,000
Income tax expense	<u>36,360</u>	<u>28,030</u>
Net income	<u>\$103,140</u>	<u>\$ 88,970</u>

The following is a detailed vertical analysis statement.

	<u>20x2</u>		<u>20x1</u>	
	<u>Amount</u>	<u>Percent</u>	<u>Amount</u>	<u>Percent</u>
Net sales	\$990,000	100.0	\$884,000	100.0
Cost of goods sold	<u>574,000</u>	58.0	<u>503,000</u>	<u>57.0</u>
Gross profit	\$416,000	42.0	\$381,000	43.0
Operating expenses:				
Selling expenses	\$130,000	13.1	\$117,500	13.3
General expenses	<u>122,500</u>	12.4	<u>120,500</u>	<u>13.6</u>
Total operating expenses	<u>\$252,500</u>	25.5	<u>\$238,000</u>	<u>26.9</u>
Income from operations	\$163,500	16.5	\$143,000	16.1
Interest expense	24,000	2.4	26,000	2.9
Income before income taxes	\$139,500	14.1	\$117,000	13.2
Income tax expense	<u>36,360</u>	3.7	<u>28,030</u>	<u>3.2</u>
Net income	<u>\$103,140</u>	10.4	<u>\$ 88,970</u>	<u>10.0</u>

EXAMPLE 4.5

The comparative balance sheet of the Ogel Supply Corporation at December 31, 20x2, appears as follows:

	<u>20x2</u>	<u>20x1</u>
ASSETS		
Current assets:		
Cash	\$ 60,000	\$ 30,000
Accounts receivable, net	113,000	79,000
Inventories	107,100	106,900
Prepaid expenses	<u>5,700</u>	<u>6,100</u>

Total current assets	\$285,800	\$222,000
Property, plant and equipment, net	<u>660,000</u>	<u>650,000</u>
Total assets	<u>\$945,800</u>	<u>\$887,000</u>

LIABILITIES

Current liabilities:

Notes payable	\$ 40,000	\$ 33,000
Accounts payable	<u>100,600</u>	<u>57,500</u>
Total current liabilities	\$140,600	\$ 90,500
Long-term debt	<u>400,000</u>	<u>410,000</u>
Total liabilities	<u>\$540,600</u>	<u>\$500,500</u>

STOCKHOLDERS' EQUITY

Common stock, no-par	\$200,000	\$200,000
Retained earnings	<u>205,200</u>	<u>186,500</u>
Total stockholders' equity	<u>\$405,200</u>	<u>\$386,500</u>
Total liabilities and stockholders' equity	<u>\$945,800</u>	<u>\$887,000</u>

Prepare a detailed vertical analysis statement.

	<u>20x2</u>		<u>20x1</u>	
	<u>Amount</u>	<u>Percent</u>	<u>Amount</u>	<u>Percent</u>
ASSETS				
Current assets:				
Cash	\$ 60,000	6.3	\$ 30,000	3.4
Accounts receivable, net	113,000	11.9	79,000	8.9
Inventories	107,100	11.3	106,900	12.1
Prepaid expenses	<u>5,700</u>	<u>0.6</u>	<u>6,100</u>	<u>.7</u>
Total current assets	\$285,800	30.1	\$222,000	25.3
Property, plant and equipment, net	<u>660,000</u>	<u>69.9</u>	<u>650,000</u>	<u>74.9</u>
Total assets	<u>\$945,800</u>	<u>100.0</u>	<u>\$887,000</u>	<u>100.0</u>
LIABILITIES				
Current liabilities:				
Notes payable	\$ 40,000	4.2	\$ 33,000	3.7
Accounts payable	<u>100,600</u>	<u>10.6</u>	<u>57,500</u>	<u>6.5</u>
Total current liabilities	\$140,600	14.8	\$ 90,500	10.2
Long-term debt	<u>400,000</u>	<u>42.3</u>	<u>410,000</u>	<u>46.2</u>
Total liabilities	<u>\$540,600</u>	<u>57.1</u>	<u>\$500,500</u>	<u>56.4</u>
STOCKHOLDERS' EQUITY				
Common stock, no-par	\$200,000	21.1	\$200,000	22.6
Retained earnings	<u>205,200</u>	<u>21.7</u>	<u>186,500</u>	<u>21.0</u>
Total stockholders' equity	<u>\$405,200</u>	<u>42.8</u>	<u>\$386,500</u>	<u>43.6</u>
Total liabilities and stockholders' equity	<u>\$945,800</u>	<u>100.0</u>	<u>\$887,000</u>	<u>100.0</u>

After completing the statement analysis, the financial analyst will consult with management to discuss problem areas, possible solutions, and the company's prospects for the future.

RATIO ANALYSIS

Ratios provide a convenient and useful way of expressing a relationship between numbers. For example, management is always interested in its ability to pay its current liabilities as they become due.

LIQUIDITY ANALYSIS

Ratios used to determine the debt-paying ability of the company include the *current ratio* and the *acid-test* or *quick ratio*. A term also frequently used in financial statement analysis is *working capital*.

Current Ratio

The current ratio is a valuable indicator of a company's ability to meet its current obligations as they become due. The ratio is computed by using the following formula:

$$\frac{\text{Current Assets}}{\text{Current Liabilities}}$$

EXAMPLE 4.6

Assume that in Example 4.3 the Ogel Supply Corporation showed the following current assets and current liabilities for the years ended December 31, 20x2, and December 31, 20x1:

	<u>20x2</u>	<u>20x1</u>
ASSETS		
Current assets:		
Cash	\$ 60,000	\$ 30,000
Accounts receivable, net	113,000	79,000
Inventories	107,100	106,900
Prepaid expenses	<u>5,700</u>	<u>6,100</u>
Total current assets	<u>\$285,800</u>	<u>\$222,000</u>
LIABILITIES		
Current liabilities:		
Notes payable	\$ 40,000	\$ 33,000
Accounts payable	<u>100,600</u>	<u>57,500</u>
Total current liabilities	<u>\$140,600</u>	<u>\$ 90,500</u>

The current ratios for 20x2 and 20x1 are:

	<u>20x2</u>	<u>20x1</u>
<u>Total current assets</u>	<u>\$285,800</u>	<u>\$222,000</u>
<u>Total current liabilities</u>	<u>\$140,600 = 2.0</u>	<u>\$90,500 = 2.5</u>

The change from 2.5 to 2.0 indicates that Ogel has a diminished ability to pay its current liabilities as they mature. However, a current ratio of 2.0 to 1 is still considered a “secure” indicator of a company’s ability to meet its current obligations incurred in operating the business.

Acid-Test or Quick Ratio

Unlike the current ratio, the acid-test or quick ratio places emphasis on the relative convertibility of the current assets into cash. The ratio places greater emphasis on receivables than on inventory, since the inventory may not be readily convertible into cash. This method also assumes that prepaid expenses have minimal resale value. The ratio is computed by using the following formula:

$$\frac{\text{Cash} + \text{Short-Term Investments} + \text{Accounts Receivable, Net}}{\text{Current Liabilities}}$$

EXAMPLE 4.7

Assumed that in Example 4.3 the Ogel Supply Corporation showed the following current assets and current liabilities for the years ended December 31, 20x2, and December 31, 20x1:

	<u>20x2</u>	<u>20x1</u>
Current assets:		
Cash	\$ 60,000	\$ 30,000
Accounts receivable, net	113,000	79,000
Inventories	107,100	106,900
Prepaid expenses	<u>5,700</u>	<u>6,100</u>
Total currents assets	<u>\$285,800</u>	<u>\$222,000</u>
Current liabilities:		
Notes payable	\$ 40,000	\$ 33,000
Accounts payable	<u>100,600</u>	<u>57,500</u>
Total current liabilities	<u>\$140,600</u>	<u>\$ 90,500</u>

The acid-test or quick ratios for 20x2 and 20x1 are:

	<u>20x2</u>	<u>20x1</u>
Current assets:		
Cash	\$ 60,000	\$ 30,000
2 Accounts receivable, net	<u>113,000</u>	<u>79,000</u>
Total currents assets	<u>\$173,000</u>	<u>\$109,000</u>
Current liabilities:		
Notes payable	\$ 40,000	\$ 33,000
Accounts payable	<u>100,600</u>	<u>57,500</u>
Total current liabilities	<u>\$140,600</u>	<u>\$ 90,500</u>
	<u>20x2</u>	<u>20x1</u>
<u>Total acid-test assets</u>	<u>\$173,000</u>	<u>\$109,000</u>

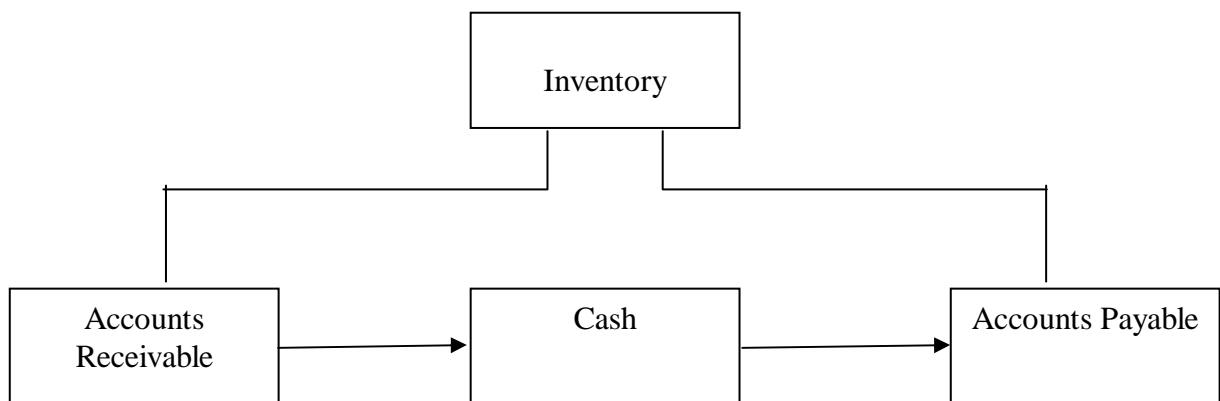
$$\text{Total current liabilities} \quad \$140,600 = 1.2 \quad \$90,500 = 1.2$$

The ratios are unchanged. This shows that, despite a significant increase in both the acid-test or quick assets and current liabilities, Ogel still maintains the same ability to meet its current obligations as they mature.

Working Capital

Working capital is the excess of current assets over current liabilities.

Working capital items are those that are flowing through the business in a regular pattern and may be diagrammed as follows:



EXAMPLE 4.8

Assumed that in Example 4.3 the Ogel Supply Corporation showed the following current assets and current liabilities for the years ended December 31, 20x2, and December 31, 20x1:

	<u>20x2</u>	<u>20x1</u>
Current assets:		
Cash	\$ 60,000	\$ 30,000
Accounts receivable, net	113,000	79,000
Inventories	107,100	106,900
Prepaid expenses	<u>5,700</u>	<u>6,100</u>
Total currents assets	<u>\$285,800</u>	<u>\$222,000</u>
Current liabilities:		
Notes payable	\$ 40,000	\$ 33,000
Accounts payable	<u>100,600</u>	<u>57,500</u>
Total current liabilities	<u>\$140,600</u>	<u>\$ 90,500</u>

Working capital for 20x2 and 20x1 is:

	<u>20x2</u>	<u>20x1</u>
Total currents assets	\$285,800	\$222,000
Total current liabilities	<u>\$140,600</u>	<u>\$ 90,500</u>
Working capital	<u>\$145,200</u>	<u>\$131,500</u>

The change from \$131,500 to \$145,200 indicates that Ogel has increased its working capital, which Ogel must now decide whether it is making effective use of. For example, should any excess working capital be used to purchase short-term income-producing investments?

Accounts-Receivable Ratios

Accounts-receivable ratios are composed of the accounts receivable turnover and the collection period, which is the number of days the receivables are held.

Accounts-Receivable Turnover

The accounts-receivable turnover is the number of times accounts receivable are collected during the year. The turnover equals net credit sales (if not available, then total sales) divided by the average accounts receivable. Average accounts receivable is usually determined by adding the beginning accounts receivable to the ending accounts receivable and dividing by two. However, average accounts receivable may be arrived at with greater accuracy on a quarterly or monthly basis, particularly for a seasonal business. Unfortunately, this information is typically known only to management. Using data for the shortest time period will provide the most reliable ratio.

The higher the accounts-receivable turnover, the more successfully the business collects cash. However, an excessively high ratio may signal an excessively stringent credit policy, with management not taking advantage of the potential profit by selling to customers with greater risk. Note that here, too, before changing its credit policy, management has to consider the profit potential versus the inherent risk in selling to more marginal customers. For example, bad debt losses will increase when credit policies are liberalized to include riskier customers.

The formula for determining the accounts-receivable turnover is expressed as follows:

$$\frac{\text{Net Credit Sales}}{\text{Average Net Accounts Receivable}}$$

EXAMPLE 4.9

Assumed that in Example 4.3 the Ogel Supply Corporation showed the following accounts-receivable totals for the years ended December 31, 20x2, and December 31, 20x1:

	<u>20x2</u>	<u>20x1</u>
Current assets:		
Accounts receivable, net	113,000	79,000

Assuming sales of \$990,000 for 20x2, calculate the accounts-receivable turnover for 20x2.

$$\text{Average accounts receivable} = (\$113,000 + \$79,000) / 2 = \$96,000$$

$$\frac{\text{Sales}}{\text{Average accounts receivable}} = \frac{\$990,000}{\$96,000} = 10.3$$

Day-Sales-in-Receivables

The days-sales-in-receivables (average collection period) determines how many days' sales remain in accounts receivable. The determination is a two-step process. First, divide the net sales by 365 days to determine the sales amount for an average day. Then divide this figure into the average net accounts receivable.

EXAMPLE 4.10

In Example 4.9 it was determined that the Ogel Supply Corporation's accounts receivable turnover was 10.3. Use this figure to calculate the days-sales-in-receivables for 20x2.

Step one:

$$\frac{\text{Net sales}}{365 \text{ days}} = \frac{\$990,000}{365} = \$2,712$$

Step two:

$$\frac{\text{Average net accounts receivable}}{\text{One day's sales}} = \frac{\$96,000}{\$2,712} = 35.4 \text{ days}$$

Inventory Ratios

A company with excess inventory is tying up funds that could be invested elsewhere for a return. Inventory turnover is a measure of the number of times a company sells its average level of inventory during the year. A high turnover indicates an ability to sell the inventory, while a low number indicates an inability. A low inventory turnover may lead to inventory obsolescence and high storage and insurance costs. The formula for determining inventory turnover is:

$$\frac{\text{Cost of Goods sold}}{\text{Average Inventory}}$$

EXAMPLE 4.11

Assume that in Example 4.3 the Ogel Supply Corporation showed the following inventory amounts for the years ended December 31, 20x2, and December 31, 20x1:

	<u>20x2</u>	<u>20x1</u>
Current assets:		
Inventories	107,100	106,900

If cost of goods sold is \$574,000 for 20x2, calculate the inventory turnover for 20x2.

$$\text{Average inventories} = (\$107,100 + \$106,900) / 2 = \$107,000$$

$$\frac{\text{Cost of goods sold}}{\text{Average inventories}} = \frac{\$574,000}{\$107,000} = 5.4$$

Operating Cycle

The operating cycle is the time needed to turn cash into inventory, inventory into receivables, and receivables back into cash. For a retailer, it is the time from purchase of inventory to collection of cash. Thus, the operating cycle of a retailer is equal to the sum of the number of days' sales in inventory and the number of days' sales in receivables. The days' sales in inventory equals 365 (or another period chosen by the analyst) divided by the inventory turnover. The days' sales in receivables equals 365 (or other number) divided by the accounts receivable turnover.

Interrelationship of Liquidity and Activity to Earnings

There is a trade-off between liquidity risk and return. Liquidity risk is reduced by holding more current assets than noncurrent assets. There will be less of a return, however, because the return rate on current assets (i.e., marketable securities) is usually less than the return rate on productive fixed assets. Further, excessive liquidity may mean that management has not been aggressive enough in finding attractive capital-investment opportunities. There should be a balance between liquidity and return.

High profitability does not automatically mean a strong cash flow. Cash problems may exist even with a high net income due to maturing debt and the need for asset replacement, among other reasons. For instance, it is possible that a growth business may have a decline in liquidity because cash is needed to finance an expanded sales base.

MEASURING A COMPANY'S ABILITY TO PAY ITS LONG-TERM DEBT

A corporation with a large amount of debt runs a greater risk of insolvency than one with a large amount of preferred or common stock outstanding. The reason is that payment of interest is mandatory, while the payment of dividends is discretionary with the corporation's board of directors. Individuals and banks that purchase the long-term notes and bonds issued by an enterprise take a special interest in a business's ability to repay its debt plus interest. Two key methods used to measure a company's ability to pay its legal obligations as they become due are the debt ratio and the times-interest-earned ratio.

Debt Ratio

The debt ratio indicates how much of the company's assets were obtained by the issuance of debt.

If the ratio is 1, it means that all of the firm's assets were financed by the issuance of debt. If the ratio is 0.6, it means that 60% of the company's assets were financed by debt. The formula for the debt ratio is:

Total Liabilities
Total Assets

EXAMPLE 4.12

Assume that in Example 4.3 the Ogel Supply Corporation showed the following current assets and current liabilities for the years ended December 31, 20x2, and December 31, 20x1:

	<u>20x2</u>	<u>20x1</u>
ASSETS		
Current assets:		
Cash	\$ 60,000	\$ 30,000
Accounts receivable, net	113,000	79,000
Inventories	107,100	106,900
Prepaid expenses	<u>5,700</u>	<u>6,100</u>
Total currents assets	\$285,800	\$222,000
Property, plant, and equipment, net	<u>660,000</u>	<u>665,000</u>
Total assets	\$945,800	\$887,000
LIABILITIES		
Current liabilities:		
Notes payable	\$ 40,000	\$ 33,000
Accounts payable	<u>100,600</u>	<u>57,500</u>
Total current liabilities	\$140,600	\$ 90,500
Long-term debt	<u>400,000</u>	<u>410,000</u>
Total liabilities	\$540,600	\$500,500

The debt ratios for 20x2 and 20x1 are:

	<u>20x2</u>	<u>20x1</u>
<u>Total liabilities</u>	\$540,600	\$500,500
Total assets	\$945,800 = 0.57	\$887,000 = 0.56

The ratios indicate that Ogel debt position has increased.

Times-Interest-Earned Ratio

The times-interest-earned ratio measures a company's ability to pay its interest obligations. For example, a times-interest-earned ratio of 5 means that the company earned enough to pay its annual interest obligation five times.

EXAMPLE 4.13

Assume that in Example 4.2 the Ogel Supply Corporation showed the following income from operations and interest expense for the years ended December 31, 20x2, and December 31, 20x1:

<u>20x2</u>	<u>20x1</u>
-------------	-------------

Interest expense	\$ 24,000	\$ 26,000
Income from operations	163,500	143,000

The times-interest-earned ratios for 20x2 and 20x1 are:

	<u>20x2</u>	<u>20x1</u>
<u>Income from operations</u>	<u>\$163,500</u>	<u>\$143,000</u>
Interest expense	\$ 24,000 = 6.8	\$ 26,000 = 5.5

The ratios indicate that Ogel will have little difficulty paying its interest obligations. Ogel might even consider borrowing more money.

PROFITABILITY RATIOS

These ratios measure the profitability of the company. The primary ratios are rate of return on net sales, rate of return on total assets, and rate of return on total stockholders' equity.

Rate Of Return On Net Sales

The formula for calculating the rate of return on net sales is as follows:

$$\frac{\text{Net Income}}{\text{Net Sales}}$$

This ratio reveals the profit margin of the business. It tells how much earnings are associated with each sales dollar.

EXAMPLE 4.14

Assume that in Example 4.2 the Ogel Supply Corporation showed the following net income and net sales figures for the years ended December 31, 20x2, and December 31, 20x1:

	<u>20x2</u>	<u>20x1</u>
Net sales	\$990,000	\$884,000
Net income	103,140	88,970

The rates of return on net sales for 20x2 and 20x1 are:

	<u>20x2</u>	<u>20x1</u>
<u>Net income</u>	<u>\$103,140</u>	<u>\$ 88,970</u>
Net sales	\$990,000 = 10.4%	\$884,000 = 10.1%

The increase in the rate of return indicates that the company is more profitable on each sales dollar obtained.

Rate Of Return On Total Assets

The rate of return measures the ability of the company to earn a profit on its total assets. In making the calculation, interest expense must be added back to the net income, since both creditors and investors have financed the company's operations. The formula is:

$$\frac{\text{Net Income} + \text{Interest Expense}}{\text{Average Total Assets}}$$

where average total assets = total assets (beginning) + total assets (ending) / 2

EXAMPLE 4.15

Assume that in Example 4.2 the Ogel Supply Corporation showed the following net income and net sales figures for the years ended December 31, 20x2, and December 31, 20x1:

	<u>20x2</u>	<u>20x1</u>
Net income	\$103,140	\$ 88,970
Interest expense	24,000	26,000
Total assets	945,800	887,000

The rate of return on total assets for 20x2 is:

$$\text{Average total assets} = \frac{\$103,140 + \$24,000}{(\$945,800 + \$887,000) / 2} = \frac{\$127,140}{\$916,400} = 13.9\%$$

Rate Of Return On Common Stockholders' Equity

The rate of return on common stock shows the relationship between net income and the common stockholders' investment in the company. To compute this rate, preferred dividends must be subtracted from net income. This leaves net income available to the common shareholders. The formula for computing the rate of return on common stock is:

$$\frac{\text{Net Income} - \text{Preferred Dividends}}{\text{Average Common Stockholders' Equity}}$$

EXAMPLE 4.16

Assume that in Examples 4.2 and 4.3 the Ogel Supply Corporation showed the following net income for 20x2, and total stockholders' equity for the years ended December 31, 20x2, and December 31, 20x1:

	<u>20x2</u>	<u>20x1</u>
Net income	\$103,140	\$ 88,970
Total stockholders' equity	405,200	386,500

The rate of return on total common stockholders' equity for 20x2 is:

$$\text{Average common stockholders' equity} = (\$405,200 + \$386,500) / 2 = \$395,850$$

$$\frac{\text{Net income}}{\text{Average common stockholders' equity}} = \frac{\$103,140 - 0}{\$395,850} = 26.1\%$$

The return on the common stockholders' equity is 26.1%, which is 12.2% higher than the return on assets, which is 13.9%. The company is borrowing at a lower rate to earn a higher rate. The practice is called trading on equity, or leverage, and is directly related to the debt ratio. However, should revenues drop, the interest on debt must still be paid. Thus, in times of operating losses, excessive debt can hurt profitability.

Earnings per Share

Earnings per share (EPS) is computed by dividing net income less the preferred dividends by the number of common shares outstanding. The preferred-share dividend must be subtracted because it represents a prior claim to dividends that must be paid before any payments of dividends can be made to the common shareholders. If there is no preferred stock, earnings per share equals net income divided by common shares outstanding.

EXAMPLE 4.17

Assume that in Examples 4.2 and 4.3 the Ogel Supply Corporation showed the following net income for 20x2 and 20x1, and that 10,000 common shares were outstanding for the years ended December 31, 20x2, and December 31, 20x1:

	<u>20x2</u>	<u>20x1</u>
Net income	\$103,140	\$ 88,970

Calculate the earnings per share for 20x2 and 20x1.

$$\frac{\text{Net income}}{\text{Common shares outstanding}} = \frac{\$103,140 - 0}{10,000} = \$10.31 \quad \frac{\$88,970 - 0}{10,000} = \$8.90$$

EVALUATING STOCK AS AN INVESTMENT

Investors purchase stock to earn a return on their investment. This return consists of both gains from the sale of appreciated stock and from dividends. Two ratios used to analyze the value of a stock include the *price-earnings ratio* and the *book value per share* of stock.

Price-Earnings Ratio

The price-earnings ratio equals the market price per share divided by the earnings per share. A high price-earnings ratio is generally favorable because it indicates that the investing public looks

at the company in a positive light. However, too high a price-earnings ratio could mean a poor investment because the stock may be overvalued, while a low price-earnings ratio stock could be a good investment if it's a case of the stock being undervalued.

EXAMPLE 4.18

Assume that for the years 20x2 and 20x1 the market price per share of common stock for Ogel Corporation was as follows:

	<u>20x2</u>	<u>20x1</u>
Market price per share	\$130.00	\$95.00

Using the earnings per share of \$10.31 for 20x2 (from Example 4.17) and \$8.90 for 20x1, the price/earnings ratio for each year can be calculated as follows.

	<u>20x2</u>		<u>20x1</u>
<u>Market price per share</u>	<u>\$130.00</u>	=	<u>\$95.00</u>
Earnings per share of common stock	\$10.31	=	\$8.9
		12.6	10.7

The increase in the price-earnings multiple indicates that the stock market had a higher opinion of the business in 20x2, possibly due to the company's increased profitability.

Book Value Per Share

The book value per share equals the net assets available to common stockholders divided by the shares outstanding. Net assets equals stockholders' equity minus preferred stock. The comparison of book value per share to market price per share provides a clue as to how investors regard the firm. The formula for calculating book value per share is as follows:

$$\frac{\text{Total Stockholders Equity} - \text{Preferred Equity}}{\text{Number of Shares of Common Stock Outstanding}}$$

EXAMPLE 4.19

Assume that for the year's 20x2 and 20x1 the stockholders' equity of Ogel Corporation was as follows:

	<u>20x2</u>	<u>20x1</u>
Total stockholders' equity	\$405,200	\$386,500

If there are 10,000 shares of common stock outstanding at December 31 of each year, the book value per share for each year would be:

	<u>20x2</u>		<u>20x1</u>
Total stockholders' equity	<u>\$405,200</u>	=	<u>\$386,500</u>
		\$40.52	\$38.65

Common shares outstanding	10,000	10,000
---------------------------	--------	--------

LIMITATIONS OF RATIO ANALYSIS

Some of the limitations of ratio analysis are as follows:

- (1) Many large businesses are involved with multiple lines of business, making it difficult to identify the industry to which a specific company belongs. A comparison of its ratios with other corporations may thus be meaningless.
- (2) Accounting and operating practices differ among companies, which can distort the ratios and make comparisons meaningless. For example, the use of different inventory-valuation methods would affect inventory and asset-turnover ratios.
- (3) Industry averages published by financial advisory services are only approximations. Therefore the company may have to look at the ratios of its major competitors if such ratios are available.
- (4) Financial statements are based on historical costs and do not consider inflation.
- (5) Management may hedge or exaggerate its financial figures. Hence certain ratios will not be accurate indicators.
- (6) A ratio does not describe the quality of its components. For example, the current ratio may be high but inventory may consist of obsolete merchandise.
- (7) Ratios are static and do not take into account future trends.

CHAPTER 5

ANALYZING QUALITY OF EARNINGS

LEARNING OBJECTIVES

After studying the material in this chapter, you will be able to:

1. Define quality of earnings.
2. Analyze discretionary costs.
3. Describe what accounting estimates can do.
4. Construct a guide for internal control and management honesty.
5. Compare and explain auditor relations and reports.

You should be familiar with the accounting factors that are involved in analyzing the income statement, including the nature of the accounting policies used, the degree of certainty in accounting estimates, discretionary costs, tax reporting, and verifiability of earnings. It is your task to adjust net income to derive an earnings figure that is most relevant to your needs.

QUALITY OF EARNINGS

Quality of earnings is relative, not absolute. It is a comparison of the favorable and unfavorable characteristics of the net incomes of competing companies. It involves looking at quantitative (e.g., ratio analysis) and qualitative factors (e.g., pending litigation). Reported earnings are adjusted to make them relevant to the user for his analytical purposes. Data in the footnotes will assist in the restatement process.

Earnings quality relates to the degree to which net income is overstated or understated, as well as to the stability of income statement elements. Earnings quality affects the price-earnings ratio, bond rating, effective interest rate, compensating balance requirement, availability of financing, and desirability of the firm as either an acquirer or acquiree. Earnings quality attributes exist in different proportions and intensifies in the earnings profiles of companies. You have to be very careful of the quality of earnings of high-accounting-risk companies, including a company in a high-risk environment or one that shows “glamour,” such as one with consistently strong growth.

Unwarranted accounting changes (principles and estimates) lower earnings quality and distort the earnings trend. Justification for an accounting change is present in a new FASB statement, AICPA Industry Audit Guide, and IRS regulations.

EXAMPLE 5.1

An asset was acquired for \$12,000 on 1/1/X1. The life is eight years, and has a salvage value of \$2,000. On 1/8/X4, the company unrealistically changed the original life to ten years, with a salvage value of \$3,000.

The adjustment required to 20X4's net income is as follows:

Depreciation expense after change in estimate		\$750
Original cost	\$12,000	
Less accumulated depreciation (\$1,250 x 3)	<u>3,750</u>	
Book value (12/31/X3)	\$ 8,250	
New salvage value	<u>3,000</u>	
Amount to be depreciated	<u>\$ 5,250</u>	
New remaining life (10 — 3) 7 years		
Recorded depreciation expense (\$5,250/7) = \$750		
Depreciation expense should be		<u>1,250</u>
Downward adjustment to 19X4 net income		<u>\$ 500</u>

Income smoothing lowers the quality of earnings. Examples are:

- Future revenue is reported in the current period.
- Income is transferred from good years to bad years.
- Expenses are shifted among the years.

A weak relationship between revenue and reported earnings may point to the existence of earnings management.

EXAMPLE 5.2

The ratio of net income to revenue for the period 20X1 to 20X4 was

20X1	20X2	20X3	20X4
14%	2%	22%	(4)%

The weak association implies the existence of income management.

The immediate recognition of revenue without the rendering of substantial services imparts lower earnings quality. An example is a health spa, which reflects income, as membership fees are collected at the beginning of the earnings cycle. On the other hand, the belated recognition of revenue results in understated earnings. Also watch out for the reversal of previously recorded items, such as profits or a prior write-off of an asset.

The underaccrual or overaccrual of expenses or losses results in poor earnings quality. For example, by underaccruing for warranty expense, net income is overstated. *What to Watch Out for:* The reduction of expenses for exaggerated expected recoveries of excess costs under contracts causing an overstatement in earnings. Also, is there a higher expense provision in the current year because of an inadequate provision in a previous year? This distorts the earnings trend. *Be on Guard Against:* A company taking a “financial bath” by writing down overstated assets all of a sudden and providing for expense and loss provisions that realistically apply to the

future. This sometimes occurs when new management takes over and wants to reduce earnings, blaming old management for a bad year, or when the current management feels that since operations are so bad anyway, a further decrease in earnings will not have a material negative effect on the market price. *What to Watch Out for:* Deferring items to an asset that should preferably be expensed. An example is advertising.

ANALYSIS OF DISCRETIONARY COSTS

Discretionary costs can be changed at management's will. *What to Do:* Examine the current level of discretionary costs relative to previous years and to future requirements. An index number may be used to compare the current-year discretionary cost to the base amount. A reduction in discretionary costs lowers earnings quality if their absence will have a detrimental effect on the future (e.g., advertising, research, repairs). *Recommendation:* Analyze the trend in the following ratios: (1) discretionary costs to sales and (2) discretionary costs to assets. If in connection with a cost-reduction program material cuts are made in discretionary costs, earnings quality has declined. However, cost control is warranted when (1) in prior years discretionary expenditures were excessive and (2) competition has decreased. A material increase in discretionary costs in a given year may have a significant positive impact on corporate earning power and future growth. Income smoothing is indicated when discretionary costs as a percentage of revenue fluctuate each year.

EXAMPLE 5.3

The following data are supplied:

	20X1	20X2	20X3
Sales	\$95,000	\$125,000	\$84,000
Research	9,000	14,000	3,000

The most representative year (base year) is 20X1. After 20X4, you believe that research is essential for the company's success because of technological factors in the industry.

	20X1	20X2	20X3
Research to sales	9.5%	11.2%	3.6%

Looking in base dollars, 20X1 represents 100. 20X2 is 156 (\$14,000/\$9,000). 20X3 has an index of 33 (\$3,000/\$9,000).

A red flag is posted for 20X3. Research is lower than in previous periods. There should have been a boost in research in light of the technological updating needed for 20X4.

ACCOUNTING ESTIMATES

The greater the degree of subjective accounting estimates in the income measurement process, the lower the quality of earnings. *What to Do:* Examine the difference between actual experience and the estimates employed. The wider the difference, the lower the quality of earnings. Look at the variation over time between a loss provision and the actual loss. A continually understated loss provision means inaccurate estimates and/or an intent to overstate earnings. Sizable gains and

losses on the sale of assets may infer inaccurate depreciation estimates.
Examine the trend in the following ratios:

- High estimation assets (e.g., fixed assets) to total assets
- Cash expenses to revenue
- Estimated expenses to revenue
- Cash revenue to revenue
- Estimated revenue to revenue
- Estimated expenses to net income
- Estimated revenue to net income

Higher estimation is indicated by long-term construction work using the percentage-of-completion contract method, and a material amount of estimated liability provisions.

EXAMPLE 5.4

The following information applies to a company:

	<i>20X1</i>	<i>20X2</i>
Cash and near-cash revenue	\$ 98,000	\$107,000
Non-cash revenue items	143,000	195,000
Total revenue	<u>\$241,000</u>	<u>\$302,000</u>
	<i>20X1</i>	<i>20X2</i>
Cash and near-cash expenses	\$ 37,000	\$ 58,000
Non-cash expenses	<u>67,000</u>	<u>112,000</u>
Total expenses	<u>\$104,000</u>	<u>\$170,000</u>
Net income	<u>\$137,000</u>	<u>\$132,000</u>

Estimation-related ratios can now be calculated.

	<i>20X1</i>	<i>20X2</i>
Estimated revenue to total revenue	59%	65%
Estimated revenue to net income	104%	148%
Estimated expenses to total expenses	64%	66%
Estimated expenses to total revenue	28%	37%
Estimated expenses to net income	49%	85%

In every case, there was greater estimation involved in the income measurement process in 20X2 relative to 20X1. The higher degree of estimation resulted in lower earnings quality.

INTERNAL CONTROL AND MANAGEMENT HONESTY

Deficient internal control casts doubt upon the integrity of the earnings stream. Look at the trend in audit fees and in audit time over the years. Increasing trends may point to internal control and audit problems. Examine disclosure of errors that cast doubt upon the integrity of financial reporting. Are there any indicators of a dishonest management, such as corporate bribes, payoffs,

or hiding of defective merchandise?

AUDITOR RELATIONS AND REPORTS

You should examine the turnover rate in auditors. High turnover rates as a result of accounting disagreements reflect negatively on earnings quality. When a conflict of opinion regarding an accounting change results in a change in auditors, determine the effect on net income if the new auditor agrees to the policy change; compare the net income computed under the new policy with that computed under the old policy. Examine the type of audit opinion rendered (unqualified, qualified, disclaimer, or adverse), and consider why that format was selected. Questions to be asked are

- What is the subject of a qualified opinion?
- Why was a disclaimer opinion called for?
- What uncertainties are present?
- Is there adequate footnote disclosure?
- Is there a significant subsequent event?
- Are there related party transactions?

CONCLUSION

Quality of earnings involves those factors that would influence investors or creditors considering investing or giving credit to firms exhibiting the same reported earnings. Specifically, two firms in a given industry may report identical earnings, but may be quite different in terms of operational performance. This is because identical earnings may possess different degrees of quality. The key in evaluating a company's earnings quality is to compare its earnings profile (the mixture and degree of favorable and unfavorable characteristics associated with reported results) with the earnings profile of other companies in the same industry. Analysts attempt to assess earnings quality in order to render the earnings comparable, and to determine what valuation should be placed upon them.

You must address the problem of evaluating earnings of competitive companies that report substantially different net incomes. The earnings quality of the firm reporting higher net income may in fact be inferior if the firm is burdened with more undesirable characteristics in earnings than its low-income competitor.

When two competitive companies use alternative accounting policies, you should adjust their net incomes to a common basis in order to reduce the diversity in accounting that exists. The best basis for adjusting earnings for comparative purposes is to derive net income figures, assuming that realistic accounting policies were used.

Quality of earnings can be looked at only in terms of accounting and financial characteristics that have an effect on the earning power of a firm, as shown in its net income figure. These characteristics are complex and interrelated, and are subject to wide varieties of interpretation depending upon your own analytical objective.

CHAPTER 6

ANALYSIS OF VARIANCE ANALYSIS FOR COST CONTROL

LEARNING OBJECTIVES

After studying the material in this chapter, you will able to:

1. Explain responsibility accounting and appreciate how important it is for managerial control.
2. Distinguish among three types of responsibility centers and see how they are evaluated.
3. Calculate different types of variances for manufacturing costs--direct materials, direct labor, and manufacturing overhead.
4. Explain the managerial significance of these variances.
5. Prepare a flexible budget and explain its advantage over the static budget format.
6. List non-financial performance measures.

Responsibility accounting is the system for collecting and reporting revenue and cost information by areas of responsibility. It operates on the premise that managers should be held responsible for their performance, the performance of their subordinates, and all activities within their responsibility center. Responsibility accounting, also called profitability accounting and activity accounting, has the following advantages:

- (1) It facilitates delegation of decision making.
- (2) It helps management promote the concept of management by objective. In management by objective, managers agree on a set of goals. The manager's performance is then evaluated based on his or her attainment of these goals.
- (3) It provides a guide to the evaluation of performance and helps to establish standards of performance which are then used for comparison purposes.
- (4) It permits effective use of the concept of management by exception, which means that the manager's attention is concentrated on the important deviations from standards and budgets.

RESPONSIBILITY ACCOUNTING AND RESPONSIBILITY CENTER

For an effective responsibility accounting system, the following three basic conditions are necessary:

- (a) The organization structure must be well defined. Management responsibility and authority must go hand in hand at all levels and must be clearly established and understood.
- (b) Standards of performance in revenues, costs, and investments must be properly determined and well defined.
- (c) The responsibility accounting reports (or performance reports) should include only items that are controllable by the manager of the responsibility center. Also, they should highlight items calling for managerial attention.

A well-designed responsibility accounting system establishes responsibility centers within the organization. A responsibility center is defined as a unit in the organization which has control over costs, revenues, and/or investment funds. Responsibility centers can be one of the following types:

Cost center. A cost center is the unit within the organization which is responsible only for costs. Examples include production and maintenance departments of a manufacturing company.

Variance analysis based on standard costs and flexible budgets would be a typical performance measure of a cost center.

Profit center. A profit center is the unit which is held responsible for the revenues earned and costs incurred in that center. Examples might include a sales office of a publishing company, and appliance department in a retail store, and an auto repair center in a department store. The contribution approach to cost allocation is widely used to measure the performance of a profit center. This topic is covered in Chapter 7.

Investment center. An investment center is the unit within the organization which is held responsible for the costs, revenues, and related investments made in that center. The corporate headquarters or division in a large decentralized organization would be an example of an investment center. This topic is covered in Chapter 8.

STANDARD COSTS AND VARIANCE ANALYSIS

One of the most important phases of responsibility accounting is establishing standard costs and evaluating performance by comparing actual costs with the standard costs. *Standard costs* are costs that are established in advance to serve as targets to be met and after the fact, to determine how well those targets were actually met. The standard cost is based on physical and dollar measures: it is determined by multiplying the standard quantity of an input by its standard price.

The difference between the actual costs and the standard costs, called the variance, is calculated for individual cost centers. Variance analysis is a key tool for measuring performance of a cost center.

The *performance reports* based on the analysis of variances must be prepared for each cost center, addressing the following questions:

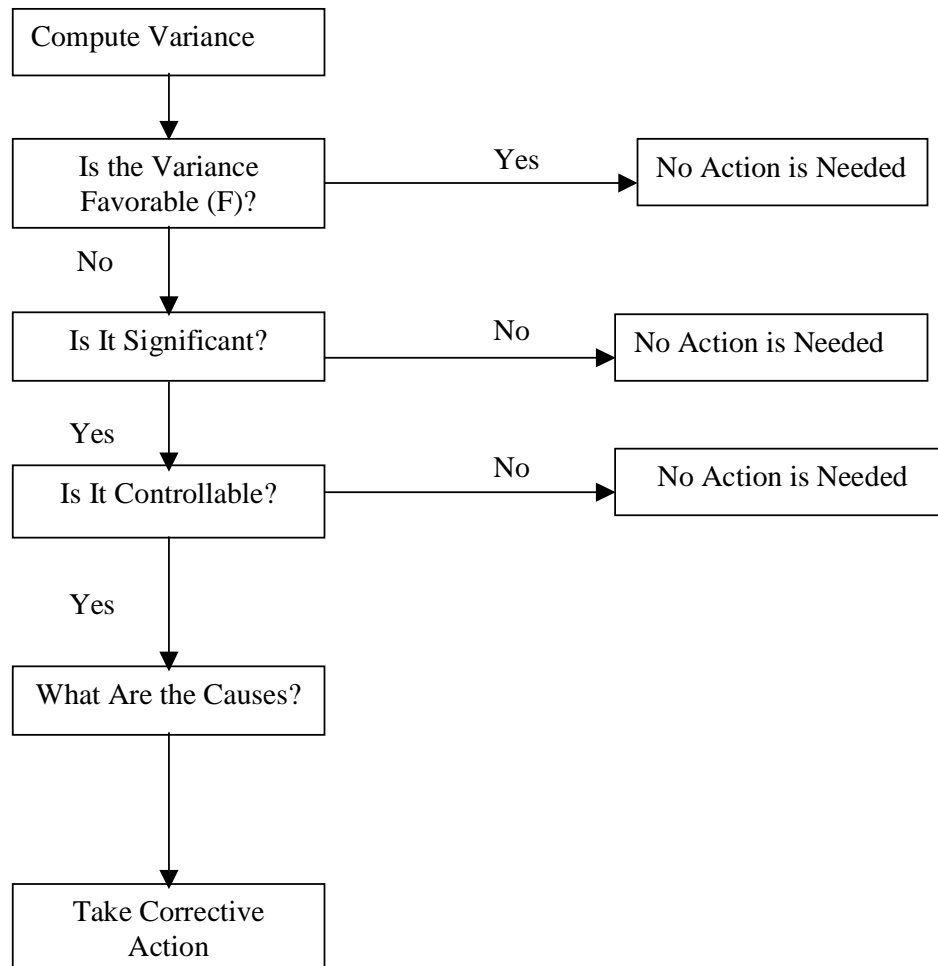
1. Is it favorable (F) or unfavorable (U)?
2. If it is unfavorable, is it significant enough for further investigation? For example, a 5% over the standard is a redflag. The decision to investigate is based on the company's policy in terms of the standard plus or minus an allowable control limit. Current practice sets the control limits subjectively, based on judgment and past experience rather than any formal identification of limits. About 45 to 47 percent of the firms surveyed used dollar or percentage control limits.

3. If it is significant, is it controllable? For example, it may be due to a strike on the part of the supplier. A material shortage and the ensuing price hike may not be within the control of the production manager.
4. If it is controllable, then who is responsible for what portion of the total variance?
5. What are the causes for an unfavorable variance?
6. What is the remedial action to take?

The whole purpose of variance analysis is to determine what happened, what the causes are, and make sure the same thing does not happen again. The report is useful in two ways: (1) in focusing attention on situations in need of management action and (2) in increasing the precision of planning and control of costs. The report should be produced as part of the overall standard costing and responsibility accounting system.

Figure 6.1 takes you, step by step, through variance analysis.

FIGURE 6.1
USING VARIANCE ANALYSIS TO CONTROL COSTS



GENERAL MODEL FOR VARIANCE ANALYSIS

Two general types of variances can be calculated for most cost items: a *price* (rate, spending) variance and a *quantity* (usage, efficiency) variance.

The price variance is calculated as follows:

$$\begin{aligned}
 \text{Price Variance} &= \text{Actual Quantity} * (\text{Actual price} - \text{Standard price}) \\
 &= \text{AQ} * (\text{AP} - \text{SP}) \\
 &= (\text{AQ} * \text{AP}) - (\text{AQ} * \text{SP})
 \end{aligned}$$

The quantity variance is calculated as follows:

$$\begin{aligned}\text{Quantity} & \quad \text{Actual} \quad \text{Standard} \quad \text{Standard} \\ & = \quad (\text{Quantity} - \text{Quantity}) * \text{Price} \\ \text{Variance} & \\ & = \quad (AQ - SQ) * SP \\ & = \quad (AQ * SP) - (SQ * SP)\end{aligned}$$

It is important to note four things:

1. A price variance and a quantity variance can be calculated for all three variable cost items -- direct materials, direct labor, and the variable portion of factory overhead. The variance is not called by the same name, however. For example, a price variance is called a materials price variance in the case of direct materials, but a labor rate variance in the case of direct labor and a variable overhead spending variance in the case of variable factory overhead.
2. A cost variance is unfavorable (U) if the actual price AP or actual quantity AQ exceeds the standard price SP or standard quantity SQ; a variance is favorable (F) if the actual price or actual quantity is less than the standard price or standard quantity.
3. The standard quantity allowed for output -- item (3) -- is the key concept in variance analysis. This is the standard quantity that should have been used to produce actual output. It is computed by multiplying the actual output by the number of input units allowed.
4. Variances for fixed overhead are of questionable usefulness for control purposes, since these variances are usually beyond the control of the production department.

We will now illustrate the variance analysis for each of the variable manufacturing cost items.

MATERIALS VARIANCES

A materials purchase price variance is isolated at the time of purchase of the material. It is computed based on the actual quantity purchased. The purchasing department is responsible for any materials price variance that might occur. The materials quantity (usage) variance is computed based on the actual quantity used. The production department is responsible for any materials quantity variance.

Unfavorable price variances may be caused by: inaccurate standard prices, inflationary cost increases, scarcity in raw material supplies resulting in higher prices, and purchasing department inefficiencies. Unfavorable material quantity variances may be explained by poorly trained workers, by improperly adjusted machines, or by outright waste on the production line.

EXAMPLE 6.1

Mighty Kings Corporation uses a standard cost system. The standard variable costs for product J are as follows:

Materials: 2 pounds per unit at \$3 per pound (\$6 per unit of Product J)
Labor: 1 hour per unit at \$5 per hour (\$5 unit of Product J)
Variable overhead: 1 hour per unit at \$3 per hour (\$3 per unit of Product J)

During March, 25,000 pounds of material were purchased for \$74,750 and 20,750 pounds of material were used in producing 10,000 units of finished product. Direct labor costs incurred were \$49,896 (10,080 direct labor hours) and variable overhead costs incurred were \$34,776.

It is important to note that the amount of materials purchased (25,000 pounds) differs from the amount of materials used in production (20,750 pounds). The materials purchase price variance was computed using 25,000 pounds purchased, whereas the materials quantity (usage) variance was computed using the 20,750 pounds used in production. A total variance cannot be computed because of the difference.

We can compute the materials variances as follows:

$$\begin{aligned}\text{Materials purchase price variance} &= \text{AQ} (\text{AP} - \text{SP}) \\ &= (\text{AQ} * \text{AP}) - (\text{AQ} * \text{SP}) \\ &= (25,000 \text{ pounds}) (\$2.99 - \$3.00) \\ &= \$74,750 - \$75,000 \\ &= \$250 (\text{F})\end{aligned}$$

$$\begin{aligned}\text{Materials quantity (usage) variance} &= (\text{AQ} - \text{SQ}) \text{SP} \\ &= (20,750 \text{ pounds} - 20,000 \text{ pounds}) (\$3.00) \\ &= \$62,250 - \$60,000 \\ &= \$2,250 (\text{U})\end{aligned}$$

LABOR VARIANCES

Labor variances are isolated when labor is used for production. They are computed in a manner similar to the materials variances, except that in the 3-column model the terms efficiency and rate are used in place of the terms quantity and price. The production department is responsible for both the prices paid for labor services and the quantity of labor services used. Therefore, the production department must explain why any labor variances occur.

Unfavorable rate variances may be explained by an increase in wages, or the use of labor commanding higher wage rates than contemplated. Unfavorable efficiency variances may be explained by poor supervision, poor quality workers, poor quality of materials requiring more labor time, machine breakdowns, and employee unrest.

EXAMPLE 6.2

Using the same data given in Example 6.1, the labor variances can be calculated as :

$$\begin{aligned}\bullet \text{ Labor rate variance} &= AH (AR - SR) \\ &= (AH * AR) - (AH * SR) \\ &= (10,080 \text{ hours}) (\$4.95 - \$5.00) \\ &= \$49,896 - \$50,400 \\ &= \$504 (F) \\ \\ \bullet \text{ Labor efficiency variance} &= (AH - SH) SR \\ &= (10,080 \text{ hours} - 10,000 \text{ hours}) * \$5.00 \\ &= \$50,400 - \$50,000 \\ &= \$400 (U)\end{aligned}$$

VARIABLE OVERHEAD VARIANCES

The variable overhead variances are computed in a way very similar to the labor variances. The production department is usually responsible for any variable overhead variance.

Unfavorable variable overhead spending variances may be caused by a large number of factors: acquiring supplies for a price different from the standard, using more supplies than expected, waste, and theft of supplies. Unfavorable variable overhead efficiency variances might be caused by such factors as: poorly trained workers, poor-quality materials, faulty equipment, work interruptions, poor production scheduling, poor supervision, employee unrest, and so on.

When variable overhead is applied using direct labor hours, the efficiency variance will be caused by the same factors that cause the labor efficiency variance. However, when variable overhead is applied using machine hours, inefficiency in machinery will cause a variable overhead efficiency variance.

EXAMPLE 6.3

Using the same data given in Example 6.1, the variable overhead variances can be computed as follows:

$$\begin{aligned}\text{Variable overhead spending variance} &= AH (AR - SR) \\ &= (AH * AR) - (AH * SR) \\ &= (10,080 \text{ hours}) (\$3.45 - \$3.00) \\ &= \$34,776 - \$30,240 \\ &= \$4,536 (U) \\ \\ \text{Variable overhead efficiency variance} &= (AH - SH) SR\end{aligned}$$

$$\begin{aligned}
&= (10,080 \text{ hours} - 10,000 \text{ hours}) * \$3.00 \\
&= \$30,240 - \$30,000 \\
&= \$240 \text{ (U)}
\end{aligned}$$

FLEXIBLE BUDGETS AND PERFORMANCE REPORTS

A flexible budget is a tool that is extremely useful in cost control. The flexible budget is characterized as follows:

1. It is geared toward a range of activity rather than a single level of activity.
2. It is dynamic in nature rather than static. By using the cost-volume formula (or flexible budget formula), a series of budgets can be easily developed for various levels of activity.

The static (fixed) budget is geared for only one level of activity and has problems in cost control. Flexible budgeting distinguishes between fixed and variable costs, thus allowing for a budget which can be automatically adjusted (via changes in variable cost totals) to the particular level of activity actually attained. Thus, variances between actual costs and budgeted costs are adjusted for volume ups and downs before differences due to price and quantity factors are computed.

The primary use of the flexible budget is to accurately measure performance by comparing actual costs for a given output with the budgeted costs for the same level of output.

EXAMPLE 6.4

To illustrate the difference between the static budget and the flexible budget, assume that the Assembly Department of Omnis Industries, Inc. is budgeted to produce 6,000 units during June. Assume further that the company was able to produce only 5,800 units. The budget for direct labor and variable overhead costs is as follows:

OMNIS INDUSTRIES, INC.

The Direct Labor and Variable Overhead Budget

Assembly Department

For the Month of June

Budgeted production	6,000 units
Actual production	5,800 units
Direct labor	\$39,000
Variable overhead costs:	
Indirect labor	6,000
Supplies	900

Repairs	<u>300</u>
	<u>\$46,200</u>

If a static budget approach is used the performance report will appear as follows:

OMNIS INDUSTRIES, INC.

Direct Labor and Variable Overhead

Static Budget Versus Actual
Assembly Department
For the Month of June

	<u>Budget</u>	<u>Actual*</u>	<u>Variance (U or F)**</u>
Production in units	6,000	5,800	200U
Direct labor	\$39,000	\$38,500	\$500F
Variable overhead costs:			
Indirect labor	6,000	5,950	50F
Supplies	900	870	30F
Repairs	<u>300</u>	<u>295</u>	<u>5F</u>
	<u>\$46,200</u>	<u>\$45,615</u>	<u>\$585F</u>

*Given.

**A variance represents the deviation of actual cost from the standard or budgeted cost. U and F stand for "unfavorable" and "favorable," respectively.

These cost variances are useless, in that they are comparing oranges with apples. The problem is that the budget costs are based on an activity level of 6,000 units, whereas the actual costs were incurred at an activity level below this (5,800 units).

From a control standpoint, it makes no sense to try to compare costs at one activity level with costs at a different activity level. Such comparisons would make a production manager look good as long as the actual production is less than the budgeted production. Using the cost-volume formula and generating the budget based on the 5,800 actual units gives the following performance report:

OMNIS INDUSTRIES, INC.

Performance Report Assembly Department
Flexible Budget Versus Actual
For the Month of June

	Budgeted production	6,000 units		
	Actual production	5,800 units		
	Cost-volume <u>formula</u>	Flexible Budget <u>5,800 units</u>	Actual <u>5,800 units</u>	Variance <u>(U or F)</u>
Direct labor	\$6.50 per unit	\$37,700	\$38,500	\$800U
Variable overhead:				
Indirect labor	1.00	5,800	5,950	150U
Supplies	0.15	870	870	0
Repairs	<u>0.05</u>	<u>290</u>	<u>295</u>	<u>5U</u>
	<u>\$7.70</u>	<u>\$44,660</u>	<u>\$45,615</u>	<u>\$955U</u>

Notice that all cost variances are unfavorable (U), as compared to the favorable cost variances on the performance report based on the static budget approach.

NONFINANCIAL PERFORMANCE MEASURES

Standard costs are widely used in manufacturing, service, and not-for-profit organizations. The list of companies using standards as a method for controlling costs and measuring performance continues to grow. For a firm to improve, managers should encompass nonfinancial (or operational) measures as well as financial measures, especially those that track factors required for world-class status. In an automated environment, labor is a smaller proportion of product cost, often less than 5%. Thus, traditional labor variances are of little value to management. Also, the manufacturing process is more reliable in an automated environment, and the traditional variances tend to be minimal.

The new performance measures tend to be nonfinancial and more subjective than standard costs. Table 1 presents five sets of *nonfinancial performance measures*. They include statistics for activities such as quality control, on-time delivery, inventory, machine downtime, and material waste. Measures such as *quality control and delivery performance* are customer oriented. These are useful performance measures in all organizations, particularly service organizations in which the focus is on services, not goods. A general model for measuring the relative success of an activity compares number of successes with total activity volume. For example, delivery performance could be measured as follows.

$$\frac{\text{Number of on-time deliveries}}{\text{Total delivery made}} = \text{delivery success rate}$$

The percentage of external failures may be monitored for quality control.

Others may be production oriented. *Reducing material waste, inventory, and machine downtime* have been shown to improve quality and efficiency. These nonfinancial performance measures and measures of performance using standard costs are not mutually exclusive. Reducing materials waste would eliminate an unfavorable materials usage variance, for example. Measures such as inventory turnover and days of inventory can be used, however. Table 6.1 illustrates nonfinancial performance measures.

TABLE 6.1
NONFINANCIAL PERFORMANCE MEASURES

<i>Task</i>	<i>Objective</i>
Inventory:	
Inventory levels	Decrease inventory levels
Number of inventoried items	Curtail number of different items
Quality control:	
Number of customer complaints	Reduce complaints
Number of defects	Reduce defects
Delivery performance:	
Delivery success rate	Increase on-time deliveries
Materials waste:	
Scrap and waste as a percentage of total cost	Decrease scrap and waste
Machine downtime:	
Percentage of machine downtime	Reduce downtime

CONCLUSION

Variance analysis is essential in the organization for the appraisal of all aspects of the business. This chapter was concerned with the control of cost centers through standard costs. It discussed the basic mechanics of how the two major variances --the price variance and the quantity variance--are calculated for direct materials, direct labor, variable overhead, and fixed overhead. The idea of flexible budgeting was emphasized in an attempt to correctly measure the efficiency of the cost center. We noted that fixed overhead volume variance has a limited usefulness at the level of a cost center, since only top management has the power to expand or contract fixed facilities.

CHAPTER 7

ANALYSIS OF SEGMENTAL PERFORMANCE AND PROFIT VARIANCE

LEARNING OBJECTIVES

After studying the material in this chapter, you will be able to:

1. Explain Segmental Reporting for Profit Centers.
2. Give examples of Profit Variance Analysis.
3. Analyze and evaluate sales mix.

Segmental reporting is the process of reporting activities of profit centers such as divisions, product lines, or sales territories. The *contribution approach* is valuable for segmented reporting because it emphasizes the cost behavior patterns and the controllability of costs that are generally useful for profitability analysis of various segments of an organization.

SEGMENTAL REPORTING FOR PROFIT CENTERS

The contribution approach is based on the thesis that:

- (1) Fixed costs are much less controllable than variable costs.
- (2) *Direct* fixed costs and *common* fixed costs must be clearly distinguished. Direct fixed costs are those fixed which can be identified directly with a particular segment of an organization, whereas common fixed costs are those costs that cannot be identified directly with the segment.
- (3) Common fixed costs should be clearly identified as unallocated in the contribution income statement by segments. Any attempt to allocate these types of costs, on some arbitrary basis, to the segments of the organization can destroy the value of responsibility accounting. It would lead to unfair evaluation of performance and misleading managerial decisions.

The following concepts are highlighted in the contribution approach:

1. Contribution margin: Sales minus variable costs
2. Segment margin: Contribution margin minus direct (traceable) fixed costs. Direct fixed costs include discretionary fixed costs such as certain advertising, R & D, sales promotion, and engineering and traceable and committed fixed costs such as depreciation, property taxes, insurance and the segment managers' salaries.

3. Net income: Segment margin less unallocated common fixed costs.

Segmental reporting can be made by:

- Division.
- Product or product line.
- Sales territory.
- Service center.
- Sales person.
- Store or branch office.
- Domestic or foreign operations.

EXAMPLE 7.1

Figure 7.1 illustrates two levels of segmental reporting:

- (1) By segments defined as divisions.
- (2) By segments defined as product lines of a division.

FIGURE 7.1

SEGMENTAL INCOME STATEMENT

(1) Segments Defined as Divisions:

	<i>SEGMENTS</i>		
	<i>Total Company</i>	<i>Division 1</i>	<i>Division 2</i>
Sales	<u>\$150,000</u>	<u>\$90,000</u>	<u>\$60,000</u>
Less: Variable costs:			
Manufacturing	40,000	30,000	10,000
Selling and admin.	20,000	14,000	6,000
Total variable costs	<u>60,000</u>	<u>44,000</u>	<u>16,000</u>
Contribution margin	\$90,000	\$46,000	\$44,000
Less: Direct fixed costs	<u>70,000</u>	<u>43,000</u>	<u>27,000</u>
Divisional segment margin	\$20,000	<u>\$3,000</u>	<u>\$17,000</u>
Less: Unallocated common fixed costs	<u>\$10,000</u>		
Net income	<u>\$10,000</u>		

(2) Segments Defined as Product Lines of Division 2

	<i>SEGMENTS</i>		
	<i>Division 2</i>	<i>Deluxe Model</i>	<i>Regular Model</i>
Sales	<u>\$60,000</u>	<u>\$20,000</u>	<u>\$40,000</u>

Less: Variable costs			
Manufacturing	10,000	5,000	5,000
Selling and administrative	6,000	2,000	4,000
Total variable costs	<u>16,000</u>	<u>7,000</u>	<u>9,000</u>
Contribution margin	<u>\$44,000</u>	<u>\$13,000</u>	<u>\$31,000</u>
Less: Direct fixed cost	<u>26,500</u>	<u>9,500</u>	<u>17,000</u>
Product line margin	<u>\$17,500</u>	<u>\$3,500</u>	<u>\$14,000</u>
Less: Unallocated common fixed costs	<u>\$500</u>		
Divisional segment margin	<u>\$17,000</u>		

The segment margin is the best measure of the profitability of a segment. Unallocated fixed costs are common to the segments being evaluated and should be left unallocated in order not to distort the performance results of segments.

PROFIT VARIANCE ANALYSIS

Profit variance analysis, often called *gross profit analysis*, deals with how to analyze the profit variance that constitutes the departure between actual profit and the previous year's income or the budgeted figure. The primary goal of profit variance analysis is to improve performance and profitability in the future.

Profit, whether it is gross profit in absorption costing or contribution margin in direct costing, is affected by at least three basic items: sales price, sales volume, and costs. In addition, in a multi-product firm, if not all products are equally profitable, profit is affected by the mix of products sold.

The difference between budgeted and actual profits is due to one or more of the following:

- (1) Changes in unit sales price and cost, called sales price and cost price variances, respectively. The difference between sales price variance and cost price variance is often called a contribution-margin-per-unit variance or a gross-profit-per-unit variance, depending upon what type of costing system being referred to, that is, absorption costing or direct costing. Contribution margin is considered, however, a better measure of product profitability because it deducts from sales revenue only the variable costs that are controllable in terms of fixing responsibility. Gross profit does not reflect cost-volume-profit relationships. Nor does it consider directly traceable marketing costs.
- (2) Changes in the volume of products sold summarized as the sales volume variance and the cost volume variance. The difference between the two is called the total volume variance.
- (3) Changes in the volume of the more profitable or less profitable items referred to as the sales mix variance.

Detailed analysis is critical to management when multi-products exist. The volume variances may be used to measure a change in volume (while holding the mix constant) and the mix may be employed to evaluate the effect of a change in sales mix (while holding the quantity constant). This type of variance analysis is useful when the products are substituted for each other, or when products which are not necessarily substitutes for each other are marketed through the same channel.

Types of Standards in Profit Variance Analysis

To determine the various causes for a favorable variance (an increase) or an unfavorable variance (a decrease) in profit we need some kind of yardsticks to compare against the actual results. The yardsticks may be based on the prices and costs of the previous year, or any year selected as the base periods. Some companies are summarizing profit variance analysis data in their annual report by showing departures from the previous year's reported income. However, one can establish a more effective control and budgetary method rather than the previous year's data. Standard or budgeted mix can be determined using such sophisticated techniques as linear and goal programming.

Single Product Firms

Profit variance analysis is simplest in a single product firm, for there is only one sales price, one set of costs (or cost price), and a unitary sales volume. An unfavorable profit variance can be broken down into four components: a sales price variance, a cost price variance, a sales volume variance, and a cost volume variance.

The sales price variance measures the impact on the firm's contribution margin (or gross profit) of changes in the unit selling price. It is computed as:

$$\text{Sales price variance} = (\text{actual price} - \text{budget price}) \times \text{actual sales}$$

If the actual price is lower than the budgeted price, for example, this variance is unfavorable; it tends to reduce profit. The cost price variance, on the other hand, is simply the summary of price variances for materials, labor and overhead. (This is the sum of material price, labor rate, and factory overhead spending variances). It is computed as:

$$\text{Cost price variance} = (\text{actual cost} - \text{budget cost}) \times \text{actual sales}$$

If the actual unit cost is lower than budgeted cost, for example, this variance is favorable; it tends to increase profit. We simplify the computation of price variances by taking the sales price variance less the cost price variance and call it the gross-profit-per-unit variance or contribution-margin-per-unit variance.

The sale volume variance indicates the impact on the firm's profit of changes in the unit sales volume. This is the amount by which sales would have varied from the budget if nothing but sales volume had changed. It is computed as:

$$\text{Sales volume variance} = (\text{actual sales} - \text{budget sales}) \times \text{budget price}$$

If actual sales volume is greater than budgeted sales volume, this is favorable; it tends to increase profit. The cost volume variance has the same interpretation. It is:

$$(\text{Actual sales} - \text{budget sales}) \times \text{budget cost per unit.}$$

The difference between the sales volume variance and the cost volume variance is called the total volume variance.

Multi-Product Firms

When a firm produces more than one product, there is a fourth component of the profit variance. This is the sales mix variance, the effect on profit of selling a different proportionate mix of products than the one that has been budgeted. This variance arises when different products have different contribution margins. In a multi-product firm, actual sales volume can differ from that budgeted in two ways. The total number of units sold could differ from the target aggregate sales. In addition, the mix of the products actually sold may not be proportionate to the target mix. Each of these two different types of changes in volume is reflected in a separate variance.

The total volume variance is divided into the two: the sales mix variance and the sales quantity variance. These two variances should be used to evaluate the marketing department of the firm. The sales mix variance shows how well the department has done in terms of selling the more profitable products while the sales quantity variance measures how well the firm has done in terms of its overall sales volume. They are computed as:

$$\begin{array}{l} \text{Sales Mix Variance} \\ (\text{Actual Sales at budget mix} - \text{Actual Sales at actual mix}) \quad \times \quad \text{Budget CM (or gross profit / unit)} \end{array}$$

$$\begin{array}{l} \text{Sales Quantity Variance} \\ (\text{Actual Sales at budget mix} - \text{Budget Sales at budget mix}) \quad \times \quad \text{Budget CM (or gross profit / unit)} \end{array}$$

$$\begin{array}{l} \text{Sales Volume Variance} \\ (\text{Actual Sales at actual mix} - \text{Budget Sales at budget mix}) \quad \times \quad \text{Budget CM (or gross profit / unit)} \end{array}$$

EXAMPLE 7.2

The Lake Tahoe Ski Store sells two ski models -- Model X and Model Y. For the years 20x1 and 20x2, the store realized a gross profit of \$246,640 and only \$211,650, respectively. The owner of the store was astounded since the total sales volume in dollars and in units was higher for 20x2 than for

20x1 yet the gross profit achieved actually declined. Given below are the store's unaudited operating results for 20x1 and 20x2. No fixed costs were included in the cost of goods sold per unit.

YEAR	<i>Selling</i>	<i>Model X Costs of Goods Sold per unit</i>	<i>Sales in Units</i>	<i>Sales Revenue</i>	<i>Selling</i>	<i>Model Y Costs of Goods Sold per unit</i>	<i>Sales in Units</i>	<i>Sales Revenue</i>
	Price				Price			
1	\$150	\$110	2,800	\$420,000	\$172	\$121	2,640	\$454,080
2	160	125	2,650	424,000	176	135	2,900	510,400

Explain why the gross profit declined by \$34,990. Include a detailed variance analysis of price changes and changes in volume both for sales and cost. Also subdivide the total volume variance into change in price and changes in quantity.

Sales price and sales volume variances measure the impact on the firm's CM (or GM) of changes in the unit selling price and sales volume. In computing these variances, all costs are held constant in order to stress changes in price and volume. Cost price and cost volume variances are computed in the same manner, holding price and volume constant. All these variances for the Lake Tahoe Ski Store are computed below.

Sales Price Variance

Actual sales for 20x2:

Model X 2,650	x	\$160	=	\$424,000
Model Y 2,900	x	176	=	<u>510,400</u>
				\$934,400

Actual 20x2 sales at 20x1 prices:

Model X 2,650	x	\$150	=	\$397,500
Model Y 2,900	x	172	=	<u>498,800</u>
				<u>896,300</u>
				<u>\$38,100 F</u>

Sales Volume Variance

Actual 20x2 sales at 20x1 prices: \$896,300

Actual 20x1 sales (at 20x1 prices):

Model X 2,800	x	\$150	=	\$420,000
Model Y 2,640	x	172	=	<u>454,080</u>
				<u>874,080</u>
				<u>\$22,220 F</u>

Cost Price Variance

Actual cost of goods sold for 20x2:

Model X 2,650	x	\$125	=	\$331,250
Model Y 2,900	x	135	=	<u>391,500</u>
				\$722,750

Actual 20x2 sales at 20x1 costs:

Model X 2,650	x	\$110	=	\$291,500
Model Y 2,900	x	121	=	<u>350,900</u>
				<u>642,400</u>
				<u>\$80,350 U</u>

Cost Volume Variance

Actual 20x2 sales at 20x1 costs: \$642,400

Actual 20x1 sales (at 20x1 costs):

Model X 2,800	x	\$110	=	\$308,000
Model Y 2,640	x	121	=	319,440
				<u>627,440</u>
				<u>\$14,960 U</u>

Total volume variance	=	sales volume variance	-	cost volume variance	
	=	\$22,220 F	-	\$14,960 U	= <u>\$7,260 F</u>

The total volume variance is computed as the sum of a sales mix variance and a sales quantity variance as follows:

Sales Mix Variance

	20x2 Actual Sale at 20x1 Mix*	20x1 Actual Sale at 20x2 Mix	Diff.	20x1 Gross Profit Per Unit	Variance (\$)
Model X	2,857	2,650	207 U	\$40	\$8,280 U
Model Y	<u>2,693</u>	<u>2,900</u>	207 F	51	<u>10,557 F</u>
	<u>5,500</u>	<u>5,550</u>			<u>\$2,277 F</u>

*This is the 20x1 mix (used as standard or budget) proportions of 51.47% (or 2,800/5,440 = 51.47%) and 48.53% (or 2,640/5,440 = 48.53%) applied to the actual 20x2 sales figure of 5,550 units.

Sales Quantity Variance

	<i>20x2 Actual Sale at 20x1 Mix*</i>	<i>20x2 Actual Sale at 20x1 Mix</i>	<i>Diff.</i>	<i>20x1 Gross Profit Per Unit</i>	<i>Variance (\$)</i>
Model X	2,857	2,800	57 F	\$40	\$2,280 F
Model Y	<u>2,693</u>	<u>2,640</u>	52 F	51	<u>2,703 F</u>
	<u>5,550</u>	<u>5,440</u>			<u>\$4,983 F</u>

A favorable total volume variance is due to a favorable shift in the sales mix (that is from Model X to Model Y) and also to a favorable increase in sales volume (by 110 units) which is shown as follows.

Sale mix variance	\$2,277 F
Sales quantity	<u>4,983 F</u>
	<u>\$7,260</u>

However, there remains the decrease in gross profit. The decrease in gross profit of \$34,990 can be explained as follows.

	<i>Gains</i>	<i>Losses</i>
Gain due to increased sales price	\$38,100 F	80,350U
Loss due to increased cost		
Gain due to increased in units sold	4,983 F	
Gain due to shift in sales mix	<u>2,277 F</u>	
	<u>\$45,360 F</u>	<u>\$80,350U</u>

Hence, net decrease in gross profit = \$80,350 - \$45,360 = \$34,990U

Despite the increase in sales price and volume and the favorable shift in sales mix, the Lake Tahoe Ski Store ended up losing \$34,990 compared to 20x1. The major reason for this comparative loss was the tremendous increase in cost of goods sold, as costs for both Model X and Model Y went up quite significantly over 20x1. The store has to take a close look at the cost picture, even though only variable and fixed costs should be analyzed in an effort to cut down on controllable costs. In doing that, it is essential that responsibility be clearly fixed to given individuals. In a retail business like the Lake Tahoe Ski Store, operating expenses such as advertising and payroll of store employees must also be closely scrutinized.

EXAMPLE 7.3

Shim and Siegel, Inc. sells two products, C and D. Product C has a budgeted unit CM (contribution margin) of \$3 and Product D has a budgeted Unit CM of \$6. The budget for a recent month called for sales of 3,000 units of C and 9,000 units of D, for a total of 12,000 units. Actual sales totaled 12,200 units, 4,700 of C and 7,500 of D. Compute the sales volume variance and break this variance down into the (a) sales quantity variance and (b) sales mix variance.

Shim and Siegel's sales volume variance is computed below. As we can see, while total unit sales increased by 200 units, the shift in sales mix resulted in a \$3,900 unfavorable sales volume variance.

Sale Volume Variance

	Actual Sales at Actual Mix	Standard Sales at Budgeted Mix	Difference	Budgeted CM per Unit	Variance (\$)
<i>Product C</i>	4,700	3,000	1,700 F	\$3	\$5,100 F
<i>Product D</i>	7,500	9,000	1,500 U	6	9,000 U
	<u>12,200</u>	<u>12,000</u>			<u>\$3,900 U</u>

In multiproduct firms, the sales volumes variance is further divided into a sales quantity variance and a sales mix variance. The computations of these variances are shown below.

Sales Quantity Variance

	<i>Actual Sales at Budgeted Mix</i>	Standard Sales at Budgeted Mix	<i>Diff.</i>	Budgeted CM per Unit	Variance (\$)
Product C	3,050	3,000	50 F	\$3	\$ 150 F
Product D	<u>9,150</u>	<u>9,000</u>	150 F	6	<u>900 F</u>
	<u>12,200</u>	<u>12,000</u>			<u>\$1,050 F</u>

Sale Mix Variance

	<i>Actual Sales at Budgeted Mix</i>	<i>Actual Sales at Actual Mix</i>	<i>Difference</i>	<i>Standard CM per Unit</i>	Variance (\$)
Product C	3,050	4,700	1,650 F	\$3	\$4,950 F
Product D	<u>9,150</u>	<u>7,500</u>	1,650 U	6	<u>9,900 U</u>
	<u>12,200</u>	<u>12,200</u>			<u>\$4,950 U</u>

The sales quantity variance reflects the impact on the CM or GM (gross margin) of deviations from the standard sales volume, whereas the sales mix variance measures the impact on the CM of deviations from the budgeted mix. In the case of Shim and Siegel, Inc., the sales quantity variance came out to be favorable, i.e., \$1,050 F and the sales mix variance came out to be unfavorable, i.e., \$4,950 U. These variances indicate that while there was favorable increase in sales volume by 200 units, it was obtained by an unfavorable shift in the sales mix, that is, a shift from Product D, with a high margin, to Product C, with a low margin.

Note that the sales volume variance of \$3,900 U is the algebraic sum of the following two variances.

Sales quantity variance	\$1,050 F
Sales mix variance	<u>4,950 U</u>
	<u>\$3,900 U</u>

In conclusion, the product emphasis on high margin sales is often a key to success for multiproduct firms. Increasing sales volume is one side of the story; selling the more profitable products is another.

Managerial Planning and Decision Making

In view of the fact that Shim and Siegel, Inc. experienced an unfavorable sales volume variance of \$3,900 due to an unfavorable (or less profitable) mix in the sales volume, the company is advised to put more emphasis on increasing the sale of Product D.

In doing that the company might wish to:

- (a) Increase the advertising budget for succeeding periods to boost Product D sales;
- (b) Set up a bonus plan in such a way that the commission is based on quantities sold rather than higher rates for higher margin items such as Product D or revise the bonus plan to consider the sale of product D;
- (c) Offer a more lenient credit term for Product D to encourage its sale;
- (d) Reduce the price of Product D enough to maintain the present profitable mix while increasing the sale of product. This strategy must take into account the price elasticity of demand for Product D.

SALES MIX ANALYSIS

Many product lines include a lower-margin price leader model, and often a high-margin deluxe model. For example, the automobile industry includes in its product line low-margin energy-efficient small cars and higher-margin deluxe models. In an attempt to increase over-all profitability, management would wish to emphasize the higher-margin expensive items, but salesmen might find it easier to sell lower-margin cheaper models. Thus, a salesman might meet his unit sales quota with each item at its budgeted price, but because of mix shifts he could be far short of contributing his share of budgeted profit.

Management should realize that

1. Greater proportions of more profitable products mean higher profits.
2. Higher proportions of lower margin sales reduce overall profit despite the increase in overall sales volume. That is to say that an unfavorable mix may easily offset a favorable increase in volume, and vice versa.

Performance Reports

Profit variance analysis aids in fixing responsibility by separating the causes of the change in profit into price, volume, and mix factors. With responsibility resting in different places, the segregation of the total profit variance is essential. The performance reports based on the analysis of profit variances must be prepared for each responsibility center, indicating the following:

1. Is it controllable?
2. Is it favorable or unfavorable?
3. If it is unfavorable, is it significant enough for further investigation?
4. Who is responsible for what portion of the total profit variance?
5. What are the causes for an unfavorable variance?
6. What is the remedial action to take?

The performance report must address these types of questions. The report is useful in two ways: (1) in focusing attention on situations in need of management action and (2) in increasing the precision of planning and control of sales and costs. The report should be produced as part of the overall standard costing and responsibility accounting system. A responsibility accounting system should have certain controls that provide for feedback reports indicating deviations from expectations. Management may then focus on those deviations (exceptions) for either reinforcement for correction.

CONCLUSION

The contribution approach attempts to measure the performance of segments of an organization. It classifies costs as being either direct (traceable) or common to the segments. Only those costs that are directly identified with the segments are allocated; costs that are not direct to the segments are treated as common costs and are not allocated.

Under the contribution approach we deduct variable costs from sales to arrive at a contribution margin. The direct fixed costs are then deducted from the contribution margin, yielding a segment margin. The segment margin is a measure of a segment success that is also useful for long-term planning and mix decision making.

This chapter has also been concerned with the analysis and evaluation of profit performances. If the responsibility is to be fixed for a profit center, comparisons of targets and attainments must be made, with the differences fully accounted for. Changes in income traceable to volume must be

separated from changes due to prices. The effect of volume changes must be further divided to reveal the quantity factor and the mix factor.

CHAPTER 8

EVALUATING DIVISIONAL PERFORMANCE

LEARNING OBJECTIVES

After studying the material in this chapter, you will be able to:

1. Compute return on investment (ROI) by means of the Du Pont formula and show how changes in sales, expenses, and assets affect the investment center's performance.
2. Calculate the residual income (RI) and explain how it differs from ROI in measuring divisional performance.
3. Explain how ROI and RI measures affect the division's investment decision.

The primary difference between centralization and decentralization is in the degree of freedom of decision making by managers at many levels. In decentralization, decision making is at as low a level as possible. The premise is that the local manager can make more informed decisions than a centralized manager. Centralization assumes decision making must be consolidated so that activities throughout the organization may be more effectively coordinated. In most organizations, a mixture of these approaches is best.

The ability to measure performance is essential in developing management incentives and controlling the operation toward the achievement of organizational goals. A typical decentralized subunit is an investment center which is responsible for an organization's invested capital (operating assets) and the related operating income. There are two widely used measurements of performance for the investment center: the rate of return on investment (ROI) and residual income (RI).

RATE OF RETURN ON INVESTMENT (ROI)

ROI relates net income to invest capital. Specifically,

$$\text{ROI} = \frac{\text{Operating income}}{\text{Operating assets}}$$

EXAMPLE 8.1

Consider the following financial data for a division:

Operating assets	\$100,000
------------------	-----------

$$\text{ROI} = \$18,000 / \$100,000 = 18\%$$

The Breakdown of ROI -- Du Pont Formula

The Du Pont Corporation was the first major company to recognize the importance of looking at both margin and asset turnover in assessing the performance of an investment center. The ROI breakdown, known as the *Du Pont formula*, is expressed as a product of these two factors, as shown below.

The Du Pont formula combines the income statement and balance sheet into this otherwise static measure of performance. Margin is a measure of profitability or operating efficiency. It is the percentage of profit earned on sales. This percentage shows how many cents attach to each dollar of sales. On the other hand, asset turnover measures how well a division manages its assets. It is the number of times by which the investment in assets turns over each year to generate sales.

EXAMPLE 8.2

$$\text{Then, ROI} = \frac{\text{Operating income}}{\text{Operating assets}} = \frac{\$18,000}{\$100,000} = 18\%$$

107

$$\begin{aligned} \text{Margin} &= \frac{\text{Operating income}}{\text{Sales}} = \frac{\$18,000}{\$200,000} = 9\% \\ \text{Turnover} &= \frac{\text{Sales}}{\text{Operating assets}} = \frac{\$200,000}{\$100,000} = 2 \text{ times} \end{aligned}$$

Therefore,

$$\text{ROI} = \text{Margin} \times \text{Turnover} = 9\% \times 2 \text{ times}$$

The breakdown provides a lot of insights to division managers on how to improve profitability of the investment center.

Specifically, it has several advantages over the original formula for profit planning. They are:

(1) Focusing on the breakdown of ROI provides the basis for integrating many of the management concerns that influence a division's overall performance. This will help managers gain an advantage in the competitive environment.

(2) The importance of turnover as a key to overall return on investment is emphasized in the breakdown. In fact, turnover is just as important as profit margin in enhancing overall return.

(3) The importance of sales is explicitly recognized, which is not there in the original formula.

(4) The breakdown stresses the possibility of trading one off for the other in an attempt to improve the overall performance of a company. The margin and turnover complement each other. In other words, a low turnover can be made up for by a high margin; and vice versa.

EXAMPLE 8.3

The breakdown of ROI into its two components shows that a number of combinations of margin and turnover can yield the same rate of return, as shown below:

<i>Margin</i>	<i>x</i>	<i>Turnover</i>	<i>= ROI</i>
(1) 9%	x	2 times	= 18%
(2) 6	x	3	= 18
(3) 3	x	6	= 18
(4) 2	x	9	= 18

ROI AND PROFIT PLANNING

The breakdown of ROI into margin and turnover gives divisional managers insight into planning for profit improvement by revealing where weaknesses exist: margin or turnover, or both. Various actions can be taken to enhance ROI. Generally, they can:

1. Improve margin
2. Improve turnover
3. Improve both

Alternative 1 demonstrates a popular way of improving performance. Margins may be increased by reducing expenses, raising selling prices, or increasing sales faster than expenses. Some of the ways to reduce expenses are:

- (a) Use less costly inputs of materials.
- (b) Automate processes as much as possible to increase labor productivity.
- (c) Bring the discretionary fixed costs under scrutiny, with various programs either curtailed or eliminated. Discretionary fixed costs arise from annual budgeting decisions by management. Examples include advertising, research and development, and management development programs. The cost-benefit analysis is called for in order to justify the budgeted amount of each discretionary program.

A division with pricing power can raise selling prices and retain profitability without losing business. Pricing power is the ability to raise prices even in poor economic times when unit sales volume may be flat and capacity may not be fully utilized. It is also the ability to pass on cost increases to consumers without attracting domestic and import competition, political opposition, regulation, new entrants, or threats of product substitution. The division with pricing power must have a unique economic position. Divisions that offer unique, high-quality goods and services (where the service is more important than the cost) have this economic position.

Alternative 2 may be achieved by increasing sales while holding the investment in assets relatively constant, or by reducing assets. Some of the strategies to reduce assets are:

- (a) Dispose of obsolete and redundant inventory. The computer has been extremely helpful in this regard, making perpetual inventory methods more feasible for inventory control.
- (b) Devise various methods of speeding up the collection of receivables and also evaluate credit terms and policies.
- (c) See if there are unused fixed assets.

(d) Use the converted assets obtained from the use of the previous methods to repay outstanding debts or repurchase outstanding issues of stock. The division may release them elsewhere to get more profit, which will improve margin as well as turnover.

Alternative 3 may be achieved by increasing sales or by any combinations of alternatives 1 and 2.

Figure 2 shows complete details of the relationship of ROI to the underlying ratios -margin and turnover--and their components. This will help identify more detailed strategies to improve margin, turnover, or both.

EXAMPLE 8.4

Assume that management sets a 20 percent ROI as a profit target. It is currently making an 18 percent return on its investment.

$$\text{ROI} = \frac{\text{Operating income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Operating assets}}$$

Present situation:

$$18\% = \frac{18,000}{200,000} \times \frac{200,000}{100,000}$$

The following are illustrative of the strategies which might be used (each strategy is independent of the other).

Alternative 1: Increase the margin while holding turnover constant. Pursuing this strategy would involve leaving selling prices as they are and making every effort to increase efficiency, so as to reduce expenses. By doing so, expenses might be reduced by \$2,000 without affecting sales and investment to yield a 20% target ROI, as follows:

$$20\% = \frac{20,000}{200,000} \times \frac{200,000}{100,000}$$

Alternative 2: Increase turnover by reducing investment in assets while holding net profit and sales constant. Working capital might be reduced or some land might be sold, reducing investment in assets by \$10,000 without affecting sales and net income to yield the 20% target ROI as follows:

$$20\% = \frac{18,000}{200,000} \times \frac{200,000}{90,000}$$

Alternative 3: Increase both margin and turnover by disposing of obsolete and redundant inventories or through an active advertising campaign. For example, trimming down \$5,000 worth of investment in inventories would also reduce the inventory holding charge by \$1,000. This strategy would increase ROI to 20%.

$$20\% = \frac{19,000}{200,000} \times \frac{200,000}{95,000}$$

Excessive investment in assets is just as much of a drag on profitability as excessive expenses. In this case, cutting unnecessary inventories also helps cut down expenses of carrying those inventories, so that both margin and turnover are improved at the same time. In practice, alternative 3 is much more common than alternative 1 or 2.

RESIDUAL INCOME (RI)

Another approach to measuring performance in an investment center is residual income (RI). RI is the operating income that an investment center is able to earn above some minimum rate of return on its operating assets. RI, unlike ROI, is an absolute amount of income rather than a specific rate of return. When RI is used to evaluate divisional performance, the objective is to maximize the total amount of residual income, not to maximize the overall ROI figure.

$$RI = \text{Operating income} - (\text{Minimum required rate of return} \times \text{Operating assets})$$

EXAMPLE 8.5

In Example 8.1, assume the minimum required rate of return is 13 percent. Then the residual income of the division is:

$$\$18,000 - (13\% \times \$100,000) = \$18,000 - \$13,000 = \$5,000$$

RI is regarded as a better measure of performance than ROI because it encourages investment in projects that would be rejected under ROI. A major disadvantage of RI, however, is that it cannot be used to compare divisions of different sizes. RI tends to favor the larger divisions due to the larger amount of dollars involved.

Residual Income and Economic Value Added

Residual income is better known as *economic value added* (EVA). Many firms are addressing the issue of aligning division managers' incentives with those of the firm by using EVA as a measure of performance. EVA encourages managers to focus on increasing the value of the company to shareholders, because EVA is the value created by a company in excess of the cost of capital for the investment base. Improving EVA can be achieved in three ways:

- (a) Invest capital in high-performing projects.
- (b) Use less capital.
- (c) Increase profit without using more capital.

INVESTMENT DECISIONS UNDER ROI AND RI

The decision whether to use ROI or RI as a measure of divisional performance affect financial managers' investment decisions. Under the ROI method, division managers tend to accept only the investments whose returns exceed the division's ROI; otherwise, the division's overall ROI would decrease. Under the RI method, on the other hand, division managers would accept an investment as long as it earns a rate in excess of the minimum required rate of return. The addition of such an investment will increase the division's overall RI.

EXAMPLE 8.6

Consider the same data given in Examples 8.1 and 8.2:

Operating assets	\$100,000
Operating income	\$18,000
Minimum required rate of return	13%

$$\text{ROI} = 18\% \text{ and } \text{RI} = \$5,000$$

Assume that the division is presented with a project that would yield 15 percent on a \$10,000 investment. The division manager would not accept this project under the ROI approach since the division is already earning 18 percent. Acquiring this project will bring down the present ROI to 17.73 percent, as shown below:

	<i>Present</i>	<i>New Project</i>	<i>Overall</i>
Operating assets (a)	\$100,000	\$10,000	\$110,000
Operating income (b)	18,000	1,500*	19,500
ROI (b / a)	18%	15%	17.73%

*\$10,000 x 15% = \$1,500

Under the RI approach, the manager would accept the new project since it provides a higher rate than the minimum required rate of return (15 percent vs. 13 percent). Accepting the new project will increase the overall residual income to \$5,200, as shown below:

	<i>Present</i>	<i>New Project</i>	<i>Overall</i>
Operating assets (a)	\$100,000	\$10,000	\$110,000

Operating income (b)	18,000	1,500	19,500
Minimum required income at 13%(c)	<u>13,000</u>	<u>1,300*</u>	<u>14,300</u>
RI (b-c)	<u>\$5,000</u>	<u>\$200</u>	<u>\$5,200</u>

*\$10,000 x 13% = \$1,300

CONCLUSION

Return on investment (ROI) and residual income (RI) are two most widely used measures of divisional performance. Emphasis was placed on the breakdown of the ROI formula, commonly referred to as the *Du Pont formula*. The breakdown formula has several advantages over the original formula in terms of profit planning. The choice of evaluation systems--ROI or RI--will greatly affect a division's investment decisions.

CHAPTER 9

ANALYZING WORKING CAPITAL

LEARNING OBJECTIVES

After studying the material in this chapter, you will be able to:

1. Evaluate working capital.
2. Give examples and explain cash management.
3. Manage accounts receivable.
4. Describe how to plan and control inventory.

Effective management of working capital (current assets less current liabilities) improves returns and minimizes the risk that the company will run short of cash. By optimally managing cash, receivables and inventory, a company can maximize its rate of return and minimize its liquidity and business risk. The amount invested in each current asset may change daily and should be monitored carefully to ensure that funds are used in the most productive way possible. Large account balances may also indicate risk; for example, inventory may not be salable and/or accounts receivable may not be collectible. On the other hand, maintaining inadequate current asset levels may be costly; business may be lost if inventory is too low.

Cash refers to currency and demand deposits; excess funds may be invested in marketable securities. Cash management involves accelerating cash inflow and delaying cash outflow. Accounts receivable management involves selecting customers with good credit standing and speeding up customer collections. Inventory management involves having the optimal order size at the right time.

EVALUATING WORKING CAPITAL

Working capital equals current assets less current liabilities. If current assets are \$6,500,000 and current liabilities are \$4,000,000, working capital equals \$2,500,000. Managing working capital--regulating the various types of current assets and current liabilities--requires making decisions on how assets should be financed (e.g., by short-term debt, long-term debt, or equity); net working capital increases when current assets are financed through noncurrent sources.

Managing working capital is also evaluating the trade-off between return and risk. If funds are transferred from fixed assets to current assets, liquidity risk is reduced, greater ability to obtain short-term financing is enhanced, and the company has greater flexibility in adjusting current assets to meet changes in sales volume. However, it also receives reduced return, because the yield on fixed assets exceeds that of current assets. Financing with noncurrent debt carries less liquidity risk than financing with current debt because the former is payable over a longer time

period. However, long-term debt often has a higher cost than short-term debt because of its greater uncertainty.

Liquidity risk may be reduced by using the *hedging* approach to financing, in which assets are financed by liabilities with similar maturity. When a company needs funds to purchase seasonal or cyclical inventory, it uses short-term financing, which gives it flexibility to meet its seasonal needs within its ability to repay the loan. On the other hand, the company's permanent assets should be financed with long-term debt. Because the assets last longer, the financing can be spread over a longer time, helping to ensure the availability of adequate funds with which to meet debt payments.

The less time it takes between purchase and delivery of goods, the less working capital needed. For example, if the company can receive a raw material in two weeks, it can maintain a lower level of inventory than if two months' lead time is required. You should purchase material early if significantly lower prices are available and if the material's cost savings exceed inventory carrying costs.

CASH MANAGEMENT

The goal of cash management is to invest excess cash for a return and at the same time have adequate liquidity. A proper cash balance, neither excessive nor deficient, should exist; for example, companies with many bank accounts may be accumulating excessive balances. Proper cash forecasting is particularly crucial in a recession and is required to determine (1) the optimal time to incur and pay back debt and (2) the amount to transfer daily between accounts. A daily computerized listing of cash balances and transaction reporting can let you know the up-to-date cash balance so you can decide how best to use the funds. You should also assess the costs you are paying for banking services, looking at each account's cost.

When cash receipts and cash payments are highly synchronized and predictable, your company may keep a smaller cash balance; if quick liquidity is needed, it can invest in marketable securities. Any additional cash should be invested in income producing securities with maturities structured to provide the necessary liquidity.

Financially strong companies that are able to borrow at favorable rates, even in difficult financial markets, can afford to keep a lower level of cash than companies that are highly leveraged or considered poor credit risks.

At a minimum, a company should hold in cash the greater, of (1) compensating balances (deposits held by a bank to compensate it for providing services) or (2) precautionary balances (money held for emergency purposes) plus transaction balances (money to cover checks outstanding). It must also hold enough cash to meet its daily requirements. Compensating balances are either (1) an absolute minimum balance or (2) a minimum average balance that bank customers must keep at the bank. These are generally required by the bank to compensate for the cost of services rendered. Maintaining compensating balances will not accelerate a company's cash inflows because less cash will be available even though the amount of cash coming in remains unchanged.

A number of factors go into the decision on how much cash to hold, including the company's liquid assets, business risk, debt levels and maturity dates, ability to borrow on short notice and on favorable terms, rate of return, economic conditions, and the possibility of unexpected problems, such as customer defaults.

Acceleration of Cash Inflow

To improve cash inflow, you should evaluate the causes of and take corrective action for delays in having cash receipts deposited. Ascertain the origin of cash receipts, how they are delivered, and how cash is transferred from outlying accounts to the main corporate account. Also investigate banking policy regarding availability of funds and the length of the time lag between when a check is received and when it is deposited.

The types of delays in processing checks are: (1) "mail float," the time required for a check to move from debtor to creditor; (2) "processing float," the time needed for the creditor to enter the payment; and (3) "deposit collection float," the time it takes for a check to clear.

You should try out all possible ways to accelerate cash receipts including the use of lockboxes, pre-authorized debits (PADs), wire transfers, and depository transfer checks.

-- *Lockbox*. A lockbox represents a way to place the optimum collection point near customers. Customer payments are mailed to strategic post office boxes geographically situated to reduce mailing and depositing time. Banks make collections from these boxes several times a day and deposit the funds to the corporate account. They then prepare a computer listing of payments received by account and a daily total, which is forwarded to the corporation.

To determine the effectiveness of using a lockbox, you should determine the average face value of checks received, the cost of operations eliminated, reducible processing overhead, and the reduction in "mail float" days. Because per-item processing costs for lockboxes is typically significant, it makes the most sense to use one for low-volume, high-dollar collections. However, businesses with high-volume, low-dollar receipts are using them more and more as technological advances lower their per-item cost.

Wholesale lockboxes are used for checks received from other *companies*. As a rule, the average dollar cash receipts are large, and the number of cash receipts is small. Many wholesale lock boxes result in mail time reductions of no more than one business day and check-clearing time reductions of only a few tenths of one day. They are therefore most useful for companies that have gross revenues of at least several million dollars and that receive large checks from distant customers.

A *retail lockbox* is the best choice if the company deals with the *public* (retail customers as distinguished from companies). Retail lockboxes typically receive many transactions of nominal amounts. The lockbox reduces float and transfers workload from the company to the bank, resulting in improved cash flow and reduced expenses.

-- *Return Envelopes*. Providing return envelopes can accelerate customer remissions. On the return envelope, you can use bar codes, nine-digit code numbers, or post office box numbers. Another option is Accelerated Reply Mail (ARM), in which a unique "truncating" ZIP code is assigned to payments such as lockbox receivables. The coded remittances are removed from the postal system and processed by banks or third parties.

-- *Pre-Authorized Debits*. Cash from customers may be collected faster if you obtain permission from customers to have pre-authorized debits (PADs) automatically charged to the customers' bank accounts for repetitive charges. This is a common practice among insurance companies, which collect monthly premium payments via PADs. These debits may take the form of paper pre-authorized checks (PACs) or paperless automatic clearing house entries. PADs are cost-effective because they avoid the process of billing the customer, receiving and processing the payment, and depositing the check. Using PADs for variable payments is less efficient because the amount of the PAD must be changed each period and the customer generally must be advised by mail of the amount of the debit. PADs are most effective when used for constant, relatively nominal periodic payments.

-- *Wire Transfers*. To accelerate cash flow, you may transfer funds between banks by wire transfers through computer terminal and telephone. Such transfers should be used only for significant dollar amounts because wire transfer fees are assessed by both the originating and receiving banks. Wire transfers are best for intraorganization transfers, such as transfers to and from investments, deposits to an account made the day checks are expected to clear, and deposits made to any other account that requires immediate availability of funds. They may also be used to fund other types of checking accounts, such as payroll accounts. In order to avoid unnecessarily large balances in the account, you may fund it on a staggered basis. However, to prevent an overdraft, you should make sure balances are maintained in another account at the bank.

There are two types of wire transfers--preformatted (recurring) and free-form (nonrepetitive). Recurring transfers do *not* involve extensive authorization and are suitable for ordinary transfers in which the company designates issuing and receiving banks and provides its account number. Nonrecurring transfers require greater control, including written confirmations instead of telephone or computer terminal confirmations.

-- *Depository Transfer Checks (DTCs)*. Paper or paperless depository checks may be used to transfer funds between the company's bank accounts. They do not require a signature, since the check is payable to the bank for credit to the company's account. DTCs typically clear in one day. *Manual* DTCs are preprinted checks that include all information except the amount and date; *automated* DTCs are printed as needed. It is usually best to use the bank's printer since it is not cost-effective for the company to purchase a printer. Automatic check preparation is advisable only for companies that must prepare a large number of transfer checks daily.

There are other ways to accelerate cash inflow. You can send bills to customers sooner than is your practice, perhaps immediately after the order is shipped. You can also require deposits on large or custom orders or submit progress billings as the work on the order progresses. You can charge interest on accounts receivable that are past due and offer cash discounts for early payment; you can also use cash-on-delivery terms. In any event, you should deposit checks immediately.

EXAMPLE 9.1

C Corporation obtains average cash receipts of \$200,000 per day. It usually takes five days from the time a check is mailed until the funds are available for use. The amount tied up by the delay is:

$$5 \text{ days} \quad \times \quad \$200,000 \quad = \quad \$1,000,000$$

You can also calculate the return earned on the average cash balance.

EXAMPLE 9.2

A company's weekly average cash balances are as follows:

Week	Average Cash Balance
1	\$12,000
2	17,000
3	10,000
4	<u>15,000</u>
Total	\$54,000

The weekly average cash balance is:

$$\frac{\$54,000}{4} = \$13,500$$

If the annual interest rate is approximately 12 percent, the monthly return earned on the average cash balance is:

$$\$13,500 \times \frac{0.12}{12} = \$135$$

If you are thinking of establishing a lockbox to accelerate cash inflow, you will need to determine the maximum monthly charge you will incur for the service.

EXAMPLE 9.3

It takes Travis Corporation about seven days to receive and deposit payments from customers. Therefore, it is considering establishing a lockbox system. It expects the system to reduce the float time to five days. Average daily collections are \$500,000. The rate of return is 12 percent.

The reduction in outstanding cash balances arising from implementing the lockbox system is:

$$2 \text{ days} \times \$500,000 = \$1,000,000$$

The return that could be earned on these funds in a year is:

$$\$1,000,000 \times 0.12 = \$120,000$$

The maximum monthly charge the company should pay for this lockbox arrangement is therefore:

$$\frac{\$120,000}{12} = \$10,000$$

You should compare the return earned on freed cash to the cost of the lockbox arrangement to determine if using the lockbox is financially advantageous.

EXAMPLE 9.4

A company's financial officer is determining whether to initiate a lockbox arrangement that will cost \$150,000 annually. The daily average collections are \$700,000. Using a lockbox will reduce mailing and processing time by two days. The rate of return is 14%.

Annual return on freed cash ($14\% \times 2 \times \$700,000$)	\$196,000
Annual cost	\$150,000
Net advantage of lockbox system	\$46,000

Sometimes you need to determine whether to switch banks in order to lower the overall costs associated with a lockbox arrangement.

EXAMPLE 9.5

You now have a lockbox arrangement in which Bank A handles \$5 million a day in return for an \$800,000 compensating balance. You are thinking of canceling this arrangement and further dividing your western region by entering into contracts with two other banks. Bank B will handle \$3 million a day in collections with a compensating balance of \$700,000, and Bank C will handle \$2 million a day with a compensating balance of \$600,000. Collections will be half a day quicker than they are now. Your return rate is 12%.

Accelerated cash receipts

(\$5 million per day \times 0.5 day)	\$2,500,000
Increased compensating balance	500,000
Improved cash flow	\$2,000,000
Rate of return	$\times 0.12$
Net annual savings	\$240,000

Delay of Cash Outlay

Delaying cash payments can help your company earn a greater return and have more cash available. You should evaluate the payees and determine to what extent you can reasonably stretch time limits without incurring finance charges or impairing your credit rating.

There are many ways to delay cash payments, including centralizing payables, having zero balance accounts, and paying by draft.

-- *Centralize Payables.* You should centralize your company's payable operation--that is, make one center responsible for making all payments--so that debt may be paid at the most profitable time and so that the amount of disbursement float in the system may be ascertained.

-- *Zero Balance Account (ZBA).* Cash payments may be delayed by maintaining zero balance accounts in one bank in which you maintain zero balances for all of the company's disbursing units

with funds being transferred in from a master account as needed. The advantages of ZBAs are that they allow better control over cash payments and reduced excess cash balances in regional banks. Using ZBAs is an aggressive strategy that requires the company to put funds into its payroll and payables checking accounts only when it expects checks to clear. However, watch out for overdrafts and service charges.

-- *Drafts*. Payment drafts are another strategy for delaying disbursements. With a draft, payment is made when the draft is presented for collection to the bank, which in turn goes to the issuer for acceptance. When the draft is approved, the company deposits the funds to the payee's account. Because of this delay, you can maintain a lower checking balance. Banks usually impose a charge for drafts, and you must endure the inconveniences of formally approving them before payment. Drafts can provide a measure of protection against fraud and theft because they must be presented for inspection before payment.

-- *Delay in Mail*. You can delay cash payment by drawing checks on remote banks (e.g., a New York company might use a Texas bank), thus ensuring that checks take longer to clear. You may also mail checks from post offices that offer limited service or at which mail must go through numerous handling points. If you utilize the mail float properly, you can maintain higher actual bank balances than book balances. For instance, if you write checks averaging \$200,000 per day and they take three days to clear, you will have \$600,000 (\$200,000 x 3) in your checking account for those three days, even though the money has been deducted in your records.

-- *Check Clearing*. You can use probability analysis to determine the expected date for checks to clear. Probability is defined as the degree of likelihood that something will happen and is expressed as a percentage from 0 to 100. For example, it's likely that not all payroll checks are cashed on the payroll date, so you can deposit some funds later and earn a return until the last minute.

-- *Delay Payment to Employees*. You can reduce the frequency of payments to employees (e.g., expense account reimbursements, payrolls); for example, you can institute a monthly payroll rather than a weekly one. In this way, you have the use of the cash for a greater time period. You can also disburse commissions on sales when the receivables are collected rather than when sales are made. Finally, you can utilize noncash compensation and remuneration methods (e.g., distribute stock instead of bonuses).

Other ways exist to delay cash payments. Instead of making full payment on an invoice, you can make partial payments. You can also delay payment by requesting additional information about an invoice from the vendor before paying it. Another strategy is to use a charge account to lengthen the time between when you buy goods and when you pay for them. In any event, never pay a bill before its due date.

EXAMPLE 9.6

Every two weeks the company disburses checks that average \$500,000 and take three days to clear. You want to find out how much money can be saved annually if the transfer of funds is delayed from an interest-bearing account that pays 0.0384 percent per day (annual rate of 14 percent) for those three days.

$$\$500,000 \quad \times \quad (0.000384 \times 3) \quad = \quad \$576$$

The savings per year is $\$576 \times 26$ (yearly payrolls) = \$14,976

CASH MODELS

A number of mathematical models have been developed to assist the financial manager in distributing a company's funds so that they provide a maximum return to the company. A model developed by William Baumol can determine the optimum amount of cash for a company to hold under conditions of certainty. The objective is to minimize the sum of the fixed costs of transactions and the opportunity cost (return forgone) of holding cash balances that do not yield a return. These costs are expressed as

$$F * \frac{(T)}{C} + i \frac{(C)}{2}$$

where F = the fixed cost of a transaction
T = the total cash needed for the time period involved
i = the interest rate on marketable securities
C = cash balance
C* = optimal level of cash

The optimal level of cash is determined using the following formula:

$$C^* = \sqrt{\frac{2FT}{i}}$$

EXAMPLE 9.7

You estimate a cash need for \$4,000,000 over a one-month period during which the cash account is expected to be disbursed at a constant rate. The opportunity interest rate is 6 percent per annum, or 0.5 percent for a one-month period. The transaction cost each time you borrow or withdraw is \$100.

The optimal transaction size (the optimal borrowing or withdrawal lot size) and the number of transactions you should make during the month follow:

$$C^* = \sqrt{\frac{2FT}{i}} = \sqrt{\frac{2(100)(4,000,000)}{0.005}} = \$400,000$$

The optimal transaction size is \$400,000.

The average cash balance is:

$$\frac{C^*}{2} = \frac{\$400,000}{2} = \$200,000$$

The number of transactions required is:

$$\frac{4,000,000}{\$400,000} = 10 \text{ transactions during the month.}$$

There is also a model for cash management when cash payments are uncertain. The Miller-Orr model places upper and lower limits on cash balances. When the upper limit is reached, a transfer of cash to marketable securities is made; when the lower limit is reached, a transfer from securities to cash occurs. No transaction occurs as long as the cash balance stays within the limits.

Factors taken into account in the Miller-Orr model are the fixed costs of a securities transaction (F), assumed to be the same for buying as well as selling; the daily interest rate on marketable securities (i); and the variance of daily net cash flows (σ^2)--(σ is sigma). The objective is to meet cash requirements at the lowest possible cost. A major assumption of this model is the randomness of cash flows. The control limits in the Miller-Orr model are "d" dollars as an upper limit and zero dollars at the lower limit. When the cash balance reaches the upper level, d less z dollars (optimal cash balance) of securities are bought, and the new balance becomes z dollars. When the cash balance equals zero, z dollars of securities are sold and the new balance again reaches z. Of course, in practice the minimum cash balance is established at an amount greater than zero because of delays in transfer; the higher minimum in effect acts as a safety buffer.

The optimal cash balance z is computed as follows:

$$Z = \sqrt[3]{\frac{3F\sigma^2}{4i}}$$

The optimal value for d is computed as 3z.

The average cash balance approximates $\frac{(z + d)}{3}$.

EXAMPLE 9.8

You wish to use the Miller-Orr model. The following information is supplied:

Fixed cost of a securities transaction	\$10
Variance of daily net cash flows	\$50
Daily interest rate on securities (10%/360)	0.000277

The optimal cash balance, the upper limit of cash needed, and the average cash balance follow:

$$z = \sqrt[3]{\frac{3(10)(50)}{4(0.000277)}} = \sqrt[3]{\frac{3(10)(50)}{0.001108}} = \sqrt[3]{\frac{1,500}{0.001108}} = \sqrt[3]{1,353,790} \\ = \$108$$

The optimal cash balance is \$108; the upper limit is \$324 (3 x \$108); and the average cash balance is \$144 $\frac{(\$108 + \$324)}{3}$.

When the upper limit of \$324 is reached, \$216 of securities (\$324 - \$108) will be purchased to bring the account to the optimal cash balance of \$108. When the lower limit of zero dollars is reached, \$108 of securities will be sold to again bring it to the optimal cash balance of \$108.

MANAGEMENT OF ACCOUNTS RECEIVABLE

Accounts receivable management directly impacts the profitability of the firm. It includes determining discount policy and credit policy for marginal customers, investigating ways of speeding up collections and reducing bad debts, and setting terms of sale to assure ultimate collection.

As part of accounts receivable management, you should appraise order entry, billing, and accounts receivable activities to be sure that proper procedures are being followed from the time an order is received until ultimate collection. Among the points to consider is how the average time lag between completing the sales transaction and invoicing the customer can be reduced. You should also consider the opportunity cost of holding receivables, that is, the return lost by having funds tied up in accounts receivable instead of invested elsewhere.

Accounts receivable management involves two types of float--invoicing and mail. *Invoicing float* is the number of days between the time goods are shipped to the customer and the time the invoice is sent out. Obviously, the company should mail invoices on a timely basis. *Mail float* is the time between the preparation of an invoice and the time it is received by the customer. Mail float may be reduced by decentralizing invoicing and mailing, coordinating outgoing mail with post office schedules, using express mail services for large invoices, enforcing due dates, and offering discounts for early payment.

Credit Policies

A key concern in accounts receivable management is determining credit terms to be given to customers, which affects sales volume and collections. For example, offering longer credit terms will probably increase sales. Credit terms have a direct bearing on the costs and revenue generated from receivables. If credit terms are tight, the company will have a lower investment in accounts receivable and incur fewer bad-debt losses, but it may also experience lower sales, reduced profits, and adverse customer reaction. On the other hand, if credit terms are lax, the company may enjoy higher sales and gross profit, but it risks increased bad debts and a higher opportunity cost of carrying the investment in accounts receivable because marginal customers take longer to pay. Receivable terms should be liberalized when you want to get rid of excessive inventory or obsolete items or if you operate in an industry in which products are sold in advance of retail seasons (e.g., swimsuits). If your products are perishable, you should impose short receivable terms and possibly require payment on delivery.

In evaluating a potential customer's ability to pay, consider the customer's integrity, financial soundness, and collateral. A customer's credit soundness may be appraised through

quantitative techniques such as regression analysis, which examines the change in a dependent variable that occurs as an independent (explanatory) variable changes. Such techniques are particularly useful when you need to evaluate a large number of small customers. You should be able to estimate bad debt losses reliably if your company sells to many customers and has not changed its credit policies for a long time.

Keep in mind that extending credit involves additional expenses--the administrative costs of operating the credit department; computer services; and fees paid to rating agencies.

You may find it useful to obtain references from retail credit bureaus and professional credit reference services as part of your customer credit evaluation. Dun and Bradstreet (D&B) reports contain information about a company's nature of business, product line, management, financial statements, number of employees, previous payment history as reported by suppliers, current debts, including any past due, terms of sale, audit opinion, lawsuits, insurance coverage, leases, criminal proceedings, banking relationships and account information (e.g., current bank loans), location, and seasonal fluctuations, if applicable.

Monitoring Receivables

There are many ways to maximize profitability from accounts receivable and keep losses to a minimum. These include proper billing, factoring, and evaluating the customers' financial health.

-- *Billing.* Cycle billing, in which customers are billed at different time periods, can smooth out the billing process. In such a system, customers with last names starting with A may be billed on the first of the month, those with last names beginning with B on the second day, and so on. Customer statements should be mailed within twenty-four hours of the close of the billing period.

To speed up collections, you can send invoices to customers when their order is processed at the warehouse instead of when the merchandise is shipped. You can also bill for services at intervals when work is performed over a period of time or charge a retainer, rather than receiving payment when the work is completed. In any event, you should bill large sales immediately.

When business is slow, seasonal datings, in which you offer delayed payment terms to stimulate demand from customers who are unable to pay until later in the season, can be used.

-- *Customer Evaluation Process.* Before giving credit, carefully analyze customer financial statements and obtain ratings from financial advisory services. Try to avoid high-risk receivables, such as customers who are in a financially troubled industry or region. Be careful of customers who have been in business less than one year since about 50 percent of businesses fail within the first two years. As a rule, consumer receivables carry a greater risk of default than do corporate receivables. You should modify credit limits and accelerate collections based on changes in a customer's financial health; you may want to withhold products or services until payments are made and ask for collateral in support of questionable accounts (the collateral value should equal or exceed the account balance). If necessary, you can use outside collection agencies to try to collect from recalcitrant customers.

You should age accounts receivable (that is, rank them by the time elapsed since they were billed) to spot delinquent customers and charge interest on late payments. After you compare current aged receivables to those of prior years, industry norms, and the competition's, you can prepare a Bad Debt Loss Report showing cumulative bad debt losses by customer, terms of sale, and size of account and then summarized by department, product line, and type of customer (e.g., industry). Bad debt losses are typically higher for smaller companies than for larger ones.

-- *Insurance Protection.* You may want to have credit insurance to guard against unusual bad debt losses. In deciding whether to acquire this protection, consider expected average bad debt losses the company's financial ability to withstand the losses, and the cost of insurance.

-- *Factoring.* Factor (sell) accounts receivable if that results in a net savings. However, you should realize that confidential information may be disclosed in a factoring transaction. (Factoring is discussed in Chapter 13.)

Credit Policy

In granting trade credit, you should consider your competition and current economic conditions. In a recession, you may want to relax your credit policy in order to stimulate additional business. For example, the company may not rebill customers who take a cash discount even after the discount period has elapsed. On the other hand, you may decide to tighten credit policy in times of short supply, because at such times your company as the seller has the upper hand.

DETERMINING THE INVESTMENT IN ACCOUNTS RECEIVABLE

To determine the dollar investment tied up in accounts receivable, use a computation that takes into account the annual credit sales and the length of time receivables are outstanding.

EXAMPLE 9.9

A company sells on terms of net/30, meaning payment is required within 30 days. The accounts are on average 20 days past due. Annual credit sales are \$600,000. The investment in accounts receivable is:

$$\frac{50}{360} \times \$600,000 = \$83,333.28$$

The *investment* in accounts receivable represents the cost tied up in those receivables, including both the cost of the product and the cost of capital.

EXAMPLE 9.10

The cost of a product is 30 percent of selling price, and the cost of capital is 10 percent of selling price. On average, accounts are paid four months after sale. Average sales are \$70,000 per month.

The investment in accounts receivable from this product is

Accounts receivable (4 months x \$70,000)	\$280,000
Investment in accounts receivable [$\$280,000 \times (0.30 + 0.10)$]	112,000

EXAMPLE 9.11

Accounts receivable are \$700,000. The average manufacturing cost is 40% of the selling price. The before-tax profit margin is 10%. The carrying cost of inventory is 3% of selling price. The sales commission is 8% of sales. The investment in accounts receivable is:

$$\$700,000 (0.40 + 0.03 + 0.08) = \$700,000 (0.51) = \$357,000$$

The average investment in accounts receivable may be computed by multiplying the average accounts receivable by the cost/selling price ratio.

EXAMPLE 9.12

If a company's credit sales are \$120,000, the collection period is 60 days, and the cost is 80% of sales price, what is (a) the average accounts receivable balance and (b) the average investment in accounts receivable?

$$\text{Accounts receivable turnover} = \frac{360}{60} = 6$$

$$\text{Average accounts receivable} = \frac{\text{Credit sales}}{\text{Turnover}} = \frac{\$120,000}{6} = \$20,000$$

$$\text{Average invest in account receivable} \quad \$20,000 \times 0.8 = \$16,000$$

DISCOUNT POLICY

In order to determine if customers should be offered a discount the early payment of account balances, the financial manager has to compare the return on freed cash resulting from customer's paying sooner to the cost of the discount.

EXAMPLE 9.13

The following data are provided:

Current annual credit sales	\$14,000,000
Collection period	3 months
Terms	net/30
Minimum rate of return	15%

The company is considering offering a 3/10, net/30 discount (that is, if the customer pays within 10 days of the date of sale, the customer will receive a 3% discount. If payment is made after 10 days, no discount is offered. Total payment must be made within 30 days.) The company expects 25 percent of the customers to take advantage of the discount. The collection period will decline to two months.

The discount should be offered, as indicated in the following calculations:

Advantage of discount

Increased profitability:

Average account receivable balance before a change in policy

$$\frac{\text{Credit sales}}{\text{Accounts receivable turnover}} = \frac{\$14,000,000}{12 \div 3 = 4} = \$3,500,000$$

$$\frac{\text{Average accounts receivable balance after change in policy}}{\text{Average receivable turnover}} = \frac{\text{Credit sales } \$14,000,000}{12 \div 2 = 6} = \$2,333,333$$

Reduction in average accounts receivable balance	\$1,116,667
Rate of return	x .15
Return	\$ 175,000

Disadvantage of discount

Cost of the discount	$0.03 \times 0.25 \times \$14,000,000$	\$ 105,000
Net advantage of discount		\$ 70,000

Changing Credit Policy

To decide whether the company should give credit to marginal customers, you need to compare the earnings on the additional sales obtained to the added cost of the receivables. If the company has idle capacity, the additional earnings is the contribution margin on the new sales, since fixed costs are constant. The additional cost of the receivables results from the likely increase in bad debts and the opportunity cost of tying up funds in receivables for a longer time period.

EXAMPLE 9.14

Sales price per unit	\$120
Variable cost per unit	80
Fixed cost per unit	15
Annual credit sales	\$600,000
Collection period	1 month
Minimum return	16%

- If you liberalize the credit policy, you project that
- Sales will increase by 40%.
 - The collection period on total accounts will increase to two months.
 - Bad debts on the increased sales will be 5%.

Preliminary calculations:

Current units ($\$600,000/\120)	5,000
Additional units ($5,000 \times 0.4$)	2,000

Advantage of the change in policy

Additional profitability:

Incremental sales volume 2,000 units	X	Contribution margin per unit
--------------------------------------	---	------------------------------

$$(\text{Selling price} - \text{variable cost}) \$120 - \$80 \quad \times \quad \$40$$

Incremental profitability \$80,000

Disadvantage of the change in policy

Incremental bad debts:

Incremental units x Selling price (2,000 x \$120)	\$240,000
Bad debt percentage	x 0.05
Additional bad debts	\$ 12,000

The first step in determining the opportunity cost of the investment tied up in accounts receivable is to compute the new average unit cost as follows:

	Units	x	Unit Cost	=	Total Cost
Current units	5,000	x	\$95	=	\$475,000
Additional units	2,000	x	\$80	=	160,000
Total	7,000				\$635,000

$$\text{New average unit cost} = \frac{\text{Total cost}}{\text{Units}} = \frac{\$635,000}{7,000} = \$90.71$$

Note that at idle capacity, fixed cost remains constant; therefore, the incremental cost is only the variable cost of \$80 per unit. Therefore, the average unit cost will drop.

We now compute the opportunity cost of funds placed in accounts receivable:

Average investment in accounts receivable after change in policy:

Credit sales				Unit cost
-----			x	-----
Accounts receivable turnover				Selling price
\$840,000@		\$90.71		
-----	x	-----	=	\$105,828
6		\$120		
@7,000 units	x	\$120	=	\$840,000

Current average investment in accounts receivable:

$$\begin{array}{rclcl} \$600,000 & & \$95 & & \\ \text{-----} & \times & \text{---} & = & 39,583 \end{array}$$

12 \$120

Additional investment in accounts receivable	\$66,245
Minimum return	x 0.16
Opportunity cost of funds tied up	\$10,599

Net advantage of relaxation in credit standards:

Additional earnings	\$80,000
Less:	
Additional bad debt losses	\$12,000
Opportunity cost	10,599
Net savings	<u>-22,599</u>
	\$57,401

The company may have to decide whether to extend full credit to presently limited credit customers or no-credit customers. Full credit should be given only if net profitability occurs.

EXAMPLE 9.15

Category	Bad Debt Percentage	Collection Period	Credit Policy	Increase in Annual Sales if Credit Restrictions are Relaxed
X	2%	30 days	Unlimited	\$80,000
Y	5%	40 days	Restricted	600,000
Z	30%	80 days	No credit	850,000

Gross profit is 25 percent of sales. The minimum return on investment is 12%.

As you decide whether credit standards should be loosened, consider the gross profit on increased sales versus the opportunity cost associated with higher receivable balances and collection expenses.

EXAMPLE 9.16

You are considering liberalizing the credit policy to encourage more customers to purchase on credit. Currently, 80 percent of sales are on credit, and there is a gross margin of 30 percent. The return rate on funds is 10 percent. Other relevant data are:

	Currently	Proposal
Sales	\$300,000	\$450,000
Credit sales	240,000	360,000
Collection expenses	4% of credit sales	5% of credit sales
Accounts receivable turnover	4.5	3

An analysis of the proposal yields of the following results:

<i>Gross profit:</i>		
Expected increase in credit sales \$360,000 - \$240,000	\$120,000	
Gross profit rate	x .30	
Increase in gross profit	\$36,000	
<i>Opportunity cost:</i>		
Average accounts receivable balance (credit sales/accounts receivable turnover)		
Expected average accounts receivable \$360,000/3	\$120,000	
Current average accounts receivable \$240,000/4.5	53,333	
Increase in average accounts receivable	\$66,667	
Return rate	x 10%	
Opportunity cost of funds tied up in accounts receivable	\$6,667	
<i>Collection expenses:</i>		
Expected collection expenses 0.05 x \$360,000	\$18,000	
Current collection expenses 0.04 x \$240,000	9,600	
Increase in collection expenses	\$8,400	
You would profit from a more liberal credit policy as follows:		
Increase in gross profit		\$36,000
Opportunity cost in accounts receivable		(6,667)
Increase in collection expenses		(8,400)
Net advantage		\$20,933

To determine whether it is advantageous to engage in a sales campaign, you should consider the gross margin earned, the sales discount, and the opportunity cost of higher receivable balances.

EXAMPLE 9.17

The company is planning a sales campaign in which it will offer credit terms of 3/10, net/45. It expects the collection period to increase from sixty days to eighty days. Relevant data for the contemplated campaign follow:

	Percent of Sales Before Campaign	Percent of Sales During Campaign
Cash sales	40%	30%
Payment from (in days)		
1-10	25	55
11-100	35	15

The proposed sales strategy will probably increase sales from \$8 million to \$10 million. There is a gross margin rate of 30%. The rate of return is 14%. Sales discounts are given on cash sales.

	<u>Without Sales Campaign</u>	<u>With Sales Campaign</u>
Gross margin ($0.3 \times \$8,000,000$)	\$2,400,000	$0.3 \times \$10,000,000$ \$3,000,000
Sales subject to discount $0.65 \times \$8,000,000$ $0.85 \times \$10,000,000$	\$5,200,000	\$8,500,000
Sales discount	$\times 0.03 - 156,000$	$\times 0.03 - 255,000$
Investment in average accounts receivable $\frac{60}{360} \times \$8,000,000 \times 0.7$ $\frac{80}{360} \times \$10,000,000 \times 0.7$	\$933,333	\$1,555,555
Return rate	$\times 0.14 - 130,667$	$\times 0.14 - 217,778$
<u>Net profit</u>	<u>\$2,113,333</u>	<u>\$2,527,222</u>

The company should undertake the sales campaign, because earnings will increase by \$413,889 (\$2,527,222 - \$2,113,333).

INVENTORY MANAGEMENT

The purpose of inventory management is to develop policies that will achieve an optimal inventory investment. This level varies among industries and among companies in a given industry. Successful inventory management minimizes inventory, lowers cost, and improves profitability.

As part of this process, you should appraise the adequacy of inventory levels, which depend on many factors, including sales, liquidity, available inventory financing, production, supplier reliability, delay in receiving new orders, and seasonality. In the event you have slow-moving products, you may wish to consider discarding them at lower prices to reduce inventory carrying costs and improve cash flow.

You should try to minimize the lead time in your company's acquisition, manufacturing, and distribution functions--that is, how long it takes to receive the merchandise from suppliers after an order is placed. Depending upon lead times, you may need to increase inventory or alter the purchasing pattern. Calculate the ratio of the value of outstanding orders to average daily purchases to indicate the lead time for receiving orders from suppliers; this ratio indicates whether you should increase the inventory balance or change your buying pattern.

You must also consider the obsolescence and spoilage risk of inventory. For example, technological, perishable, fashionable, flammable, and specialized goods usually have high salability risk, which should be taken into account in computing desired inventory levels.

Inventory management involves a trade-off between the costs of keeping inventory and the benefits of holding it. Different inventory items vary in profitability and the amount of space they take up, and higher inventory levels result in increased costs for storage, casualty and theft insurance, spoilage, property taxes for larger facilities, increased staffing, and interest on funds borrowed to finance inventory acquisition. On the other hand, an increase in inventory lowers the

possibility of lost sales from stockouts and the production slowdowns caused by inadequate inventory. Additionally, large volume purchases result in greater purchase discounts.

Inventory levels are also affected by short-term interest rates. As short-term interest rates increase, the optimum level of holding inventory is reduced.

You may have to decide whether it is more profitable to sell inventory as is or to sell it after further processing. For example, assume inventory can be sold as is for \$40,000 or for \$80,000 if it is put into further processing costing \$20,000. The latter should be selected because the additional processing yields a \$60,000 profit, compared to \$40,000 for the current sale.

Quantity Discount

You may be entitled to a quantity discount when purchasing large orders. The discount reduces the cost of materials.

EXAMPLE 9.18

A company purchases 1,000 units of an item having a list price of \$10 each. The quantity discount is 5 percent. The net cost of the item is:

Acquisition cost (1,000 x \$10)	\$10,000
Less: Discount (0.05 x \$10,000)	500
Net cost	\$ 9,500

Investment in Inventory

You should consider the average investment in inventory, which equals the average inventory balance times the per unit cost.

EXAMPLE 9.19

Savon Company places an order for 5,000 units at the beginning of the year. Each unit costs \$10. The average investment is:

Average inventory (a)	2,500 units
Unit cost, \$	x \$10
Average investment	\$25,000

$$(a) \frac{\text{Quantity}(Q)}{2} = \frac{5,000}{2}$$

To get an average, add the beginning balance and the ending balance and then divide by 2. This gives the mid-value.

The more frequently a company places an order, the lower the average investment.

Determining Carrying and Ordering Costs

You want to determine the costs for planning, financing, record keeping, and control associated with inventory. Once inventory costs are known, you can compute the amount of timeliness of financing.

Inventory carrying costs include warehousing, handling, insurance, property taxes, and the opportunity cost of holding inventory. A provisional cost for spoilage and obsolescence should also be included in the analysis. The more the inventory held, the greater the carrying cost.

Carrying cost equals:

$$\text{Carrying Cost} = \frac{Q}{2} \times C$$

where $\frac{Q}{2}$ represents average quantity and C is the carrying cost per unit.

A knowledge of inventory carrying costs will help you determine which items are worth storing.

Inventory ordering costs are the costs of placing an order and receiving the merchandise. They include freight and the clerical costs incurred in placing the order. To minimize ordering you should enter the fewest number of orders possible. In the case of produced items, ordering cost also includes scheduling cost. Ordering cost equals:

$$\text{Ordering Cost} = \frac{S}{Q} \times P$$

where S = total usage, Q = quantity per order, and P = cost of placing an order.

The total inventory cost is therefore:

$$\frac{QC}{2} + \frac{SP}{C}$$

A knowledge of ordering costs helps you decide how many orders you should place during the period to suit your needs.

A tradeoff exists between ordering and carrying costs. A large order quantity increases carrying costs but lowers ordering cost.

The economic order quantity (EOQ) is the optimum amount of goods to order each time to minimize total inventory costs. EOQ analysis should be applied to every product that represents a significant proportion of sales.

$$EOQ = \sqrt{\frac{2SP}{C}}$$

The EOQ model assumes:

- Demand is constant and known with certainty.
- Depletion of stock is linear and constant.
- No discount is allowed for quantity purchases.

-- Lead time, the time interval between placing an order and receiving delivery, is a constant (that is, stockout is not possible).

The number of orders for a period is the usage (S) divided by the EOQ.

In the next two examples, we compute for a product the EOQ, the number of orders, and the number of days that should elapse before the next order is placed.

EXAMPLE 9.20

You want to know how frequently to place orders to lower your costs. The following information is provided:

S	=	500 units per month
P	=	\$40 per order
C	=	\$4 per unit

$$\text{EOQ} = \sqrt{\frac{2SP}{C}} = \sqrt{\frac{2(500)(40)}{4}} = \sqrt{10,000} = 100 \text{ units}$$

The number of orders each month is:

$$\frac{S}{\text{EOQ}} = \frac{500}{100} = 5$$

Therefore, an order should be placed about every six days (31/5).

EXAMPLE 9.21

A company is determining its frequency of orders for product X. Each product X costs \$15. The annual carrying cost is \$200. The ordering cost is \$10. The company anticipates selling 50 product Xs each month. Its desired average inventory level is 40.

$$S = 50 \times 12 = 600$$

$$P = \$10$$

$$C = \frac{\text{Purchase price} \times \text{carrying cost}}{\text{Average investment}} = \frac{\$15 \times \$200}{40 \times \$15} = \$5$$

$$\text{EOQ} = \sqrt{\frac{2SP}{C}} = \sqrt{\frac{2(600)(10)}{5}} = \sqrt{\frac{12,000}{5}} = \sqrt{2,400} = 49 \text{ (rounded)}$$

The number of orders per year is:

$$\frac{S}{EOQ} = \frac{600}{49} = 12 \text{ orders (rounded)}$$

The company should place an order about every thirty days (365/12).

The Reorder Point

The reorder point (ROP) is a signal that tells you when to place an order. Calculating the reorder point requires a knowledge of the lead time between order and receipt of merchandise. It may be influenced by the months of supply or total dollar ceilings on inventory to be held or inventory to be ordered.

Reorder point is computed as follows:

$$ROP = \text{lead time} \times \text{average usage per unit of time}$$

This reveals the inventory level at which a new order should be placed. If a safety stock is needed, add to the ROP.

You have to know at what inventory level you should place an order to reduce inventory costs and have an adequate stock of goods with which to satisfy customer orders.

EXAMPLE 9.22

A company needs 6,400 units evenly throughout the year. There is a lead time of one week. There are 50 working weeks in the year. The reorder point is:

$$1 \text{ week} \times \frac{6,400}{50 \text{ weeks}} = 1 \times 128 = 128 \text{ units}$$

When the inventory level drops to 128 units, a new order should be placed.

An optimal inventory level can be based on consideration of the incremental profitability resulting from having more merchandise compared to the opportunity cost of carrying the higher inventory balances.

EXAMPLE 9.23

The current inventory turnover is 12 times. Variable costs are 60 percent of sales. An increase in inventory balances is expected to prevent stockouts, thus increasing sales. Minimum rate of return is 18 percent. Relevant data include:

<i>Sales</i>	<i>Turnover</i>
\$800,000	12
890,000	10
940,000	8
980,000	7

(1) Sales	(2) Turnover	(3) [(1)/(2)] Average Inventory Balance	(4) Opportunity Cost of Carrying Incremental Inventory (a)	(5) Increased Profitability (b)	(6) [(5)-(4)] Net Savings
\$800,000	12	\$66,667	----	----	----
890,000	10	89,000	\$4,020	36,000	14,870
940,000	8	117,500	5,130	20,000	14,870
980,000	7	140,000	4,050	16,000	11,950

(a) Increased inventory from column 3 x 0.18

(b) Increased sales from column 1 x 0.40

The optimal inventory level is \$89,000, because it results in the highest net savings.

Control of Stockouts

It is desirable to minimize both the cost of carrying safety stock and the costs of running out of an item, i.e., of stockouts. Safety stock is the amount of extra stock that is kept to guard against stockouts. It is the inventory level at the time of reordering minus the expected usage while the new goods are in transit. Delivery time, usage rate, and level of safety stock are therefore considerations in controlling stockouts.

Safety stocks protect against the losses caused by stockouts. These can take the form of lost sales or lost production time. Safety stock is necessary because of the variability in lead time and usage rates. As the variability of lead time increases, that is, as the standard deviation of the probability distribution of lead times increases, the risk of a stockout increases, and a company will tend to carry larger safety stocks.

CONCLUSION

To maximize cash flow, cash collections should be accelerated and cash payments delayed. Accounts receivable management requires decisions on whether to give credit and to whom, the amount to give, and the terms. The proper amount of investment in inventory may change daily and requires close evaluation. Improper inventory management occurs when funds tied up in inventory can be used more productively elsewhere. A buildup of inventory may carry risk, such as obsolescence. On the other hand, an excessively low inventory may result in reduced profit through lost sales.

CHAPTER 10

CORPORATE INVESTMENTS

LEARNING OBJECTIVES

After studying the material in this chapter, you will be able to:

1. Explain accounting aspects of an investment portfolio.
2. Outline analytical implications.
3. Describe how to obtain investment information.
4. Compare risk versus return.
5. List financial assets.
6. List and explain real assets.
7. Outline how to perform portfolio analysis.
8. Explain features of mutual funds.
9. Distinguish between fundamental analysis and technical analysis.

Investment analysis is concerned with evaluating the quality of an existing portfolio as well as determining what and when to buy or sell financial and real assets. Appropriate sources of investment information must be searched out and evaluated for optimal decision making. A risk-return analysis is required to achieve a proper mix of securities in the portfolio. The types of financial assets and real assets to invest in must be known, along with their respective advantages and disadvantages. Diversification by investing in mutual funds is also addressed. Fundamental and technical analyses are discussed to assist you in selecting the right securities at the right time. Microcomputers greatly aid in the investment analysis process.

ACCOUNTING ASPECTS

As per FASB No. 12, an investment portfolio is recorded at aggregate cost or market value, whichever is lower. For marketable securities (short-term investments), the unrealized loss is shown in the income statement. For noncurrent investments (long-term securities), the unrealized loss is shown as a separate item in the stockholders' equity section, thus bypassing the income statement. While a security transferred between categories must be transferred at the lower of cost or market value, with a realized loss recognized in the income statement, category switching allows for corporate flexibility in reporting future earnings. *Warning:* Be on guard for frequent and questionable reclassifications, because earnings quality may be adversely affected.

EXAMPLE 10.1

On November 1, 20X2, a company reclassified a security from current to noncurrent that had a cost of \$28,000 and a market value of \$24,000. It therefore reported a realized loss of \$4,000. If you conclude that the real motivation behind the switch was to avoid reflecting expected future unrealized losses against income, you should downwardly adjust net income in future years for such decline, even though such losses are reported as a contra to stockholders' equity.

ANALYTICAL IMPLICATIONS

An investment portfolio with a market value higher than cost constitutes an undervalued asset. For example, if a portfolio has a cost of \$400,000 and a market value of \$460,000, it will be reported in the balance sheet at \$400,000, but the realistic value for analytical purposes is \$460,000.

Special Note: Debt securities may be retained at cost, even though their market value is less. For analytical purposes, value the debt investments at market.

Be on Guard: Watch for declines in portfolio market values not fully reflected in the accounts. An indication of fair value is the revenue (interest income, dividend income) generated by the portfolio. A declining trend in the percentage of earnings on investments to carrying value may point to higher asset realization risk. If there has been a subsequent event disclosure in the annual report applicable to unrealized losses that have occurred on the securities' portfolio, downwardly adjust the investment to account for the decline.

EXAMPLE 10.2

A company reports the following information.

	20X1	20X2
Investments	\$30,000	\$33,000
Income from investments (dividends and interest)	4,000	3,200

The 20X2 annual report has a footnote titled "Subsequent Events," which indicates that there was a \$5,000 decline in the investment portfolio as of March 3, 20X3.

The ratio of investment income to total investments went down from 13.3 percent (\$4,000/\$30,000) in 20X1 to 9.7 percent (\$3,200/\$33,000) in 20X2, pointing to higher realization risk in the portfolio. Further, the post-balance sheet disclosure of a reduction in value of \$5,000 in the portfolio should make you downwardly adjust the realizability of the year-end portfolio.

Indicators of Riskiness in a Portfolio

- *Volatile securities.* Diversify the portfolio by industry and economic sector. However, volatile securities can be more profitable in a bull market.
- *Positively correlated securities.* Try to have securities that are negatively correlated to each other in order to add price stability to the portfolio. With negatively correlated securities, some securities will go up in value while others go down in value.
- *Variability in rate of return.* Determine the standard deviation of the rate of return on the investment portfolio.

Considerations in Selecting an Investment

- Liquidity needs.
- Desired rate of return.
- Risk. *Rule:* The higher the risk, the higher the rate of return must be.
- Tax rate. If one is in a high tax bracket, tax-free securities may be preferred (e.g., municipal bonds).
- Rate of change in price.
- Annual income.
- Future prospects.
- Maturity period. A longer maturity period means a greater chance of price fluctuation.
- Amount of available funds.

OBTAINING INFORMATION

Prior to making an investment decision, you should be familiar with economic conditions, political environment, market status, industry surroundings, *and* corporate performance. Investment information is either descriptive or analytical. *Descriptive* information reveals prior performance of the economy, politics, market, and specific investment. *Analytical* information consists of current data, including forecasts and recommendations as to specific securities. Both types of investment information assist you in assessing the risk and return of a particular choice and enable you to see whether the investment satisfies your objectives. “Almost free” information is contained in newspapers and magazines.

You will have to pay for additional information from a financial advisory service publication like *Value Line*. Other sources of investment data include market information and indexes, economic and current events, and industry and company data.

Market Information and Indexes

Market price information provides past, present, and prospective prices of securities. Data on current and recent price behavior of stocks are contained in price quotations.

The Dow Jones Industrial Average is an average of the market prices of the 30 industrial stocks having wide ownership and volume activity as well as significant market value. Dow Jones calculates separate averages for public utilities, transportation, and the composite.

Standard & Poor’s has five common stock indexes. The S&P Index compares the present price of a group of stocks to the base prices from 1941 to 1943. The S&P indexes are industrial (400 companies), financial (40 companies), transportation (20 companies), public utility (40 companies), and composite (500 companies). S&P also has indexes for consumer and capital goods companies as well as low-grade and high-grade common stocks.

The New York Stock Exchange Index includes all the stocks on the exchange. The American Stock Exchange Index reflects the price changes of its stocks. The National Association of Security Dealers Automated Quotation (NASDAQ) Index reflects activity in the over-the-counter market. Its composite index consists of about 2,300 companies traded on the NASDAQ system.

Barron's has a 50-stock average as well as the average price of the 20 most active and 20 lowest-priced stocks. Other averages and indexes are published by some financial advisory services. For example, *Value Line* has a composite of 1,700 companies as an indication of the overall behavior of the stock market.

There are also indicators of bond performance. Bond yields are typically quoted for a group of bonds of similar type and quality. Some sources of bond yield information are the Federal Reserve, Standard & Poor's, Moody's, and *Barron's*.

Economic and Political Events

The analysis of economic and political events provides information in forecasting national and international economic trends. *Recommendation:* Read the financial section of a good newspaper (e.g., *Barron's*) and business magazines (e.g., *Forbes*).

The *Federal Reserve Bulletin* provides data on the performance of the national economy. Included are a summary of business conditions; statistics on employment and retail prices; the Federal Reserve Board Index of industrial production; and information about gross national product, national income, interest rates, and yields.

The U.S. Department of Commerce issues monthly the *Survey of Current Business* and *Business Conditions Digest*. The *Survey* has a monthly update by industry of business information about exports, inventories, personal consumption, and labor market statistics. The *Digest* publishes cyclical indicators of economic activity, including leading, coincident, and lagging.

Subscription services publish data of economic and corporate developments. They also publish forecasts of business trends and detailed economic information and analysis. An example is the *Kiplinger Washington Letter*.

Industry and Company Analysis

You should select an industry that looks good before picking a particular company. You can obtain industry data from reading an industry trade publication such as the *Public Utilities Fortnightly*. Financial advisory reports on companies, such as Standard & Poor's and Moody's, may be helpful as well. Financial advisory reports typically present and analyze a company's financial history, current financial position, and future expectations. For example, Dun and Bradstreet issues *Key Business Ratios* and *Billion Dollar Directory*.

Brokerage research reports also provide useful analyses and recommendations on industries and companies.

Microcomputers and Electronic Data Bases

With the use of a microcomputer, you have instant access to business data and immediate analytical ability (e.g., comparing data to predetermined criteria), and you can compute a rating of all your investments. Software exists for record keeping (shares, cost, selling price, revenue),

graphics for plotting prices, timing buys and sells, and portfolio management. Some programs enable you to perform sophisticated fundamental and technical analysis and contain price and dividend history as well. Investment selection software aids in determining whether to buy or sell a stock. Investment monitoring software permits you to keep track of your portfolio by using investment information in data bases. You can add new prices to the files or modify *old* ones. Dividend information is also available. Tax investment software enables you to consider the tax aspects of certain securities. Investment programs can accommodate and track stocks, bonds, treasury securities, options, warrants, mutual funds, and commodities.

Dow Jones News/Retrieval contains many data bases, including current and historical Dow Jones Quotes, Corporate Earnings Estimator (earnings per share or EPS estimates), Disclosure II (corporate financial statements and footnote data), Media General Financial Services (stock performance related ratings; comparisons to market indicators; bond, mutual fund, and money market information), Merrill Lynch Research Service, Weekly Economic Survey and Update (economic data, trends, and analysis), and Wall Street Highlights. The Dow Jones Spreadsheet Link obtains financial information, such as stock prices from Dow Jones News/Retrieval, and puts them on a data disk. The data are then transferred to a spreadsheet for financial analysis calculations.

Numerous Internet services, such as MSN, AOL, Yahoo, CNBC, and CNNfn, provides financial data on companies, economic information and projections, money market trends, and earnings results and forecasts. Included are Value Line and Standard and Poor's information.

Most investment programs communicate through computer terminals with other outside data bases and various brokerage firms (via stock bulletin board services). To access them you need a modem and telecommunications software (e.g., Crosstalk).

Standard & Poor's CompuStat tapes provides 20 years of annual financial data for more than 3,000 companies.

RISK VERSUS RETURN

Return from an investment comes from current income and appreciation in market value. The expected return rate on a security is the weighted average of possible returns, weights being probabilities. The holding period return is the total return you earn from holding an investment for a specified period of time, and equals

$$\text{Holding period return} = \frac{\text{Current income} + \text{Capital gain (or Loss)}}{\text{Purchase price}}$$

EXAMPLE 10.3

You invest \$100 in a security, sell it for \$107, and earn a cash dividend of \$13.

The holding period return is

$$\frac{\$13 + \$7}{\$100} = \frac{\$20}{\$100} = 20\%$$

Risk is the variability of possible returns applicable to an investment. Greater return is required to compensate for higher risk. Risk can be measured by the standard deviation, which is a measure of the dispersion of the probability distribution of possible returns. The higher the standard deviation, the wider the distribution, and thus the greater is the investment risk. *Special*

Note: Be careful using the standard deviation to compare risk, since it is only an absolute measure of dispersion (risk), and does not consider the dispersion of outcomes in relation to an expected return. *Recommendation:* In comparing securities with differing expected returns, you should use the coefficient of variation. The coefficient of variation equals the standard deviation for a security divided by its expected value. The higher the coefficient, the riskier the security.

EXAMPLE 10.4

Stock X has a standard deviation of 14.28 percent and an expected value of 19 percent. The coefficient of variation equals

$$\frac{14.28\%}{19\%} = 0.75$$

Types of Risk

- Business risk is due to earnings variability, which may be caused by variability in demand, selling price, and cost. It is the uncertainty surrounding the basic operations of the entity.
- Liquidity risk is the possibility that an asset may not be able to be sold for its market value on short notice.
- Default risk is the risk that the borrower will not be able to pay interest or principal on debt.
- Market risk applies to changes in stock price caused by changes in the stock market as a whole, regardless of the fundamental change in a company's earning power.
- Interest rate risk applies to fluctuation in the value of the asset as interest rate, money market, and capital market conditions change. Interest rate risk applies to all investment instruments, such as fixed income securities. For example, a decline in interest rates will result in an increase in bond and stock prices.
- Purchasing power risk applies to the possibility that you will receive less in purchasing power than originally invested. Bonds in particular are affected by this risk, since the issuer will be paying back in cheaper dollars during an inflationary period. However, the return on common stock tends to move with the inflation rate.
- Systematic risk is nondiversifiable, resulting in situations beyond management's control, and is thus not unique to the particular security. Examples are interest rates, purchasing power, and market risks.
- Unsystematic risk is the portion of the security's risk that is controlled through

diversification. It is the risk unique to a given security. Examples are liquidity, default, and business risks. Most of the unsystematic risk can be diversified away in an efficiently constructed portfolio.

FINANCIAL ASSETS

Investments may be in the form of financial assets or real assets. The former comprise all intangible investments representing equity ownership of a company, providing evidence that someone owes you debt, or your right to buy or sell an ownership interest at a later date. Financial assets include common stock, preferred stock, bonds, options and warrants, mutual funds, certificates of deposit, treasury bills, commercial paper, commodity and financial futures, savings accounts, and money market funds. Real assets are those that physically can be touched, including precious metals and real estate. Real assets are discussed in the next section.

Short-term securities (to be held one year or less) have minimal risk and provide liquidity. Long-term securities (to be held for more than one year) usually are invested in for capital appreciation and annual income.

Common Stock

Common stock is the equity investment representing ownership of a company. The margin requirement is 50 percent for common stock. Advantages of owning common stock are voting rights, appreciation in stock price, receipt of dividends, and a better hedge against inflation than fixed-income obligations. Disadvantages of common stock ownership are a decline in stock price in bearish markets, lack of sizable dividends, and higher risk than debt securities and preferred stock, since you are the last to be paid in corporate liquidation.

Types of Common Stock

- *Blue chip stock.* This is common stock of high-quality companies with a long record of earnings and dividends. They are typically held for a long term, have low risk, and generate modest but dependable return. An example is IBM.
- *Growth stocks.* These have a long record of higher-than-average earnings. Typically there is a low dividend payment, since funds are retained for expansion. They grow faster than the economy and industry. An example is high-tech firms.
- *Income stocks.* These stocks are suitable for those wishing higher current income instead of future capital gains with minimal risk. These are above-average returns and dividend payouts. Examples are utility stocks.
- *Cyclical stocks.* These are stocks that fluctuate in price depending on economic changes. An example is airlines.
- *Defensive stocks.* These are basically not affected by downswings in the business cycle; they are recession-resistant. An example is consumer products.
- *Speculative stocks.* These do not have a track record of high earnings and dividends. While profits are uncertain, they do have the potential for providing a substantial return. Speculative stocks are for you if you are willing to accept substantial risk in return for potentially high return. An example is cancer-related pharmaceuticals.

- *Penny stocks.* This refers to some over-the-counter stocks of high risk and low quality that nevertheless have potential for high return. Some are on the way toward failure, while others have just entered the market and are barely surviving.

Preferred Stock

Preferred stock is a hybrid of common stock and bonds. It is an equity investment (with no voting rights), but has many characteristics of a bond issue. The amount of dividend is typically fixed.

There is an 80 percent dividend exclusion for dividends received on stock. Preferred stock is riskier than bonds, and as such has a higher return. Preferred stockholders take precedence over common stockholders in the receipt of dividends and in the event of liquidation. There is no maturity date, but preferred stock is often convertible into common stock. Preferred stock may be callable at the company's option, and it generally provides only dividend income rather than significant appreciation in price.

$$\text{Preferred dividend yield} = \frac{\text{Annual stated dividend income}}{\text{Preferred stock price}}$$

Bonds

A bond represents a long-term obligation to pay by a corporation or government. Bonds are typically in \$1,000 denominations. You can buy or sell a bond before maturity at a price other than face value. Investment in bonds can provide you with both interest income and capital gains. Interest rates and bond prices move in opposite directions. A decrease in interest rate will result in an increase in bond price. Bonds are good for fixed income.

Corporate bonds have more risk than government bonds because companies can fail. A tax disadvantage to bonds is that interest income is fully taxed, while there is an 80 percent dividend exclusion. *Recommendation:* If you want stability in principal, buy variable rate bonds, since the interest rate is changed to keep the bonds at par. Disadvantages of bond investment are constancy of interest income over the life of the bond, decrease in purchasing power during an inflationary period, sensitivity of prices to interest rate swings, and less marketability in the secondary market compared to stocks.

Convertible Securities

Convertible securities may be converted into common stock at a later date. Two examples of these securities are convertible bonds and convertible preferred stock. These securities provide fixed income in the form of interest (convertible bonds) or dividends (convertible preferred stock). You also benefit from the appreciation value of the common stock.

Warrants

A warrant permits you to purchase a given number of shares at a specified price during a given time period. Warrants are typically good for several years. They are often given as sweeteners for a bond issue. Warrants are not frequently issued, and are not available for all securities. There are no dividend payments or voting rights. A warrant permits you to take part indirectly in price

appreciation of common stock and to derive a capital gain.

When the price per common share rises, you may either sell the warrant (because it also increases in value) or exercise it to obtain stock. Trading in warrants is speculative because of the possibility of variability in return, but the potential for high return exists.

EXAMPLE 10.5

A warrant in ABC Company stock permits you to buy one share at \$10. If the stock rises in price prior to the expiration date, the warrant increases in value. If the stock drops below \$10, the warrant loses value.

The warrant's exercise price is typically constant over its life. But the price of some warrants may increase as the expiration date becomes closer. Exercise price is adjusted for stock splits and stock dividends.

$$\text{Return on a warrant} = \frac{\frac{\text{Selling price} - \text{Purchase price}}{\text{Years}}}{\text{Average investment}}$$

EXAMPLE 10.6

You bought a warrant for \$18 and sold it for \$30 after three years. Your return rate is:

$$\frac{\frac{\$30 - \$18}{3}}{(\$30 + \$18)/2} = \$4/\$24 = 16.7\%$$

Warrants are a speculative investment because their value depends on the price of common stock they may be exchanged for. The value of a warrant varies as the related stock's price varies.

Value of a warrant = (Market price of common stock - Exercise price of warrant) x Number of common shares bought for one warrant

EXAMPLE 10.7

The exercise price of a warrant is \$40. Two warrants equal one share. The stock has a market price of \$58.

$$\text{Value of a warrant} = (\$58 - \$40) \times 0.5 = \$9$$

Options

An option allows for the purchase of a security (or property) at a certain price during a specified time period. An option is neither debt nor equity. It is an opportunity to take advantage of an expected change in the price of a security. The option holder has no guaranteed return. The

option may not be attractive to exercise, since the market price of the underlying common stock has not risen, for example, or the option time period may elapse. If this occurs, you will lose your investment. Thus, options involve considerable risk.

A *call* is an option to *buy*, whereas a *put* is an option to *sell*, a security at a specified price by a given date. Calls and puts can be bought in round lots, typically 100 shares. They are usually written for widely held and actively traded stock. Calls and puts are an alternative investment to common stock. They provide leverage opportunity and are speculative. You do not have to exercise a call or put to earn a return. You can trade them in the secondary market for their value at the time.

In purchasing a call you have the opportunity to make a substantial gain from a small investment, but you risk losing your entire investment if the stock price does not increase. Calls are in bearer form, with a life of one to nine months. Calls have no voting rights, ownership interest, or dividend income. However, option contracts are adjusted for stock splits and stock dividends. The value of a call rises as the underlying common stock increases in market price.

$$\text{Value of call} = (\text{Market price of stock} - \text{Exercise price of call}) \times 100$$

EXAMPLE 10.8

The market price of a stock is \$60, with an exercise price of \$53.

$$\text{Value of call} = (\$60 - \$53) \times 100 = \$700$$

EXAMPLE 10.9

You have a three-month call option permitting you to buy 700 shares of a company's stock at \$15 per share. Within the time period, you exercise the option when the market price is \$23. The gain is \$5,600 (\$8 X 700). If the price had declined or remained at \$15 per share you would not have been able to exercise the call option, and would have lost the entire cost of the option.

In purchasing a call you buy common stock for a fraction of the cost of purchasing regular shares. Calls are bought at a much lower price than common stock. Leverage exists, since a little change in common stock price can result in a significant change in the call option's price. Part of the percentage gain in the call price is the speculative premium applicable to the remaining time period on the call. Calls let you control 100 shares of stock without making a significant dollar investment.

EXAMPLE 10.10

A stock has a price of \$35. You can for \$300 purchase a call that permits the acquisition of 100 shares at \$35 each. The stock price goes to \$57, at which time you exercise the call. The profit is \$22 on each of the 100 shares of stock in the call, or a total of \$2,200, on an investment of only \$300. The net return is 633 percent $[(\$2,200 - \$300)/\$300]$.

As previously mentioned, your return on a put comes when stock price declines.

$$\text{Value of put} = (\text{Exercise price of put} - \text{Market price of stock}) \times 100$$

EXAMPLE 10.11

Stock price is \$40. You acquire a put to sell 100 shares of stock at \$40. The cost of the put is \$250. When stock price goes to \$27, you exercise the put. The profit is \$1,300 (\$13 X 100). Your net gain is \$1,050 (\$1,300 - \$250). Your net return is 420 percent (\$1,050/\$250).

Investment strategies with calls and puts include hedging, straddles, and spreads. If you own a call and put option you can *hedge* by holding on to two or more securities to lower risk and at the same time earn a profit. It may involve purchasing a stock and later buying an option on it. For instance, a stock may be acquired along with writing a call on it. Further, a holder of a security that has increased in price may acquire a put to bring about downside risk protection.

Straddling integrates a call and put on the identical security with the same exercise price and exercise date. It is employed by a speculator trading on both sides of the market. The speculator looks to a significant change in stock price in one direction in order to earn a gain exceeding the cost of both options. But if the large change in prices does not occur, there is a loss equal to the cost of the options. A straddle holder can increase risk and earning potential by closing one option prior to closing the other.

With a *spread*, you buy an option (long position) and write an option (short position) in the same security using call options. There is high risk and a potential for high return. With a spread, you buy one call and sell another. The net profit from a spread position depends on the change between two option prices as the stock price increases or decreases.

Straddles and spreads are not traded on listed exchanges, but rather must be bought through brokerage houses and members of the Put and Call Brokers and Dealers Association.

Futures Contracts

In the futures market you can trade in commodities and financial instruments. A future is a contract to buy or sell a specified amount of an item for a certain price by a given date. The seller of a futures contract agrees to deliver the item to the buyer of the contract, who agrees to buy the item. In the contract are specified the amount, valuation, method, quality, expiration date, manner of delivery, and exchange to be traded in.

Commodity contracts are assurances by a seller to deliver a commodity (e.g., wheat). Financial contracts are seller agreements to deliver a financial instrument (e.g., Treasury bill) or a given amount of foreign currency. Futures are high-risk investments partly because they depend on international economic conditions and the volatile nature of prices.

A “long position” is buying a contract in the hope that the price will increase. A “short position” is selling a contract with the expectation that the price will decline. The position may be terminated by reversing the transaction. For example, the long buyer may subsequently become a short seller of the same amount of the commodity or financial instrument. Practically all futures

are offset prior to delivery.

A futures contract can be traded in the futures market. Trading is accomplished through specialized brokers, and some commodity firms deal only in futures. Fees depend on the contract amount and the price of the item.

Commodities futures

Commodity contracts may last up to one year. There are standardized unit sizes of some commodity contracts (e.g., 50,000 pounds for cotton). You can invest in a commodity directly, indirectly through a mutual fund, or by a limited partnership involved in commodity investments. The latter is more conservative, because risk is spread among many owners and professional management runs the limited partnership. You may look to commodity trading for high rates of return and as an inflation hedge. *Recommendation:* To reduce your risk, diversify your portfolio. Commodity and financial futures are traded in the Chicago Board of Trade, which is the largest exchange. There are other exchanges, some specializing in given commodities (e.g., New York Cotton Exchange).

The return on futures contracts is in the form of capital gain because no current income is earned. There is high return potential due to price volatility of the commodity and leverage effects from low margin requirements. But if things go the opposite way, the entire investment in the form of margin can be lost rapidly.

$$\text{Return on commodity contract} = \frac{\text{Selling price} - \text{Purchase price}}{\text{Margin deposit}}$$

EXAMPLE 10.12

You buy a commodity contract for \$30,000 giving a margin deposit of \$6,000. You sell the contract for \$32,000.

$$\text{Return on commodity contract} = \frac{\$32,000 - \$30,000}{\$6,000} - \frac{\$2,000}{\$6,000} = 0.33$$

The margin on a commodity contract is low, typically from 5 percent to 10 percent of the contract's value.

Financial futures

Financial futures may relate to interest rate futures, foreign currency futures, and stock-index futures. As a result of instability in interest and exchange rates, financial futures can be used to hedge. They can also be used to speculate, because of the possibility of major price changes. There is a lower margin requirement with financials than with commodities. For example, the margin on a U.S. Treasury bill is about 2 percent. For the most part, financial futures are for fixed-income debt securities to hedge or speculate on interest rate changes and foreign currency. With an interest rate futures contract, you have the right to a certain amount of the applicable debt security at a subsequent date (typically no more than three years). Examples are Treasury

bills and notes, certificates of deposit, and commercial paper.

The value of interest rate futures contracts is directly linked to interest rates. For instance, as interest rates decrease, the contract's value increases. As the price or quote of the contract increases, the buyer of the contract gains, while the seller loses.

If you are a speculator, financial futures are attractive because of the possibility of a significant return on a small investment. But there is much risk to interest futures because of their volatility, along with significant gain or loss potential.

With a currency futures contract you have the right to a certain amount of foreign currency at a later date. The contracts are standardized; no secondary markets exist. Currency futures are expressed in dollars or cents per unit of the related foreign currency. The delivery period is usually no more than one year. There are standardized trading units for different currencies (e.g., the British pound has a 25,000 trading unit).

EXAMPLE 10.13

Assume a standardized contract of \$100,000. In March you buy a currency futures contract for delivery in July. The contract price is \$1, or £2. The total value of the contract is \$50,000, and the margin requirement is \$6,000. The pound strengthens until £1.8 equal \$1. Thus, the value of your contract rises to \$55,556, providing you with a return of 92.6 percent. However, if there was a weakening in the pound, you would have incurred a loss on the contract.

A stock-index futures contract is tied to a broad stock market index (e.g., S&P 500 Stock Index, New York Stock Exchange Composite Stock Index). They permit you to take part in the general change in the entire stock market. You are in effect purchasing and selling the market as a whole instead of a specific security. *When to Use:* If you believe there will be a bull market but are uncertain as to which individual stock will increase, buy (long position) a stock-index future. There is high risk involved, however.

REAL ASSETS

Real (tangible) assets are those that physically exist (e.g., can be touched). They include real estate, precious metals, gems, collectibles, common metals, and oil. We will discuss here only the first two, since they are relevant for corporate investors.

Real property can be used to diversify a portfolio, since it typically increases in value when financial assets are decreasing in value. Disadvantages of tangible assets are that there is less liquidity (a secondary market does not always exist), dealer commission rates are higher than with financial assets, there may be storage and insurance costs, a substantial capital investment is required, and no current income is provided (except for rental real estate).

Real Estate

Real estate ownership can take the form of residential property, commercial property, raw land, limited partnership in a real estate syndicate, and ownership of shares in a real estate investment trust (REIT).

Real estate generates capital appreciation potential. Some types of real estate investment property (residential and commercial) provide annual income. Advantages of investing in real estate are building equity, high yield, inflation hedge, and leverage opportunity. Leverage improves earnings when the return earned on borrowed funds is greater than the after-tax interest cost. Disadvantages of investing in real estate are possible governmental regulation (e.g., building codes), high property taxes, possible losses if property declines in value, and limited marketability.

Commercial and industrial properties have differing degrees of risk depending on the tenants. There are also significant operating expenses.

Raw land has the highest risk but possesses the greatest return potential. There is no annual income; return is from appreciation in value.

REITs issue shares to obtain investment, which along with borrowed funds is put into long-term mortgages and real estate projects. REITs are similar to mutual funds, and are traded on the exchanges or over the counter. Real estate investment trusts have liquidity because of the existence of a secondary market.

A limited partnership (real estate syndicate) is a tax-sheltered investment with capital gain potential. The general partner (decision maker) sells participation units to limited partners (whose obligations are typically limited to their investments). Besides making cash investments, the partnership often incurs debt in the acquisition of properties. The advantage of a limited partnership is the greater and more diversified holdings. Disadvantages of a limited partnership are that limited partners have minimal control over activities, high fees are charged by the general partner, foreclosure can occur if borrowed amounts are not paid, and there is no secondary market, which precludes their sale.

Considerations in a Real Estate Arrangement

- Possible lawsuits against the partnership
- Prior performance
- Previous delays in paying limited partners
- Where funds are invested (e.g., identifiable or nonidentifiable property)
- Whether the limited partnership investment is publicly or privately traded

Precious Metals

Precious metals (e.g., gold and silver) are volatile investments, but they do furnish a hedge against inflation. The price of precious metals typically *increases* during troubled times because of investor uncertainty and decreases during stable, predictable periods. When interest rates are high, it is expensive to invest in gold or silver. Precious metals are liquid (have international markets)

and are not periodically taxed.

Gold

Gold acts as an inflation hedge and is a good investment when there is a depreciation in paper currency and when interest rates are low. Gold typically reacts opposite to the way in which common stock does. Gold may be acquired directly or indirectly (e.g., shares in a gold mine). Investment in shares of gold mines does provide portfolio diversification. Disadvantages of gold investment are high storage cost, high transaction costs, no dividend revenue, price volatility, and the fact that some types of gold are in bearer form. An advantage to owning gold is the possibility of large appreciation in price.

Silver

The return from silver comes from capital appreciation. While silver is much lower in price than gold, there is a relatively higher carrying cost. You may also buy stock in silver mining companies.

PORTFOLIO ANALYSIS

The investment portfolio should be diversified into many different types of securities in different industry groups as well as international markets. A balanced portfolio contains stocks, bonds, real estate, money market (e.g., commercial paper), precious metals, and options. There is a trade-off of return and risk. Portfolio risk can be minimized by diversifying. The degree of reduction in portfolio risk depends on the correlation between the assets being combined.

EXAMPLE 10.14

A portfolio has a risk-free rate of 10 percent, market portfolio return of 14 percent, and beta of 0.9. The expected rate of return is

$$10\% + 0.9(14\% - 10\%) = 13.6\%$$

Note: A feasible portfolio that offers the highest expected return for a given risk or the least risk for a given expected return is called an efficient portfolio.

MUTUAL FUNDS

Mutual funds represent investment *in* a professionally managed portfolio of securities. You receive shares of stock in a mutual fund investment company. Advantages are diversification, excellent management, more informed decisions, size (e.g., bid buys may influence the price of a stock up), ownership in many securities with minimal capital investment, dividend reinvestment, check writing options, and easy record keeping (it is done by the fund). Disadvantages are commission charges and professional management fees. Generally, mutual fund performance has not materially done better than the market as a whole. However, certain mutual funds are well known for excellent performance over the years, as rated by independent sources like *Forbes* and *Money* magazine.

Mutual funds may be classified by type depending on organization, fees charged, methods of

trading funds, and investment purpose. With open-end funds, you can purchase from and sell shares back to the fund itself. On the other hand, closed-end funds have a fixed number of shares outstanding. These shares are traded similarly to common stock in secondary markets. All open- and closed-end funds charge management fees. Load funds charge sales commissions while no-load funds do not.

There are also specialized mutual funds (e.g., money market fund). Mutual funds may have different investment purposes: growth, safety and income, capital appreciation, and growth plus income, for instance. You may invest in index funds to control portfolio risk and assure market performance. An index fund follows the change in a selected broad market index (e.g., Standard & Poor's 500) by holding investment commitments in the same proportion as those that comprise the index itself.

Types of Mutual Funds

- *Growth.* The purpose is capital appreciation. The stocks invested in have growth potential, but greater risk.
- *Income.* The objective is to obtain current income (e.g., dividends, interest income). Typically, the portfolio comprises high-dividend common stock, preferred stock, and debt securities. Generally, high-quality securities are bought.
- *Balanced.* These funds provide capital gains and current income. A high percentage of the portfolio is in high-quality common stock to achieve capital appreciation with a lower percentage in fixed income securities. There is a safe return with minimal risk. It is a hybrid between growth and income funds.
- *Bonds.* An investment is made in different types and qualities of bonds. Interest income is the paramount concern. The funds provide liquidity, safety, and diversification. Some bond funds invest only in municipal securities to obtain tax-free income.
- *Money market.* These funds invest in short-term money market securities such as commercial paper, so there is liquidity with low risk. Usually the return on the fund exceeds what can be earned on a bank account.

A fund may invest in only one industry (e.g., Fidelity Select) or a group of industries. They try to maximize the rate of return, but higher risk is usually involved.

The return from mutual funds comes in the form of dividends, capital gain, and change in capital or net asset value (NAV) of the fund.

$$\text{Holding Period Return} = \frac{\text{Dividends} + \text{Capital Gain Distribution} + \text{Change in Net Asset Value}}{\text{Beginning Net Asset Value}}$$

FUNDAMENTAL ANALYSIS

Fundamental analysis evaluates a stock by analyzing the company's financial statements. It considers overall financial health, economic and political conditions, industry factors, and future outlook of the company. It tries to determine whether stock is overpriced, underpriced, or

correctly priced. Financial statement analysis provides you with much of the data you require to forecast earnings, dividends, and selling price.

You have to look at economic risk. What is the effect of business cycles on the firm? Business cycles arise from three conditions: (1) changes in demand; (2) diversification of customer base; and (3) product diversification. The greater the changes in product demand, the more the company is affected by the business cycle, and thus the greater the profit variability. Fundamental analysis is discussed in detail in Chapters 4, 5, and 6.

TECHNICAL ANALYSIS

According to technical analysis, the market can be predicted in terms of direction and magnitude. You can evaluate the stock market by employing numerous indicators, including studying economic factors within the marketplace.

Stock prices tend to move with the market because they react to numerous demand and supply forces. You may attempt to forecast short-term price changes to properly time purchase and sale of securities. You try to recognize a recurring pattern in prices or a relationship between stock price changes and other market data. You can also employ charts and graphs of internal market data, such as price and volume.

The two major techniques of technical analysis are key indicators and charting.

Key Indicators

Key indicators of market and stock performance include trading volume, market breadth, Barron's Confidence Index, mutual fund cash position, short selling, odd-lot theory, and the Index of Bearish Sentiment.

Trading volume

A reflection of the health of the stock market is the number of shares traded. Price follows volume. For instance, increased price usually occurs with increased volume. Trading volume is based on supply-demand relationships and indicates market strength or weakness. A strong market occurs when volume rises as prices increase. A weak market occurs when volume increases as prices decrease. If the demand of new stock offerings exceeds the supply, stock prices will increase. *Note:* Supply-demand evaluation is more concerned with the short term than the long term.

Volume is closely tied into stock price change. A bullish market occurs when there is a new high on heavy volume. But a new high with light trading volume is considered temporary. A new low with light volume is deemed significantly better than one with high volume, since fewer investors are involved. A bearish situation occurs when there is high volume with the new low price.

Watch out for a "selling climax," when prices decrease for a long period at an increased

rate, coupled with increased volume. Subsequent to the climax, we expect prices to increase, and the low at the point of climax is not anticipated to be violated for a long time. A selling climax usually happens at the end of a bear market.

When prices have been going up for several months, a low price increase coupled with high volume is a bearish indicator.

An upside-downside index shows the difference between advances *and* decreases in stock volume typically based on a 10-day or 30-day moving average. The index assists in predicting stock market turning points. A bull market continues only where buying pressures continue to be strong.

The final stage of a major increase in stock price is referred to as the “exhaustion move.” It takes place when there is a rapid decline in volume *and* price. A trend reversal is indicated.

Market breadth

Market breadth refers to the dispersion of a general price increase or decrease. You can use it as an advance reflection of major stock price declines or advances. It can be used to analyze the prime turning points of the market *on* the basis of stock market cycles. A bull market is a long time period in which securities approach their highs slowly, with the individual peaks increasing as market averages approach a turning point. In a bear market, many stock prices decrease materially in a short time period. Market weakness occurs when *many* stocks are decreasing in prices while the averages increase. In forecasting *the* end of a bear market, the degree of stock selling is considered.

A breadth measure looks at the activity of a broader range of securities than does a market average (e.g., Dow Jones Industrial). The Dow Jones stocks are not representative of the whole market, since the average is weighted toward large companies. Hence, all stocks on an exchange may be analyzed by considering advances and declines.

The Breadth Index computes on a daily basis the net advances or declining issues on the New York Stock Exchange. Net advances is a positive sign. The amount of strength depends on the spread between the number of advances and declines. *Recommendation:* Look at relevant figures in *The Wall Street Journal*.

$$\text{Breadth index} = \frac{\text{Net advances or declines}}{\text{Number of securities traded}}$$

Advances less declines typically move in the same direction as a popular market average. However, they may go in the opposite direction at a market peak or bottom. Breadth analysis concentrates on change instead of level. *Suggestion:* Chart the Breadth Index against a market average (e.g., Dow Jones Industrial). In most cases they move together. *Caution:* In a bull market, carefully watch an extended divergence between the Breadth Index, such as where it drops gradually, to new lows and the Dow Jones, such as where it goes to new highs.

Recommendation: Compare the Breadth Index for the current period to a base year. When the Breadth Index and Dow Jones Industrial Average are both dropping, it points to market weakness.

EXAMPLE 10.15

Net declines are 24 on securities traded of 1,160. The Breadth Index is -2.1percent (-24/1,160).

A possible sign to the end of a bull market is when the Dow Jones Industrial Average is rising but the number of daily declines exceeds the number of daily advances on a continual basis. This possibly reflects that conservative investors are purchasing blue chip stocks, but do not have confidence in the overall market. A market upturn is pointed to when the Dow Jones Industrial Average is dropping, but advances continually lead declines.

Market breadth can be applied to individual securities as well. Net volume (rises in price minus decreases in price) should be computed.

EXAMPLE 10.16

Sixty thousand shares are traded in Company X for one day. Forty-five thousand are on the upside (rising in price), 10,000 are on the downside (decreasing in price), and 5,000 have no change. The net volume difference is 35,000, traded on upticks. You have to appraise any sign of divergence between the price trend and the net volume for the company. If there is a divergence, you may expect a reversal in the price trend. Accumulation occurs when price decreases and net volume increases.

Barron's Confidence Index

Barron's Confidence Index evaluates the trading pattern of bond investors. It helps in deciding when to buy and sell stocks. The assumption used is that bond traders have more knowledge than stock traders, and hence spot trends more quickly. If you know what bond traders are doing today, you can predict what stock traders will be doing next. Barron's Confidence Index is calculated as follows:

$$\frac{\text{Yield on Barron's 10 top-grade corporate bonds}}{\text{Yield on Dow Jones 40-bond average}}$$

EXAMPLE 10.17

The Dow Jones' yield is 15 percent and the Barron's yield is 14 percent. Barron's Confidence Index = 93.3% (14%/15%)

The numerator has a lower yield relative to the denominator since it contains higher-quality bonds. Lower risk means lower return. Obviously, the index will always be less than 100 percent. In the case where bond investors are bullish, there will be a small yield difference between high-grade and low-grade bonds (probably around 95 percent). In bearish times, bond investors will look to high-quality issues. If investors continue to place money in lower-quality bonds, they will demand a higher yield to compensate for the increased risk. The Confidence

Index will now be lower because of an increasing denominator. If confidence is high, investors will buy lower-grade bonds. Consequently, the yield on high-grade bonds will decrease while the yield on low-grade bonds will increase.

Mutual fund position

The buying pattern of mutual funds reflects the purchasing potential of large institutional investors. *Recommendation:* Look at the Investment Company Institute's monthly ratio of mutual fund cash and cash equivalents to total assets. A change in the ratio points to changes in institutional investor opinions.

Typically, the ratio is between 5 and 25 percent. When a mutual fund's cash position is 15 percent of assets or higher, you can assume the fund represents significant purchasing power, which points to a possible market upturn. The higher the cash position of the fund, the more bullish is the general market outlook. The investment of this cash will cause a rise in stock prices. On the other hand, a low ratio is a bearish indicator.

Short selling

You can engage in short selling when you believe stock prices will go down. In effect, you sell high and buy low. In a short sale you make a profit if the market price of the security drops. To make a short sale, your broker borrows the security from someone else and then sells it for you to another. Subsequently, you buy the shares back. Of course, if market price goes up, you have a loss. You "sell short against the box" when you sell short shares you actually own.

EXAMPLE 10.18

You sell short 100 shares of Company Y stock, which has a market price of \$60 per share. You later buy them back for \$48 per share. Your profit is \$1,200 (\$12 per share x 100 shares).

Technical analysts evaluate the number of shares sold short. They also examine the ratio of latest reported short interest position for the month to the daily average volume for the month. Short interest refers to the number of shares sold short in the market at any given time. A high ratio is bullish and a low ratio is bearish. Typically, the ratio for all stockholders on the New York Stock Exchange has been between 1.0 and 1.75. A short interest ratio of 2.0 or greater indicates a market low.

The examination of short sales is an example of a "contrary opinion rule." Some analysts are of the opinion that a rise in the number of short sellers points to a bullish market. It is believed that short sellers overreact. Further, the short seller will subsequently buy the short-sold stock back, resulting in an increased market demand. However, some analysts believe that increased short selling points to a downward and technically weak market, which results from investor pessimism.

The Wall Street Journal publishes the amount of short interest on the New York Stock Exchange and the American Stock Exchange. By monitoring short interests you can forecast future market demand and determine whether the current market is optimistic or pessimistic.

Advice: A significant short interest in a stock should make you question the security's value.

Why not also look at odd-lot short sales? Many odd-lot traders are uninformed. An odd-lot ratio of 3.0 or more reflects pessimism.

Specialists make markets in various securities and are deemed "smart money" investors. *Recommendation:* Look at the ratio of specialists' short sales to the total number of short sales on an exchange.

Odd-lot theory

An odd lot is a transaction in which less than 100 shares of a security are involved. Odd-lot trading is indicative of popular opinion. It rests on the theory of contrary opinion. *Guideline:* Determine what losers are doing and then do the opposite. In essence, sophisticated investors should sell when small traders are buying and buy when they are selling. Refer to *The Wall Street Journal* for odd-lot trading information. Volume is typically expressed in shares instead of dollars. But some technical analysts employ the *SEC Statistical Bulletin* where volume is expressed in dollars.

$$\text{Odd-lot index} = \frac{\text{Odd-lot purchases}}{\text{Odd-lot sales}}$$

The ratio typically is between 0.40 and 1.60.

You may also examine the ratio of odd-lot short sales to total odd-lot sales, and the ratio of total odd-lot volume (buys and sells) to round-lot volume on the New York Stock Exchange. These figures act to substantiate the conclusions reached by evaluating the ratio of odd-lot selling volume to odd lot buying volume.

As per the odd-lot theory, the small trader is right most of the time but does not recognize key market turns. For instance, odd-lot traders correctly begin selling part of their portfolios in an upward market trend, but as the market continues to rise, small traders try to make substantial profits by becoming significant net buyers. However, this precedes a market fall.

Index of Bearish Sentiment

Investors Intelligence's Index of Bearish Sentiment is based on the opposite of the recommendations of investment advisory services; it is a contrary opinion rule. For example, if investment advisory services say buy, you should sell. According to Investors Intelligence, when 42 percent or more of the advisory services are bearish, the market will go up. On the other hand, when 17 percent or fewer of the services are bearish, the market will drop.

$$\text{Index of Bearish Sentiment} = \frac{\text{Bearish services}}{\text{Total number of services giving an opinion}}$$

When the ratio goes toward 10 percent, it means the Dow Jones Industrial Average is about to move from bullish to bearish. When the index approaches 60 percent, the Dow Jones Industrial

Average is about to go from bearish to bullish. The reasoning of the theory is that advisory services are trend followers instead of anticipators.

Puts and calls

You may look toward option trading activity to forecast market trends.

$$\text{Put-call ratio} = \frac{\text{Put volume}}{\text{Call volume}}$$

The index increases when there is more put activity because of pessimism around market bottom. The ratio goes down when there is more call activity because investors are optimistic around the market peak.

$$\text{Option buy call percentage} = \frac{\text{Option buy call transactions}}{\text{Total call volume}}$$

A high ratio points to investor optimism.

Charting

Charts are useful in analyzing market conditions and price behavior of individual securities. Reference can be made to Standard & Poor's *Trendline*, which provides charting data on companies. Chart interpretation requires the ability to evaluate formations and identify buy and sell indicators. The major types of charts are line (Figure 10.1), bar (Figure 10.2), and point-and-figure.

A chart provides information about resistance levels (points). A breakout from the resistance level notes market direction. The longer the sideways movement prior to a break, the more stock can increase in price.

Benefits of the chart are they help you to ascertain whether there is a major market upturn or downturn and whether the trend will reverse. You can further appraise what price may be achieved by a given stock or market average. Also, these charts help in forecasting the magnitude of a price swing.

Moving average

Moving averages assist in analyzing intermediate and long-term stock movements. By evaluating the trend in current prices relative to the long-term moving average of prices, you can predict a reversal in a major uptrend in price of a company's stock or of the general market. The underlying direction and degree of change in volatile numbers are depicted in a moving average.

FIGURE 10.1
Line Chart

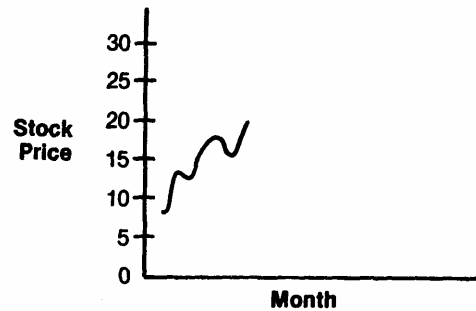
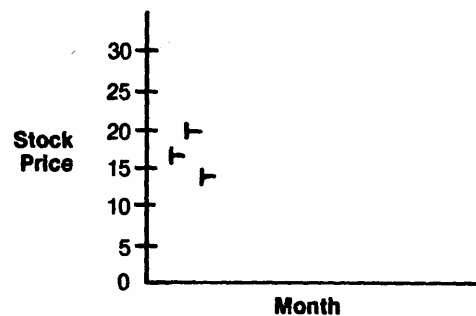


FIGURE 10.2
Bar Chart



Moving average computation:

- Step 1: Average a portion of the series
- Step 2: Add the following number to the numbers already averaged, omitting the first number
- Step 3: Obtain a new average

Typically, a 200-day moving average of daily ending prices is used. The average is usually graphed to spot directions. *What to Do:* Buy when the 200-day average line becomes constant or increases after a decline and when the daily price of stock moves beyond the average line.

EXAMPLE 10.19

Day	Index	Three-Day Moving Total	Three-Day Moving Average
1	115		
2	126		
3	119	360 (days 1—3)	120 (360/3)
4	133	378 (days 2—4)	126 (378/3)

Suggestion: Buy when stock price surpasses the 200-day line, then goes down toward it but not through it, and then goes up again.

Relative strength analysis

Appraisal of relative strength assists in predicting individual stock prices.

$$\text{Relative strength (method 1)} = \frac{\text{Monthly average stock price}}{\text{Monthly average market index (or industry group index)}}$$

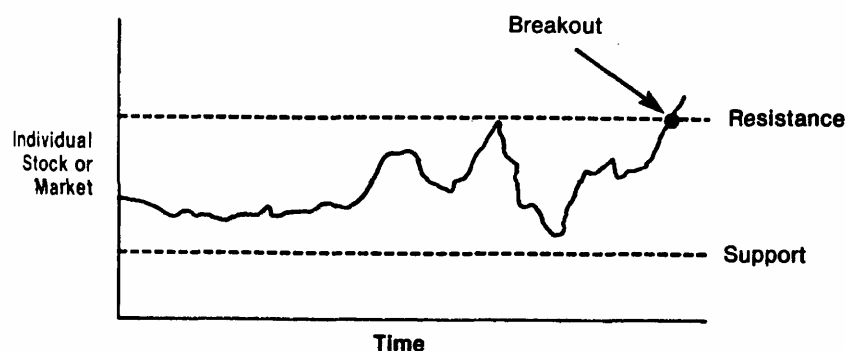
$$\text{Relative strength (method 2)} = \frac{\text{Specific industry group price index}}{\text{Total market index}}$$

What to Watch Out for: When a stock or industry group outperforms the market, that stock or industry is considered favorably because it should become even stronger. Some analysts distinguish between relative strength in a declining market and relative strength in an increasing market. When a stock does better than a major stock average in an advance, it may shortly turn around. However, when the stock is superior to the rest of the market in a decline, the stock will typically remain strong.

Support and resistance levels

A support level is the lower end of a trading range, while the resistance level is the upper end (see Figure 10.3). Support may happen when a security goes to a lower trading level, since new investors may now desire to buy it. If such is the case, there will be new demand in the market. Resistance occurs when a stock goes to the high side of the normal trading range. If you purchase on an earlier high, you may see this as an opportunity to sell the security at a gain. When market price is higher than the resistance point or less than the support point, you may assume the stock is trading in a new range and that higher or lower trading values are imminent.

FIGURE 10.3
Support and Resistance



Dow theory

Dow Theory applies to individual stocks and to the overall market. It is based on the movements

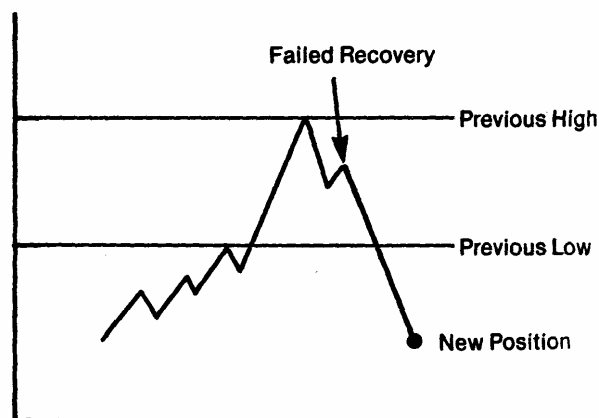
of the Dow Jones Industrial Average and the Dow Jones Transportation Average. Stock market direction has to be confirmed by both averages. According to the theory, price trend in the overall market points to the termination of both bull and bear markets. It confirms when a reversal has taken place. The following three movements in the market are assumed to occur simultaneously:

- *Primary*. A primary trend can be either bullish or bearish and typically lasts 28 to 33 months.
- *Secondary*. A secondary trend goes counter to the primary movement and typically lasts three weeks to three months.
- *Day-to-day*. This variability makes up the first two movements of the market.

Secondary movements and daily fluctuations reflect a long-term primary movement trend.

A major primary rise in market averages coexists with intermediate secondary downward reactions, eliminating a material amount of the previous increase. At the culmination of each reaction, a price recovery occurs that falls short of the previous rise. If, subsequent to an unsuccessful recovery, a downward reaction goes below the low point of the last prior reaction, it is inferred that the market is in a primary downturn. (See Figure 10.4.)

FIGURE 10.4
Dow Theory Chart



According to the Dow Theory, there is an upward market when the cyclical movements of the market averages increase over time and the successive market lows become higher. There is a downward market when the successive highs and successive lows in the market are lower than the previous highs and lows.

CONCLUSION

Portfolio investment analysis is needed to achieve maximum return on investments at minimal risk. A determination must be made of which investment vehicle is best under certain circumstances. Proper timing of buys and sells is also essential. Diversification is a must to guard against unusual price changes in one particular market.

CHAPTER 11

OBTAINING FUNDS: SHORT-TERM AND LONG-TERM FINANCING

LEARNING OBJECTIVES

After studying the material in this chapter, you will be able to:

1. Explain what financial planning involves.
2. Distinguish between short-term and intermediate-term financing sources
3. Compare short-term to long-term financing
4. List long-term financing sources.
5. Identify and compute each source of cost of capital.

You can finance short-term (less than one year), intermediate-term (one to five years), or long-term (in excess of five years) . Each has its own merits and deficiencies. Under what circumstances is one better than the other? Are you able to adjust your financing strategy to meet changing times? Do you know the changing impact that economic, political, and industry conditions have on the entity's flow of funds? What is the degree of internally generated funds?

FINANCIAL PLANNING

After you have decided on the length of the financing, the proper type within the category must be chosen. In selecting a given financing instrument, you have to consider the following:

- Cost.
- Effect on financial ratios.
- Effect on credit rating (some sources of short-term financing may negatively impact the company's credit rating, such as factoring accounts receivable).
- Risk (reliability of the source of funds for future borrowing). If your company is materially affected by outside forces, it will need more stable and reliable financing.
- Restrictions, such as requiring a minimum level of working capital.
- Flexibility.
- Expected money market conditions (e.g., future interest rates) and availability of future financing.
- Inflation rate.
- Company profitability and liquidity positions, both of which must be favorable if the company is to be able to pay its near term obligations.
- Stability and maturity of operations.
- Tax rate.

SHORT-TERM FINANCING

Short-term financing may be used to meet seasonal and temporary fluctuations in funds position as well as to meet long-term needs. For example, short-term financing may be used to provide additional working capital, finance current assets (such as receivables and inventory), or provide

interim financing for a long-term project (such as the acquisition of plant and equipment) until long-term financing is arranged. (Long-term financing may not always be appropriate because of perceived long-term credit risk or excessively high cost.)

When compared to long-term financing, short-term financing has several advantages. It is usually easier to arrange and less expensive and has more flexibility. The drawbacks of short-term financing are that it is subject to greater fluctuations in interest rates, refinancing is frequently required, there is greater risk of default because the loan comes due sooner, and any delinquency may damage the company's credit rating.

The sources of short-term financing include trade credit, bank loans, bankers' acceptances, finance company loans, commercial paper, receivable financing, and inventory financing. One particular source may be more appropriate than another in a given circumstance; some are more desirable than others because of interest rates or collateral requirements.

Using Trade Credit

Trade credit (accounts payable) are balances owed by your company to suppliers. It is a spontaneous (recurring) financing source for creditworthy companies since it comes from normal operations. Trade credit is the least expensive form of financing inventory. Its benefits are that it is readily available, since suppliers want business; it requires no collateral; there is no interest charge or else a minimal one; it is convenient; and it is likely to be extended if the company gets into financial trouble. If the company has liquidity difficulties, it may be able to stretch (extend) accounts payable; however, the company will be required to give up any cash discount offered and accept a lower credit rating. The company should prepare a report analyzing accounts payable in terms of lost discounts, aged debit balances, aged unpaid invoices, and days to pay.

EXAMPLE 11.1

The company purchases \$500 worth of merchandise per day from suppliers. The terms of purchase are net/60, and the company pays on time. The accounts payable balance is:

$$\$500 \text{ per day} \times 60 \text{ days} = \$30,000$$

The company should typically take advantage of a cash discount offered for early payment because failing to do so results in a high opportunity cost. The cost of not taking a discount equals:

$$\left(\frac{\text{Discount Lost}}{\text{Dollar Proceeds You Have}} \right) \times \left(\frac{360}{\text{Number of Days You have Use of}} \right)$$

Use of by Not Taking the the Money by Not Taking the
Discount Discount

Bank Loans

Even though other institutions, such as savings and loan associations and credit unions, provide banking services, most banking activities are conducted by commercial banks. Commercial banks allow the company to operate with minimal cash and still be confident of planning activities even in uncertain conditions.

Commercial banks favor short-term loans since they like to get their money back within one year. If the company is large, a group of banks may form a consortium to furnish the desired level of capital.

The prime interest rate is a benchmark for the short-term loan interest rate banks charge creditworthy corporate borrowers. Good companies with strong financial strength can get terms below prime. Your company's interest rate may be higher depending upon the risk the bank believes it is taking.

Bank financing may take the following forms:

- Unsecured loans
- Secured loans
- Lines of credit
- Letters of credit
- Revolving credit
- Installment loans

-- *Unsecured Loans.* Most short-term unsecured (uncollateralized) loans are self-liquidating. This kind of loan is recommended if the company has an excellent credit rating. It is usually used to finance projects having quick cash flows and is appropriate if the company has immediate cash and can either repay the loan in the near future or quickly obtain longer-term financing. Seasonal cash shortfalls and desired inventory buildups are among the reasons to use an unsecured loan. The disadvantages of this kind of loan are that it carries a higher interest rate than a secured loan since there is no collateral and that a lump sum payment is required.

-- *Secured Loans.* If the company's credit rating is deficient, the bank may lend money only on a secured basis. Collateral can take many forms, including inventory, marketable securities, or fixed assets. Even if the company is able to obtain an unsecured loan, it may be better off taking a collateralized loan at a lower interest rate.

-- *Lines of Credit.* Under a line of credit, the bank agrees to lend money up to a specified amount on a recurring basis. The bank typically charges a commitment fee on the amount of the unused credit line. Credit lines are typically established for a one-year period and may be renewed annually. You can determine if the preferred line of credit is adequate for your company's present and immediate future needs by considering the current and expected cash requirements of the business.

The advantages of a line of credit are that it offers easy and immediate access to funds during tight money market conditions and it enables the company to borrow only as much as it needs

and to repay immediately when cash is available. You should use a line of credit if the company is working on large individual projects for a long time period and will obtain minimal or no payments until the job is completed. The disadvantages of lines of credit relate to the collateral requirements and the additional financial information that must be presented to the bank. Banks also may place restrictions on the company, such as setting a ceiling on capital expenditures or requiring a minimum level of working capital.

When the company borrows under a line of credit, it may be required to maintain a compensating balance (a noninterest-bearing account) with the bank. The compensating balance is stated as a percentage of the loan and effectively increases the cost of the loan. A compensating balance may also be placed on the unused portion of a line of credit, in which case the interest rate is reduced.

A line of credit is typically decided upon prior to the actual borrowing. In the days between the arrangement for the loan and the actual borrowing, interest rates may change. Therefore, the agreement will stipulate the loan is at the prime interest rate prevailing when the loan is extended plus a risk premium. (The prime interest rate will not be known until you actually borrow the money since market interest rates may change from the time you contract for a loan and the time you receive the funds.)

The bank may test the company's financial capability by requiring it to "clean up," that is, repay the loan for a brief time during the year (e.g., for one month). The payment shows the bank that the loan is actually seasonal rather than permanent. If the company is unable to repay a short-term loan, it should probably finance with long-term funds.

-- *Letters of Credit.* A letter of credit is a document issued by a bank guaranteeing the payment of a customer's drafts up to a specified amount for a designated time period. In effect, the bank's credit is substituted for that of the buyer, minimizing the seller's risk. Payment may be made on submission of proof of shipment or other performance. Letters of credit are used primarily in international trade.

There are different types of letters of credit. A *commercial letter of credit* is typically drawn in favor of a third party. A *confirmed letter of credit* is provided by a correspondent bank and guaranteed by the issuing bank.

The advantages of letters of credit are that the company does not have to pay cash in advance of shipment, using funds that could be used elsewhere in the business.

-- *Revolving Credit.* A revolving credit is an agreement between the bank and the borrower in which the bank contracts to make loans up to a specified ceiling within a prescribed time period. With revolving credit, notes are short term (typically ninety days). When part of the loan is paid, an amount equal to the repayment may again be borrowed under the terms of the agreement. Advantages are the readily available credit and few restrictions compared to line-of-credit agreements. A major disadvantage may be restrictions imposed by the bank.

-- *Installment Loans.* An installment loan requires monthly payments of interest and principal. When the principal on the loan decreases sufficiently, you may be able to refinance at a lower interest rate. The advantage of this kind of loan is that it may be tailored to satisfy seasonal financing needs.

Interest

Interest on a loan may be paid either at maturity (ordinary interest) or in advance (discounting the loan). When interest is paid in advance, the loan proceeds are reduced and the effective (true) interest rate is increased.

Commercial Finance Loans

When credit is unavailable from a bank, the company may have to go to a commercial finance company, which typically charges a higher interest rate than the bank and requires collateral. Typically, the value of the collateral is greater than the balance of the loan and may consist of accounts receivable, inventories, and fixed assets. Commercial finance companies also finance the installment purchases of industrial equipment. A portion of their financing is sometimes obtained through commercial bank borrowing at wholesale rates.

Commercial Paper

Commercial paper is a short-term unsecured obligation with a maturity ranging from two to 270 days, issued by companies to investors with temporarily idle cash. Commercial paper can be issued only if the company possesses a very high credit rating; therefore, the interest rate is less than that of a bank loan typically one-half percent below the prime interest rate. Commercial paper is sold at a discount (below face value), with the interest immediately deducted from the face of the note by the creditor; however, the company pays the full face value. Commercial paper may be issued through a dealer or directly placed to an institutional investor (a dealer is a company that buys securities and then sells them out of its own inventory, while an institutional investor is an entity that buys large volumes of securities, such as banks and insurance companies).

The benefits of commercial paper are that no security is required, the interest rate is typically less than that required by banks or finance companies, and the commercial paper dealer often offers financial advice. The drawbacks are that commercial paper can be issued only by large, financially sound companies and that commercial paper dealings are impersonal. Commercial paper is usually backed by a bank letter of credit.

We now look at an example that determines whether the amount of commercial paper issued by a company is excessive.

EXAMPLE 11.2

The company needs \$300,000 for the month of November. Its options are:

1. Obtaining a one-year line of credit for \$300,000 with a bank. The commitment fee is 0.5%, and the interest charge on the used funds is 12%.

2. Issuing two-month commercial paper at 10% interest. Because the funds are needed only for one month, the excess funds (\$300,000) can be invested in 8% marketable securities for December. The total transaction fee for the marketable securities is 0.3%.

The line of credit costs:

Commitment fee for unused period (0.005) (300,000) (11/12)	\$1,375
Interest for one month (0.12) (300,000) (1/12)	<u>3,000</u>
Total cost	<u>\$4,375</u>

The commercial paper costs:

Interest charge (0.10) (300,000) (2/12)	\$5,000
Transaction fee (0.003) (300,000)	900
Less interest earned on marketable securities (0.08) (300,000) (1/12)	<u>(2,000)</u>
Total cost	<u>\$3,900</u>

Since \$3,900 is less than \$4,375, the commercial paper arrangement is the better option.

Using Receivables for Financing

In accounts receivable financing, the accounts receivable serve as security for the loan as well as the source of repayment.

Financing backed by accounts receivable generally takes place when:

- Receivables are at least \$25,000.
- Sales are at least \$250,000.
- Individual receivables are at least \$100.
- Receivables apply to selling merchandise rather than rendering services.
- Customers are financially strong.
- Sales returns are low.
- The buyer receives title to the goods at shipment.

Receivable financing has several advantages. It eliminates the need to issue bonds or stock to obtain a recurring cash flow. Its drawback is the high administrative costs of monitoring many small accounts.

Accounts receivable may be financed under either a factoring agreement or an assignment (pledging) arrangement. *Factoring* is the outright sale of accounts receivable to a bank or finance company without recourse; the purchaser takes all credit and collection risks. The proceeds received by the seller are equal to the face value of the receivables less the commission charge, which is usually 2 to 4 percent higher than the prime interest rate. The cost of the factoring arrangement is the factor's commission for credit investigation, interest on the unpaid balance of

advanced funds, and a discount from the face value of the receivables if there is high credit risk. Remissions by customers are made directly to the factor.

The advantages of factoring are that it offers immediate cash, it reduces overhead because the credit examination function is no longer needed, it provides financial advice, it allows for receipt of advances as required on a seasonal basis, and it strengthens the company's balance sheet position.

The disadvantages of factoring include both the high cost and the negative impression left with customers as a result of the change in ownership of the receivables. Factors may also antagonize customers by their demanding methods of collecting delinquent accounts.

In an *assignment* (pledging) arrangement, ownership of the accounts receivable is not transferred. Instead, receivables are given to a finance company with recourse. The finance company usually advances between 50 and 85 percent of the face value of the receivables in cash; your company is responsible for a service charge, interest on the advance, and any resulting bad debt losses, and continues to receive customer remissions.

The assignment of accounts receivable has the advantages of providing immediate cash, making cash advances available on a seasonal basis, and avoiding negative customer feelings. The disadvantages include the high cost, the continuing of administrative costs, and the bearing of all credit risk.

Financial managers must be aware of the impact of a change in accounts receivable policy on the cost of financing receivables. When accounts receivable are financed, the cost of financing may rise or fall. For example, when credit standards are relaxed, costs rise; when recourse for defaults is given to the finance company, costs decrease; and when the minimum invoice amount of a credit sale is increased, costs decline.

Using Inventories for Financing

Financing inventory, which typically takes place when the company has completely used its borrowing capacity on receivables, requires the existence of marketable, nonperishable, and standardized goods that have quick turnover and that are not subject to rapid obsolescence. Good collateral inventory can be easily sold. However, you should consider the price stability of the merchandise and the costs of selling it when deciding on a course of action.

The cash advance for financed inventory is high when there is marketable inventory. In general, the financing of raw materials and finished goods is about 75 percent of their value; the interest rate is approximately 3 to 5 points over the prime interest rate.

The drawbacks of inventory financing include the high interest rate and the restrictions it places on inventory.

Types of inventory financing include floating (blanket) liens, warehouse receipts, and trust receipts. With a *floating lien*, the creditor's security lies in the aggregate inventory rather than in its components. Even though the company sells and restocks, the lender's security interest continues. With a *warehouse receipt*, the lender receives an interest in the inventory stored at a public warehouse; the fixed costs of this arrangement are high. There may be a field warehouse arrangement in which the warehouse sets up a secured area directly at the company's location; the company has access to the goods but must continually account for them. With a *trust receipt* loan, the creditor has title to the goods but releases them to the company to sell on the creditor's behalf; as goods are sold, the company remits the funds to the lender. The drawback of the trust receipt arrangement is that a trust receipt must be given for specific items.

A collateral certificate guaranteeing the existence of pledged inventory may be issued by a third party to the lender. The advantage of a collateral certificate is its flexibility; merchandise need not be segregated or possessed by the lender.

Financing with Other Assets

Assets other than inventory and receivables may be used as security for short-term bank loans. Possibilities include real estate, plant and equipment, cash surrender value of life insurance policies, and securities. Lenders are also usually willing to advance a high percentage of the market value of bonds or to make loans based on a third-party guaranty.

Short-term financing is easier to arrange, has lower cost, and is more flexible than long-term financing. However, short-term financing leaves the borrower more vulnerable to interest-rate swings, requires more frequent refinancing, and requires earlier payment. As a rule, you should use short-term financing to provide additional working capital, to finance short-lived assets, or to serve as interim financing on long-term projects. Long-term financing is more appropriate for the financing of long-term assets or construction projects.

INTERMEDIATE-TERM FINANCING: TERM LOANS AND LEASING

We now consider the use of intermediate-term loans, primarily through banks and leases, to meet corporate financing needs. Examples are bank loans, insurance company term loans, and equipment financing.

Purposes of Intermediate-term Bank Loans

Intermediate-term loans are loans with a maturity of more than one year but less than five years. They are appropriate when short-term unsecured loans are not, such as when a business is acquired, new fixed assets are purchased, or long-term debt is retired. If a company wants to float long-term debt or issue common stock but market conditions are unfavorable, it may seek an intermediate loan to bridge the gap until conditions improve. A company may use extendable debt when it will have a continuing financing need, reducing the time and cost required for repeated debt issuance.

The interest rate on intermediate-term loans is typically higher than that for short-term loans because of the longer maturity period and varies with the amount of the loan and the company's financial strength. The interest rate may be either fixed or variable.

Ordinary intermediate-term loans are payable in periodic equal installments except for the last payment, which may be higher (a balloon payment). The schedule of loan payments should be based on the company's cash flow position to satisfy the debt. The periodic payment in a term loan equals:

$$\text{Periodic Payment} = \frac{\text{Amount of loan}}{\text{Present value factor}}$$

TYPES OF LONG-TERM DEBT

Different types of debt instruments are appropriate in different circumstances. The amount of debt a company may have depends largely on its available collateral. Sources of long-term debt include mortgages and bonds.

Mortgages

Mortgages are notes payable that are secured by real assets and that require periodic payments. Mortgages can be issued to finance the purchase of assets, the construction of a plant, or the modernization of facilities. Banks require that the value of the property exceed the mortgage on that property and usually lend up to between 70 percent and 90 percent of the value of the collateral. Mortgages may be obtained from a bank, life insurance company, or other financial institution. As a rule, it is easier to obtain mortgage loans for multiple-use real assets than for single-use real assets.

There are two types of mortgages: *senior* mortgages, which have first claim on assets and earnings, and *junior* mortgages, which have subordinate liens.

A mortgage may have a closed-end provision that prevents the company from issuing additional debt of the same priority against the specific property. If the mortgage is open-ended, the company can issue additional first-mortgage bonds against the property.

Mortgages have a number of advantages, including favorable interest rates, fewer financing restrictions than bonds, extended maturity dates for loan repayment, and easy availability.

Bonds

Long-term corporate debt usually takes the form of bonds payable and loans payable. A *bond* is a certificate indicating that the company has borrowed money and agrees to repay it. A written agreement, called an *indenture*, describes the features of the bond issue (e.g., payment dates, call price should the issuer decide to reacquire the bonds, conversion privileges, and any restrictions).

The indenture is a contract between the company, the bondholder, and the trustee, who makes sure that the company meets the terms of the bond contract (in many instances, the trustee is the

trust department of a commercial bank). Although the trustee is an agent for the bondholder, it is selected by the issuing company prior to the issuance of the bonds. If a provision of the indenture is violated, the bonds are in default. (Covenants in the indenture should be flexible enough to allow companies to respond quickly to changes in the financial world.) The indenture may also have a negative pledge clause, which precludes the issuance of new debt that takes priority over existing debt in the event of liquidation. The clause can apply to assets currently held as well as to assets that may be purchased in the future.

The price of a bond depends on several factors, including its maturity date, interest rate, and collateral. In selecting a maturity period for long-term debt, you should structure the debt repayment schedule so that not all of the debt comes due close together. It is best to spread out the payments to avoid possibility that the cash flow will be inadequate to meet the debt payment. Also, if you expect your company's credit rating to improve in the near term, you should issue short-term debt and then refinance later at a lower interest rate. *Note:* A call provision allows the issuer of a bond to redeem the bond (call it in) earlier than the specified maturity date. This provision is an advantage to the issuer but not the investor. It provides the issuer with flexibility if interest rates decline and refinancing becomes appropriate.

Bond prices and market interest rates are inversely related. As market interest rates increase, the price of existing bonds falls because investors can invest in new bonds paying higher interest rates. The price of a bond on the open market depends on several factors such as its maturity value, interest rate, and collateral.

Interest. Bonds are issued in \$1,000 denominations; many have maturities of 10 to 30 years. The interest payment to the bondholder is called *nominal interest*, which is the interest on the face of the bond and which is equal to the coupon (nominal) interest rate times the face value of the bond. Although the interest rate is stated on an annual basis, interest on a bond is usually paid semiannually. Interest expense incurred by the issuer is tax deductible .

COST OF CAPITAL

The cost of capital is defined as the rate of return that is necessary to maintain the market value of the firm (or price of the firm's stock). Financial managers must know the cost of capital (the minimum required rate of return) in (1) making capital budgeting decisions, (2) helping to establish the optimal capital structure, and (3) making decisions such as leasing, bond refunding, and working capital management. The cost of capital is used either as a discount rate under the NPV method or as a hurdle rate under the IRR method in Chapter 3. The cost of capital is computed as a weighted average of the various capital components, which are items on the right-hand side of the balance sheet such as debt, preferred stock, common stock, and retained earnings.

COMPUTING INDIVIDUAL COSTS OF CAPITAL

Each element of capital has a component cost that is identified by the following:

$$k_i = \text{before-tax cost of debt}$$

$$k_d = k_i (1-t) = \text{after-tax cost of debt, where } t = \text{tax rate}$$

k_p	=	cost of preferred stock
k_s	=	cost of retained earnings (or internal equity)
k_e	=	cost of external equity, or cost of issuing new common stock
k_o	=	firm's overall cost of capital, or a weighted average cost of capital

COST OF DEBT

The before-tax cost of debt can be found by determining the internal rate of return (or yield to maturity) on the bond cash flows.

However, the following short-cut formula may be used for approximating the yield to maturity on a bond:

$$k_i = \frac{I + (M - V) / n}{(M + V) / 2}$$

where

I	=	annual interest payments in dollars
M	=	par or face value, usually \$1,000 per bond
V	=	market value or net proceeds from the sale of a bond
n	=	term of the bond n years

Since the interest payments are tax-deductible, the cost of debt must be stated on an after-tax basis.

The after-tax cost of debt is:

$$k_d = k_i (1 - t)$$

where t is the tax rate.

EXAMPLE 11.3

Assume that the Carter Company issues a \$1,000, 8%, 20-year bond whose net proceeds are \$940. The tax rate is 40%. Then, the before-tax cost of debt, k_i , is:

$$\begin{aligned} k_i &= \frac{I + (M - V) / n}{(M + V) / 2} \\ &= \frac{\$80 + (\$1,000 - \$940) / 20}{(\$1,000 + \$940) / 2} = \frac{\$83}{\$970} = 8.56\% \end{aligned}$$

Therefore, the after-tax cost of debt is:

$$\begin{aligned} k_d &= k_i (1 - t) \\ &= 8.56\% (1 - 0.4) = 5.14\% \end{aligned}$$

COST OF PREFERRED STOCK

The cost of preferred stock, k_p , is found by dividing the annual preferred stock dividend, d_p , by the net proceeds from the sale of the preferred stock, p , as follows:

$$k_p = \frac{d_p}{p}$$

Since preferred stock dividends are not a tax-deductible expense, these dividends are paid out after taxes. Consequently, no tax adjustment is required.

EXAMPLE 11.4

Suppose that the Carter company has preferred stock that pays a \$13 dividend per share and sells for \$100 per share in the market. The flotation (or underwriting) cost is 3 percent, or \$3 per share. Then the cost of preferred stock is:

$$\begin{aligned} k_p &= \frac{d_p}{p} \\ &= \frac{\$13}{\$97} = 13.4\% \end{aligned}$$

COST OF EQUITY CAPITAL

The cost of common stock, k_e , is generally viewed as the rate of return investors require on a firm's common stock. Two techniques for measuring the cost of common stock equity capital are widely used:

- (1) the Gordon's growth model and
- (2) the *capital asset pricing model* (CAPM) approach.

The Gordon's Growth Model. The Gordon's model is:

$$P_0 = \frac{D_1}{r - g}$$

where

P_0	=	value (or market price) of common stock
D_1	=	dividend to be received in 1 year
r	=	Investor's required rate of return
g	=	rate of growth (assumed to be constant over time)

Solving the model for r results in the formula for the cost of common stock:

$$r = \frac{D_1}{P_0} + g \quad \text{or} \quad k_e = \frac{D_1}{P_0} + g$$

Note that the symbol r is changed to k_e to show that it is used for the computation of cost of capital.

EXAMPLE 11.5

Assume that the market price of the Carter Company's stock is \$40. The dividend to be paid at the end of the coming year is \$4 per share and is expected to grow at a constant annual rate of 6 percent. Then the cost of this common stock is:

$$k_e = \frac{D_1}{P_0} + g = \frac{\$4}{\$40} + 6\% = 16\%$$

The cost of new common stock, or external equity capital, is higher than the cost of existing common stock because of the *flotation costs* involved in selling the new common stock. Flotation costs, sometimes called *issuance costs*, are the total costs of issuing and selling a security that include printing and engraving, legal fees, and accounting fees.

If f is flotation cost in percent, the formula for the cost of new common stock is:

$$k_e = \frac{D_1}{P_0(1-f)} + g$$

EXAMPLE 11.6

Assume the same data as in Example 11.5, except the firm is trying to sell new issues of stock A and its flotation cost is 10 percent.

Then:

$$\begin{aligned} k_e &= \frac{D_1}{P_0(1-f)} + g \\ &= \frac{\$4}{\$40(1-0.1)} + 6\% = \frac{\$4}{\$36} + 6\% = 11.11\% + 6\% = 17.11\% \end{aligned}$$

The Capital Asset Pricing Model (CAPM) Approach. An alternative approach to measuring the cost of common stock is to use the CAPM, which involves the following steps:

1. Estimate the risk-free rate, r_f , generally taken to be the United States Treasury bill rate.
2. Estimate the stock's beta coefficient, b , which is an index of systematic (or nondiversifiable market) risk.
3. Estimate the rate of return on the market portfolio, r_m , such as the Standard & Poor's 500 Stock Composite Index or Dow Jones 30 Industrials.
4. Estimate the required rate of return on the firm's stock, using the CAPM equation:

$$k_e = r_f + b(r_m - r_f)$$

EXAMPLE 11.7

Assuming that r_f is 7 percent, b is 1.5, and r_m is 13 percent, then:

$$k_e = r_f + b(r_m - r_f) = 7\% + 1.5(13\% - 7\%) = 16\%.$$

This 16 percent cost of common stock can be viewed as consisting of a 7 percent risk-free rate plus a 9 percent risk premium, which reflects that the firm's stock price is 1.5 times more volatile than the market portfolio to the factors affecting nondiversifiable, or systematic, risk.

COST OF RETAINED EARNINGS

The cost of retained earnings, k_s , is closely related to the cost of existing common stock, since the cost of equity obtained by retained earnings is the same as the rate of return investors require on the firm's common stock. Therefore,

$$k_e = k_s$$

MEASURING THE OVERALL COST OF CAPITAL

The firm's overall cost of capital is the weighted average of the individual capital costs, with the weights being the proportions of each type of capital used. Let k_o be the overall cost of capital.

$k_o = \Sigma$ (percentage of the total capital structure supplied by each source of capital \times cost of capital for each source)

$$= w_d k_d + w_p k_p + w_e k_e + w_s k_s$$

where

w_d	=	% of total capital supplied by debts
w_p	=	% of total capital supplied by preferred stock
w_e	=	% of total capital supplied by external equity
w_s	=	% of total capital supplied by retained earnings (or internal equity)

The weights can be *historical*, *target*, or *marginal*.

HISTORICAL WEIGHTS

Historical weights are based on a firm's existing capital structure. The use of these weights is based on the assumption that the firm's existing capital structure is optimal and therefore should be maintained in the future. Two types of historical weights can be used - book value weights and market value weights.

Book Value Weights. The use of book value weights in calculating the firm's weighted cost of capital assumes that new financing will be raised using the same method the firm used for its present capital structure. The weights are determined by dividing the book value of each capital component by

the sum of the book values of all the long-term capital sources. The computation of overall cost of capital is illustrated in the following example.

EXAMPLE 11.8

Assume the following capital structure and cost of each source of financing for the Carter Company:

		<u>Cost</u>
Bonds (\$1,000 par)	\$20,000,000	5.14% (from Example 11.3)
Preferred stock (\$100 par)	5,000,000	13.40% (from Example 11.4)
Common stock (\$40 par)	20,000,000	17.11% (from Example 11.6)
Retained earnings	5,000,000	16.00% (from Example 11.6)
Total	<u>\$50,000,000</u>	

<u>Source</u>	<u>Book Value</u>	<u>Weights</u>	<u>Cost</u>	<u>Weighted Cost</u>
Debt	\$20,000,000	40%(a)	5.14%	2.06%(b)
Preferred stock	5,000,000	10	13.40%	1.34
Common stock	20,000,000	40	17.11%	6.84
Retained earnings	5,000,000	10	16.00%	1.60
	<u>\$50,000,000</u>	<u>100%</u>		<u>11.84%</u>

Overall cost of capital = k_o = 11.84%

(a) $\$20,000,000 / \$50,000,000 = .40 = 40\%$

(b) $5.14\% \times 40\% = 2.06\%$

Market Value Weights. Market value weights are determined by dividing the market value of each source by the sum of the market values of all sources. The use of market value weights for computing a firm's weighted average cost of capital is theoretically more appealing than the use of book value weights because the market values of the securities closely approximate the actual dollars to be received from their sale.

EXAMPLE 11.9

In addition to the data from Example 11.8, assume that the security market prices are as follows:

Mortgage bonds	=	\$1,100 per bond
Preferred stock	=	\$90 per share
Common stock	=	\$80 per share

The firm's number of securities in each category is:

$$\text{Mortgage bonds} = \frac{\$20,000,000}{\$1,000} = 20,000$$

$$\text{Preferred stock} = \frac{\$5,000,000}{\$100} = 50,000$$

$$\text{Common stock} = \frac{\$20,000,000}{\$40} = 500,000$$

Therefore, the market value weights are:

<u>Source</u>	<u>Number of Securities</u>	<u>Price</u>	<u>Market Value</u>
Debt	20,000	\$1,100	\$22,000,000
Preferred stock	50,000	\$90	4,500,000
Common stock	500,000	\$80	<u>40,000,000</u>
			<u>\$66,500,000</u>

The \$40 million common stock value must be split in the ratio of 4 to 1 (the \$20 million common stock versus the \$5 million retained earnings in the original capital structure), since the market value of the retained earnings has been impounded into the common stock.

The firm's cost of capital is as follows:

<u>Source</u>	<u>Market Value</u>	<u>Weights</u>	<u>Cost</u>	<u>Weighted Average</u>
Debt	\$22,000,000	33.08%	5.14%	1.70%
Preferred stock	4,500,000	6.77	13.40%	0.91
Common stock	32,000,000	48.12	17.11%	8.23
Retained earnings	<u>8,000,000</u>	<u>12.03</u>	16.00%	<u>1.92</u>
	\$66,500,000	100.00%		<u>12.76%</u>

$$\text{Overall cost of capital} = k_o = 12.76\%$$

CONCLUSION

Cost of capital is an important concept within financial management. It is the rate of return that must be achieved in order for the price of the stock to remain unchanged. Therefore, the cost of capital is the minimum acceptable rate of return for the company's new investments. The chapter discussed how to calculate the individual costs of financing sources, various ways to calculate the overall cost of capital, and how the optimal budget for capital spending can be constructed. Financial officers should be thoroughly familiar with the ways to compute the costs of various sources of financing for financial, capital budgeting, and capital structure decisions.

CHAPTER 12

ANALYZING MERGERS AND ACQUISITIONS

LEARNING OBJECTIVES

After studying the material in this chapter, you will be able to:

1. Define and explain mergers.
2. Decide on acquisition terms.
3. Describe how to acquire another business.
4. Identify the impact of merger on earnings per share and market price per share.
5. Identify risk factors.
6. Describe uses of a holding company.

External growth occurs when a business purchases the existing assets of another entity through a merger. You are often required to appraise the suitability of a potential merger as well as participate in merger negotiations. Besides the growth aspect, a merger may enable the reduction of corporate risk through diversification. The three common ways of joining two or more companies are a merger, consolidation, or a holding company.

In a *merger*, two or more companies are combined into one, where only the acquiring company retains its identity. Generally, the larger of the two companies is the acquiring company.

With a *consolidation*, two or more companies combine to create a new company. None of the consolidation firms legally survive. For example, companies A and B give all their assets, liabilities, and stock to the new company, C, in return for C's stock, bonds, or cash.

A *holding* company owns sufficient shares of common stock to possess voting control of one or more other companies. The holding company comprises a group of businesses, each operating as a separate entity. By possessing more than 50 percent of the voting rights through common stock, the holding company has effective control of another company with a smaller percent of ownership, such as 25 percent. The holding company is referred to as the *parent*, and each company controlled is termed a *subsidiary*.

Depending on the intent of the combination, there are three common ways in which businesses get together so as to obtain advantages in their market. They are

- *Vertical merger*. This occurs when a company combines with a supplier or customer. An example is when a wholesaler combines with retailers.
- *Horizontal merger*. This occurs when two companies in a similar business combine. An example is the combining of two airlines.

- *Conglomerate merger.* This occurs when two companies in unrelated industries combine, such as where an electronics company joins with an insurance company.

MERGERS

A merger of two companies may be achieved in one of two ways. The acquirer may negotiate with the management of the prospective acquired company, which is the preferred approach. If negotiations are not successful, the acquirer may make a tender offer directly to the stockholders of the targeted company. A *tender offer* represents a cash offer for the common shares held by stockholders. The offer is made at a premium above the current market price of the stock. In some cases, the tender may be shares in the acquiring company rather than cash. Usually an expiration date exists for the tender.

Note:

1. A good takeover candidate includes a cash-rich business, a company with a low debt-to-equity ratio, and a company with significant growth potential.
2. In a two-tier offer, better terms are offered to shareholders who sell early. For example, early sellers may receive cash and late sellers, bonds.
3. Leverage buyout (LBO) is used as a defensive tactic against a hostile takeover by tender offer. A leveraged buyout (LBO) entails the company going private. A small group of investors, usually including senior management purchases the publicly owned shares. The shares will then be delisted because they will no longer be traded. Thus, an LBO competes with a hostile tender offer as alternative.

In negotiating with management, the acquiring company usually makes a stock offer based on a specified exchange ratio. The merger may occur if the acquired company receives an offer at an acceptable premium over the current market price of stock. Sometimes contingent payments are also given, such as stock warrants.

There are various financing packages that buyers may use for mergers, such as common stock, preferred stock, convertible bonds, debt, cash, and warrants. A key consideration in choosing the final package is its effect on current earnings per share (EPS).

If common stock is exchanged, the seller's stock is given in exchange for the buyer's stock, resulting in a tax-free exchange. The drawback is that the stock issuance reduces earnings per share because the buyer's outstanding shares are increased. When an exchange of cash for common *stock occurs*, the selling company's stockholders receive cash, resulting in a taxable transaction. This type of exchange may increase earnings per share since the buying company is obtaining new earnings without increasing outstanding shares.

There are many reasons why a business might prefer external growth through mergers instead of internal growth.

Advantages of a Merger

- Aids in diversification, such as reducing cyclical and operational effects.
- Achieves a synergistic effect, which means that the results of a combination are greater than the sum of the parts. For example, greater profit may be derived from the combined entity than would occur from each individual company because of increased efficiency and cost savings. A greater probability of synergy exists with a horizontal merger because of the elimination of duplicate facilities.
- Provides a missed attribute; that is, a company gains something it lacked. For example, superior management quality or research capability may be obtained.
- Aids in the company's ability to raise funds when it combines with another possessing highly liquid assets and low debt.
- Enhances the market price of stock in certain cases, resulting in a higher P—E ratio for the stock. For instance, the stock of a larger company may be perceived to be more marketable, stable, and secure.
- Aids the company in financing an acquisition that would not otherwise be possible to obtain, such as where acquiring a company by exchanging stock is less costly than constructing new capital facilities, which would require a substantial outlay of cash. For example, a company may be unable to finance significant internal expansion but can accomplish it by buying a business already having such capital facilities.
- Generates a good return on investment when the market value of the acquired company is materially less than its replacement cost.
- Obtains a tax loss carry-forward benefit if the acquired company has been operating at a net loss. The acquirer may utilize the tax loss carry-forward benefit to offset its own profitability, thus lowering its taxes. The tax loss may be carried forward 15 years to reduce the acquiring company's future earnings. In essence, the government is financing part of the acquisition.

EXAMPLE 12.1

Harris Company is evaluating whether to buy Stone Company. Stone has a tax loss of \$500,000. The company expects pretax earnings of \$400,000 and \$300,000 for the next two years. The tax rate is 46 percent.

The taxes to be paid by Harris follow.

Year 1	\$400,000 - \$400,000	=	0	
Year 2	\$300,000 - \$100,000	=	\$200,000 x 46%	= \$92,000

Disadvantages of a Merger

- Adverse financial effects because expected benefits were not forthcoming. For example, anticipated cost reductions did not occur.
- Problems are caused by dissenting minority stockholders.
- Government antitrust action delays or prevents the proposed merger.

Note: A proxy fight is an attempt by dissident shareholders to gain control of the corporation, or at least gain influence, by electing directors. A proxy is a power of attorney given by a shareholder that authorizes the holder to exercise the voting rights of the shareholder. The proxy is limited in its duration, usually for a specific occasion like the annual shareholders' meeting. The issuer of a proxy statement must file a copy with SEC ten days prior to mailing it to shareholders all material information concerning the issues. A form that indicates the shareholder's agreement or disagreement must be provided. Also, if the purpose is for voting for directors, proxies must be accompanied by an annual report.

Appraisal of a potential merger must consider its effect on the financial performance of the company, including:

- *Earnings per share.* The merger should result in higher earnings or improve its stability.
- *Dividends per share.* The dividends before and after the merger should be maintained to stabilize the market price of stock.
- *Market price per share.* The market price of the stock should be higher or at least the same after the merger.
- *Risk.* The merged business should have less financial and operating risk than before.

DECIDING ON ACQUISITION TERMS

When determining acquisition terms, you should consider the following:

- Earnings in terms of absolute dollars and percentage change
- Dividends
- Market price of stock
- Book value per share
- Net working capital per share

The weight of each of the aforementioned elements on a merger varies depending upon the circumstances involved.

Earnings

In determining the value of earnings in a merger, you should consider expected future earnings and projected P-E ratio. A rapidly growing company is anticipated to have a higher P-E multiple.

Dividends

Dividend receipts are desirable to stockholders. However, the more a company's growth rate and earnings, the less is the impact of dividends on market price of stock. On the other hand, if earnings are dropping, the greater is the effect of dividends on per share price.

Market Price of Stock

The price of a security considers projected earnings and dividends. The value assigned to the company in the acquisition will most likely be greater than the present market price in the

following cases:

- The business is in a depressed industry.
- The acquired company is of greater value to the acquirer (e.g., has high-quality management, aids diversification) than to the stock market in general.
- A higher market price than the current one is offered to induce existing stockholders to give up their shares.

Book Value per Share

Since book value is based on historical cost rather than current value, it is not an important factor to consider. However, when book value is greater than market value, there may be an expectation that market price will go up after the merger because of improved circumstances (e.g., superior management).

Net Working Capital per Share

If the acquired business has a very low debt position or very liquid assets, the acquirer may borrow the funds for the acquisition by using the acquired company's strong liquidity position.

Factors to Consider in Determining the Price to Be Paid for a Business

- Financial analysis of the acquired company, such as the quality of earnings and growth rate.
- Future expected rate of return on assets and sales along with the probability of achieving those expected returns.
- Tax effects, such as unused tax credits.
- Management quality, such as experienced and dynamic management.
- Marketing position, such as favorable marketing image and market share.
- Degree of competition.
- Employee relations, such as the absence of unionization.
- Political environment, such as the absence of stringent governmental regulation and operations in politically unstable areas.
- Risk level, such as having sufficient insurance coverage for assets.
- Economic environment, including recession-resistant business.
- Corporate characteristics, including having negatively correlated product lines.
- Industry characteristics, such as being in a growing industry rather than a declining one.
- Structure of the arrangement, making it taxable or nontaxable.
- Effect of the acquisition on the acquiring company's financial strength and operating performance (e.g., liquidity, solvency).
- Enhancement of integration and/or diversification.
- Legal implications, such as the likelihood of stockholder liability *suits*.
- Possible attack for antitrust violation.

Be Careful: Detailed financial planning and analysis are required in the acquisition process.

ACQUISITION OF ANOTHER BUSINESS

Should stock or assets be given in the acquisition?

Advantages of Giving Stock

- Quick.
- Simple in terms of document preparation. There is a transfer of stock certificates in exchange for immediate or deferred payment.
- Typically, stockholder votes authorizing the purchase or sale are not required.
- Minority stockholders may not have appraisal rights.

Disadvantages of Giving Stock

- The acquirer in buying stock of the target company assumes its liabilities, whether disclosed or not.
- If the target is liquidated after acquisition, much work is required in conveying the target company's assets as part of the liquidation.

Advantages of Giving Assets

- Acquirer has full control over the assets it buys and the liabilities it assumes.
- Typically, no acquiring company stockholder vote is needed.

Disadvantages of Giving Assets

- Difficult to determine the fair value of each asset.
- Target company's stockholders must approve.
- State transfer taxes must be paid.
- Creditor agreement may be required for certain transfers and assignments.
- Must conform to bulk sales laws.

In evaluating whether to buy another business, capital budgeting techniques may be used. Also, the effect of the new capital structure on the entity's overall cost of capital has to be projected.

EXAMPLE 12.2

Weiss Corporation is considering buying Poczter Corporation for \$95,000. Weiss' current cost of capital is 12 percent. Poczter's estimated overall cost of capital after the acquisition is 10 percent. Projected cash inflows from years one through eight are \$13,000.

The net present value is:

<i>Year</i>	<i>Present Value</i>
0(-\$95,000 x 1)	-\$95,000
1-8 (13,000 x 5.334926)	<u>+ 69,354*</u>
Net present value	<u>-\$25,646</u>

*Using 10 percent as the discount rate.

The acquisition is not feasible because of the negative net present value.

EXAMPLE 12.3

Charles Company desires to purchase certain fixed assets of Blake Company. However, the latter wants to sell out its business. The balance sheet of Blake Company follows.

<i>Assets</i>	
Cash	\$4,000
Accounts receivable	8,000
Inventory	10,000
Equipment 1	16,000
Equipment 2	28,000
Equipment 3	42,000
Building	<u>110,000</u>
Total assets	<u>\$218,000</u>

<i>Liabilities and Stockholders' Equity</i>	
Total liabilities	\$80,000
Total equity	<u>138,000</u>
Total liabilities and equity	<u>\$218,000</u>

Charles wants only equipment 1 and 2 and the building. The other assets, excluding cash, can be sold for \$24,000. The total cash received is thus \$28,000 (\$24,000 + \$4,000 initial cash balance). Blake desires \$50,000 for the entire business. Charles will therefore have to pay a total of \$130,000, which is \$80,000 in total liabilities and \$50,000 for its owners. The actual net cash outlay is therefore \$102,000 (\$130,000 - \$28,000). It is anticipated that the after-tax cash inflows from the new equipment will be \$27,000 per year for the next five years. The cost of capital is 8 percent.

The net present value of the acquisition is

<i>Year</i>	<i>Present Value</i>
0(-\$102,000 x 1)	-\$102,000
1-5 (27,000 x 3.992710)	<u>107,803</u>
Net present value	<u>\$ 5,803</u>

The positive net present value indicates that the acquisition should take place.

A company may be bought by exchanging stock in accord with a predetermined ratio. The acquirer typically offers more for each share of the acquired company than the current market price of stock. The *exchange ratio* equals

$$\frac{\text{Amount paid per share of the acquired company}}{\text{Market price of the acquiring company's shares}}$$

EXAMPLE 12.4

Travis Company buys Boston Company. Travis Company's stock sells for \$75 per share while Boston's stock sells for \$45. According to the merger negotiations, Travis offers \$50 per share. The exchange ratio is 0.667 (\$50/\$75).

Travis exchanges 0.667 shares of its stock for one share of Boston.

**IMPACT OF MERGER ON EARNINGS PER SHARE
AND MARKET PRICE PER SHARE**

A merger can have a positive or negative effect on net income and market price per share of common stock.

EXAMPLE 12.5

The following information applies:

	<i>Company A</i>	<i>Company B</i>
Net income	\$50,000	\$84,000
Outstanding shares	5,000	12,000
EPS	\$10	\$7
P-E ratio	7	10
Market price	\$70	\$70

Company B acquires Company A and exchanges its shares for A's shares on a one-for-one basis. The effect on EPS follows.

	<i>B Shares Owned After Merger</i>	<i>EPS Before Merger</i>	<i>EPS After Merger</i>
A stockholders	5,000	\$10	\$7.88*
B stockholders	<u>12,000</u>	\$ 7	\$7.88*
Total	<u>17,000</u>		

*Total net income is determined as:

$$\begin{array}{r}
 5,000 \text{ shares} \times \$10 \quad \$50,000 \\
 12,000 \text{ shares} \times \$7 \quad \underline{84,000} \\
 \hline
 \$134,000
 \end{array}$$

$$= \frac{\text{Net income}}{\text{Total shares}} = \frac{\$134,000}{17,000} = \underline{7.88} \text{ (rounded)}$$

EPS goes down by \$2.12 for A stockholders and up by \$0.88 for B stockholders.

The effect on market price is not clear. Assuming the combined entity has the same P-E ratio as Company B, the market price per share will be \$78.80 (10 x \$7.88). The stockholders experience

a higher market value per share. The increased market value arises because net income of the combined entity is valued at a P-E ratio of 10, the same as Company B, while prior to the merger, Company A had a lower P-E multiple of 7. But if the combined entity is valued at Company A's multiplier of 7, the market value would be \$55.16 (7 x \$7.88). In this case, the stockholders in each firm experience a reduction in market value of \$14.84 (\$70.00 -- \$55.16).

Because the impact of the merger on market value per share is not clear, the key consideration is EPS.

EXAMPLE 12.6

The following situation exists:

$$\begin{aligned} \text{Market price per share of acquiring company} &= \$100 \\ \text{Market price per share of acquired company} &= \$20 \\ \\ \text{Price per share offered} &= \$24 \end{aligned}$$

The exchange ratio equals

$$\begin{aligned} \text{Shares} & \$24/\$100 = 0.24 \\ \text{Market price} & \$24/\$20 = 1.20 \end{aligned}$$

EXAMPLE 12.7

Mart Company wants to buy James Company by issuing its shares. Relevant data follow.

	<i>Mart</i>	<i>James</i>
Net income	\$40,000	\$26,000
Outstanding shares	20,000	8,000

The exchange ratio is 2 to 1. The EPS based on the original shares of each company follows.

$$\begin{aligned} \text{EPS of combined entity} &= \frac{\text{Combined net income}}{\text{Total Shares}} \\ &= \frac{\$66,000}{20,000 + (8,000 \times 2)} = \frac{\$66,000}{36,000 \text{ shares}} \\ &= \$1.83 \text{ (rounded)} \\ \\ \text{EPS of Mart} &= \$1.83 \\ \\ \text{EPS of James} &= \$1.83 \times 2 = \$3.66 \end{aligned}$$

EXAMPLE 12.8

O'Connor Corporation wants to buy Phil Corporation by exchanging 1.8 shares of its stock for

each share of Phil. O'Connor expects to have the same P-E ratio subsequent to the merger as prior to it. Applicable data follow.

	<i>O'Connor</i>	<i>Phil</i>
Net income	\$500,000	\$150,000
Shares	225,000	30,000
Market price per share	\$60	\$5

The exchange ratio of market price equals

$$\frac{\text{Offer price}}{\text{Market price of Phil}} = \frac{\$50 \times 1.8}{\$60} = \frac{\$90}{\$60} = 1.5$$

EPS and P-E ratios for each company are

	<i>O'Connor</i>	<i>Phil</i>		
EPS	\$500,000/225,000 = \$2.22 (rounded)	\$150,000/30,000	=	\$5
P-E ratio	\$50/\$2.22 = 22.5 (rounded)	\$60/\$5	=	12

The P-E ratio used in obtaining Phil is

$$\frac{1.8 \times \$50}{\$5} = \frac{\$90}{\$5} = 18 \text{ times}$$

The EPS of O'Connor subsequent to the acquisition is

$$\frac{\$650,000}{225,000 + (30,000 \times 1.8)} = \frac{\$650,000}{279,000} = 2.33 \text{ (rounded)}$$

The expected market price per share of the combined entity is \$2.33 x 22.5 times = \$52.43 (rounded)

RISK

In evaluating the risk associated with an acquisition, a *scenario analysis* may be used, looking at best case, worst case, and most likely case. Operating scenarios consider assumptions as to variables, including sales, volume, cost, competitive reaction, customer perception, and government interference. You derive the probability for each scenario on the basis of experience. *Sensitivity analysis* may also be used to indicate how sensitive the project's returns are to variances from expected values of essential variables. For instance, you may undertake a sensitivity analysis on selling prices assuming they are, for example, 8 or 12 percent higher or lower than expected. The theory behind sensitivity analysis is to adjust key variables from their expected values in the most likely case. The analysis can be performed assuming one purchase price or all possible purchase prices. What is the impact, for example, of a 2 percent change in the gross profit rate on projected returns?

What price should you pay for a target company? You should pay an amount resulting in a cutoff return given the most likely operating scenario.

Warning: It is difficult to accomplish successful unrelated diversification. Examples are General Electric's acquisition of Utah International and RCA's acquisition of CIP. Both firms have divested their acquisitions. *Recommendation:* Acquisition of companies operating in related fields usually have a higher success rate.

HOLDING COMPANY

A holding company is one whose only purpose is owning the stock of other businesses. To obtain voting control of a business, the holding company may make a direct market purchase or a tender offer. A company may decide to become a holding company if its basic business is in a state of decline and it decides to liquidate its assets and uses the funds to invest in companies with high growth potential.

Because the operating companies owned by the holding company are separate legal entities, the obligations of one are isolated from the others. If one goes bankrupt, no claim exists on the assets of the other companies. *Recommendation:* A loan officer lending to one company should attempt to obtain a guarantee by the other companies.

Advantages of a Holding Company

- Ability to obtain a significant amount of assets with a small investment. In essence, the holding company can control more assets than it could acquire through a merger.
- Risk protection, in that the failure of one company does not result in the failure of another or of the holding company. If the owned company fails, the loss of the holding company is limited to its investment in it.
- Ease of obtaining control of another company; all that is involved is buying sufficient stock in the marketplace. Unlike a merger, in which stockholder or management approval is required, no approval is necessary for a holding company.
- Ability to obtain a significant amount of control with a small investment by getting voting control in a company for a minimal amount and then using that firm to gain voting control in another, and so on.

Disadvantages of a Holding Company

- Multiple tax because the income the holding company receives is in the form of cash. Prior to paying dividends, the subsidiary must pay taxes on the earnings. When profit is distributed to the holding company as dividends, it must pay tax on the dividends received less an 80 percent dividend exclusion. But if the holding company owns 80 percent or more of the subsidiary's shares, a 100 percent dividend exemption exists. No multiple tax exists for a subsidiary that is part of a merged company.
- More costly to administer than a single company emanating from a merger because economies of scale are not achieved.
- Possibility that the U.S. Department of Justice will deem the holding company a near

monopoly and require dissolution of some of the owned companies.

- Incurrence of increased debt because the acquisition may magnify variability in earnings, thus subjecting the holding company to greater risk.

EXAMPLE 12.9

A holding company owns 70 percent of another firm. Dividends received are \$20,000. The tax rate is 46 percent. The tax paid on the dividends follows.

Dividend	\$20,000
Dividend exclusion (80%)	<u>16,000</u>
Dividend subject to tax	\$ 4,000
Tax rate	<u>x 46%</u>
Tax	<u>\$ 1,840</u>

The effective tax rate is 9.2% (\$1,840/ \$20,000).

CONCLUSION

In analyzing a potential merger and acquisition, many considerations must be taken into account, such as the market price of stock, earnings per share, dividends, book value of assets, risk, and tax considerations. A detailed evaluation of the target company is necessary to ensure that the price paid is realistic given the particular circumstances.

CHAPTER 13

FORECASTING AND FINANCIAL PLANNING

LEARNING OBJECTIVES

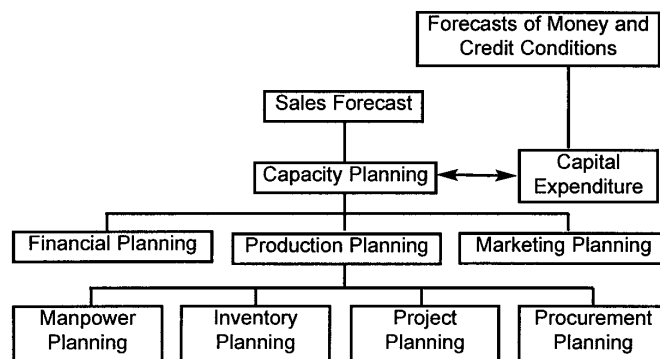
After studying the material in this chapter, you will be able to:

1. Explain who uses forecasts.
2. List and describe each of forecasting methods.
3. Select a forecasting method.
4. Define the qualitative approach.
5. Describe common features and assumptions inherent in forecasting.
6. Illustrate the steps in the forecasting process.

Financial management in both private and public organizations typically operate under conditions of uncertainty or risk. Probably the most important function of business is *forecasting*. A forecast is a starting point for planning. The objective of forecasting is to reduce risk in decision making. In business, forecasts are the basis for capacity planning, production and inventory planning, manpower planning, planning for sales and market share, financial planning and budgeting, planning for research and development and top management's strategic planning. Sales forecasts are especially crucial aspects of many financial management activities, including budgets, profit planning, capital expenditure analysis, and acquisition and merger analysis.

Figure 13.1 illustrates how sales forecasts relate to various managerial functions of business.

FIGURE 13.1
SALE FORECASTS AND MANAGERIAL FUNCTIONS



WHO USES FORECASTS?

Forecasts are needed for marketing, production, purchasing, manpower, and financial planning. Further, top management needs forecasts for planning and implementing long-term strategic objectives and planning for capital expenditures. More specifically, marketing managers use sales forecasts to determine 1) optimal sales force allocations, 2) set sales goals, and 3) plan promotions and advertising. Other things such as market share, prices, and trends in new product development are required.

Production planners need forecasts in order to:

- .Schedule production activities
- .Order materials
- .Establish inventory levels
- .Plan shipments

Some other areas which need forecasts include material requirements (purchasing and procurement), labor scheduling, equipment purchases, maintenance requirements, and plant capacity planning.

As shown in Figure 13.1, as soon as the company makes sure that it has enough capacity, the production plan is developed. If the company does not have enough capacity, it will require planning and budgeting decisions for capital spending for capacity expansion.

On this basis, the financial manager must estimate the future cash inflow and outflow. He must plan cash and borrowing needs for the company's future operations. Forecasts of cash flows and the rates of expenses and revenues are needed to maintain corporate liquidity and operating efficiency. In planning for capital investments, predictions about future economic activity are required so that returns or cash inflows accruing from the investment may be estimated.

Forecasts must also be made of money and credit conditions and interest rates so that the cash needs of the firm may be met at the lowest possible cost. The finance and accounting functions must also forecast interest rates to support the acquisition of new capital, the collection of accounts receivable to help in planning working capital needs, and capital equipment expenditure rates to help balance the flow of funds in the organization. Sound predictions of foreign exchange rates are increasingly important to financial managers of multinational companies (MNCs).

Long-term forecasts are needed for the planning of changes in the company's capital structure. Decisions as to whether to issue stock or debt in order to maintain the desired financial structure of the firm require forecasts of money and credit conditions.

The personnel department requires a number of forecasts in planning for human resources in the business. Workers must be hired and trained, and for these personnel there must be benefits provided that are competitive with those available in the firm's labor market. Also, trends that

affect such variables as labor turnover, retirement age, absenteeism, and tardiness need to be forecast as input for planning and decision making in this function.

Managers of nonprofit institutions and public administrators must also make forecasts. Hospital administrators face the problem of forecasting the health care needs of the community. In order to do this efficiently, a projection has to be made of:

- .The growth in absolute size of population
- .The changes in the number of people in various age groupings
- .The varying medical needs these different age groups will have.

Universities forecast student enrollments, cost of operations, and in many cases, what level of funds will be provided by tuition and by government appropriations.

The service sector which today account for 2/3 of the U.S. gross domestic product (GDP), including banks, insurance companies, restaurants, and cruiseships, need various projections for their operational and long-term strategic planning. Take a bank, for example. The bank has to forecast:

- .Demands of various loans and deposits
- .Money and credit conditions so that it can determine the cost of money it lends

FORECASTING METHODS

There is a wide range of forecasting techniques which the company may choose from. There are basically two approaches to forecasting: qualitative and quantitative. They are as follows:

1. Qualitative approach - forecasts based on judgment and opinion.
 - .Executive opinions
 - .Delphi technique
 - .Sales force polling
 - .Consumer surveys
 - .Techniques for eliciting experts' opinions - PERT derived
2. Quantitative approach
 - a) Forecasts based on historical data
 - .Naive methods
 - .Moving averages
 - .Exponential smoothing
 - .Trend analysis
 - .Decomposition of time series
 - .Box-Jenkins
 - b) Associative (Causal) forecasts
 - .Simple regression
 - .Multiple regression
 - .Econometric modeling
 - c) Forecasts based on consumer behavior - Markov approach

- d) Indirect methods
 - .Market surveys
 - .Input-output analysis
 - .Economic indicators

Figure 13.2 summarizes the forecasting methods.

Quantitative models work superbly as long as little or no systematic change in the environment takes place. When patterns or relationships do change, by themselves, the objective models are of little use. It is here where the qualitative approach based on human judgment is indispensable. Because judgmental forecasting also bases forecasts on observation of existing trends, they too are subject to a number of shortcomings. The advantage, however, is that they can identify systematic change more quickly and interpret better the effect of such change on the future. We will discuss the qualitative method here in this chapter, while various quantitative methods along with their illustrations will be taken up in subsequent chapters.

SELECTION OF FORECASTING METHOD

The choice of a forecasting technique is significantly influenced by the stage of the product life cycle, and sometimes by the firm or industry for which a decision is being made.

In the beginning of the product life cycle, relatively small expenditures are made for research and market investigation. During the first phase of product introduction, these expenditures start to increase. In the rapid growth stage, considerable amounts of money are involved in the decisions; therefore a high level of accuracy is desirable. After the product has entered the maturity stage, the decisions are more routine, involving marketing and manufacturing. These are important considerations when determining the appropriate sales forecast technique.

After evaluating the particular stages of the product, and firm and industry life cycles, a further probe is necessary. Instead of selecting a forecasting technique by using whatever seems applicable, decision makers should determine what is appropriate. Some of the techniques are quite simple and rather inexpensive to develop and use, whereas others are extremely complex, require significant amounts of time to develop, and may be quite expensive. Some are best suited for short-term projections, whereas others are better prepared for intermediate- or long-term forecasts.

What technique or techniques to select depends on the following criteria:

1. What is the cost associated with developing the forecasting model compared with potential gains resulting from its use? The choice is one of benefit-cost trade-off.
2. How complicated are the relationships that are being forecasted?
3. Is it for short-run or long-run purposes?
4. How much accuracy is desired?
5. Is there a minimum tolerance level of errors?
6. How much data are available? Techniques vary in the amount of data they require.

THE QUALITATIVE APPROACH

The qualitative (or judgmental) approach can be useful in formulating short-term forecasts and also can supplement the projections based on the use of any of the qualitative methods. Four of the better known qualitative forecasting methods are Executive Opinions, the Delphi Method, Sales Force Polling, and Consumer Surveys.

EXECUTIVE OPINIONS

The subjective views of executives or experts from sales, production, finance, purchasing and administration are averaged to generate a forecast about future sales. Usually this method is used in conjunction with some quantitative method such as trend extrapolation. The management team modifies the resulting forecast based on their expectations.

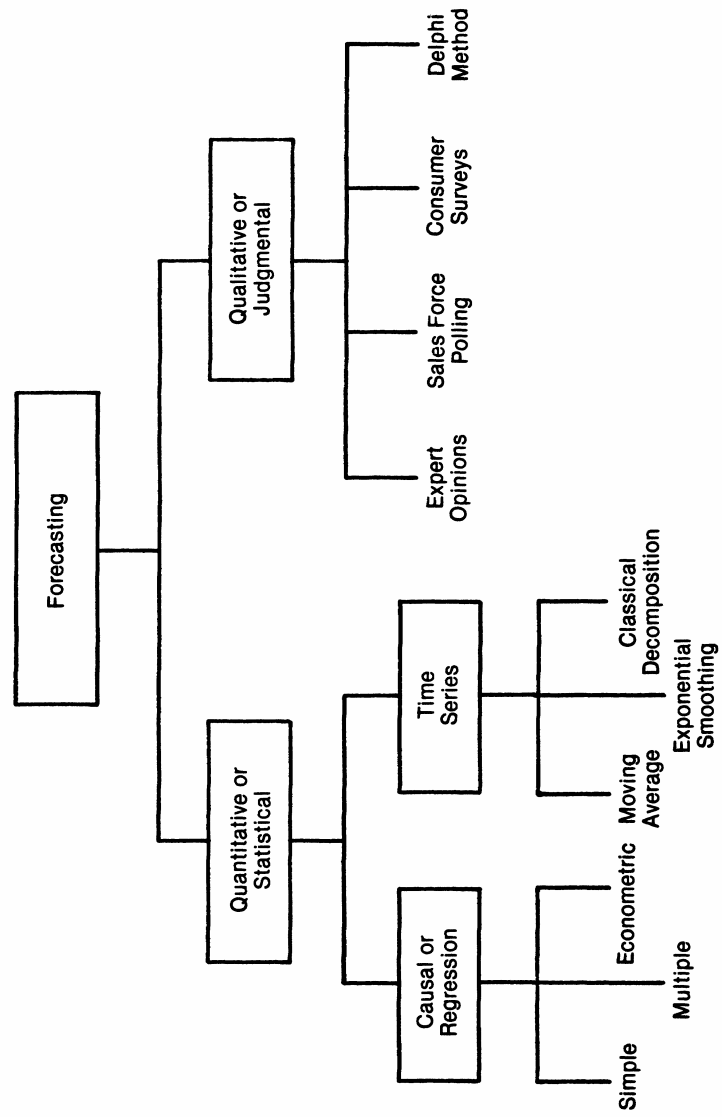
The advantage of this approach is that the forecasting is done quickly and easily, without need of elaborate statistics. Also, the jury of executive opinions may be the only feasible means of forecasting in the absence of adequate data. The disadvantage, however, is that of "group think." This is a set of problems inherent to those who meet as a group. Foremost among these problems are high cohesiveness, strong leadership, and insulation of the group. With high cohesiveness, the group becomes increasingly conforming through group pressure which helps stifle dissension and critical thought. Strong leadership fosters group pressure for unanimous opinion. Insulation of the group tends to separate the group from outside opinions, if given.

THE DELPHI METHOD

It is a group technique in which a panel of experts are individually questioned about their perceptions of future events. The experts do not meet as a group in order to reduce the possibility that consensus is reached because of dominant personality factors. Instead, the forecasts and accompanying arguments are summarized by an outside party and returned to the experts along with further questions. This continues until a consensus is reached by the group, especially after only a few rounds. This type of method is useful and quite effective for long-range forecasting.

The technique is done by "questionnaire" format and thus it eliminates the disadvantages of group think. There is no committee or debate. The experts are not influenced by peer pressure to forecast a certain way, as the answer is not intended to be reached by consensus or unanimity. Low reliability is cited as the main disadvantage of the Delphi Method, as well as lack of consensus from the returns. Table 13.1 shows how effective this method can be.

FIGURE 13.2
Forecasting Methods



SALES-FORCE POLLING

Some companies use as a forecast source sales people who have continual contacts with customers. They believe that the sales force that are closest to the ultimate customers may have significant insights regarding the state of the future market. Forecasts based on sales-force polling may be averaged to develop a future forecast. Or they may be used to modify other quantitative and/or qualitative forecasts that have been generated internally in the company. The advantages to this way of forecast are that (1) it is simple to use and understand, (2) it uses the specialized knowledge of those closest to the action, (3) it can place responsibility for attaining the forecast in the hands of those who most affect the actual results, and (4) the information can be easily broken down by territory, product, customer or salesperson.

The disadvantages include salespeople being overly optimistic or pessimistic regarding their predictions, and inaccuracies due to broader economic events that are largely beyond their control.

TABLE 13.1
AN EXAMPLE OF THE USE OF THE DELPHI METHOD

1	2	3	4	5
Population (in millions)	Midpoint	Number of Panelists	Probability Distribution of Panelists	Weighted Average (2 × 4)
30 and above	—	0	0.00	0
20–30	25	1	0.05	1.25
15–19	17	2	0.10	1.70
10–14	12	2	0.10	1.20
5–9	7	7	0.35	2.45
2–4	3	8	0.40	1.20
Less than 2	1	0	0.00	0
Total		20	1.00	7.80
Case example: "In 1982, a panel of 20 representatives, with college educations, from different parts of the U.S.A., were asked to estimate the population of Bombay, India. None of the panelists had been to India since World War I. "The population was estimated to be 7.8 million, which is very close to the actual population." Source: Singhvi, Surendra. "Financial Forecast: Why and How?" <i>Managerial Planning</i> . March–April 1984.				

CONSUMER SURVEYS

Some companies conduct their own market surveys regarding specific consumer purchases. Surveys may consist of telephone contacts, personal interviews, or questionnaires as a means of obtaining data. Extensive statistical analysis is usually applied to survey results in order to test hypotheses regarding consumer behavior.

PERT-DERIVED FORECASTS

A technique known as PERT (Program Evaluation and Review Technique) has been useful in producing estimates based on subjective opinions such as executive opinions or sales force

polling. The PERT methodology requires that the expert provide three estimates: (1) pessimistic (a), (2) the most likely (m), and (3) optimistic (b). The theory suggests that these estimates combine to form an expected value, or forecast, as follows:

$$EV = (a + 4m + b)/6$$

with a standard deviation of

$$\sigma = (b - a)/6$$

where EV = expected value (mean) of the forecast

σ = standard deviation of the forecast

For example, suppose that management of a company believes that if the economy is in recession, the next year's sales will be \$300,000 and if the economy is in prosperity \$330,000. Their most likely estimate is \$310,000. The PERT method generates an expected value of sales as follows:

$$EV = (\$300,000 + 4(\$310,000) + \$330,000)/6 = \$311,667$$

with a standard deviation of

$$\sigma = (\$330,000 - \$300,000)/6 = \$5,000$$

There are two distinct advantages to this method:

- (1) It is often easier and more realistic to ask the expert to give optimistic, pessimistic and most likely estimates than a specific forecast value.
- (2) The PERT method includes a measure of dispersion (the standard deviation), which makes it possible to develop probabilistic statements regarding the forecast. For example, in the above example the forecaster is 95 percent confident that the true value of the forecasted sales lies between plus or minus two standard deviations from the mean (\$311,667). That is the true value can be expected between \$301,667 and \$321,667.

COMMON FEATURES AND ASSUMPTIONS INHERENT IN FORECASTING

As pointed out, forecasting techniques are quite different from each other. But there are certain features and assumptions that underlie the business of forecasting. They are:

1. Forecasting techniques generally assume that the same underlying causal relationship that existed in the past will continue to prevail in the future. In other words, most of our techniques are based on historical data.
2. Forecasts are very rarely perfect. Therefore, for planning purposes, allowances should be made for inaccuracies. For example, the company should always maintain a safety stock in anticipation of stockouts.

3. Forecast accuracy decreases as the time period covered by the forecast (that is, the time horizon) increases. Generally speaking, a long-term forecast tends to be more inaccurate than a short-term forecast because of the greater uncertainty.
4. Forecasts for groups of items tend to be more accurate than forecasts for individual items, since forecasting errors among items in a group tend to cancel each other out. For example, industry forecasting is more accurate than individual firm forecasting.

STEPS IN THE FORECASTING PROCESS

There are six basic steps in the forecasting process. They are:

1. Determine the what and why of the forecast and what will be needed. This will indicate the level of detail required in the forecast (for example, forecast by region, forecast by product, etc.), the amount of resources (for example, computer hardware and software, manpower, etc.) that can be justified, and the level of accuracy desired.
2. Establish a time horizon, short-term or long-term. More specifically, project for the next year or next 5 years, etc.
3. Select a forecasting technique. Refer to the criteria discussed before.
4. Gather the data and develop a forecast.
5. Identify any assumptions that had to be made in preparing the forecast and using it.
6. Monitor the forecast to see if it is performing in a manner desired. Develop an evaluation system for this purpose. If not, go to step 1.

CHAPTER 14 FORECASTING METHODOLOGY

LEARNING OBJECTIVES

After studying the material in this chapter, you will be able to:

1. Identify and explain naive models.
2. Give examples of smoothing techniques
3. Describe step by step the forecasting method using decomposition of time series

This chapter discusses several forecasting methods that fall in the *quantitative approach* category. The discussion includes naive models, moving averages, and exponential smoothing methods. Time series analysis and regressions are covered in future chapters. The qualitative methods were described in the previous chapter.

NAIVE MODELS

Naive forecasting models are based exclusively on historical observation of sales or other variables such as earnings and cash flows being forecast. They do not attempt to explain the underlying causal relationships, which produce the variable being forecast.

Naive models may be classified into two groups. One group consists of simple projection models. These models require inputs of data from recent observations, but no statistical analysis is performed. The second group are made up of models, while naive, are complex enough to require a computer. Traditional methods such as classical decomposition, moving average, and exponential smoothing models are some examples.

Advantages: It is inexpensive to develop, store data, and operate.

Disadvantages: It does not consider any possible causal relationships that underlie the forecasted variable.

1. A simplest example of a naive model type would be to use the actual sales of the current period as the forecast for the next period. Let us use the symbol Y'_{t+1} as the forecast value and the symbol Y_t as the actual value. Then, $Y'_{t+1} = Y_t$
2. If you consider trends, then

$$Y'_{t+1} = Y_t + (Y_t - Y_{t-1})$$

This model adds the latest observed absolute period-to-period change to the most recent observed level of the variable.

3. If you want to incorporate the rate of change rather than the absolute amount, then

$$Y'_{t+1} = Y_t \frac{Y_t}{Y_{t-1}}$$

EXAMPLE 14.1

Consider the following sales data:

20X1	
<u>Month</u>	<u>Monthly Sales of Product</u>
1	\$3,050
2	2,980
3	3,670
4	2,910
5	3,340
6	4,060
7	4,750
8	5,510
9	5,280
10	5,504
11	5,810
12	6,100

We will develop forecasts for January 20X2 based on the aforementioned three models:

1. $Y'_{t+1} = Y_t = \$6,100$
2. $Y'_{t+1} = Y_t + (Y_t - Y_{t-1}) = \$6,100 + (\$6,100 - \$5,810) = \$6,100 + \$290 = \$6,390$
- 3.

$$Y'_{t+1} = Y_t \frac{Y_t}{Y_{t-1}}$$

$$= \$6,100 \times \frac{\$6,100}{\$5,810} = \$6,100 (1.05) = \$6,405$$

The naive models can be applied, with very little need of a computer, to develop forecasts for sales, earnings, and cash flows. They must be compared with more sophisticated models such as the regression and Box-Jenkins methods for forecasting efficiency.

SMOOTHING TECHNIQUES

Smoothing techniques are a higher form of naive models. There are two typical forms: moving average and exponential smoothing. Moving averages are the simpler of the two.

MOVING AVERAGES

Moving averages are averages that are updated as new information is received. With the moving average, a manager simply employs the most recent observations to calculate an average, which is used as the forecast for the next period.

EXAMPLE 14.2

Assume that the marketing manager has the following sales data.

<u>Date</u>	<u>Actual Sales (Y_t)</u>
Jan.1	46
2	54
3	53
4	46
5	58
6	49
7	54

In order to predict the sales for the seventh and eighth days of January, the manager has to pick the number of observations for averaging purposes. Let us consider two cases: one is a six-day moving average and the other is a three-day average.

Case 1

$$Y'_7 = \frac{46 + 54 + 53 + 46 + 58 + 49}{6} = 51$$

$$Y'_8 = \frac{54 + 53 + 46 + 58 + 49 + 54}{6} = 52.3$$

where Y' = predicted

Case 2

$$Y'_7 = \frac{46 + 58 + 49}{3} = 51$$

$$Y'_8 = \frac{58 + 49 + 54}{3} = 53.6$$

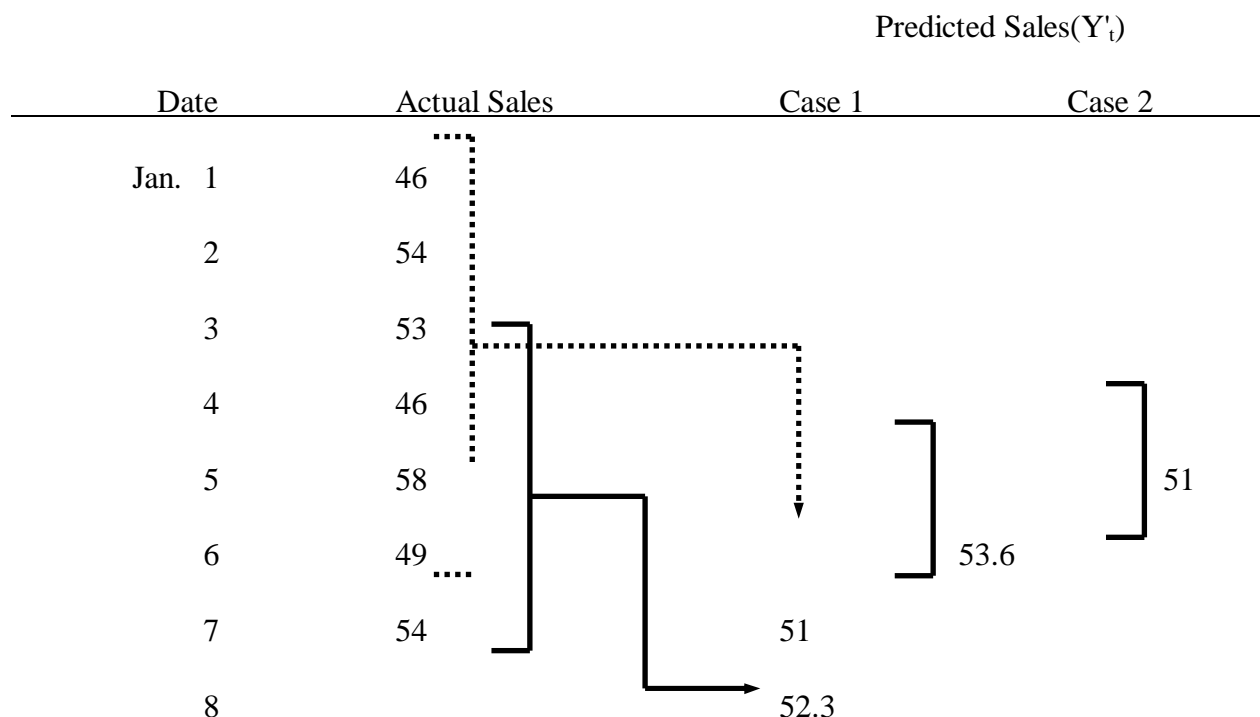


Figure 14.1 summarizes the results of Cases 1 and 2 above.

In terms of weights given to observations, in case 1, the old data received a weight of $5/6$, and the current observation got a weight of $1/6$. In case 2, the old data received a weight of only $2/3$ while the current observation received a weight of $1/3$.

Thus, the marketing manager's choice of the number of periods to use in a moving average is a measure of the relative importance attached to old versus current data.

ADVANTAGES AND DISADVANTAGES

The moving average is simple to use and easy to understand. However, there are two shortcomings.

- It requires you to retain a great deal of data and carry it along with you from forecast period to forecast period.
- All data in the sample are weighted equally. If more recent data are more valid than older data, why not give it greater weight?

The forecasting method known as exponential smoothing gets around these disadvantages.

EXPONENTIAL SMOOTHING

Exponential smoothing is a popular technique for short-run forecasting by financial managers. It uses a weighted average of past data as the basis for a forecast. The procedure gives heaviest weight to more recent information and smaller weights to observations in the more distant past. The reason for this is that the future is more dependent upon the recent past than on the distant past. The method is known to be effective when there is randomness and no seasonal fluctuations in the data. One disadvantage of the method, however, is that it does not include industrial or economic factors such as market conditions, prices, or the effects of competitors' actions.

THE MODEL

The formula for exponential smoothing is:

$$Y'_{t+1} = \alpha Y_t + (1 - \alpha) Y'_t$$

or in words,

$$Y'_{\text{new}} = \alpha Y_{\text{old}} + (1 - \alpha) Y'_{\text{old}}$$

where Y'_{new} = Exponentially smoothed average to be used as the forecast.

Y_{old} = Most recent actual data.

Y'_{old} = Most recent smoothed forecast.

α = Smoothing constant.

The higher the α , the higher the weight given to the more recent information.

EXAMPLE 14.3

The following data on sales are given below.

<u>Time period (t)</u>	<u>Actual sales (1000)(Y_t)</u>
1	\$60.0
2	64.0
3	58.0
4	66.0
5	70.0
6	60.0
7	70.0
8	74.0
9	62.0
10	74.0
11	68.0
12	66.0
13	60.0
14	66.0
<u>15</u>	<u>62.0</u>

To initialize the exponential smoothing process, we must have the initial forecast. The first smoothed forecast to be used can be

1. First actual observations.
2. An average of the actual data for a few periods

For illustrative purposes, let us use a six-period average as the initial forecast Y'_7 with a smoothing constant of $\alpha = 0.40$.

$$\begin{aligned} \text{Then } Y'_7 &= (Y_1 + Y_2 + Y_3 + Y_4 + Y_5 + Y_6)/6 \\ &= (60 + 64 + 58 + 66 + 70 + 60)/6 = 63 \end{aligned}$$

Note that $Y_7 = 70$. Then Y'_8 is computed as follows:

$$\begin{aligned} Y'_8 &= \alpha Y_7 + (1 - \alpha) Y'_7 \\ &= (0.40)(70) + (0.60)(63) \\ &= 28.0 + 37.80 = 65.80 \end{aligned}$$

Similarly,

$$\begin{aligned} Y'_9 &= \alpha Y_8 + (1 - \alpha) Y'_8 \\ &= (0.40)(74) + (0.60)(65.80) \\ &= 29.60 + 39.48 = 69.08 \end{aligned}$$

and

$$\begin{aligned} Y'_{10} &= \alpha Y_9 + (1 - \alpha) Y'_9 \\ &= (0.40)(62) + (0.60)(69.08) \\ &= 24.80 + 41.45 = 66.25 \end{aligned}$$

By using the same procedure, the values of Y'_{11} , Y'_{12} , Y'_{13} , Y'_{14} , and Y'_{15} can be calculated. The following table shows a comparison between the actual sales and predicted sales by the exponential smoothing method.

Due to the negative and positive differences between actual sales and predicted sales, the forecaster can use a higher or lower smoothing constant (α), in order to adjust his/her prediction as quickly as possible to large fluctuations in the data series. For example, if the forecast is slow in reacting to increased sales, (that is to say, if the difference is negative), he/she might want to try a higher value. For practical purposes, the optimal α may be picked by minimizing what is known as the *mean squared error* (MSE), which will be discussed in more detail in a later chapter.

$$MSE = \Sigma (Y_t - Y'_t)^2 / (n - i)$$

where i = the number of observations used to determine the initial forecast (in our example, $i=6$).

TABLE 14.1
COMPARISON OF ACTUAL SALES AND PREDICTED SALES

<u>Time period (t)</u>	<u>Actual sales (Y_t)</u>	<u>Predicted sales (Y'_t)</u>	<u>Difference (Y_t - Y'_t)</u>	<u>Difference² (Y_t - Y'_t)²</u>
1	\$60.0			
2	64.0			
3	58.0			
4	66.0			
5	70.0			
6	60.0			
7	70.0	63.00	7.00	49.00
8	74.0	65.80	8.20	67.24
9	62.0	69.08	-7.08	50.13
10	74.0	66.25	7.75	60.06
11	68.0	69.35	-1.35	1.82
12	66.0	68.81	-2.81	7.90
13	60.0	67.69	-7.69	59.14
14	66.0	64.61	1.39	1.93
15	62.0	65.17	-3.17	10.05
				<u>307.27</u>

In our example,

$$\text{MSE} = 307.27 / (15 - 6) = 307.27 / 9 = 34.14$$

The idea is to select the α that minimizes MSE, which is the average sum of the variations between the historical sales data and the forecast values for the corresponding periods.

The Computer and Exponential Smoothing

As a manager, you will be confronted with complex problems requiring large sample data. You will also need to try different values of α for exponential smoothing. Virtually all forecasting software has an exponential smoothing routine.

FORECASTING USING DECOMPOSITION OF TIME SERIES

When sales exhibit seasonal or cyclical fluctuation, we use a method called *classical decomposition*, for dealing with seasonal, trend, and cyclical components together. Note that the classical decomposition model is a time series model. This means that the method can only be used to fit the time series data, whether it is monthly, quarterly, or annually. The types of time series data the company deals with include sales, earnings, cash flows, market share, and costs.

We assume that a time series is combined into a model that consists of the four components - trend (T), cyclical (C), seasonal (S), and random (R). We assume the model is of a multiplicative type, i.e.,

$$Y_t = T \times C \times S \times R$$

In this section, we illustrate, step by step, the classical decomposition method by working with the quarterly sales data.

The approach basically involves the following four steps:

1. Determine seasonal indices, using a four-quarter moving average.
2. Deseasonalize the data.
3. Develop the linear least squares equation in order to identify the trend component of the forecast.
4. Forecast the sales for each of the four quarters of the coming year.

The data we are going to use are the quarterly sales data for the video set over the past four years. (See Table 14.2) We begin our analysis by showing how to identify the seasonal component of the time series.

Step 1: Use moving average to measure the combined trend-cyclical (TC) components of the time series. This way we eliminate the seasonal and random components, S and R.

More specifically, Step 1 involves the following sequences of steps:

TABLE 14.2
QUARTERLY SALES DATA FOR VCRS OVER THE PAST 4 YEARS

Year	Quarter	Sales
1	1	5.8
	2	5.1
	3	7.0
	4	7.5
2	1	6.8
	2	6.2
	3	7.8
	4	8.4
3	1	7.0
	2	6.6
	3	8.5
	4	8.8
4	1	7.3
	2	6.9
	3	9.0
	4	9.4

a) Calculate the 4-quarter moving average for the time series, which we discussed in the above. However, the moving average values computed do not correspond directly to the original quarters of the time series.

b) We resolve this difficulty by using the midpoints between successive moving-average values. For example, since 6.35 corresponds to the first half of quarter 3 and 6.6 corresponds to the last half of quarter 3, we use $(6.35+6.6)/2 = 6.475$ as the moving average value of quarter 3.

Similarly, we associate $(6.6+6.875)/2 = 6.7375$ with quarter 4. A complete summary of the moving-average calculation is shown in Table 14.3.

TABLE 14.3
MOVING AVERAGE CALCULATIONS FOR THE VCRS SALES TIME SERIES

Year	Quarter	Sales	Four-Quarter Mov. Av.	Centered Mov. Ave.
1	1	5.8		
	2	5.1		
	3	7.0	6.35	6.475
	4	7.5	6.6	6.7375
2	1	6.8	6.875	6.975
	2	6.2	7.075	7.1875
	3	7.8	7.3	7.325
	4	8.4	7.35	7.4
3	1	7.0	7.45	7.5375
	2	6.6	7.625	7.675
	3	8.5	7.725	7.7625
	4	8.8	7.8	7.8375
4	1	7.3	7.875	7.9375

		8	
2	6.9		8.075
		8.15	
3	9.0		
4	9.4		

c) Next, we calculate the ratio of the actual value to the moving average value for each quarter in the time series having a 4-quarter moving average entry. This ratio in effect represents the seasonal-random component, $SR=Y/TC$. The ratios calculated this way appear in Table 14.4.

TABLE 14.4
SEASONAL RANDOM FACTORS FOR THE SERIES

Year	Quarter	Sales	Four-Quarter Mov. Av.	Centered Mov. Av. TC	Sea.-Rand. SR=Y/TC
1	1	5.8			
	2	5.1			
	3	7.0	6.35	6.475	1.081
	4	7.5	6.6	6.738	1.113
2			6.875		
	1	6.8	7.075	6.975	0.975
	2	6.2		7.188	0.863
	3	7.8	7.3	7.325	1.065
3			7.35		
	4	8.4	7.45	7.400	1.135
	1	7.0	7.625	7.538	0.929
	2	6.6	7.725	7.675	0.860
	3	8.5		7.763	1.095
	4	8.8	7.8	7.838	1.123
			7.875		

4	1	7.3		7.938	0.920
			8		
	2	6.9		8.075	0.854
			8.15		
	3	9.0			
	4	9.4			

d) Arrange the ratios by quarter and then calculate the average ratio by quarter in order to eliminate the random influence.

For example, for quarter 1

$$(0.975+0.929+0.920)/3=0.941$$

e) The final step, shown below, adjusts the average ratio slightly (for example, for quarter 1, 0.941 becomes 0.940), which will be the *seasonal index*.

Step 2: After obtaining the seasonal index, we must first remove the effect of season from the original time series. This process is referred to as deseasonalizing the time series. For this, we must divide the original series by the seasonal index for that quarter. This is shown in Table 14.5.

Step 3: Looking at the graph in Figure 14.1, we see the time series seem to have an upward linear trend. To identify this trend, we develop the least squares trend equation. This procedure is shown in Table 14.6, which was discussed in a previous chapter.

TABLE 14.5
SEASONAL COMPONENT CALCULATIONS

Quarter	Sea.Rand. SR	Seasonal Factor S	Adjusted S
1	0.975		
	0.929		
	0.920	0.941	0.940
2	0.863		
	0.860		
	0.854	0.859	0.858
3	1.081		
	1.065		
	1.095	1.080	1.079
4	1.113		
	1.135		
	1.123	1.124	1.123
		4.004	4.000

TABLE 14.6
DESEASONALIZED DATA

Year	Quarter	Sales	Seas. S	Des. Data	t	tY	t ²
1	1	5.8	0.940	6.17	1	6.17	1
	2	5.1	0.858	5.94	2	11.89	4
	3	7.0	1.079	6.49	3	19.46	9
	4	7.5	1.123	6.68	4	26.72	16
2	1	6.8	0.940	7.23	5	36.17	25
	2	6.2	0.858	7.23	6	43.35	36
	3	7.8	1.079	7.23	7	50.59	49
	4	8.4	1.123	7.48	8	59.86	64
3	1	7.0	0.940	7.45	9	67.01	81
	2	6.6	0.858	7.69	10	76.91	100
	3	8.5	1.079	7.88	11	86.64	121
	4	8.8	1.123	7.84	12	94.07	144
4	1	7.3	0.940	7.76	13	100.94	169
	2	6.9	0.858	8.04	14	112.57	196
	3	9.0	1.079	8.34	15	125.09	225
	4	9.4	1.123	8.37	16	133.98	256
				117.82	136	1051.43	1496

t-bar= 8.5 y-bar= 7.3638

b = 0.1469

a = 6.1147

which means $y = 6.1147 + 0.1469 t$ for the forecast periods:

t= 17

18
19
20

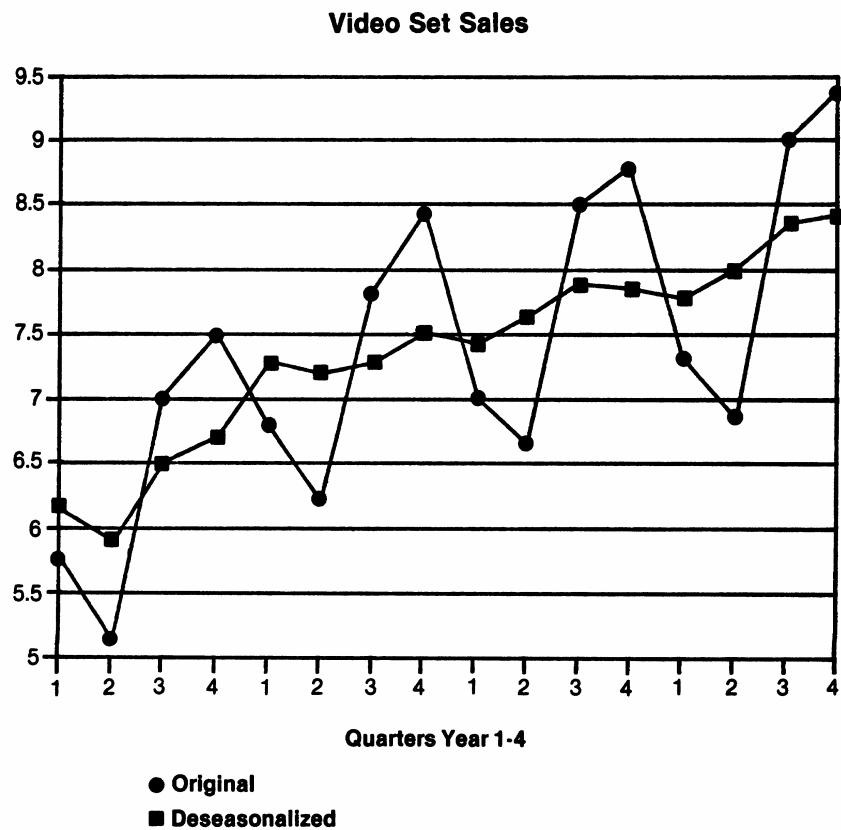
Step 4: Develop the forecast using the trend equation and adjust these forecasts to account for the effect of season. The quarterly forecast, as shown in Table 14.7, can be obtained by multiplying the forecast based on trend times the seasonal factor.

TABLE 14.7
QUARTER-TO-QUARTER SALES FORECASTS FOR YEAR 5

<i>Year</i>	<i>Quarter</i>	<i>Trend Forecast</i>	<i>Seasonal Factor</i>	<i>Quarterly Forecast</i>
5	1	8.6128 (a)	0.940	8.0971
	2	8.7598	0.858	7.5170
	3	8.9067	1.079	9.6121
	4	9.0537	1.123	10.1632

Note: (a) $y = 6.1147 + 0.1469 t = 6.1147 + 0.1469 (17) = 8.6128$

FIGURE 14.1
ACTUAL VERSUS DESEASONALIZED DATA



CONCLUSION

Various quantitative forecasting methods exist. Naive techniques are based solely on previous experience. Smoothing approaches include moving average and exponential smoothing. Moving averages and exponential smoothing employs a weighted average of past data as the means of deriving the forecast. The classical decomposition method is utilized for seasonal and cyclical situations.

CHAPTER 15

FORECASTING WITH REGRESSION AND MARKOV METHODS

LEARNING OBJECTIVES

After studying the material in this chapter, you will be able to:

1. Explain the least-squares method.
2. Discuss regression statistics.
3. Identify statistics to look for in multiple regressions.
4. Evaluate forecasting performance.
5. Outline checklists on how to choose the best forecasting equation.
6. Select and use a computer statistical package for multiple regression.
7. Explain forecasting sales using the Markov model.

Regression analysis is a statistical procedure for estimating mathematically the average relationship between the dependent variable and the independent variable(s). *Simple regression* involves one independent variable, price or advertising in a demand function, whereas *multiple regression* involves two or more variables, that is price and advertising together.

In this chapter, we will discuss *simple (linear) regression* to illustrate the *least-squares method*, which means that we will assume the $Y = a + bX$ relationship.

THE LEAST-SQUARES METHOD

The least-squares method is widely used in regression analysis for estimating the parameter values in a regression equation. The regression method includes all the observed data and attempts to find a line of best fit. To find this line, a technique called the least-squares method is used.

To explain the least-squares method, we define the error as the difference between the observed value and the estimated one and denote it with u . Symbolically,

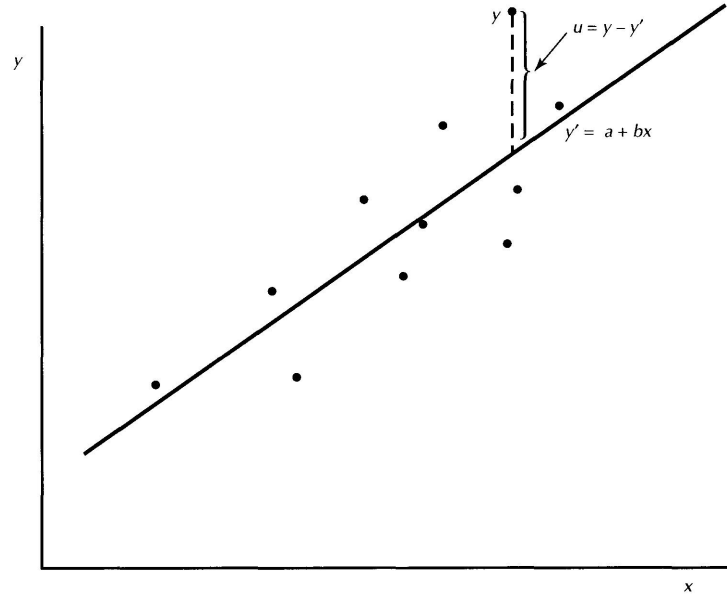
$$u = Y - Y'$$

where Y = observed value of the dependent variable
 Y' = estimated value based on $Y' = a + bX$

The least-squares criterion requires that the line of best fit be such that the sum of the squares of the errors (or the vertical distance in Figure 15.1 from the observed data points to the line) is a minimum, i.e.,

$$\text{Minimum: } \sum u^2 = \sum (Y - a - bX)^2$$

FIGURE 15.1
Y AND Y'



Using differential calculus we obtain the following equations, called normal equations:

$$\begin{aligned}\Sigma Y &= na + b\Sigma X \\ \Sigma XY &= a\Sigma X + b\Sigma X^2\end{aligned}$$

Solving the equations for b and a yields

$$b = \frac{n\Sigma XY - (\Sigma X)(\Sigma Y)}{n\Sigma X^2 - (\Sigma X)^2}$$

$$a = \bar{Y} - b\bar{X}$$

$$\text{where } \bar{Y} = \frac{\Sigma Y}{n} \text{ and } \bar{X} = \frac{\Sigma X}{n}$$

EXAMPLE 15.1

To illustrate the computations of b and a, we will refer to the data in Table 15.1. All the sums required are computed and shown below.

TABLE 15.1

COMPUTED SUMS

Advertising X (000)	Sales Y (000)	XY	X ²	Y ²
\$9	15	135	81	225
19	20	380	361	400
11	14	154	121	196
14	16	224	196	256
23	25	575	529	625
12	20	240	144	400
12	20	240	144	400
22	23	506	484	529
7	14	98	49	196
13	22	286	169	484
15	18	270	225	324
<u>17</u>	<u>18</u>	<u>306</u>	<u>289</u>	<u>324</u>
<u>\$174</u>	<u>\$225</u>	<u>3,414</u>	<u>2,792</u>	<u>4,359</u>

From the table above:

$$\Sigma X = 174; \quad \Sigma Y = 225; \quad \Sigma XY = 3,414; \quad \Sigma X^2 = 2,792.$$

$$\bar{X} = \Sigma X/n = 174/12 = 14.5; \quad \bar{Y} = \Sigma Y/n = 225/12 = 18.75.$$

Substituting these values into the formula for b first:

$$b = \frac{n \Sigma XY - (\Sigma X)(\Sigma Y)}{n \Sigma X^2 - (\Sigma X)^2} = \frac{(12)(3,414) - (174)(225)}{(12)(2,792) - (174)^2} = \frac{1,818}{3,228} = 0.5632$$

$$a = \bar{Y} - b\bar{X} = 18.75 - (0.5632)(14.5) = 18.75 - 8.1664 = 10.5836$$

Thus, $Y' = 10.5836 + 0.5632 X$

EXAMPLE 15.2

Assume that the advertising of \$10 is to be expended for next year; the projected sales for the next year would be computed as follows:

$$\begin{aligned} Y' &= 10.5836 + 0.5632 X \\ &= 10.5836 + 0.5632 (10) \\ &= \$16.2156 \end{aligned}$$

Note that ΣY^2 is not used here but rather is computed for r-squared (R^2).

TREND ANALYSIS

Trends are the general upward or downward movements of the average over time. These movements may require many years of data to determine or describe them. They can be described by a straight line or a curve. The basic forces underlying the trend include technological advances, productivity changes, inflation, and population change. Trend analysis is a special type of simple regression. This method involves a regression whereby a trend line is fitted to a time series of data.

The *linear* trend line equation can be shown as

$$Y = a + b t$$

where t = time.

The formula for the coefficients a and b are essentially the same as the cases for simple regression. However, for regression purposes, a time period can be given a number so that $\Sigma t = 0$. When there is an odd number of periods, the period in the middle is assigned a zero value. If there is an even number, then -1 and $+1$ are assigned the two periods in the middle, so that again $\Sigma t = 0$.

With $\Sigma t = 0$, the formula for b and a reduces to the following:

$$b = \frac{n \sum tY}{n \sum t^2}$$

$$a = \frac{\sum Y}{n}$$

EXAMPLE 15.3

Case 1 (odd number)

	20X1	20X2	20X3	20X4	20X5
$t =$	-2	-1	0	+1	+2

Case 2 (even number)

	20X1	20X2	20X3	20X4	20X5	20X6
$t =$	-3	-2	-1	+1	+2	+3

In each case $\Sigma t = 0$.

EXAMPLE 15.4

Consider ABC Company, whose historical sales follows.

Year	Sales (in millions)
20X1	\$ 10
20X2	12
20X3	13
20X4	16
20X5	17

Since the company has five years' data, which is an odd number, the year in the middle is assigned a zero value.

<u>Year</u>	<u>t</u>	<u>Sales(in millions)(Y)</u>	<u>tY</u>	<u>t²</u>	<u>Y²</u>
20X1	-2	\$ 10	-20	4	100
20X2	-1	12	-12	1	144
20X3	0	13	0	0	169
20X4	+1	16	16	1	256
<u>20X5</u>	<u>+2</u>	<u>17</u>	<u>34</u>	<u>4</u>	<u>289</u>
	0	68	18	10	958

$$b = \frac{(5)(18)}{5(10)} = 90/50 = 1.8$$

$$a = \frac{68}{5} = 13.6$$

Therefore, the estimated trend equation is

$$Y' = \$13.6 + \$1.8 t$$

To project 20X6 sales, we assign +3 to the t value for the year 20X6.

$$\begin{aligned} Y' &= \$13.6 + \$1.8 (3) \\ &= \$19 \end{aligned}$$

Table 15.1 contains a summary of the more commonly used forecasting methods discussed thus far.

TABLE 15.1
Summary of Commonly Used Forecasting Methods

Technique	Moving Average	Exponential Smoothing	Trend Analysis	Regression Analysis
Description	Each point of a moving average of a time series is the arithmetic or weighted average of a number of consecutive points of the series, where the number of data points is chosen so that the effects of seasons or irregularity or both are eliminated.	Similar to moving average, except that more recent data points are given more weight. Descriptively, the new forecast is equal to the old one plus some proportion of the past forecasting error. Effective when there is random demand and no seasonal fluctuation in the data series.	Fits a trend line to a mathematical equation and then projects it into the future by means of this equation. There are several variations: the slope-characteristic method, polynomials, logarithms, and so on.	Functionally relates sales to other economic, competitive, or internal variables and estimates an equation using the least-squares technique. Relationships are primarily analyzed statistically, although any relationship could be selected for testing on a rational ground.
Accuracy				
Short-term (0–3 months)	Poor to good	Fair to very good	Very good	Good to very good
Medium-term (3 months–2 years)	Poor	Poor to good	Good	Good to very good

Long-term (2 years and over)	Very poor	Very poor	Good	Poor
Typical application	Inventory control for low-volume items	Production and inventory control, forecasts of sales, and financial data	New product forecasts (particularly intermediate and long-term)	Forecasts of sales by product classes, forecasts of income and other financial data.
Data required	A minimum of two years of sales history if seasonals are present. Otherwise, fewer data. (Of course, the more history the better.) The moving average must be specified.	The same as for a moving average	Varies with the technique used. However, a good rule of thumb is to use a minimum of five years' annual data to start. Thereafter, the complete history.	Several years' quarterly history to obtain good, meaningful relationships. Mathematically necessary to have two more observations than there are independent variables.
Cost of forecasting with a computer	Very minimal	Minimal	Varies with application	Varies with application.
Time required to develop an application and make forecasts	1 day	1 day	1 day	Depends on ability to identify relationships.

REGRESSION STATISTICS

Regression analysis is a statistical method. Hence, it uses a variety of statistics to tell about the accuracy and reliability of the regression results. They include:

1. Correlation coefficient (R) and coefficient of determination (R^2)
2. Standard error of the estimate (S_e) and prediction confidence interval
3. Standard error of the regression coefficient (S_b) and t-statistic

Each of these statistics is explained below.

1. Correlation coefficient (R) and coefficient of determination (R^2)

The correlation coefficient R measures the degree of correlation between Y and X. The range of values it takes on is between -1 and +1. More widely used, however, is the coefficient of determination, designated R^2 (read as r-squared). Simply put, R^2 tells us how good the estimated regression equation is. In other words, it is a measure of "goodness of fit" in the regression. Therefore, the higher the R^2 , the more confidence we have in our estimated equation.

More specifically, the coefficient of determination represents the proportion of the total variation in Y that is explained by the regression equation. It has the range of values between 0 and 1.

EXAMPLE 15.5

The statement "Sales is a function of advertising expenditure with $R^2 = 70$ percent," can be interpreted as "70 percent of the total variation of sales is explained by the regression equation or the change in advertising and the remaining 30 percent is accounted for by something other than advertising, such as price and income."

The coefficient of determination is computed as

$$R^2 = 1 - \frac{\sum (Y - Y')^2}{\sum (Y - \bar{Y})^2}$$

In a simple regression situation, however, there is a short-cut method available:

$$R^2 = \frac{[n \sum XY - (\sum X)(\sum Y)]^2}{[n \sum X^2 - (\sum X)^2][n \sum Y^2 - (\sum Y)^2]}$$

Comparing this formula with the one for b, we see that the only additional information we need to compute R^2 is $\sum Y^2$.

EXAMPLE 15.6

To illustrate the computations of various regression statistics, we will refer to the data in Table 15.1.

Using the shortcut method for R^2 ,

$$R^2 = \frac{(1,818)^2}{[3,228][(12)(4,359) - (225)^2]} = \frac{3,305,124}{[3,228][52,308 - 50,625]} = \frac{3,305,124}{(3,228)(1,683)}$$

$$= \frac{3,305,124}{5,432,724} = 0.6084 = 60.84\%$$

This means that about 60.84 percent of the total variation in sales is explained by advertising and the remaining 39.16 percent is still unexplained. A relatively low R^2 indicates that there is a lot of room for improvement in our estimated forecasting formula ($Y' = \$10.5836 + \$0.5632X$). Price or a combination of advertising and price might improve R^2 .

2. Standard Error of the Estimate (S_e) and Prediction Confidence Interval

The standard error of the estimate, designated S_e , is defined as the standard deviation of the regression. It is computed as:

$$S_e = \sqrt{\frac{\sum (Y - Y')^2}{n - 2}} = \sqrt{\frac{\sum Y^2 - a \sum Y - b \sum XY}{n - 2}}$$

This statistic can be used to gain some idea of the accuracy of our predictions.

EXAMPLE 15.7

Going back to our example data, S_e is calculated as :

$$S_e = \sqrt{\frac{\sum Y^2 - a \sum Y - b \sum XY}{n - 2}} = \sqrt{\frac{4,359 - (10.5836)(225) - (0.5632)(3,414)}{12 - 2}} = \sqrt{\frac{54.9252}{10}} =$$

$$= 2.3436$$

Suppose you wish to make a prediction regarding an individual Y value--such as a prediction about the sales when an advertising expense = \$10. Usually, we would like to have some objective measure of the confidence we can place in our prediction, and one such measure is a *confidence (or prediction) interval* constructed for Y .

A confidence interval for a predicted Y, *given a value for X*, can be constructed in the following manner.

$$Y' \pm t S_e \sqrt{1 + \frac{1}{n} + \frac{(X_p - \bar{X})^2}{\sum X^2 - \frac{(\sum X)^2}{n}}}$$

where Y' = the predicted value of Y given a value for X;

X_p = the value of independent variable used as the basis for prediction.

Note: t is the critical value for the level of significance employed. For example, for a significant level of 0.025 (which is equivalent to a 95% confidence level in a two-tailed test), the critical value of t for 10 degrees of freedom is 2.228 (See Table 15.3). As can be seen, the confidence interval is the linear distance bounded by limits on either side of the prediction.

EXAMPLE 15.8

If you want to have a 95 percent confidence interval of your prediction, the range for the prediction, given an advertising expense of \$10 would be between \$10,595.10 and \$21,836.10, as determined as follows: Note that from Example 4.2, $Y' = \$16.2156$

The confidence interval is therefore established as follows:

$$\$16.2156 \pm (2.228)(2.3436) \sqrt{1 + \frac{1}{12} + \frac{(10 - 14.5)^2}{2,792 - \frac{(174)^2}{12}}}$$

$$= \$16.2156 \pm (2.228)(2.3436) (1.0764)$$

$$= \$16.2156 \pm 5.6205$$

which means the range for the prediction, given an advertising expense of \$10 would be between \$10.5951 and \$21.8361. Note that $\$10.5951 = \$16.2156 - 5.6205$ and $\$21.8361 = \$16.2156 + 5.6205$.

3. Standard Error of the Regression Coefficient (S_b) And t-Statistic

The standard error of the regression coefficient, designated S_b , and the t-statistic are closely related. S_b is calculated as:

$$S_b = \frac{S_e}{\sqrt{\sum (X - \bar{X})^2}}$$

or in short-cut form

$$S_b = \frac{S_e}{\sqrt{\sum X^2 - \frac{(\sum X)^2}{n}}}$$

S_b gives an estimate of the range where the true coefficient will "actually" fall.

t-statistics (or t-value) is a measure of the statistical significance of an independent variable X in explaining the dependent variable Y. It is determined by dividing the estimated regression coefficient b by its standard error S_b . It is then compared with the table t-value (See Table 15.3). Thus, the t-statistic measures how many standard errors the coefficient is away from zero.

Rule of thumb: Any t-value greater than +2 or less than -2 is acceptable. The higher the t-value, the greater the confidence we have in the coefficient as a predictor. Low t-values are indications of low reliability of the predictive power of that coefficient.

EXAMPLE 15.9

The S_b for our example is:

$$S_b = \frac{S_e}{\sqrt{X^2 - \bar{X} \sum X}} = \frac{2.3436}{\sqrt{2,792 - (14.5)(174)}} = \frac{2.3436}{\sqrt{2,792 - 2,523}} = 0.143$$

$$\text{Thus, } t\text{-statistic} = \frac{b}{S_b} = \frac{0.5632}{0.143} = 3.94$$

Since, $t = 3.94 > 2$, we conclude that the b coefficient is statistically significant. As was indicated previously, the table's critical value (cut-off value) for 10 degrees of freedom is 2.228 (from Table 15.3 at the end of the chapter).

To review:

- (1) t-statistic is more relevant to multiple regressions which have more than one b's.
- (2) R^2 tells you how good the forest (overall fit) is while t-statistic tells you how good an individual tree (an independent variable) is.

In summary, the table t value, based on a degree of freedom and a level of significance, is used:

- (1) To set the prediction range -- upper and lower limits -- for the predicted value of the dependent variable.
- (2) To set the confidence range for regression coefficients.
- (3) As a cutoff value for the t-test.

Figure 15.3 shows an Excel regression output that contains the statistics we discussed so far.

FIGURE 15.3
EXCEL REGRESSION OUTPUT

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.77998
R Square	0.60837 (R^2)
Adjusted R Square	0.56921
Standard Error	2.34362 (S_e)
Observations	12

<i>ANOVA</i>				
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>Significance F</i>
Regression	1	85.32434944	85.3243	0.002769
Residual	10	54.92565056	5.49257	
Total	11	140.25		

	<i>Coefficients</i>	<i>Standard Error (S_b)</i>	<i>t Stat</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Upper 95.0%</i>
Intercept	10.5836	2.17960878	4.85575	5.727171	15.4401	15.4401
Advertising	0.5632	0.142893168	3.94139	0.244811	0.88158	0.88158

- (1) R-squared (R^2) = .608373 = 60.84%
- (2) Standard error of the estimate (S_e) = 2.343622
- (3) Standard error of the coefficient (S_b) = 0.142893
- (4) t-value = 3.94

All of the above are the same as the ones manually obtained.

Note: Linear regression makes several assumptions: that errors are normally distributed with a mean of zero, that the variance of the errors is constant (constant variance or homoscedasticity), and that the independent variables are not correlated with each other.

STATISTICS TO LOOK FOR IN MULTIPLE REGRESSIONS

In multiple regressions that involve more than one independent (explanatory) variable, managers must look for the following statistics:

- t-statistics
- R-bar squared (\bar{R}^2) and F-statistic
- Multicollinearity
- Autocorrelation (or serial correlation)

t-Statistics

The t-statistic was discussed earlier, but is taken up again here since it is more valid in multiple regressions than in simple regressions. The t-statistic shows the significance of each explanatory variable in predicting the dependent variable. It is desirable to have as large (either positive or negative) a t-statistic as possible for each independent variable. Generally, a t-statistic greater than +2.0 or less than -2.0 is acceptable. Explanatory variables with low t-value can usually be eliminated from the regression without substantially decreasing R^2 or increasing the standard error of the regression. In a multiple regression situation, the t-statistic is defined as

$$t\text{-statistic} = \frac{b_i}{S_{b_i}}$$

where $i = i_{th}$ independent variable

R-bar Squared (\bar{R}^2) and F-Statistic

A more appropriate test for goodness of fit for multiple regressions is R-bar squared (\bar{R}^2):

$$\bar{R}^2 = 1 - (1 - R^2) \frac{n-1}{n-k}$$

where n = the number of observations

k = the number of coefficients to be estimated

An alternative test of the overall significance of a regression equation is the F-test.

Virtually all computer programs for regression analysis show an F-statistic.

The F-statistic is defined as

$$F = \frac{(Y' - \bar{Y})^2 / k}{(Y - Y')^2 / (n - k - 1)} = \frac{\text{Explained variation}/k}{\text{Unexplained variation}/(n - k - 1)}$$

If the F-statistic is greater than the table value, it is concluded that the regression equation is statistically significant in overall terms.

Multicollinearity

When using more than one independent variable in a regression equation, there is sometimes a high correlation between the independent variables themselves. Multicollinearity occurs when these variables interfere with each other. It is a pitfall because the equations with multicollinearity may produce spurious forecasts.

Multicollinearity can be recognized when

- The t-statistics of two seemingly important independent variables are low

- The estimated coefficients on explanatory variables have the opposite sign from that which would logically be expected

There are two ways to get around the problem of multicollinearity:

- One of the highly correlated variables may be dropped from the regression
- The structure of the equation may be changed using one of the following methods:
 - Divide both the left and right-hand side variables by some series that will leave the basic economic logic but remove multicollinearity
 - Estimate the equation on a first-difference basis
 - Combine the collinear variables into a new variable, which is their weighted sum

Autocorrelation (Serial Correlation)

Autocorrelation is another major pitfall often encountered in regression analysis. It occurs where there is a correlation between successive errors. The Durbin-Watson statistic provides the standard test for autocorrelation. Table 15.2 at the end of the chapter provides the values of the Durbin-Watson statistic for specified sample sizes and explanatory variables. Table 15.2 gives the significance points for d_L and d_U for tests on the autocorrelation of residuals (when no explanatory variable is a lagged endogenous variable). The number of explanatory variables, K excludes the constant term.

Generally speaking,

<i>Durbin-Watson Statistic</i>	<i>Autocorrelation</i>
Between 1.5 and 2.5	No autocorrelation
Below 1.5	Positive Autocorrelation
Above 2.5	Negative Autocorrelation

Autocorrelation usually indicates that an important part of the variation of the dependent variable has not been explained. *Recommendation:* The best solution to this problem is to search for other explanatory variables to include in the regression equation.

CHECKLISTS--HOW TO CHOOSE THE BEST FORECASTING EQUATION

Choosing among alternative forecasting equations basically involves two steps. The first step is to eliminate the obvious losers. The second is to select the winner among the remaining contenders.

HOW TO ELIMINATE LOSERS

1. Does the equation make sense? Equations that do not make sense intuitively or from a theoretical standpoint must be eliminated.
2. Does the equation have explanatory variables with low t-statistics? These equations should be reestimated or dropped in favor of equations in which all independent variables are significant. This test will eliminate equations where multicollinearity is a problem.

3. How about a low \bar{R}^2 ? The \bar{R}^2 can be used to rank the remaining equations in order to select the best candidates. A low \bar{R}^2 could mean:
- A wrong functional was fitted
 - An important explanatory variable is missing
 - Other combinations of explanatory variables might be more desirable

HOW TO CHOOSE THE BEST EQUATION

1. Best Durbin-Watson statistic. Given equations that survive all previous tests, the equation with the Durbin-Watson statistic closest to 2.0 can be a basis for selection.
2. Best forecasting accuracy. Examining the forecasting performance of the equations is essential for selecting one equation from those that have not been eliminated. The equation whose prediction accuracy is best in terms of measures of forecasting errors, such as MAD, MSE, RMSE, or MPE (to be discussed in detail in a later chapter) generally provides the best basis for forecasting.

It is important to note that neither Lotus 1-2-3 nor Quattro Pro calculate many statistics such as R-bar squared (\bar{R}^2), F-statistic, and Durbin-Watson statistic. You have to go to regression packages such as *Statistical Analysis System (SAS)*, *STATPACK*, and *Statistical Packages for Social Scientists (SPSS)*, to name a few. These packages do all have PC versions.

USE OF A COMPUTER STATISTICAL PACKAGE FOR MULTIPLE REGRESSION

EXAMPLE 15.10

Stanton Consumer Products Corporation wishes to develop a forecasting model for its dryer sale by using multiple regression analysis. The marketing department has prepared the following sample data.

<i>Month</i>	<i>Sales of Washers (X₁)</i>	<i>Disposable Income (X₂)</i>	<i>Savings (X₃)</i>	<i>Sales of Dryers (Y)</i>
January	\$45,000	\$16,000	\$71,000	\$29,000
February	42,000	14,000	70,000	24,000
March	44,000	15,000	72,000	27,000
April	45,000	13,000	71,000	25,000
May	43,000	13,000	75,000	26,000
June	46,000	14,000	74,000	28,000
July	44,000	16,000	76,000	30,000
August	45,000	16,000	69,000	28,000
September	44,000	15,000	74,000	28,000
October	43,000	15,000	73,000	27,000

The computer statistical package called SPSS was employed to develop the regression model. Figure 15.4 contains the input data and output that results using three explanatory

variables. To help you understand the listing, illustrative comments are added whenever applicable.

FIGURE 15.4
SPSS REGRESSION OUTPUT

Variables Entered/Removed^a

Model	Variables Entered	Variables Removed	Method
1	SAVINGS, sales, INCOME ^a	.	Enter

a. All requested variables entered.

b. Dependent Variable: SALESDRY

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.992 ^a	.983	.975	286.1281	2.094

a. Predictors: (Constant), SAVINGS, sales, INCOME

b. Dependent Variable: SALESDRY

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-45796.3	4877.651		-9.389	.000
	sales	.597	.081	.394	7.359	.000
	INCOME	1.177	.084	.752	13.998	.000
	SAVINGS	.405	.042	.508	9.592	.000

a. Dependent Variable: SALESDRY

1. *The forecasting equation.* From the SPSS output we see that

$$Y' = -45,796.35 + 0.597X_1 + 1.177X_2 + 0.405X_3$$

Suppose that in November the company expects

X_1	=	sales of washers	=	\$43,000
X_2	=	disposable income	=	\$15,000
X_3	=	Savings	=	\$75,000

Then the forecast sales for the month of November would be

$$\begin{aligned} Y' &= -45,796.35 + 0.597(43,000) + 1.177(15,000) + 0.405(75,000) \\ &= -45,796 + 25,671 + 17,655 + 30,375 \\ &= \$27,905.35 \end{aligned}$$

2. *The coefficient of determination.* Note that the SPSS output gives the value of R , R^2 , and R^2 adjusted. In our example, $R = 0.992$ and $R^2 = 0.983$

In the case of multiple regression, R^2 is more appropriate, as was discussed previously.

$$\begin{aligned} \bar{R}^2 &= 1 - (1 - R^2) \frac{n-1}{n-k} \\ &= 1 - (1 - 0.983) \frac{10-1}{10-3} = 1 - 0.017 (9/7) \\ &= 1 - 0.025 = 0.975 \end{aligned}$$

This tells us that 97.5 percent of total variation in sales of dryers is explained by the three explanatory variables. The remaining 2.2 percent was unexplained by the estimated equation.

3. *The standard error of the estimate (S_e).* This is a measure of dispersion of actual sales around the estimated equation. The output shows $S_e = 286.1281$.

4. *Computed t .* We read from the output

	<u>t-Statistic</u>
X_1	7.359
X_2	13.998
X_3	9.592

All t values are greater than a rule-of-thumb table t value of 2.0. (Strictly speaking, with $n - k - 1 = 10 - 3 - 1 = 6$ degrees of freedom and a level of significance of, say, 0.01, we see from Table 15.3 that the table t value is 3.707.) For a two-sided test, the level of significance to look up was .005. In any case, we conclude that all three explanatory variables we have selected were statistically significant.

4. *F-test.* From the output, we see that

$$\begin{aligned} F &= \frac{(Y' - \bar{Y})^2 / k}{(Y - Y')^2 / (n - k - 1)} = \frac{\text{Explained variation} / k}{\text{Unexplained variation} / (n - k - 1)} = \frac{29.109 / 3}{0.491 / 6} \\ &= 9.703 / 0.082 = 118.517 \text{ (which is given in the printout.)} \end{aligned}$$

At a significance level of 0.01, our F-value is far above the value of 9.78 (which is from Table 15.4), so we conclude that the regression as a whole is highly significant.

6. *Conclusion.* Based on statistical considerations, we see that:

- The estimated equation had a good fit
- All three variables are significant explanatory variables
- The regression as a whole is highly significant
- The model developed can be used as a forecasting equation with a great degree of confidence

TABLE 15.2
Values of the Durbin-Watson d for Specified Samples Sizes (T) and Explanatory Variables
Significance level = 0.01

T	$K = 1$		$K = 2$		$K = 3$		$K = 4$		$K = 5$	
	d_L	d_U	d_L	d_U	d_L	d_U	d_L	d_U	d_L	d_U
15	1.08	1.36	0.95	1.54	0.82	1.75	0.69	1.97	0.56	2.21
16	1.10	1.37	0.98	1.54	0.86	1.73	0.74	1.93	0.62	2.15
17	1.13	1.38	1.02	1.54	0.90	1.71	0.78	1.90	0.67	2.10
18	1.16	1.39	1.05	1.53	0.93	1.69	0.82	1.87	0.71	2.06
19	1.18	1.40	1.08	1.53	0.97	1.68	0.86	1.85	0.75	2.02
20	1.20	1.41	1.10	1.54	1.00	1.68	0.90	1.83	0.79	1.99
21	1.22	1.42	1.13	1.54	1.03	1.67	0.93	1.81	0.83	1.96
22	1.24	1.43	1.15	1.54	1.05	1.66	0.96	1.80	0.86	1.94
23	1.26	1.44	1.17	1.54	1.08	1.66	0.99	1.79	0.90	1.92
24	1.27	1.45	1.19	1.55	1.10	1.66	1.01	1.78	0.93	1.90
25	1.29	1.45	1.21	1.55	1.12	1.66	1.04	1.77	0.95	1.89
26	1.30	1.46	1.22	1.55	1.14	1.65	1.06	1.76	0.98	1.88
27	1.32	1.47	1.24	1.56	1.16	1.65	1.08	1.76	1.01	1.86
28	1.33	1.48	1.26	1.56	1.18	1.65	1.10	1.75	1.03	1.85
29	1.34	1.48	1.27	1.56	1.20	1.65	1.12	1.74	1.05	1.84

30	1.35	1.49	1.28	1.57	1.21	1.65	1.14	1.74	1.07	1.83
31	1.36	1.50	1.30	1.57	1.23	1.65	1.16	1.74	1.09	1.83
32	1.37	1.50	1.31	1.57	1.24	1.65	1.18	1.73	1.11	1.82
33	1.38	1.51	1.32	1.58	1.26	1.65	1.19	1.73	1.13	1.81
34	1.39	1.51	1.33	1.58	1.27	1.65	1.21	1.73	1.15	1.81
35	1.40	1.52	1.34	1.58	1.28	1.65	1.22	1.73	1.16	1.80
36	1.41	1.52	1.35	1.59	1.29	1.65	1.24	1.73	1.18	1.80
37	1.42	1.53	1.36	1.59	1.31	1.66	1.25	1.72	1.19	1.80
38	1.43	1.54	1.37	1.59	1.32	1.66	1.26	1.72	1.21	1.79
39	1.43	1.54	1.38	1.60	1.33	1.66	1.27	1.72	1.22	1.79
40	1.44	1.54	1.39	1.60	1.34	1.66	1.29	1.72	1.23	1.79
45	1.48	1.57	1.43	1.62	1.38	1.67	1.34	1.72	1.29	1.78
50	1.50	1.59	1.46	1.63	1.42	1.67	1.38	1.72	1.34	1.77
55	1.53	1.60	1.49	1.64	1.45	1.68	1.41	1.72	1.38	1.77
60	1.55	1.62	1.51	1.65	1.48	1.69	1.44	1.73	1.41	1.77
65	1.57	1.63	1.54	1.66	1.50	1.70	1.47	1.73	1.44	1.77
70	1.58	1.64	1.55	1.67	1.52	1.70	1.49	1.74	1.46	1.77
75	1.60	1.65	1.57	1.68	1.54	1.71	1.51	1.74	1.49	1.77
80	1.61	1.66	1.59	1.69	1.56	1.72	1.53	1.74	1.51	1.77
85	1.62	1.67	1.60	1.70	1.57	1.72	1.55	1.75	1.52	1.77
90	1.63	1.68	1.61	1.70	1.59	1.73	1.57	1.75	1.54	1.78
95	1.64	1.69	1.62	1.71	1.60	1.73	1.58	1.75	1.56	1.78
100	1.65	1.69	1.63	1.72	1.61	1.74	1.59	1.76	1.57	1.78

Critical Values for the t Statistic

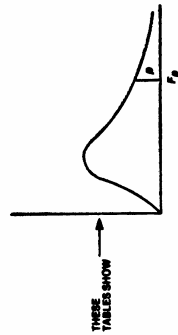
<i>Values of t</i>						
<i>d.f.</i>	$t_{0.100}$	$t_{0.050}$	$t_{0.025}$	$t_{0.010}$	$t_{0.005}$	<i>d.f.</i>
1	3.078	6.314	12.706	31.821	63.657	1
2	1.886	2.920	4.303	6.965	9.925	2
3	1.638	2.353	3.182	4.541	5.841	3
4	1.533	2.132	2.776	3.747	4.604	4
5	1.476	2.015	2.571	3.365	4.032	5
6	1.440	1.943	2.447	3.143	3.707	6
7	1.415	1.895	2.365	2.998	3.499	7
8	1.397	1.860	2.306	2.896	3.355	8
9	1.383	1.833	2.262	2.821	3.250	9
10	1.372	1.812	2.228	2.764	3.169	10
11	1.363	1.796	2.201	2.718	3.106	11
12	1.356	1.782	2.179	2.681	3.055	12
13	1.350	1.771	2.160	2.650	3.012	13
14	1.345	1.761	2.145	2.624	2.977	14
15	1.341	1.753	2.131	2.602	2.947	15
16	1.337	1.746	2.120	2.583	2.921	16
17	1.333	1.740	2.110	2.567	2.898	17
18	1.330	1.734	2.101	2.552	2.878	18
19	1.328	1.729	2.093	2.539	2.861	19
20	1.325	1.725	2.086	2.528	2.845	20
21	1.323	1.721	2.080	2.518	2.831	21
22	1.321	1.717	2.074	2.508	2.819	22
23	1.319	1.714	2.069	2.500	2.807	23
24	1.318	1.711	2.064	2.492	2.797	24
25	1.316	1.708	2.060	2.485	2.787	25
26	1.315	1.706	2.056	2.479	2.779	26
27	1.314	1.703	2.052	2.473	2.771	27
28	1.313	1.701	2.048	2.467	2.763	28
29	1.311	1.699	2.045	2.462	2.756	29
Inf.	1.282	1.645	1.960	2.326	2.576	Inf.

Note: The t value describes the sampling distribution of a deviation from a population value divided by the standard error.

Degrees of freedom ($d.f.$) are in the first column. The probabilities indicated as subvalues of t in the heading refer to the sum of a one-tailed area under the curve that lies outside the point t . For example, in the distribution of the means of samples of size $n = 10$, $d.f. = n - 2 = 8$; then 0.0025 of the area under the curve falls in one tail outside the interval $t \pm 2.306$.

TABLE 15.4

Values of F_P for specified probabilities P and degrees of freedom in the numerator n_1 and degrees of freedom in the denominator n_2



F_P is the value of the Snedecor F random variable such that the probability of obtaining a sample F value at least as large as F_P is P . In the first comprehensive table, the level of significance P is 0.05 for all *lightface entries* and 0.01 for all *boldface entries*. This table continues on four pages with the degrees of freedom in the numerator specified across the top and the degrees of freedom in the denominator specified along the side. The areas are shown in the illustration above. For example, given $n_1 = 4$ and $n_2 = 9$, the value of F is 3.63 when 5% of the total area is in the right tail of the distribution.

F Distribution

$n_1 = \text{degrees of freedom for numerator} = k$												$n_2 = \text{degrees of freedom for denominator} = n - k - 1$											
	1	2	3	4	5	6	7	8	9	10	11	12											
1	161	200	216	225	230	234	237	239	241	242	243	244											
	4.052	4.999	5.408	5.625	5.764	5.859	5.928	5.981	6.023	6.054	6.082	6.106											
2	18.51	19.00	19.16	19.25	19.30	19.33	19.36	19.37	19.38	19.39	19.40	19.41											
	98.49	99.01	99.17	99.25	99.30	99.33	99.34	99.36	99.38	99.40	99.41	99.42											
3	10.13	9.55	9.28	9.12	9.01	8.94	8.88	8.84	8.81	8.78	8.76	8.74											
	34.12	30.81	29.46	28.71	28.24	27.91	27.67	27.49	27.34	27.23	27.13	27.06											
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.93	5.91											
	21.20	18.00	16.69	15.98	15.52	15.21	14.98	14.80	14.66	14.54	14.45	14.37											
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.78	4.74	4.70	4.68											
	16.26	13.27	12.06	11.39	10.87	10.67	10.45	10.27	10.15	10.05	9.96	9.89											
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.03	4.00											
	13.74	10.92	9.78	9.15	8.76	8.47	8.26	8.10	7.98	7.87	7.79	7.72											
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.63	3.60	3.57											
	12.25	9.55	8.45	7.85	7.44	7.19	7.00	6.84	6.71	6.62	6.54	6.47											

8	5.32	4.48	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.34	3.31	3.28
9	11.26	8.64	7.69	7.01	6.63	6.37	6.19	6.03	5.91	5.82	5.74	5.67
	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.13	3.10	3.07
10	10.66	8.02	6.99	6.42	6.06	5.30	5.62	5.47	5.35	5.26	5.18	5.11
	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.97	2.94	2.91
11	10.04	7.54	6.55	5.99	5.64	5.39	5.21	5.06	4.95	4.85	4.78	4.71
	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.86	2.82	2.79
12	9.65	7.20	6.22	5.67	5.32	5.07	4.88	4.74	4.63	4.54	4.46	4.40
	4.75	3.88	3.49	3.26	3.11	3.00	2.92	2.85	2.80	2.76	2.72	2.69
13	9.33	6.93	5.95	5.41	5.04	4.82	4.65	4.50	4.39	4.30	4.22	4.16
	4.67	3.80	3.41	3.18	3.02	2.92	2.84	2.77	2.72	2.67	2.63	2.60
14	9.07	6.70	5.74	5.20	4.86	4.62	4.44	4.30	4.19	4.10	4.02	3.96
	4.60	3.74	3.34	3.11	2.96	2.85	2.77	2.70	2.65	2.60	2.56	2.53
15	8.86	6.51	5.56	5.03	4.69	4.46	4.28	4.14	4.03	3.94	3.86	3.80
	4.54	3.68	3.29	3.06	2.90	2.79	2.70	2.64	2.59	2.55	2.51	2.48
16	8.62	6.36	5.42	4.89	4.56	4.32	4.14	4.00	3.89	3.80	3.73	3.67
	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.45	2.42
17	8.53	6.23	5.29	4.77	4.44	4.20	4.03	3.89	3.78	3.69	3.61	3.55
	4.45	3.59	3.20	2.96	2.81	2.70	2.62	2.55	2.50	2.45	2.41	2.38
18	8.40	6.11	5.18	4.67	4.34	4.10	3.93	3.79	3.68	3.59	3.52	3.45
	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.37	2.34
19	8.26	6.01	5.09	4.58	4.25	4.01	3.86	3.71	3.60	3.51	3.44	3.37
	4.38	3.52	3.13	2.90	2.74	2.63	2.55	2.48	2.43	2.38	2.34	2.31
20	8.18	5.98	5.01	4.50	4.17	3.94	3.77	3.63	3.52	3.43	3.36	3.30
	4.35	3.49	3.10	2.87	2.71	2.60	2.52	2.45	2.40	2.35	2.31	2.28
21	8.10	5.86	4.94	4.43	4.10	3.87	3.71	3.56	3.45	3.37	3.30	3.23
	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32	2.28	2.25
22	8.02	5.78	4.87	4.37	4.04	3.81	3.65	3.51	3.40	3.31	3.24	3.17
	4.30	3.44	3.05	2.82	2.66	2.55	2.47	2.40	2.35	2.30	2.26	2.23
23	7.94	5.72	4.82	4.31	3.99	3.76	3.69	3.45	3.35	3.26	3.18	3.12
	4.28	3.42	3.03	2.80	2.64	2.53	2.45	2.38	2.32	2.28	2.24	2.20
24	7.88	5.64	4.76	4.28	3.94	3.71	3.54	3.41	3.30	3.21	3.14	3.07
	4.26	3.40	3.01	2.78	2.62	2.51	2.43	2.36	2.30	2.26	2.22	2.18
25	7.82	5.61	4.72	4.22	3.90	3.67	3.50	3.36	3.25	3.17	3.09	3.03
	4.24	3.38	2.99	2.76	2.60	2.49	2.41	2.34	2.28	2.24	2.20	2.16
26	7.77	5.57	4.68	4.13	3.86	3.63	3.46	3.32	3.21	3.13	3.05	2.99
	4.22	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27	2.22	2.18	2.15
	7.72	5.83	4.64	4.14	3.82	3.59	3.42	3.29	3.17	3.09	3.02	2.96

MEASURING ACCURACY OF FORECASTS

The performance of a forecast should be checked against its own record or against that of other forecasts. There are various statistical measures that can be used to measure performance of the model. Of course, the performance is measured in terms of forecasting error, where error is defined as the difference between a predicted value and the actual result.

$$\text{Error (e)} = \text{Actual (A)} - \text{Forecast (F)}$$

MAD and MSE

Two commonly used measures for summarizing historical errors are the *mean absolute deviation* (MAD) and the *mean squared error* (MSE). The formulas used to calculate MAD and MSE are

$$\text{MAD} = \Sigma |e| / n$$

$$\text{MSE} = \Sigma e^2 / (n - 1)$$

The following example illustrates the computation of MAD and MSE.

EXAMPLE 15.11

Sales data of a microwave oven manufacturer are given below.

Period	Actual (A)	Forecast (F)	e (A-F)	|e|	e ²
1	217	215	2	2	4
2	213	216	-3	3	9
3	216	215	1	1	1
4	210	214	-4	4	16
5	213	211	2	2	4
6	219	214	5	5	25
7	216	217	-1	1	1
8	212	216	-4	4	16
			<u>-2</u>	<u>22</u>	<u>76</u>

Using the figures,

$$\text{MAD} = \Sigma |e| / n = 22/8 = 2.75$$

$$\text{MSE} = \Sigma e^2 / (n - 1) = 76/7 = 10.86$$

One way these measures are used is to evaluate forecasting ability of alternative forecasting methods. For example, using either MAD or MSE, a forecaster could compare the results of exponential smoothing with alphas and elect the one that performed best in terms of the lowest MAD or MSE for a given set of data. Also, it can help select the best initial forecast value for exponential smoothing.

THE U STATISTIC AND TURNING POINT ERRORS

There is still a number of statistical measures for measuring accuracy of the forecast. Two standards may be identified. First, one could compare the forecast being evaluated with a naive forecast to see if there are vast differences. The naive forecast can be anything like the same as last year, moving average, or the output of an exponential smoothing technique. In the second case, the forecast may be compared against the outcome when there is enough to do so. The comparison may be against the actual level of the variable forecasted, or the change observed may be compared with the change forecast.

The Theil U Statistic is based upon a comparison of the predicted change with the observed change. It is calculated as:

$$U = \frac{(1/n) \sum (F - A)^2}{(1/n) \sum F^2 + (1/n) \sum A^2}$$

As can be seen, $U=0$ is a perfect forecast, since the forecast would equal actual and $F - A = 0$ for all observations. At the other extreme, $U=1$ would be a case of all incorrect forecasts. The smaller the value of U , the more accurate are the forecasts. If U is greater than or equal to 1, the predictive ability of the model is lower than a naive no-change extrapolation. *Note:* Many computer software packages routinely compute the U Statistic.

CONTROL OF FORECASTS

It is important to monitor forecast errors to insure that the forecast is performing well. If the model is performing poorly based on some criteria, the forecaster might reconsider the use of the existing model or switch to another forecasting model or technique. The forecasting control can be accomplished by comparing forecasting errors to predetermined values, or limits. Errors that fall within the limits would be judged acceptable while errors outside of the limits would signal that corrective action is desirable. Forecasts can be monitored using either tracking signals or control charts.

A tracking signal is based on the ratio of cumulative forecast error to the corresponding value of MAD.

$$\text{Tracking signal} = \Sigma(A - F) / \text{MAD}$$

The resulting tracking signal values are compared to predetermined limits. These are based on experience and judgment and often range from plus or minus 3 to plus or minus 8. Values within the limits suggest that the forecast is performing adequately. By the same token, when the signal goes beyond this range, corrective action is appropriate.

EXAMPLE 15.12

Going back to Example 15.11, the deviation and cumulative deviation have already been computed:

$$\text{MAD} = \Sigma |A - F| / n = 22 / 8 = 2.75$$

$$\text{Tracking signal} = \Sigma (A - F) / \text{MAD} = -2 / 2.75 = -0.73$$

A tracking signal is as low as -0.73, which is substantially below the limit (-3 to -8). It would not suggest any action at this time.

Note: Plot the errors and see if all errors are within the limits, so that the forecaster can visualize the process and determine if the method being used is in control.

EXAMPLE 15.13

For the sales data below, using the naive forecast, we will determine if the forecast is in control. For illustrative purposes, we will use 2 sigma control limits.

<u>Year</u>	<u>Sales</u>	<u>Forecasts</u>	<u>Error</u>	<u>Error²</u>
1	320			
2	326	320	6	36
3	310	326	-16	256
4	317	310	7	49
5	315	317	-2	4
6	318	315	3	9
7	310	318	-8	64
8	316	310	6	36
9	314	316	-2	4
10	317	314	<u>3</u>	<u>9</u>
			<u>-3</u>	<u>467</u>

First, compute the standard deviation of forecast errors.

$$S_f = \sqrt{e^2 / (n - 1)} = \sqrt{467 / (9 - 1)} = 7.64$$

Two sigma limits are then plus or minus $2(7.64) = -15.28$ to $+15.28$

Note that the forecast error for year 3 is below the lower bound, so the forecast is not in control. The use of other methods such as moving average, exponential smoothing, or regression would possibly achieve a better forecast.

FORECASTING SALES WITH THE MARKOV MODEL

The forecasting methods we have discussed to date were, for the most part, based on the use of historical data. They did not consider aspects of consumer behavior in making purchase decisions in the marketplace. In this section, we will present a model based on learned behavior, called the *Markov model*. We operate on the thesis that consumption is a form of learned behavior. That is, consumers tend to repeat their past consumption activities. Some consumers become loyal to certain product types as well as specific brands. Others seek other brands and products. In general, there is a great degree of regularity about such behavior. The Markov model is developed so as to predict market share by considering consumer brand loyalty and switching behaviors.

The model has the following objectives:

1. To predict the market share that a firm will have at some point in the future.
2. To predict whether some constant or level market share will be obtained in the future. Most Markov models will result in a final constant market share where changes in market share will no longer result with the passage of time.
3. To investigate the impact of the company's marketing strategies and promotional efforts, such as advertising, on gain or loss in market share.

To answer these questions, we need to compute what is called transition probabilities for all the companies involved in the market. Transition probabilities are nothing more than the probabilities that a certain seller will retain, gain, and lose customers. To develop this, we need sample data of past consumer behavior. Let us assume that there are three battery manufacturers, A, B, and C. Each of the firms know that consumers switch from one firm to another over time because of advertising, dissatisfaction with service, and other sales promotion efforts. We assume that each firm maintains records of consumer movements for a specified time period, like one month. We further assume that no new customers enter and no old customers leave the market during this period.

Table 15.5 provides data on the flows among all the firms.

TABLE 15.5
FLOW OF CUSTOMERS

<i>Firms</i>	<i>Jan. 1</i>	<i>Gains</i>			<i>To</i>	<i>Losses</i>			<i>Feb. 1</i>
	<i>Customers</i>	<i>From</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>Customers</i>
A	300		0	45	35	0	30	30	320
B	600		30	0	20	45	0	15	590
C	400		30	15	0	35	20	0	390

This table can be converted into a matrix form as shown in Table 15.6.

TABLE 15.6
RETENTION, GAIN, AND LOSS

		<i>Retention and Loss to</i>			<i>Total</i>
<i>Firms</i>		<i>A</i>	<i>B</i>	<i>C</i>	
<i>Retention</i>	A	240	30	30	300
<i>And</i>	B	45	540	15	600
<i>Gain</i>	C	<u>35</u>	<u>20</u>	<u>345</u>	<u>400</u>
	Total	320	590	390	1300

Table 15.7 is a matrix of the same sizes as the one in Table 15.6 illustrating exactly how each probability was determined

TABLE 15.7
TRANSITION PROBABILITY MATRIX

<i>Probability of Customers being Retained or gained</i>	<i>Firms</i>	<i>Probability of Customers Being Retained or Lost</i>		
		<i>A</i>	<i>B</i>	<i>C</i>
	A	240/300=.80	30/300=.10	30/300=.10
	B	45/600=.075	540/600=.9	15/600=.025
	C	35/400=.0875	20/400=.05	345/400=.8625

The rows in this matrix show the probability of the retention of customers and the loss of customers; the columns represent the probability of retention of customers and the gain of customers. For example, row 1 indicates that A retains .8 of its customers (30) to C. Also, column 1, for example, indicates that A retains .8 of its customers (240), gains .075 of B's customers (45), and gains .0875 of C's customers (35).

The original market share a January 1 was:
 $(300A \ 600B \ 400C) = (.2308A \ .4615B \ .3077C)$

With this, we will be able to calculate market share, using the transition matrix we developed in Table 15.7.

To illustrate, Company A held 23.08 percent of the market at January 1. Of this, 80 percent was retained, Company A gained 10 percent of Company B's 46.15 percent of the market, and another 10 percent of Company C's 30.77 percent.

The February 1 market share of Company A is, therefore, calculated to be:

Retention	$.8 \times .2308 = .1846$
Gain from B	$.1 \times .4615 = .0462$
Gain from C	$.1 \times .3077 = .0308$
	<u><u>.2616*</u></u>

Similarly, Company B's market share is as follows:

Gain from A	$.075 \times .2308 = .0173$
Retention	$.9 \times .4615 = .4154$
Gain from C	$.025 \times .3077 = .0077$
	<u><u>.4404*</u></u>

Company C's market share is:

Gain from A	$.0875 \times .2308 = .0202$
Gain from B	$.05 \times .4615 = .0231$
Retention	$.8625 \times .3077 = .2654$
	<u><u>.3087*</u></u>

*These numbers do not add up to exactly 100 percent due to rounding errors.

In summary, the February 1 market share came out to be approximately:

26% for Company A

44% for Company B

30% for Company C

The market share forecasts may then be used to generate a specific forecast of sales. For example, if industry sales are forecast to be, say, \$10 million, obtained through regression analysis, input-output analysis, or some other technique, the forecast of sales for A is \$2.6 million (\$100 million x .26).

If the company wishes to forecast the market share for March, then, the procedure is exactly the same as before, except using the February 1 forecasted market share as a basis. The forecaster must be careful when using the Markov casting market shares in the near future. Distant forecasts, after many time periods, generally are not very reliable forecasts by this method. Even in short-term forecasts, constant updating of the transition matrix is needed for accuracy of projection.

At least in theory, most Markov models will result in a final constant market share in which market share will no longer change with the passage of time. However, this market share and its derivation will not be discussed here. In effect, this model has very little practical application because the constant or level condition assumes no changes in competitive efforts of the firms within the industry.

CONCLUSION

Regression analysis is the examination of the effect of a change in independent variables on the dependent variable. It is a popularly used method to forecast sales. This chapter discussed the well-known estimation technique, called the *least-squares method*.

To illustrate the method, we assume a simple regression, which involves one independent variable in the form of $Y = a + bX$. In an attempt to obtain a good fit, we discussed various regression statistics. These statistics tell you how good and reliable your estimated equation is and help you set the confidence interval for your prediction.

Most importantly, we discussed how to utilize spreadsheet programs such as Excel to perform regressions, step by step. The program calculates not only the regression equation, but also all the regression statistics discussed in this chapter. Multiple regression analysis is the examination of the effect of a change in explanatory variables on the dependent variable. For example, various financial ratios bear on a firm's market price of stock. Many important statistics that are unique to multiple regression analysis were explained with computer illustrations. An emphasis was placed on how to pick the best forecasting equation.

There is always a cost associated with a failure to predict a certain variable accurately. Because all forecasts tend to be off the mark, it is important to provide a measure of accuracy for each forecast. Several measures of forecast accuracy and a measure of turning point error can be calculated. These quite often are used to help managers evaluate the performance of a given method as well as to choose among alternative forecasting techniques. Control of forecasts involves deciding whether a forecast is performing adequately, using either a control chart or a tracking signal. Selection of a forecasting method involves choosing a technique that will serve its intended purpose at an acceptable level of cost and accuracy.

The Markov model can be used to take into account learned behavior, such as consumer spending patterns.

CHAPTER 16

FINANCIAL FORECASTING AND BUDGETING TOOLS

LEARNING OBJECTIVES

After studying the material in this chapter, you will be able to:

1. Forecast external financing needs with the percent-of-sales method.
2. Describe how budgeting and financial planning works.
3. Give examples of how the budget works.
4. Discuss zero-base budgeting.
5. Outline the certified public accountant's involvement and responsibility with prospective financial statements.

Financial forecasting, an essential element of planning, is the basis for *budgeting* activities. It is also needed when estimating future financing requirements. The company may look either internally or externally for financing. Internal financing refers to cash flow generated from the company's normal operating activities. External financing refers to capital provided by parties external to the company. You need to analyze how to estimate *external* financing requirements. Basically, forecasts of future sales and related expenses provide the firm with the information to project future external financing needs. The chapter discusses (1) the *percent-of-sales method* to determine the amount of external financing needed, (2) budgeting and financial planning, (3) zero-base budgeting, and (4) the CPA's involvement in prospective financial statements.

FORECASTING EXTERNAL FINANCING NEEDS--THE PERCENT-OF-SALES METHOD

Percentage of sales is the most widely used method for projecting the company's financing needs. Financial officers need to determine the next year's fund requirements, the portion of which has to be raised externally. This way they can have a head start for arranging a least-cost financing plan.

This method involves estimating the various expenses, assets, and liabilities for a future period as a percent of the sales forecast and then using these percentages, together with the projected sales, to construct pro forma balance sheets.

Basically, forecasts of future sales and their related expenses provide the firm with the information needed to project its future needs for financing.

The basic steps in projecting financing needs are:

1. Project the firm's sales. The sales forecast is the initial most important step. Most other forecasts (budgets) follow the sales forecast.

2. Project additional variables such as expenses.
3. Estimate the level of investment in current and fixed assets that are required to support the projected sales.
4. Calculate the firm's financing needs.

The following example illustrates how to develop a pro forma balance sheet and determine the amount of external financing needed.

EXAMPLE 16.1

Assume that sales for 20X0 = \$20, projected sales for 20X1 = \$24, net income = 5% of sales, and the dividend payout ratio = 40%.

The steps for the computations are outlined as follows:

Step 1. Express those balance sheet items that vary directly with sales as a percentage of sales. Any item such as long-term debt that does not vary directly with sales is designated "n.a.," or "not applicable."

Step 2. Multiply these percentages by the 20X1 projected sales = \$24 to obtain the projected amounts as shown in the last column.

Step 3. Simply insert figures for long-term debt, common stock and paid-in-capital from the 20X0 balance sheet.

Step 4. Compute 20X1 retained earnings as shown in (b).

Step 5. Sum the asset accounts, obtaining a total projected assets of \$7.2, and also add the projected liabilities and equity to obtain \$7.12, the total financing provided. Since liabilities and equity must total \$7.2, but only \$7.12 is projected, we have a shortfall of \$0.08 "external financing needed."

Although the forecast of additional funds required can be made by setting up pro forma balance sheets as described above, it is often easier to use the following formula:

External funds needed (EFN)	Required Increase in assets	Spontaneous increase in liabilities	Increase in retained earnings
EFN	$(A/S)\Delta S$	$(L/S)\Delta S$	$(PM)(PS)(1-d)$

where:

A/S	=	Assets that increase spontaneously with sales as a percentage of sales.
L/S	=	Liabilities that increase spontaneously with sales as a percentage of sales.
ΔS	=	Change in sales.
PM	=	Profit margin on sales.
PS	=	Projected sales
d	=	Dividend payout ratio.

EXAMPLE 16.2

In Example 16.1,

A/S	=	\$6/\$20	=	30%
L/S	=	\$2/\$20	=	10%
ΔS	=	(\$24 - \$20)	=	\$4
PM	=	5% on sales		
PS	=	\$24		
d	=	40%		

Plugging these figures into the formula yields:

$$\begin{aligned}\text{EFN} &= 0.3(\$4) - 0.1(\$4) - (0.05)(\$24)(1 - 0.4) \\ &= \$1.2 - \$0.4 - \$0.72 = \$0.08\end{aligned}$$

Thus, the amount of external financing needed is \$800,000, which can be raised by issuing notes payable, bonds, stocks, or any combination of these financing sources.

The major advantage of the percent-of-sales method of financial forecasting is that it is simple and inexpensive to use. To obtain a more precise projection of the firm's future financing needs, however, the preparation of a cash budget is required. One important assumption behind the use of the method is that the firm is operating at full capacity. This means that the company has no sufficient productive capacity to absorb a projected increase in sales and thus requires additional investment in assets.

BUDGETING AND FINANCIAL PLANNING

A comprehensive (master) budget is a formal statement of management's expectation regarding sales, expenses, volume, and other financial transactions of an organization for the coming period. Simply put, a budget is a set of pro forma (projected or planned) financial statements. It consists basically of a pro forma income statement, pro forma balance sheet and cash budget. A budget is a tool for both planning and control. At the beginning of the period, the budget is a plan or standard; at the end of the period it serves as a control device to help management measure its performance against the plan so that future performance may be improved.

It is important to realize that with the aid of computer technology, budgeting can be used as an effective device for evaluation of "what-if" scenarios. This way management should be able to move toward finding the best course of action among various alternatives through simulation. If management does not like what they see on the budgeted financial statements in terms of various financial ratios such as liquidity, activity (turnover), leverage, profit margin, and market value ratios, they can always alter their contemplated decision and planning set.

FIGURE 16.1

**PRO FORM BALANCE SHEET
(IN MILLIONS OF DOLLARS)**

	Present (20X1)	% of Sales (20X1 Sales = \$20)	Projected (20X2 Sales = \$24)
Assets			
Current assets	2	10	2.4
Fixed assets	4	20	4.8
Total assets	<u>6</u>		<u>7.2</u>
LIABILITIES AND STOCKHOLDERS' EQUITY			
Current liabilities	2	10	2.4
Long-term debt	2.5	n.a.	2.5
Total liabilities	<u>4.5</u>		<u>4.9</u>
Common stock	0.1	n.a.	0.1
Capital surplus	0.2	n.a.	0.2
Retained earnings	1.2		1.92 ^a
Total equity	<u>1.5</u>		<u>2.22</u>
Total liabilities and stockholders' equity	<u>6</u>		<u>7.12</u>
			Total financing provided
			External financing needed
			<u>0.08^b</u>
			<u>7.2</u>
			Total

$$\begin{aligned}
 ^a \text{ 20X2 retained earnings} &= \text{20X1 retained earnings} + \text{projected net income} \\
 &\quad - \text{cash dividends paid} \\
 &= \$1.2 + 5\%(\$24) - 40\%(5\%(\$24)) \\
 &= \$1.2 + \$1.2 - \$0.48 = \$2.4 - \$0.48 = \$1.92
 \end{aligned}$$

$$\begin{aligned}
 ^b \text{ External financing needed} &= \text{projected total assets} - (\text{projected total liabilities} \\
 &\quad + \text{projected equity}) \\
 &= \$7.2 - (\$4.9 + 2.22) = \$7.2 - \$7.12 = \$0.08
 \end{aligned}$$

The budget is classified broadly into two categories:

1. Operating budget, reflecting the results of operating decisions.
2. Financial budget, reflecting the financial decisions of the firm.

The operating budget consists of:

- Sales budget
- Production budget
- Direct materials budget
- Direct labor budget
- Factory overhead budget
- Selling and administrative expense budget
- Pro forma income statement

The financial budget consists of:

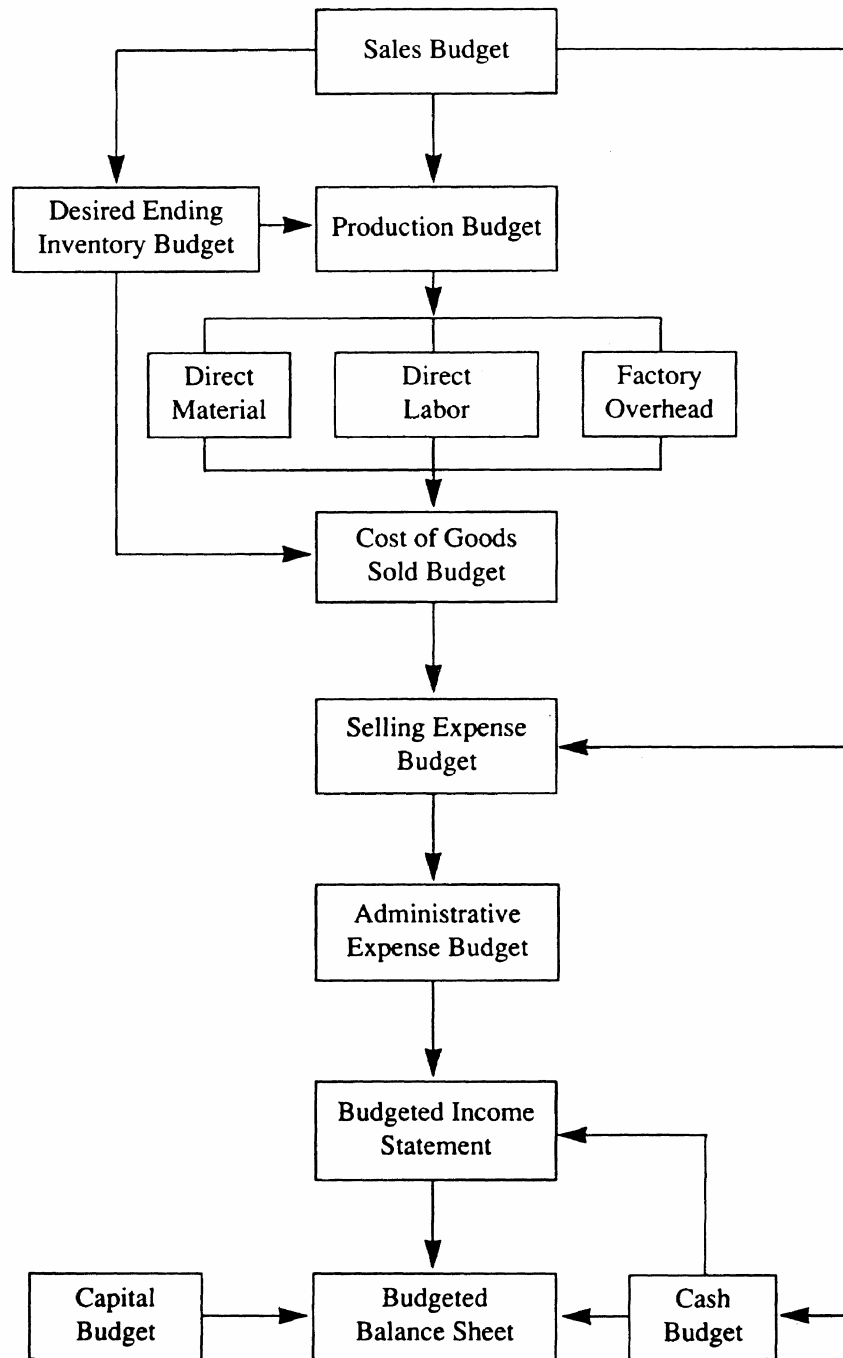
- Cash budget
- Pro forma balance sheet

The major steps in preparing the budget are:

1. Prepare a sales forecast.
2. Determine expected production volume.
3. Estimate manufacturing costs and operating expenses.
4. Determine cash flow and other financial effects.
5. Formulate projected financial statements.

Figure 16.2 shows a simplified diagram of the various parts of the comprehensive (master) budget, the master plan of the company.

FIGURE 16.2
MASTER BUDGET



HOW THE BUDGET WORKS: AN EXAMPLE

To illustrate how all these budgets are put together, we will focus on a *manufacturing* company called the Putnam Company, which produces and markets a single product. We will make the following assumptions:

- The company uses a single material and one type of labor in the manufacture of the product.
- It prepares a master budget on a *quarterly* basis.
- Work in process inventories at the beginning and end of the year are negligible and are ignored.
- The company uses a single cost driver—direct labor hours (DLH)—as the allocation base for assigning all factory overhead costs to the product.

THE SALES BUDGET

The sales budget is the starting point in preparing the master budget, since estimated sales volume influences nearly all other items appearing throughout the master budget. The sales budget should show total sales in quantity and value. The expected total sales can be break-even or target income sales or projected sales. It may be analyzed further by product, by territory, by customer and, of course, by seasonal pattern of expected sales.

Generally, the sales budget includes a computation of expected cash collections from credit sales, which will be used later for cash budgeting.

EXAMPLE 16.3

THE PUTNAM COMPANY Sales Budget

For the Year Ended December 31, 20B

	QUARTER				Year as a Whole
	1	2	3	4	
Expected sales in units*	1000	1800	2000	1200	6000
Unit sales price*	x \$150	x \$150	x \$150	x \$150	x \$150
Total sales	\$150,000	\$270,000	\$300,000	\$180,000	\$900,000

*Given.

SCHEDULE OF EXPECTED CASH COLLECTIONS

Accounts receivable 12/31/20A	100,000+				\$100,000
	60,000++	\$ 90,000+++			150,000
		108,000	\$162,000		270,000
			120,000	\$180,000	300,000
				72,000	72,000
Total cash collections	\$160,000	\$198,000	\$282,000	\$252,000	\$892,000

+ All of the \$100,000 accounts receivable balance is assumed to be collectible in the first quarter.

++ 40 percent of a quarter's sales are collected in the quarter of sale.

+++ 60 percent of a quarter's sales are collected in the quarter following.

MONTHLY CASH COLLECTIONS FROM CUSTOMERS

Frequently, there are time lags between monthly sales made *on account* and their related monthly cash collections. For example, in any month, credit sales are collected as follows: 15% in month of sale, 60% in the following month, 24% in the month after, and the remaining 1 percent are uncollectible.

	<i>April-Actual</i>	<i>May-Actual</i>	<i>June-Budgeted</i>	<i>July-Budgeted</i>
Credit sales	\$320	200	300	280

The budgeted cash receipts for June and July are computed as follows:

For June:		
From April sales	\$320 x .24	\$ 76.80
From May sales	200 x .6	120.00
From June sales	300 x .15	<u>45.00</u>
Total budgeted collections in June		\$241.80

For July:		
From May sales	\$200 x .24	\$ 48
From June sales	300 x .6	180
From July sales	280 x .15	<u>42</u>
Total budgeted collections in July		\$270

THE PRODUCTION BUDGET

After sales are budgeted, the production budget can be determined. The production budget is a statement of the output by product and is generally expressed in units. It should take into account the sales budget, plant capacity, whether stocks are to be increased or decreased and outside purchases. The number of units expected to be manufactured to meet budgeted sales and inventory requirements is set forth in the production budget.

$$\text{Expected Production Volume} = \text{Desired Planned sales inventory} + \text{ending} - \text{Beginning inventory}$$

The production budget is illustrated as follows:

EXAMPLE 16.4

THE PUTNAM COMPANY Production Budget For the Year Ended December 31, 20B					
	QUARTER				Year as a Whole
	1	2	3	4	
Planned sales (Example 16.3)	1,000	1,800	2,000	1,200	6,000
Desired ending inventory*	180	200	120	300**	300
Total Needs	1,180	2,000	2,120	1,500	6,300
Less: Beginning inventory	200**	180***	200	120	200
Units to be produced	980	1,820	1,920	1,380	6,100

* 10 percent of the next quarter's sales. (For example, 180 = 10% x 1,800).
 ** Given.
 *** The same as the previous quarter's ending inventory.

INVENTORY PURCHASES – MERCHANDISING FIRM

Putnam Company is a manufacturing firm, so it prepares a production budget, as shown in Example 16.4. If it were a *merchandising* (retailing or wholesaling) firm, then instead of a production budget, it would develop a *merchandise purchase budget* showing the amount of goods to be purchased from its suppliers during the period. The merchandise purchase budget is in the same basic format as the production budget, except that it shows *goods to be purchased* rather than goods to be produced, as shown below:

Budgeted cost of goods sold (in units or dollars)	\$500,000
Add: Desired ending merchandise inventory	120,000
Total needs	\$620,000
Less: Beginning merchandise inventory	(90,000)
Required purchases (in units or in dollars)	\$530,000

THE DIRECT MATERIAL BUDGET

When the level of production has been computed, a direct material budget should be constructed to show how much material will be required for production and how much material must be purchased to

meet this production requirement.

The purchase will depend on both expected usage of materials and inventory levels. The formula for computation of the purchase is:

$$\text{Purchase in units} = \text{Usage} + \text{Desired ending material inventory units} - \text{Beginning inventory units}$$

The direct material budget is usually accompanied by a computation of expected cash payments for materials.

EXAMPLE 16.5

THE PUTNAM COMPANY Direct Material Budget					
For the Year Ended December 31, 20B					
	QUARTER				Year as a Whole
	1	2	3	4	
Units to be produced (Sch.2)	980	1,820	1,920	1,380	6,100
Material needs per unit (lbs)*	x 2	x 2	x 2	x 2	x 2
Production needs (usage)	1,960	3,640	3,840	2,760	12,200
Desired ending inventory of materials**	910	960	690	520***	520
Total needs	2,870	4,600	4,530	3,280	12,720
Less: Beginning inventory of materials	490	910****	960	690	490
Materials to be purchased	2,380	3,690	3,570	2,590	12,230
Unit price*	x \$5	x \$5	x \$5	x \$5	x \$5
Purchase cost	\$11,900	\$18,450	\$17,850	\$12,950	\$61,150

SCHEDULE OF EXPECTED CASH DISBURSEMENTS

Accounts payable, 12/31/20A	\$6,275+				\$ 6,275
1st quarter purchases (\$11,900)	5,950++	5,950++			11,900
2d quarter purchases (\$18,450)		9,225	9,225		18,450
3d quarter purchases (\$17,850)			8,925	8,925	17,850
4th quarter purchases (\$12,950)				6,475	6,475
Total disbursements	\$12,225	\$15,175	\$18,150	\$15,400	\$60,950

- * Given.
- ** 25 percent of the next quarter's units needed for production. For example, the 2nd quarter production needs are 3,640 lbs. Therefore, the desired ending inventory for the 1st quarter would be 25% x 3,640 lbs. = 910 lbs.
- *** Assume that the budgeted production needs in lbs. for the 1st quarter of 20B = 2,080 lbs. So, 25% x 2,080 lbs. = 520 lbs.
- **** The same as the prior quarter's ending inventory.
- + All of the \$6,275 accounts payable balance (from the balance sheet, 20A) is assumed to be paid in the first quarter.
- ++ 50 percent of a quarter's purchases are paid for in the quarter of purchase; the remaining 50% are paid for in the following quarter.

THE DIRECT LABOR BUDGET

The production requirements as set forth in the production budget also provide the starting point for the preparation of the direct labor budget. To compute direct labor requirements, expected production volume for each period is multiplied by the number of direct labor hours required to produce a single unit. The direct labor hours to meet production requirements is then multiplied by the (standard) direct labor cost per hour to obtain budgeted total direct labor costs.

EXAMPLE 16.6

THE PUTNAM COMPANY Direct Labor Budget For the Year Ended December 31, 20B

	QUARTER				Year as a Whole
	1	2	3	4	
Units to be produced (Example 16.4)	980	1,820	1,920	1,380	6,100
Direct labor hours per unit*	x 5	x 5	x 5	x 5	x 5
Total hours	4,900	9,100	9,600	6,900	30,500
Direct labor cost per hour*	x \$10	x \$10	x \$10	x \$10	x \$10
Total direct labor cost	\$49,000	\$91,000	\$96,000	\$69,000	\$305,000

*Both are given.

THE FACTORY OVERHEAD BUDGET

The factory overhead budget should provide a schedule of all manufacturing costs other than direct materials and direct labor. Using the contribution approach to budgeting requires the cash budget. We must remember that depreciation does not entail a cash outlay and therefore must be deducted from the total factory overhead in computing cash disbursement for factory overhead.

EXAMPLE 16.7

To illustrate the factory overhead budget, we will assume that:

- Total factory overhead budgeted = \$18,300 fixed (per quarter), plus \$2 per hour of direct labor. This is one example of a cost-volume (or flexible budget) formula ($y = a + bx$), developed via the *regression (least-squares) method* with a high R^2 .
- Depreciation expenses are \$4,000 each quarter.
- Overhead costs involving cash outlays are paid for in the quarter incurred.

THE PUTNAM COMPANY Factory Overhead Budget For the Year Ended December 31, 20B

	QUARTER				Year as a Whole
	1	2	3	4	
Budgeted direct labor hours (Example 16.6)	4,900	9,100	9,600	6,900	30,500
Variable overhead rate	x \$2	x \$2	x \$2	x \$2	x \$2
Variable overhead budgeted	9,800	18,200	19,200	13,800	61,000
Fixed overhead budgeted	18,300	18,300	18,300	18,300	73,200
Total budgeted overhead	28,100	36,500	37,500	32,100	134,200
Less: Depreciation*	4,000	4,000	4,000	4,000	16,000
Cash disbursements for factory overhead	\$24,100	\$32,500	\$33,500	\$28,100	\$118,200

*Depreciation does not require a cash outlay.

THE ENDING FINISHED GOODS INVENTORY BUDGET

The ending finished goods inventory budget provides us with the information required for the construction of budgeted financial statements. After completing Examples 16.3-16.7, sufficient data will have been generated to compute the per-unit manufacturing cost of finished product. This computation is required for two reasons: (1) to help compute the cost of goods sold on the budgeted income statement; and (2) to give the dollar value of the ending finished goods inventory to appear on the budgeted balance sheet.

EXAMPLE 16.8

THE PUTNAM COMPANY

Ending Finished Goods Inventory Budget

For the Year Ended December 31, 20B

<i>Ending Inventory Units</i>	<i>Unit Product Cost</i>	<i>Total</i>
300 units (Ex. 16.4)	\$82*	\$24,600

*The unit product cost of \$82 is computed as follows:

	<i>Unit Cost</i>	<i>Units</i>	<i>Total</i>
Direct materials	\$ 5 per lbs.	2 pounds	\$10
Direct labor	10 per hr.	5 hours	50
Factory overhead**	4.40 per hr.	5 hours	22
Unit product cost			\$82

** Predetermined factory overhead applied rate = Budgeted annual factory overhead/budgeted annual activity units = \$134,200/30,500 DLH = \$4.40.

THE SELLING AND ADMINISTRATIVE EXPENSE BUDGET

The selling and administrative expense budget lists the operating expenses involved in selling the products and in managing the business. Just as in the case of the factory overhead budget, this budget can be developed using the cost-volume (*flexible budget*) formula in the form of $y = a + bx$.

If the number of expense items is very large, separate budgets may be needed for the selling and administrative functions.

EXAMPLE 16.9

THE PUTNAM COMPANY

Selling and Administrative Expense Budget

For the Year Ended December 31, 20B

	QUARTER				Year as a Whole
	1	2	3	4	
Expected sales in units	1,000	1,800	2,000	1,200	6,000

Variable selling and administrative expense per unit*	x \$3	x \$3	x \$3	x \$3	x \$3
Budgeted variable expense	\$3,000	\$5,400	\$6,000	\$3,200	\$18,000
Fixed selling and administrative expense**:					
Advertising	20,000	20,000	20,000	20,000	80,000
Insurance		12,600			12,600
Office salaries	40,000	40,000	40,000	40,000	160,000
Taxes				7,400	7,400
Total budgeted selling and administrative expenses***	\$63,000	\$78,000	\$66,000	\$71,000	\$278,000

*Assumed. It includes sales agents' commissions, shipping, and supplies.

**Scheduled to be paid.

***Paid for in the quarter incurred.

THE CASH BUDGET

The cash budget is prepared for the purpose of cash planning and control. It presents the expected cash inflow and outflow for a designated time period. The cash budget helps management keep cash balances in reasonable relationship to its needs. It aids in avoiding unnecessary idle cash and possible cash shortages. The cash budget consists typically of four major sections:

1. The *cash receipts* section, which is a cash collection from customers and other cash receipts such as royalty income and investment income.
2. The *cash disbursements* section, which comprises all cash payments made by purpose.
3. The *cash surplus* or *deficit* section, which simply shows the difference between the total cash available and the total cash needed including a *minimum cash balance* if required. If there is surplus cash, loans may be repaid or temporary investments made.
4. The *financing* section, which provides a detailed account of the borrowings, repayments, and interest payments expected during the budgeting period.

The *investments* section, which encompasses investment of excess cash and liquidation of investment of surplus cash.

EXAMPLE 16.10

To illustrate, we will make the following assumptions:

- Putnam Company has an open line of credit with its bank, which can be used as needed to bolster the cash position.
- The company desires to maintain a \$10,000 minimum cash balance at the end of each quarter. Therefore, borrowing must be sufficient to cover the cash shortfall and to provide for the minimum cash balance of \$10,000
- All borrowings and repayments must be in multiples of \$1,000 amounts, and interest is 10 percent per annum.
- Interest is computed and paid on the principal as the principal is repaid.

- All borrowings take place at the beginning of a quarter, and all repayments are made at the end of a quarter.
- No investment option is allowed in this example. The loan is *self-liquidating* in the sense that the borrowed money is used to obtain resources that are combined for sale, and the proceeds from sales are used to pay back the loan.

Note: To be useful for cash planning and control, the cash budget must be prepared on a *monthly* basis.

Note the following:

Cash balance, beginning
 Add receipts:
 Total cash available before financing (a)
 Deduct disbursements:
 Total cash disbursements (b)
 + Minimum cash balance desired
 Total cash needed (c)
 Cash surplus or deficit (a) – (c)
 Financing:
 Borrowing (at beginning)
 Repayment (at end)
 Interest
 Total effects of financing (d)
 Cash balance, ending [(a) – (b) + (d)]

THE PUTNAM COMPANY
Cash Budget
For the Year Ended December 31, 20B

	From Example	1	QUARTER			Year as a Whole
			2	3	4	
Cash balance, beginning		\$19,000*	10,675	10,000	10,350	19,000
Add: Receipts:						
Collections from customers	16.3	160,000	198,000	282,000	252,000	892,000
Total cash available (a)		179,000	208,675	292,000	262,350	911,000
Less:						
Disbursements:						
Direct materials	16.5	12,225	15,175	18,150	15,400	60,950
Direct labor	16.6	49,000	91,000	96,000	69,000	305,000
Factory overhead	16.7	24,100	32,500	33,500	28,100	118,200
Selling and Admin.	16.9	63,000	78,000	66,000	71,000	278,000
Equipment purchase	Given	30,000	12,000	0	0	42,000
Dividends	Given	5,000	5,000	5,000	5,000	20,000
Income tax	16.12	15,000	15,000	15,000	15,000	60,000
Total disbursements (b)		198,325	248,675	233,650	203,500	884,150
Minimum cash balance		10,000	10,000	10,000	10,000	10,000
Total cash needed (c)		208,325	258,675	243,650	213,500	894,150
Cash surplus (deficit) (a) – (c)		(29,325)	(50,000)	48,350	48,850	16,850
Financing:						
Borrowing		30,000**	50,000	0	0	80,000
Repayment		0	0	(45,000)	(35,000)	(80,000)
Interest effects of financing (d)		0	0	(3,000)**	(2,625)+	(5,625)
Total		30,000	50,000	(48,000)	(37,625)	(5,625)
Cash balance, ending		\$10,675	10,000	10,350	21,225	\$21,225
[(a)–(b) + (d)]						

* \$19,000 (from the balance sheet 20A).

** The company desires to maintain a \$10,000 minimum cash balance at the end of each quarter. Therefore, borrowing must be sufficient to cover the cash shortfall of \$19,325 and to provide for the minimum cash balance of \$10,000, for a total of \$29,325.

*** The interest payments relate only to the principal being repaid at the time it is repaid. For example, the interest in quarter 3 relates only to the interest due on the \$30,000 principal being

repaid from quarter 1 borrowing and on the \$15,000 principal being repaid from quarter 2 borrowing. Total interest being paid is \$3,000, shown as follows:

$$\begin{array}{rcl}
 \$30,000 \times 10\% \times \frac{3}{4} & = & \$2,250 \\
 \$15,000 \times 10\% \times \frac{2}{4} & = & 750 \\
 + \$35,000 \times 10\% \times \frac{3}{4} & = & \$2,625
 \end{array}$$

THE BUDGETED INCOME STATEMENT

The budgeted income statement summarizes the various component projections of revenue and expenses for the budgeting period. However, for control purposes the budget can be divided into quarters or even months depending on the need.

EXAMPLE 16.11

THE PUTNAM COMPANY Budgeted Income Statement For the Year Ended December 31, 20B

From Example			
Sales (6,000 units @ \$150)	16.3		\$900,000
Less: Cost of goods sold			
Beginning finished goods inventory	16.12	\$16,400	
Add: Cost of goods manufactured			
(6,100 units @\$82)	6	500,200	
Cost of goods available for sale		516,600	
Less: Ending finished goods inventory	16.10	(24,600)	\$492,000
Gross margin			\$408,000
Less: Selling and administrative expense	16.11		278,000
Operating income			130,000
Less: Interest expense	16.10		5,625
Net income before taxes			124,375
Less: Income taxes			60,000*
Net income after taxes			\$64,375

*Estimated.

THE BUDGETED BALANCE SHEET

The budgeted balance sheet is developed by beginning with the balance sheet for the year just ended and adjusting it, using all the activities that are expected to take place during the budgeting period. Some of the reasons why the budgeted balance sheet must be prepared are:

- It could disclose some unfavorable financial conditions that management might want to avoid.
- It serves as a final check on the mathematical accuracy of all the other schedules.
- It helps management perform a variety of ratio calculations.
- It highlights future resources and obligations.

We can construct the budgeted balance sheet by using:

- ◆ The December, 20A balance sheet (Example 16.12)
- ◆ The cash budget (Example 16.10)
- ◆ The budgeted income statement (Example 16.11).

Putnam's budgeted balance sheet for December 31, 20B, is presented below. Supporting calculations of the individual statement accounts are also provided.

EXAMPLE 16.12

To illustrate, we will use the following balance sheet for the year 20A.

THE PUTNAM COMPANY

Balance Sheet

December 31, 20A

Assets

Current assets:

Cash	\$ 19,000	
Accounts receivable	100,000	
Materials inventory (490 lbs.)	2,450	
Finished goods inventory (200 units)	16,400	
Total current assets		\$137,850

Plant and equipment:

Land	30,000	
Buildings and equipment	250,000	
Accumulated depreciation	(74,000)	
Plant and equipment, net		206,000
Total assets		\$343,850

Liabilities and Stockholders' Equity

Current liabilities

Accounts payable (raw materials)	\$ 6,275	
Income tax payable	60,000	
Total current liabilities		\$66,275

Stockholders' equity:

Common stock, no par	\$200,000	
Retained earnings	77,575	
Total stockholders' equity		277,575

Total liabilities and stockholders' equity	\$343,850
--	-----------

THE PUTNAM COMPANY
Balance Sheet
December 31, 20B

Assets			
Cash	\$ 21,225	(a)	
Accounts receivable	108,000	(b)	
Materials inventory (520 lbs.)	2,600	(c)	
Finished goods inventory (300 units)	24,600	(d)	
Total current assets			\$156,425
Plant and equipment:			
Land	30,000	(e)	
Buildings and equipment	292,000	(f)	
Accumulated depreciation	(90,000)	(g)	
Plant and equipment, net			232,000
Total assets			\$388,425
Current liabilities			
Accounts payable (raw materials)	\$ 6,475	(h)	
Income tax payable	60,000	(i)	
Total current liabilities			\$66,475
Stockholders' equity:			
Common stock, no par	\$200,000	(j)	
Retained earnings	121,950	(k)	
Total stockholders' equity			321,950
Total liabilities and stockholders' equity			\$388,425

Supporting computations:

- (a) From Example 16.10 (cash budget).
- (b) \$100,000 (Accounts receivable, 12/31/20A) + \$900,000 (Credit sales from Example 1) - \$892,000 (Collections from Example 16.3) = \$108,000, or 60% of 4th quarter credit sales, from Example 16.3 (\$180,000 x 60% = \$108,000).
- (c) Direct materials, ending inventory = 520 pounds x \$ 5 = \$2,600 (From Example 16.5)
- (d) From Example 16.8 (ending finished goods inventory budget).
- (e) From the 20A balance sheet and Example 16.10 (no change).
- (f) \$250,000 (Building and Equipment, 12/31/20A) + \$42,000 (purchases from Example 16.10) = \$292,000.

- (g) $\$74,000$ (Accumulated Depreciation, 12/31/20A) + $\$16,000$ (depreciation expense from Example 16.7) = $\$90,000$.
- (h) Note that all accounts payable relate to material purchases.
 $\$6,275$ (Accounts payable, 12/31/20A) + $\$61,150$ (credit purchases from Example 16.5) - $\$60,950$ (payments for purchases from Example 16.5) = $\$6,475$,
 or 50% of 4th quarter purchase = 50% ($\$12,950$) = $\$6,475$.
- (i) From Example 16.11.
- (j) From the 20A balance sheet and Example 16.10(no change).
- (k) $\$77,575$ (Retained earnings, 12/31/20A) + $\$64,375$ (net income for the period, Example 16.11) – $\$20,000$ (cash dividends from Example 16.10) = $\$121,950$.

SOME FINANCIAL CALCULATIONS

To see what kind of financial condition the Putnam Company is expected to be in for the budgeting year, a sample of financial ratio calculations are in order: (Assume 20A after-tax net income was $\$45,000$)

	20A	20B
Current ratio:		
(Current assets/ current liabilities)	$\$137,850/\$66,275$ =2.08	$\$156,425/\$66,475$ =2.35
Return on total assets:		
(Net income after taxes / total assets)	$\$45,000/\$343,850$ =13.08%	$\$64,375/\$388,425$ =16.57%

Sample calculations indicate that the Putnam Company is expected to have better liquidity as measured by the current ratio. Overall performance will be improved as measured by return on total assets. This could be an indication that the contemplated plan may work out well.

COMPUTER-BASED AND SPREADSHEET MODELS FOR BUDGETING

More and more companies are developing computer-based models for financial planning and budgeting, using powerful, yet easy-to-use, financial modeling languages such as *BudgetMastro* and *Up Your Cash Flow*. The models help not only build a budget for profit planning but answer a variety of “what-if” scenarios. The resultant calculations provide a basis for choice among alternatives under conditions of uncertainty. Furthermore, budget modeling can also be accomplished using spreadsheet programs such as *Microsoft's Excel*. This is covered in greater detail in Chapter 21.

ZERO BASE BUDGETING

The traditional budgeting techniques involve adding or subtracting a given percentage increase or decrease to the preceding period's budget and arriving at a new budget. The prior period's costs are considered to be basic and the emphasis is usually placed on what upward revisions are to be made for the upcoming year. The traditional method focuses on inputs rather than outputs related to goal

achievement and as such never calls for the evaluation of corporate activities from a cost/benefit perspective.

Zero-Base Budgeting (ZBB) can generally be described as a technique, which requires each manager to justify his entire budget request in detail from a base of zero and as such asks for an analysis of the output values of each activity of a particular cost/responsibility center. This approach requires that all activities under scrutiny be defined in decision packages, which are to be evaluated and ranked in order of importance at various levels. As an end product, a body of structured data is obtained that enables management to allocate funds confidently to the areas of greatest potential gain.

ZBB is most applicable in planning service and support expenses rather than direct manufacturing expenses. This technique is best suited to operations and programs over which management has some discretion. For example, it can be used to develop:

- Administrative and General Support
- Marketing
- Research
- Engineering
- Manufacturing Support
- Capital Budgets

It should not be used for:

- Direct labor
- Direct material
- Factory overhead

which are usually budgeted through various methods discussed in the previous section. Figure 16.2 helps our understanding of ZBB by indicating the key differences between ZBB and traditional (incremental) budgeting systems.

FIGURE 16.2

DIFFERENCES BETWEEN TRADITIONAL AND ZERO BASE BUDGETING

Traditional	Zero Base
Starts from existing base	Starts with base zero
Examines cost/benefit for new activities	Examines cost/benefit for all activities
Starts with dollars	Starts with purposes and activities
Does not examine new ways of operating as integral part of process	Explicitly examines new approaches
Results in a non-alternative budget	Results in a choice of several levels of service and cost

THE CERTIFIED PUBLIC ACCOUNTANT'S INVOLVEMENT AND RESPONSIBILITY WITH PROSPECTIVE FINANCIAL STATEMENTS

The American Institute of Certified Public Accountants (AICPA) in *Statement of Position 45-4* provides guidelines for business enterprises, which publish financial forecasts. Improved financial forecasting should be of concern to the AICPA and the Securities and Exchange Commission as a basis for financial decision making, security analysis, and in affecting the future market value of securities through investor expectations. There are three types of functions that CPAs can perform with respect to prospective financial statements that will be relied upon by third parties: examination, compilation, and application of agreed-upon procedures. CPAs must prepare prospective financial statements according to AICPA standards. There must be disclosure of the underlying assumptions.

Prospective financial statements may be for general use or limited use. General use is for those not directly dealing with the client. The general user may take the deal or leave it. Limited use is for those having a direct relationship with the client.

Prospective financial statements may be presented as a complete set of financial statements (balance sheet, income statement, and statement of cash flows). However, in most cases, it is more practical to present them in summarized or condensed form. At a minimum, the financial statement items to be presented are:

- Sales
- Gross margin
- Nonrecurring items
- Taxes
- Income from continuing operations
- Income from discontinued operations
- Net income
- Primary and fully diluted earnings per share
- Material changes in financial position

Not considered prospective financial statements are pro-forma financial statements and partial presentations.

The American Institute of CPA's Code of Professional Ethics includes the following guidelines regarding prospective financial statements:

- Cannot vouch for the achievability of prospective results.
- Must disclose assumptions.
- Accountant's report must state the nature of the work performed and the degree of responsibility assumed.

CPAs are not permitted to furnish services on prospective financial statements if the statements are solely appropriate for limited use but are distributed to parties not involved directly with the issuing company. They are not allowed to use plain-paper services on prospective financial statements for third-party use.

A prospective financial statement may be classified as either a forecast or a projection.

FINANCIAL FORECAST

A financial forecast presents management's expectations, and there is an expectation that all assumptions will take place. Management is usually responsible for assumptions underlying prospective financial statements. However, the responsible party may be a party outside the entity, such as a possible acquirer. *Note:* A financial forecast encompasses a presentation that management expects to occur, but that is not necessarily most probable. A financial forecast may be most useful to general users, since it presents the client's expectations. A financial forecast and not a financial projection may be issued to passive users, or those not negotiating directly with the client.

A financial forecast may be given a single monetary amount based on the best estimate, or as a reasonable range. *Caution:* This range must not be chosen in a misleading manner.

Irrespective of the accountant's involvement, management is the only one who has responsibility for the presentation because only management knows how it plans to run the business and accomplish its plans.

FINANCIAL PROJECTION

A financial projection presents a "what-if" scenario that management does not necessarily expect to occur. However, a given assumption may actually occur if management moves in that direction. A financial projection may be most beneficial for limited users, since they may seek answers to hypothetical questions based on varying assumptions. These users may wish to alter their scenarios based on anticipated changing situations. A financial projection, like a forecast, may contain a range.

A financial projection may be presented to general users only when it supplements a financial forecast. Financial projections are not permitted in tax shelter offerings and other general-use documents.

TYPES OF ENGAGEMENTS

The following five types of engagements may be performed by the CPA in connection with prospective financial statements:

Plain paper

The CPA's name is not associated with the prospective statements. This service can only be conducted if all of the following conditions are satisfied:

- The CPA is not reporting on the presentation.
- The prospective statements are on paper not identifying the accountant.
- The prospective financial statements are not shown with historical financial statements that have been audited, reviewed, or compiled by the CPA.

Internal use

The prospective financial statements are only assembled, meaning mathematical and clerical

functions are performed. Assembling financial data is permitted if the following two criteria exist:

- Third parties will not use the statements.
- The CPA's name is associated with the statement.

Note that assembling prospective financial statements is limited only to internal use. Appropriate language on the statements might be "For Internal Use Only."

Compilation

This is the lowest level of service performed for prospective financial statements directed for third parties. The compilation engagement involves:

- Assembling prospective data.
- The conduct of procedures to ascertain whether the presentation and assumptions are appropriate.
- Preparation of a compilation report.

With a compilation, no assurance is given regarding the presentation or assumptions, but rather it serves to identify obvious matters to be investigated further. Working papers have to be prepared to show there was proper planning and supervision of the work, as well as compliance with required compilation procedures. The CPA must also obtain a management letter from the client regarding representations given to him.

Warning: A compilation should not be made when the forecasted financial statements exclude disclosure of the significant assumptions or when the financial projections exclude the hypothetical assumptions.

Agreed-upon procedures

This relates to applying procedures agreed to or requested by specific users, and issuing a report. The report identifies the procedures undertaken, gives the accountant's findings, and restricts distribution of the report to the particular parties. The specified users have to participate in establishing the nature and procedures. Also, the procedures undertaken must be more than just reading the prospective data.

Examination

The CPA appraises the preparation underlying the supporting assumptions and the presentation of prospective financial information in accordance with AICPA standards. A report is then issued on whether AICPA guidelines have been adhered to and whether the assumptions are reasonable. It is the highest level of assurance. An adverse opinion must be given if there is a failure to disclose a material assumption or if disclosed assumptions are unreasonable. For example, there may be not reasonable expectation that the actual figure will fall within the range of assumptions presented in a forecast having a range. A disclaimer opinion is necessary in the event of a scope limitation, such as when a required examination procedure cannot be performed because of client restrictions or inappropriate circumstances.

CONCLUSION

A budget is a detailed quantitative plan outlining the acquisition and use of financial and other resources of an organization over some given time period. It is a tool for planning. If properly

constructed, it is used as a control device. This chapter showed, step-by-step, how to formulate a master budget. The process begins with the development of a sales budget and proceeds through a number of steps that ultimately lead to the cash budget, the budgeted income statement, and the budgeted balance sheet. In recent years computer-based models and spreadsheet software have been utilized for budgeting in an effort to speed up the budgeting process and allow managerial accountants to investigate the effects of changes in budget assumptions. Zero-base budgeting (ZBB) has received considerable attention recently as a new approach to budgeting, particularly for use in nonprofit, governmental, and service-type organizations. The chapter discussed the pros and cons of ZBB. A CPA's involvement with prospective financial statements may be in the form of an examination, compilation, or agreed-upon procedures.

CHAPTER 17

FORECASTING CASH FLOWS

LEARNING OBJECTIVES

After studying the material in this chapter, you will be able to:

1. Define the Markov Approach.
2. Illustrate the Lagged Regression Approach.

A forecast of cash collections and potential writeoffs of accounts receivable is essential in *cash budgeting* and in judging the appropriateness of current credit and discount policies. The critical step in making such a forecast is estimating the cash collection and bad debt percentages to be applied to sales or accounts receivable balances. This chapter discusses several methods of estimating *cash collection rates* (or *payment proportions*) and illustrates how these rates are used for cash budgeting purposes.

The first approach, which is based on the *Markov model*, involves the use of a probability matrix based on the estimates of what is referred to as transition probabilities. This method is described on a step-by-step basis using an illustrative example. The second approach involves a simple average. The third approach, empirically tested and improved by the author, offers a more pragmatic method of estimating collection and bad debt percentages by relating credit sales and collection data. This method employs *regression analysis*. By using these approaches, a financial planner should be able to

- Estimate future cash collections from accounts receivable
- Establish an allowance for doubtful accounts
- Provide a valuable insight into better methods of managing accounts receivable

MARKOV APPROACH

The Markov (probability matrix) approach has been around for a long time. This approach has been successfully applied by Cyert and others to accounts receivable analysis, specifically to the estimation of that portion of the accounts receivable that will eventually become uncollectible. The method requires classification of outstanding accounts receivable according to age categories that reflect the stage of account delinquency, e.g., current accounts, accounts one month past due, accounts two months past due, and so forth. Consider the following example. XYZ department store divides its accounts receivable into two classifications: 0 to 60 days old and 61 to 120 days old. Accounts that are more than 120 days old are declared uncollectible by XYZ. XYZ currently has \$10,000 in accounts receivable: \$7,000 from the 0-60-day-old category and \$3,000 from the 61-120-day-old category. Based on an analysis of its past records, it provides us with what is known as the matrix of transition probabilities. The matrix is given as shown in Table 17.1.

TABLE 17.1
PROBABILITY MATRIX

From To	Collected	Uncollectible	0–60 Days Old	61–120 Days Old
Collected	①	0	0	0
Uncollectible	0	①	0	0
0–60 days old	.3	0	.5	.2
61–120 days old	.5	.1	.3	.1

Transition probabilities are nothing more than the probability that an account receivable moves from one age stage category to another. We noted three basic features of this matrix. First, notice the squared element, 0 in the matrix. This indicates that \$1 in the 0-60-day-old category cannot become a bad debt in one month's time. Now look at the two circled elements. Each of these is 1, indicating that, in time, all the accounts receivable dollars will either be paid or become uncollectible. Eventually, all the dollars do wind up either as collected or uncollectible, but XYZ would be interested in knowing the probability that a dollar of a 0-60-day-old or a 61-120-day-old receivable would eventually find its way into either paid bills or bad debts. It is convenient to partition the matrix of transition probabilities into four submatrices, as follows.

$$\begin{bmatrix} I & O \\ R & Q \end{bmatrix}$$

so that

$$I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \quad O = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$$

$$R = \begin{bmatrix} .3 & 0 \\ .5 & .1 \end{bmatrix} \quad Q = \begin{bmatrix} .5 & .2 \\ .3 & .1 \end{bmatrix}$$

Now we are in a position to illustrate the procedure used to determine:

- Estimated collection and bad debt percentages by age category
- Estimated allowance for doubtful accounts

Step-by-step, the procedure is as follows:

Step 1. Set up the matrix $[I - Q]$.

$$[I - Q] = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} - \begin{bmatrix} .5 & .2 \\ .3 & .1 \end{bmatrix} = \begin{bmatrix} .5 & -.2 \\ -.3 & .9 \end{bmatrix}$$

Step 2. Find the inverse of this matrix, denoted by N.

$$N = [I - Q]^{-1} = \begin{bmatrix} 2.31 & .51 \\ .77 & 1.28 \end{bmatrix}$$

Note: The inverse of a matrix can be readily performed by spreadsheet programs such as *Lotus 1-2-3*, *Microsoft's Excel*, or *Quattro Pro*.

Step 3. Multiply this inverse by matrix R.

$$NR = \begin{bmatrix} 2.31 & .51 \\ .77 & 1.28 \end{bmatrix} \begin{bmatrix} .3 & 0 \\ .5 & .1 \end{bmatrix} = \begin{bmatrix} .95 & .05 \\ .87 & .13 \end{bmatrix}$$

NR gives us the probability that an account will eventually be collected or become a bad debt. Specifically, the top row in the answer is the probability that \$1 of XYZ's accounts receivable in the 0-60-day-old category will end up in the collected and bad debt category will be paid, and a .05 probability that it will eventually become a bad debt. Turning to the second row, the two entries represent the probability that \$1 now in the 61-120-day-old category will end up in the collected and bad debt categories. We can see from this row that there is a .87 probability that \$1 currently in the 61-120-day-category will be collected and a .13 probability that it will eventually become uncollectible.

If XYZ wants to estimate the future of its \$10,000 accounts receivable (\$7,000 in the 0-60 day category and \$3,000 in the 61-120 day category), it must set up the following matrix multiplication:

$$\begin{bmatrix} 7,000 & 3,000 \end{bmatrix} \begin{bmatrix} .95 & .05 \\ .87 & .13 \end{bmatrix} = \begin{bmatrix} 9,260 & 740 \end{bmatrix}$$

Hence, of its \$10,000 in accounts receivable, XYZ expects to collect \$9,260 and to lose \$740 to bad debts. Therefore, the estimated allowances for the collectible accounts is \$740.

The variance of each component is equal to

$$A = \text{be}(\text{cNR} - (\text{cNR})_{\text{sq}})$$

where $c_i = b_i / \sum_{i=1}^2 b_i$ and e is the unit vector.

In our example, $b = (7,000 \quad 3,000)$, $c = (.7 \quad .3)$. Therefore,

$$A = [7,000 \quad 3,000] \begin{bmatrix} 1 \\ 1 \end{bmatrix} \left\{ [.7 \quad .3] \begin{bmatrix} .95 & .05 \\ .87 & .13 \end{bmatrix} - [.7 \quad .3] \begin{bmatrix} .95 & .05 \\ .87 & .13 \end{bmatrix}_{sq} \right\}$$

$$= 10,000 [[.926 \quad .074] - [.857476 \quad .005476]]$$

$$= [685.24 \quad 685.24]$$

which makes the standard deviation equal to \$26.18 ($\sqrt{\$685.24}$). If we want to be 95 percent confident about our estimate of collections, we would set the interval estimate at \$9,260 + 2(26.18), or \$9,207.64 - \$9,312.36, assuming $t = 2$ as a rule of thumb. We would also be able to set the allowance to cover the bad debts at \$740 + 2(26.18), or \$792.36.

SIMPLE AVERAGE

The most straightforward way to estimate collection percentages is to compute the average value realized from past data, i.e.,

$$P'_i = \text{AVE } (C_{t+i}/S_t) \\ = \frac{1}{N} \sum_{t=1}^N \frac{C_{t+i}}{S_t}, \quad i = 0, 1, 2, \dots$$

where P'_i = an empirical estimate of collection percentages,
 C_{t+i} = cash collection in month $t+i$ from credit sales in month t ,
 S_t = credit sales in month t , and
 N = the number of months of past data to compute the average.

LAGGED REGRESSION APPROACH

A more scientific approach to estimating cash collection percentages (or payment proportions) is to utilize *multiple regression*. We know that there is typically a time lag between the point of a credit sale and realization of cash. More specifically, the lagged effect of credit sales and cash inflows is distributed over a number of periods, as follows:

$$C_t = b_1 S_{t-1} + b_2 S_{t-2} + \dots b_i S_{t-i}$$

where C_t = cash collection in month t
 S_t = credit sales made in period t

b_1, b_2, \dots, b_i = collection percentages (the same as P'_i) and

i = number of periods lagged

By using the regression method discussed previously, we will be able to estimate these collection rates. We can utilize Excel or special packages such as *SPSS*, *SAS*, or *Minitab*.

It should be noted that the cash collection percentages, (b_1, b_2, \dots, b_i) may not add up to 100 percent because of the possibility of bad debts. Once we estimate these percentages by using the regression method, we should be able to compute the bad debt percentage with no difficulty.

Table 17.2 shows the regression results using actual monthly data on credit sales and cash inflows for a real company. Equation I can be written as follows:

$$C_t = 60.6\%(S_{t-1}) + 19.3\%(S_{t-2}) + 8.8\%(S_{t-3})$$

This result indicates that the receivables generated by the credit sales are collected at the following rates: first month after sale, 60.6 percent; second month after sale, 19.3 percent; and third month after sale, 8.8 percent. The bad debt percentage is computed as 6.3 percent (100-93.7%).

It is important to note, however, that these collection and bad debt percentages are probabilistic variables; that is, variables whose values cannot be known with precision. However, the standard error of the regression coefficient and the 5-value permit us to assess the probability that the true percentage is between specified limits. The confidence interval takes the following form:

$$b \pm t S_b$$

where S_b = standard error of the coefficient.

TABLE 17.2
REGRESSION RESULTS FOR CASH COLLECTION (C_T)

<u>Independent Variables</u>	<u>Equation I</u>	<u>Equation II</u>
S_{t-1}	0.606 ^a (0.062) ^b	0.596 ^a (0.097)
S_{t-2}	0.193 ^a (0.085)	0.142 (0.120)
S_{t-3}	0.088 (0.157)	0.043 (0.191)
S_{t-4}		0.136 (0.800)

R^2	0.754	0.753
Durbin-Watson	2.52 ^c	2.48 ^c
Standard Error of the estimate(S_e)	11.63	16.05
Number of monthly observations	21	20
Bad debt percentages	0.063	0.083

a Statistically significant at the 5% significance level.

b This figure in the parentheses is the standard error of the e estimate for the coefficient (S_b).

c No autocorrelation present at the 5% significance level.

EXAMPLE 17.1

To illustrate, assuming $t = 2$ as a rule of thumb at the 95 percent confidence level, the true collection percentage from the prior month's sales will be

$$60.6\% \pm 2(6.2\%) = 60.6\% \pm 12.4\%$$

Turning to the estimation of cash collections and allowance for doubtful accounts, the following values are used for illustrative purposes:

$S_{t-1} = \$77.6$, $S_{t-2} = \$58.5$, $S_{t-3} = \$76.4$, and forecast average monthly net credit sales = \$75.2

Then, (a) the forecast cash collection for period t would be

$$C_t = 60.6\%(77.6) + 19.3\%(58.5) + 8.8\%(76.4) = \$65.04$$

If the financial manager wants to be 95 percent confident about this forecast value, then the interval would be set as follows:

$$C_t \pm t S_e$$

where S_e = standard error of the estimate.

To illustrate, using $t = 2$ as a rule of thumb at the 95 percent confidence level, the true value for cash collections in period t will be

$$\$65.04 \pm 2(11.63) = \$65.04 \pm 23.26$$

(b) the estimated allowance for uncollectible accounts for period t will be

$$6.3\% (\$75.2) = \$4.74$$

By using the limits discussed so far, financial planners can develop flexible (or probabilistic) cash budgets, where the lower and upper limits can be interpreted as pessimistic and

optimistic outcomes, respectively. They can also simulate a cash budget in an attempt to determine both the expected change in cash collections for each period and the variation in this value.

In preparing a conventional cash inflow budget, the financial manager considers the various sources of cash, including cash on account, sale of assets, incurrence of debt, and so on. Cash collections from customers are emphasized, since that is the greatest problem in this type of budget.

EXAMPLE 17.2

The following data are given for Erich Stores:

	September	October	November	December
	<u>Actual</u>	<u>Actual</u>	<u>Estimated</u>	<u>Estimated</u>
Cash sales	\$ 7,000	\$ 6,000	\$ 8,000	\$ 6,000
Credit sales	<u>50,000</u>	<u>48,000</u>	<u>62,000</u>	<u>80,000</u>
Total sales	\$57,000	\$54,000	\$70,000	\$86,000

Past experience indicates net collections normally occur in the following pattern:

- No collections are made in the month of sale
- 80% of the sales of any month are collected in the following month
- 19% of sales are collected in the second following month
- 1% of sales are uncollectible

We can project total cash receipts for November and December as follows:

	<i>November</i>	<i>December</i>
Cash receipts		
Cash sales	\$ 8,000	\$ 6,000
Cash collections		
September sales		
50,000 (19%)	9,500	
October sales		
48,000 (80%)	38,400	
48,000 (19%)		9,120
November sales		
62,000 (80%)		<u>49,600</u>
Total cash receipts	<u>\$55,900</u>	<u>\$64,720</u>

IS CASH FLOW SOFTWARE AVAILABLE?

Computer software allows for day-to-day cash management, determining cash balances, planning and analyzing cash flows, finding cash shortages, investing cash surpluses, accounting for cash

transactions, automating accounts receivable and payable, and dial-up banking. Computerization improves availability, accuracy, timeliness, and monitoring of cash information at minimal cost. Daily cash information aids in planning how to use cash balances. It enables the integration of different kinds of related cash information such as collections on customer accounts and cash balances, and the effect of cash payments on cash balances.

Spreadsheet program software such as *Microsoft's Excel*, *Lotus 1-2-3*, and *Quattro Pro* can assist you in developing cash budgets and answering a variety of "what-if" questions. For example, you can see the effect on cash flow from different scenarios (e.g., the purchase and sale of different product lines).

There are computer software packages specially designed for cash management. Three popular ones are briefly described below.

1. Quicken (Intuit, Inc., 800-246-8848, www.quicken.com)

This program is a fast, easy to use, inexpensive accounting program that can help a small business manage its cash flow. Bills can be recorded as postdated transactions when they arrive; the program's *Billminder* feature automatically reminds the payer when bills are due. Then, checks can be printed for due bills with a few mouse and/or keystrokes. Similarly, he/she can record invoices and track aged receivables. Together, these features help maximize cash on hand.

2. Up Your Cash Flow (Granville Publications Software, 10960 Wilshire Blvd., Suite 826, Los Angeles, CA 90024, (800) 873-7789)

This program contains automatically prepared spreadsheets for profit/loss forecasts, cash flow budgets, projected balance sheet, payroll analysis, term loan amortization schedule, sales/cost of sales by product, ratio analysis, and graphs. It is a menu-driven system and can be customized to forecasting needs.

3. Cash Flow Analysis (Superior Software, 16055 Ventura Blvd., Suite 725, Encino, CA 91436, (800) 421-3264)

This software provides projections of cash inflow and cash outflow. Data are input into eight categories: sales, cost of sales, general and administrative expenses, long-term debt, other cash receipts, inventory build-up/reduction, capital expenditures (acquisition of long-term assets such as store furniture), and income tax. The program allows changes in assumptions and scenarios and provides a complete array of reports.

Telecommunications software may be used to link up your personal computer via modem and telephone lines to the bank so as to execute cash payments, transfers between accounts, and obtain current cash balance information. Software available from banks aid in managing cash collections, payments, investment, and borrowing. An example is JP Morgan/Chase's InfoCash software package which includes modules for:

.Cash Reporter - provides account information up to the close of the previous day. Information available includes checks cleared and money transfers.

- .Current Day Reporter* - provides information on current day transactions.
- .Regional Bank Reporter* - provides information on checking accounts held at other banks.
- .Money Transfer Input* - enables the transfer of funds between accounts.

CONCLUSION

Two methods of estimating the expected collectible and uncollectible patterns were presented. One advantage of the Markov model is that the expected value and standard deviation of these percentages can be determined, thereby making it possible to specify probabilistic statements about these figures. We have to be careful about these results, however, since the model makes some strong assumptions. A serious assumption is that the matrix of transition probabilities is constant over time. We do not expect this to be perfectly true. Updating of the matrix may have to be done, perhaps through the use of such techniques as exponential smoothing and time series analysis.

The regression approach is relatively inexpensive to use in the sense that it does not require a lot of data. All it requires is data on cash collections, and credit sales. Furthermore, credit sales values are all predetermined; we use previous months' credit sales to forecast cash collections, that is, there is no need to forecast credit sales. The model also allows you to make all kinds of statistical inferences about the cash collection percentages and forecast values.

Extensions of these models can be made toward setting credit and discount policies. Corresponding to a given set of policies, there are

- An associated transition matrix in the Markov model
- Associated collection percentages in the regression model

By computing long-term collections and bad debts for each policy, an optimal policy can be chosen that maximizes expected long-run profits per period.

CHAPTER 18

HOW TO USE CORPORATE PLANNING MODELS

LEARNING OBJECTIVES

After studying the material in this chapter, you will be able to:

1. Identify the types of analysis.
2. Explain typical questions addressed via corporate modeling
3. Identify types of corporate planning models
4. Outline current trends in modeling
5. Discuss the relationships among MIS, DSS, EIS, and personal computers
6. Describe the future of corporate planning models

Today more and more companies are using, developing, or experimenting with some form of corporate planning model. This is primarily due to development of planning and modeling software packages that make it possible to develop the model without much knowledge of computer coding and programming. For the accountant and financial analyst, the attractive features of corporate modeling are the formulation of budgets, budgetary planning and control, and financial analyses that can be used to support management decision making. However, corporate modeling involves much more than the generation of financial statements and budgets. Depending on the structure and breadth of the modeling activity, a variety of capabilities, uses, and analyses are available.

A corporate planning model is an integrated business planning model in which marketing and production models are linked to the financial model. More specifically, a corporate model is a description, explanation, and interrelation of the functional areas of a firm (accounting, finance, marketing, production, and others) expressed in terms of a set of mathematical and logical relationships so as to produce a variety of reports including financial statements. The ultimate goals of a corporate planning model are to improve quality of planning and decision making, reduce the decision risk, and, more importantly, influence or even to shape the future environment.

Generally speaking, a corporate model can be used to:

1. Simulate an alternative strategy by evaluating its impact on profits.
2. Help establish corporate and divisional goals.
3. Measure the interactive effect of parts with the firm.
4. Help management better understand the business and its functional relationships and help improve decision making ability.
5. Link the firm's goals and strategies to its master budgets.
6. Assess critically the assumptions underlying environmental constraints.

TYPES OF ANALYSIS

The type of the corporate model management is looking for would depend on what types of analysis it wishes to perform. There are typically three types of model investigations.

The first type of questions to be raised are "What is" or "what has been" questions such as the relationship between variables of the firm and external macroeconomic variables such as GNP or inflation. The goal of this type of model investigation is to obtain a specific answer based on the stipulated relationship. For example, what is or has been the firm's profit when the price of raw material was \$12.50?

The second type of investigation focuses on "what-if" questions. This is done through simulation or sensitivity analysis. This analysis often takes the following form: "What happens under a given set of assumptions if the decision variable(s) is changed in a prescribed manner?" For example, "What is going to happen to the company's cash flow and net income if it is contemplating a reduction of the price by 10% and an increase in advertising budget by 25%?"

The third type of question that can be addressed by way of corporate planning modeling takes the following form: "What has to be done in order to achieve a particular objective?" This type of analysis is often called "goal seeking." It usually requires the use of optimization models such as linear programming and goal programming.

TYPICAL QUESTIONS ADDRESSED VIA CORPORATE MODELING

The following is a list of questions management addresses itself using corporate modeling.

- What are the effects of different pricing policies?
- What is the effect of different interest rates and current exchange rates on the income statement and balance sheet of the firm?
- What will be the demand for the end products of the firm at various locations and different times?
- What is and will be the unit contribution margin for certain production, transportation, and sales allocations?
- What will the absence and turnover rates of the employees of the firm be and what effect will they have?
- What is the effect of advertising and distribution expenditures on sales?
- What marketing strategy can and should the firm follow?
- What do price-demand or supply relations on the output or input side of the firm look like?
- What are the effects of price/cost changes on sales?
- How do certain states of the national or world economy influence sales of the firm on the one side and purchase price of the production factors on the other?
- What is the nature of the conditions that must be fulfilled if the total sales of the firm at a certain time are supposed to be higher than a certain budget value?
- Should the firm produce and sell a certain product, purchase and sell the product, or not get involved at all?
- In what range will the return on investment on various projects and units lie?

- How will the income statement, the balance sheet, and the cash flow statement develop for several operating divisions? What will their contributions be?
- What effects with respect to the financial position of the firm could an acquisition or merger with another firm have?

Benefits derived from the corporate planning models include:

- The ability to explore more alternatives
- Better quality decision making
- More effective planning
- A better understanding of the business
- Faster decision making
- More timely information
- More accurate forecasts
- Cost savings

TYPES OF MODELS

Corporate planning models can be categorized according to two approaches: simulation and optimization. Simulation models are attempts to mathematically represent the operations of the company or of the conditions in the external economic environment. By adjusting the values of controllable variables and assumed external conditions, the future implications of present decision making can be estimated. Probabilistic simulation models incorporate probability estimates into the forecast sequence, while deterministic models do not. Optimization models are intended to identify the best decision, given specific constraints.

HISTORY OF MODELS

The rudiments of corporate modeling can be placed in the early 1960s with the large, cumbersome simulation models developed by major corporations such as AT&T, Wells Fargo Bank, Dow Chemical, IBM, Sun Oil, and Boise Cascade. Most of the models were written in one of the general programming languages (GPLs) such as FORTRAN, and were used for generating pro forma financial statements. The models typically required several man-years to develop and, in some cases, never provided benefits sufficient to outweigh the costs of development. Planning models were considered an untested concept, suitable only for those corporations large enough to absorb the costs and risks of development.

Important advancements in computer technology in the early 1970s provided the means for greater diversity and affordability in corporate modeling. Interactive computing facilities allowed for faster and more meaningful input/output sequences for modelers; trial-and-error adjustments of inputs and analyses were possible while on-line to the central computer or to an outside timesharing service. The advent of corporate simulation languages enabled analysts with little experience with GPLs to write modeling programs in an English-like programming language-- for example, Comshare's *IFPS/PLUS*, *Planning*, and *Decision*, and *Encore Plus*. In addition, a number of spreadsheet programs such as *Microsoft's Excel* became available for use by corporate planning modelers. Currently, virtually

every Fortune 1000 company is using a corporate simulation model. This statistic will definitely increase to cover small and medium size firms.

As companies gained experience in developing basic, deterministic simulations, renewed effort was directed toward consolidating and integrating smaller models into the larger corporate models. Furthermore, certain companies were attempting the more difficult optimization models and were increasing predictive power by using econometric models to link their simulations with product markets and the external economy. Early successes with the simpler models led to a boom in modeling, but an increasing number of failures in more ambitious projects soon moderated the general enthusiasm. As the economy entered a recession and became more unstable (less predictable), the weaknesses in the rationale underlying many corporate models were revealed. Managers realized that the purpose of a model must be well defined and that the end users should be involved in its development. Although the bad experiences of the mid 1970s have prejudiced some executives against models to the present day, most veterans of the period have developed a realistic attitude toward the capabilities of models and are employing recent advancements in techniques to construct more serviceable models.

CURRENT TRENDS IN MODELING

Among the reasons cited by corporations for using planning models were

- * Economic uncertainty
- * Shortages of resources
- * Diminishing increase in productivity
- * International competition
- * Tight money and inflation
- * Political upheavals (affecting foreign operations)
- * Environmental problems
- * New business opportunities

There was general agreement that models enabled managers to run alternative analyses and to adjust decision variables, while reducing the time needed for report writing. The many possible applications of corporate planning models are listed in Table 18.1. Financial forecasting and pro-forma balance sheet statements were the most common applications of most companies. The models proved to be useful tools in "what-if" analysis, sensitivity analysis, simulations, best/worst case scenarios, goal seeking, optimization, and report preparation.

TABLE 18.1
APPLICATIONS OF CORPORATE PLANNING MODELS

Financial forecasting	Construction scheduling
Pro-forma financial statements	Tax planning
Capital budgeting	Energy requirements
Market decision-making	Labor contract negotiation fees
Merger and acquisition analysis	Foreign currency analysis
Lease versus purchase decisions	Utilities

Production scheduling	Load forecasting
New venture evaluation	Rate cases
Manpower planning	Generation planning
Profit planning	
Sales forecasting	
Investment analysis	

The end users of the models were usually strategic planning groups, the treasurer's department, and the controller's department. Despite the growing diversity of modeling techniques available, the vast majority of corporate models encountered in the surveys were basic, deterministic simulations. Probabilistic considerations were seldom incorporated into the models by any but the largest corporations. Not many firms appear to use optimization models as a planning tool. Evidently, the accuracy of optimization models, as well as their clarity to upper management, must improve before they receive significant use.

Attitudes and Problems

The reluctance of many firms to experiment with corporate planning models derives chiefly from a fear of the unknown. Confusion over what models are and how they are used precludes serious investigation of their potential benefits. Myths that discourage managers from considering models include the following:

- Models are complicated. On the contrary, most effective models are fairly simple structures, incorporating only the essential processes of the problem under investigation. The math involved is often basic algebra, and modeling languages reduce complex terminology.
- The company is not large enough. Models do not consist solely of comprehensive simulations. Some of the most frequently used models center on a limited number of key relationships.
- We do not have any modelers. Modern planning languages have so simplified the modeling process that even a novice quickly becomes competent. Outside consultants are also available for assistance.

The growing acceptance of planning models has enabled managers and technicians to identify areas requiring improvement and to formulate criteria for success. Optimization models are one technique in need of refinement. *Note:* Optimization models are inscrutable "black boxes" to those managers who have had no part in the modeling effort. Naturally, top management has little confidence in forecasts produced by a model they cannot understand. The need to monitor several financial and nonfinancial variables precludes the construction of simple optimization models.

The reasons for discontinuation of corporate planning models are listed in Table 18.2. The common justifications were model deficiencies and human problems in implementation. Three of the prevalent reasons (inflexibility, lack of management support, excessive input data requirements) are familiar shortcomings, as discussed earlier. The need for management's support for successful model

making cannot be overemphasized; its role as champion of the effort is essential for companywide acceptance of the final product. It is interesting to note that excessive development time and costs were not often a basis for rejection.

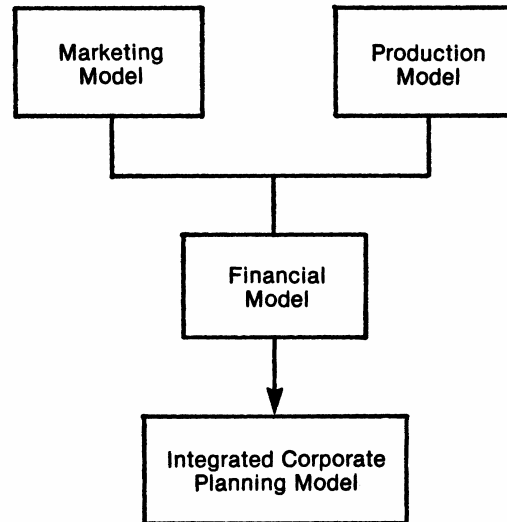
TABLE 18.2
REASONS FOR DISCONTINUED MODELS

- Lack of sufficient flexibility
- Lack of adequate management support
- Excessive amounts of input data required
- Replaced by a better model
- The need no longer existed
- The model did not perform as expected
- New management de-emphasized planning
- Poor documentation
- Lack of user interest
- Excessive development costs
- Excessive operating costs
- Excessive development time required

State-of-the-Art and Recommended Practice

The acceptance of corporate planning models has resulted in many firms' establishing planning departments responsible for developing and implementing planning models. The structure of the typical corporate financial model is an integration of smaller modules used by each department or business unit for planning purposes. Figure 18.1 shows that marketing, production, and financial models from each business unit can be consolidated to drive a comprehensive model used by upper management.

FIGURE 18.1
Typical Structure of an Integrated Planning Model



Optimal procedures for assembling effective models are still largely at the discretion of the individual planning department, but useful guidelines have been published.

1. Determine which process(es) can be modeled effectively
2. Decide whether to use a model
3. Formalize the specifications of the model (e.g., inputs and outputs, structure, etc.)
4. Prepare a proposal
5. Conduct modeling and data gathering concurrently
6. Debug the model
7. Educate the prospective users
8. Have users validate the model
9. Put model to use
10. Update and modify the model as needed

Table 18.3 is a list of prerequisites for modeling and control factors for success.

TABLE 18.3
SUCCESS FACTORS IN MODELING

Uncontrollable Prerequisites

Operations understood, data plentiful
 Relevant data accessible
 Budgets, plans, and control systems are well defined, understood
 Modelers have management's support

Management scientists accept responsibility for implementation
Similar innovative techniques used in the past
Manager and modeler share status and background

Controllable Factors

Involve potential users in development process
Define model's goals explicitly
Input and output are in familiar formats
Company procedures are modified little at first
Look for common management problems to model
Start simple and keep it simple
Allow for ample judgmental inputs
Be realistic about planning time and expected results
Put a manager (not a modeler) in charge
Define roles clearly
Demonstrate part of model early on
Build model within users' organization
Develop expertise to manage and update model
Provide ample documentation

The anatomy of the contemporary financial model is composed of five parts: the documentation supporting the calculations; input assumptions regarding future periods; the projections and decision points leading to the forecasted values; managerial (financial) ratios; and graphics displaying information from decision points. The forecasting systems utilized depend upon the breadth and planning horizon of the model; typical methods include market research and Etc method, time trends, moving averages, Box-Jenkins, and various casual methods, such as leading indicators, life cycle analysis, and regression.

Forecasting methods should be reviewed periodically by an independent party to ensure that the techniques have not become outdated. This can be determined only by maintaining a current management information system (MIS), which provides data to econometric models of the external environment. *Note:* The critical importance of external data in determining company strategy is the central theorem of MIS. Thus, planners make assumptions about the business environment for a particular planning horizon, based upon the output from the MIS. The information is combined with internal data to prepare demand forecasts, and the results can be input to a planning model or used to check the validity of forecasts produced by current techniques.

Planning and modeling languages (PMLs) have been a major incentive in involving higher management in modeling. General programming languages, such as FORTRAN, are seldom used in current models; oddly, COBOL, the "business language," has never been used extensively in modeling. The advantages of PMLs are steadily edging out GPLs: with PMLs, models are built more easily, with shorter development and data processing, are more easily understood by upper management, and are periodically updated with enhancement from the vendor.

Today more than 70 PMLs are available at reasonable cost, including IFPS, Encore Plus, and Venture. A further convenience offered to companies looking into modeling is premade planning packages sold by software vendors. The packages have often been criticized for their inflexibility, but the newer models allow for more user specificity. Analytical portfolio models are commercial packages that tell a conglomerate how to distribute resources across the portfolio of profit centers. Boston Consulting Group, Arthur D. Little, and McKinsey have developed models that categorize investments into a matrix of profit potentials and recommended strategies.

A model for Profit Impact of Market Strategy (PIMS) is offered by the Strategic Planning Institute. The package is a large multiple regression model used to identify the optimal strategy in a given business environment. Similar packages will likely proliferate in the future as more companies are forced to use decision models to remain competitive. Furthermore, more spreadsheet-based *add-ins* and *templates* for budgeting are being developed for *Lotus 1-2-3*, *Microsoft Excel*, and *Quattro Pro*.

MIS, DSS, EIS, AND PERSONAL COMPUTERS

The analytic and predictive capabilities of corporate planning models depend in large part upon the supporting data base. Information technology has advanced to the point that data bases consist of logic-mathematical models and highly integrated collections of data, derived from both inside and outside the firm. The data bases are called *Management Information Systems* (MISs), *Decision Support Systems* (DSSs), or *Executive Information Systems* (EISs). They store the data and decision tools utilized by management.

A primary value of the MIS, DSS, and EIS are their large storage capacity for data and the potential to more accurately model the external economy and to forecast business trends. Managers are finding that effective long-range planning depends primarily upon a thorough understanding of their competitors and the forces in the marketplace. A considerable body of data is required to develop insight into the competitive environment. *Note:* Information derived from within the company has little strategic value for those purposes, thus the collection of external data should be emphasized.

As a result, the relevance of information to future conditions is the standard by which input of data to the MIS is controlled.

Once the strategic data have been stored in the mainframe computer system, managers need quick access to the data base and a means for inputting alternative data sets and/or scenarios into the econometric models. Only recently have such activities been made possible by the development of communication links between mainframe systems and PCs. Many of the applications of the mainframe-PC connection involve rather basic analyses, such as accounts payable, receivables, general ledger, and the like. However, internal financial planning packages (e.g., Comshare's *Planning* for a single user and *Decision for a multiple user*) are currently available, as are external time-sharing services, such as Dow Jones and The Source.

The outlook for the next few years indicates increasing integration of the PC with the mainframe and the Web. Corporate planning software packages for PCs are already proliferating.

Applications range from cash flow analysis and budget projections to regressions, time series analysis, and probabilistic analysis. The trend in PC technology is aimed toward incorporating as many mainframe, analytical capabilities into the microcomputer as the market will support.

THE FUTURE OF CORPORATE PLANNING MODELS

The interest in obtaining corporate models is likely to continue. The concept of the strategic business unit (SBU) as an object of analysis may prove to be unviable. There has been no consistent definition of SBU, and most models treat them as independent of one another, even though this may not be accurate. The SBU is typically forced into short-term profit making (rather than long-term development), eventually sapping its vitality. Consequently, an improved rationale may cause models to be built around a different grouping of profit centers.

We can expect to see an increased linking of portfolio models with corporate simulation and optimization models. Modeling software will become more modular in order to perform limited analyses or comprehensive projections. More software will be written for microcomputers, graphics will improve, and modeling languages will become more user friendly. The future of modeling is somewhat assured because it is intimately linked with the continued expansion of the computer market. As a matter of fact, PC networks begin to oust mainframes in some companies. Though shakeouts may frequently occur among hardware manufacturers, planning models will always have a market, as software writers improve their understanding of the planner's needs and produce more efficient decision-making tools.

Many models will fully integrate with today's faster Windows operating systems and supports Microsoft Office 2000 so users can easily prepare reports and graph data using Excel. They can be deployed as either stand-alone or LAN/WAN connected. Interfaces to common data sources will be a standard--not an option-- to develop and maintain. Further, planning models will function on either Web or client/server platforms, and requires no installation on the user's PC beyond the Java-enabled Web browser. All information is stored in a centralized database, for consistency and easy deployment of data enterprise-wide and in multiple locations. They will support all of the world's leading multidimensional databases, including Microsoft SQL Server OLAP (OnLine Analytical Processing) Services, IBM DB2 OLAP Server, Hyperion Essbase and OLE DB for OLAP compliant databases.

CONCLUSION

In the face of uncertainty about the future, management is particularly interested in following the best possible course of action under a given circumstance. The corporate planning model is used as a tool to help minimize risk and uncertainty and to develop the best course of action for the company. For example, management is able to examine the effects of proposed mergers and acquisitions with much less uncertainty and to estimate with more confidence the potential profits from new markets.

CHAPTER 19

FINANCIAL MODELING FOR "WHAT-IF" ANALYSIS

LEARNING OBJECTIVES

After studying the material in this chapter, you will be able to:

1. Define a financial model.
2. Apply and use financial models.
3. Put financial modeling into practice.
4. List and explain each of the quantitative techniques used in financial models.
5. Develop financial models.
6. Identify model specification.

This section introduces financial modeling. We begin with a review of:

- .What is a financial model?
- .What are some typical uses of financial model?
- .What are the types of financial modeling?
- .How widespread is the use of financial modeling in practice?
- .How do we go about building a financial model?

A FINANCIAL MODEL

A financial model, narrowly called a budgeting model, is a system of mathematical equations, logic and data which describes the relationships among financial and operating variables. A financial model can be viewed as a subset of broadly defined corporate planning models or a stand-alone functional system that attempts to answer a certain financial planning problem.

A financial model is one in which:

- (1) one or more financial variables appear (expenses, revenues, investment, cash flow, taxes, earnings, etc.);
- (2) the model user can manipulate (set and alter) the value of one or more financial variables; and
- (3) the purpose of the model is to influence strategic decisions by revealing to the decision maker the implications of alternative values of these financial variables.

Types of Financial Models

Financial models fall into two types: simulation better known as what-if models and optimization models. What-if models attempt to simulate the effects of alternative management policies and assumptions about the firm's external environment. They are basically a tool for management's laboratory. Optimization models are the ones in which the goal is to maximize or minimize an objective

such as present value of profit or cost. Multi-objective techniques such as goal programming are being experimented.

Models can be deterministic or probabilistic. Deterministic models do not include any random or probabilistic variables whereas probabilistic models incorporate random numbers and/or one or more probability distributions for variables such as sales, costs, etc. Financial models can be solved and manipulated computationally to derive from it the current and projected future implications and consequences. Due to technological advances in computers (such as spreadsheets, financial modeling languages, graphics, data base management systems, and networking), more companies are using modeling.

APPLICATIONS AND USES OF FINANCIAL MODELING

Basically, a financial model is used to build a comprehensive budget (that is, projected financial statements such as the income statement, balance sheet, and cash flow statement). Such a model can be called a budgeting model, since we are essentially developing a master budget with such a model. Applications and uses of the model, however, go beyond developing a budget. They include:

- Financial forecasting and analysis
- Capital expenditure analysis
- Tax planning
- Exchange rate analysis
- Analysis for mergers and acquisitions
- Labor contract negotiations
- Capacity planning
- Cost-volume-profit analysis
- New venture analysis
- Lease/purchase evaluation
- Appraisal of performance by segments
- Market analysis
- New product analysis
- Development of long-term strategy
- Planning financial requirements
- Risk analysis
- Cash flow analysis
- Cost and price projections

PUTTING FINANCIAL MODELING INTO PRACTICE

The use of financial modeling, especially a computer-based financial modeling system is rapidly growing. The reason is quite simple: the growing need for improved and quicker support for management decisions as a decision support system (DSS) and wide and easy availability of computer hardware and software.

Some of the functions currently served by financial models are:

- Projecting financial results under a given set of assumptions; to evaluate the financial impact of various assumptions and alternative strategies; and to prepare long range financial forecasts.
- Computing income, cash flow, and ratios for five years by months; also energy sales, revenue, power generation requirements, operating and manufacturing expenses, manual or automatic financing, and rate structure analysis.
- Providing answers to insights into financial 'what-if?' questions, and to produce financial scheduling information.
- Forecast of balance sheet and income statement with emphasis on alternatives for the investment securities portfolio.
- Projecting operating results and various financing needs, such as plant and property levels and financing requirements.
- Computing manufacturing profit, given sales forecasts, and any desired processing sequence through the manufacturing facilities; simulate effect on profits of inventory policies.
- Generating profitability reports of various cost centers.
- Projecting financial implications of capital investment programs.
- Showing the effect of various volume and activity levels on budget and cash flow.
- Forecasting corporate sales, costs, and income by division, by month.
- Providing : (1) sales revenue for budget; (2) a basis for evaluating actual sales department performance; and (3) other statistical comparisons.
- Determine pro forma cash flow for alternative development plans for real estate projects.
- Analyzing the impact of acquisition on company earnings.
- Determining economic attractiveness of new ventures, products, facilities, acquisitions, and so on.
- Evaluate alternatives of leasing or buying computer equipment.
- Determining corporate taxes as a function of changes in price.
- Evaluate investments in additional capacity at each major refinery.
- Generating income statements, cash flow, present value, and discounted rate of return for potential ventures, based on production and sales forecasts.

Supported by the expanded capabilities provided by models, many companies are increasingly successful in including long-term strategic considerations in their business plans, thus enabling them to investigate the possible impact of their current decisions on the long term welfare of the organization.

QUANTITATIVE METHODS USED IN FINANCIAL MODELS

In view of the development of sophisticated quantitative models for analysis in business planning and decision making, there is a rapid growing trend for their use, certainly with the aid of computer technology. Here is a list of these techniques used by the model builders:

- Econometric and statistical methods

Simple and multiple regressions
Econometric modeling
Time series models
Exponential smoothing
Risk analysis
Simulation

- Optimization models
 - Linear programming
 - Goal programming
 - Integer programming
 - Dynamic programming

DEVELOPING FINANCIAL MODELS

Development of financial models essentially involves two steps: (1) definition of variables and input parameters and (2) model specification. As far as model specification goes, we will concentrate only on the simulation-type model in this section. Generally speaking, the model consists of three important ingredients:

- Variables
- Input parameter values
- Definitional and/or functional relationships

Definition of Variables and Input Parameters

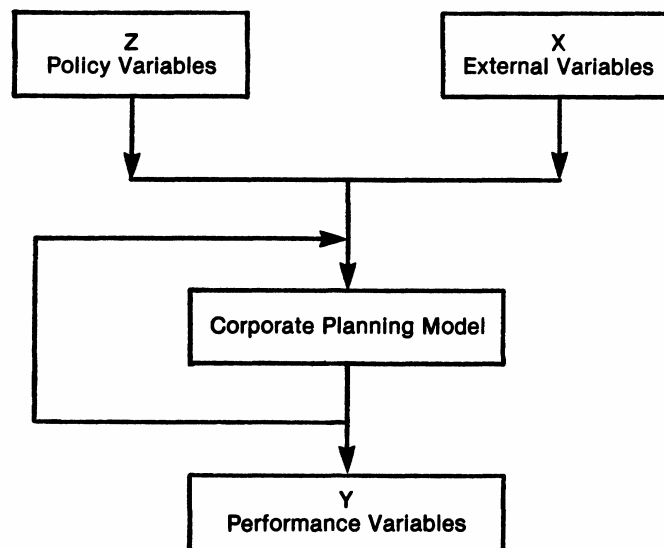
Fundamental to the specification of a financial model is the definition of the variables to be included in the model. There are basically three types of variables: policy variables (Z), external variables (X), and performance variables (Y).

Policy variables: The policy variables (often called control variables) are those management can exert some degree of control over. Examples of financial variables are cash management, working capital, debt management, depreciation, tax, merger-acquisition decisions, the rate and direction of the firm's capital investment programs, the extent of its equity and external debt financing and the financial leverage represented thereby, and the size of its cash balances and liquid asset position. Policy variables are denoted by the symbol Z in Figure 19.1.

External variables: The external variables are the environmental variables that are external to the company and which influence the firm's decisions from outside of the firm, generally exogenous in nature. Generally speaking, the firm is embedded in an industry environment. This industry environment, in turn, is influenced by overall general business conditions. General business conditions exert influences upon particular industries in several ways. Total volume of demand, product prices, labor costs, material costs, money rates, and general expectations are among the industry variables affected by the general business conditions. The symbol X represents the external variable in Figure 1.

Performance variables: The performance variables measure the firm's economic and financial performance, which are usually endogenous. We use the symbol Y in the diagram. The Y's are often called output variables. The output variables of a financial model would be the line items of the balance sheet, cash budget, income statement, or statement of cash flow. How to define the output variables of the firm will depend on the goals and objectives of management. They basically indicate how management measures the performance of the organization or some segments of it. Management is likely to be concerned with: (1) the firm's level of earnings; (2) growth in earnings; (3) projected earnings; (4) growth in sales; and (5) cash flow.

FIGURE 19.1
Flowchart of Variables in a Corporate Model



Frequently when we attempt to set up a financial model we face risk or uncertainty associated with particular projections. In a case such as this, we treat some of these variables such as sales as random variables with given probability distributions. The inclusion of random variables in the model transforms it from a deterministic model to a risk analysis model. However, the use of the risk analysis model in practice is rare because of the difficulty involved in modeling and computation.

Input Parameter Values

The model includes various input parameter values. For example, in order to generate the balance sheet, the model needs to input beginning balances of various asset, liability, and equity accounts. These input and parameter values are supplied by management. The ratio between accounts receivable and financial decision variables such as the maximum desired debt-equity ratio would be good examples of parameters.

The general process involved in a corporate financial model is presented in Figure 19.2.

MODEL SPECIFICATION

Once we define various variables and input parameters for our financial model, we must then specify a set of mathematical and logical relationships linking the input variables to the performance variables. The relationships usually fall into two types of equations: definition equations and behavioral equations. Definitional equations take the form of accounting identities. Behavioral equations involve theories or hypotheses about the behavior of certain economic and financial events. They must be empirically tested and validated before they are incorporated into the financial model.

Definitional Equations

Definitional equations are exactly what the term refers to--mathematical or accounting definitions. For example,

$$\begin{aligned}\text{Assets} &= \text{Liabilities} + \text{Equity} \\ \text{Net Income} &= \text{Revenues} - \text{Expenses}\end{aligned}$$

These definitional equations are fundamental definitions in accounting for the balance sheet and income statement, respectively. Two more examples are given below:

$$\text{CASH} = \text{CASH}(-1) + \text{CC} + \text{OCR} + \text{DEBT} - \text{CD} - \text{LP}$$

This equation is a typical cash equation in a financial model. It states that ending cash balance (CASH) is equal to the beginning cash balance (CASH(-1)) plus cash collections from customers (CC) plus other cash receipts (OCR) plus borrowings (DEBT) minus cash disbursements (CD) minus loan payments (LP).

$$\text{INV} = \text{INV}(-1) + \text{MAT} + \text{DL} + \text{MO} - \text{CGS}$$

This equation states that ending inventory (INV) is equal to the beginning inventory (INV(-1)) plus cost of materials used (MAT) plus cost of direct labor (DL) plus manufacturing overhead (MO) minus the cost of goods sold (CGS).

Behavioral Equations

Behavioral equations describe the behavior of the firm regarding the specific activities that are subject to empirical testing and validation. The classical demand function in economics is :

$$Q = f(P) \text{ or more specifically } Q = a - bP$$

It simply says that the quantity demanded is negatively related to the price. That is to say, the higher the price the lower is the demand.

However, the firm's sales is more realistically described as follows:

$$\text{SALES} = f(P, \text{ADV.}, I, \text{GNP}, P_c, \text{etc.}) \text{ or}$$

assuming linear relationship among these variables, we can specify the model as follows:

$$\text{SALES} = a + bP + c\text{ADV} + dI + e\text{GNP} + fP_c$$

which says that the sales are affected by such factors as price (P), advertising expenditures (ADV), consumer income (I), gross national product (GNP), prices of competitive goods (P_c), etc.

With the data on SALES, P, ADV, I, GNP, and P_c, we will be able to estimate parameter values a, b, c, d, e, and f, using linear regression. We can test the statistical significance of each of the parameter estimates and evaluate the overall explanatory power of the model, measured by the t-statistic and r-squared, respectively.

This way we will be able to identify most influential factors that affect the sales of a particular product. With the best model chosen, management can simulate the effects on sales of alternative pricing and advertising strategies. We can also experiment with alternative assumptions regarding the external economic factors such as GNP, consumer income, and prices of competitive goods.

Model Structure

A majority of financial models that have been in use are recursive and/or simultaneous models. Recursive models are the ones in which each equation can be solved one at a time by substituting the solution values of the preceding equations into the right hand side of each equation. An example of a financial model of recursive type is given below:

(1) SALES	= A - B*PRICE + C*ADV
(2) REVENUE	= SALES*PRICE
(3) CGS	= .70*REVENUE
(4) GM	= SALES - CGS
(5) OE	= \$10,000 + .2*SALES
(6) EBT	= GM - OE
(7) TAX	= .46*EBT
(8) EAT	= EBT - TAX

In this example, the selling price (PRICE) and advertising expenses (ADV) are given. A, B and C are parameters to be estimated and

SALES	= sales volume in units
REVENUE	= sales revenue
CGS	= cost of goods sold
GM	= gross margin
OE	= operating expenses
EBT	= earnings before taxes

TAX	= income taxes
EAT	= earnings after taxes

Simultaneous models are frequently found in econometric models which require a higher level of computational methods such as matrix inversion. An example of a financial model of this type is presented below:

$$\begin{aligned}
 (1) \text{ INT} &= .10 * \text{DEBT} \\
 (2) \text{ EARN} &= \text{REVENUE} - \text{CGS} - \text{OE} - \text{INT} - \text{TAX} - \text{DIV} \\
 (3) \text{ DEBT} &= \text{DEBT}(-1) + \text{BOW} \\
 (4) \text{ CASH} &= \text{CASH}(-1) + \text{CC} + \text{BOW} + \text{EARN} - \text{CD} - \text{LP} \\
 (5) \text{ BOW} &= \text{MBAL} - \text{CASH}
 \end{aligned}$$

Note that earnings (EARN) in equation (2) is defined as sales revenue minus CGS, OE, interest expense (INT), TAX, and dividend payment (DIV). But INT is a percentage interest rate on total debt in equation (1). Total debt in equation (3) is equal to the previous period's debt (DEBT(-1)) plus new borrowings (BOW). New debt is the difference between a minimum cash balance (MBAL) minus cash. Finally, the ending cash balance in equation (5) is defined as the sum of the beginning balance (CASH(-1)), cash collection, new borrowings and earnings minus cash disbursements and loan payments of the existing debt (LP). Even though the model presented here is a simple variety, it is still simultaneous in nature, which requires the use of a method capable of solving simultaneous equations. Very few of the financial modeling languages have the capability to solve this kind of system.

Decision Rules

The financial model may, in addition to the ones previously discussed that are definitional equations and behavioral equations, include basic decision rules specified in a very general form. The decision rules are not written in the form of conventional equations. They are described algebraically using conditional operators, consisting of statements of the type: "IF...THEN...ELSE." For example, suppose that we wish to express the following decision rule: "If X is greater than 0, then Y is set equal to X multiplied by 5. Otherwise, Y is set equal to 0." Then we can express the rule as follows:

$$Y = \text{IF } X \text{ GT } 0 \text{ THEN } X * 5 \text{ ELSE } 0$$

Suppose the company wishes to develop a financing decision problem based upon alternative sales scenarios. To determine an optimal financing alternative, managers might want to incorporate some decision rules into the model for a "what-if" or sensitivity analysis. Some examples of these decision rules are as follows:

- The amount of dividends paid are determined on the basis of targeted earnings available to common stockholders and a maximum dividend payout ratio specified by management.

- After calculating the external funds needed to meet changes in assets as a result of increased sales, dividends, and maturing debt, the amount of long-term debt to be floated is selected on the basis of a prespecified leverage ratio.

- The amount of equity financing to be raised is chosen on the basis of funds needed which are not financed by new long-term debt, but is constrained by the responsibility to meet minimum dividend payments.

In the model we have just described, simultaneity is quite evident. A sales figure is used to generate earnings and this in turn lead to, among other items, the level of long-term debt required. Yet the level of debt affects the interest expense incurred within the current period and therefore earnings. Furthermore, as earnings are affected, so are the price at which new shares are issued, the number of shares to be sold, and thus earnings per share. Earnings per share then "feeds back" into the stock price calculation.

Lagged Model Structure

Lagged model structure is common in financial modeling. Virtually all balance sheet equations or identities are of this type. For example,

$$\text{Capital} = \text{capital}(-1) + \text{net income} + \text{contributions} - \text{cash dividends}$$

More interestingly,

$$\text{CC} = a * \text{SALES} + b * \text{SALES}(-1) + c * \text{SALES}(-2)$$

where:

$$\begin{aligned} \text{CC} &= \text{cash collections from customers} \\ a &= \text{percent received in the month of sale.} \\ b &= \text{percent received in the month following sale.} \\ c &= \text{percent received in the second month following sale.} \end{aligned}$$

This indicates that the realization of cash lags behind credit sales.

COMPREHENSIVE FINANCIAL MODEL

A comprehensive corporate financial model is illustrated in Example 19.1.

EXAMPLE 19.1

A Corporate Financial Model

Balance Sheet Equations

$$\text{Cash}_t = \text{Cash}_{t-1} + \text{Cash receipts}_t - \text{Cash disbursements}_t$$

$$\begin{aligned} \text{Accounts receivable}_t = & (1-a) \text{ Sales} + (1-b-a) \text{ Sales}_{t-1} \\ & + (1-c-b-a) \text{ Sales}_{t-2} \end{aligned}$$

$$\text{Inventory}_t = \text{Inventory}_{t-1} + \text{Inventory purchase}_t \\ - \text{Variable cost per unit} \left(\frac{\text{Sales}_t}{\text{Selling price per unit}} \right)$$

$$\text{Plant} = \text{Initial value}$$

$$\text{Accounts payable}_t = (m)\text{Variable selling/administrative expenses}_{t-1} \\ + (n)\text{Variable selling/administrative expenses}_t \\ + \text{Inventory purchase}_t + \text{Fixed expenses}_t$$

$$\text{Bank loan}_t = \text{Bank loan}_{t-1} + \text{Loan}_t - \text{Loan repayment}_t$$

$$\text{Common stock} = \text{Initial value}$$

$$\text{Retained earnings}_t = \text{Retained earnings}_{t-1} + \text{Net income}_t$$

Income Statement and Cash Flow Equations

$$\text{Cash receipts}_t = (a) \text{Sales}_t + (b) \text{Sales}_{t-1} \\ + (c) \text{Sales}_{t-2} + \text{Loan}_t$$

$$\text{Cash disbursements}_t = \text{Accounts payable}_{t-1} + \text{Interest}_t \\ + \text{Loan repayments}_t$$

$$\text{Inventory purchase}_t, [\geq 0] = \text{Variable cost per unit}$$

$$\left(\frac{\text{Sales}_t + \text{Sales}_{t-1} + \text{Sales}_{t-2} + \text{Sales}_{t-3}}{\text{Selling price per unit}} \right) - \text{Inventory}_{t-1}$$

$$\text{Interest}_t = (i) \text{Bank loan}_t$$

$$\text{Variable cost of sales}_t = \text{Sales}_t \left(\frac{\text{Variable cost per unit}}{\text{Selling price per unit}} \right)$$

$$\text{Variable selling/}$$

$$\text{administrative expenses}_t = (x) \text{Sales}_t$$

$$\text{Net income before taxes}_t = \text{Sales}_t - \text{Interest}_t \\ + \text{Variable cost of sales}_t \\ + \text{Variable selling/administrative expenses}_t \\ - \text{Fixed expenses}_t - \text{Depreciation}_t$$

$$\text{Tax expense}_t, (\geq 0) = (r) \text{Net income before taxes}_t$$

$$\text{Net income}_t = \text{Net income before taxes}_t - \text{Tax expense}_t$$

Input Variables (Dollars)

Sales_{*t-1, t-2, t-3*}

Loan_{*t*}

Loan repayment_{*t*}

Fixed expense_{*t*}

Depreciation_{*t*}

Selling price per unit

Variable cost per unit

Input Parameters

Accounts receivable collection patterns

a—Percent received within current period

b—Percent received with one-period lag

c—Percent received with two-period lag

$a + b + c < 1$

Lag in accounts payable cash flow

m—Percent paid from previous period

n—Percent paid from current period

$m + n = 1$

r = Tax rate

i = Interest rate

x = Ratio of variable selling/administrative expense to sales

Initial Values (Dollars)

Plant

Common stock

Cash_{*t-1*}

Sales_{*t-1, t-2*}

Inventory_{*t-1*}

Retained earnings_{*t-1*}

Bank loan_{*t-1*}

Variable selling/administrative expenses_{*t-1*}

Accounts payable_{*t-1*}

Assumptions: time interval equals one month; accounts payable paid in full in next period; no lag between inventory purchase and receipt of goods; and no dividends paid.

CONCLUSION

Financial models comprise a functional branch of a general corporate planning model. They are essentially used to generate pro forma financial statements and financial ratios. These are the basic tools for budgeting and profit planning. Also, the financial model is a technique for risk analysis and "what-if" experiments. The financial model is also needed for day-to-day operational and tactical decisions for immediate planning problems.

In recent years, spreadsheet software and computer-based financial modeling software have been developed and utilized for budgeting and planning in an effort to speed up the budgeting process and allow budget planners to investigate the effects of changes in budget assumptions and scenarios.

CHAPTER 20

USING OPTIMIZATION TECHNIQUES TO BUILD OPTIMAL BUDGETS

LEARNING OBJECTIVES

After studying the material in this chapter, you will be able to:

1. Explain how linear programming works.
2. Differentiate between and linear programming and goal programming.

In the preceding section, we discussed, step by step, how to develop a budget. This section shows how optimization techniques, such as linear programming or goal programming, can help develop an optimal budget. For this purpose, we will illustrate with a simple example.

USE OF LINEAR PROGRAMMING

Linear programming (LP) is a mathematical technique designed to determine an optimal decision (or an optimal plan) chosen from a large number of possible decisions. The optimal decision is the one that meets the specified objective of the company, subject to various restrictions or constraints. It concerns itself with the problem of allocating scarce resources among competing activities in an optimal manner. The optimal decision yields the highest profit, contribution margin (CM), return on investment (ROI), revenue, or the lowest cost. A linear programming model consists of two important ingredients:

1. *Objective function.* The company must define the specific objective to be achieved.
2. *Constraints.* Constraints are in the form of restrictions on availability of resources or meeting minimum requirements. As the name linear programming indicates, both the objective function and constraints must be in *linear* form.

Applications of LP

Applications of LP are numerous. They include:

1. Selecting least-cost mix of ingredients for manufactured products
2. Developing an optimal budget
3. Determining an optimal investment portfolio (or asset allocation)
4. Allocating an advertising budget to a variety of media.
5. Scheduling jobs to machines
6. Determining a least-cost shipping pattern
7. Scheduling flights
8. Gasoline blending
9. Optimal manpower allocation
10. Selecting the best warehouse location to minimize shipping costs.

For our purposes, we will use this technique first to find the optimal product mix and then to develop the budget on the optimal program.

EXAMPLE 20.1

The CSU Company produces and sells two products: snowmobiles (A) and outboard motors (B). The sales price of A is \$900 per unit and that of B \$800 per unit. Production department estimates on the basis of standard cost data are that the capacity required for manufacturing one unit of A is 10 hours while one unit of product B requires 20 hours. The total available capacity for the company is 160 hours. The variable manufacturing costs of A are \$300 per unit and they are all paid in cash at the same rate at which the production proceeds. The variable manufacturing costs of B are \$600 per unit. These costs are also paid in cash.

For simplicity we assume no variable selling costs. Demand forecasts have been developed: the maximum amount of product A that can be sold is 8 units whereas that of B is 12 units. Product A is sold with one period credit while one half of the sales of product B is received in the same period in which the sales are realized. Additional information:

- The company has existing loans, which require \$2,100 in payment.
- The company plans to maintain a minimum balance of \$500.
- The accounts payable balance of \$900 must be paid in cash in this period.
- The balance sheet and the fixed overhead budget are given below:

Balance Sheet			
Assets		Liabilities	
Current assets		Current liabilities	
Cash	\$1,000	Accounts Payable	900
Accounts Receivable	6,800	Short-term loan	<u>10,000</u>
Inventory	<u>6,000</u>		10,900
Fixed assets	<u>4,500</u>	Equity	
Total assets	<u>\$18,300</u>	Total Liability & equity	<u>\$18,300</u>

Fixed Overhead Budget

Expenses involving cash	\$1,900
Accruals	800
Depreciation	<u>500</u>
	<u>\$3,200</u>

Formulation of the LP Model

We begin the formulation of the model by setting up the objective function which is to maximize the company's total contribution margin(CM). By definition, CM per unit is the difference between the unit sales price and the variable cost per unit:

	Product	
	A	B
Sales price	\$900	\$800
Variable cost	<u>300</u>	<u>600</u>

CM per unit \$600 \$200

Let us define

A = the number of units of product A to be produced
 B = the number of units of product B to be produced

Then the total CM is:

$$TCM = 600A + 200B$$

Remember that demand forecasts show that there were upper limits of the demand of each product as follows:

$$A \leq 6, B \leq 10$$

The planned use of capacity must not exceed the available capacity. Specifically, we need the restriction:

$$10A + 20B \leq 160$$

We also need the cash constraint. It is required that the funds tied up in the planned operations will not exceed the available funds. The initial cash balance plus the cash collections of accounts receivable are available for the financing of operations. On the other hand, we need some cash to pay for expenses and maintain a minimum balance. The cash constraint we are developing involves two stages. In the first stage, we observe the cash receipts and disbursements that can be considered fixed regardless of the planned production and sales.

Funds initially available	Beginning cash balance	\$1,000	
	Accounts receivable	<u>6,800</u>	7,800
Funds to be disbursed	Accounts payable	\$900	
	Repayment of loans	2,100	
	Fixed cash expenses	<u>1,900</u>	<u>4,900</u>
Difference			2,900
Minus: Minimum cash balance required			<u>500</u>
Funds available for the financing of operations			<u>\$2,400</u>

In the second stage, we observe the cash receipts and disbursements caused by the planned operations.

First, the total sales revenues:

Product A 900A
 B 800B

The cash collections from:

$$\begin{array}{rcl} \text{product A} & (0) 900A & = 0 \\ \text{B} & (0.5) 800B & = 400B \end{array}$$

Secondly, the variable manufacturing costs are:

$$\begin{array}{rcl} \text{Product A} & 300A & \\ \text{B} & 600B & \end{array}$$

Therefore, the cash disbursements for:

FIGURE 20.1 LINDO Output

Then, the cash
must not exceed

This can be sin

Using a widely
program, (see

ned operations
:

ation)

```

: MAX 600A + 200B
> ST
> A<=6
> B<=10
> 10A+20B<=160
> 300A+600B<=2400
> END
: LOOK ALL

MAX 600 A + 200 B
SUBJECT TO 300A + 600B ≤ 2400
2) A ≤ 6
3) B ≤ 10
4) 10 A + 20 B ≤ 160
5) 300 A + 600 B ≤ 2400
: GO
LP OPTIMUM FOUND AT STEP 2

OBJECTIVE FUNCTION VALUE

1) 4200.00000

VARIABLE VALUE REDUCED COST
A 6.000000 .000000
B 3.000000 .000000

ROW SLACK OR SURPLUS DUAL PRICES
2) .000000 300.000000
3) 7.000000 .000000
4) 40.000000 .000000
5) .000000 1.000000

NO. ITERATIONS= 2

DO RANGE (SENSITIVITY) ANALYSIS? >
4) 40.000000 .000000
5) .000000 1.000000

NO. ITERATIONS= 2

DO RANGE (SENSITIVITY) ANALYSIS? > YES
RANGES IN WHICH THE BASIS IS UNCHANGED

OBJ COEFFICIENT RANGES
VARIABLE CURRENT COEF ALLOWABLE INCREASE ALLOWABLE DECREASE
A 600.000000 INFINITY 300.000000
B 200.000000 INFINITY 200.000000

```

Generation of Budgets on the Basis of Optimal Mix

The sales budget would look like:

<i>Sales Budget</i>			
<i>Product</i>	<i>Price</i>	<i>Quantity</i>	<i>Revenues</i>
A	\$900	6	\$5,400
B	800	3	<u>2,400</u>
			<u>\$7,800</u>

Similarly, production and cost budgets can be easily developed. We will skip directly to show the cash budget, budgeted balance sheet and budgeted income statement, as shown below.

Cash Budget

Beginning cash balance				\$1,000
Accounts receivable			6,800	
Cash collections from credit sales				
	A: (0) 900A = (0)(900)(6)		0	
	B: (.5)800B = 400B = 400(3)		<u>1,200</u>	<u>8,000</u>
Total cash available				9,000
Cash disbursements:				
Production:				
	A: 300A = 300(6)		1,800	
	B: 600B = 600(3)		<u>1,800</u>	3,600
Fixed cash expenses:				
	Accounts payable balance		900	
	Repayment of loan		2,100	
	Fixed expenses		<u>1,900</u>	<u>4,900</u>
Ending cash balance				<u>\$500</u>

Budgeted Income Statement

Sales		(1) \$7,800
Less: Variable costs		(2) <u>3,600</u>
Contribution margin (CM)		4,200
Less: Fixed expenses		
	Depreciation	500
	Payables in cash	1,900
	Accruals	<u>800</u>
Operating income		<u>\$1,000</u>

Supporting calculations:

	<u>A</u>	<u>B</u>	<u>Total</u>
(1)	900(6) = 5,400	800(3) = 2,400	7,800
(2)	300(6) = 1,800	600(3) = 1,800	3,600

Budgeted Balance Sheet

Assets:			
Current assets:			
	Cash	(1) \$500	
	Accounts receivable	(2) 6,600	
	Inventories	(3) <u>6,000</u>	
Total current assets			13,100
Fixed assets:			
	Beg. balance	4,500	
	Less: Accumulated		
	Depreciation	<u>(500)</u>	4,000
Total assets			<u>\$17,100</u>
Liabilities:			
	Current liabilities:		
	Accounts payable	(4) 800	
	Short-term debt	(5) <u>7,900</u>	8,700
Equity			(6) <u>8,400</u>
Total liabilities & equity			<u>\$17,100</u>

Supporting calculations:

(1) from the cash budget

(2) A: $900(6) = 5,400$

B: $400(3) = \underline{1,200}$

6,600

(3) Production and sales were assumed to be equal. This implies there is no change in inventories.

(4) Accrual of fixed costs

(5) Beginning balance - repayment = $\$10,000 - 2,100 = 7,900$

(6) Beginning balance + net income = $\$7,400 + 1,000 = 8,400$

USE OF GOAL PROGRAMMING (GP)

In the previous section, we saw how we can develop a budget based on an optimal program (or product mix), using LP. LP, however, has one important drawback in that it is limited primarily to solving problems where the objectives of management can be stated in a single goal such as profit maximization or cost minimization. But management must now deal with multiple goals, which are often incompatible and conflicting with each other. Goal programming (GP) gets around this difficulty. In GP, unlike LP, the objective function may consist of multiple, incommensurable, and conflicting goals. Rather than maximizing or minimizing the objective criterion, the deviations from these set goals are minimized, often based on the priority factors assigned to each goal. The fact that the management will have multiple goals that are in conflict with each other, means that management will attempt to satisfy these goals instead of maximize or minimize. In other words, they will look for a satisfactory solution rather than an optimal solution.

To illustrate how we can utilize a GP model in order to develop an optimal - more exactly satisfactory - budget, we will use the same data in the LP problem.

EXAMPLE 20.2

We will further assume that fixed cash receipts include (a) new short-term loan amount of \$1,200,

(b) a dividend payment of \$700, and (c) a capital expenditure of \$500. Now the company has two goals, income and working capital. In other words, instead of maximizing net income or contribution margin, the company has a realistic, satisfactory level of income to achieve. On the other hand, the company wants to have a healthy balance sheet with working capital at least at a given level. (For example, a lending institution might want to see that before approving any kind of line of credit).

For illustrative purposes, we will make the following specific assumptions:

The company wants to achieve a return of 20 percent on equity. That means 20 % of \$7,400 = \$1,480, which translates into a CM of \$1,480 + 3,200 (fixed expenses) = \$4,680

The company wants a working capital balance to be at least \$3,000. Currently, it is \$2,900 (current assets of \$13,800 - current liabilities of \$10,900 = \$2,900).

These two goals are clearly in conflict. The reason is that we can increase the working capital by increasing cash funds or the inventory. However, the funds in the form of idle cash and the goods in the form of unsold inventories will not increase profits.

The first goal can be set up as follows:

$$600A + 200B + d^- - d^+ = \$4,680$$

Note that working capital balance = beginning balance + net income + depreciation - dividends - capital expenditures = beginning balance + (sales - variable costs - fixed costs) - dividend - capital expenditure.

Using this definition, the second goal can be set up as follows:

Sales	Variable costs	Fixed expenses
$2,900 + 900A + 800B$	$- 300A - 600B$	$-2,700 - 700 - 500$
$\geq 3,000$		

This can be simplified to form an inequality:

$$600A + 200B \geq 4,000$$

Then our GP model is as follows:

Min D	=	$d^- + d^+$	
subject to		A	≤ 6
		B	≤ 10
	$10A + 20B$		≤ 160
	$300A + 200B$	$\leq 2,400$	
	$600A + 200B$	$\geq 4,000$	
	$600A + 200B + d^- - d^+$		$= 4,680$
			all variables ≥ 0

This particular problem can be easily solved by LINDO.

FIGURE 20.2
LINDO Output Showing the GP Solution

```

MIN      D1 + D2
SUBJECT TO
2)      A <= 6
3)      B <= 10
4)      10 A + 20 B <= 160
5)      300 A + 200 B <= 2400
6)      600 A + 200 B >= 4000
7)      D1 - D2 + 600 A + 200 B = 4680
END

:GO
LP OPTIMUM FOUND AT STEP    4

                OBJECTIVE FUNCTION VALUE
1)      480.000000

VARIABLE          VALUE          REDUCED COST
      D1          480.000000          .000000
      D2           .000000          2.000000
      A           6.000000          .000000
      B           3.000000          .000000

ROW          SLACK OR SURPLUS          DUAL PRICES
 2)           .000000          300.000000
 3)           7.000000          .000000
 4)          40.000000          .000000
 5)           .000000          1.000000
 6)          200.000000          .000000
 7)           .000000         -1.000000

NO. ITERATIONS=    4

DO RANGE (SENSITIVITY) ANALYSIS? >
NO. ITERATIONS=    4

DO RANGE (SENSITIVITY) ANALYSIS? > YES
RANGES IN WHICH THE BASIS IS UNCHANGED

                OBJ COEFFICIENT RANGES
VARIABLE          CURRENT          ALLOWABLE          ALLOWABLE
                  COEF          INCREASE          DECREASE
      D1          1.000000          INFINITY          1.000000
      D2          1.000000          INFINITY          2.000000
      A           .000000          300.000000          INFINITY
      B           .000000          200.000000          200.000000

```

The GP solution is:

$$\begin{array}{rcl}
 A & = & 6 \\
 B & = & 3 \\
 d- & = & 480 \\
 d+ & = & 0
 \end{array}$$

which means that the income target was underachieved by \$480. Just in the case of LP, financial executives will be able to develop the budget using this optimal solution in exactly the same manner as presented in the previous section. More sophisticated GP models can be developed with "preemptive" priority factors assigned to multiple goals, which is beyond the scope of this course.

CONCLUSION

Thus far we presented how optimization techniques, such as LP and GP, can help develop an overall optimal plan for the company. However, in the Naylor study it was found that only 4 percent of the users of corporate planning models employed an optimization type model. The disadvantage with using optimization models to develop optimal plans for a firm as a whole is that problems are difficult to define and the firm has multiple objectives. It is not easy to develop an optimization model that incorporates performance variables such as ROI, profits, market share and cash flow as well as the line items of the income statement, balance sheet and cash flow statement. Despite the availability of goal programming that handles multiple objectives, the possibility of achieving global optimization is very rare at the corporate level. The usage tends to be limited to sub-models and sub-optimization within the overall corporate level. Thus, the use of these models in corporate modeling will probably continue to be focused at the operational level. Production planning and scheduling, advertising, resource allocation, and many other problem areas will continue to be solved with huge success by these techniques.

CHAPTER 21

USING SPREADSHEET AND FINANCIAL MODELING PACKAGES

LEARNING OBJECTIVES

After studying the material in this chapter, you will be able to:

1. Use spreadsheet programs.
2. Forecast business failures with Z scores.
3. Be familiar with financial modeling languages.

Financial forecasting and planning can be done using a PC with a powerful spreadsheet program such as Excel. Or it can be done using a specific financial modeling language such as Comshare's Planning.

USING SPREADSHEET PROGRAMS

In this section we discuss how we can use spreadsheet programs such as Excel. The following problems are illustrated:

- (1) three examples of projecting an income statement
- (2) forecasting financial distress with Z score

EXAMPLE 21.1

Given:

Sales for 1st month = \$60,000
Cost of sales = 42% of sales, all variable
Operating expenses = \$10,000 fixed plus 5% of sales
Taxes = 30% of net income
Sales increase by 5% each month

(a) Based on this information, Figure 21.1 presents a spreadsheet for the contribution income statement for the next 12 months and in total.

(b) Figure 21.2 shows the same in (1) assuming that sales increase by 10% and operating expenses = \$10,000 plus 10% of sales. This is an example of "what-if" scenarios.

**FIGURE
21.1
PROJECTED INCOME STATEMENT**

	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	<i>9</i>	<i>10</i>	<i>11</i>	<i>12</i>	<i>TOTAL</i>	<i>PERCEN T</i>
Sales	\$60,000	\$63,000	\$66,150	\$69,458	\$72,930	\$76,577	\$80,406	\$84,426	\$88,647	\$93,080	\$97,734	\$102,620	\$955,028	100%
Less: VC														
Cost of sales	\$25,200	\$26,460	\$27,783	\$29,172	\$30,631	\$32,162	\$33,770	\$35,459	\$37,232	\$39,093	\$41,048	\$43,101	\$401,112	42%
Operating ex.	\$3,000	\$3,150	\$3,308	\$3,473	\$3,647	\$3,829	\$4,020	\$4,221	\$4,432	\$4,654	\$4,887	\$5,131	\$47,751	5%
CM	\$31,800	\$33,390	\$35,060	\$36,812	\$38,653	\$40,586	\$42,615	\$44,746	\$46,983	\$49,332	\$51,799	\$54,389	\$506,165	53%
Less: FC														
Op. expenses	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$120,000	13%
Net income	\$21,800	\$23,390	\$25,060	\$26,812	\$28,653	\$30,586	\$32,615	\$34,746	\$36,983	\$39,332	\$41,799	\$44,389	\$386,165	40%
Less: Tax	\$6,540	\$7,017	\$7,518	\$8,044	\$8,596	\$9,176	\$9,785	\$10,424	\$11,095	\$11,800	\$12,540	\$13,317	\$115,849	12%
NI after tax	\$15,260	\$16,373	\$17,542	\$18,769	\$20,057	\$21,410	\$22,831	\$24,322	\$25,888	\$27,533	\$29,259	\$31,072	\$270,315	28%

**FIGURE
21.2
PROJECTING INCOME STATEMENT**

	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	<i>9</i>	<i>10</i>	<i>11</i>	<i>12</i>	<i>TOTAL</i>	<i>PERCEN T</i>
Sales	\$60,000	\$66,000	\$72,600	\$79,860	\$87,846	\$96,631	\$106,294	\$116,923	\$128,615	\$141,477	\$155,625	\$171,187	\$1,283,057	134%
Less: VC														
Cost of sales	\$25,200	\$27,720	\$30,492	\$33,541	\$36,895	\$40,585	\$44,643	\$49,108	\$54,018	\$59,420	\$65,362	\$71,899	\$538,884	56%
Operating ex.	\$6,000	\$6,600	\$7,260	\$7,986	\$8,785	\$9,663	\$10,629	\$11,692	\$12,862	\$14,148	\$15,562	\$17,119	\$64,153	7%
CM	\$28,800	\$31,680	\$34,848	\$38,333	\$42,166	\$46,383	\$51,021	\$56,123	\$61,735	\$67,909	\$74,700	\$82,170	\$615,867	64%
Less: FC														
Op. expenses	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$120,000	13%
Net income	\$18,800	\$21,680	\$24,848	\$28,333	\$32,166	\$36,383	\$41,021	\$46,123	\$51,735	\$57,909	\$64,700	\$72,170	\$495,867	52%
Less: Tax	\$5,640	\$6,504	\$7,454	\$8,500	\$9,650	\$10,915	\$12,306	\$13,837	\$15,521	\$17,373	\$19,410	\$21,651	\$148,760	16%
NI after tax	\$13,160	\$15,176	\$17,394	\$19,833	\$22,516	\$25,468	\$28,715	\$32,286	\$36,215	\$40,536	\$45,290	\$50,519	\$347,107	36%

EXAMPLE 21.2

Delta Gamma Company wishes to prepare a three-year projection of net income using the following information:

1. 2005 base year amounts are as follows:

Sales revenues	\$4,500,000
Cost of sales	2,900,000
Selling and administrative expenses	800,000
Net income before taxes	800,000

2. Use the following assumptions:

- Sales revenues increase by 6% in 2006, 7% in 2007, and 8% in 2008.
- Cost of sales increase by 5% each year.
- Selling and administrative expenses increase only 1% in 2006 and will remain at the 2006 level thereafter.
- The income tax rate = 46%

Figure 21.3 presents a spreadsheet for the income statement for the next three years.

Figure 21.3
Delta Gamma Company
Three-Year Income Projections (2005-2008)

	<u>2005</u>	<u>2006</u>	<u>2007</u>	<u>2008</u>
	-	-	-	-
Sales	\$4,500,000	\$4,770,000	\$5,103,900	\$5,512,212
Cost of sales	\$2,900,000	\$3,045,000	\$3,197,250	\$3,357,113
Gross margin	\$1,600,000	\$1,725,000	\$1,906,650	\$2,155,100
Selling & adm. exp.	\$800,000	\$808,000	\$808,000	\$808,000
Earnings before tax	\$800,000	\$917,000	\$1,098,650	\$1,347,100
Tax	\$368,000	\$421,820	\$505,379	\$619,666
Earnings after tax	<u>\$432,000</u>	<u>\$495,180</u>	<u>\$593,271</u>	<u>\$727,434</u>

EXAMPLE 21.3

Based on specific assumptions (see Figure 21.4), develop a budget using *Up Your Cash Flow* (Figure 21.5).

FIGURE 21.4

Category	Assumptions
Sales:	alternative 1 from both of your cash flow
Cost of goods sold:	use 45% of sales
Advertising:	5% of sales
Automobile:	Company has 4 auto @ 150 ea. $4 \times 1500 = 6000 \div 12 = 500$ per month
Bad debts:	maintain @ 2% of sales - I hope!
Business promotion:	Prin year was \$6500. 10% increase equals \$7150 $\div 12$
Collection costs:	use 100 per month
Continuing education:	\$1000 per month
Depreciation:	\$84,000 for year - use 700 per month
Donations:	\$10,000 for year = $\div 12$
Insurance—general:	agent said \$24,000; use 2000 per month
Insurance—group:	15 employees @ 1,500 ea = $22,500 \div 12 =$ monthly #.
Insurance—life:	600 per month
Interest:	expect to borrow 250M @ 15% = $37,500 \div 12 = 3125$ per month + other borrowings.
Office supplies:	2% of sales - and keep it there please!
Rent:	4000 per month
Repairs and maintenance:	use 400 per month
Salaries:	schedule the payrolls per month
Taxes and license:	Prin year was 1.5% of sales use same this year.
Taxes, payroll:	20% of monthly payroll
Telephone—utilities:	\$2900 last year. Use $3300 \div 12$
	Travel - use \$1000 per month.

FIGURE 21.5

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Sales	\$129,030	\$129,030	\$129,030	\$129,030	\$192,610	\$192,610	\$162,690	\$129,030	\$192,610	\$129,030	\$162,690	\$192,610	\$1,870,000
Cost of Sales @ 45%	58,063	58,063	58,063	58,063	86,675	86,675	73,211	58,063	86,675	58,063	73,211	86,675	841,500
Gross profit	70,967	70,967	70,967	70,967	105,935	105,935	89,479	70,967	105,935	70,967	89,479	105,935	1,028,500
Advertising @ 5%	6,450	6,450	6,450	6,450	9,600	9,600	8,100	6,450	9,600	6,450	8,100	10,050	93,750
Automobile	500	500	500	500	500	500	500	500	500	500	500	500	6,000
Bad debts @ 2%	2,580	2,580	2,580	2,580	3,840	3,840	3,240	2,580	3,840	2,580	3,240	3,920	37,400
Business promotions	5,958	5,958	5,958	5,958	5,958	5,958	5,958	5,958	5,958	5,958	5,958	5,962	71,500
Collection costs	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	12,000
Continuing education	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	12,000
Depreciation	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	84,000
Donations	833	833	833	833	833	833	833	833	833	833	833	837	10,000
Dues & subscriptions	833	833	833	833	833	833	833	833	833	833	833	837	10,000
Insurance—general	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	24,000
Insurance—group	1,875	1,875	1,875	1,875	1,875	1,875	1,875	1,875	1,875	1,875	1,875	1,875	22,500
Insurance—life	600	600	600	600	600	600	600	600	600	600	600	600	7,200
Interest	3,125	3,125	3,125	3,125	4,375	4,375	4,375	4,450	4,450	4,450	4,450	4,450	47,875
Legal & accounting	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	12,000
Office supplies @ 2%	2,580	2,580	2,580	2,580	3,840	3,840	3,240	2,580	3,840	2,580	3,240	3,920	37,400
Rent	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	48,000
Repairs	400	400	400	400	400	400	400	400	400	400	400	400	4,800
Salaries	21,000	21,000	21,000	21,000	21,000	21,000	24,833	24,833	24,833	24,833	24,833	24,835	275,000
Taxes & license @ 1.5%	1,935	1,935	1,935	1,935	2,880	2,880	2,430	1,935	2,880	1,935	2,430	2,890	28,000
Taxes, payroll	4,200	4,200	4,200	4,200	4,200	4,200	4,966	4,966	4,966	4,966	4,966	4,970	55,000
Telephone—utilities	2,750	2,750	2,750	2,750	2,750	2,750	2,750	2,750	2,750	2,750	2,750	2,750	33,000
Travel	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	12,000
Profit	\$(1,652)	\$(1,652)	\$(1,652)	\$(1,652)	\$25,451	\$25,451	\$7,546	\$(7,576)	\$20,777	\$(7,576)	\$7,471	\$20,139	\$85,075

FORECASTING FINANCIAL DISTRESS WITH Z SCORE

There has recently been an increasing number of bankruptcies. Will your company go bankrupt? Will your major customers or suppliers go bankrupt? What warning signs exist and what can be done to avoid corporate failure?

Prediction models can help in a number of ways: In merger analysis, it can help to identify potential problems with a merger candidate. Bankers and other business concerns can use it to determine whether or not to give a new loan (credit) or extend the old one. Investors can use it to screen out stocks of companies which are potentially risky. Internal auditors can use such a model to assess the financial health of the company. Those investing in or extending credit to a company may sue for losses incurred. The model can help as evidence in a lawsuit.

Financial managers, investment bankers, financial analysts, security analysts and auditors have been using early warning systems to detect the likelihood of bankruptcy. But their system is primarily based on financial ratios of one type or the other as an indication of financial strength of a company. Each ratio (or set of ratios) is examined independent of others. Plus, it is up to the professional judgment of a financial analyst to decide what the ratios are really telling.

To overcome the shortcomings of financial ratio analysis, it is necessary to combine mutually exclusive ratios into a group to develop a meaningful predictive model. Regression analysis and multiple discriminant analysis (MDA) are two statistical techniques that have been used thus far.

Z-SCORE MODEL

This section describes the Z-score predictive model which uses a combination of several financial ratios to predict the likelihood of future bankruptcy. Altman developed a bankruptcy prediction model that produces a Z score as follows:

$$Z = 1.2 \cdot X_1 + 1.4 \cdot X_2 + 3.3 \cdot X_3 + 0.6 \cdot X_4 + 0.999 \cdot X_5$$

Where:

- X1 = Working capital/Total assets
- X2 = Retained earnings/Total assets
- X3 = Earnings before interest and taxes (EBIT)/Total assets
- X4 = Market value of equity/Book value of debt (Net worth for privately-held firms)
- X5 = Sales/Total assets

Altman established the following guideline for classifying firms:

<u>Z score</u>	<u>Probability of failure</u>
1.8 or less	Very high
3.0 or higher	Unlikely
1.81 - 2.99	Not sure

The Z score is known to be about 90 percent accurate in forecasting business failure one year in the future and about 80 percent accurate in forecasting it two years in the future. There are more updated versions of Altman's model.

EXAMPLE 21.4

Navistar International (formerly International Harvester), the maker of heavy-duty trucks, diesel engines, and school buses, continues to struggle. Exhibit 11-7 shows the 23-year financial history and the Z scores of Navistar. Exhibit 11-8 presents the corresponding graph.

The graph shows that Navistar International performed at the edge of the ignorance zone ("unsure area"), for the year 1981. Since 1982, though, the company started signaling a sign of failure. However, by selling stock and assets, the firm managed to survive. Since 1985, the company showed an improvement in its Z scores, although the firm continually scored on the danger zone. Note that the 1991-2003 Z-score are in the high probability range of <1.81 , except the year 1999. In late 2004, the company was in talks with truck components makers in India about sourcing components in a bid to cut manufacturing costs.

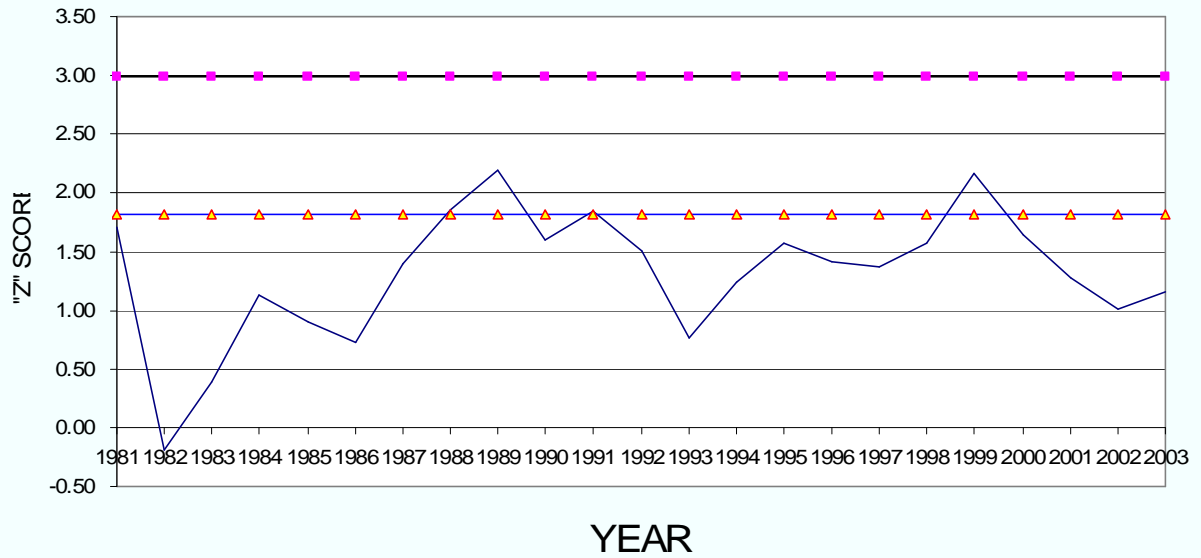
Exhibit 21.6

NAVISTAR INTERNATIONAL - NAV (NYSE)
Z SCORE - PREDICTION OF FINANCIAL DISTRESS

Balance Sheet							Income Statement		Stock Data	Calculations					Misc Graph Value			
Year	Current Assets (CA)	Total Assets (TA)	Current Liability (CL)	Total Liability (TL)	Retained Earnings (RE)	Working Capital (WC)	SALES	EBIT	Market Value or Net worth (MKT-NW)	WC/TA (X1)	RE/TA (X2)	EBIT/TA (X3)	MKT-NW/TL (X4)	SALES/TA (X5)	Z Score	TOP GRAY	BOTTOM GRAY	Year
1981	2672	5346	1808	3864	600	864	7018	-16	376	0.1616	0.1122	-0.0030	0.0973	1.3128	1.71	2.99	1.81	1981
1982	1656	3699	1135	3665	-1078	521	4322	-1274	151	0.1408	-0.2914	-0.3444	0.0412	1.1684	-0.18	2.99	1.81	1982
1983	1388	3362	1367	3119	-1487	21	3600	-231	835	0.0062	-0.4423	-0.0687	0.2677	1.0708	0.39	2.99	1.81	1983
1984	1412	3249	1257	2947	-1537	155	4861	120	575	0.0477	-0.4731	0.0369	0.1951	1.4962	1.13	2.99	1.81	1984
1985	1101	2406	988	2364	-1894	113	3508	247	570	0.0470	-0.7872	0.1027	0.2411	1.4580	0.89	2.99	1.81	1985
1986	698	1925	797	1809	-1889	-99	3357	163	441	-0.0514	-0.9813	0.0847	0.2438	1.7439	0.73	2.99	1.81	1986
1987	785	1902	836	1259	-1743	-51	3530	219	1011	-0.0268	-0.9164	0.1151	0.8030	1.8559	1.40	2.99	1.81	1987
1988	1280	4037	1126	1580	150	154	4082	451	1016	0.0381	0.0372	0.1117	0.6430	1.0111	1.86	2.99	1.81	1988
1989	986	3609	761	1257	175	225	4241	303	1269	0.0623	0.0485	0.0840	1.0095	1.1751	2.20	2.99	1.81	1989
1990	2663	3795	1579	2980	81	1084	3854	111	563	0.2856	0.0213	0.0292	0.1889	1.0155	1.60	2.99	1.81	1990
1991	2286	3443	1145	2866	332	1141	3259	232	667	0.3314	0.0964	0.0674	0.2326	0.9466	1.84	2.99	1.81	1991
1992	2472	3627	1152	3289	93	1320	3875	-145	572	0.3639	0.0256	-0.0400	0.1738	1.0684	1.51	2.99	1.81	1992
1993	2672	5060	1338	4285	-1588	1334	4696	-441	1765	0.2636	-0.3138	-0.0872	0.4119	0.9281	0.76	2.99	1.81	1993
1994	2870	5056	1810	4239	-1538	1060	5337	233	1469	0.2097	-0.3042	0.0461	0.3466	1.0556	1.24	2.99	1.81	1994
1995	3310	5566	1111	4696	-1478	2199	6342	349	966	0.3951	-0.2655	0.0627	0.2057	1.1394	1.57	2.99	1.81	1995
1996	2999	5326	820	4410	-1431	2179	5754	188	738	0.4091	-0.2687	0.0353	0.1673	1.0804	1.41	2.99	1.81	1996
1997	3203	5516	2416	4496	-1301	787	6371	316	1374	0.1427	-0.2359	0.0573	0.3055	1.1550	1.37	2.99	1.81	1997
1998	3715	6178	3395	5409	-1160	320	7885	515	1995	0.0518	-0.1878	0.0834	0.3688	1.2763	1.57	2.99	1.81	1998
1999	3203	5516	2416	4496	-1301	787	8642	726	2494	0.1427	-0.2359	0.1316	0.5547	1.5667	2.17	2.99	1.81	1999
2000	2374	6851	2315	5409	-143	59	8451	370	2257	0.0086	-0.0209	0.0540	0.4173	1.2335	1.64	2.99	1.81	2000
2001	2778	7164	2273	6037	-170	505	6739	162	2139	0.0705	-0.0237	0.0226	0.3543	0.9407	1.28	2.99	1.81	2001
2002	2607	6957	2407	6706	-721	200	6784	-89	2146	0.0287	-0.1036	-0.0128	0.3200	0.9751	1.01	2.99	1.81	2002
2003	2210	6900	2204	6590	-824	6	7340	149	2118	0.0009	-0.1194	0.0216	0.3214	1.0638	1.16	2.99	1.81	2003

Note: (1) To calculate "Z" score for private firms, enter Net Worth in the MKT-NW column. (For public-held companies, enter Markey Value of Equity).

Figure 21.7
"Z" SCORE GRAPH
(NAVISTAR)



— "Z" SCORE —■ TOP OF GRAY AREA —▲ BOTTOM OF GRAY AREA

MORE APPLICATIONS OF THE Z SCORE

Various groups of business people can take advantage of this tool for their own purposes. For example,

1. *Merger analysis.* The Z score can help identify potential problems with a merger candidate.
2. *Loan credit analysis.* Bankers and lenders can use it to determine if they should extend a loan. Other creditors such as vendors have used it to determine whether to extend credit.
3. *Investment analysis.* The Z score model can help an investor in selecting stocks of potentially troubled companies.
4. *Auditing analysis.* Internal auditors are able to use this technique to assess whether the company will continue as a going concern.
5. *Legal analysis.* Those investing or giving credit to your company may sue for losses incurred. The Z score can help in your company's defense.

WORDS OF CAUTION

The "Z" score offers an excellent measure for predicting a firm's insolvency. But, like any other tool, one must use it with care and skill. The "Z" score of a firm should be looked upon not for just one or two years but for a number of years. Also, it should not be used as a sole basis of evaluation.

The "Z" score can also be used to compare the economic health of different firms. Here again extreme care should be exercised. Firms to be compared must belong to the same market. Also, "Z" scores of the same periods are to be compared.

BUDGETING AND PLANNING SOFTWARE

In recent years, the focus has been on moving away from spreadsheets to enterprise budgeting applications in order to make the planning and budgeting process more efficient and the data more reliable. However the underlying process remains fundamentally unchanged; it is still about capturing and consolidating line item expenses. Several popular ones are described briefly.

Adaytum Planning

Adaytum Planning by Adaytum Software (www.adaytum.com) (1-800-262-4445) is a multi-user budgeting, planning, and forecasting system. It gives you the flexibility to:

- Update hierarchies directly from General Ledger (G/L).
- Combine top-down planning with bottom-up budgeting
- Make last minute changes to model structure
- Empower end-users to do ad hoc modeling without information system (IS) support.

Budget Maestro v5.8

Centage's Budget Maestro (www.centage.com) is probably the best answer to distributed budgeting, strategic planning and financial control. Budget Maestro shortens your budgeting cycle and puts you into control of the process. Its information-driven environment guides you through budgeting, planning, modeling, forecasting, resource management, consolidation, analysis, and

reporting. CFOs and budget managers can plan, analyze and manage, in ways never before possible. Look at a user's screen and make changes directly without ever being there. Deliver budget models and deploy reconfigured software updates to many users at once. Plus manage budgetary information, even enterprise wide information systems, with a single consistent interface. Budget Maestro is designed to put CFOs and financial managers in control of all aspects of managing budgets, creating financial models and building and deploying financial plans. Budget Maestro allows business managers unparalleled flexibility in analyzing cash flow and business performance throughout the enterprise. Budget Maestro significantly shortens your budgeting and planning cycles. It eliminates rekeying and formatting of data. It increases your data accuracy and integrity. It allows your time to manage and analyze your business. It is an excellent tool that provides you the ability to perform:

- Budgeting
- Forecasting; rolling forecasts
- Planning
- What-if scenario building
- Payroll and Benefits Management
- Headcount Planning
- Capital Asset Planning
- Debt Management
- Automatic data consolidation
- Management Reports
- Extensive drill-down Reporting
- Income Statement, Balance Sheet & Statement of Cash Flows

As an alternative to spreadsheets, Budget Maestro automates many of the complex and repetitive tasks in the budgeting process while eliminating the need for creating complicated formulas and manual consolidation of multiple worksheets.

Budget Maestro offers three editions:

Desktop Edition - A single user license that is ideal for the CEO, CFO or Controller of small to mid-sized organizations that have a centralized budgeting and planning process.

Small Business Edition - This edition supports up to 3 users operating in a collaborative environment to generate budgets, forecasts and financial reports.

Enterprise Edition - An enterprise-wide application for use by finance executives and departmental/line managers to foster a more collaborative and participatory planning environment.

Microsoft Business Solutions for Analytics—Forecaster

This is Web-based budgeting and planning solution from FRx Software (www.frxsoftware.com/). Many organizations find it difficult to perform the ongoing budgeting and planning processes necessary to keep business performance on target. Financial "surprises" are met with panic, and more often than not, companies are forced to make sacrifices in places they cannot afford. The result is a direct, negative impact on their strategic objectives. But it's not for lack of trying. Finance departments simply don't have the time it takes to combine multiple spreadsheets submitted from across the company (Let alone the resources to make sure all line managers understand the importance of the budgeting and planning process, and of submitting well-planned

information on time!). *Forecaster* puts the systems and processes in place to help you immediately realize the benefits of an effective budgeting and planning process, and make it an ongoing part of your business strategy.

Host Budget V3.2

(www.hostanalytics.com) HOST BUDGET is an integrated budgeting and planning software that provides streamlined budgeting, forecasting, reporting, and analysis. Modules are used to automatically manage, consolidate, and change information for planning and replanning. These budgeting, forecasting, and planning modules include:

- Integration with Host's Performance Measurement Scorecard
- SG&A Budget module
- Human Resources Budget module
- Sales and Operation Planning (S&OP) module
- Sales Forecasting module
- Capital Expenditure Budget module and others

HOST BUDGET is architected for the Web so that the individuals involved in budgeting and planning can use all of the features. All that is needed by the user is a web browser to access and update the application. Microsoft Excel spreadsheets can be used "on-line" or "live" to the database for queries and updates. Or, if the user prefers to work disconnected from the central database the user can work "off-line" and easily upload the Excel file later or submit via email.

Because of the streamlined effects of HOST BUDGET on an organization's budgeting process, budgets and forecasts can be refined on an ongoing basis. Managers can consider what has happened so far and can regularly look into the future aided by actual versus budgeted information along with current forecast projections in their effort to meet financial goals. Executive Managers can create top down budgets and "push down" the budget to lower levels of the organization. Line managers and department heads can create budgets from the bottom up and submit budgets for approval.

Continuous rolling forecasts can easily be created with HOST FORECASTER and bi-directional data integration allows the detailed budgets to be loaded to or from other applications.

Based on best practices, HOST FORECASTER provides a rich set of tools to facilitate sales forecasting using standard methods including:

- Statistical forecasting.
- Top down forecasting allocated to the SKU level based on prior year history, current estimate, last two years average sales, and other basis.
- Bottom up forecasting for product introductions and discontinued products.
- Ability to smooth forecasts to eliminate the impact of infrequent sales events.

SRC Systems

SRC Budgeting

Balancing flexibility and control, sophistication and ease-of-use, SRC Budgeting (www.srcsoftware.com) provides the tools you need to create and execute detailed budgets—transforming strategic goals into operational plans. SRC Budgeting not only simplifies the budgeting process, but also streamlines the sharing of data with key managers. The result is:

Greater accuracy, enhanced accountability, and increased ownership by business units—all while dramatically reducing the time required for the planning process.

The benefits are:

- Increase collaboration while streamlining the budget process.
- Model budgets to fit your business.
- Align budgets with strategic plans and forecasts.
- Create flexible and sophisticated budgets.

SRC Sales Planning

With SRC Sales Planning, all deals can be tracked—not just the hot ones—and sales managers can adjust focus, training, and incentives to increase sales. Greater visibility into how leads play out at various points in the sales pipeline improves management decision-making ability.

Understand which leads are working and which ones are not. Understand which products and services are in demand, identify and investigate changes and fluctuations, and take appropriate action—whether it means realigning the salesforce or adjusting production and distribution.

The benefits are:

- Create a robust sales forecast.
- Make more accurate and timely planning decisions.
- Align sales, supply chain, and operations.

SRC Forecasting

This system allows you to create timely, high-level, dimensionally independent rolling forecasts—driven by the strategic plan—and translated into operational targets. SRC Forecasting streamlines and speeds the forecasting cycle, leverages a sophisticated and customizable modeling process, and helps ensure organizational alignment.

The benefits are:

- Streamline financial forecasting
- Customize and model forecasts for accurate planning
- Align forecasts with detailed budgets.

CONCLUSION

As was discussed, there is a number of software packages for financial and corporate modeling. Companies just entering the modeling arena must keep in mind that the differences that exist between the software packages available in the market can be substantial. A comparison should be made by examining the software in light of the planning system, the information system, and the modeling activities. The companies also consider making effective use of in-house computer hardware, micro, mini, or mainframe, and data bases. An effective modeling system does not necessarily imply an outside time-sharing system or an external economic data base.

CHAPTER 22

USING MANAGEMENT GAMES FOR EXECUTIVE TRAINING

LEARNING OBJECTIVES

After studying the material in this chapter, you will be able to:

1. Discuss a variety of executive management games.
2. Validate the game.
3. Outline a new role for computerized executive games.

Management games offer a unique means of teaching business managers and financial executives financial and managerial concepts and developing their strategic abilities. More and more companies as well as virtually all MBA programs across the nation are using management games as a basic teaching tool for industrial training programs. Games have also found their way into university and corporate executive development programs. In addition researchers are using games to determine their effectiveness in teaching strategic thinking skills.

The management game is a form of simulation. The distinction between a game and a simulation is subtle. Both are mathematical models, but they differ in purpose and mode of use. As was discussed in the previous chapters, simulation models are designed to simulate a system and to generate a series of quantitative and financial results regarding system operations. Games are a form of simulation, except that in games human beings play a significant part. In games, participants make decisions at various stages; thus games are distinguished by the idea of play. The major goals of the game play can be summarized as follows:

- .Improve decision making and analytical skills
- .Facilitate participants' understanding of the external environment simulated
- .Integratively apply the knowledge, concepts, and skills acquired in various business courses
- .Develop awareness of the need to make decisions without complete information
- .Improvise appropriately and adapt constructively from previously learned concepts, theories, and techniques
- .Develop ability to recognize the need for additional factual material
- .Develop an understanding of the interrelationships of the various functions within the firm and how these interactions affect overall performance

- .Teach the effects of present decisions or future decisions
- .Develop an understanding of the fact of uncertainty and the impact of the competitive environment on the firm
- .Develop an understanding of the necessity for good communications, teamwork, and leadership
- .Develop an ability to function cooperatively and effectively in a group situation

Management games generally fall into two categories: executive games and functional games. Executive games are general management games and cover all functional areas of business and theory interactions and dynamics. Executive games are designed to train general executives. Functional games, on the other hand, focus on middle management decisions and emphasize particular functional areas of the firm. They cover such areas as:

- . Resource allocation in general
- . Production planning and scheduling
- . Manpower requirements and allocation
- . Logistics systems
- . Material management
- . Maintenance scheduling
- . Sales management
- . Advertising and promotion
- . Stock transactions
- . Investment analysis
- . Research and development management

The objective in playing functional games is usually to minimize cost by achieving efficient operations or to maximize revenues by allocating limited resources efficiently. With emphasis on efficiency in specific functional areas, rather than on competition in a marketplace, which is the case in executive management games, there is no or little interaction in many functional games between player decisions. From that standpoint, functional games are very similar to simulation models. Here is a partial list of some well known functional games:

Name of Functional Games	Areas They Cover
<ul style="list-style-type: none"> ▪Worldwide Simulation Exercise ▪The Multinational Game - MicroVersion ▪Multinational Management Game ▪Multinational Business Game ▪International Operations Simulation ▪The Business Policy Game 	International game

▪Management Accounting Game	Accounting game
▪COMPETE	Marketing
▪MARKSTRAT	
▪Marketing Game	
▪MICROSIM	Economics game
▪The Westinghouse Plant Scheduling Warehouse Simulation Exercise	Distribution and Logistics
▪Green and Sission's	
Materials Inventory Management Game	Inventory planning
Production scheduling	
Scheduling Management Game	Production scheduling
X-Otol	Distribution
• Interpretive Software'	
PharmaSim Brand management simulation	
AutoSim	Marketing laboratory
ServiceSim	Managing customer satisfaction
▪IBM Production Manpower Decision Model	Production and manpower scheduling decisions
▪FINASIM	Financial management simulation
▪PERT-SIM	Project planning and control

A partial list of some well-known executive management games follows.

- The Business Strategy Game: A Global Industry Simulation by Arthur A. Thompson and Gregory J. Stappenbeck (6th edition), Irwin/McGraw-Hill. (www.mhhe.com/thompson), 1999.
- Capstone Business Simulation by Management Simulations, Inc. , Northfield, IL 60093 (1-888-472-7554), 2001.
- PriSim Business War Games and Business Simulations by PriSim (<http://www.prisim.com>)

- The Business Policy Game: An International Simulation, by Richard. V. Cotter and David J. Fritzsche .
- StratSim: The Strategy Simulation by Interpretive Software, Inc. (1-800-SIMUL8R) (<http://www.interpretive.com>)
- The Executive Game (XGAME) by R.C. Henshaw, Jr. and J.R. Jackson
- MICROMATIC, by A. Strickland.
- TEMPOMATIC IV, by O. Embry.
- DECIDE, by T. Pary.
- The Business Management Laboratory by Ronald L. Jensen
- Decision Making Exercise by John E. Van Tassel
- Electronic Industry Game by James Francisco
- Executive Decision Making Through Simulation By P.R. Cone, et al.
- The Executive Simulation by Bernard Keys
- Integrated Simulation by W.N. Smith, et al.
- The IMAGINIT MANAGEMENT GAME, by R. Barton
- COGITATE, by Carnegie Mellon University
- Top Management Decision Game, by R. Schrieber
- Harvard Business Game, by Harvard University
- AIRLINE: A Business Simulation
- Alacrity Team Simulation Exercise
- CEO: A Business Simulation for Policy and Strategic Management
- Collective Bargaining Simulated
- COMPETE: A Dynamic Marketing Simulation
- The Global Business Game
- Corporation: A Global Business Simulation
- Entrepreneur: A Business Simulation in Retailing
- The Human Resources Management Simulation
- INTOPIA: International Operations Simulation/Mark 2000
- MANAGEMENT 500: A Business Simulation for Production and Operations Management
- Manager: A Simulation Game
- Marketer: A Simulation Game
- Marketplace
- Multinational Management Game, The
- Threshold Competitor: A Management Simulation

EXECUTIVE MANAGEMENT GAMES

Executive (general management) games offer a unique means of teaching the participants management concepts and developing strategic abilities. Executive games involve sequential decision making in which the problems at any point in the decision process are at least partly dependent upon a participant's prior actions. Following the introduction of management games, their number and use expanded rapidly, so that by 1990 it was estimated that there were more than 500 games in existence and over 1 million executives had played them. Robinson (1985) catalogued 100 executive games, and their estimation disclosed that by 2000 virtually all business schools were using management games.

Management games have been developed by computer manufacturers, educational institutions, and private consulting firms. Some of the most notable ones include PriSim Business War Games and Business Simulations by PriSim (<http://www.prisim.com>), Henshaw and Jackson's Executive Game, Cotter's Business Policy Game: An International Simulation, Thompson and Stappenbeck's The Business Strategy game, and Strickland's MICROMATIC. These games differ in the level of sophistication, subject matter, coverage of decision variables, and so forth, but are typical of general management games.

The Association for Business Simulation and Experiential Learning (<http://www.absel.com>) lists some popular simulation and game packages in the market today and their Websites. They are as follows:

- AIRLINE: A Business Simulation
- Alacrity Team Simulation Exercise
- Business Management Laboratory, The
- Business Policy Game, The
- BusSim: An Integrated Business Instruction System
- CEO: A Business Simulation for Policy and Strategic Management
- Collective Bargaining Simulated
- COMPETE: A Dynamic Marketing Simulation
- The Global Business Game
- Corporation: A Global Business Simulation
- DEAL: An Entrepreneurship Gaming Simulation
- Entrepreneur: A Business Simulation in Retailing
- GEO: An International-Business Gaming Simulation
- The Human Resources Management Simulation
- INFOGAME: Game for Research and Education in Information Systems
- INTOPIA: International Operations Simulation/Mark 2000
- MAGEUR: A General Business Game
- MANAGEMENT 500: A Business Simulation for Production and Operations Management
- Manager: A Simulation Game
- Marketer: A Simulation Game
- Marketplace
- Multinational Management Game, The
- Threshold Competitor: A Management Simulation

Management games have been developed by computer manufacturers, educational institutions, and private consulting firms. Some of the most notable ones include Thompson and Stappenbeck's The Business Strategy Game (1999), Henshaw and Jackson's Executive Game (1986), Schrieber's Top Management Decision Game (1971), and the Carnegie Tech Management Game (1964). These games

differ in the level of sophistication, subject matter, coverage of decision variables, and so forth, but are typical of general management games.

The game environment is an oligopolistic industry composed of the participating players who represent companies in the industry. A single product is made by the companies, and this product is sold in a single market. The period of operations covered by the game is usually assumed to be one quarter of a year. *Tip:* To be successful, participant managers need to adopt the top management viewpoint. That is to say, they need to first define the goals and objectives of the firm they represent. *Caution:* They must always keep in mind that they are competing with the management teams of other firms in their industry. The game simulation model is designed to include general relationships that might exist in any competitive industry (or, more precisely, any oligopolistic industry). Participants need to use, in a small-group setting, their knowledge and experience in order to make certain deductions about the economy in which they are operating and about general relationships within the game. These deductions must be combined with knowledge and experience about the specific relationships with the team's belief about what action the competitors are likely to take.

A set of quarterly decisions designed to meet the organization's goals and objectives ideally will be apparent after data are analyzed and forecasting methods are applied. Figure 22.1 is a flowchart of a variety of activities to be performed by the teams involved in preparing quarterly decisions.

In the course of playing the game, players will encounter a variety of business situations. It will be necessary to undertake business forecasting, sales forecasting, and profit planning. Cash and capital budgets will have to be formulated. Production planning and scheduling must be done. Cost analysis, formulation of pricing policies, and development of marketing and advertising programs must be done. The potential effects of investment and financing decision on the capital structure must be investigated. In addition, players must prepare and analyze financial statements, cost and sales data and general informational reports regarding their competitors, industry, and economic conditions.

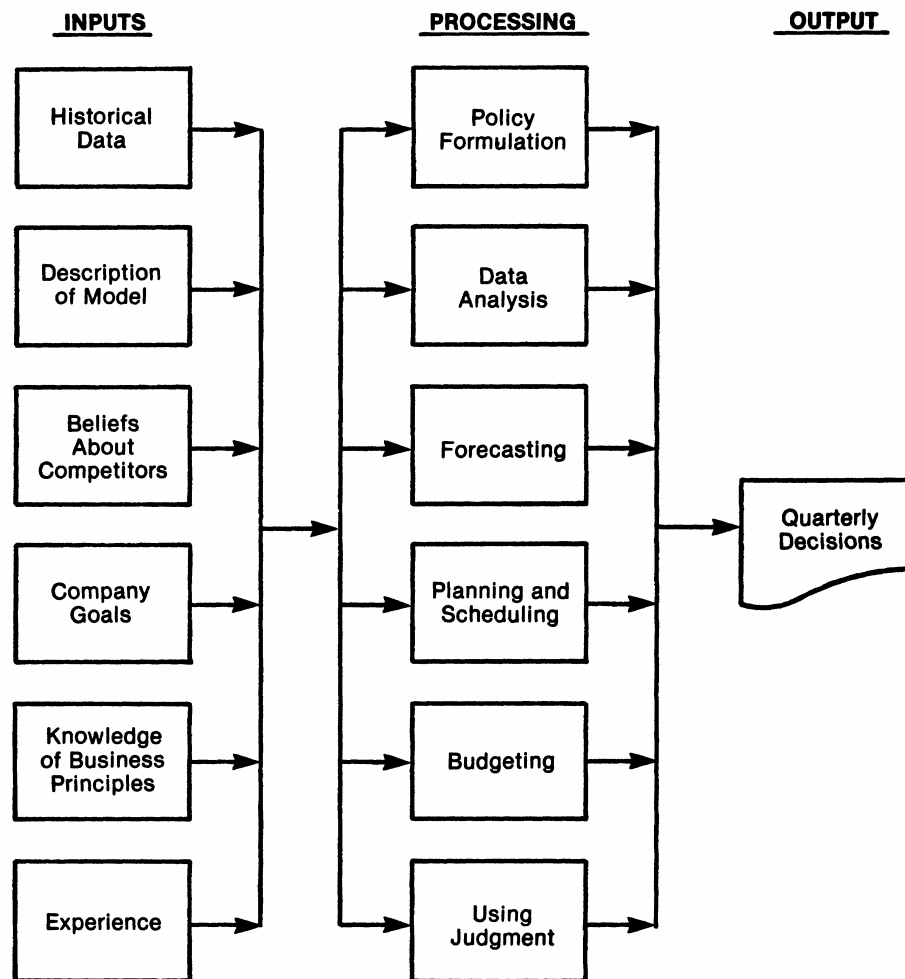
The Executive Game (XGAME) is typical of top management games. The game environment is an oligopolistic industry composed of the participating players or teams who represent companies in the industry. A single product is made by the companies, and this product is sold in a single market. The teams manage their companies by making the following quarterly decisions:

- . Price of product
- . Marketing budget
- . Research and development budget
- . Maintenance budget
- . Production volume scheduled
- . Investment in plant and equipment
- . Purchase of materials
- . Dividends declared

After decisions have been made they are transmitted via a terminal, along with historical data summarizing the conditions of the firms at the end of the preceding quarter, into a computer. The computer, having been programmed to simulate the industry's operations, generates historical data and prints the following reports for each firm:

- .General economic information
- .Information on competitors
- .Market potential
- .Sales volume
- .Percent share of industry sales
- .Production this quarter
- .Inventory, finished goods
- .Plant capacity next quarter
- .Income statement
- .Cash flow statement
- .Balance sheet

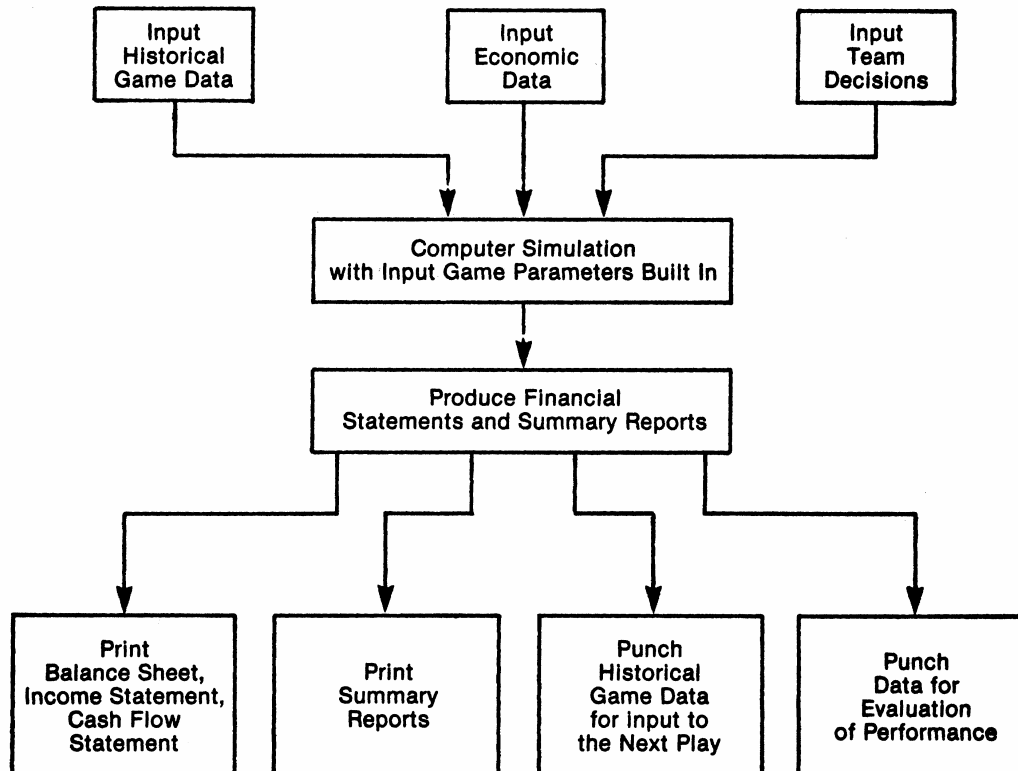
Figure 22.1
Flowchart for Quarterly Decisions



For the next quarter, a new set of decisions is made. This set, together with operating results of the preceding quarter and external economic conditions, are given as input data to the computer program, which then calculates results of play for the next quarter. The program prepares a new set of reports, which are returned to the players, and the cycle continues until the end of the game.

Figure 22.2 illustrates the basic structure of a typical executive game. For each play, data inputs for team decisions, current economic index, status of the game from preceding plays, and parameters of the model functions are built into the game model. Teams' decisions include price, marketing expenditures, R & D expenditures, production rate, investment in plant and equipment, and the like. The model then simulated interactions between the simulated environment and the decisions of the participants. At the end of each simulated period of play, financial statements and summary reports for each company are prepared and printed (see Figure 22.3)

Figure 22.2
Structure of a Typical Executive Game



.Historical game data for input to the next play are generated

.Data needed for performance evaluation purposes are stored so that the game administrator is able to rate them, as shown in Figure 22.4

This process is repeated for each firm in the industry.

FIGURE 22.3**Company Financial Statement and Summary Report**

MODEL 1 PERIOD 3 JFM PRICE INDEX 104.0 FORECAST ANNUAL CHANGE 4.3
 0/0 SEAS.INDEX 90. NEXT QTR. 100. ECON.INDEX 91. FORECAST,NEXT QTR. 90.

INFORMATION ON COMPETITORS

	PRICE	DIVIDEND	SALES VOLUME	NET PROFIT
FIRM 1	\$ 25.75	\$200000.	145215.	\$ 99384.
FIRM 2	\$ 25.75	\$ 20000.	108796.	\$ 1342.
FIRM 3	\$ 26.00	\$100000.	113323.	\$ -455219.
FIRM 4	\$ 26.00	\$ 0	106000.	\$ 67275.
FIRM 5	\$ 25.70	\$ 75000.	106559.	\$ -48419.
FIRM 6	\$ 25.75	\$ 55000.	68550.	\$ -355738.

FIRM 7 2**OPERATING STATEMENTS**

MARKET POTENTIAL	108796.
SALES VOLUME	108796.
PERCENT SHARE OF INDUSTRY	17.
PRODUCTION,THIS QUARTER	120000.
INVENTORY,FINISHED GOODS	11204.
PLANT CAPACITY,NEXT QUARTER	114192.

INCOME STATEMENT

RECEIPTS,SALES REVENUE		\$ 2801489.
EXPENSES,MARKETING	\$ 275000.	
RESEARCH AND DEVELOPMENT	350000.	
ADMINISTRATION	351332.	
MAINTENANCE	80000.	
LABOR(COST/UNIT EX.OVERTIME	723186.	
\$ 5.82)		
MATERIALS CONSUMED(COST/UNIT	723127.	
6.03)		
REDUCTION,FINISHED GOODS INV.	-137769.	
DEPRECIATION (3.125 0/0)	242460.	
FINISHED GOODS CARRYING	22961.	
COSTS		
RAW MATERIALS CARRYING	40753.	
COSTS		
ORDERING COSTS	51234.	
SHIFTS CHANGE COSTS	0	
PLANT INVESTMENT EXPENSES	16000.	
FINANCING CHARGES AND	0	
PENALTIES		
SUNDRIES	92595.	2830879.
PROFIT BEFORE INCOME TAX		-29390.
INCOME TAX(IN.TX.CR. 10.		-30732.
0/0,SURTAX 0 0/0)		

FIGURE 22.3 (continued)

NET PROFIT AFTER INCOME TAX		1342.
DIVIDENDS PAID		20000.
ADDITION TO OWNERS EQUITY		- 18658.
CASH FLOW		
RECEIPTS, SALES REVENUE		\$ 2801489.
DISBURSEMENTS, CASH EXPENSE	\$ 2003061.	
INCOME TAX	- 30732.	
DIVIDENDS PAID	20000.	
PLANT INVESTMENT	400000.	
MATERIALS PURCHASED	750000.	3142329.
ADDITION TO CASH ASSETS		- 340840.
FINANCIAL STATEMENT		
NET ASSETS, CASH		\$ 736478.
INV. VALUE, FINISHED GOODS		137769.
INVENTORY VALUE, MATERIALS		841939.
PLANT BOOK		7916256.
VALUE (REPLACE. VAL. \$ 8516087.)		
OWNERS EQUITY (ECONOMIC EQUITY \$10232273.)		9632442.

FIGURE 22.4
Performance Evaluation Data

EXECUTIVE GAME END OF FISCAL YEAR 1.						
FIRM NO.	NET CASH ASSETS (\$)	INVENTORY VALUE FIN-GOODS (\$)	INVENTORY VALUE MATERIALS (\$)	PLANT REPLACE. VALUE (\$)	OWNERS ECONOMIC EQUITY (\$)	
7 1	868469.	0.	1344725.	7724297.	9937491.	
7 2	492619.	225250.	814990.	8695345.	10228204.	
7 3	830205.	0.	228009.	8433799.	9492013.	
7 4	1757777.	0.	918532.	7735186.	10411495.	
7 5	684679.	127477.	1087781.	8160278.	10060215.	
7 6	745705.	0.	907815.	7953408.	9606928.	
AVERAGES PER QUARTER FOR FISCAL YEAR 1. ONLY						
FIRM NO.	MARKETING (\$)	R AND D (\$)	SALES VOLUME (UNITS)	NET PROFIT (\$)	RATE OF RETURN* (O/O)	RANK*
7 1	403125.	500000.	138107.	45644.	8.81	1
7 2	306250.	387500.	109953.	-29567.	5.76	4
7 3	387500.	625000.	129138.	-69184.	4.19	5
7 4	350000.	375000.	112732.	25584.	7.85	2
7 5	300000.	462500.	114301.	-21617.	5.96	3
7 6	251250.	775000.	123015.	-136277.	1.32	6
*RANK AND ANNUAL RATE OF RETURN ARE BASED UPON DIVIDEND PAY-OUT FOR ALL 4 PERIODS AND OWNERS ECONOMIC EQUITY AT THE END OF FISCAL YEAR 1.						

ADVANTAGES AND DISADVANTAGES OF EXECUTIVE GAMES

Executive games are most useful to individuals seeking expanded business background. With this goal as a basis for participation, the individuals playing executive games will receive valuable insight into decision-making environments. The effectiveness of these games is dependent upon the trade-off between simplicity in model formulation and the maintenance of realism. *Warning:* As the complexity of the system grows, the participating audience loses its attentiveness with the game. It is for these reasons that simplicity is of major importance in designing an effective and informative executive game. Ease of understanding, playing, and administration are the factors that should be of utmost consideration to the designer. With this in mind, an optimal model can be designed for the use intended.

The intended use of executive games is for the participants to draw a basic understanding of the complexity of a modern-day concern. Players attempt to determine the effects of various decisions on the specific environment being simulated. The interaction of several endogenous variables (marketing budget, research and development budget, plant maintenance budget, scheduled production volume, plant investment, purchase of raw materials, declaration of cash dividends, selected by the players with exogenous variables (economic index, general price index, seasonal demand) formulated by the administrator to portray prevailing market and economic conditions, allows for excellent simulation of actual conditions found in today's business world.

VALIDATING THE GAME

A good executive game should be a valid one. Fortunately, the user of simulators are seldom concerned with proving the truth of a model. *Recommendation:* A model should be established on the basis that no one excellent decision or combination of poor decisions by others should permit one team to capture an overwhelming portion of the market. Built into the system should be parameters that prohibit high degrees of elasticity from affecting any one decision. The executive game previously discussed has implemented these controlling factors along with the controls maintained by the game administrator. The administrator can change or revise any of the exogenous variables or goals of the game to facilitate proper play by the participating teams. This executive game uses these controls to magnify its intended purpose for practical business applications. Removal of controlling factors might enhance realism, but at the same time would interfere with competition and finally destroy the executive lessons to be learned.

It is the learning process which the simple executive game wishes to portray, although for significantly large problems, realism makes the simulation technique highly preferable to others. Many decisions are made on the basis of simulation results, and these decisions can only prove to be as good as the data employed in the simulation. Thus, strong statistical inference should be made to test the validity of the data.

While models of this type offer adequate feedback to beginning executives, the more advanced find drawbacks to an oversimplified model because they lack detailed relationships in functional areas. The lack of competitive interaction among players is the prime reason for the deficient descriptiveness in functional areas. Those seeking these descriptive relationships should make use of functional games that focus their attention on efficiency rather than competition. It is this competitive nature of executive games that enhances their appeal to participate. *Recommendation:* The interaction and competition of players can be increased by allowing these individuals to actually operate computers.

BENEFITS OF GAME PLAY

- .Ability to explore more alternatives
- .Better understanding of the interaction of functional areas in business
- .Facilitates group interaction
- .Provides immediate feedback
- .Develops decision-making skills
- .Better learning device than case methods

A NEW ROLE FOR COMPUTERIZED EXECUTIVE GAMES

An additional purpose has been found for executive games. Researchers are using the games in many different ways. The effectiveness of teaching using computerized games; the effectiveness of changing behaviors, performance, and analytical skills are just some of the research topics academics are pursuing.

CONCLUSION

Management games are useful in instructing financial managers on how to make good decisions in various operating scenarios and circumstances. Financial executives should make decisions in various stages of the process so they can modify their policies as appropriate. The two types of games are executive games, covering the overall strategic plan of the firm, and functional games, concentrating on specific aspects of the business. Executive games require adjustment and changes in expectations given the variety of assumed business situations experienced. Functional games try to reduce cost via efficient operations or maximize revenue through properly allocating resources.

Academia uses computerized executive games to research the effectiveness of this teaching tool on changing the behaviors and performance of managers and the effectiveness of teaching analytical and strategic thinking skills of business students. This area of study is currently a hot topic open for debate. More research is needed before any conclusions on the effectiveness of these games can be made.

REFERENCES AND ADDITIONAL READINGS

The Association for Business Simulation and Experiential Learning

(<http://www.towson.edu/absel/>) has the following links to a variety of games.

- AIRLINE: A Business Simulation
- Alacrity Team Simulation Exercise
- Business Management Laboratory, The
- Business Policy Game, The
- BusSim: An Integrated Business Instruction System
- CEO: A Business Simulation for Policy and Strategic Management
- Collective Bargaining Simulated
- COMPETE: A Dynamic Marketing Simulation
- The Global Business Game
- Corporation: A Global Business Simulation
- DEAL: An Entrepreneurship Gaming Simulation
- Entrepreneur: A Business Simulation in Retailing
- GEO: An International-Business Gaming Simulation
- The Human Resources Management Simulation
- INFOGAME: Game for Research and Education in Information Systems
- INTOPIA: International Operations Simulation/Mark 2000
- MAGEUR: A General Business Game
- MANAGEMENT 500: A Business Simulation for Production and Operations Management

- Management Accounting Simulation, The
- Manager: A Simulation Game
- Marketer: A Simulation Game
- Marketplace
- Multinational Management Game, The
- Threshold Competitor: A Management Simulation

Barker, J. R., Temple, C.S., & Sloan, H. M., III. *WORLDWIDE SIMULATION EXERCISE: User's Manual*. (Available from the authors, 33 Hayden Street, Lexington, MA), 1976.

Biggs, W.D. "Functional Business Games," *Simulation & Games*, 18, 242-267, 1987

Burgess, T.F. "The Use of Computerized Business Games in Business Studies." *Educational and Training Technology International*, 26(3), 226-238, 1989.

Burgess, T.F. "The Use of Computerized Management and Business Simulations in the United Kingdom." *Simulation & Games*, 22, 174-195, 1991.

Carvalho, Gerard F. "Evaluating Computerized Business Simulators for Objective Learning Validity, *Simulation & Games*, 22, 328-349, 1990.

Cotter, R., & Fritzsche, D. *Modern Business Decisions*. Englewood Cliffs, NJ: Prentice-Hall, 1985.

Cotter, Richard V. and David S. Fritzsche. *Business Policy Game-Player's Manual*. Prentice-Hall, Inc., Englewood Cliffs, N.J. Second Edition, 1986.

Edge, A. G., Keys, B., & Remus, W. *Multinational Management Game: User Manual*. Dallas, TX: Business Publications, Inc., 1979.

Edge, A., Keys, B., & Remus, W. *The Multinational Game - MicroVersion..* Homewood, IL: Irwin, 1989.

Elgood, C. *Handbook of Management Games* (4th ed.). Aldershot:Gower, 1988.

Embry, O., Strickland, A., & Scott, C. *TEMPOMATIC IV: A Management Simulation*. Boston: Houghton Mifflin, 1974.

Faria, A. J. "A Survey of the Use of Business Games in Academia and Business," *Simulation & Games*, 18, 207-224, 1987.

Faria, A., Nulsen, R., & Roussos, D. *COMPETE: A Dynamic Marketing Simulation*. (3rd ed.). Dallas, TX: Business Publications, Inc., 1984.

Gold, S., Pray, T., & Dennis, T. *MICROSIM A Computerized Microeconomics Simulation*. New York: Macmillan, 1984.

Goosen, Kenneth. *Introduction to Management Accounting: A Business Game*. Scott Foresman, Glenview, Ill., 1994.

Hemmasi, M., Graf, L. A., & Kellogg, C. E. "A Comparison Of the Performance Behaviors, and Analysis Strategies of MBA Versus BBA Students in A Simulation Environment," *Simulation & Games*, 20, 15-30, 1989.

Henshaw, Richard C. and James R. Jackson. *The Executive Game*. Richard D. Irwin, Inc., 1986.

Horn, R. E., & Cleaves, A. *The Guide To Simulation/Games For Education And Training*. London: Sage, 1989.

Hoskins, W. R. *MULTINATIONAL BUSINESS GAME: User Manual*. Phoenix, AZ.: American Graduate School of Business, 1983.

Interpretive Software, Inc. (<http://www.interpretive.com>) *StratSim: The Business Strategy Simulation*, Charlottesville, Virginia, 1997-99.

Interpretive Software, Inc. (<http://www.interpretive.com>) *A Brand Management Simulation*, Charlottesville, Virginia, 1997-99.

Interpretive Software, Inc. (<http://www.interpretive.com>) *AutoSim: The Marketing Laboratory*, Charlottesville, Virginia, 1997-99.

Interpretive Software, Inc. (<http://www.interpretive.com>) *ServiceSim: Managing Customer Satisfaction*, Charlottesville, Virginia, 1997-99.

Jensen, R., & Cherrington, D. *The BUSINESS MANAGEMENT LABORATORY*, Dallas, TX: Business Publications, Inc., 1977

Keys, B. "Total Enterprise Business Games," *Simulation & Games*, 18, 225-241, 1987.

Klein, Ronald D. and Fleck, Jr. Robert A. "International Business Simulation/Gaming: An Assessment and Review," *Simulation & Games*, 21, 147-165, 1990.

Larreche, J. & Gatignon, H. *MARKSTRAT: A Marketing Strategy Game*. Scientific Press, 1977.

Mehreg, A. A., Reichel, A., & Olami, R. "The Business Game Versus Reality," *Simulation & Games*, 18, 488-500, 1987.

Mills, L., & McDowell, D. *The BUSINESS GAME*. Boston: Little Brown, 1985.

Parasuraman, A. "Assessing the Worth of Business Simulation Games: Problems and Prospects," *Simulation & Games*, 12, 189-200, 1981.

Pray, T., & Strang, D. *DECIDE: A Management Decision Making Simulation*. New York.: Random House, 1980.

Pray, T.F. "Management Training: It's All in The Game," *Personnel Administrator*, 32, 68-72, 1987.

Pray, T. F., and Methe David T. "Modeling Radical Changes in Technology Within Strategy-Oriented Business Simulations," *Simulation & Games*, 22, 19-35, 1991.

Remus, W., & Jenner, S. "Playing Business Games: Expectations and Realities," *Simulation & Games*, 12, 480-488, 1981.

Robinson, J. N. "Games and Simulation in Management and Economics: A Survey," *Economics*, 21 (Winter), 163-171, 1985.

Segev, E. "Strategy, Strategy-Making, and Performance in The Business Game," *Strategic Management Journal*, 8, 565-577, 1987.

Strickland, A., & Scott, T. *MICROMATIC - A Management Simulation*. Boston: Houghton Mifflin, 1985.

Thorelli, H.B., & Graves, R.L. *INTERNATIONAL OPERATIONS SIMULATION: User's Manual*. New York: Free Press and Macmillan, 1964.

Wolfe, J. "The Teaching Effectiveness of Games in Collegiate Business Courses: A 1973-1983 Update," *Simulation & Games*, 16, 251-288, 1985.

Wolfe, J., & Roberts, C.R. "The External Validity of A Business Management Game: A Five-Year Longitudinal Study," *Simulation & Games*, 17, 45-59, 1986.

GLOSSARY

ACID TEST RATIO: $(\text{Current assets} - \text{inventories}) / \text{current liabilities}$. This ratio is a more stringent measure of liquidity than the current ratio in that it subtracts inventories (the least liquid current asset) from current assets; also called *quick ratio*.

ANALYSIS OF VARIANCES (VARIANCE ANALYSIS): analysis and investigation of causes for variances between standard costs and actual costs. A variance is considered favorable if actual costs are less than standard costs; it is unfavorable if actual costs exceed standard costs. Unfavorable variances are the ones that need further investigation for their causes.

BANKER'S ACCEPTANCE: Time draft drawn by a business firm whose payment is guaranteed by the bank's "acceptance" of it. It is especially important in foreign trade, because it allows the seller of goods to be certain that the buyer's draft will actually have funds behind it.

BETA (COEFFICIENT): A measure of risk based on the sensitivity of an individual stock's returns to changes in the returns of a broad stock market index; also called systematic, market, undiversifiable, and relative risk. A beta less than 1 means that the company's stock is less risky than the market.

BREAK-EVEN ANALYSIS: A branch of cost-volume-profit (CVP) analysis that determines the break-even sales, which is the level of sales where total costs equal total revenue.

CAPITAL ASSET PRICING MODEL (CAPM): A formula according to which a security's expected return is equal to the risk free rate plus a risk premium. The model shows the relationship between an investment's expected (or required) return and its beta. It can be used to estimate the cost of equity of a firm or a project. **capital budget:** a budget or plan of proposed acquisitions and replacements of long-term assets and their financing. A capital budget is developed using a variety of capital budgeting techniques such as the discount cash flow method.

CAPITAL STRUCTURE DECISION: Deciding on the amount of debt relative to equity capital a firm should take on; also called financial structure decision.

CAPITAL STRUCTURE: The mix of long term sources of funds used by the firm; also called capitalization. The relative total (percentage) of each source of fund is emphasized.

CAPITAL RATIONING: The problem of selecting the mix of acceptable projects that provides the highest overall net present value (NPV) where a company has a limit on the budget for capital spending.

CASH BUDGET: A budget for cash planning and control presenting expected cash inflow and outflow for a designated time period. The cash budget helps management keep its cash balances

in reasonable relationship to its needs. It aids in avoiding idle cash and possible cash and possible cash shortages.

CASH FLOW FORECASTING: Forecasts of cash flow including cash collections from customers, investment income, and cash disbursements.

CLASSICAL DECOMPOSITION METHOD: The approach to forecasting that seeks to decompose the underlying pattern of a time series into cyclical, seasonal, trend, and random sub-patterns. These subpatterns are then analyze individually, extrapolated into the future, and recombined to obtain forecasts of the original series.

COEFFICIENT OF DETERMINATION: A statistical measure of how good the estimated regression equation is, designated as R^2 (read as R-squared). Simply put, it is a measure of “goodness of fit” in the regression. Therefore, the higher the R-squared, the more confidence we can have in our equation.

CONCENTRATION BANKING: Acceleration of cash collections from customers by having funds sent to several regional banks and transferred to a main concentration account in another hank. The transfer of funds can be accomplished electronically.

CONTRIBUTION MARGIN (CM): The difference between sales and the variable costs of the product or service, also called marginal income. It is the amount of money available to cover fixed costs and generate profits.

CORRELATION COEFFICIENT (R): A measure of the degree of correlation between two variables. The range of values it takes is between -1 and +1. A negative value of R indicates an inverse relationship; a zero value of R indicated that the two variables are independent of each other; the closer R is to + or -1, the stronger the relationship between the two variables.

CORRELATION: The degree of relationship between business and economic variables such as cost and volume. Correlation analysis evaluates cause / effect relationships. It looks consistently at how the value of one variable changes when the value of the other is changed. A prediction can be made based on the relationship uncovered. An example is the effect of advertising on sales. A degree of correlation is measured statistically by the coefficient of determination (R-squared).

COST OF CAPITAL: The rate that must be earned in order to satisfy the required rate of return of the firm's investors; also called minimum required rate of return. It may also be defined as the rate of return on investments at which the price of the firm's common stock will remain unchanged. The cost of capital is based on the opportunity cost of funds as determined in the capital markets.

COST-VOLUME-PROFIT (CVP) ANALYSIS: Analysis that deals with how profits and costs change with a change in volume. It looks at the effects on profits of changes in such factors as variable costs, fixed costs, selling prices, volume, and mix of products sold.

DECISION TREE: A pictorial representation of sequential decisions, states of nature, probabilities attached to the state of nature, and conditional benefits and losses.

DELPHI METHOD: A qualitative forecasting method that seeks to use the judgment of experts systematically in arriving at a forecast of what future events will be or when they may occur. It brings together a group of experts who have access to each other's opinions in an environment where no majority opinion is disclosed.

DEPENDENT VARIABLE: A variable whose value depends on the values of other variables and constants in some relationship. For example, in the relationship $Y = f(X)$, Y is the dependent variable influenced by various independent variables, such as earnings per share, debt / equity ratio, and beta (see also Independent Variable).

DESEASONALIZED DATA: Removal of the seasonal pattern in a data series. Deseasonalizing facilitates the comparison of month-to-month changes.

DIVERSIFICATION: Spreading investments among different companies in different fields. Diversification is also offered by the securities of many individual companies because of the wide range of their activities.

DUMMY VARIABLE: Often referred to as a binary variable whose value is either 0 or 1, a dummy variable frequently is used to quantify qualitative or categorical events. For example, a peace or war situation could be represented by a dummy variable.

DU PONT FORMULA: The breakdown of return on investment (ROI) into profit margin and asset turnover.

DURBIN-WATSON STATISTIC: A summary measure of the amount of autocorrelation in the error terms of the regression. By comparing the computed value of the Durbin-Watson test with the appropriate values from the table of values of the D-W statistic (Appendix Table A.4), the significance can be determined (see also Autocorrelation).

EARNINGS FORECAST: Projection of earnings or earnings per share (EPS) frequently made by management and independent security analysts. Examples of forecast sources include (1) Lynch, Jones and Ryan's Institutional Brokers Estimate System (IBES), (2) Standard & Poor's The Earnings Forecaster, and (3) Zacks Investment Research's Icarus Service.

ECONOMIC ORDER QUANTITY (EOQ): the order size that should be ordered at one time to minimize the sum of carrying and ordering costs.

EXPONENTIAL SMOOTHING: A forecasting technique that uses a weighted moving average of past data as the basis for a forecast. The procedure gives heaviest weight to more recent information and smaller weights to observations in the more distant past. The method is effective when there is random demand and no seasonal fluctuations in the data. The method is popular technique for short-run forecasting by business forecasters.

F-TEST: In statistics the ratio of two mean squares (variances) often can be used to test the significance of some item of interest. For example, in regression, the ratio of (mean square due to the regression) to (mean square due to error) can be used to test the overall significance of the regression model. By looking up F-tables, the degree of significance of the computed F-value can be determined.

FINANCIAL MODEL: A system of mathematical equations, logic, and data that describes the relationship among financial and operating variables.

FINANCIAL PROJECTION: An essential element of planning that is the basis for budgeting activities and estimating future financing needs of a firm. Financial projections (forecasts) begin with forecasting sales and their related expenses.

FORECAST: 1. A projection or an estimate of future sales revenue, earnings, or costs (see also Sales Forecasting). 2. A projection of future financial position and operating results of an organization (see also Financial Projection).

FUNDAMENTAL ANALYSIS: The process of gathering basic financial, accounting and economic data on a company and determining whether that company is fairly priced by market standards.

GOODNESS OF FIT: A degree to which a model fits the observed data. In a regression analysis, the goodness of fit is measured by the coefficient of determination (R-squared).

HOMOSCEDASTICITY: One of the assumptions required in a regression in order to make valid statistical inferences about population relationships, also known as constant variance. Homoscedasticity requires that the standard deviation and variance of the error terms is constant for all Xs, and that the error terms are drawn from the same population. This indicated that there is a uniform scatter or dispersion of data points about the regression line. If the assumption does not hold, the accuracy of the b coefficient is open to question.

INDEPENDENT VARIABLE: A variable that may take on any value in a relationship. For example, in a relationship $Y = f(X)$, X is the independent variable. For example, independent variables that influence sales are advertising and price (see also Dependent Variable).

INTERNAL RATE OF RETURN (IRR): The rate of interest that equates the initial investment with the present value of future cash inflows.

INVESTMENT CENTER: A responsibility center within an organization that has control over revenue, cost, and investment funds. It is a profit center whose performance is evaluated on the basis of the return earned on invested capital.

JUDGMENTAL (QUALITATIVE) FORECAST: A forecasting method that brings together, in an organized way, personal judgments about the process being analyzed.

LEAST-SQUARES METHOD: A statistical technique for fitting a straight line through a set of points in such a way that the sum of the squared distances from the data points to the line is minimized.

LEVERAGED BUYOUT (LBO): A corporate restructuring where the existing shareholders sell their shares to a small group of investors. The purchasers of the stock use the firm's unused debt capacity to borrow the funds to pay for the stock.

LINEAR PROGRAMMING (LP): A technique used to find an optimal solution to the resource allocation problem under constrained conditions.

LINEAR REGRESSION: A regression that deals with a straight line relationship between variables. It is in the form of $Y = a + bX$ whereas nonlinear regression involves curvilinear relationships such as exponential and quadratic functions (see also Regression Analysis).

MASTER (COMPREHENSIVE) BUDGET: A plan of activities expressed in monetary terms of the assets, equities, revenues, and costs which will be involved in carrying out the plans. A set of projected or planned financial statements.

MATERIALS PRICE VARIANCE: The difference between what is paid for a given quantity of materials and what should have been paid, multiplied by actual quantity of materials purchased.

MATERIALS QUANTITY (USAGE) VARIANCE: The difference between the actual quantity of materials used in production and the standard quantity of materials allowed for actual production, multiplied by the standard price per unit.

MARKOV ANALYSIS: A method of analyzing the current behavior of some variable to predict the future behavior of that portion of the accounts receivable that will eventually become uncollectible.

MEAN ABSOLUTE DEVIATION (MAD): The mean or average of the sum of all the forecast errors with regard to sign.

MEAN ABSOLUTE PERCENTAGE ERROR (MAPE): The mean or average of the sum of all the percentage errors for a given data set taken without regard to sign. (That is, their absolute values are summed and the average computed.) It is one measure of accuracy commonly used in quantitative methods of forecasting.

MEAN SQUARE ERROR (MSE): A measure of accuracy computed by squaring the individual error for each item in a data set and then finding the average or mean value of the sum of those squares. The mean squared error gives greater weight to large errors than to small errors because the errors are squared before being summed.

MOVING AVERAGE (MA): (1) For a time series an average that is updated as new information is received. With the moving average, the analyst employs the most recent observations to calculate an average, which is used as the forecast for next period. (2) In Box-Jenkins modeling the MA in ARIMA stands for “moving average” and means that the value of the time series at time t is influenced by a current error term and (possibly) weighted error terms in the past.

MULTICOLLINEARITY: The condition that exists when the independent variables are highly correlated with each other. In the presence of multicollinearity, the estimated regression coefficients may be unreliable. The presence of multicollinearity can be tested by investigating the correlation between the independent variables.

MULTIPLE REGRESSION ANALYSIS: A statistical procedure that attempts to assess the relationship between the dependent variable and two or more independent variables. For example, sales of Coca-Cola is a function of various factors such as its price, advertising, taste, and the prices of its major competitors. For forecasting purposes, a multiple regression equation falls into the category of a causal forecasting model (see also Regression Analysis).

MUTUAL FUND: A company which uses its capital to invest in other companies. There are two principal types closed-end and open-end. Shares in close-end investment trusts, are readily transferable in the open market and are bought and sold like other shares. Capitalization of these companies is fixed. Open-end funds sell their own new shares to investors, stand ready to buy back their old shares, and are not listed. Open-end funds are so called because their capitalization is not fixed and they issue more shares as people want them.

NAIVE FORECAST: Forecasts obtained with a minimal amount of effort and data manipulation, and based solely on the most recent information available. One such naive method would be to use the most recent datum available as the future forecast.

OPERATING LEVERAGE: The responsiveness to sales changes of the firm's earnings before interest and taxes. This responsiveness arises from the firm's use of fixed operating costs.

OPTIMAL PARAMETER OR WEIGHT VALUE: Those values that give the best performance for a given model applied to a specific set of data. It is those optimal parameters that then are used in forecasting.

PORTFOLIO: Holdings of securities by an individual or institution. A portfolio may contain bonds, preferred stocks, and common stocks of various types of enterprises.

PROCESSING FLOAT: Funds tied up during the time required for the firm to process remittance checks before they can be deposited in the bank.

PRODUCT LIFE CYCLE: The concept that is particularly useful in forecasting and analyzing historical data of new products. It presumes that demand for a product follows an S-shaped curve growing slowly in the early stages, achieving rapid and sustained growth in the middle stages, and slowing again in the mature stage.

PROJECTED (BUDGETED) BALANCE SHEET: A schedule for expected assets, liabilities, and stockholders' equity. It projects a company's financial position as of the end of the budgeting year. Reasons for preparing a budgeted balance sheet follow: (1) discloses unfavorable financial condition that management may want to avoid; (2) serves as a final check on the mathematical accuracy of all other budgets; and (3) highlights future resources and obligations.

PROJECTED (BUDGETED) INCOME STATEMENT: A summary of various component projections of revenues and expenses for the budget period. It indicates the expected net income for the period.

QUANTITATIVE FORECASTING: A technique that can be applied when information about the past is available - if that information can be quantified and if the pattern included in past information can be assumed to continue into the future.

R-SQUARED: See Coefficient of Determination.

R-BAR SQUARED (\bar{R}^2): R^2 adjusted for the degrees of freedom. (See R-Squared.)

RATE OF RETURN ON INVESTMENT (ROI): (1) for the company as a whole, net income after taxes divided by invested capital. (2) for the segment of an organization, net operating income divided by operating assets, (3) for capital budgeting purposes. also called simple accounting, or unadjusted rate of return, expected future net income divided by initial (or average) investment.

REGRESSION ANALYSIS: A statistical procedure for estimating mathematically the average relationship between the dependent variable (sales, for example) and one or more independent variables (price and advertising, for example).

REGRESSION COEFFICIENTS: When a dependent measure Y is regressed against a set of independent measures X_1 through X_k the analyst wishes to estimate the values of the unknown coefficients by least-squares procedures. For example, in a linear regression equation $Y = a + bX$, a and b are regression coefficients. Specifically, a is called the y-intercept or constant, while b is called a slope. The properties of these regression coefficients can be used to understand the importance of each independent variable (as it relates to Y) and the interrelatedness among the independent variables (as they relate to Y).

REGRESSION EQUATION (MODEL): A forecasting model that relates the dependent variable (sales, for example) to one or more independent variables (advertising and income, for example).

RESIDUAL: A synonym for error. It is calculated by subtracting the forecast value from the actual value to give a “residual” or error value for each forecast period.

RESIDUAL INCOME (RI): The operating income which an investment center is able to earn above some minimum return on its assets.

RESPONSIBILITY ACCOUNTING: The collection, summarization, and reporting of financial information about various decision centers (responsibility centers) throughout an organization. Also called activity accounting or profitability accounting.

RESPONSIBILITY CENTER: A unit in the organization which has control over costs, revenues, or investment funds. For accounting purposes, responsibility centers are classified as cost centers, revenue centers, profit centers, and investment centers, depending on what each center is responsible for.

RISK: (1) A term used to describe a situation in which a firm makes an investment that requires a known cash outlay without knowing the exact future cash flow the decision will generate. (2) The chance of losing money. (3) The possible variation associated with the expected return measured by the standard deviation or coefficient of variation.

RISK PREMIUM: The additional return expected for assuming risk.

RISK ADJUSTED DISCOUNT RATE: A method for incorporating the project's level of risk into the capital budgeting process, in which the discount rate is adjusted upward to compensate for higher than normal risk or downward to compensate for lower than normal risk.

SALES FORECASTING: A projection or prediction of future sales. It is the foundation for the quantification of the entire business plan and a master budget. Sales forecasts serve as a basis for planning. They are the basis for capacity planning, budgeting, production and inventory planning, manpower planning, and purchasing planning.

SEGMENT MARGIN: Contribution margin less direct (traceable) fixed costs.

SEGMENTED REPORTING: The process of reporting activities of various segments of an organization such as divisions, product lines, or sales territories.

SERIAL CORRELATION: See Autocorrelation.

SEASONAL INDEX: A number that indicates the seasonality for a given time period. For example, a seasonal index for observed values in July would indicate the way in which that July

value is affected by the seasonal pattern in the data. Seasonal indexes are used to obtain deseasonalized data.

SIMPLE REGRESSION: A regression analysis that involves one independent variable. For example, the demand for automobiles is a function of its price only (see also Multiple Regression; Regression Analysis).

SIMULATION MODELS: "What-if" models that attempt to simulate the effects of alternative management policies and assumptions about the firm's external environment. They are basically a tool for management's laboratory.

SLOPE: The steepness and direction of the line. More specifically, the slope is the change in Y for every unit change in X.

SPIN OFF: The separation of a subsidiary from its parent, with no change in the equity ownership. The management of the parent company gives up operating control over the subsidiary, but the shareholders maintain their same percentage ownership in both firms. New shares representing ownership in the averted company are issued to the original shareholders on a pro rata basis.

STANDARD ERROR OF THE REGRESSION COEFFICIENT: A measure of the amount of sampling error in a regression coefficient.

STANDARD ERROR OF THE ESTIMATE: The standard deviation of the regression. The statistic can be used to gain some idea of the accuracy of our predictions.

t-STATISTIC: See t-value.

t-TABLE: A table that provides t-values for various degrees of freedom and sample sizes. The t-table is based on the student t-probability distribution (see also t-value).

t-TEST: In regression analysis, a test of the statistical significance of a regression coefficient. It involves basically two steps: (1) compute the t-value of the regression coefficient as follows: $t\text{-value} = \text{coefficient} / \text{standard error of the coefficient}$; (2) compare the value with the t-table value. High t-values enhance confidence in the value of the coefficient as a predictor. Low values (as a rule of thumb, under 2.0) are indications of low reliability of the coefficient as a predictor (see also t-Value).

t-VALUE: A measure of the statistical significance of an independent variable b in explaining the dependent variable Y. It is determined by dividing the estimated regression coefficient b by its standard error.

TENDER OFFER: A bid by an interested party, usually a corporation, for controlling interest in another corporation.

TEMPLATE: A worksheet or computer program that includes the relevant formulas for a particular application but not the data. It is a blank worksheet that we save and fill in the data as needed for a future forecasting and budgeting application.

THEIL U STATISTIC: A measure of the predictive ability of a model based on a comparison of the predicted change with the observed change. The smaller the value of U, the more accurate are the forecasts. If U is greater than or equal to 1, the predictive ability of the model is lower than a naive, no-change extrapolation.

TIME SERIES MODEL: A function that relates the value of a time series to previous values of that time series, its errors, or other related time series (see ARIMA).

TIME VALUE OF MONEY: value of money at different time periods. As a rule, one dollar today is worth more than one dollar tomorrow. The time value of money is a critical consideration in financial decisions.

TIMES INTEREST EARNED RATIO: Earnings before interest and taxes (EBIT)/interest expense. A ratio that measures the firm's ability to meet its interest payments from its annual operating earnings.

TOTAL LEVERAGE: A measure of total risk, referring to how earnings per share is affected by a change in sales. It equals the percentage change in earnings per share divided by the percentage change in sales. Total leverage at a given level of sales is the operating leverage multiplied by the financial leverage.

TRACKING SIGNALS: One way of monitoring how well a forecast is predicting actual values. The running sum of forecast is predicting actual values. The running sum of forecast error is divided by the mean absolute deviation (MAD). When the signal goes beyond a set range, corrective action may be required.

TREND ANALYSIS: A special form of simple regression in which time is the independent variable (see also Trend Equation).

TREND EQUATION: A special case of simple regression, where the X variable is a time variable. This equation is used to determine the trend in the variable Y, which can be used for forecasting.

TREND LINE: A line fitted to sets of data points that describes the relationship between time and the dependent variable.

TURNING POINT ERROR: Also known as “error in the direction of prediction.” It represents the failure to forecast reversals of trends. For example, it may be argued that the ability to anticipated reversals of interest rate trends is more important than the precise accuracy of the forecast.

VARIANCE: The difference of revenues, costs, and profit from the planned amounts. One of the most important phases of responsibility accounting is establishing standards in costs, revenues, and profit and establishing performance by comparing actual amounts with the standard amounts. The differences (variances) are calculated for each responsibility center, analyzed, and unfavorable variances are investigated for possible remedial action.

WHAT-IF ANALYSIS : SIMULATION MODEL.

WEIGHT: The relative importance given to an individual item included in forecasting, such as alpha in exponential smoothing. In the method of moving averages all of those past values included in the moving average are given equal weight.

Z-SCORE: A score produced by Altman's bankruptcy prediction model, known to be about 90 percent accurate in forecasting business failure one year in the future and about 80 percent accurate in forecasting it two years in the future.