The Pocket CFO: Tools And Metrics

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Course Description

This course is a one-stop problem-solver for today's busy executive. The course is a working guide to help you quickly pinpoint in the complex world of business.

- What to look for
- What to do
- What to watch out for
- How to do it

You'll find ratios, formulas, guidelines, and rules of thumb to help analyze and evaluate any business-related problem. Throughout, you'll find this course practical, quick, and useful. Part I takes you through accounting principles and guidelines for evaluating a company's financial health. You will have an increased understanding of various financial statements and their implications. You will be exposed to Corporate Responsibility Law, better known as the Sarbanes-Oxley (SOX) Act. Part II takes a look at financial analysis tools, financial metrics, and financing methods for decision making. Part III takes you through the seemingly complex world of quantitative analysis. You'll use statistics for forecasting and validity testing. Decision theories include linear programming, learning curve theory, and queuing models; these are presented concisely and comprehensively to help you use such sophisticated techniques with relative ease. And, you'll learn how computer applications facilitate the many complex procedures. This course has been designed in question-and-answer format in order to address the pertinent issues that come up during the course of business.

Field of Study	Finance
Level of Knowledge	Basic to Intermediate
Prerequisite	None
Advanced Preparation	None

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PREFACE

This course is a one-stop problem-solver for today's busy executive. It is a sequel to *The Pocket MBA: Concepts and Strategies.* The course is a working guide to help you quickly pinpoint in the complex world of business.

- What to look for
- What to do
- What to watch out for
- How to do it

You'll find ratios, formulas, guidelines, and rules of thumb to help you analyze and evaluate any business-related problem. Throughout, you'll find this course practical, quick, and useful. Uses for this course are as varied as the topics presented.

Part I (Chapters 1, 2, and 3) takes you through accounting principles and guidelines for evaluating a company's financial health. You will have an increased understanding of various financial statements and their implications. You will be exposed to Corporate Responsibility Law, better known as the Sarbanes-Oxley (SOX) Act. You'll learn techniques for analyzing another company's financial position should you wish to invest, extend credit, or compare. You will also learn how to improve a company's corporate profitability and shareholder value. We present internal managerial accounting applications to help you evaluate your own company's performance, profitability, marketing effectiveness, and budgeting process. You'll learn how to highlight problem areas with variance analysis. You will also learn some valuable new tools, such as activity-based costing (ABC), life-cycle costing, target costing, and corporate balanced scorecard.

Part II (Chapters 4, 5, and 6) takes a look at financial analysis tools, financial metrics, and financing methods for decision making. Through break-even and sensitivity analysis, you'll be able to move your company toward greater profits. For investment purposes, this part presents guidelines for evaluating proposals, whether they be short or long term, for profit potential and risk-return comparisons. You'll learn management and financing techniques to ensure the best possible strategies for maximizing and acquiring cash. Also covered are basic financial tenets of portfolio theory, the Capital Asset Pricing Model (CAPM), and the Arbitrage Pricing Model (APM).

Part III (Chapters 7 and 8) takes you through the seemingly complex world of quantitative analysis. You'll use statistics for forecasting and validity testing. Decision theories include linear programming, learning curve theory, and queuing models; these are presented concisely and comprehensively to help you use such sophisticated techniques with relative ease. And, you'll learn how computer applications facilitate the many complex procedures. Computer applications are heavily stressed throughout the chapters.

This course has been designed in question-and-answer format in order to address the pertinent issues that come up during the course of business. The questions are typical of those asked by persons like yourself. The answers are clear, concise, and to the point. In short, this is a veritable cookbook of guidelines, illustrations, and "how-to's" for you, the modern decision maker.

Chapter 1:

Financial Statements, the Sarbanes-Oxley Act, and Corporate Governance

Learning Objectives:

After completing this section, you should be able to:

- Understand the objectives of financial reporting and the key elements contained within different financial statements.
- Recognize the purpose and content of the statement of cash flows.
- Identify key sections contained with the annual report.
- Recognize issues addressed by the Sarbanes-Oxley (SOX) Act and the groups impacted by it.

Knowing the financial health of your company is important. Such knowledge can help you allocate resources and pinpoint areas requiring development and problems needing correction. Do you know how your company is doing financially? Is it growing or contracting? Will it be around for a long time? How profitable is your department, and what can be done to improve the profitability picture? These questions and others can be answered if you understand corporate financial statements. On the other hand, if you do not know how your company is doing financially, you cannot provide the needed financial leadership.

A series of accounting scandals on the heels of the infamous Enron debacle, coupled with frequent financial restatements because of financial reporting fraud and/or accounting errors, have led to new sweeping accounting guidelines, proposals, and legislation, notably the Sarbanes-Oxley (SOX) Act in 2002

This chapter looks at the key financial statements from an external viewpoint. The Sarbanes-Oxley (SOX) Act is also summarized.

1.1 What and Why of Financial Statements

What are financial statements? What is their significance?

Financial decisions are typically based on information generated from the accounting system. Financial management, stockholders, potential investors, and creditors are concerned with how well the company is doing. The three reports generated by the accounting system and included in the company's annual report are the *balance sheet, income statement,* and *statement of cash flows.* Although the form of these financial statements may vary among different businesses or other economic units, their basic purposes do not change.

The objectives of financial reporting are concerned with the underlying goals and purposes of accounting. They are to provide information that (1) is useful to those making investment and credit decisions, assuming that those individuals have a reasonable understanding of business and economic activities; (2) is helpful to current and potential investors and creditors and other users such as labor and government agencies in assessing the amount, timing, and uncertainty of future cash flows; and (3) discloses economic resources, claims to those resources, and the changes therein.

The balance sheet portrays the financial position of the organization at a particular point in time. It shows what you own (assets), how much you owe to vendors and lenders (liabilities), and what is left (assets minus liabilities, known as equity or net worth). A balance sheet is a snapshot of the company's financial position as of a certain date. The balance sheet equation can be stated as: Assets - Liabilities = Stockholders' Equity.

The income statement, on the other hand, measures the operating performance for a specified period of time (e.g., for the year ended December 31, 2X12). If the balance sheet is a snapshot, the income statement is a motion picture. The income statement serves as the bridge between two consecutive balance sheets. Simply put, the balance sheet indicates the wealth of your company and the income statement tells you how your company did last year.

The balance sheet and the income statement tell different things about your company. For example, the fact the company made a big profit last year does not necessarily mean it is liquid (has the ability to pay current liabilities using current assets) or solvent (noncurrent assets are enough to meet noncurrent liabilities). A company may have reported a significant net income but still have a deficient net worth. In other words, to find out how your organization is doing, you need both statements. The income statement summarizes your company's operating results for the accounting period; these results are reflected in the equity (net worth) on the balance sheet. This relationship is shown in Figure 1.1. The third basic financial statement is the statement of cash flows. This statement provides useful information about the inflows and outflows of cash that cannot be found in the balance sheet and the income statement.

Figure 1.1

The Balance Sheet and Income Statement

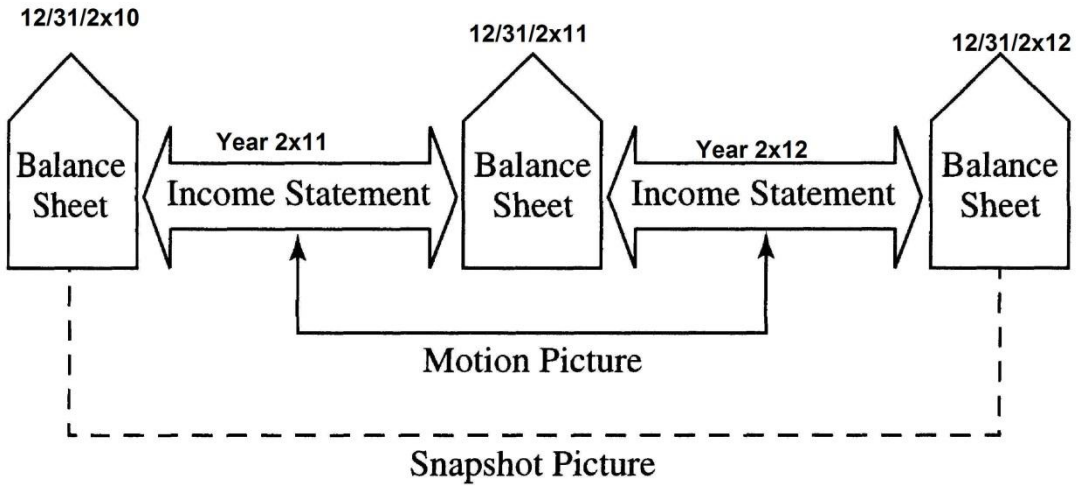
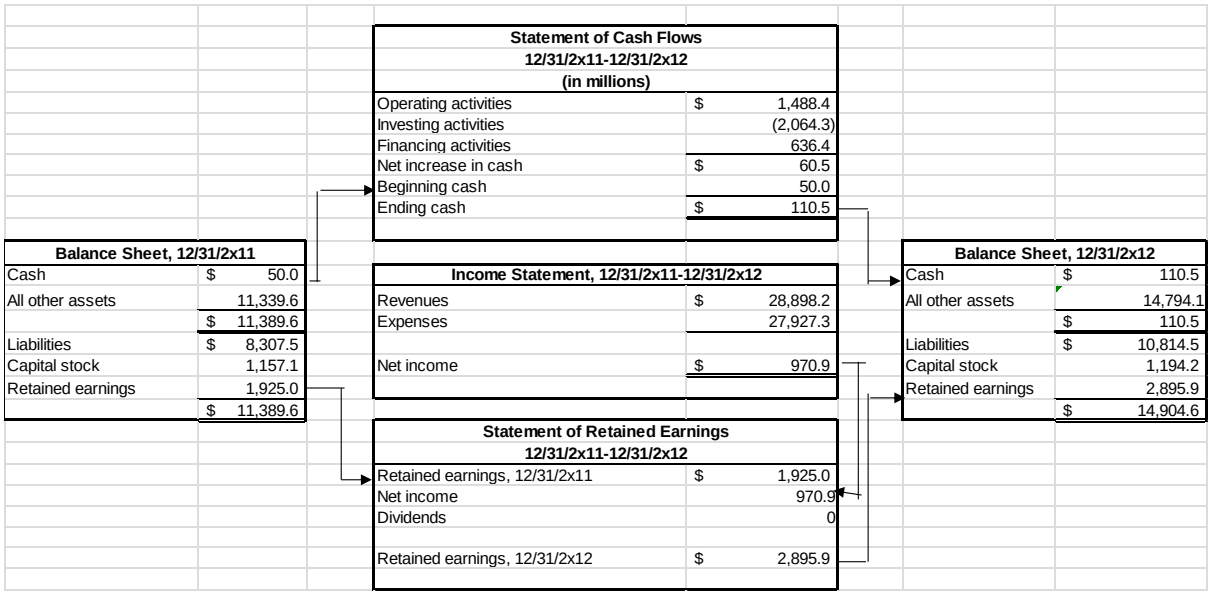


Figure 1.2 shows how these statements, including the statement of retained earnings (to be discussed later), tie together with numerical figures. NOTE: The beginning amount of cash ($50 million) from the 2X12 balance sheet is added to the net increase or decrease in cash (from the statement of cash flows) to derive the cash balance ($111 million) as reported on the 2X12 balance sheet. Similarly, the retained earnings balance as reported on the 2X12 balance sheet comes from the beginning retained earnings balance (2X12 balance sheet) plus net income for the period (from the income statement) less dividends paid. As you study financial statements, these relationships will become clearer and you will understand the concept of articulation better.

Figure 1.2
How the Financial Statements Tie Together



Balance Sheet, 12/31/2x11	
Cash	$ 50.0
All other assets	11,339.6
	$ 11,389.6
Liabilities	$ 8,307.5
Capital stock	1,157.1
Retained earnings	1,925.0
	$ 11,389.6

Statement of Cash Flows 12/31/2x11-12/31/2x12 (in millions)	
Operating activities	$ 1,488.4
Investing activities	(2,064.3)
Financing activities	636.4
Net increase in cash	$ 60.5
Beginning cash	50.0
Ending cash	$ 110.5

Income Statement, 12/31/2x11-12/31/2x12	
Revenues	$ 28,898.2
Expenses	27,927.3
Net income	$ 970.9

Statement of Retained Earnings 12/31/2x11-12/31/2x12	
Retained earnings, 12/31/2x11	$ 1,925.0
Net income	970.9
Dividends	0
Retained earnings, 12/31/2x12	$ 2,895.9

Balance Sheet, 12/31/2x12	
Cash	$ 110.5
All other assets	14,794.1
	$ 110.5
Liabilities	$ 10,814.5
Capital stock	1,194.2
Retained earnings	2,895.9
	$ 14,904.6

What does the income statement tell you?

The income statement (profit and loss statement) shows the revenue, expenses, and net income (or net loss) *for a period of time.* It is typically dated "For the year ended December 31, 2XXX." A definition of each element follows.

Revenue is the increase in capital arising from the sale of merchandise or the performance of services. When revenue is earned, it results in an increase in either cash (money received) or accounts receivable (amounts owed to you by customers).

Expenses decrease capital and result from performing activities necessary to generate revenue. Expenses that reduce net income can be categorized as the cost of goods sold and selling and general administrative expenditures necessary to conduct business operations (e.g., rent expense, salary expense, depreciation expense) during the period.

Net income is the amount by which total revenue exceeds total expenses. The resulting profit is added to the *retained earnings* account (accumulated earnings of a company since its inception less dividends). If total expenses are greater than total revenue, a net loss results, decreasing retained earnings.

Revenue does not necessarily mean receipt of cash, and expense does not automatically imply a cash payment. Net income and net cash flow (cash receipts less cash payments) are different. For example, taking out a bank loan generates cash, but this cash is not revenue since no merchandise has been sold and

no services have been provided. Further, owners' equity does not change as the loan represents a liability, rather than a stockholders' investment, and must be repaid.

Each revenue and expense item has its own account. Such a system enables you to better evaluate and control revenue and expense sources and to examine the relationships among account categories.

1.2 Classified Financial Statements

Although companies differ in nature and therefore the specific transactions and accounts differ from business to business, it is useful to classify the entries in financial statements into major categories. Financial statements organized in such a fashion are called classified financial statements.

How detailed is a classified income statement?

In a *classified* income statement, each major revenue and expense function is listed separately to facilitate analysis. The entries in an income statement are usually classified into four major functions: revenue, cost of goods sold (cost of inventory sold), operating expenses, and other revenue or expenses. The entries in classified income statements covering different time periods are easily compared; the comparison over time of revenue sources, expense items, and the relationship between them can reveal areas that require attention and corrective action. For example, if revenue from services has been sharply declining over the past several months, you will want to know why and then take action to reverse the trend.

Revenue comprises the gross income generated by selling goods (sales) or performing services (professional fees, commission income). To determine *net* sales, gross sales are reduced by sales returns, allowances (discounts given for defective merchandise), and sales discounts.

Cost of goods sold is the cost of the merchandise or services sold. In a retail business, the cost of goods sold is the beginning inventory plus the cost of buying goods from the manufacturer minus ending inventory; in a service business, it is the cost of the employee services rendered. For a manufacturing company, cost of goods sold is the cost of goods manufactured plus the beginning finished goods inventory minus the ending finished goods inventory.

Operating expenses are expenses incurred or resources used in generating revenue. Two types of operating expenses are selling expenses and general and administrative expenses. *Selling expenses* are costs incurred in the sale of goods or services (e.g., advertising, salesperson salaries) and in distributing the merchandise (e.g., freight paid on shipments); they relate solely to the selling function. If a sales manager is responsible for generating sales, his or her performance is judged on the relationship between promotion costs and sales obtained. *General and administrative expenses* are the costs of running the business as a whole. The salaries of the office clerical staff, administrative executive salaries, and depreciation on office equipment are examples of general and administrative expenses.

Other revenue (expenses) covers incidental sources of revenue and expense that are *nonoperating* in nature and that do not relate to the major purpose of the business. Examples are interest income, dividend income, and interest expense.

Figure 1.3 shows a classified income statement.

FIGURE 1.3
A CLASSIFIED INCOME STATEMENT - X COMPANY
For the Year Ended December 2X12

Sales Revenue			
Sales			$3,053,081
Less: Sales discounts		$ 24,241	
Sales returns and allowances		56,427	80,668
Net sales revenue			2,972,413
Cost of Goods Sold			
Merchandise inventory, Jan. 1		461,219	
Purchases	$1,989,693		
Less: Purchase discounts	19,270		
Net purchases	1,970,423		
Freight and transportation-in	40,612	2,011,035	
Total merchandise available for sale		2,472,254	
Less: Merchandise inventory, Dec. 31		489,713	
Cost of goods sold			1,982,541
Gross profit on sales			989,872
Operating Expenses			
Selling expenses			
Sales salaries and commissions	202,644		
Sales office salaries	59,200		
Travel and entertainment	48,940		
Advertising expense	38,315		
Freight and transportation-out	41,209		
Shipping supplies and expense	24,712		
Postage and stationery	16,788		
Depreciation of sales equipment	9,005		
Telephone and Internet expense	12,215	453,028	
Administrative expenses			
Officers' salaries	186,000		
Office salaries	61,200		
Legal and professional services	23,721		
Utilities expense	23,275		
Insurance expense	17,029		
Depreciation of building	18,059		
Depreciation of office equipment	16,000		
Stationery, supplies, and postage	2,875		
Miscellaneous office expenses	2,612	350,771	803,799
Income from operations			186,073
Other Revenues and Gains			
Dividend revenue		98,500	
Rental revenue		72,910	171,410
			357,483
Other Expenses and Losses			
Interest on bonds and notes			126,060
Income before income tax			231,423
Income tax			66,934
Net income for the year			$ 164,489
Earnings per common share			$1.74

What is a classified balance sheet?

The balance sheet is classified into major groups of assets, liabilities, and owners' equity. An *asset is* something owned, such as land and automobile; a *liability is* something owed, such as loans payable and mortgage payable. Owners' equity is the residual interest remaining after assets have been reduced by liabilities.

Assets

A classified balance sheet generally breaks down assets into five categories: current assets, long-term investments, property, plant, and equipment (fixed assets), intangible assets, and deferred charges. This breakdown aids in analyzing the type and liquidity of the assets held.

Current assets are assets expected to be converted into cash or used up within *one year* or the normal operating cycle of the business, whichever is greater. (The operating cycle is the time period between the purchase of inventory merchandise for resale and the transfer of inventory through sales, listed as accounts receivable, or receipt of cash. In effect, the operating cycle takes you from paying cash to receiving it.) Examples of current assets are cash, short-term investments or short-term investments (investments with a maturity of more than 90 days but intended to be held only until cash is needed for current operations), accounts receivable, inventory, and prepaid expenses (expenditures that will expire within one year from the balance sheet date and that represent a prepayment for an expense that has not yet been incurred.)

Long-term investments refer to investments in other companies' stocks (common or preferred) or bonds where the *intent* is to hold them for a period greater than one year. Securities that may be held as short-term or long-term investments fall into three categories: held-to-maturity securities, trading securities, and available-for-sale securities. Trading securities are classified as *short-term investments*. Available-for-sale securities, depending on the company's intent to hold them, may be classified as either short-term or long-term investments. However, in almost all cases, they are noncurrent. Held-to-maturity securities are always classified as long-term investment.

Property, plant, and equipment (often called fixed assets) are assets employed in the production of goods or services that have a life greater than one year. They are *tangible,* meaning they have physical substance (you can physically see and touch them) and are actually being used in the course of business. Examples are land, buildings, machinery, and automobiles. Unlike inventory, these assets are not held for sale in the normal course of business.

Intangible assets are assets with a long-term life that lack physical substance and that arise from a right granted by the government, such as patents, copyrights, and trademarks, or by another company, such as a franchise license. An example of the latter is the right (acquired by paying a fee) to open a fast food franchise and use the name of McDonald's.

Deferred charges are certain expenditures that have already been incurred but that are deferred to the future either because they are expected to benefit future revenues or because they represent an appropriate allocation of costs to future operations. In other words, deferred charges are costs charged to

an asset because future benefit exists; they are amortized as an expense in the year the related revenue is recognized and the benefit consumed in conformity with the accounting principle requiring matching of expense to revenue. Examples are plant rearrangement costs and moving costs. No cash can be realized from such assets; for example, you cannot sell deferred moving costs to anyone because no one will buy them.

Liabilities and Stockholders' Equity

Liabilities are classified as either current or noncurrent. *Current liabilities* (those due in one year or less) will be satisfied out of current assets. Examples are accounts payable (amounts owed to creditors), short-term notes payable (written evidence of loans due within one year), and accrued expense liabilities (e.g., salaries payable).

Examples of *long-term liabilities,* which have a maturity of greater than one year, are bonds payable and mortgage payable. The current portion of a long-term liability (that part that is to be paid within one year) is shown under current liabilities. For example, if $1,000 of a $10,000 mortgage is to be paid within the year, that $1,000 is listed as a current liability; the remaining $9,000 is shown under noncurrent liabilities. The stockholders' equity section of the balance sheet consists of capital stock, paid-in-capital, retained earnings, and total stockholders' equity. These are defined below.

Capital stock describes the ownership of the corporation in terms of the number of shares outstanding. Each share is assigned a par value when it is first authorized by the state in which the business is incorporated. Capital stock is presented on the balance sheet at total par value. Therefore, the capital stock account, which is at *par value,* agrees with the stock certificates (imprinted with the par value) held by stockholders. Preferred stock is listed before common stock because it receives preference should the company be liquidated.

Paid-in capital shows the amount received by the company over the par value for the stock issued. This helps keep track of the par value of issued shares and the excess over par value paid for it.

Retained earnings represent the accumulated earnings of the company since its inception less dividends declared and paid to stockholders. There is usually a surplus in this account, but a deficit may occur if the business has been operating at a loss.

Total stockholders' equity is the sum of capital stock, paid-in capital, and retained earnings. In a corporation, owners' equity is referred to as stockholders' equity; in a sole proprietorship or partnership, owners' equity is referred to as capital.

A classified balance sheet is presented in Figure 1.4.

FIGURE 1.4

BALANCE SHEET - X COMPANY

DECEMBER 31, 2X12

ASSETS		
Current Assets		
Cash	$3,000	
Marketable Securities	1,000	
Accounts Receivable	6,000	
Inventory	5,000	
Total Current Assets		$15,000
Long-Term Investments		
Investment in Y Company Stock		2,000
Property, Plant, and Equipment		
Land	$20,000	
Building (less accumulated depreciation)	30,000	
Machinery (less accumulated depreciation)	7,000	
Delivery Trucks (less accumulated depreciation)	5,000	
Total Property, Plant, and Equipment		62,000
Intangible Assets		
Patents (less accumulated amortization)		3,000
Deferred Charges		
Deferred Moving Costs		1,000
Total Assets		$83,000
LIABILITIES AND STOCKHOLDERS' EQUITY		
Current Liabilities		
Accounts Payable	$8,000	
Notes Payable (9 months)	4,000	
Accrued Expense Liabilities	2,000	
Total Current Liabilities		$14,000
Noncurrent Liabilities		
Bonds Payable		30,000
Total Liabilities		$44,000
Stockholders' Equity		
Capital Stock	$20,000	
Paid-in Capital	4,000	
Retained Earnings*	15,000	
Total Stockholders' Equity		39,000
Total Liabilities and Stockholders' Equity		$83,000

* A schedule of retained earnings follows:

Retained earnings—January 1	$10,000
Net income	12,500
Dividends	(7,500)
Retained earnings—December 31	$15,000

1.3 Statement of Cash Flows

Why is the statement of cash flows so important?

It is important to know your cash flow so that you may adequately plan your expenditures. Should there be a cut back on payments because of a cash problem? Is the organization getting most of your cash? What products or projects are cash drains or cash cows? Is there enough money to pay bills and buy needed machinery?

A Statement of Cash Flows is required to be prepared by all business enterprises and nonprofit organizations. It contains useful information for external users, such as lenders and investors, who make economic decisions about a company. The statement presents the sources and uses of cash and is a basis for cash flow analysis. In this section, we discuss what the statement of cash flows is, how it looks, and how to analyze it.

What are the specific contents of the statement of cash flows?

The statement of cash flows classifies cash receipts and cash payments arising from investing activities, financing activities, and operating activities.

Investing Activities

Investing activities include the results of the purchase or sale of debt and equity securities of other entities and fixed assets. Cash inflows from investing activities are comprised of (1) receipts from sales of equity and debt securities of other companies and (2) amounts received from the sale of fixed assets. Cash outflows for investing activities include (1) payments to buy equity or debt securities of other companies and (2) payments to buy fixed assets.

Financing Activities

Financing activities include the issuance of stock and the reacquisition of previously issued shares (treasury stock), as well as the payment of dividends to stockholders. Also included are debt financing and repayment. Cash inflows from financing activities are comprised of funds received from the sale of stock and the incurrence of debt. Cash outflows for financing activities include (1) repaying debt, (2) repurchasing of stock, and (3) issuing dividend payments.

Operating Activities

Operating activities are connected to the manufacture and sale of goods or the rendering of services. Cash inflows from operating activities include (1) cash sales or collections on receivable arising from the initial sale of merchandise or rendering of service and (2) cash receipts from debt securities (e.g., interest income)

or equity securities (e.g., dividend income) of other entities. Cash outflows for operating activities include (1) cash paid for raw material or merchandise intended for resale, (2) payments on accounts payable arising from the initial purchase of goods, (3) payments to suppliers of operating expense items (e.g., office supplies, advertising, insurance), and (4) wages. Figure 1.5 shows an outline of the statement of cash flows.

FIGURE 1.5

THE STATEMENT OF CASH FLOWS

FORMAT OF THE STATEMENT OF CASH FLOWS (INDIRECT METHOD)

Net cash flow from operating activities:		
Net income	$980,000	
Adjustments for noncash expenses, revenues, losses, and gains included in income:		
Depreciation	20,000	
Net cash flow from operating activities		$1,000,000
Cash flows from investing activities:		
Purchase machinery	$(630,000)	
Investments in other companies' stocks	(70,000)	
Sale of land	200,000	
Net cash flows provided (used) by investing activities		(500,000)
Cash flows from financing activities:		
Issuance of common stock	$ 400,000	
Issuance of bonds payable	100,000	
Payment on long-term mortgage payable	(160,000)	
Payment of dividends	(40,000)	
Net cash provided (used) by financing activities		300,000
Net increase (decrease) in cash		$800,000
Schedule of noncash investing and financing activities:		
Issuance of preferred stock for building		$180,000
Conversion of bonds payable to common stock		100,000

Chapter 1 Review Questions – Section 1

1. Financial decisions are typically based on three reports: Gant Load Chart, Gant scheduling chart, and the Program Evaluation and Review Technique (PERT). True or False?

2. An objective of financial reporting is

A. Providing information useful to investors, creditors, management, labor, and government agencies, and other users for decision making.
B. Assessing the adequacy of internal control.
C. Evaluating management results compared with standards.
D. Providing information on compliance with established procedures.

3. The primary purpose of the balance sheet is to reflect

A. The fair value of the firm's assets at some moment in time.
B. The status of the firm's assets in case of forced liquidation of the firm.
C. Assets, liabilities, and equity.
D. The firm's potential for growth in stock values in the stock market.

4. Revenue always means receipt of cash, and expenses automatically implies cash payment. True or False?

5. Intangible assets are often called fixed assets that are employed in the production of goods and/or services that have a life greater than one year. True or False?

6. The amount received by a company over par value for stock is paid-in capital. True or False?

7. The statement of cash flows is required in annual reports since it is for external use only. True or False?

8. A financial statement includes all of the following items: operating activities, financial activities and investing activities. What financial statement is this?

A. Statement of cash flows.
B. Balance sheet.
C. Income statement.
D. Statement of retained earnings.

1.4 Cash Flow Analysis

How do you analyze the cash flow position of a company?

Along with financial ratio analysis, cash flow analysis is a valuable tool. The cash flow statement provides information on how your company generated and used cash, that is, why cash flow increased or decreased. An analysis of the statement is helpful in appraising past performance, projecting the company's future direction, forecasting liquidity trends, and evaluating your company's ability to satisfy its debts at maturity.

CHECKLIST FOR CASH FLOW ANALYSIS QUESTIONS

Because the statement lists the specific sources and uses of cash during the period, it can be used to answer the following:

- How was the expansion in plant and equipment financed?
- What use was made of net income?
- Where did you obtain funds?
- How much required capital is generated internally?
- Is the dividend policy in balance with its operating policy?
- How much debt was paid off?
- How much was received from the issuance of stock?
- How much debt financing was taken out?

The cash flow per share equals net cash flow divided by the number of shares. A high ratio is desirable because it indicates a liquid position, that is, that the company has ample cash on hand .

Operating Section

An analysis of the operating section of the statement of cash flows determines the adequacy of cash flow from operating activities. For example, an operating cash outlay for refunds given to customers for deficient goods indicates a quality problem with the merchandise, while payments of penalties, fines, and lawsuit damages reveal poor management practices that result in non-beneficial expenditures.

Investing Section

An analysis of the investing section can identify investments in other companies. These investments may lead to an attempt to assume control of another company for purposes of diversification. The analysis may also indicate a change in future direction or a change in business philosophy.

An increase in fixed assets indicates capital expansion and future growth. A contraction in business arising from the sale of fixed assets without adequate replacement is a negative sign.

Financing Section

An evaluation of the financing section reveals the company's ability to obtain financing in the money and capital markets as well as its ability to meet obligations. The financial mixture of bonds, long-term loans from banks, and equity instruments affects risk and the cost of financing. Debt financing carries greater risk because the company must generate adequate funds to pay the interest costs and to retire the obligation at maturity; thus, a very high percent of debt to equity is generally not advisable. The problem is acute if earnings and cash flow are declining. On the other hand, reducing long-term debt is desirable because it points to lowered risk.

The ability to obtain financing through the issuance of common stock at attractive terms (high stock price) indicates that the investing public is optimistic about the financial well-being of the business. The issuance of preferred stock may be a negative sign, since it may mean the company is having difficulty selling its common stock. Perhaps investors view the company as very risky and will invest only in preferred stock since preferred stock has a preference over common stock in the event of the company's liquidation. Evaluate the company's ability to pay dividends. Stockholders who rely on a fixed income, such as a retired couple, may be unhappy when dividends are cut or eliminated.

How do you prepare and analyze the statement of cash flows?

In this section, we do an analysis of a hypothetical statement of cash flows, prepared from sample balance sheet and income statement figures.

EXAMPLE 1.1

X Company provides the following financial statements:

X Company
Comparative Balance Sheets
December 31
(in millions)

ASSETS	2X12	2X11
Cash	$ 40	$ 47
Accounts receivable	30	35
Prepaid expenses	4	2
Land	50	35
Building	100	80
Accumulated depreciation	(9)	(6)
Equipment	50	42
Accumulated depreciation	(11)	(7)
Total assets	$254	$228
LIABILITIES AND STOCKHOLDERS' EQUITY		
Accounts payable	$ 20	$ 16
Long-term notes payable	30	20
Common stock	100	100
Retained earnings	104	92
Total liabilities and stockholders' equity	$254	$228

X Company
Income Statement
for the Year Ended December 31, 2X12
(in millions)

Revenue		$300
Operating expenses (excluding depreciation)	$200	
Depreciation	7	207
Income from operations		$ 93
Income tax expense		32
Net income		$ 61

X Company
Statement of Cash Flows
for the Year Ended December 31, 2X12
(in millions)

Operating activities:			
Net income			$61
Adjustments to reconcile net income to cash provided by operating activities:			
Depreciation		$ 7	
Changes in operating assets and liabilities:			
Decrease in accounts receivable		5	
Increase in prepaid items		(2)	
Increase in accounts payable		4	
Cash provided by operating activities			75
Cash flow from investing activities			
Purchase of land	($15)		
Purchase of building	(20)		
Purchase of equipment	(8)		(43)
Cash flow from financing activities			
Issuance of long-term notes payable	$10		
Payment of cash dividends	(49)		(39)
Net decrease in cash			$ 7

Assume the company has a policy of paying very high dividends.

Information for 2X11 follows: Net income, $32; cash flow from operations, $20.

A financial analysis of the statement of cash flows reveals that the profitability and operating cash flow of X Company improved from 2X11 to 2X12. The company's earnings performance was good, and the $61 earnings resulted in cash inflow from operations of $75. Thus, compared to 2X11, 2X12 showed better results.

The decrease in accounts receivable may reveal better collection efforts. The increase in accounts payable is a sign that suppliers are confident they will be paid and are willing to give interest-free financing. The acquisition of land, building, and equipment points to a growing business undertaking capital expansion. The issuance of long-term notes payable indicates that the company is financing part of its assets through debt. Stockholders will be happy with the significant dividend payout of 80.3 percent (dividends divided by net income, or $49/$61). Overall, there was a decrease in cash on hand of $7, but this should not cause alarm because of the company's profitability and the fact that cash was used for capital expansion and dividend payments. We recommend that the dividend payout be reduced from its high level and that the funds be reinvested in the business; the reduction of dividends by more than $7 would result in a positive net cash flow for the year, which is needed for immediate liquidity.

EXAMPLE 1.2

Y Company presents the following statement of cash flows.

Y Company
Statement of Cash Flows
for the Year Ended December 31, 20X0

Operating activities:		
Net income		$134,000
Adjustments to reconcile net income to cash provided by operating activities:		
Depreciation	$21,000	
Changes in operating assets and liabilities:		
Decrease in accounts receivable	10,000	
Increase in prepaid items	(6,000)	
Increase in accounts payable	35,000	60,000
Cash provided by operating activities		$194,000
Cash flows from investing activities		
Purchase of land	($70,000)	
Purchase of building	(200,000)	
Purchase of equipment	(68,000)	
Cash used by investing activities		(338,000)
Cash flows from financing activities		
Issuance of bonds	150,000	
Payment of cash dividends	(18,000)	
Cash provided by financing activities		132,000
Net decrease in cash		$(12,000)

An analysis of the statement of cash flows reveals that the company is profitable and that cash flow from operating activities exceeds net income, which indicates good internal cash generation. The ratio of cash flow from operating activities to net income is a solid 1.45 ($194,000/$134,000). A high ratio is desirable because it shows that earnings are backed up by cash. The decline in accounts receivable may indicate better collection efforts; the increase in accounts payable shows the company can obtain interest-free financing. The company is definitely in the process of expanding for future growth, as demonstrated by the purchase of land, building, and equipment. The debt position of the company has increased, indicating greater risk for investors. The dividend payout was 13.4 percent ($18,000/$134,000), which is good news for stockholders, who look positively on companies that pay dividends. The decrease of $12,000 in cash flow for the year is a negative sign.

How can you use the statement of cash flows for corporate planning?

Current profitability is only one important factor in predicting corporate success; current and future cash flows are also essential. In fact, it is possible for a profitable company to have a cash crisis; for example, a company with significant credit sales but a very long collection period may show a profit without actually having the cash from those sales.

Financial managers are responsible for planning how and when cash will be used and obtained. When planned expenditures require more cash than planned activities are likely to produce, financial managers must decide what to do. They may decide to obtain debt or equity funds or to dispose of some fixed assets or a whole business segment. Alternatively, they may decide to cut back on planned activities by modifying operational plans, such as ending a special advertising campaign or delaying new acquisitions, or to revise planned payments to financing sources, such as bondholders or stockholders. Whatever is decided, the financial manager's goal is to balance the cash available and the needs for cash over both the short and the long term.

Evaluating the statement of cash flows is essential if you are to appraise accurately an entity's cash flows from operating, investing, and financing activities and its liquidity and solvency positions. Inadequacy in cash flow has possible serious implications, including declining profitability, greater financial risk, and even possible bankruptcy.

1.5 Other Sections of the Annual Report

What other crucial information the annual report contains?

Other sections in the annual report in addition to the financial statements are helpful in understanding the company's financial health. These sections include the highlights, review of operations, footnotes, supplementary schedules, and auditor's report.

Highlights

The highlights section provides comparative financial statement information and covers important points such as profitability, sales, dividends, market price of stock, and asset acquisitions. At a minimum, the company provides sales, net income, and earnings per share figures for the last two years.

Review of Operations

The review of operations section discusses the company's products, services, facilities, and future directions in both numbers and narrative form.

Report of Independent Public Accountants

The independent accountant is a certified public accountant (CPA) in public practice who has no financial or other interest in the client whose financial statements are being examined. In this part of the annual report, he or she expresses an opinion on the fairness of the financial statement numbers.

CPAs render four types of audit opinions: an unqualified opinion, a qualified opinion, a disclaimer of opinion, and an adverse opinion. The auditor's opinion is heavily relied on since he or she is knowledgeable, objective, and independent.

Unqualified Opinion. An unqualified opinion means the CPA is satisfied that the company's financial statements present fairly its financial position and results of operations and gives the financial manager confidence that the financial statements are an accurate reflection of the company's financial health and operating performance.

A typical standard report presenting an unqualified opinion follows.

Independent Auditor's Report

We have audited the accompanying balance sheet of ABC Company as of December 31, 2X12 and the related statements of income, retained earnings, and cash flows for the year then ended. These financial statements are the responsibility of the Company's management. Our responsibility is to express an opinion on these financial statements based on our audit.

We conducted our audit in accordance with generally accepted auditing standards in the Unites States. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. We believe that our audit provides a reasonable basis for our opinion.

In our opinion, the financial statements referred to above present fairly, in all material respects, the financial position of ABC Company as of December 31, 2X12, and the results of its operations and its cash flows for the year then ended in conformity with generally accepted accounting principles (GAAP). *Note:* GAAP are the "conventions, rules, and procedures necessary to define accepted accounting at a particular time." They include both the broad guidelines and the detailed practices and procedures promulgated by the profession that provide uniform standards to measure financial presentations.

If the company is facing a situation with an uncertain outcome that may substantially affect its financial health, such as a lawsuit, the CPA may still give an unqualified opinion. However, there will probably be an explanatory paragraph describing the material uncertainty; this uncertainty will undoubtedly affect readers' opinions of the financial statement information. As a financial manager, you are well advised to note the contingency (potential problem, such as a dispute with the government) and its possible adverse financial effects on the company.

Qualified Opinion. The CPA may issue a qualified opinion if your company has placed a "scope limitation" on his or her work. A scope limitation prevents the independent auditor from doing one or more of the following: (1) gathering enough evidential matter to permit the expression of an unqualified opinion; (2) applying a required auditing procedure; or (3) applying one or more auditing procedures considered necessary under the circumstances.

If the scope limitation is fairly minor, the CPA may issue an "except for" qualified opinion. This may occur, for example, if the auditor is unable to confirm accounts receivable or observe inventory.

Disclaimer of Opinion. When a severe scope limitation exists, the auditor may decide to offer a disclaimer of opinion. A disclaimer indicates that the auditor was unable to form an opinion on the fairness of the financial statements.

Adverse Opinion. The auditor may issue an adverse opinion when the financial statements do *not* present the company's financial position, results of operations, retained earnings, and cash flows fairly and in conformity with GAAP. By issuing an adverse opinion, the CPA is stating that the financial statements may be misleading.

Obviously, the financial manager wants the independent auditor to render an unqualified opinion. Disclaimers and adverse opinions are viewed very negatively by readers such as investors and creditors, who then put little if any faith in the company's financial statements.

Notes

Financial statements themselves are concise and condensed, and any explanatory information that cannot readily be abbreviated is added in greater detail in the notes. In such cases, the report contains a statement similar to this: "The accompanying notes are an integral part of the financial statements."

Notes provide detailed information on financial statement figures, accounting policies, explanatory data such as mergers and stock options, and any additional disclosure.

Notes disclosures usually include accounting methods, estimated figures such as inventory pricing, pension fund, and profit-sharing arrangements, terms and characteristics of long-term debt, particulars of lease agreements, contingencies, and tax matters.

The notes appear at the end of the financial statements and explain the figures in those statements both in narrative form and in numbers. It is essential that the financial manager evaluate notes information to arrive at an informed opinion about the company's financial stature and earning potential.

Supplementary Schedules and Tables

Supplementary schedules and tables enhance the financial manager's comprehension of the company's financial position. Some of the more common schedules are five-year summary of operations, two-year quarterly data, and segmental information. This summary provides income statement information for the

past five years, including dividends on preferred stock and common stock. It also reveals operating trends. Some companies provide ten-year comparative data.

Two-Year Quarterly Data. This schedule gives a quarterly breakdown of sales, profit, high and low stock price, and the common stock dividend. Quarterly operating information is particularly useful for a seasonal business, because it helps readers to track the business's highs and lows more accurately. The quarterly market price reveals fluctuations in the market price of stock, while the dividend quarterly information reveals how regularly the company pays dividends.

Segmental Disclosure. This important supplementary schedule presents financial figures for the segments of the business, enabling readers to evaluate each segment's profit potential and risk. Segmental data may be organized by industry, foreign area, major customer, or government contract.

A segment is reportable if any *one* of the following conditions exists:

- Revenue is 10 percent or more of total corporate revenue.
- Operating profit is 10 percent or more of total corporate operating profit.
- Identifiable assets are 10 percent or more of total corporate assets.

The company must also disclose if foreign operations, sales to a major customer, or domestic contract revenue provide 10 percent or more of total sales. The percentage derived and the source of the sales must be stated.

Useful segment information that may be disclosed includes sales, operating profit, total assets, fixed assets, intangible assets, inventory, cost of sales, depreciation, and amortization.

History of Market Price

While this information is optional, many companies provide a brief history of the market price of stock, such as quarterly highs and lows. This information reveals the variability and direction in market price of stock.

1.6 Quarterly Report

How do you read a quarterly report?

In addition to the annual report, publicly-held companies issue quarterly reports that provide updated information on sales and earnings and describe any material changes that have occurred in the business or its operations. These quarterly reports may provide unaudited financial statements or updates on

operating highlights, changes in outstanding shares, compliance with debt restrictions, and pending lawsuits.

At a minimum, quarterly reports must provide data on sales, net income, taxes, nonrecurring revenue and expenses, accounting changes, contingencies (e.g., tax disputes), additions or deletions of business segments, and material changes in financial position.

The company may provide financial figures for the quarter itself (e.g., the third quarter, from July 1 to September 30) or cumulatively from the beginning of the year (cumulative up to the third quarter, or January 1 to September 30). Prior-year data must be provided in a form that allows for comparisons. The financial manager should read the quarterly report in conjunction with the annual report.

1.7 The Management's Discussion and Analysis (MD&A) Section of an Annual Report

What does the management's discussion and analysis (MD&A) section of an annual report address to the user?

The Management's Discussion and Analysis (MD&A) section of an annual report must be included in SEC filings. The content of the MD&A section is required by regulations of the SEC. The MD&A contains standard financial statements and summarized financial data for at least 5 years. Other matters must be included in annual reports to shareholders and in Form 10-K filed with the SEC. It addresses in a nonquanitified manner the prospects of the company. The SEC examines it with care to determine that management has disclosed material information affecting the company's future results. Disclosures about commitments and events that may affect operations or liquidity are mandatory. Thus, the MD&A section pertains to liquidity, capital resources, and results of operations.

1.8 The Sarbanes-Oxley (Sox) Act

What sweeping changes the Sarbanes-Oxley (sox) act involve in corporate financial reporting?

President George W. Bush signed the Sarbanes-Oxley Act of 2002 (Public Law 107-204) on Tuesday, July 30, 2002. Congress presented the Act **(www.whitehouse.gov/infocus/corporateresponsibility/)** to the president on July 26, 2002, after passage in the Senate by a 99-0 vote and in the House by a 423-3 margin.

GROUPS IMPACTED BY THE ACT

1. CPAs and CPA firms auditing public companies;

2. Publicly traded companies, their employees, officers, and owners—including holders of more than 10 percent of the outstanding common shares. This category would include CPAs employed by publicly traded companies as chief financial officers (CFOs) or in the finance department;

3. Attorneys who work for or have as clients publicly traded companies; and

4. Brokers, dealers, investment bankers and financial analysts who work for these companies.

The Act changes how publicly traded companies are audited, and reshapes the financial reporting system. This Act adopts tough new provisions to deter and punish corporate and accounting fraud and corruption, ensures justice for wrongdoers, and protects the interests of workers and shareholders.

This bill improves the quality and transparency of financial reporting, independent audits, and accounting services for public companies. It also:

- Creates a Public Company Accounting Oversight Board (**www.pcaobus.org**) to enforce professional standards, ethics, and competence for the accounting profession;
- Strengthens the independence of firms that audit public companies;
- Increases corporate responsibility and the usefulness of corporate financial disclosure;
- Increases penalties for corporate wrongdoing;
- Protects the objectivity and independence of securities analysts; and
- Increases Securities and Exchange Commission resources.

REMEMBER THIS: Under this law, CEOs and CFOs must personally vouch for the truth and fairness of their company's disclosures. And those financial disclosures will be broader and better than ever before.

Corporate officials will play by the same rules as their employees. In the periods when workers are prevented from buying and selling company stock in their pensions or 401 (k)s, corporate officials will also be banned from any buying or selling.

Corporate misdeeds will be found and punished. This law authorizes new funding for investigators and technology at the SEC to uncover wrongdoing. The SEC will now have the administrative authority to bar dishonest directors and officers from ever again serving in positions of corporate responsibility. The penalties for obstructing justice and shredding documents are greatly increased.

Specifics

<u>New Public Company Accounting Oversight Board (PCAOB)</u>

- The law establishes a five-member Public Accounting Oversight Board (PCAOB) that is subject to Securities and Exchange Commission (SEC) oversight.
- Though the board oversees accounting firms, only two members of the board may be CPAs.

- The SEC will appoint the board.
- Duties of the board include registering public accounting firms that prepare audit reports; and establishing or adopting auditing, quality control, ethics and independence standards.
- The board also inspects, investigates and disciplines public accounting firms and enforces compliance with the act.
- **Registration with the Board Is Mandatory.** For public accounting firms, foreign or domestic, that participates in the preparation or issuance of any audit report with respect to a public company. Registration and annual fees collected from each registered CPA firm will go towards the costs of processing and reviewing applications and annual reports.
- **Seven-Year Record Retention Requirement.** PCAOB must adopt a rule to require registered CPA firms to prepare and maintain audit work papers and other information related to an audit for at least seven years in sufficient detail to support the conclusions reached in the audit report. (A separate criminal provision requires retention of all audit and review workpapers for five years from the end of the fiscal year in which the audit or review was completed.)
- **Cooperation with CPA Groups.** The board will cooperate with professional accountant groups and advisory groups to increase the effectiveness of the standards setting process. (The PCAOB may cooperate, but authority to set standards rests with the PCAOB, subject to SEC review.)
- **Annual Inspections.** Inspection of registered public accounting firms shall occur annually for every registered public accounting firm that regularly provides audit reports for more than 100 issuers (at least once every three years for registered firms that audit fewer than 100 issuers).
- **Investigations.** The board may investigate any act, omission or practice by a registered firm or an individual associated with a registered firm for any possible violation of the act, the board's rules, professional standards, or provisions of the securities laws relating to the preparation and issuance of audit reports.
    - The board may require testimony or documents and information (including audit work papers) from a registered firm or individual associated with a registered firm or in the possession of any other person.
- Sanctions for violations that the board finds may include:
    - Suspension or revocation of a registration;
    - Suspension or bar of a person from further associating with any registered public accounting firm;
    - Limitations on the activities of a firm or person associated with the firm; and
    - Penalize the firm up to $2 million per violation, up to a maximum of $15 million.
    - Individuals employed or associated with a registered firm who violate the act can face penalties that range from required additional continuing professional education (CPE) or training, disbarment of the individual from further association with any registered public accounting firm, or even a fine up to $100,000 for each violation, up to a maximum of $750,000.
        - A portion of the penalties collected will go to accounting scholarships.
- **Funding.** The law also provides independent funding for the Financial Accounting Standards Board (FASB). While the SEC and American Institute of CPAs (AICPA) both have recognized FASB as the standard setting body for accounting principles, federal authority to issue auditing, quality control,

ethics and independence standards may seriously impact the AICPAs' role in official pronouncements.

(a) **Source.** The budget for the board and FASB will be payable from "annual accounting support fees" set by the board and approved by the Commission. The fees will be collected from publicly traded companies and will be determined by dividing the average monthly equity market capitalization of the company for the preceding fiscal year by the average monthly equity market capitalization of all such companies for that year.

Other Requirements for CPA Firms

- **Most Consulting Banned for Audit Clients.** Title II of the act prohibits most "consulting" services outside the scope of practice of auditors.
- **Services** are prohibited even if pre-approved by the issuer's audit committee.
    - Prohibited services include:
        - Bookkeeping and related services,
        - Design and implementation of financial information systems,
        - Appraisal or valuation services (including fairness opinions and contribution-in-kind reports),
        - Actuarial services,
        - Internal audit outsourcing,
        - Services that provide any management or human resources,
        - Investment or broker/dealer services, and
        - Legal and "expert services unrelated to the audit."
        - Any other service that the board determines, by regulation, is impermissible.
    - Services Not Prohibited**.** Firms, however, may provide tax services (including tax planning and tax compliance) or others that are not listed, provided the firm receives pre-approval from the board. However, certain tax planning products, like tax avoidance services, may be considered prohibited nonaudit services.
- **Audit Reports Require Concurring Partner Review.** Requires a concurring or second partner's review and approval of all audit reports and their issuance.
- **"Revolving Door" Employment of CPAs with Audit Clients Is Banned.** A registered CPA firm is prohibited from auditing any SEC registered client whose chief executive, CFO, controller or equivalent was on the audit team of the firm within the past year.
- **Audit Partner Rotation Required.** Audit partners who either have performed audit services or been responsible for reviewing the audit of a particular client must be rotated every five consecutive years. CPAs should read carefully the requirements for rotation of both the partner-in-charge and the concurring review partner for certain organizational constraints.
    - **No Firm Rotation Requirement.** Firm rotation is not required.
- **CPA Firms Are Required to Report Directly to the Audit Committee.**

- **CPA Firm Consolidations to Be Studied.** The U.S. Comptroller General will conduct a study analyzing the impact of the merger of CPA firms to determine if consolidation leads to higher costs, lower quality of services, impairment of auditor independence, or lack of choice.
- **Corporate and Criminal Fraud Accountability.** Changes to the securities laws can penalize anyone found to have destroyed, altered, hid or falsified records or documents to impede, obstruct or influence an investigation conducted by any federal agency, or in bankruptcy, with fines or up to 20 years imprisonment, or both.
- **Current Requirements for Audit Firms.** Accountants are required to maintain all audit or review workpapers for a period of five years from the end of the fiscal period in which the audit or review was concluded.
- **Additional Rules.** The law requires the SEC to promulgate rules and regulations on the retention of any and all materials related to an audit, including communications, correspondence and other documents created, sent or received in connection with an audit or review. (a) **Penalties.** For violating the requirement or the rules that will be developed will result in a fine, or up to 10 years imprisonment, or both.

Of Note to Industry Members—Requirements for Corporations, Their Officers and Board Members

- **No Lying to the Auditor.** The act makes unlawful for an officer or director or anyone acting for a principal to take any action to fraudulently influence, coerce, manipulate or mislead the auditing CPA firm.
- **Code of Ethics for Financial Officers.** The SEC is mandated to issue rules adopting a code of ethics for senior financial officers.
- **Financial Expert Requirement.** The SEC is required to issue rules requiring a publicly traded company's audit committee to be comprised of at least one member who is a financial expert.
- **Audit Committee Responsible for Public Accounting Firm.** The Act vests the audit committee of a publicly traded company with responsibility for the appointment, compensation and oversight of any registered public accounting firm employed to perform audit services.
- **Audit Committee Independence.** Requires audit committee members to be members of the board of directors of the company, and to otherwise be independent.
- **CEOs & CFOs Required to Affirm Financials.** Chief executive officers (CEOs) and CFOs must certify in every annual report that they have reviewed the report and that it does not contain untrue statements or omissions of material facts.
    - Penalty for Violation**.** If material noncompliance causes the company to restate its financials, the CEO and CFO forfeit any bonuses and other incentives received during the 12-month period following the first filing of the erroneous financials.
- **CEOs & CFOs Must Enact Internal Controls.** CEOs and CFOs will be responsible for establishing and maintaining internal controls to ensure they are notified of material information.
- **Penalties for Fraud.** The Act also has stiffened penalties for corporate and criminal fraud by company insiders. The law makes it a crime to destroy, alter or falsify records in a federal investigation or if a company declares bankruptcy. The penalty for those found guilty includes fines, or up to 20 years imprisonment, or both.

- **Companies Affected by the Act.** Publicly traded companies affected by the Act are those defined as an "issuer" under Section 3 of the Securities Exchange Act of 1934, whose securities are registered under Section 12 of the 1934 Act. An issuer also is considered a company that is required to file reports under Section 15(d) of the Act, or that files or has filed a registration statement that has not yet become effective under the Securities Act of 1933. The SEC has yet to provide further guidance as to entities covered by the Act.
- **Debts Not Dischargeable in Bankruptcy.** Amends federal bankruptcy law to make non-dischargeable in bankruptcy certain debts that result from a violation relating to federal or state securities law, or of common law fraud pertaining to securities sales or purchases.
- **Expanded Statute of Limitations for Securities Fraud.** For a civil action brought by a non-government entity or individual, an action involving a claim of securities fraud, deceit or manipulation may be brought not later than the earlier of two years after discovery or five years after the violation.
- **No Listing on National Exchanges for Violators.** The SEC will direct national securities exchanges and associations to prohibit the listing of securities of a noncompliant company.
- **No Insider Trading.** No insider trading is permitted during pension fund blackout periods. The insider must forfeit any profit during this period to the company.
- **SEC Rules on Enhanced Financial Disclosures.**
    - Off-Balance Sheet Transactions: All quarterly and annual financial reports filed with the SEC must disclose all material off-balance sheet transactions, arrangements, obligations (including contingent obligations), and other relationships of the issuer with unconsolidated entities. Disclosure must be made on significant aspects relating to financial condition, liquidity, capital expenditures, resources, and components of revenue and expenses.
    - Pro Forma Figures: Pro forma financial information in any report filed with the SEC or in any public release cannot contain false or misleading statements or omit material facts necessary to make the financial information not misleading.
- **No Personal Loans.** No personal loans or extensions of credit to company executives either directly or through a subsidiary, except for certain extensions of credit under an open-ended credit plan or charge card, home improvement and manufactured home loans, or extensions of credit by a broker or dealer to its employee to buy, trade or carry securities.
    - The terms of permitted loans cannot be more favorable than those offered to the general public.

Criminal Penalties Enhanced*

BEHAVIOR	SENTENCE
The alteration, destruction, concealment of any records with the intent of obstructing a federal investigation.	Fine and/or up to 10 years imprisonment.
Failure to maintain audit or review "workpapers" for at least five years.	Fine and/or up to 5 years imprisonment.
Anyone who "knowingly executes, or attempts to execute, a scheme" to defraud a purchaser of securities.	Fine and/or up to 10 years imprisonment.
Any CEO or CFO who "recklessly" violates his or her certification of the company's financial statements. If violation is willful.	Fine of up to $1,000,000 and/or up to 10 years imprisonment. Fine of up to $5 million and/or up to 20 years imprisonment.
Two or more persons who conspire to commit any offense against or to defraud the U.S. or its agencies.	Fine and/or up to 10 years imprisonment.
Any person who "corruptly" alters, destroys, conceals, etc., any records or documents with the intent of impairing the integrity of the record or document for use in an official proceeding.	Fine and/or up to 20 years imprisonment.
Mail and wire fraud. Violating applicable Employee Retirement Income Security Act (ERISA) provisions.	Increase from 5 to 20 years imprisonment. Various lengths depending on violation.

* Source: Sarbanes-Oxley Act of 2002 and New York City Office of the Comptroller.

Analyst Conflicts of Interest

- **No Retaliation against Analysts.** Brokers and dealers of securities are not allowed to retaliate or threaten to retaliate against an analyst employed by the broker or dealer as a result of an adverse, negative or unfavorable research report on a public company.
- **Conflict of Interest Disclosures.** Securities analysts and brokers or dealers are required to disclose conflicts of interest, such as:

  a) Whether the analyst has investments or debt in the company she is reporting on;
  b) Whether any compensation received by the broker, dealer or analyst is "appropriate in the public interest and consistent with the protection of investors;"
  c) Whether an issuer has been a client of the broker or dealer; and
  d) Whether the analyst received compensation with respect to a research report based on investment banking revenues.

Attorney Requirements

Requirement on Attorneys to Report Violations. The SEC is required to issue rules setting forth minimum standards of professional conduct for attorneys appearing and representing a public company in any manner in front of the Commission. As part of this requirement, the SEC will be required to issue rules on the following:

(a) Requiring attorneys employed by a public company to report to the chief counsel or CEO of the company, evidence of a "material" violation of securities law, breach of fiduciary duty, or similar violation by the company or its agent.

(b) Once reported, if the counsel or CEO does not appropriately respond to the evidence, the attorney must report the evidence to the board of directors or its audit committee.

Chapter 1 Review Questions – Section 2

9. The annual report, in addition to the financial statements, is helpful in understanding the company's financial health. True or False?

10. An audit of the financial statements of Camden Corporation is being conducted by an external auditor. The external auditor is expected to

A. Express an opinion as to the fairness of Camden's financial statements
B. Express an opinion as to the attractiveness of Camden for investment purposes.
C. Certify to the correctness of Camden's financial statements
D. Critique the wisdom and legality of Camden's business decisions

11. The auditor's opinion refers to generally accepted accounting principles (GAAP). Which of the following best describes GAAP?

A. The interpretations of accounting rules and procedures by certified public accountants on audit engagements
B. The pronouncements of the Financial Accounting Standards Board and its predecessor, the Accounting Principles Board.
C. The guidelines set forth by various governmental agencies that derive their authority from Congress,
D. The conventions, rules, and procedures that are necessary to define accepted accounting practice at a particular time.

12. The Management's Discussion and Analysis (MD&A) section of an annual report

A. Includes the company president's letter.
B. Covers three financial aspects of a firm's business: liquidity, capital resources, and results of operations.
C. Is a technical analysis of past results and a defense of those results by management.
D. Covers marketing and product line issues.

13. The content of the Management's Discussion and Analysis (MD&A) section of an annual report is

A. Mandated by pronouncements of the Financial Accounting Standards Board (FASB).

B. Mandated by regulations of the Securities and Exchange Commission (SEC).
C. Reviewed by independent auditors.
D. Mandated by regulations of the Internal Revenue Service (IRS).

14. Under the “Sarbanes-Oxley Act” (SOX), CEOs and CFOs must personally vouch for the truth and fairness of their company’s disclosures. True or False?

Chapter 2:

How To Evaluate And Improve A Company's Financial Performance

Learning Objectives:

After completing this section, you should be able to:

- Recognize key financial ratios and how they can be used.
- Calculate the value for different financial ratios.
- Recognize the relationship between margin and turnover.
- Compute ROI and recognize how it can be improved.

This chapter covers how to analyze a company's financial statements comprising of the balance sheet and income statement. Financial statement analysis attempts to answer the following basic questions:

1. How well is the business doing?
2. What are its strengths?
3. What are its weaknesses?
4. How does it fare in the industry?
5. Is the business improving or deteriorating?

A complete set of financial statements, as explained in the previous chapter, will include the balance sheet, income statement, and statement of cash flows. The first two are vital in financial statement analysis. We will discuss the various financial statement analysis tools that you will use in evaluating the firm's present and future financial condition. These tools include horizontal, vertical, and ratio analysis, which give relative measures of the performance and financial condition of the company. We will also discuss tools that can be used to help improve corporate profitability and shareholder value. They include return on investment (ROI), the Du Pont formula, financial leverage, and return on equity (ROE).

2.1 How To Evaluate A Company's Financial Performance

What and why of financial statement analysis?

The analysis of financial statements means different things to different people. It is of interest to creditors, present and prospective investors, and the firm's own management.

A *creditor* is primarily interested in the firm's debt-paying ability. A short-term creditor, such as a vendor or supplier is ultimately concerned with the firm's ability to pay its bills and therefore wants to be assured that the firm is liquid. A long-term creditor such as a bank or bondholder, on the other hand, is interested in the firm's ability to repay interest and principal on borrowed funds.

An *investor* is interested in the present and future level of return (earnings) and risk (liquidity, debt, and activity). You, as an investor, evaluate a firm's stock based on an examination of its financial statements. This evaluation considers overall financial health, economic and political conditions, industry factors, and future outlook of the company. The analysis attempts to ascertain whether the stock is overpriced, underpriced, or priced in proportion to its market value. A stock is valuable to you only if you can predict the future financial performance of the business. Financial statement analysis gives you much of the data you will need to forecast earnings and dividends.

Management must relate the analysis to all of the questions raised by creditors and investors, since these interested parties must be satisfied for the firm to obtain capital as needed.

2.1.1 Horizontal and Vertical Analysis

How does horizontal and vertical analysis work?

Comparison of two or more years' financial data is known as *horizontal analysis*. Horizontal analysis concentrates on the trend in the accounts in dollar *and* percentage terms over the years. It is typically presented in comparative financial statements (see TLC, Inc. financial data in Figures 2.1 and 2.2). In annual reports, comparative financial data are usually shown for five years.

Through horizontal analysis you can pinpoint areas of wide divergence requiring investigation. For example, in the income statement shown in Figure 2.2, the significant rise in sales returns taken with the reduction in sales for 2X11-2X12 should cause concern. You might compare these results with those of competitors.

It is essential to present both the dollar amount of change and the percentage of change since the use of one without the other may result in erroneous conclusions. The interest expense from 2X11-2X12 went up by 100.0%, but this represented only $1,000 and may not need further investigation. In a similar vein, a large number change might cause a small percentage change and not be of any great importance. Key changes and trends can also be highlighted by the use of *common-size statements*. A common size statement is one that shows the separate items appearing on it in percentage term. Preparation of common-size statements is known as *vertical analysis*. In vertical analysis, a material financial statement item is used as a base value, and all other accounts on the financial statement are compared to it. In the balance sheet, for example, total assets equal 100%. Each asset is stated as a percentage of total assets. Similarly, total liabilities and stockholders' equity is assigned 100% with a given liability or equity account stated as a percentage of the total liabilities and stockholders' equity, respectively. Figure 2.3 shows a common-size income statement based on the data provided in Figure 2.2.

Placing all assets in common-size form clearly shows the relative importance of the current assets as compared to the noncurrent assets. It also shows that significant changes have taken place in the composition of the current assets over the last year. Notice, for example, that receivables have increased in relative importance and that cash has declined in relative importance. The deterioration in the cash position may be a result of inability to collect from customers.

For the income statement, 100% is assigned to net sales with all other revenue and expense accounts related to it. It is possible to see at a glance how each dollar of sales is distributed between the various costs, expenses, and profits. For example, notice from Figure 2.3 that 64.8 cents of every dollar of sales was needed to cover cost of goods sold in 2X12, as compared to only 57.3 cents in the prior year; also notice that only 9.9 cents out of every dollar of sales remained for profits in 2X12--down from 13.6 cents in the prior year.

You should also compare the vertical percentages of the business to those of the competition and to the industry norms. Then you can determine how the company fares in the industry.

FIGURES 2.1

TLC, INC.

COMPARATIVE BALANCE SHEET (IN THOUSANDS OF DOLLARS)

DECEMBER 31, 2X12, 2X11, 2X10

				Increase/ Decrease		% Increase/ Decrease	
	2X12	**2X11**	**2X10**	**2X12-2X11**	**2X11-2X10**	**2X12-2X11**	**2X11-2X10**
ASSETS							
Current Assets:							
Cash	$28	$36	$36	(8.00)	0.00	-22.2%	0.0%
Short-term investments	22	15	7	7.00	8.00	46.7%	114.3%
Accounts Receivable	21	16	10	5.00	6.00	31.3%	60.0%
Inventory	53	46	49	7.00	(3.00)	15.2%	-6.1%
Total Current Assets	124	113	102	11.00	11.00	9.7%	10.8%
Plant And Equip.	103	91	83	12.00	8.00	13.2%	9.6%
Total Assets	227	204	185	23.00	19.00	11.3%	10.3%
LIABILITIES							
Current Liabilities	56	50	51	6.00	(1.00)	12.0%	-2.0%
Long-term debt	83	74	69	9.00	5.00	12.2%	7.2%
Total Liabilities	139	124	120	15.00	4.00	12.1%	3.3%
STOCKHOLDERS' EQUITY							
Common Stock, $10 par, 4,600 shares	46	46	46	0.00	0.00	0.0%	0.0%
Retained Earnings	42	34	19	8.00	15.00	23.5%	78.9%
Total Stockholders' Equity	88	80	65	8.00	15.00	10.0%	23.1%
Total Liab. and Stockholders' Equity	$227	$204	$185	$23.00	$19.00	11.3%	10.3%

FIGURE 2.2

TLC, INC.

COMPARATIVE INCOME STATEMENT (IN THOUSANDS OF DOLLARS)

FOR THE YEARS ENDED DECEMBER 31, 2X12, 2X11, 2X10

				Increase/ Decrease		% Increase/ Decrease	
	2X12	2X11	2X10	2X12-2X11	2X11-2X10	2X12-2X11	2X11-2X10
Sales	$98.3	$120.0	$56.6	($21.7)	$63.4	-18.1%	112.0%
Sales Return & Allowances	18.0	10.0	4.0	8.0	6.0	80.0%	150.0%
Net Sales	80.3	110.0	52.6	(29.7)	57.4	-27.0%	109.1%
Cost of Goods Sold	52.0	63.0	28.0	(11.0)	35.0	-17.5%	125.0%
Gross Profit	28.3	47.0	24.6	(18.7)	22.4	-39.8%	91.1%
Operating Expenses							
Selling Expenses	12.0	13.0	11.0	(1.0)	2.0	-7.7%	18.2%
General Expenses	5.0	8.0	3.0	(3.0)	5.0	-37.5%	166.7%
Total Operating Expenses	$17.0	$21.0	$14.0	($4.0)	$7.0	-19.0%	50.0%
Income from Operations	$11.3	$26.0	$10.6	($14.7)	$15.4	-56.5%	145.3%
Nonoperating Income	4.0	1.0	2.0	3.0	(1.0)	300.0%	-50.0%
Income before Interest & Taxes	15.3	27.0	12.6	(11.7)	14.4	-43.3%	114.3%
Interest Expense	2.0	2.0	1.0	0.0	1.0	0.0%	100.0%
Income before Taxes	13.3	25.0	11.6	(11.7)	13.4	-46.8%	115.5%
Income Taxes (40%)	5.3	10.0	4.6	(4.7)	5.4	-46.8%	115.5%
Net Income	$8.0	$15.0	$7.0	($7.0)	$8.0	-46.8%	115.5%

FIGURE 2.3
INCOME STATEMENT AND COMMON SIZE ANALYSIS
TLC, INC.
(IN THOUSANDS OF DOLLARS)
FOR THE YEARS ENDED DECEMBER 31, 2X12 & 2X11

	2X12		*2X11*	
	Amount	*%*	*Amount*	*%*
Sales	$98.30	122.40%	$120.00	109.10%
Sales Return & Allowances	18.00	22.40%	10.00	9.10%
Net Sales	80.30	100.00%	110.00	100.00%
Cost of Goods Sold	52.00	64.80%	63.00	57.30%
Gross Profit	28.30	35.20%	47.00	42.70%
Operating Expenses				
Selling Expenses	12.00	14.90%	13.00	11.80%
General Expenses	5.00	6.20%	8.00	7.30%
Total Operating Expenses	$17.00	21.20%	$21.00	19.10%
Income from Operations	$11.30	14.10%	$26.00	23.60%
Nonoperating Income	4.00	5.00%	1.00	0.90%
Income before Interest & Taxes	15.30	19.10%	27.00	24.50%
Interest Expense	2.00	2.50%	2.00	1.80%
Income before Taxes	13.30	16.60%	25.00	22.70%
Income Taxes (40%)	5.30	6.60%	10.00	9.10%
Net Income	$8.00	9.90%	$15.00	13.60%

2.1.2 Working with Financial Ratios

What is ratio analysis?

Horizontal and vertical analysis compares one figure to another within the same category. It is also vital to compare two figures applicable to different categories. This is accomplished by ratio analysis. In this section, you will learn how to calculate the various financial ratios and how to interpret them. The results of the ratio analysis will allow you:

1. To appraise the position of a business,
2. To identify trouble spots that need attention, and
3. To provide the basis for making projections and forecasts about the course of future operations.

Think of ratios as measures of the relative health or sickness of a business. Just as a doctor takes readings of a patient's temperature, blood pressure, heart rate, etc., you will take readings of a business's liquidity, profitability, leverage, efficiency in using assets, and market value. Where the doctor compares the readings to generally accepted guidelines such as a temperature of 98.6 degrees as normal, you make some comparisons to the norms.

What are the two major comparisons?

To obtain useful conclusions from the ratios, you must make two comparisons:

- *Industry comparison.* This will allow you to answer the question "how does a business fare in the industry?" You must compare the company's ratios to those of competing companies in the industry or with industry standards (averages). You can obtain industry norms from financial services such as Value Line, Dun and Bradstreet, Philadelphia-based Risk Management Association (RMA), and Standard and Poor's. Numerous online services such as AOL and MSN Money Central, to name a few, also provide these data. For example, RMA has been compiling statistical data on financial statements for more than 75 years. The RMA Annual Statement Studies provide statistical data from more than 150,000 actual companies on many key financial ratios, such as gross margin, operating margins and return on equity and assets. If you're looking to put real authority into the "industry average" numbers that your company is beating, the Statement Studies are the way to go. They're organized by SIC codes, and you can buy the financial statement studies for your industry for $59.95 in report form or over the Internet (**www.rmahq.org**).

- *Trend analysis.* To see how the business is doing over time, you will compare a given ratio for one company over several years to see the direction of financial health or operational performance.

What are the major categories of financial ratios?

Financial ratios can be grouped into the following types: liquidity, asset utilization (activity), solvency (leverage and debt service), profitability, and market value.

LIQUIDITY

Liquidity is the firm's ability to satisfy maturing short-term debt. Liquidity is crucial to carrying out the business, especially during periods of adversity. It relates to the short term, typically a period of one year or less. Poor liquidity might lead to higher cost of financing and inability to pay bills and dividends. The three basic measures of liquidity are (a) net working capital, (b) the current ratio, and (c) the quick (acid-test) ratio.

Throughout our discussion, keep referring to Figures 2.1 and 2.2 to make sure you understand where the numbers come from.

Net working capital equals current assets minus current liabilities. Net working capital for 2X12 is:

Net working capital = current assets - current liabilities

= $124 - $56 = $68

In 2X11, net working capital was $63. The rise over the year is favorable.

The current ratio equals current assets divided by current liabilities. The ratio reflects the company's ability to satisfy current debt from current assets.

Current ratio = (Current Assets)/(Current Liabilities)

For 2X12, the current ratio is:

$124/$56 = 2.21

In 2X11, the current ratio was 2.26. The ratio's decline over the year points to a slight reduction in liquidity.

A more stringent liquidity test can be found in the quick (acid-test) ratio. Inventory and prepaid expenses are excluded from the total of current assets, leaving only the more liquid (or quick) assets to be divided by current liabilities.

Quick (Acid-test) ratio = (Cash + Marketable Securities) / (Current Liabilities)

The quick ratio for 2X12 is:

($28 + $22 + $21)/ $56 = 1.27

In 2X11, the ratio was 1.34. A small reduction in the ratio over the period points to less liquidity.

The overall liquidity trend shows a slight deterioration as reflected in the lower current and quick ratios, although it is better than the industry norms (see Table 2.4 for industry averages). But a mitigating factor is the increase in net working capital.

ASSET UTILIZATION

Asset utilization (activity, turnover) ratios reflect the way in which a company uses its assets to obtain revenue and profit. One example is how well receivables are turning into cash. The higher the ratio, the more efficiently the business manages its assets.

Accounts receivable ratios comprise the accounts receivable turnover and the average collection period.

The *accounts receivable turnover* provides the number of times accounts receivable are collected in the year. It is derived by dividing net credit sales by average accounts receivable.

You can calculate average accounts receivable by the average accounts receivable balance during a period.

Accounts receivable turnover = (net credit sales) / (average accounts receivable)

For 2X12, the average accounts receivable is:

($21 + $16) / 2 = $18.50

The accounts receivable turnover for 2X12 is:

$80.30/$18.50 = 4.34

In 2X11, the turnover was 8.46. There is a sharp reduction in the turnover rate pointing to a collection problem.

The *average collection period* is the length of time it takes to collect receivables. It represents the number of days receivables are held.

Average collection period = 365 / (accounts receivable turnover)

In 2X12, the collection period is:

365/4.34 = 84.1 days

It takes this firm about 84 days to convert receivables to cash. In 2X11, the collection period was 43.1 days. The significant lengthening of the collection period may be a cause for some concern. The long collection period may be a result of the presence of many doubtful accounts, or it may be a result of poor credit management.

Inventory ratios are useful especially when a buildup in inventory exists. Inventory ties up cash. Holding large amounts of inventory can result in lost opportunities for profit as well as increased storage costs. Before you extend credit or lend money, you should examine the firm's *inventory turnover* and *average age of inventory*.

Inventory turnover = (Cost of Goods Sold) / (Average Inventory)

The inventory turnover for 2X12 is:

$52/$49.5 = 1.05

For 2X11, the turnover was 1.33.

Average age of inventory = 365 / (Inventory Turnover)

In 2X12, the average age is:

365/1.05 = 347.6 days

In the previous year, the average age was 274.4 days.

The reduction in the turnover and increase in inventory age points to a longer holding of inventory. You should ask why the inventory is not selling as quickly.

The *operating cycle* is the number of days it takes to convert inventory and receivables to cash.

Operating cycle = average collection period + average age of inventory

In 2X12, the operating cycle is:

84.1 days + 347.6 days = 431.7 days

In the previous year, the operating cycle was 317.5 days. An unfavorable direction is indicated because additional funds are tied up in noncash assets. Cash is being collected more slowly.

By calculating the *total asset turnover*, you can find out whether the company is efficiently employing its total assets to obtain sales revenue. A low ratio may indicate too high an investment in assets in comparison to the sales revenue generated.

Total asset turnover = (Net Sales) / (Average Total Assets)

In 2X12, the ratio is:

$80.3/[($204+$227)/2] = $80.3/ $215.5 = 0.37

In 2X11, the ratio was .57 ($110/$194.5). There has been a sharp reduction in asset utilization.

TLC, Inc. has suffered a sharp deterioration in activity ratios, pointing to a need for improved credit and inventory management, although the 2X12 ratios are not far out of line with the industry averages (See Figure 2.4). It appears that problems are inefficient collection and obsolescence of inventory.

SOLVENCY (LEVERAGE AND DEBT SERVICE)

Solvency is the company's ability to satisfy long-term debt as it becomes due. You should be concerned about the long-term financial and operating structure of any firm in which you might be interested. Another important consideration is the size of debt in the firm's capital structure, which is referred to as *financial leverage*. (Capital structure is the mix of the *long term* sources of funds used by the firm).

Solvency also depends on earning power; in the long run a company will not satisfy its debts unless it earns profit. A leveraged capital structure subjects the company to fixed interest charges, which contributes to earnings instability. Excessive debt may also make it difficult for the firm to borrow funds at reasonable rates during tight money markets.

The *debt ratio* reveals the amount of money a company owes to its creditors. Excessive debt means greater risk to the investor. (Note that equity holders come after creditors in bankruptcy.) *Note:* How much debt is too much? The rule of thumb is: The debt portion should be less than 50%.

All of bankruptcies arise from a company's inability to meet its debt obligations, according to wwww.BankruptcyData.com).

The debt ratio is:

Debt ratio =(Total Liabilities)/(Total Assets)

In 2X12, the ratio is:

$139/$227 = 0.61

The *debt-equity ratio* will show you if the firm has a great amount of debt in its capital structure. Large debts mean that the borrower has to pay significant periodic interest and principal. Also, a heavily indebted firm takes a greater risk of running out of cash in difficult times. The interpretation of this ratio depends on several variables, including the ratios of other firms in the industry, the degree of access to additional debt financing, and stability of operations.

Debt-equity ratio = (Total Liabilities) / (Stockholders' Equity)

In 2X12, the ratio is:

$139/$88 = 1.58

In the previous year, the ratio was 1.55. The trend is relatively static.

Table 2.1 shows the debt equity ratios for selected companies compared with industry averages.

TABLE 2.1
DEBT EQUITY RATIOS

Company	Industry	November 11 2013	Industry Average
Boeing (BA)	Aerospace/Defense - Major Diversified	0.97	0.84
Google (GOOG)	Internet Information Providers	.03	.0.3
Toyota (TM)	Auto Manufacturers - Major	0.61	0.81
Nordstrom (JWN)	Apparel stores	1.34	0.98
Intel (INTC)	Semiconductor - Broad Line	0.24	0.24
Wal Mart (WMT)	Discount, Variety Stores	0.61	0.61

Source: **MSN Money (http://money.msn.com/)--key ratios—Financial Condition**

Times interest earned (interest coverage ratio) tells you how many times the firm's before-tax earnings would cover interest. It is a safety margin indicator in that it reflects how much of a reduction in earnings a company can tolerate.

Times interest earned = (Income before interest and taxes) / (Interest expense)

For 2X12, the ratio is:

$15.3/$2.0 = 7.65

In 2X11, interest was covered 13.5 times. The reduction in coverage during the period is a bad sign. It means that fewer earnings are available to satisfy interest charges.

You must also note liabilities that have not yet been reported in the balance sheet by closely examining footnote disclosure. For example, you should find out about lawsuits, noncapitalized leases, and future guarantees.

As shown in Figure 2.3, the company's overall solvency is poor, relative to the industry averages although it has remained fairly constant. There has been no significant change in its ability to satisfy long-term debt. Note that significantly less profit is available to cover interest payments.

PROFITABILITY

A company's ability to earn a good profit and return on investment is an indicator of its financial well-being and the efficiency with which it is managed. Poor earnings have detrimental effects on market price of stock and dividends. Total dollar net income has little meaning unless it is compared to the input in getting that profit.

The *gross profit margin* shows the percentage of each dollar remaining once the company has paid for goods acquired. A high margin reflects good earning potential.

Gross profit margin = (Gross Profit) / (Net Sales)

In 2X12, the ratio is:

$28.3/$80.3 = 0.35

The ratio was .43 in 2X11. The reduction shows that the company now receives less profit on each dollar sales. Perhaps higher relative cost of merchandise sold is at fault.

Profit margin shows the earnings generated form revenue and is a key indicator of operating performance. It gives you an idea of the firm's pricing, cost structure, and production efficiency.

Profit margin = (Net Income) / (Net Sales)

The ratio in 2X12 is:

$8/$80.3 = 0.10

For the previous year, profit margin was .14. The decline in the ratio shows a downward trend in earning power. (Note that these percentages are available in the common size income statement as given in Figure 2.2).

Return on investment is a prime indicator because it allows you to evaluate the profit you will earn if you invest in the business. Two key ratios are the *return on total assets* and the *return on equity*.

The return on total assets shows whether management is efficient in using available resources to get profit.

Return on total assets = (Net Income) / (Average Total Assets)

In 2X12, the return is:

$8 / [($227+$204)/2] = 0.037

In 2X11, the return was .077. There has been a deterioration in the productivity of assets in generating earnings.

The *return on equity* (ROE) reflects the rate of return earned on the stockholders' investment.

Return on common equity = (Net Income available to stockholder)/(Average stockholders' equity)

The return in 2X12 is:

$8 / [($88+$80)/2] = 0.095

In 2X11, the return was .207. There has been a significant drop in return to the owners.

The overall profitability of the company has decreased considerably, causing a decline in both the return on assets and return on equity. Perhaps lower earnings were due in part to higher costs of short-term financing arising from the decline in liquidity and activity ratios. Moreover, as turnover rates in assets go down, profit will similarly decline because of a lack of sales and higher costs of carrying higher current asset balances. As indicated in Figure 2.4, industry comparisons reveal that the company is faring very poorly in the industry.

Table 2.2 shows industries with high return on equity (in excess of 20%).

Table 2.2

Industries with High Return on Equity (ROE) Rates - (in excess of 20%) - 2013

Discount, variety stores	19.7%
Semiconductor	165.5
Apparel	25.2
Beverages	24.5
Diversified computer systems	66.6
Food processing	34.9

Source: **MSN Money Central Investor (http://moneycentral.msn.com/investor/home.asp)**

MARKET VALUE

Market value ratios relate the company's stock price to its earnings (or book value) per share. Also included are dividend-related ratios.

Earnings per share (EPS) is the ratio most widely watched by investors. EPS shows the net income per common share owned. You must reduce net income by the preferred dividends to obtain the net income available to common stockholders. Where preferred stock is not in the capital structure, you determine EPS by dividing net income by common shares outstanding. EPS is a gauge of corporate operating performance and of expected future dividends.

EPS = (Net Income – Preferred Dividend)/(Common Shares Outstanding)

EPS in 2X12 is:

$8,000/4,600 shares = $1.74

For 2X11, EPS was $3.26. The sharp reduction over the year should cause alarm among investors. As you can see in Figure 2.4, the industry average EPS in 2X12 is much higher than that of TLC, Inc. ($4.51 per share vs. $1.74 per share).

Table 2.3 provides EPS for selected companies.

Table 2.3
EPS

Company	Industry	November 11 2013
Boeing (BA)	Aerospace/Defense - Major Diversified	5.64
Google (GOOG)	Internet Information Providers	37.92
Toyota (TM)	Auto Manufacturers - Major	893
Nordstrom (JWN)	Apparel Stores	3.77
Intel (INTC)	Semiconductor - Broad Line	1.86
Wal Mart (WMT)	Discount, Variety Stores	5.12

Source: **MSN Money (http://money.msn.com/)**

The *price/earnings (P/E) ratio*, also called *earnings multiple*, reflects the company's relationship to its stockholders. The P/E ratio represents the amount investors are willing to pay for each dollar of the firm's earnings. A high multiple (cost per dollar of earnings) is favored since it shows that investors view the firm positively. On the other hand, investors looking for value would prefer a relatively lower multiple (cost per dollar of earnings) as compared with companies of similar risk and return.

Price/earnings ratio = (Market Price Per Share) / (Earnings Per Share)

Assume a market price per share of $12 on December 31, 2X12, and $26 on December 31, 2X11. The P/E ratios are:

2X12: $12/$1.74 = 6.9

2X11: $26/$3.26 = 7.98

From the lower P/E multiple, you can infer that the stock market now has a lower opinion of the business. However, some investors argue that a low P/E ratio can mean that the stock is undervalued. Nevertheless, the decline over the year in stock price was 54% ($14/$26), which should cause deep investor concern.

Table 2.4 shows price-earnings ratios of certain companies compared with industry averages.

Table 2.4
P/E ratios

Company	Industry	November 11 2013	Industry Average
Boeing (BA)	Aerospace/Defense - Major Diversified	23.42	20.41
Google (GOOG)	Internet Information Providers	28.25	36.1
Toyota (TM)	Auto Manufacturers - Major	12.97	13.91
Nordstrom (JWN)	Apparel Stores	16.39	-153.85
Intel (INTC)	Semiconductor - Broad Line	12.16	25.58
Wal Mart (WMT)	Discount, Variety Stores	14.75	16.67

Source: **MSN Money (http://money.msn.com/)--key ratios—Price Ratios**

Book value per share equals the net assets available to common stockholders divided by shares outstanding. By comparing it to market price per share you can get another view of how investors feel about the business.

Book value per share = (Total Stockholders' Equity – Preferred Stock) / (Common Shares Outstanding)

The book value per share in 2X12 is:

$88,000-$0 / 4,600 = $19.13

In 2X11, book value per share was $17.39.

The increased book value per share is a favorable sign, because it indicates that each share now has a higher book value. However, in 2X12, market price is much less than book value, which means that the stock market does not value the security highly. In 2X11, market price did exceed book value, but there is

now some doubt in the minds of stockholders concerning the company. However, some analysts may argue that the stock is underpriced.

The *price/book value ratio* shows the market value of the company in comparison to its historical accounting value. A company with old assets may have a high ratio whereas one with new assets may have a low ratio. Hence, you should note the changes in the ratio in an effort to appraise the corporate assets.

The ratio equals:

Price/book value = (Market Price per Share) / (Book Value per Share)

In 2X12, the ratio is:

$12/$19.13 = 0.63

In 2X11, the ratio was 1.5. The significant drop in the ratio may indicate a lower opinion of the company in the eyes of investors. Market price of stock may have dropped because of a deterioration in liquidity, activity, and profitability ratios. The major indicators of a company's performance are intertwined (i.e., one affects the other) so that problems in one area may spill over into another. This appears to have happened to the company in our example.

Dividend ratios help you determine the current income from an investment. Two relevant ratios are:

Dividend yield = (Dividends per Share) / (Market Price per Share)

Dividend payout = (Dividends per Share) / (Earnings per Share)

Table 2.5 shows the dividend payout ratios of some companies.

TABLE 2.5
DIVIDEND PAYOUT RATIOS

Company	Industry	November 11 2013
Boeing (BA)	Aerospace/Defense - Major Diversified	35.57%
Google (GOOG)	Internet Information Providers	NA
Toyota (TM)	Auto Manufacturers - Major	0
Nordstrom (JWN)	Apparel stores	30.21
Intel (INTC)	Semiconductor - Broad Line	48.46
Wal Mart (WMT)	Discount, Variety Stores	41.18

Source: **MSN Money (http://money.msn.com/)--Financial Highlights**

There is no such thing as a "right" payout ratio. Stockholders look unfavorably upon reduced dividends because it is a sign of possible deteriorating financial health. However, companies with ample opportunities for growth at high rates of return on assets tend to have low payout ratios.

AN OVERALL EVALUATION -- SUMMARY OF FINANCIAL RATIOS

As indicated in the chapter, a single ratio or a single group of ratios is not adequate for assessing all aspects of the firm's financial condition. Figure 2.4 summarizes the 2X11 and 2X12 ratios calculated in the previous sections, along with the industry average ratios for 2X12. The figure also shows the formula used to calculate each ratio. The last three columns of the figure contain subjective assessments of TLC's financial condition, based on trend analysis and 2X12 comparisons to the industry norms. (5-year ratios are generally needed for trend analysis to be more meaningful, however.)

By appraising the trend in the company's ratios from 2X11 to 2X12, we see from the drop in the current and quick ratios that there has been a slight detraction in short-term liquidity, although they have been above the industry averages. But working capital has improved. A material deterioration in the activity ratios has occurred, indicating that improved credit and inventory policies are required. They are not terribly alarming, however, because these ratios are not way out of line with industry averages. Also, total utilization of assets, as indicated by the total asset turnover, shows a deteriorating trend.

Leverage (amount of debt) has been constant. However, there is less profit available to satisfy interest charges. TLC's profitability has deteriorated over the year. In 2X12, it is consistently below the industry average in every measure of profitability. In consequence, the return on the owner's investment and the return on total assets have gone down. The earnings decrease may be partly due to the firm's high cost of short-term financing and partly due to operating inefficiency. The higher costs may be due to receivable and inventory difficulties that forced a decline in the liquidity and activity ratios. Furthermore, as receivables and inventory turnover less, profit will fall off from a lack of sales and the costs of carrying more in current asset balances.

The firm's market value, as measured by the price/earnings (P/E) ratio, is respectable as compared with the industry. But it shows a declining trend.

In summary, it appears that the company is doing satisfactorily in the industry in many categories. The 2X11-2X12 period, however, seems to indicate that the company is heading for financial trouble in terms of earnings, activity, and short-term liquidity. The business needs to concentrate on increasing operating efficiency and asset utilization.

Is ratio analysis a panacea?

While ratio analysis is an effective tool for assessing a business's financial condition, you must also recognize the following limitations:

1. Accounting policies vary among companies and can inhibit useful comparisons. For example, the use of different depreciation methods (straight-line vs. double declining balance) will affect profitability and return ratios.

2. Management may "fool around" with ("window-dress") the figures. For example, it can reduce needed research expense just to bolster net income. This practice, however, will almost always hurt the company in the long run.

3. A ratio is static and does not reveal future flows. For example, it will not answer questions such as "How much cash do you have in your pocket now?" or "Is that sufficient, considering your expenses and income over the next month?"

4. A ratio does not indicate the quality of its components. For example, a high quick ratio may contain receivables that may not be collected.

5. Reported liabilities may be undervalued. An example is a lawsuit on which the company is contingently liable.

6. The company may have multiple lines of business, making it difficult to identify the industry group the company is a part.

7. Industry averages cited by financial advisory services are only approximations. Hence, you may have to compare a company's ratios to those of competing companies in the industry.

FIGURE 2.4
TLC, INC.
SUMMARY OF FINANCIAL RATIOS - TREND AND INDUSTRY COMPARISONS

Ratios	Definitions	2X11	2X12	Industry[a]	Evaluation[b] Ind	Trend	Overall
LIQUIDITY							
Net working capital	Current assets - current liabilities	63	68	56	good	good	good
Current Ratio	Current assets/current liabilities	2.26	2.21	2.05	OK	OK	OK
Quick (Acid-test) ratio	(Cash + short-term investments + accounts receivable)/current liabilities	1.34	1.27	1.11	OK	OK	OK
ASSET UTILIZATION							
Accounts receivable turnover	Net credit sales/average accounts receivable	8.46	4.34	5.5	OK	poor	poor
Average collection period	365 days/accounts receivable turnover (days)	43.1	84.1	66.4	OK	poor	poor
Inventory turnover	Cost of goods sold/average inventory	1.33	1.05	1.2	OK	poor	poor
Average age of inventory	365 days/inventory turnover (days)	274.4	347.6	N/A	N/A	poor	poor
Operating cycle	Average collection period + average age of inventory (days)	317.5	431.7	N/A	N/A	poor	poor
Total asset turnover	Net sales/average total assets	0.57	0.37	0.44	OK	poor	poor
SOLVENCY							
Debt ratio	Total liabilities/total assets	0.61	0.61	N/A	N/A	OK	OK
Debt-equity ratio	Total liabilities/stockholders' equity	1.55	1.58	1.3	poor	poor	poor
Times interest earned	Income before interest and taxes/interest expense (times)	13.5	7.65	10	OK	poor	poor
PROFITABILITY							
Gross profit margin	Gross profit/net sales	0.43	0.35	0.48	poor	poor	poor
Profit margin	Net income/net sales	0.14	0.1	0.15	poor	poor	poor
Return on total assets	Net income/average total assets	0.077	0.037	0.1	poor	poor	poor
Return on equity(ROE)	Earnings available to common stockholders/ avg. stockholders' equity	0.207	0.095	0.27	poor	poor	poor

FIGURE 2.4
TLC, INC.
SUMMARY OF FINANCIAL RATIOS - TREND AND INDUSTRY COMPARISONS

Ratios	Definitions	2X11	2X12	Industry[a]	Evaluation[b] Ind	Trend	Overall
MARKET VALUE							
Earnings per share(EPS)	(Net income -preferred dividend)/common shares outstanding	3.26	1.74	4.51	poor	poor	poor
Price/earnings (P/E) ratio	Market price per share/EPS	7.98	6.9	7.12	OK	poor	poor
Book value per share	(Total stockholders' eqty - Preferred stock)/ common shrs outstanding	17.39	19.13	N/A	N/A	good	good
Price/book value ratio	Market price per share/book value per share	1.5	0.63	N/A	N/A	poor	poor
Dividend yield	Dividends per share/market price per share						
Dividend payout	Dividends per share/EPS						

(a) Obtained from sources not included in this chapter
(b) Represent subjective evaluation

Chapter 2 Review Questions – Section 1

1. In financial statement analysis, expressing all financial statement items as a percentage of base-year amounts is called

A. Horizontal common-size analysis.
B. Vertical common-size analysis.
C. Trend analysis.
D. Ratio analysis.

2. In assessing the financial prospects for a firm, financial analysts use various techniques. An example of vertical, common-size analysis is

A. An assessment of the relative stability of a firm's level of vertical integration.
B. Advertising expense for the current year is 2% of sales.
C. A comparison in financial ratio from among two or more firms in the same industry.
D. Advertising expense is 2% greater compared with the previous year.

3. A firm's average collection period is equal to

A. The length of time it takes to collect receivables.
B. The inventory conversion period.
C. The cash conversion cycle.
D. The inventory divided by average daily sales.

4. To determine the operating cycle for a retail department store, which one of the following pairs of items is needed?

A. Days' sales in accounts receivable and average merchandise inventory.
B. Cash turnover and net sales.
C. Accounts receivable turnover and inventory turnover.
D. Asset turnover and return on sales.

5. A measure of long-term debt-paying ability is a company's

A. Length of the operating cycle.

B. Return on assets.
C. Inventory turnover.
D. Times interest earned.

6. The times-interest-earned ratio is primarily an indication of

A. Liquidity.
B. Asset management.
C. Debt-paying capacity (Solvency).
D. Profitability.

7. What type of ratio is profit margin ratio?

A. Liquidity ratio.
B. Profitability ratio.
C. Activity ratio.
D. Leverage ratio.

8. What type of ratio is earnings per share (EPS)?

A. Market value ratio.
B. Activity ratio.
C. Liquidity ratio.
D. Leverage ratio.

9. A company has 100,000 outstanding common shares with a market value of $20 per share. Dividends of $2 per share were paid in the current year, and the enterprise has a dividend-payout ratio of 40%. The price-to-earnings ratio of the company is

A. 2.5.
B. 10.
C. 4.
D. 50.

10. Which combination of changes in asset turnover and profit margin on sales will maximize the return on investment?

A. Increase Asset Turnover, and Decrease Profit margin
B. Increase Asset Turnover, and Increase Profit margin
C. Decrease Asset Turnover, and Increase Profit margin
D. Decrease Asset Turnover, and Decrease Profit margin

2.2 How to Analyze and Improve Corporate Profitability and Shareholder Value

How do you measure managerial performance and the return to stockholders?

The ability to measure performance is essential in developing incentives and controlling operations toward the achievement of organizational goals. Perhaps the most widely used single measure of profitability of an organization is the rate of return on investment (ROI). Related is the return to stockholders, known as the return on equity (ROE). You will have an understanding of the relationship between ROI and ROE. The ability to measure managerial performance is essential in controlling operations toward the achievement of organizational goals. As companies grow or their activities become more complex, they attempt to decentralize decision making as much as possible. They do this by restructuring the firm into several divisions and treating each as an independent business. The managers of these subunits or segments are then evaluated on the basis of the effectiveness with which they use the assets entrusted to them.

2.2.1 Return on Investment (ROI) and the Du Pont Formula

What is return on investment (ROI)?

ROI relates net income to invested capital (total assets). ROI provides a standard for evaluating how efficiently management employs the average dollar invested in a firm's assets, whether that dollar came from owners or creditors. Furthermore, a better ROI can also translate directly into a higher return on the stockholders' equity.

ROI is calculated as:

ROI = (Net Profit after Taxes) / (Total Assets)

EXAMPLE 2.1

Consider the following financial data:

Total assets = $100,000

Net profit after taxes = 18,000

Then, ROI = (Net profits after taxes) / (Total assets) = $18,000/$100,000 = 18%

The problem with this formula is that it only tells you about how a company did and how well it fared in the industry. It has very little value from the standpoint of profit planning.

What Is ROI Made Up Of--Du Pont Formula?

ROI can be broken down into two factors--profit margin and asset turnover. In the past, managers have tended to focus only on the profit margin earned and have ignored the turnover of assets. It is important to realize that excessive funds tied up in assets can be just as much of a drag on profitability as excessive expenses. The Du Pont Corporation was the first major company to recognize the importance of looking at both net profit margin and total asset turnover in assessing the performance of an organization. The ROI breakdown, known as the *Du Pont formula*, is expressed as a product of these two factors, as shown below.

ROI = (net profits after taxes) / (total assets) = (net profit after taxes)/sales x sales/(total assets)

= Net profit margin x Total asset turnover

The Du Pont formula combines the income statement and balance sheet into this otherwise static measure of performance. Net profit 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, total asset turnover measures how well a company manages its assets. It is the number of times by which the investment in assets turn over each year to generate sales.

The breakdown of ROI is based on the thesis that the profitability of a firm is directly related to management's ability to manage assets efficiently and to control expenses effectively.

EXAMPLE 2.2

Assume the same data as in Example 2.1. Also assume sales of $200,000.

Then, ROI = (net profit after taxes) / (total assets) = $18,000/$100,000 = 18%

Alternatively,

Net profit margin = (net profit after taxes) / (total sales) = $18,000/$200,000 = 9%

Total asset turnover = Sales / (total assets) = $200,000/$100,000 = 2 times

Therefore,

ROI = Net profit margin x Total asset turnover = 9% x 2 times = 18%

The breakdown provides a lot of insights to financial managers on how to improve profitability of the company and investment strategy. (Note that net profit margin and total asset turnover are called hereafter margin and turnover, respectively, for short). Specifically, it has several advantages over the original formula (i.e., net profit after taxes/total assets) for profit planning. They are:

(1) 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.

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

(3) 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 by a high margin; and vice versa.

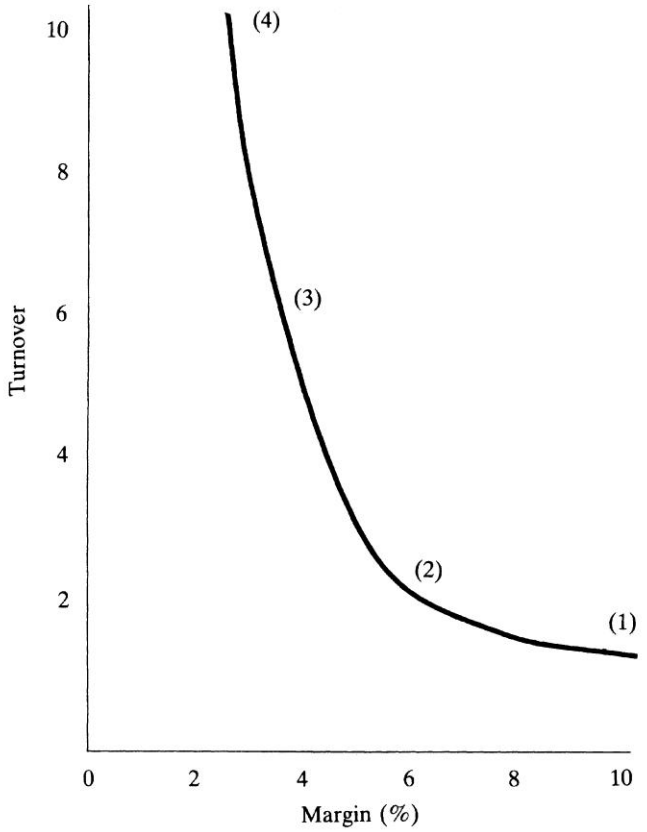
EXAMPLE 2.3

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:

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

The turnover-margin relationship and its resulting ROI is depicted in Figure 2.5.

FIGURE 2.5
TURNOVER-MARGIN RELATIONSHIP



Is there an optimal ROI?

Figure 2.1 can also be looked at as showing four companies that performed equally well (in terms of ROI), but with varying income statements and balance sheets. There is no ROI that is satisfactory for all companies. Sound and successful operation must point toward the optimum combination of profits, sales, and capital employed. The combination will necessarily vary depending upon the nature of the business and the characteristics of the product. An industry with products tailor-made to customers' specifications will have different margins and turnover ratios, compared with industries that mass produce highly competitive consumer goods. For example, the combination (4) may describe a supermarket operation which inherently works with low margin and high turnover, while the combination (1) may be a jewelry store which typically has a low turnover and high margin.

How do you use Du Pont formula for profit planning?

The breakdown of ROI into margin and turnover gives management 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, management 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, although this can be dangerous in today's quality-oriented environment.
(b) Automate processes as much as possible to increase labor productivity. But this will probably increase assets, thereby reducing turnover.
(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 company 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 company with pricing power must have a unique economic position. Companies that offer unique, high-quality goods and services (where the service is more important than the cost) have this economic position.

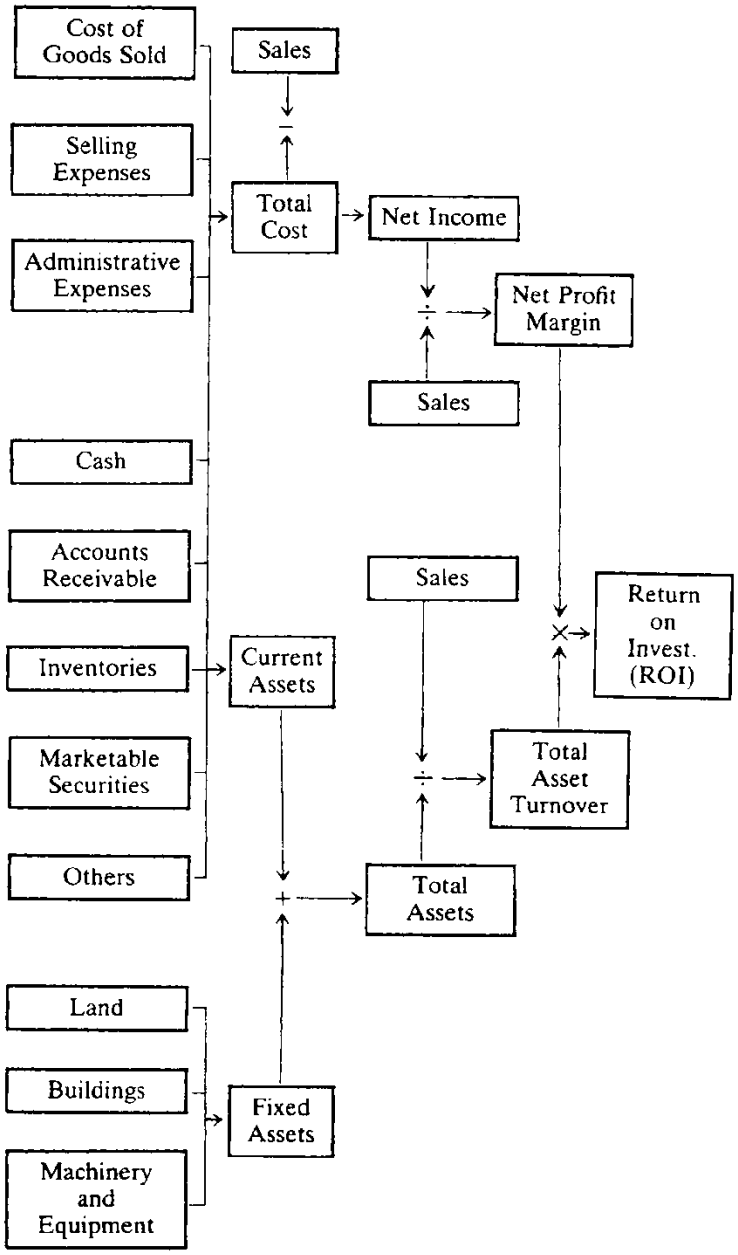
Alternative 2 may be achieved by increasing sales while holding the investment in assets relatively constant, or by reducing assets. Some of the strategies to reduce assets are:

(a) Dispose of obsolete and redundant inventory. The computer has been extremely helpful in this regard, making continuous monitoring of inventory more feasible for better 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 (primarily cash) obtained from the use of the previous methods to repay outstanding debts or repurchase outstanding issues of stock. You may use those funds 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 2.6 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.

FIGURE 2.6
RELATIONSHIPS OF FACTORS INFLUENCING ROI



EXAMPLE 2.4

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

ROI = (net profit after taxes)/(total assets) = (net profits after taxes)/(sales) x (sales)/(total assets)

Present situation:

18% = 18,000/200,000 x 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% = 20,000/200,000 x 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% =18,000/200,000 x 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% = 19,000/200,000 x 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.

2.2.2 Return on Equity (ROE) and the Modified Du Pont Formula

What is the relationship between ROI and return on equity (ROE)? Can you improve return to stockholders through financial leverage?

Generally, a better management performance (i.e., a high or above-average ROI) produces a higher return to equity holders. However, even a poorly managed company that suffers from a below-average performance can generate an above-average return on the stockholders' equity, simply called the return on equity (ROE). This is because borrowed funds can magnify the returns a company's profits represent to its stockholders.

Another version of the Du Pont formula, called the modified Du Pont formula reflects this effect. The formula ties together the ROI and the degree of financial leverage (use of borrowed funds). The financial leverage is measured by the equity multiplier, which is the ratio of a company's total asset base to its equity investment, or, stated another way, the ratio of how many dollars of assets held per dollar of stockholders' equity. It is calculated by dividing total assets by stockholders' equity. This measurement gives an indication of how much of a company's assets are financed by stockholders' equity and how much with borrowed funds.

The return on equity (ROE) is calculated as:

ROE = (net profit after taxes) / (stockholders' equity)

= (net profit after taxes) / (total assets) x (total assets) / (stockholders equity)

= ROI x Equity multiplier

ROE measures the returns earned on the owners' (both preferred and common stockholders') investment. The use of the equity multiplier to convert the ROI to the ROE reflects the impact of the leverage (use of debt) on the stockholders' return.

The equity multiplier = (total assets) / (stockholders equity)

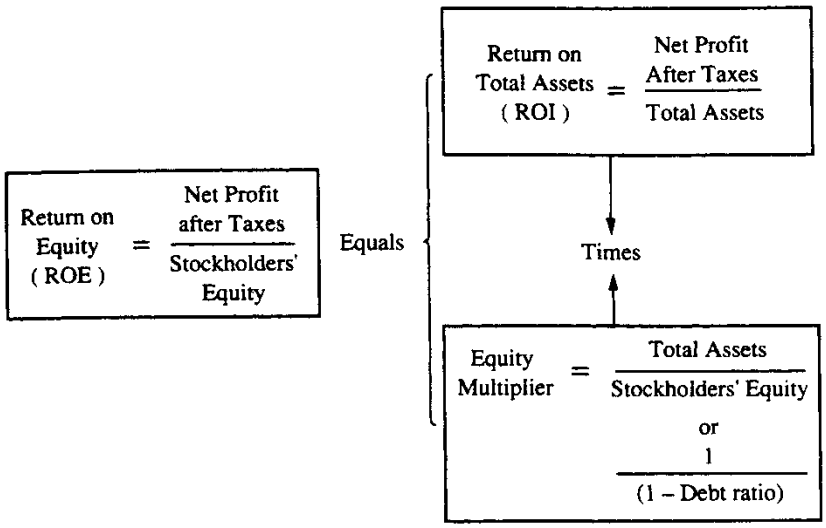
= (total assets) / (total assets – total liabilities)

=1 / [1- (total liabilities/total assets)]

= 1/ (1 –debt ratio)

Figure 2.7 shows the relationship among ROI, ROE, and financial leverage.

FIGURE 2.7
ROI, ROE, AND FINANCIAL LEVERAGE



EXAMPLE 2.5

In Example 2.1, assume stockholders' equity of $45,000.

Then, equity multiplier =(total assets) / (stockholders equity) = $100,000/$45,000 = 2.22

= 1 / (1 – debt ratio) = 1 / (1-0.55) = 1/0.45 = 2.22.

ROE = (net profit after taxes) / (stockholders equity) = $18,000/$5,000 = 40%

ROE = ROI x equity multiplier = 18% x 2.22 = 40%

If the company used only equity, the 18% ROI would equal ROE. However, 55% of the firm's capital is supplied by creditors ($45,000/$100,000 =45% is the equity-to-asset ratio; $55,000/$100,000 = 55% is the debt ratio). Since the 18% ROI all goes to stockholders, who put up only 45% of the capital, the ROE is higher than 18%. This example indicates the company was using leverage (debt) favorably.

EXAMPLE 2.6

To further demonstrate the interrelationship between a firm's financial structure and the return it generates on the stockholders' investments, let us compare two firms that generate $300,000 in operating income. Both firms employ $800,000 in total assets, but they have different capital structures. One firm employs no debt, whereas the other uses $400,000 in borrowed funds. The comparative capital structures are shown as:

	A	B
Total assets	$800,000	$800,000
Total liabilities	--	$400,000
Stockholders' equity(a)	$800,000	$400,000
Total liabilities and stockholders' equity	$800,000	$800,000

Firm B pays 10% interest for borrowed funds. The comparative income statements and ROEs for firms A and B would look as follows:

Operating income	$300,000	$300,000
Interest expense	-	(40,000)
Profit before taxes	$300,000	$260,000
Taxes (30% assumed)	(90,000)	(78,000)
Net Profit after taxes (b)	$210,000	$182,000
ROE [(b)/(a)]	26.25%	45.5%

The absence of debt allows firm A to register higher profits after taxes. Yet the owners in firm B enjoy a significantly higher return on their investments. This provides an important view of the positive contribution debt can make to a business, but within a certain limit. Too much debt can increase the firm's financial risk and thus the cost of financing.

What is the role of financial leverage in enhancing shareholder value?

If the assets in which the funds are invested are able to earn a return greater than the fixed rate of return required by the creditors, the leverage is positive and the common stockholders benefit. The advantage of this formula is that it enables the company to break its ROE into a profit margin portion (net profit margin), an efficiency-of-asset-utilization portion (total asset turnover), and a use-of-leverage portion (equity multiplier). It shows that the company can raise shareholder return by employing leverage - taking on larger amounts of debt to help finance growth.

Since financial leverage affects net profit margin through the added interest costs, management must look at the various pieces of this ROE equation, within the context of the whole, to earn the highest return for stockholders. Financial managers have the task of determining just what combination of asset return and leverage will work best in its competitive environment. Most companies try to keep at least a level equal to what is considered to be "normal" within the industry.

A WORD OF CAUTION: Unfortunately, leverage is a two-edged sword. If assets are unable to earn a high enough rate to cover fixed finance charges, then the stockholder suffers. The reason is that part of the profits from the assets which the stockholder has provided to the firm will have to go to make up the shortfall to the long-term creditors, and he/she will be left with a smaller return than otherwise have been earned.

Chapter 2 Review Questions – Section 2

11. An investor has been given several financial ratios for a firm but none of the financial reports. Which combination of ratios can be used to derive return on equity?

A. Market-to-book-value ratio and total-debt-to-total-assets ratio.
B. Net profit margin, total assets turnover, and equity multiplier.
C. Price-to-earnings ratio, earnings per share, and net profit margin.
D. Price-to-earnings ratio and return-on-assets ratio.

12. The following ratios relate to a company's financial situation compared with that of its industry: The company has an ROI of 7.9% and an ROE of 15.2%. The industry has an ROI of 9.2% and an ROE of 12.9%. What conclusion could a financial analyst validly draw from these ratios?

A. The company's product has a high market share leading to higher profitability.
B. The company uses more debt than does the average company in the industry.
C. The company's profits are increasing over time.
D. The company's shares have a higher market value to carrying amount than does the rest of the industry.

13. If a company is profitable and is effectively using leverage, return on total assets is likely to be the largest. True or False?

14. When you establish a price, you should also consider the customer's perception of prestige—higher may suggest a "quality" image to the consumer. True or False?

15. Marketing effectiveness can be measured by examining the number of product warranty complaints and their disposition. True or False?

16. Life-cycle costing tracks and accumulates all production costs in the value chain from research and development and design of products and processing through production, marketing, distribution, and customer service. True or False?

Chapter 3:

Internal Accounting Applications for Your Company

Learning Objectives:

After completing this section, you should be able to:

- Understand the concept of Economic Value Added (EVA) and how it can be improved.
- Recognize major elements of budgeting process.
- Identify different attributes and uses of variance analysis as a control device.
- Recognize how accounting systems work, including activity-based costing, life-cycle costing and target costing.
- Recognize the value of a balanced scorecard approach.

In this chapter you will find measures and guidelines for internally evaluating your company's performance. There are discussions of

- Divisional and departmental performance analysis
- Selling price formulation and strategy
- Product-line evaluation techniques
- Budgeting process and budget types
- Variance analysis for highlighting and correcting problem areas
- Cost management and Activity-based Costing (ABC)
- Life-cycle costs and target costing
- Balanced scorecards

As a management executive, your goals should be many. Among them include profitability, high market share, product leadership, personnel development, productivity, and employee satisfaction. The guidelines set forth in this chapter will help you to realize your company's potential in all these areas.

3.1 How to Analyze Divisional and Departmental Performance

Responsibility Accounting and Responsibility Center

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, an 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.

Contribution center. It is responsible for revenues and variable costs, but not invested capital.

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.

What criteria are used for measuring performance?

In evaluating how well a business segment is doing, use the following criteria:

- Budgeted versus actual cost
- Profitability-in order to arrive at the profit of a division, prices for internal transfers may have to be established
- Return of investment
- Residual income

FOR MANAGERIAL ACCOUNTANTS: You can evaluate administrative functions by preparing performance reports. Look at such dollar indicators as executive salaries and service department costs as well as nondollar measures like number of files handled, phone calls taken, and invoices processed. NOTE: It's more difficult for you to evaluate the performance of a marketing department than a manufacturing department. Why? The former depends more on external factors, which are more difficult to control than internal ones.

When evaluating a division manager, you should look at controllable profit; that is, controllable revenue less controllable costs. REMEMBER: The manager should not be held accountable for factors (costs, for example) beyond his or her control.

What is the cost center approach?

The cost center approach is an efficiency evaluation in which budgeted cost is compared to actual cost. A cost center is most often the smallest segment of activity or area of responsibility for which costs are accumulated. This approach is typically used by departments rather than divisions. Departmental profit is difficult to derive because of problems with revenue and cost allocations.

What is divisional profit?

Divisional profit equals a division's revenue less direct and indirect costs. Since it is possible to determine divisional earnings, profit is the most often used method of evaluation. The divisional profit concept allows for decentralization, as each division is treated as a separate business entity with responsibility for making its own profit

How do I use transfer pricing?

In determining divisional profit, a transfer price may be necessary. This is the price charged among divisions for the transfer of an assembled product or service. MANAGERIAL ACCOUNTANTS: Possible transfer prices include:

- *Actual cost plus profit markup.* This allows cost inefficiencies to be passed on from the selling division to the buying division.
- *Negotiated market price.* This equals the outside market price less the amount saved (e.g. for transportation. salesperson salaries, and commissions) by working from within the organization. The negotiated market value for services may be based on a per-hour rate or a flat rate. If a negotiated price cannot be agreed upon, the transfer price would be established arbitrarily by a higher authority. This is the best price to use, because it reflects the true value of the item.
- *Budgeted cost plus profit markup.* This should be used when a negotiated market price is not available, say for a new product. Here, the selling division has an incentive to control its cost since credit will be applied on the basis of budgeted cost only.

EXAMPLE 3.1

Division A wants to transfer an assembled item to Division B. Division A can sell the item to an outside company for $100. Cost savings of transferring the item internally are $20 (i.e. shipping costs, insurance on delivery, sales commission). Thus, the transfer price should be $80.

SUGGESTION: Do not use a temporarily high or low market price. Rather, use the average market price for the given period.

RULE OF THUMB: The maximum transfer price is the price that the buying division can purchase the item for outside. Do not allow the selling division to charge a higher price. In fact, if the buying division can get the item from the outside for less than inside, you probably should consider the selling division quite inefficient.

EXAMPLE 3.2

The selling division wants to charge $50 for an internal transfer. The buying division can acquire the same item from outside for $45. The transfer price should be $45.

SOMETHING TO THINK ABOUT If the buying division can get the item at less than the selling division price, should the buying division be forced to buy inside (at the outside price, of course), or should it be permitted to buy outside? The answer depends on what would be best for overall corporate profitability.

EXAMPLE 3.3

The selling division wants to charge $70 for 100 assembled units. Current statistics for the selling division follow:

Units sold	10,000
Variable cost per unit	$50
Fixed cost	$100,000

Therefore, the selling division's fixed cost per unit is currently

$10 ($100,000/10,000)

Idle capacity (underutilization of facilities) exists. The buying division can buy the item outside for $55, so this should be the maximum transfer price. The buying division should buy from inside because it would be best for overall corporate profitability. Here's evidence:

Savings to selling division (variable cost x units): $50 x 100	$5,000
Cost to buying division (outside price x units): $55 x 100	$5,500
Disadvantage to company for buying division to go outside:	$500

CONCLUSION: There is no saving in fixed cost to the selling division if the buying division goes outside. Why? When idle capacity exists, fixed cost remains constant regardless of units produced.

How is divisional profit determined?

Now that you understand transfer pricing, you can determine the divisional profit.

EXAMPLE 3.4

XYZ Corporation has two production divisions (assembling and finishing) and one service division (maintenance). The assembling division assembles 800 units, 200 of which are sold to an outside concern for $40 each. The other 600 units are transferred to the finishing division, which in turn sells the units at $80 each. The negotiated market value is $35 each. The maintenance division earns revenue of $3,000 rendering services to the public. This division also renders repair services to the assembling division at a fair market value of $6,000 and to the finishing division at a fair market value of $8,000. The costs applicable to the divisions are

	Assembling	*Finishing*	*Maintenance*
Direct	$4,000	$5,000	$4,300
Indirect (allocated)	6,000	7,000	5,000

MANAGERIAL ACCOUNTANTS: You can now determine the profit of each division as shown in Figure 3.1. The total profit of XYZ Corporation equals the aggregate of its divisions, or $27,700 ($13,000 **+** $7,000 **+** $7,700), excluding nonallocated central costs. This is verified as follows:

Revenue to outside ($8,000 +$48,000 **+** $3,000)	$59,000
Less cost	
Direct ($4,000 **+** $5,000 **+**$4,300)	$13,300
Indirect ($6,000 + $7,000 +$5,000)	18,000
Total costs	(31,300)
Profit (before nonallocated costs)	$27,700

NOTE: Certain corporate costs are not allocated to any division. Examples of these include interest expense on corporate debt and the president's salary.

How to measure return on investment (ROI)?

Return on investment equals net income divided by total assets.

This performance measure is superior to profit because it accounts not only for earnings, but also the assets to get those earnings.

EXAMPLE 3.5

Compare the following data for Divisions X and Y:

	Division X	*Division Y*
Net income	$ 100	$ 1,000
Assets	$1,000	$100,000
Return on investment	10%	1%

Division X is clearly the better division. Why? It earns a higher rate on assets employed.

MANAGERIAL ACCOUNTANTS: In deriving ROI for a division, you would assign revenue, expenses, and assets, including direct and indirect, for each division. Those belonging to the corporation are allocated to each division by some predetermined basis.

In using ROI you should value total assets at replacement cost or CPI-adjusted value. If you use book value or gross cost, ROI goes up artificially over time because total assets (the denominator) decrease.

When is residual income used to evaluate divisional performance?

Another approach to measuring divisional performance is residual income (RI). RI is the operating income, which a division 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 is regarded as a better measure of performance than ROI because it encourages investment in projects that would be rejected under ROI. If performance is evaluated using ROI, a manager may reject a project that exceeds the minimum return if the project will decrease overall ROI. For example, given a target rate of 20%, a project with an ROI of 22% might be rejected if the current ROI is 25%.

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.

Why is Economic Value Added (EVA) gaining popularity as a financial metric?

Residual income is more widely 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.

COMPANIES THAT USE EVA

Here are a number of well-known companies that use EVA:

Bausch & Lomb	Georgia-Pacific	Toys "R" Us
Briggs & Stratton	HermanMiller	Tupperware
Coca-Cola	JC Penney	Whirlpool
Eli Lilly	Sprint	

FIGURE 3.1

Assembling A		*Finishing (F)*		*Maintenance (M)*	
Revenue 200 x $40	$8,000	Revenue: 600 x $80	$48,000	Revenue	$3,000
Transfer price (F):	21,000			Transfer price A	6,000
Total revenue	$29,000			Transfer price (F)	8,000
Costs		**Costs**		**Total revenue**	**$17,000**
Direct	$4,000	Direct	$ 5000	Costs	
Indirect	6,000	Indirect	7,000	Direct	$ 4,300
Transfer price (M)	6,000	Transfer price A	21,000	Indirect	5,000
Total costs	$16,000	Transfer price (M)	8,000	Total costs	$ 9,300
Profit	$13,000	Total costs Profit	$41,000	Profit	$ 7,700

INTERNAL AUDITORS: Consider the following advantages of residual income as a measure of divisional performance:

- It incorporates risk. The riskier the division, the higher the minimum required rate of return assigned to it.
- It uses different rates of return for different types of assets.
- It assigns different rates of return to different divisions depending on risk.
- It is expressed in dollars rather than as a percent. This leads to goal consistency between the corporation and the division.

WARNING: Since the assignment of risk is subjective, residual income will always have this basic limitation.

How should I weigh controllability?

When evaluating a divisional manager, you should look at the controllable profit for which he or she is responsible. WARNING: If you allocate uncontrollable costs to the manager. you'll breed resentment.

3.2 Contribution Margin Analyses

What is the contribution margin?

The contribution margin equals sales less variable costs. A detailed contribution margin income statement has the following components:

Sales
- Less: Variable cost of sales
- Manufacturing contribution margin
- Less: Variable selling and administrative expenses
- Contribution margin
- Less: Fixed costs
- Net income

EXAMPLE 3.6

The selling price of an item is $6; unit sales total 520,000; beginning inventory is 40,000; ending inventory is 60,000; unit variable manufacturing cost is $4; variable selling cost per unit is $1.20; fixed manufacturing overhead totals $200,000, and selling and administrative expenses come to $80,000.

With this information, the units produced for the period can be calculated as follows:

Sales	520,000
Ending inventory	60,000
Merchandise needed	580,000
Less beginning inventory	(40,000)
Production	540,000

The contribution margin income statement would be as follows:

Sales (520,000 x $6)		$3,120,000
Less variable cost of sales		
Beginning inventory (40,000 x $4)	$ 160,000	
Variable cost of goods manufactured (540,000 x $4)	2,160,000	
Variable cost of goods available	2,320,000	
Less ending Inventory (60,000 x $4)	(240.000)	
Total		(2,080,000)
Manufacturing contribution margin		$1,040,000
Less variable selling and administrative expenses (520,000 x $1.20)		(624,000)
Contribution margin		$416,000
Less fixed costs		

Overhead	200,000	
Selling and administrative	80,000	
Total		(280,000)
Net income		$ 136,000

MANAGEMENT EXECUTIVES: Use contribution margin analysis to appraise the performance of your manager and program. CAUTION: This approach is acceptable only for internal reporting.

When should I sell a product below normal selling price?

A company should accept an order at below-normal selling price when idle capacity exists (since fixed cost remains constant), as long as there is a contribution margin on that order.

EXAMPLE 3.7

Ten thousand units are currently sold at $30 per unit. Variable cost per unit is $18, and fixed costs total $100,000. Therefore, the fixed cost per unit equals $10 ($l00,000/l0,000). Idle capacity exists. A prospective customer is willing to buy 100 units at a selling price of only $20 per unit.

Ignoring market considerations (for example, unfavorable reaction by customers paying $30 per unit), you should recommend the sale of the additional 100 units. Why? Because it results in a positive additional (marginal) profitability of $200, as indicated in the following example:

Sales (100 x $20)	$2,000
Less variable cost (100 x $18)	(1.800)
Contribution margin	200
Less fixed cost	0[a]
Net income	$ 200

[a]Because of idle capacity, there is no additional fixed cost. If the order were to increase fixed cost by $50, say, because it required a special tool, it is still financially advantageous to sell the item at $20. The additional profit is now $150, as illustrated in this example:

Sales (100 x $20)	$2,000
Less variable cost (100 x $18)	(l,800)
Contribution margin	200
Less fixed cost	(50)
Net income	$ 150

EXAMPLE 3.8

Financial data for T Corporation are given as follows:

	Per Unit
Selling price	$5.40
Direct material	1.50
Direct labor	1.70
Variable overhead	0.40
Fixed overhead ($100,000/40,000 units)	2.50

Selling and administrative expenses are fixed except for sales commissions, which are 12% of the selling price. Idle capacity exists.

An additional order has been received for 600 units from a prospective customer at a selling price of $4.50. You should accept the order because, since fixed costs stay the same at idle capacity, a net profit results, as illustrated in this example:

Sales (600 x $4.50)	$ 2,700
Less variable manufacturing costs (600 x $3.60')	(2,160)
Manufacturing contribution margin	$ 540
Less variable selling and administrative expenses (12% x $2,700)	(324)
Contribution margin	$ 216
Less fixed cost	(0)
Net income	$ 216

[a]Variable manufacturing cost equals variable manufacturing cost per unit times number of units produced.

EXAMPLE 3.9

The marketing manager had decided that for Product A he wants a markup of 30% over cost. Particulars concerning a unit of Product A are given as follows:

Direct material	$ 4,000
Direct labor	10,000
Overhead	2,500
Total cost	$16,500
Markup on cost (30%)	4,950
Selling price	$21,450

Total direct labor for the year equals $1,200,000. Total overhead for the year equals 25% of direct labor ($300,000), of which 40% is fixed and 60% is variable. The customer offers to buy a unit of Product A for $18,000. Idle capacity exists. You should accept the extra order because it provides a marginal profit, as indicated in this example:

Selling price		$18,000
Less variable cost		
Direct material	$4,000	
Direct Labor	10,000	
Variable overhead ($10,000 x 15%)[a]	1,500	(15,500)
Contribution margin		$2,500
Less fixed overhead		(0)
Net income		$ 2,500

[a]Variable overhead equals 15% of direct labor, calculated as follows:

$$\frac{\text{Variable overhead}}{\text{Direct labor}} = \frac{60\% \times \$300{,}000}{\$1{,}200{,}000}$$

$$= \frac{\$180{,}000}{\$1{,}200{,}000} = 15\% \text{ of direct labor}$$

MANAGEMENT EXECUTIVES: You can employ contribution analysis to see the optimum way of utilizing capacity.

EXAMPLE 3.10

A company produces a raw metal that can either be sold at this stage or can be processed further and sold as an alloy. Information on the raw metal and alloy are given as follows:

	Raw Metal	*Alloy*
Selling price	$150	$230
Variable cost	80	110

Total fixed cost is $300,000; the raw metal, the alloy, or both can be manufactured; 800,000 hours of capacity are available; unlimited demand exists for both the raw metal and the alloy; two hours are required to make one ton of raw metal; and three hours are needed to produce one ton of alloy.

The contribution margin per hour is computed as follows:

	Raw Metal	*Alloy*
Selling price	$150	$230
Less variable cost	(80)	(110)
Contribution margin	70	120
Hours per ton	2	3
Contribution margin per hour	$ 35	$ 40

You should produce only the alloy, because it results in a higher contribution margin per hour. Fixed costs do not enter into the calculation because they are constant regardless of whether the raw metal or

the alloy is manufactured.

FOR MANAGERIAL ACCOUNTANTS: Use contribution margin analysis to determine the bid price on a contract.

EXAMPLE 3.11

Travis Company has received an order for 6,000 units. The management executive wants to know the minimum bid price that would produce a $14,000 increase in profit. The current income statement follows:

	Income Statement	
Sales (30,000 units x $20)		$600,000
Less cost of sales		
Direct material	$60,000	
Direct labor	150,000	
Variable overhead (150,000 x 40%)	60,000	
Fixed overhead	80,000	(350,000)
Gross margin		$250,000
Less selling and administrative expenses		
Variable (includes transportation costs of $0.20 per unit)	15,000	
Fixed	85,000	(100,000)
Net income		$150,000

If the contract is taken, the cost patterns for the extra order will remain the same, with these exceptions:

- Transportation costs will be paid by the customer
- Special tools costing $6,000 will be required for just this order and will not be reusable
- Direct labor time for each unit under the order will be 10% longer

WHAT TO DO: Derive the bid price in this manner

	Current Cost Per Unit	*Computation*
Selling price	$20	($600,000/30,000)
Direct material	$2	($60,000/30,000)
Direct labor	$5	($150,000/30,000)
Variable overhead =	40% of direct labor cost	($60,000/$150,000)
Var selling and Admin expense	$0.50	($15,000/30,000)

See Figure 3.2. First compute the total cost for the company including the new orders, and then add the required profit to derive the selling price.

Figure 3.2

INCOME STATEMENT			
Units	30,000	36,000	
	Current	Projected	
Sales	$600,000	$680,000[d]	(last computation)
Cost of sales			
Direct material ($2 x 36,000)	$ 60,000	$ 72,000	
Direct labor ($150,000 + [6,000 x $5.50[a]]	150,000	183,000	
Variable overhead ($183,000 x 40%)	60,000	73,200	
Fixed overhead ($80,000 + $6,000)	80,000	86,000	
Total	$350,000	$414,200	
Variable selling and administrative costs ($15,000 + [6,000 x $.30])[b]	$15,000	$16,800	
Fixed selling and administrative costs	$85,000	$85,000	
Total	$150,000	$101,800	
Net income	$150,000	$164,000[c]	

[a] $5 x 1.10 = $5.50

[b] $0.50 - $0.20 = $0.30

[c] $150,000 + $14,000 = $164,000

[d] Net income + selling and administrative expenses + cost of sales = sales

$164,000 + $101,800 + $414,200 = $680,000

The contract price for the 6,000 units should be $80,000 ($680,000- $600,000), or $13.33 per unit ($80,000/6,000).

The contract price per unit of $13.33 is less than the $20 current selling price per unit. Remember, by accepting the order, total fixed cost will remain the same except for the $6,000 cost of special tools.

EXAMPLE 3.12

MANAGEMENT EXECUTIVES: The contribution margin income statement approach can be used to evaluate the performance of department managers as well as their divisions.

Let's assume a three-division company. Relevant data are displayed in Figure 3.3.

You can conclude from Figure 3.3 that Division X shows highest profit.

FIGURE 3.3

			DIVISIONS	
	Total	*X*	*Y*	Z
Sales	$500,000	$300,000	$150,000	$ 50,000
Less variable manufacturing costs[a]	(200,000)	(100,000)	(70,000)	(30,000)
Manufacturing contribution margin	$300,000	$200,000	$ 80,000	$ 20,000
Less variable selling and administrative expenses[b]	60,000	(25,000)	(30,000)	(5,000)
Contribution margin	$240,000	$175,000	$ 50,000	$ 15,000
Less controllable fixed costsc	(40,000)	(20,000)	(18,000)	(2,000)
Short-run performance margin[d]	$200,000	$155,000	$ 32,000	$ 13,000
Less uncontrollable fixed costs[e]	(60,000)	(50,000)	(9,000)	(1,000)
Segment margin[f]	$140,000	$105,000	$ 23,000	$ 12,000
Joint fixed costs[g]	30,000			
Net income	$110,000			

[a]Variable manufacturing costs equal direct material, direct labor, and variable overhead. The variable manufacturing costs are derived by multiplying the variable manufacturing cost per unit by the number of units produced.

[b]Variable selling and administrative costs equal variable selling and administrative cost per unit times number of units sold.

[c]Controllable fixed costs are controllable by the division manager, if, for instance, he or she is responsible for advertising.

[d]Short-run performance margin equals the profitability figure used to evaluate the division manager's performance.

[e]Uncontrollable fixed costs equal costs for which the division manager has no responsibility, such as property taxes and insurance.

[f]Segment margin is the profitability figure used to evaluate divisional performance. This is the last earnings figure shown for each division. The segment margin of all divisions is equal to the total segment margin of the company.

[g]Joint fixed costs are not allocated to divisions because it is not rational to do so since they do not apply to them. These might include professional fees, president's salary, and interest expense on corporate debt.

3.3 Pricing Tools

What pricing method should I use?

Product pricing is a matter of concern to management executives, accountants, and marketing managers. Use either of the following two methodologies:

- ***Absorption costing approach.*** Here, pricing equals total cost plus profit markup. This approach covers all costs and should be employed when pricing new products and current business.
- ***Contribution margin approach.*** When a new order comes in and the prospective customer will buy only at a lower price, you should use the contribution margin approach, particularly when idle capacity exists. Here, the price is set at the variable cost plus profit markup. Remember, at idle capacity, fixed cost is constant. The order should only be accepted when selling price is greater than variable cost.

How do I analyze pricing policies if I am a managerial accountant?

Analyze the impact that economies of scale have on the costs and required production time. Evaluate the degree to which increased worker experience (i.e., the learning curve) will lower the per-unit cost with increased production.

You should determine different prices based on the segment involved, whether manufacturer, wholesaler, retailer, or consumer. The price to each segment will differ depending on the applicable marketing costs, such as advertising and distribution.

What price methods should I use if I am a marketing manager?

When you establish a price, take the following factors into account:

- Return on sales
- Share of market
- Age categorization
- Economic breakdown
- Regional location
- Social aspects
- Ethnic wants

Also, consider the customer's perception of prestige— higher may suggest a "quality" image to the consumer.

When you want to attract further business for other products or service contracts, you should prefer contribution margin pricing over full costing. However, do not use this approach if you think selling at a lower price will bring a negative reaction from existing customers.

CAUTION: When you decide to increase the price, do so only to the point that it does not cause a

disproportionate decrease in volume. For instance, a 14-percent price increase may result in a 20-percent reduction in volume, thereby effecting overall lower earnings.

Set target rates of return for products that depend on risk, stage in the life cycle, and whether the initial sale generates subsequent business for other products or services. Ask to what extent the product line is affected by the learning curve (see Section 8.4).

3.4 Evaluating the Product Line

What factors do I consider when evaluating a product line?

IF YOU'RE A MANAGEMENT EXECUTIVE:

Appraise introduction of a new product according to its synergistic effects, that is, how the new product fits into the whole product line.

IF YOU'RE A FINANCIAL MANAGER: Decide whether to discontinue products that shows losses. In making your decision, consider the following factors:

- Eliminating a product would reduce volume and sales commissions but would necessitate higher base salaries for salespeople
- Fixed costs must still be recovered

You may still keep products that show a net loss based on full costing but that show a contribution margin.

Inventory stockouts should be recorded along with lost sales. Back-order costs should likewise be determined.

SUGGESTION: Finance risky product lines with less risky funding, thereby reducing overall business risk. For example, a fad item should be financed with equity.

IF YOU'RE A MARKETING MANAGER: You can appraise the riskiness of product lines by computing the probability distribution in price, volume, and cost for products.

How should I prepare marketing analysis reports?

To make your reports clear, you should express them not only in dollars but in percentages, ratios, and graphs. You should also provide reasons for any problems along with appropriate recommendations.

3.5 How to Measure Marketing Effectiveness

How do I measure marketing effectiveness?

Here's what you can do within your job function:

- *Management executives*: Examine product warranty complaints and their disposition.
- *Managerial accountants*: Determine revenue, cost, and earnings by product line, customer, industry segment, geographic area, distribution channel, type of marketing effort, and average order size.
- *Financial managers*: Prepare new product evaluations in terms of risk and profitability.
- *Marketing managers*: Appraise strengths and weaknesses of the competition as well as promotional effectiveness. Evaluate revenue, marketing costs, and profits before, during, and after promotion efforts. Also, know your competitor's reaction. Identify advertising costs by media, including newspaper, journal, direct mail, television, and radio.

How do I measure the effectiveness of the sales force?

GUIDE FOR MANAGERIAL ACCOUNTANTS:

Gauge sales force effectiveness by looking at income generated by salespeople, call frequency, sales incentives, sales personnel costs (e.g., salary, auto, hotel), and dollar value of orders obtained per hour spent.

FINANCIAL MANAGERS: To gauge performance of your marketing employees, compute the following ratios:

- Revenue and/or net income per employee
- Marketing costs to sales

By doing so, you derive a proper selling price, identify poor marketing activities, and establish a proper discount.

FOR MARKETING MANAGERS: In determining salesperson profitability, subtract variable product costs and selling expenses from sales. Also, determine the profitability by type of sales solicitation (phone, mail, or personal visit). Find out the break-even point for each salesperson.

Establish an optimal commission plan for salespeople by incorporating the following strategies:

- Give a higher commission for original business than for repeat business.

- Vary commission rates depending on the territory and type of product being sold (e.g., a slow-moving item could have a higher commission).
- Base the commission on the product's profitability rather than on the selling price.
- Use a graduated commission rate on product sales that exceed the established quota.

SUGGESTION: Do not evaluate sales performance on actual sales generated but rather on profitability.

What financial measures should I use to evaluate success?

Financial measures of marketing success include

- Market share
- Sales
- Trend in inventory at wholesalers and retailers
- Profit margin

IF YOU'RE A MANAGEMENT EXECUTIVE: Look at marketing costs in terms of physical distribution, including inventory management, order processing, packaging, warehousing, shipping vehicle, and customer services.

IF YOU'RE A FINANCIAL MANAGER: Evaluate marketing costs according to the means of distribution, whether retailer, direct mail, or wholesaler. Examine the trend in the percentage of marketing cost to revenue as a basis for ascertaining the selling price.

Chapter 3 Review Questions – Section 1

1. Decentralized firms can delegate authority and yet retain control and monitor managers' performance by structuring the organization into responsibility centers. Which one of the following organizational segments is most like an independent business?

A. Revenue center.
B. Profit center.
C. Cost center.
D. Investment center.

2. Responsibility accounting defines an operating center that is responsible for revenue and costs as a(n)

A. Profit center.
B. Revenue center.
C. Division.
D. Operating unit.

3. The least complex segment or area of responsibility for which costs are allocated is a(n)

A. Profit center.
B. Cost center.
C. Investment center.
D. Contribution center.

4. Which of the following techniques would be best for evaluating the management performance of a department that is operated as a cost center?

A. Variance analysis.
B. Return on assets.
C. Return on investment (ROI).
D. Payback method.

5. Division A of a company is currently operating at 50% capacity. It produces a single product and sells all its production to outside customers for $13 per unit. Variable costs are $7 per unit, and fixed costs are $6 per unit at the current production level. Division B, which currently purchases this product from an outside supplier for $12 per unit, would like to purchase the product from Division A. Division A will

operate at 80% capacity to meet outside customers' and Division B's demand. What is the minimum price that Division A should charge Division B for this product?

A. $7.00 per unit.
B. $6.00 per unit.
C. $12.00 per unit.
D. $13.00 per unit.

6. Residual income (RI) is a performance evaluation that is used in conjunction with, or instead of, return on investment (ROI). In many cases, RI is preferred to ROI because

A. Residual income is a measure over time, while ROI represents the results for one period.
B. Residual income concentrates on maximizing absolute dollars of income rather than a percentage return as with ROI.
C. The imputed interest rate used in calculating residual income is more easily derived than the target rate that is compared to the calculated ROI.
D. Average investment is employed with residual income while year-end investment is employed with ROI.

7. Economic value added (EVA) is a measure of managerial performance. EVA equals

A. Operating income after interest – (weighted-average cost of capital x operating assets).
B. Operating income - (minimum required rate of return x operating assets)
C. Earnings before interest and taxes – residual income.
D. Operating income divided by operating assets.

8. When only differential manufacturing costs are taken into account for special-order pricing, an essential assumption is that

A. Manufacturing fixed and variable costs are linear.
B. Selling and administrative fixed and variable costs are linear.
C. A seller has idle capacity.
D. Acceptance of the order will not cause unit selling and administrative variable costs to increase.

3.6 Budgeting Techniques

What is a budget?

A budget is a plan that quantifies the company's goals in terms of specific financial and operating objectives. It is a financial plan to control future operations and results. Budgeting facilitates control and communication and provides motivation to employees. The process of budgeting forces a company to establish goals, determine the resources necessary to achieve those goals, and anticipate future difficulties in their achievement. A budget is also a control tool because it establishes standards and facilitates comparison of actual and budgeted performance. Thus, it motivates good performance by highlighting the work of effective managers. Moreover, the nature of budgeting fosters communication of goals to company subunits and coordination of their efforts. Budgeting activities must be coordinated because they are interdependent.

Follow these steps in the budgeting process:

- Establish goals
- Develop strategies
- Formulate plans of action
- Evaluate the market
- Look at economic and political conditions
- Analyze competition
- Identify the life cycle of the product
- Appraise the company's financial strength
- Take corrective action

How do I formulate a budget?

Budgets may cover a long-or short-term period. The first step is to estimate future sales, and then production costs are based upon them.

A flexible budget employs budgeted figures at different capacity levels. Choose the best expected (normal) capacity level (100 percent) and assign pessimistic (80-percent), optimistic (110-percent), and full (150-percent) capacity levels. A flexible budget is a tool that is extremely useful in cost control. In contrast to a *static budget*, which is for only one level of activity, 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. A flexible budget is designed to allow

adjustment of the budget to the actual level of activity before comparing the budget activity with actual results.

MANAGEMENT EXECUTIVES: You can then see how the company's performance is at varying capacity levels. Fixed costs remain constant as long as the firm operates below full capacity.

What types of budgets must I prepare?

Many types of budgets should be prepared, including production, cash, sales, costs, profit**,** purchases, and forecasted financial statements.

Production Budgets. The production budget process usually begins with the sales budget. The number of units expected to be manufactured to meet budgeted sales and inventory requirements is set forth in the production budget. If you're a financial manager, this budget will help you to find out your cash needs. MANAGERIAL ACCOUNTANTS: You need this budget for proper planning.

EXAMPLE 3.13

A company has a sales budget of 30,000 finished units. Beginning inventory is 6,000 units, and the expected ending inventory is 18,000 units. The cost per unit is $8. Budgeted production cost is estimated as follows:

Budgeted sales	30,000
Desired ending inventory	18,000
Need	48,000
Beginning inventory	(6,000)
Budgeted production	42,000
Budget cost of production (42,000 x $8)	$336,000

Assume three pieces of raw material are needed to produce one unit. There are 65,000 pieces on hand at the beginning of the period. Desired ending inventory is 80,000 pieces. Budgeted purchases of needed pieces are as follows:

Needed for production (42,000 x 3)	126,000
Desired ending inventory	80,000
Need	206,000
Beginning inventory	(65,000)
Budgeted purchases	141,000

If each piece costs $1.50, the budgeted cost of purchases

is $211,500 (141,000 x $1.50).

Cash Budgets. In preparing a cash budget, start with beginning cash, add cash receipts, and subtract cash payments to arrive at ending cash, Cash receipts include anything that yields cash, like borrowing money or selling assets. CAUTION: Cash receipts are not necessarily the same as revenue (e.g., credit sales). Cash payments consist of cash disbursements, like buying assets or paying off debt. Not all expenses are cash payments (for example, depreciation).

OF SPECIAL NOTE: In many cases, cash collections will have to be predicted when a cash discount is given for early collection.

EXAMPLE 3.14

A company sells on terms of 3%/10 days, net/30 days. The following collection pattern has been observed:

- 60% of credit sales are collected within the discount period
- 30% are collected at the end of 30 days
- The balance is collected at the end of 60 days
- At the end of any month, 25% of sales on which cash discounts will be taken are still uncollected

Estimated sales are

	Oct.	*Nov.*	*Dec.*
Cash sales	$ 50,000	$ 40,000	$ 80,000
Credit sales	$100,000	$90,000	$120,000

September credit sales are $110,000 and August credit sales are $85,000.

Figure 3.4 is a table of collections on sales.

FIGURE 3.4

	Collections on Current Month's Sale		Collections from Previous Month's Sales		Collections from Credit Sales Made Two Months Ago	Total
Month	Cash	Credit	Discount	No Discount		
October	$50,000	$43,650	$16,005	$33,000	$8,500	$151,155
November	$40,000	$39,285	$14,550	$30,000	$11,000	$134,835
December	$80,000	$52,380	$13,095	$27,000	$10,000	$182,475

[a]0.6 x 0.97 x 0.75 x current sales

[b]0.6 x 0.97 x 0.25 x credit sales from previous month

[c]0.3 x credit sales from previous month

[d]0.1 x credit sales from two months ago

INTERNAL AUDITORS: To appraise performance of managers and programs, make a comparison between budgeted and actual revenue, cost, and time.

*Zero-Base Budgeting (ZBB)**.*** With ZBB, each year's expected expenditure must be justified. Existing and new programs must have value and contribute to overall objectives of the firm. Each project is reexamined at the beginning of the period. When a project does not meet established criteria, it is dropped.

STEPS FOR FINANCIAL MANAGERS IN USING ZBB

- Question the activity of a division, department, or operation
- Analyze each activity from a cost-benefit perspective
- Formulate a decision package that accomplishes the specified goal
- Rank the decision packages in order of priority
- Assign limited funds to competing activities on the basis of merit

What should the decision package include?

The decision package describes the activity to be performed and consists of various ways in time and money to meet the objective. The manager indicates a recommended path as well as alternative possibilities. Then upper management decides which path to fund, assuming it wishes to accept the activity.

A decision package may be rejected, accepted at a minimal funding level, accepted at the minimal funding level plus an increment, or approved at the requested funding level.

Top-down Budgeting. It entails imposition of a budget by top management on lower-level employees. It is the antithesis of participatory budgeting.

Life-cycle Budgeting. It estimates a product's revenues and costs for each link in the value chain from R&D and design to production, marketing, distribution, and customer service. The product life cycle ends when customer service is withdrawn.

3.7 Highlighting Problem Areas with Variance Analysis

What is a variance analysis?

Variance analysis is a comparison between standard and actual performance. If you are a managerial accountant, financial manager, production manager, or are in marketing, variance analysis will be useful to you. All significant variances should be investigated, whether favorable or unfavorable. Standard costing is used to isolate the variances between expected costs and actual costs. It allows management to measure performance and to correct inefficiencies, thereby helping to control costs. Use variance analysis to

- Control costs
- "Red flag" present and prospective problems (this way, you can follow the management by exception principle)
- Identify responsibility so you know whom to "call on the carpet"
- Formulate corporate objectives
- Aid in decision making
- Provide a vehicle for better communication within the organization

You should prepare performance reports that focus on the difference between budgeted and actual figures. Look at these items:

- Production (cost, quantity, and quality), to gauge the foremen's performance
- Sales and market share, to evaluate marketing managers
- Profit, to appraise overall operations
- Return on investment, to evaluate asset utilization

How do marketing managers compute sales variances?

EXAMPLE 3.15

Budgeted sales for 2X11

Product A: 8,000 units at $5.50 per unit	$ 44,000
Product B: 24,000 units at $7.50 per unit	180,000
Expected sales revenue	$224,000

Actual sales for the year

Product A: 6,000 units at $6.00 per unit	$36,000
Product B: 28,000 units at $7.00 per unit	196,000
Actual sales revenue	$232,000

A positive sales variance of $8,000 is composed of sales price and volume variances. The sales price variance equals actual selling price versus (minus) budgeted selling price times actual units sold.

Product A ($6.00 vs. $5.50 x 6,000)	$ 3,000 F[a]	
Product B ($7.00 vs. $7.50 x 28,000)	14,000 U[b]	
Sales price variance		$11,000 U

[a]Favorable.

[b]Unfavorable.

The sales volume variance equals actual quantity versus budgeted quantity times budgeted selling price.

Product A (6,000 vs. 8,000 x $5.50)	$11,000 U	
Product B (28,000 vs. 24,000 x $7.50)	30,000 F	
Sales volume variance		$19,000 F

Proof

Sales price variance	$11,000 U
Sales volume variance	19,000 F
Sales variance	$ 8,000 F

How do I apply standards and cost variances?

When actual cost exceeds standard cost, variance is unfavorable. Be sure to determine the reason behind the variance in order to facilitate appropriate corrective action.

Set standards according to their application as follows:

Job Function	*Situation*	*Standard*
Financial managers	Cost reduction	Stringent
Managerial accountants	Inventory valuation	Fair
Marketing managers	Pricing decision	Realistic
Buyers	Expensive purchases	Perfection

When should I do a variance analysis?

Standard prices (material price, wage rate) are determined at the beginning of the period.

Variance analysis can be performed by year, quarter, month, day, or hour depending on the importance of identifying a problem quickly.

MANAGERIAL ACCOUNTANTS: Because you do not know the number of units produced or services rendered until the end of the period, you cannot arrive at such variances until then.

How do I interpret a variance analysis?

Immaterial variance percentages (i.e. variance divided by standard cost) not exceeding 5 percent need not be investigated further unless they occur consistently and show a potential problem.

MANAGERIAL ACCOUNTANTS: When a product is made or a service is rendered, you need to compute these three measures:

- Actual cost equals actual price times actual quantity, where actual quantity equals actual quantity per unit of work times actual units of work produced.
- Standard cost equals standard price times standard quantity, where standard quantity equals standard quantity per unit of work times actual units of work produced.
- Control variance equals actual cost minus standard cost.

Control variance consists of the following components:

- Price (rate, cost) variance (standard price versus actual price times actual quantity)
- Quantity (usage, efficiency) variance (standard quantity versus actual quantity times standard price)

Compute these for both material and labor.

MANAGERIAL ACCOUNTANTS: The material price variance permits you to appraise the purchasing department function and examine the effect of raw material cost changes on overall corporate earnings. The material quantity variance is the responsibility of the production supervisor**.**

EXAMPLE 3.16

The standard cost of one unit of output (product or service) was $15: three pieces at $5 per piece. During the period, 8,000 units were produced. Actual cost was $14 per unit: two pieces at $7 per piece.

Material control variance

Standard quantity times standard price (24,000 x $5)	$120,000
Actual quantity times actual price (l6,000 x $7)	112,000
	$ 8,000 F

Material price variance

Standard price versus actual price times actual quantity ($5 vs. $7 x 16,000) $ 32,000 U

Material quantity variance

Standard quantity versus actual quantity times standard price
(24,000 vs. 16,000 x $5*)* $40,000 F

MANAGEMENT EXECUTIVES: You cannot control material price variances when higher prices arise from inflation or shortage situations or when rush orders are required by the customer who will bear the ultimate cost increase.

Look for possible causes of unfavorable material variances.

CHECKLIST OF UNFAVORABLE MATERIAL VARIANCE

Cause	*Responsible Entity*
Unnecessarily high prices paid	Purchasing
Purchased material differed from specifications	Purchasing
Inspection did not reveal defective goods	Receiving
Workers' incompetency	Foremen
Poor supervision	Foremen
Deficient mix in material	Production manager
Immediate delivery of materials by plane	Traffic
Unfavorable quantity variance	Foremen
Forced acquisitions	Purchasing
Unanticipated change in production volume	Sales manager

SOLUTIONS FOR MANAGEMENT EXECUTIVES:

By examining the nature and degree of the material price variance, you may decide to

- Increase prices
- Substitute cheaper materials
- Change a production method or specification
- Implement a cost-reduction plan

Labor Variances. The standard labor rate should be based on the contracted hourly wage rate. Where wage rates are set by union contract, the labor rate variance will typically be minimal. Labor efficiency standards are normally established by engineers on the basis of an analysis of the manufacturing operation. Determine labor variance exactly as you would material variance.

EXAMPLE 3.17

The standard cost for labor is four hours times $9 per hour, or $36 per unit.
During the period, 7,000 units were manufactured.
The actual cost is six hours times $8 per hour, or $48 per unit.

Labor control variance

Standard quantity times standard price (28,000 x $9)	$252,000
Actual quantity times actual price (42,000 x $8)	336,000
	$ 84,000 U

Labor price variance

Standard price versus actual price times actual quantity (hours) ($9 vs. $8 x 42,000)

$ 42,000 F

Labor quantity variance

Standard quantity versus actual	
quantity x standard price (28,000 vs.42,000 x 49)	$126,000 U

INTERNAL AUDITORS: Examine reasons for an unfavorable labor price variance. Some examples are

Cause	*Responsible entity*
Use of overqualified workers	Production manager or union contract
Use of excessive number of workers	Production manager or union contract
Improper work assignments from poor job descriptions	Personnel
Overtime	Production planning

NOTE: An unfavorable labor price variance may be unavoidable when experienced workers are in short supply.

Determine reasons for an unfavorable labor efficiency variance, including

Cause	*Responsible entity*
Improper supervision	Factory foremen
Deficient machinery	Maintenance
Poor quality material	Purchasing
Inadequate material supply	Purchasing

Overhead Variances. The overhead variance consists of the controllable and volume variances. The necessary computations are

- Overhead control variance equals actual overhead versus standard overhead (standard hours times standard overhead rate)
- Controllable variance equals actual overhead versus budget adjusted to standard hours. Note: Budget adjusted to standard hours equals fixed overhead plus variable overhead (standard hours times standard variable overhead rate)
- Volume variance equals standard overhead versus budget adjusted to standard hours

EXAMPLE 3.18

The following information is provided by Company M:

Budgeted overhead (includes fixed overhead of $7,500 and variable overhead of $10,000)		$17,500
Budgeted hours		10,000
Actual overhead		$ 8,000
Actual units produced		800
Standard hours per unit of production		5

Preliminary calculations

Budgeted fixed overhead ($7,500/10,000 hr)		$0.75
Budgeted variable overhead ($10,000/10,000 hr)		1.00
Total budgeted overhead ($17,500/10,000 hr)		$1.75
Standard hours (800 units x 5 hr per unit)		4,000 hr
Overhead control variance		
Actual overhead		$ 8,000
Standard overhead		
Std hours	4,000 hr	
Std overhead rate	$1.75	(7,000)
		$1,000 Unfavorable
Controllable variance		
Actual overhead		$ 8,000
Budget adjusted to standard hours		
Fixed overhead	$7,500	
Variable overhead (standard hours x standard variable over-head rate) (4,000 x $1)	4,000	11,500

	3,500 Favorable
Volume variance	
Standard overhead	$7,000
Budget adjusted to standard hours	11,500
	$4,500 Unfavorable

Factory foremen have responsibility for the controllable variance and thus influence actual overhead incurred. The volume variance looks at plant utilization and thus is controllable by management executives and production managers.

MANAGEMENT EXECUTIVES: Variable overhead variance data are useful in formulating output level and output mix decisions. They also help in appraising decisions regarding variable inputs. WARNING: Fixed overhead variance data do not generate useful information for operating decisions, but they do furnish information regarding decision-making astuteness when buying some combination of fixed plant size and variable production inputs.

A consistently unfavorable overhead volume variance may arise from purchasing the wrong size plant, deficient scheduling, insufficient orders, material shortages, equipment failure, long operating time, or poorly trained employees. Idle capacity may indicate long-run operating planning problems.

Raw Material Costs. Examine the variability in raw material costs. Managerial ACCOUNTANTS: Look at price instability as discussed in trade publications. HINT TO MANAGEMENT EXECUTIVES: Emphasize vertical integration to reduce the price and supply risk of raw materials.

Variances for Selling Expenses. Cost variances for the selling function may pertain to the territory, product, or personnel. MARKETING MANAGERS: Evaluate your sales force within a territory, including time spent and expenses incurred.

EXAMPLE 3.19

Company O provided the following sales data:

Standard cost	$240,000
Standard salesperson days	2,000
Standard rate per salesperson day	$ 120
Actual cost	$238,000
Actual salesperson days	1,700
Actual rate per salesperson day	$ 140
Total cost variance	
Actual cost	$238,000

Standard cost	240,000
	$ 2,000 F

Categorize the total favorable variance of $2,000 into salesperson days and salesperson costs.

Variance in salesperson days

Actual days versus standard days times

Standard rate per day (1,700 vs. 2,000 x $120)	$36,000 F

Since fewer days than expected were required to handle the sales territory, the variance is favorable.

Variance in salesperson costs

Actual rate versus standard rate times actual days ($140 vs. $120 x 1,700) $34,000 U

Because the actual rate per day exceeded the standard rate per day, the variance is unfavorable.

What is benchmarking and how is it useful?

Benchmarking is a process of comparing an organization's products or services against those considered to be the best in a particular industry or market segment. There are several types of benchmarking. Benchmarking typically involves the following steps:

- Identify those practices needing improvement.
- Identify a company that is the world leader in performing the process.
- Interview the managers of the company and analyze data obtained.

The benchmarking procedures that should be followed include the following:

- Identify a particular product, service, procedure, or function that could be improved
- Create a benchmarking team
- Target a particular organization or group of organizations having characteristics that would be most suitable for analysis
- Evaluate practices, procedures, and functions within a given market that are the most productive and then adapt and implement those that would be most useful to the target organization

NOTE: The benchmark may be financial or nonfinancial. For example, the labor rate of a competitor is a financial benchmark, the cost per pound of a product at the company's most efficient plant, or the cost of a training program is financial, while the percentage of orders delivered on time at the company's most efficient plant is an example of a nonfinancial benchmark. Examples of nonfinancial measures are defect rates, number of patents, and number of customer complaints.

3.8 Activity-Based Costing (ABC)

What is wrong with traditional cost systems?

Many companies use a traditional cost system such as job-order costing or process costing, or some hybrid of the two. This traditional system may provide distorted product cost information. In fact, companies selling multiple products are making critical decisions about product pricing, making bids, or product mix, based on inaccurate cost data. In all likelihood, the problem is not with assigning the costs of direct labor or direct materials. These prime costs are traceable to individual products, and most conventional cost systems are designed to ensure that this tracing takes place.

However, the assignment of overhead costs to individual products is another matter. Using the traditional methods of assigning overhead costs to products, using a single predetermined overhead rate based on any single activity measure, can produce distorted product costs. Activity-based costing (ABC) attempts to get around this problem. An ABC system assigns costs to products based on the product's use of activities, not product volume. It has proved to produce more accurate product costing results in an environment where there is diversity in product line and services coming out of the same shop.

OVERHEAD COSTING: A SINGLE-PRODUCT SITUATION

The accuracy of overhead cost assignment becomes an issue only when multiple products are manufactured in a single facility. If only a single product is produced, all overhead costs are caused by it and traceable to it. The overhead cost per unit is simply the total overhead for the year divided by the number of hours or units produced.

The cost calculation for a single-product setting is illustrated in Table 3.1. There is no question that the cost of manufacturing the product illustrated in Table 3.1 is $ 28.00 per unit. All manufacturing costs were incurred specifically to make this product. Thus, one way to ensure product-costing accuracy is to focus on producing one product. For this reason, some multiple product firms choose to dedicate entire plants to the manufacture of a single product.

By focusing on only one or two products, small manufacturers are able to calculate the cost of manufacturing the high-volume products more accurately and price them more effectively.

TABLE 3.1
UNIT COST COMPUTATION: SINGLE PRODUCT

	Manufacturing Costs	Produced Units	Unit Cost
Direct materials	$800,000	50,000	$16.00
Direct labor	200,000	50,000	4.00
Factory overhead	400,000	50,000	8.00
Total	$1,400,000	50,000	$28.00

OVERHEAD COSTING: A MULTIPLE-PRODUCT SITUATION

In a multiple-product or multi-job situation, manufacturing overhead costs are caused jointly by all products. The problem is one of trying to identify the amount of overhead caused or consumed by each. This is accomplished by searching for *cost drivers*, or activity measures that cause costs to be incurred. In a traditional setting, it is normally assumed that overhead consumption is highly correlated with the volume of production activity, measured in terms of direct labor hours, machine hours, or direct labor dollars. These volume-related cost drivers are used to assign overhead to products to develop *plant-wide* or *departmental* rates. Activity-based costing (ABC) is an accounting system that collects financial and operating data on the basis of the underlying nature and extent of the cost drivers. ABC differs from traditional product costing because it uses multiple allocation bases and therefore allocates overhead more accurately. The result is that ABC often changes low-volume products with more overhead than a traditional system. For example, the cost of machine setup may be the same for production runs of widely varying sizes. This relationship is reflected in an ABC system that allocates setup costs on the basis of the number of setups. However, a traditional system using an allocation base such as machine hours may underallocate setup costs to low-volume products. Many companies adopting ABC have found that they have been losing money on low-volume products because costs were actually higher than originally thought. *Note:* Multiple rates are appropriate when a process differs substantially among departments or when products do not go through all departments or all processes. The trend in cost accounting is toward activity-based costing, which divides production into numerous activities and identifies the cost driver(s) most relevant to each. The result is a more accurate tracing of costs.

EXAMPLE 3.20

To illustrate the limitation of this traditional approach and ABC, assume that Global Metals, Inc. has established the following overhead cost pools and cost drivers for their product:

Overhead Cost Pool	***Budgeted Overhead Cost***	***Cost Driver***	***Predicted Level for Cost Driver***	***Predetermined Overhead Rate***
Machine Set-ups	$100,000	Number of set-ups	100	$1,000 per set-up
Material Handling	100,000	Weight of raw material	50,000 pounds	$2.00 per pound
Waste Control	50,000	Weight of chemicals	10,000 pounds	$5.00 per pound
Inspection	75,000	Number of inspections	1,000	$75 inspection
Other O/H Costs	$200,000	Machine Hours	20,000	$10 per hour
	$525,000			

Job No. 107 consists of 2,000 special purpose machine tools with the following requirements:

Machine set-ups	2 set-ups
Raw material required	10,000 pounds
Waste material required	2,000 pounds
Inspections	10 inspections

Machine hours	500 machine hours	

The overhead assigned to Job No. 107 is computed below:

Overhead Cost Pool	*Predetermined Overhead Rate*	*Level of Cost Driver*	*Assigned Overhead Cost*
Machine set-ups	$1,000 per set-up	2 set-ups	$2,000
Material handling	$2.00 per pound	10,000 pounds	20,000
Waste control	$5.00 per pound	2,000 pounds	10,000
Inspection	$75 per inspection	10 inspections	750
Other overhead cost	$10 per machine hour	500 machine hour	5,000
Total			$37,750

The total overhead cost assigned to Job No. 107 is **$37,750,** or $18.88 per tool ($37,750/2,000).

Compare this with the overhead cost that is assigned to the job if the firm uses a single predetermined overhead rate based on machine hours:

Total budgeted overhead cost / Total predicted machine hours
= $525,000 / 20,000
= $26.25 per machine hour

Under this approach, the total overhead cost assigned to Job No. 107 is $13,125 ($26.25 per machine hour x 500 machine hours). This is only $6.56 per tool ($13,125/2,000), which is about 1/3 of the overhead cost per tool computed when multiple cost drivers are used.

To summarize,

	ABC	*Traditional*
Total factory overhead assigned	$37,750	$13,125
Per tool	$18.88	$6.56

The reason for this wide discrepancy is that these special purpose tools require a relatively large number of machine set-ups, a sizable amount of waste materials, and several inspections. Thus, they are relatively costly in terms of driving overhead costs. Use of a single predetermined overhead rate obscures that fact.

Inaccurately calculating the overhead cost per unit to the extent illustrated above can have serious adverse consequences for the firm. For example, it can lead to poor decisions about pricing, product mix, or contract bidding.

COST ACCOUNTANTS: The cost accountant needs to weigh carefully such considerations in designing a product costing system. A costing system using multiple cost drivers is more costly to implement and use, but it may save millions through improved decisions.

REMEMBER*:* An ABC approach is expensive to implement and keep. Companies considering ABC should perform a cost-benefit test. The benefits are most significant when a company has

(1) different products or services that make different demands on resources

(2) stiff competition where knowledge of costs and cost control is critical.

ABC forces management to think in terms of simplifying operations (activities). Once activities that are consumed by a product are identified, the process can be evaluated with a view to cut costs.

CHECKLIST FOR COST DRIVERS

MANUFACTURING:

Machine hour
Direct labor hour or dollars
Number of setups
Weight of materials handled
Number of units reworked
Number of orders placed
Number of orders received
Number of inspections
Number of material handling operations
Number of orders shipped
Hours of testing time
Miles driven
Computer time
Square footage
Number of vendors
Asset value
Number of labor transactions
Number of units scrapped
Number of parts
Replacement cost
Design time

NON-MANUFACTURING:

Number of hospital beds occupied
Number of surgeries
Number of take-offs and landings for an airline
Flight hours
Number of rooms occupied in a hotel

SELLING

Number of sales calls
Number of orders obtained
Volume of sales

WAREHOUSING

Number of items stored
Volume of items stored

CREDIT AND COLLECTION

Number of customer orders
Dollar amount of customer orders on account

NOTE: Two major factors should be considered in selecting cost drivers: (1) the cost of measurement and (2) the degree of correlation between the cost driver and the actual consumption of overhead. For example, the proper cost driver for material handling costs is the number of components in a finished product.

What are Theory of Constraints (TOC) and bottlenecks management?

The theory of constraints (TOC) views a business as a linked sequence of processes that transforms inputs into salable outputs, like a chain. To improve the strength of the chain, a TOC company identifies the weakest link, which is the constraint. TOC exploits constraints so that throughput is maximized and inventories and operating costs are minimized. It then develops a specific approach to manage constraints to support the objective of continuous improvement.

Bottlenecks occur whenever demand (at least temporarily) exceeds capacity. For example, although a legal secretary has enough total time to do all her wordprocessing, she may be given several jobs in quick succession, so that a queue (waiting line) builds up. This is a bottleneck, which delays the other activities waiting for the wordprocessing to be finished. TOC seeks to maximize "throughput" by

- Larger lot sizes at bottleneck work stations, to avoid time lost on changeovers;
- Small transfer batches—forwarding a small batch of work to the next work station, so that the next operation can begin before the entire lot is finished at the preceding work station; and
- Rules for inserting buffer stock before or after certain bottlenecks.

3.9 Life-Cycle Costs and Target Costing

What is life-cycle costing?

Life-cycle costing tracks and accumulates all product costs in the value chain from research and development and design of products and processes through production, marketing, distribution, and customer service. The value chain is the set of activities required to design, develop, produce, market, and service a product (or service). The terms "cradle-to-grave costing" and "womb-to tomb" costing"

conveys the sense of fully capturing all costs associated with the product.

It focuses on minimizing locked-in costs, for example, by reducing the number of parts, promoting standardization of parts, and using equipment that can make more than one kind of product. Product life cycle is simply the time a product exists—from conception to abandonment. *Life-cycle costs* are all costs associated with the product for its entire life cycle. These costs include development (planning, design, and testing), manufacturing (conversion activities), and logistics support (advertising, distribution, warranty, and so on).

Can you achieve cost reduction through life-cycle costing?

Because total customer satisfaction has become a vital issue in the new business setting, whole-life cost has emerged as the central focus of life-cycle cost management. *Whole-life cost* is the life-cycle cost of a product plus after-purchase (or post-purchase) costs that consumers incur, including operation, support, maintenance, and disposal. Since the costs a purchaser incurs after buying a product can be a significant percentage of whole-life costs and, thus, an important consideration in the purchase decision, managing activities so that whole-life costs are reduced can provide an important competitive advantage. NOTE: Cost reduction not cost control is the emphasis. Moreover, cost reduction is achieved by judicious analysis and management of activities.

Studies show that 90 percent or more of a product's costs are committed during the development stage. Thus, it makes sense to emphasize management of activities during this phase of a product's existence. Every dollar spent on premanufacturing activities is known to save $8-$10 on manufacturing and postmanufacturing activities. The real opportunities for cost reduction occur before manufacturing begins. Managers need to invest more in premanufacturing assets and dedicate more resources to activities in the early phases of the product life cycle so that overall whole-life costs can be reduced.

What is the role of target costing? How does it differ from cost-plus pricing?

Life-cycle and whole-life cost concepts are associated with target costing and target pricing. A firm may determine that market conditions require that a product sell at a given target price. Hence, target cost can be determined by subtracting the desired unit profit margin from the target price. The cost reduction objectives of life-cycle and whole-life cost management can therefore be determined using target costing.

Thus, *target costing* becomes a particularly useful tool for establishing cost reduction goals. Toyota, for example, calculates the lifetime target profit for a new car model by multiplying a target profit ratio times the target sales. They then calculate the estimated profit by subtracting the estimated costs from target sales. Usually, (at this point), target profit is greater than estimated profit. The cost reduction goal is defined by the difference between the target profit and the estimated profit. Toyota then searches for cost reduction opportunities through better design of the new model. Toyota's management recognizes that more opportunities exist for cost reduction during product planning than in actual development and production.

The Japanese developed target costing to enhance their ability to compete in the global marketplace. This approach to product pricing differs significantly from the cost-based methods just described. Instead of first determining the cost of a product or service and then adding a profit factor to arrive at its price, target costing reverses the procedure. Target costing is a pricing method that involves (1) identifying the price at which a product will be competitive in the marketplace, (2) defining the desired profit to be made on the product, and (3) computing the target cost for the product by subtracting the desired profit from the competitive market price. The formula

Target Price — Desired Profit = Target Cost

Target cost is then given to the engineers and product designers, who use it as the maximum cost to be incurred for the materials and other resources needed to design and manufacture the product. It is their responsibility to create the product at or below its target cost.

Figure 3.5 compares the cost plus philosophy with the target costing philosophy.

Figure 3.5
Cost-plus pricing versus target costing

	Formula	*Implications*
Cost-plus pricing	Cost base + markup = selling price	• Cost is the base (given) • Markup is added (given) • The firm puts the product on the market and hopes the selling price is accepted
Pricing based on target costing	Target selling price - Desired profit = Target cost	• Markets determine prices (given) • Desired profit must be sustained for survival (given) • Target cost is the residual, the variable to be managed

EXAMPLE 3.21

A salesperson at Walker Hill Products Company has reported that a customer is seeking price quotations for two electronic components: a special-purpose battery charger (Product X101) and a small transistorized machine computer (Product Y101). Competing for the customer's order are one French company and two Japanese companies. The current market price ranges for the two products are as follows:

Product X101 $310—$370 per unit

Product Y101 $720—$820 per unit

The salesperson feels that if Walker Hill could quote prices of $325 for Product X101 and $700 for Product Y101, the company would get the order and gain a significant share of the global market for those goods. Walker Hill's usual profit markup is 25 percent of total unit cost. The company's design engineers and cost accountants put together the following specifications and costs for the new products:

Activity-based cost rates:

Materials handling activity	$1.30 per dollar of raw materials and purchased parts cost
Production activity	$3.50 per machine hour
Product delivery activity	$24.00 per unit of X101
	$30.00 per unit of Y101

	Product X101	**Product Y101**
Projected unit demand	26,000	18,000
Per unit data:		
Raw materials cost	$30.00	$65.00
Purchased parts cost	$15.00	$45.00
Manufacturing labor		
Hours	2.6	4.8
Hourly labor rate	$12.00	$15.00
Assembly labor		
Hours	3.4	8.2
Hourly labor rate	$14.00	$16.00
Machine hours	12.8	28.4

The company wants to address the following three questions:

1. What is the target cost for each product?
2. What is the projected total unit cost of production and delivery?
3. Using the target costing approach, should the company produce the products?

1. Target cost for each product:

Product X101 = $325.00 ÷ 1.25 = $260.00*
Product Y101 = $700.00 ÷ 1.25 = $560.00

*Target Price - Desired Profit = Target Cost
$325.00 - .25X = X

$325.00 = 1.25X

$$X = \frac{\$325.00}{1.25} = \$260.00$$

2. Projected total unit cost of production and delivery:

	Product X101	Product Y101
Raw materials cost	$30.00	$ 65.00
Purchased parts cost	$15.00	$45.00
Total cost of raw materials and parts	$45.00	$110.00
Manufacturing labor		
X101 (2.6 hours X $12.00)	$31.20	
Y101 (4.8 hours x $15.00)		$72.00
Assembly labor		
X101 (3.4 hours X $14.00)	$47.60	
Y101 (8.2 hours X $16.00)		$131.20
Activity-based costs		
Materials handling activity		
X101 ($45.00 x $1.30)	$58.500	
Y101 ($110.00 x $1.30)		$143.00
Production activity		
X101 (12.8 machine hours x $3.50)	$44.80	
Y101 (28.4 machine hours X $3.50)		$99.40
Product delivery activity		
X101	$24.00	
Y101	_____	$30.00
Projected total unit cost	$251.10	$585.60

3. Production decision:

	Product X101	**Product Y101**
Target unit cost	$260.00	$560.00
Less: projected unit cost	251.10	585.60
Difference	$8.90	($25.60)

Product X101 can be produced below its target cost, so it should be produced. As currently designed, Product Y101 cannot be produced at or below its target cost; either it needs to be redesigned or the company should drop plans to make it.

3.10 Balanced scorecard

How does a balanced scorecard to evaluate performance work?

A problem with just assessing performance with financial measures like profit, ROI and Economic Value Added (EVA) is that the financial measures are "backward looking.'" In other words, today's financial measures tell you about the accomplishments and failures of the past. An approach to performance measurement that also focuses on what managers are doing today to create future shareholder value is the Balanced Scorecard.

Essentially, a Balanced Scorecard is a set of performance measures constructed for four dimensions of performance. As indicated in Figure 3.6, the dimensions are financial, customer, internal processes, and learning and growth. Having financial measures is critical even if they are backward looking. After all, they have a great effect on the evaluation of the company by shareholders and creditors. Customer measures examine the company's success in meeting customer expectations. Internal process measures examine the company's success in improving critical business processes. And learning and growth measures examine the company's success in improving its ability to adapt, innovate, and grow. The customer, internal processes, and learning and growth measures are generally thought to be predictive of *future* success (i.e., they are not backward looking).

How is balance achieved in a balanced scorecard?

A variety of potential measures for each dimension of a Balanced Scorecard are indicated in Figure 3.6. After reviewing these measures, note how "balance" is achieved:

- Performance is assessed across a *balanced set of dimensions* (financial, customer, internal processes, and innovation).
- *Quantitative* measures (e.g., number of defects) are balanced with *qualitative* measures (e.g., ratings of customer satisfaction).
- There is a balance of *backward-looking* measures (e.g., financial measures like growth in sales) and *forward-looking* measures (e.g., number of new patents as an innovation measure).

FIGURE 3.6
BALANCED SCORECARD

		Measures
Financial	Is the company achieving its financial goals?	Operating income Return on assets Sales growth Cash flow from operations Reduction of administrative expense

Customer	Is the company meeting customer expectations?	Customer satisfaction Customer retention New customer acquisition Market share On-time delivery Time to fill orders
Internal Processes	Is the company improving critical internal processes?	Defect rate Lead time Number of suppliers Material turnover Percent of practical capacity
Learning and Growth	Is the company improving its ability to innovate?	Amount spent on employee training Employee satisfaction Employee retention Number of new products New product sales as a percent of total sales Number of patents

Chapter 3 Review Questions - Section 2

9. The major objectives of any budget system are to

A. Define responsibility centers, provide a framework for performance evaluation, and promote communication and coordination among organization segments.
B. Define responsibility centers, facilitate the fixing of blame for missed budget predictions, and ensure goal congruence between superiors and subordinates.
C. Foster the planning of operations, provide a framework for performance evaluation, and promote communication and coordination among organization segments.
D. Foster the planning of operations, facilitate the fixing of blame for missed budget predictions, and ensure goal congruence between superiors and subordinates.

10. Which one of the following budgeting methodologies would be most appropriate for a firm facing a significant level of uncertainty in unit sales volumes for next year?

A. Top-down budgeting.
B. Life-cycle budgeting.
C. Static budgeting.
D. Flexible budgeting.

11. The master budget

A. Shows forecasted and actual results.
B. Reflects controllable costs only.
C. Can be used to determine manufacturing cost variances.
D. Contains the operating budget.

12. The use of different capacity levels in the budgeting process signifies that an organization has most likely implemented a

A. Flexible budget.
B. Capital budget.
C. Static budget.
D. Strategic budget.

13. Which of the following is a purpose of standard costing?

A. Determine breakeven production level.
B. Control costs.
C. Eliminate the need for subjective decisions by management.
D. Allocate cost with more accuracy.

14. An efficiency variance equals

A. A flexible budget amount minus a static budget amount.
B. Actual operating income minus flexible budget operating income.
C. Actual unit price minus budgeted unit price, times the actual units produced.
D. Budgeted unit price times the difference between actual inputs and budgeted inputs for the actual activity level achieved.

15. Which of the following factors should *not* be considered when deciding whether to investigate a variance?

A. Magnitude of the variance and the cost of investigation.
B. Trend of the variances over time.
C. Likelihood that an investigation will eliminate future occurrences of the variance.
D. Whether the variance is favorable or unfavorable.

16. Which department is customarily held responsible for an unfavorable materials quantity (usage) variance?

A. Quality control.
B. Purchasing.
C. Engineering.
D. Production.

17. The benchmarking organization against which a firm is comparing itself must be a direct competitor. True or False?

18. An example of a nonfinancial benchmark is

A. The labor rate of comparably skilled employees at a major competitor's plant.
B. The percentage of customer orders delivered on time at the company's most efficient plant.
C. The average actual cost per pound of a specific product at the company's most efficient plant.

D. A $50,000 limit on the cost of employee training programs at each of the company's most efficient plant.

19. Which of the following would be a reasonable basis for assigning the materials handling cost to the units produced in an ABC system?

A. Number of production runs per year.
B. Number of components per completed unit.
C. Amount of overhead applied to each completed unit.
D. Machine hours

20. The use of activity-based costing normally results in

A. Substantially greater unit costs for low-volume products than is reported by traditional product costing.
B. Substantially lower unit costs for low-volume products than is reported by traditional product costing.
C. Decreased setup costs being charged to low-volume products.
D. Equalizing setup costs for all product lines.

21. Multiple or departmental overhead rates are considered preferable to a single or plant-wide overhead rate when

A. Manufacturing is limited to a single product flowing through identical department in a fixed sequence.
B. Various products are manufactured that do not pass through the same departments or use the same manufacturing techniques.
C. Cost drivers, such as direct labor, are the same over all processes.
D. Individual cost drivers cannot accurately be determined with respect to cause-and –effect relationships.

Chapter 4:

Cost-Volume-Profit Analysis, Operating Leverage, and Discounting Analysis

Learning Objectives:

After completing this section, you should be able to:

- Recognize the value of cost-volume-profit (CVP) analysis in solving business problems.
- Identify some applications of present (discounting) and future (compound) values.

Break-even analysis lies at the heart of your company's success. Whether you're a management executive, managerial accountant, financial manager, or financial analyst, understanding this technique is a must.

As its basis, break-even analysis draws upon contribution margin analysis, discussed in Chapter 3. Operating leverage follows directly from break-even analysis. The third component, discounting analysis (present and future value analysis), completes the spectrum of analytic techniques found in this chapter. Together, they will help you keep your company afloat and turn a profit.

4.1 Cost-Volume-Profit (CVP) Analysis

What is cost-volume-profit analysis?

Cost-volume-profit (CVP) analysis, together with cost behavior information, helps MBAs perform many useful analyses. CVP analysis deals with how profit and costs change with a change in volume. More specifically, 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. By studying the relationships of costs, sales, and net income, management is better able to cope with many planning decisions. Closely related is the concept of *leverage*, what is that portion of the fixed costs which represents a risk to the firm.

What is break-even analysis?

Break-even analysis, a branch of CVP analysis, determines the break-even sales. Break-even point—the financial crossover point when revenues exactly match costs—does not show up in corporate earnings reports, but CFOs find it an extremely useful measurement in a variety of ways.

How may you use CVP analysis in solving business problems?

CVP analysis tries to answer the following questions:

1. What sales volume is required to break even?
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 income volume and profit potential?

What are the uses of break-even analysis?

Use break-even analysis to organize your thinking on important broad features of your business. It is especially pertinent when beginning a new activity, such as starting a new business, expanding an already existing business, or introducing a new product or service.

Many managers within a company will find uses for break-even analysis. It answers these important questions:

- *Management executives:* Have the company's break-even possibilities been improving, or have they been deteriorating over time? What will be the impact of major labor negotiations?
- *Marketing managers:* Will a major marketing campaign generate sufficient sales to justify the cost of the campaign? Would introduction of a new product add or detract from the company's profitability?
- *Production managers:* Would modernization of production facilities pay for itself?

If you are an accountant, providing data for the break-even analysis will be your responsibility. If you are a financial analyst or investor, you might want to know about efforts a company makes to reduce its break-even point.

CHECKLIST OF USES FOR BREAK-EVEN ANALYSIS

1. *Economic analysis of new product.* Based on demand forecasts and estimates of production costs (variable and fixed), the economic impact of a new product can be estimated.

2. *Labor contract negotiations.* The effect of increased variable costs resulting from higher wages on the break-even level of output can be analyzed.

3. *Choice of production process.* The choice of reducing variable costs at the expense of incurring higher fixed costs can be evaluated. Management might decide to become more capital-intensive by performing tasks in the production process through use of equipment rather than labor. Application of the CVP model can indicate what the effects of this tradeoff will be on the break-even output for the given product.

4. *Pricing policy.* The sales price of a new product can be set to achieve a target income level. Furthermore, should market penetration be a prime objective, the price could be set that would cover slightly more than the variable costs of production and provide only a partial contribution to the recovery of fixed costs. The negative income at several possible sales prices can then be studied.

5. *Location selection.* Some of the costs of having a facility in a location will be fixed, and some will vary with the volume of business. The cost structure and the volume of sales will probably be different for each location being considered. It is important to realize that the lowest-cost location will always be the maximum-profit location.

6. *Financing decisions.* Analysis of the firm's cost structure will reveal the proportion that fixed operating costs bear to sales. If this proportion is high, the firm might reasonably decide not to add any fixed financing costs on top of the high fixed operating costs.

7. *Make or buy decision.* Break-even analysis can often be used to determine volume requirements in deciding whether to purchase from suppliers or manufacture in-house a certain component part.

8. *Capital budgeting analysis*. As a complementary technique to discounted cash flow (DCF) techniques, the CVP model locates in a rough way the sales volume needed to make a project economically beneficial to the firm. It should not be used to replace the DCF methodology.

What are the key factors in break-even analysis?

The break-even point depends on three factors:

- The product’s selling price
- The variable costs of production, selling, and administration

- The fixed costs of production, selling, and administration

The stability of the selling price during a given income period depends on several factors, including the general market conditions and the behavior of the economy overall.

Break-even analysis, if used properly, will enable an in-depth evaluation of production and administrative activities. WHAT TO DO: You need to forecast production, selling, and administrative costs and then separate those that are fixed or variable.

4.2 Contribution Margin

What does contribution margin mean?

For accurate CVP analysis, a distinction must be made between costs as being either variable or fixed. Mixed costs must be separated into their variable and fixed components.

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

The contribution margin 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) over the unit variable cost (v). Symbolically, unit CM = p - v.

CM RATIO

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

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

The CM ratio can also be computed using per-unit data as follows:

$$\text{CM Ratio} = \frac{\text{Unit CM}}{p} = \frac{(p-v)}{p} = 1 - \frac{v}{p}$$

Note that the CM ratio is 1 minus the variable cost ratio. For example, if variable costs are 40% of sales, then the variable cost ratio is 40% and the CM ratio is 60%

EXAMPLE 4.1

To illustrate the various concepts of CM, consider the following data for Porter Toy Store:

	Total	*Per Unit*	*Percentage*
Sales (1,500 units)	$37,500	$25	100%
Less: Variable costs	15,000	10	40
Contribution margin	$22,500	$15	60%
Less: Fixed costs	15,000		
Net income	$7,500		

From the data listed above, CM, unit CM, and the CM ratio are computed as:

CM = S - VC = $37,500 - $15,000 = $22,500
Unit CM = p - v = $25 - $10 = $15
CM Ratio = CM / S = $22,500 / $37,500 = 1 - ($15,000 / $37,500 = 1 - 0.4 = 0.6 = 60%
Or = Unit CM / p = $15 / $25 = 0.6 = 60%

How can the break-even sales be computed?

The break-even point represents the level of sales revenue that equals the total of the variable and fixed costs for a given volume of output at a particular capacity use rate. For example, you might want to ask the break-even occupancy rate (or vacancy rate) for a hotel or the break-even load rate for an airliner

Generally, the lower the break-even point, the higher the profit and the less the operating risk, other things being equal. The break-even point also provides managerial accountants with insights into profit planning.

It can be computed in two different ways: the equation approach and graphical approach. The *equation approach* is based on the cost-volume-profit equation which shows the relationships among sales, variable and fixed costs, and net income.

S = VC + FC + Net Income

At the break-even volume, S = VC + FC + 0. Defining x = volume in *units*, the above relationship can be written in terms of x:

$$px = vx + FC$$
$$(p\text{-}v)x = FC$$

Solving for x yields the following formula for break-even sales volume:

$$x = \frac{FC}{(p-v)} = \frac{\text{Fixed Costs}}{\text{Unit CM}}$$

Or

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

Note: The sales revenue needed to breakeven is that point at which the company covers all costs but generates no income.

$$S = VC + FC + 0$$
$$S = (VC/S)S + FC$$
$$(1 - VC/S)S = FC$$

$$S = \frac{FC}{(1 - VC/S)} = \frac{\text{Fixed Costs}}{(1 - \text{Variable Cost Ratio})} = \frac{\text{Fixed Costs}}{\text{CM Ratio}}$$

EXAMPLE 4.2

Using the same data given in Example 4.1, where unit CM = $25 - $10 = $15 and CM ratio = 60%, we get:

Break-even point in units = $15,000/$15 = 1,000 units

Break-even point in dollars = $15,000/0.6 = $25,000

Or, alternatively, 1,000 units X $25 = $25,000

Can I express break-even graphically?

The graphical approach to obtaining the break-even point is based on the so-called *break-even (B-E) chart* as shown in Figure 4.1. Sales revenue, variable costs, and fixed costs are plotted on the vertical axis while volume, x, is plotted on the horizontal axis. The break-even point is the point where the total sales revenue line intersects the total cost line. The chart can also effectively report profit potentials over a wide range of activity and therefore be used as a tool for discussion and presentation.

The *profit-volume (P-V) chart,* as shown in Figure 4.2, focuses directly on how profits vary with changes

in volume. Profits are plotted on the vertical axis while units of output are shown on the horizontal axis. The P-V chart provides a quick condensed comparison of how alternatives on pricing, variable costs, or fixed costs may affect net income as volume changes. The P-V chart can be easily constructed from the B-E chart. NOTE: The slope of the chart is the unit CM.

FIGURE 4.1
BREAK-EVEN CHART

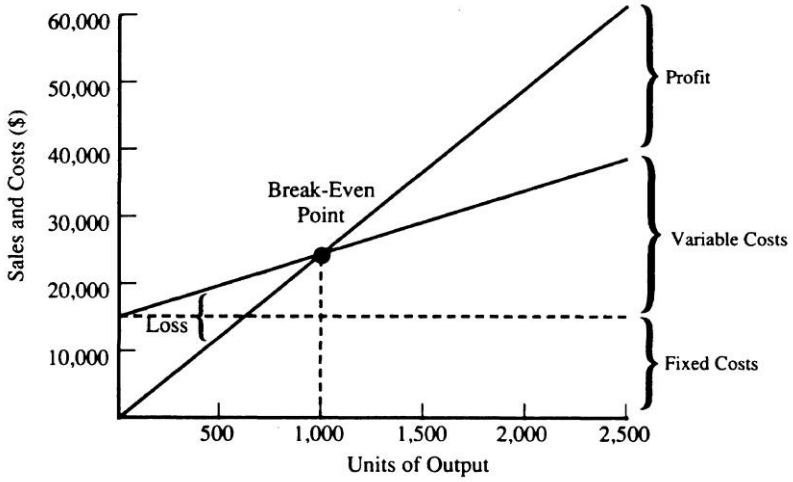
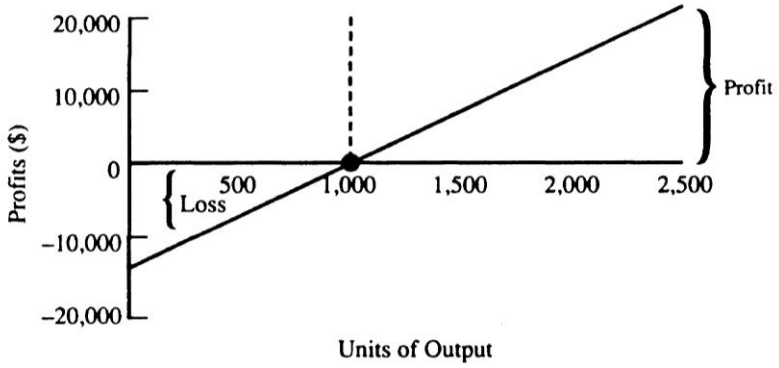


FIGURE 4.2
PROFIT-VOLUME (P-V) CHART



4.3 From Break-Even to Target Profits

How can I determine desired profit levels?

The objective of your business is not simply to break-even but to make a profit. Break-even analysis can be easily extended to focus on a target level of profits. A simple modification of the break-even formula will help you compute target profits:

Besides determining the break-even point, CVP analysis determines the sales required to attain a particular income level or target net income. There are two ways in which target net income can be expressed:

Case 1. As a specific dollar amount

Case 2. As a percentage of sales

Case 1

As a specific dollar amount, the formula is:

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

Case 2

Specifying target income as a percentage of sales, the cost-volume equation is

$$px = vx + FC + \%(px)$$

Solving this for x yields:

$$\frac{FC}{p - v - \%(p)}$$

In words.

$$\text{Target income sales volume} = \frac{\text{Fixed Costs}}{\text{Unit CM} - (\%\text{ of Unit Sales Price})}$$

EXAMPLE 4.3

Using the same data given in Example 4.1, assume that Porter Toy Store wishes to attain:

Case 1. A target income of $15,000 before tax

Case 2. A target income of 20% of sales

In Case 1, the target income volume would be:

($15,000 + $15,000) / ($25 - $10) = $30,000 / $15 = 2,000 Units

`In Case 2, the target income volume required is:

$15,000/[($25 - $10 – (20%)($25)] = $15,000/($15 - $5) = 1,500 Units

What is the impact of income taxes on target income volume?

If target income (expressed as a specific dollar amount) is given on an after-tax basis, an adjustment is necessary before we use the previous formula. The reason is that the profit target is expressed in before-tax terms. Therefore, the after-tax target income must be first converted to a before-tax target, as follows:

$$\text{Before-tax target income} = \frac{\text{After - tax Target Income}}{(1 - \text{Tax Rate})}$$

EXAMPLE 4.4

Assume in Example 4.1 that Porter Toy Store wants to achieve an after-tax income of $6,000. The tax rate is 40 percent. Then, the first step is:

$$\frac{\$6{,}000}{(1-0.4)} = \$10{,}000$$

The second step is to plug this figure into our regular formula as follows:

Target income volume = ($15,000 + $10,000) / 15 = 1,667 Units

EXAMPLE 4.5

Using the same data given in Example 4.1, assume that Porter Toy Store wishes to attain a target income of $15,000 before tax.

Then, the target income volume would be:

($15,000 + $15,000) / ($25 - $10) = $30,000 / $15 = 2,000 Units

What is the cash break-even point?

If a company has a minimum of available cash or the opportunity cost of holding excess cash is too high, management 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 operating costs involve cash payments. For example, depreciation expenses are non-cash fixed charges. Another example is prepaid expenses such as prepaid insurance and prepaid rent. The time period for which the breakeven analysis is being performed might not involve an actual cash outlay for insurance coverage. To find the cash break-even point, the non-cash charges must be subtracted from fixed costs. Therefore, the cash break-even point is lower than the usual break-even point. The formula is:

Cash break-even point = (Fixed costs - Noncash expenses) / Unit CM

EXAMPLE 4.6

Assume from Example 4.1 that the total fixed costs of $15,000 include depreciation of $1,500. Then the cash break-even point is:

($15,000 - $1,500) / ($25 - $10) = $13,500 / $15 = 900 Units

Porter Toy Store has to sell 900 units to cover only the fixed costs involving cash payments of $13,500 and to break even.

What is the use of margin of safety?

The margin of safety is a measure of difference between the actual sales and the break-even sales. It is the amount by which sales revenue may drop before losses begin, and is expressed as a percentage of expected sales:

Margin of Safety = (Expected sales - Break-even sales)/Expected sales

The margin of safety is used as a measure of operating risk. The larger the ratio, the safer the situation since there is less risk of reaching the break-even point.

EXAMPLE 4.7

Assume Porter Toy Store projects sales of $35,000 with a break-even sales level of $25,000. The projected margin of safety is:

($35,000 - $25,000) / $35,000 = 28.57%

4.4 “What-if” Analysis

How is CVP analysis used in solving "what-if" scenarios?

The concepts of contribution margin and the contribution income statement have many applications in profit planning and short-term decision making. “What-if” (sensitivity) analysis can be done through various possible scenarios and computes the impact on profit of various predictions of future events, especially utilizing a spreadsheet program such as *Excel.* Some applications are illustrated in Examples 4.8 to 4.12 using the same data as in Example 4.1.

EXAMPLE 4.8

Recall from Example 4.1 that Porter Toy Store has a CM of 60 percent and fixed costs of $15,000 per period. Assume that the store expects sales to go up by $10,000 for the next period. How much will income increase?

Using the CM concepts, we can quickly compute the impact of a change in sales on profits. The formula for computing the impact is:

Change in net income = Dollar change in sales X CM ratio

Thus:

Increase in net income = $10,000 X 60% = $6,000

Therefore, the income will go up by $6,000, assuming there is no change in fixed costs.

If we are given a change in unit sales instead of dollars, then the formula becomes:

Change in net income = Change in unit sales X Unit CM

EXAMPLE 4.9

Assume that the store expects sales to go up by 400 units. How much will income increase? From Example 4.1, the store's unit CM is $15. Again, assuming there is no change in fixed costs, the income will increase by $6,000.

400 units x $15 = $6,000

EXAMPLE 4.10

What net income is expected on sales of $47,500?

The answer is the difference between the CM and the fixed costs:

CM: $47,500 X 60%	$28,500
Less: Fixed costs	15,000
Net income	$13,500

EXAMPLE 4.11

Porter Toy Store is considering increasing the advertising budget by $5,000, which would increase sales revenue by $8,000. Should the advertising budget be increased?

The answer is no, since the increase in the CM is less than the increased cost:

Increase in CM: $8,000 X 60%	$4,800
Increase in advertising	5,000
Decrease in net income	$(200)

EXAMPLE 4.12

Consider the original data. Assume again that Porter Toy Store is currently selling 1,500 units per period. In an effort to increase sales, management is considering cutting its unit price by $5 and increasing the advertising budget by $1,000.

If these two steps are taken, management feels that unit sales will go up by 60 percent. Should the two steps be taken?

A $5 reduction in the selling price will cause the unit CM to decrease from $15 to $10. Thus,

Proposed CM: 2,400 units X $10	$24,000
Present CM: 1,500 units X $15	22,500
Increase in CM	$1,500
Increase in advertising outlay	1,000
Increase in net income	$500

The answer, therefore, is yes. Alternatively, the same answer can be obtained by developing comparative income statements in a contribution format:

	A *Present* *(1,500 units)*	*B* *Proposed* *(2,400 units)*	*(B - A)* *Difference*
Sales	$37,500 (@$25)	$48,000 (@$20)	$10,500
Less: Variable cost	15,000 (@$10)	24,000 (@$10)	9,000
CM	$22,500	$24,000	$1,500
Less: Fixed costs	15,000	16,000	1,000
Net income	$ 7,500	$ 8,000	$500

4.5 Sales Mix Analysis

What effect does the sales mix have?

Break-even and cost-volume-profit analysis requires some additional computations and assumptions when a company produces and sells more than one product. In multi-product firms, sales mix is an important factor in calculating an overall company break-even point.

Different selling prices and different variable costs result indifferent unit CM and CM ratios. As a result, the break-even points and cost-volume-profit relationships vary with the relative proportions of the products sold, called the *sales mix*.

In break-even and CVP analysis, it is necessary to predetermine the sales mix and then compute a weighted average unit 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 4.13

Assume that Knibex, Inc. produces cutlery sets out of high-quality wood and steel. The company makes a deluxe cutlery set and a standard set that have the following unit CM data:

	Deluxe	*Standard*
Selling price	$15	$10
Variable cost per unit	12	5
Unit CM	$3	$5
Sales mix	60%	40%
	(based on sales volume)	
Fixed costs	$76,000	

The weighted average unit CM = ($3)(0.6) + ($5)(0.4) = $3.80. Therefore, the company's break-even point in units is:

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

which is divided as follows:

Deluxe: 20,000 units x 60%	= 12,000 units
Standard: 20,000 units x 40%	= 8,000
	= 20,000 units

NOTE: An alternative is to build a package containing 3 deluxe models and 2 standard models (3:2 ratio). By defining the product as a package, the multiple-product problem is converted into a single-product one. Then use the following three steps as follows:

Step 1: Computer the package CM as follows:

	Deluxe	*Standard*
Selling price	$15	$10
Variable cost per unit	12	5
Unit CM	$3	$5
Sales mix	3	2
Package CM	$9	$10
	$19 package total	

Step 2: Determine the number of packages that need to be sold to break even, as follows:

$76,000/$19 per package = 4,000 packages

Step 3: Multiply this number by their respective mix units:

Deluxe:	4,000	packages x 3 units =	12,000 units
Standard:	4,000	packages x 2 units =	8,000 units
			20,000 units

EXAMPLE 4.14

Assume that Dante, Inc. is a producer of recreational equipment. It expects to produce and sell three types of sleeping bags--the Economy, the Regular, and the Backpacker. Information on the bags is given below:

	Budgeted			
	Economy	*Regular*	*Backpacker*	***Total***
Sales	$30,000	$60,000	$10,000	$100,000
Sales mix	30%	60%	10%	100%
Less VC	24,000	40,000	5,000	69,000

	(80%)	(66 2/3%)	(50%)	
CM	$6,000	$20,000	$5,000	$31,000
CM ratio	20%	33 1/3%	50%	31%
Fixed costs				$18,600
Net income				$12,400

The CM ratio for Dante, Inc. is $31,000/$100,000 = 31 percent.

Therefore the break-even point in dollars is

$$\$18,600/0.31 = \$60,000$$

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

Economy:	$60,000 x 30% =	$18,000
Regular:	$60,000 x 60% =	36,000
Backpacker:	$60,000 x 10% =	6,000
		$60,000

One of the most important assumptions underlying CVP analysis in a multi-product firm is that the sales mix will not change during the planning period. But if the sales mix changes, the break-even point will also change.

EXAMPLE 4.15

Assume that total sales from Example 15 was achieved at $100,000 but that an actual mix came out differently from the budgeted mix (i.e., for Economy, 30% to 55%, for Regular, 60% to 40%, and for Backpacker, 10% to 5%).

	Actual			
	Economy	*Regular*	*Backpacker*	*Total*
Sales	$55,000	$40,000	$5,000	$100,000
Sales mix	55%	40%	5%	100%
Less: VC	44,000	26,667*	2,500**	73,167
CM	$11,000	$13,333	$2,500	$26,833
CM ratio	20%	33 1/3%	50%	26.83%
Fixed Costs				$18,600
Net income				$8,233

* $26,667 = $40,000 x (100% - 33 1/3%) = $40,000 x 66 2/3%

* $2,500 = $5,000 x (100% - 50%) = $5,000 x 50%

Note: The shift in sales mix toward the less profitable line, Economy, has caused the CM ratio for the company as a whole to drop from 31 percent to 26.83 percent.

The new break-even point will be $18,600/0.2683 = $69,325

The break-even dollar volume has increased from $60,000 to $69,325.

The deterioration (improvement) in the mix caused net income to go down (up). It is important to note that generally, the shift of emphasis from low-margin products to high-margin ones will increase the overall profits of the company.

What are the limitations of break-even analysis?

In its simplest form, break-even analysis makes a number of assumptions about which you must be very clear. One such assumption treats the unit selling price as a constant. This, in turn, rests on two further assumptions: (I) the elasticity of demand must be very high for the unit selling price to remain constant as sales volume expands and (2) the selling price must remain relatively stable over the income period. In truth, neither is likely to hold in actual practice, and this makes forecasting the unit selling price much more difficult.

The second major assumption holds that unit variable costs are also constant and that fixed and variable costs have been properly separated, identified, and quantified. However, separating out variable from fixed costs is an ongoing problem.

Once you have determined the unit variable cost, make certain it remains constant over the income period. If it does not, then you must compute a series of breakdown calculations incorporating the most probable unit variable costs.

Likewise, examine the likelihood that total fixed costs will remain constant. Do this at every level of your analysis. If you find factors that will cause fixed costs to vary, then you must compute a series of break-even analyses using the most probable values of total fixed costs.

A RULE FOR MANAGEMENT EXECUTIVES: One of your major objectives should be to keep a tight grip on your company's break-even volume. This means constant efforts to keep break-even from increasing as a result of adverse conditions that lower unit selling price and raise unit variable costs and total fixed costs.

CHECKLIST OF QUESTIONS CONCERNING BREAK-EVEN ANALYSIS

- Is demand sufficiently elastic that rises in sales volume would have no appreciable effect on unit selling price?
- Is unit selling price expected to be relatively stable over the income period to which the break-even analysis applies?
- Have costs been measured properly? Have historical costs been adjusted appropriately to reflect future costs during the income period or income periods under study?
- Are total fixed costs expected to remain constant over the income period under study?
- Does the break-even analysis assume organizational slack, that is, are costs assumed to have been appropriately minimized?
- Is unit variable cost assumed to be constant?
- Is the probable range of break-even volumes estimated in terms of a particular future period or periods?
- Does the break-even analysis provide probability estimates as to whether or not break-even can be achieved?

4.6 Operating Leverage

What is leverage and what are the types?

Companies wish to know where they are with respect to the break-even point. If they are operating around break-even point sales, management may be more conservative in its approach to implementing changes and mapping out new strategies. On the other hand, if they are operating well away from the break-even point, management will be more liberal since the downside risk is not as great. A measure that relates to this distance between break-even sales and the current or planned sales volume is *leverage.*

Leverage is that portion of the fixed costs which represents a risk to the firm. Operating leverage, a measure of operating risk, refers to the fixed operating costs found in the firm's income statement. Financial leverage, a measure of financial risk, refers to financing a portion of the firm's assets, bearing fixed financing charges in hopes of increasing the return to the common stockholders. The higher the financial leverage, the higher the financial risk, and the higher the cost of capital. Cost of capital rises because it costs more to raise funds for a risky business. Total leverage is a measure of total risk.

How do you measure operating leverage?

Operating leverage is a measure of operating risk and arises from fixed operating costs. A simple indication of operating leverage is the effect that a change in sales has on earnings.

The formula is:

Operating leverage at a given level of sales (x)

$$= \frac{\text{Percentage change in operating income}}{\text{Percentage change in sales}}$$

$$= \frac{(p - v)x}{(p - v)x - FC}$$

where operating income = $(p - v)x - FC$

Thus, profits become more sensitive to changes in sales volume as the DOL increases.

EXAMPLE 4.16

The Wayne Company manufactures and sells doors to homebuilders. The doors are sold for $25 each. Variable costs are $15 per door, and fixed operating costs total $50,000. Assume further that the Wayne Company is currently selling 6,000 doors per year. Its operating leverage is:

$$\frac{(p - v)}{(p - v)x - FC} = \frac{(\$25 - \$15)(6{,}000)}{(\$25 - \$15)(6{,}000) - \$50{,}000} = \frac{\$60{,}000}{\$10{,}000} = 6$$

which means if sales increase (decrease) by 1 percent, the company can expect its net income to increase (decrease) by six times that amount, or 6 percent.

Chapter 4 Review Questions – Section 1

1. Contribution margin is the excess of revenues over

A. Cost of goods sold.
B. Manufacturing cost.
C. Direct cost.
D. All variable costs.

2. Which of the following will result in raising the breakeven point (BEP)?

A. A decrease in the variable cost per unit.
B. An increase in the fixed cost per unit.
C. An increase in the contribution margin (CM) per unit.
D. A decrease in income tax rates.

3. The ratio of fixed costs to the unit contribution margin gives

A. Breakeven point.
B. Profit margin.
C. Operating profit.
D. Contribution margin ratio.

4. In using cost-volume-profit analysis to calculate expected unit sales, which of the following should be added to fixed costs in the numerator?

A. Predicted operating loss.
B. Target income (TI).
C. Unit contribution margin (CM).
D. Variable costs.

5. When an organization is operating above the breakeven point, the degree or amount that sales may decline before losses are incurred is called the

A. Residual income rate.
B. Marginal rate of return.
C. Margin of safety.
D. Target (hurdle) rate of return.

6. The percentage change in earnings before interest and taxes (EBIT) associated with the percentage change in sales volume is the degree of

A. Operating leverage.
B. Financial leverage.
C. Breakeven leverage.
D. Combined leverage.

7. A higher degree of operating leverage (DOL) compared with the industry average implies that the firm

A. Has higher variable costs.
B. Has profits that are more sensitive to changes in sales volume.
C. Is more profitable.
D. Is less risky.

4.7 Time Value of Money—Future and Present Values

You will often find that today's and tomorrow's dollars are treated the same when, in fact, they are not. A dollar now is worth more than a dollar to be received later. This statement sums up an important principle: money has a time value. The truth of this principle is not that inflation might make the dollar received at a later time worth less in buying power. The reason is that you could invest the dollar now and have more than a dollar at the specified later date.

Time value of money is a critical consideration in financial and investment decisions. For example, compound interest calculations are needed to determine future sums of money resulting from an investment. Discounting, or the calculation of present value, which is inversely related to compounding, is used to evaluate the future cash flow associated with capital budgeting projects. There are plenty of applications of time value of money in finance.

What is the importance of present (discounting) and future (compound) value calculations?

If you are a management executive, planner, financial or investment analyst, or investor, present and compound value calculations lie at the very heart of your decisions.

Use present and compound value techniques when estimating the present values of items reported in a statement of financial condition. BE AWARE: Every statement is composed of present values of asset, liability, and ownership interest. In reality, accountants do not report most items appearing on the statement in terms of present values, but rather on historical costs or some modification thereof. The longer an item appears on a statement, the less likely it is that these cost values relate to present values. You must be aware of this limitation in order to use the statement properly.

Present and compound value techniques are essential for planning purposes, particularly when estimating

- Present values used in investment and capital budget decisions
- Effects of inflation on organizational activities
- Present values of loans, bonds, annual installments to a sinking fund, and so on

What is money worth in the future?

A dollar in hand today is worth more than a dollar to be received tomorrow because of the interest it could earn from putting it in a savings account or placing it in an investment account. Compounding

interest means that interest earns interest. For the discussion of the concepts of compounding and time value, let us define:

F_n = future value = the amount of money at the end of year n
P = principal
i = annual interest rate
n = number of years

Then,

F_1 = the amount of money at the end of year 1
= principal and interest = P + iP = P(1+i)
F_2 = the amount of money at the end of year 2
= $F_1(1+i) = P(1+i)(1+i) = P(1+i)^2$

The future value of an investment compounded annually at rate i for n years is

$$F_n = P(1+i)^n = P \bullet T_1(i,n)$$

where $T_1(i,n)$ is the compound amount of \$1 and can be found in Table 4.1 at the end of the chapter.

EXAMPLE 4.17

You place \$1,000 in a savings account earning 8 percent interest compounded annually. How much money will you have in the account at the end of 4 years?

$F_n = P(1+i)^n$
$F_4 = \$1{,}000\ (1 + 0.08)^4 = \$1{,}000\ T_1(8\%,4 \text{ years})$

From Table 4.1, the T_1 for 4 years at 8 percent is 1.361. Therefore,

$F_4 = \$1{,}000\ (1.361) = \$1{,}361.$

EXAMPLE 4.18

You invested a large sum of money in the stock of PWU Corporation. The company paid a \$3 dividend per share. The dividend is expected to increase by 20 percent per year for the next 3 years. You wish to project the dividends for years 1 through 3.

$F_n = P(1+i)^n$
$F_1 = \$3(1+0.2)^1 = \$3\ T_1(20\%,1) = \$3\ (1.200) = \$3.60$
$F_2 = \$3(1+0.2)^2 = \$3\ T_1(20\%,2) = \$3\ (1.440) = \$4.32$
$F_3 = \$3(1+0.2)^3 = \$3\ T_1(20\%,3) = \$3\ (1.728) = \$5.18$

How does intrayear compounding affect future values?

Interest is often compounded more frequently than once a year. Banks, for example, compound interest quarterly, daily and even continuously. If interest is compounded m times a year, then the general formula for solving the future value becomes

$$F_n = P(1+\frac{i}{m})^{n\bullet m} = P\bullet T_1(i/m, n\bullet m)$$

The formula reflects more frequent compounding (n•m) at a smaller interest rate per period (i/m). For example, in the case of semiannual compounding (m = 2), the above formula becomes

$$F_n = P(1+i/2)^{n\bullet 2} = P \bullet T_1(i/2, n\bullet 2)$$

EXAMPLE 4.19

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 calculated as follows:

$$F_n = P(1+\frac{i}{m})^{n\bullet m} = P\bullet T_1(i/m, n\bullet m)$$

where P = $10,000
i/m = 20%/4 = 5%
n•m = 5 x 4 = 20

Therefore,

$$F_5 = \$10,000(1 + .05)^{20} = \$10,000\ T_1(5\%, 20) = \$10,000\ (2.653) = \$26,530$$

EXAMPLE 4.20

Assume that P = $1,000, i = 8% and n = 2 years. Then for

Annual compounding (m=1):

$$F_2 = \$1,000(1+0.08)^2 = \$1,000\ T_1(8\%, 2) = \$1,000(1.166) = \$1,166.00$$

Semiannual compounding (m=2):

$$F_2 = \$1,000(1+\frac{0.08}{2})^{2\bullet 2}$$
$$= \$1,000(1+.04)^4 = \$1,000\ T_1(4\%, 4)$$
$$= \$1,000(1.170)$$

= $1,170.00

Quarterly compounding (m=4):

$$F_2 = \$1{,}000\left(1 + \frac{0.08}{4}\right)^{2\bullet 4}$$
$$= \$1{,}000(1+.02)^8 = \$1{,}000\, T_1(2\%,8)$$
$$= \$1{,}000(1.172)$$
$$= \$1{,}172.00$$

As the example shows, the more frequently interest is compounded, the greater the amount accumulated. This is true for any interest for any period of time.

How do I determine future value of an ordinary annuity?

An annuity is defined as a series of payments (or receipts) of a fixed amount for a specified number of periods. Each payment is assumed to occur at the *end of the period*. The future value of an annuity is a compound annuity which involves depositing or investing an equal sum of money at the end of each year for a certain number of years and allowing it to grow.

Let S_n = the future value on an n-year annuity

A = the amount of an annuity

Then we can write

$$S_n = A(1+i)^{n-1} + A(1+i)^{n-2} + \ldots + A(1+i)^0$$

$$= A[(1+i)^{n-1}+(1+i)^{n-2}+ \ldots + (1+i)^0]$$

$$= A \bullet \sum_{t=0}^{n-1}(1+i)^t = A\left[\frac{(1+i)^n - 1}{i}\right] = A \bullet T_2(i,n)$$

where $T_2(i,n)$ represents the future value of an annuity of $1 for n years compounded at i percent and can be found in Table 4.2 .

EXAMPLE 4.21

You wish to determine the sum of money you will have in a savings account at the end of 6 years by depositing $1,000 at the end of each year for the next 6 years. The annual interest rate is 8 percent. The T_2(8%,6 years) is given in Table 4.2 as 7.336. Therefore,

$S_6 = \$1{,}000\ T_2(8\%,6) = \$1{,}000\ (7.336) = \$7{,}336$

EXAMPLE 4.22

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:

$$S_n = A \bullet T_2(i, n)$$

where A = $30,000
i = 8%/2 = 4%
n = 10 x 2 = 20

Therefore,

$$S_n = \$30{,}000\ T_2(4\%, 20)$$
$$= \$30{,}000\ (29.778) = \$893{,}340$$

What is present value? How much money is worth now?

Present value is the present worth of future sums of money. The process of calculating present values, or discounting, is actually the opposite of finding the compounded future value. In connection with present value calculations, the interest rate i is called the *discount rate*. The discount rate we use is more commonly called the *cost of capital*, which is the minimum rate of return required by the investor.

Recall that $F_n = P\ (1+i)^n$

Therefore,

$$P = \frac{F_n}{(1+i)^n} = F_n \left[\frac{1}{(1+i)^n}\right] = F_n \,.\, T_3(i,n)$$

Where $T_3(i,n)$ represents the present value of $1 and is given in Table 4.3.

EXAMPLE 4.23

You have been given an opportunity to receive $20,000 6 years from now. If you can earn 10 percent on your investments, what is the most you should pay for this opportunity? To answer this question, you must compute the present value of $20,000 to be received 6 years from now at a 10 percent rate of discount. F_6 is $20,000, i is 10 percent, and n is 6 years. $T_3(10\%,6)$ from Table 4.3 is 0.565.

$P = \$2{,}000\left[\frac{1}{(1+0.1)^{6}}\right] = \$20{,}000\ T_3(10\%,6) = \$20{,}000(0.565) = \$11{,}300$

This means that you can earn 10 percent on your investment, and you would be indifferent to receiving $11,300 now or $20,000 6 years from today since the amounts are time equivalent. In other words, you could invest $11,300 today at 10 percent and have $20,000 in 6 years.

How do you compute mixed streams of cash flows?

The present value of a series of mixed payments (or receipts) is the sum of the present value of each individual payment. We know that the present value of each individual payment is the payment times the appropriate T_3 value.

EXAMPLE 4.24

You are thinking of starting a new product line that initially costs $32,000. Your annual projected cash inflows are:

Year 1	$10,000
Year 2	$20,000
Year 3	$5,000

If you must earn a minimum of 10 percent on your investment, should you undertake this new product line?

The present value of this series of mixed streams of cash inflows is calculated as follows:

Year	*Cash inflows*	*x T_3(10%, n)*	*Present Value*
1	$10,000	0.909	$9,090
2	$20,000	0.826	$16,520
3	$5,000	0.751	$3,755
			$29,365

Since the present value of your projected cash inflows is less than the initial investment, you should not undertake this project.

What is the present value of an annuity?

Interest received from bonds, pension funds, and insurance obligations all involve annuities. To compare these financial instruments, we need to know the present value of each. The present value of an annuity (P_n) can be found by using the following equation:

$$P_n = A \bullet \left[\frac{1}{(1+i)^1}\right] + A \bullet \left[\frac{1}{(1+i)^2}\right] + \bullet\bullet\bullet + A \bullet \left[\frac{1}{(1+i)^n}\right]$$

$$= A \bullet \left[\frac{1}{(1+i)^1} + \frac{1}{(1+i)^2} + \bullet\bullet\bullet + \frac{1}{(1+i)^n}\right]$$

$$= A \bullet \sum_{t=1}^{n} \frac{1}{(1+i)^t} = A \bullet \frac{1}{i}\left[1 - \frac{1}{(1+i)}\right]$$

$$= A \bullet T_4(i,n)$$

where $T_4(i,n)$ represents the present value of an annuity of \$1 discounted at i percent for n years and is found in Table 4.4 .

EXAMPLE 4.25

Assume that the cash inflows in Example 4.24 form an annuity of \$10,000 for 3 years. Then the present value is

$P_n = A \bullet T_4(i,n)$

$P_3 = \$10{,}000\ T_4(10\%, 3 \text{ years}) = \$10{,}000\ (2.487) = \$24{,}870$

What is perpetuities?

Some annuities go on forever, called perpetuities. An example of a perpetuity is preferred stock which yields a constant dollar dividend indefinitely. The present value of a perpetuity is found as follows:

Present value of a perpetuity = $\frac{\text{receipt}}{\text{discount rate}} = \frac{A}{i}$

EXAMPLE 4.26

Assume that a perpetual bond has an $80-per-year interest payment and that the discount rate is 10 percent. The present value of this perpetuity is:

$$P = \frac{A}{i} = \frac{\$80}{0.10} = \$800$$

What are the uses of present and compound values?

Future and present values have numerous applications in financial and investment decisions. Six of these applications are presented below.

DEPOSITS TO ACCUMULATE A FUTURE SUM (OR SINKING FUND)

A financial manager might wish to find the annual deposit (or payment) that is necessary to accumulate a future sum. To find this future amount (or sinking fund) we can use the formula for finding the future value of an annuity.

$$S_n = A \bullet T_2(i,n)$$

Solving for A, we obtain:

$$\text{Annual deposit amount} = A = \frac{S_n}{T_2(i,n)}$$

EXAMPLE 4.27

You wish to determine the equal annual end-of-year deposits required to accumulate $5,000 at the end of 5 years in a fund. The interest rate is 10 percent. The annual deposit is:

$S_5 = \$5,000$

$T_2(10\%, 5 \text{ years}) = 6.105$ (from Table 4.2)

$$A = \frac{\$5{,}000}{6.105} = \$819$$

In other words, if you deposit $819 at the end of each year for 5 years at 10 percent interest, you will have accumulated $5,000 at the end of the fifth year.

EXAMPLE 4.28

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

S_{30} = $1,000,000

T_2(10%, 30 years) = 164.49

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

AMORTIZED LOANS

If a loan is to be repaid in equal periodic amounts, it is said to be an amortized loan. Examples include auto loans, mortgage loans, and most commercial loans. The periodic payment can easily be computed as follows:

$$P_n = A \bullet T_4(i,n)$$

Solving for A, we obtain:

$$\text{Amount of loan} = A = \frac{P_n}{T_4(i,n)}$$

EXAMPLE 4.29

You borrow $200,000 for five years at an interest rate of 14 percent. The annual year-end payment on the loan is calculated as follows:

P_5 = $200,000

T_4(14%, 5 years) = 3.433 (from Table 4.4)

Amount of loan = A = $\frac{P_5}{T_4(14\%,5 \text{ years})} = \frac{\$200,000}{3.433}$

= $58,258.08

EXAMPLE 4.30

You take out a 40-month bank loan of $5,000 at a 12 percent annual interest rate. You want to find out the monthly loan payment.

i = 12% / 12 months = 1%

P_{40} = $5,000

T_4(1%, 40 months) = 32.835 (from Table 4.4)

Therefore, A = $\frac{\$5,000}{32.835}$ = $152.28

So, to repay the principal and interest on a $5,000, 12 percent, 40-month loan, you have to pay $152.28 a month for the next 40 months.

EXAMPLE 4.31

Assume that a firm borrows $2,000 to be repaid in three equal installments at the end of each of the next 3 years. The bank charges 12 percent interest. The amount of each payment is

P_3 = $2,000

T_4(12%, 3 years) = 2.402

Therefore, A = $\frac{\$2,000}{2.402}$ = $832.64

HOW TO DEVELOP LOAN AMORTIZATION SCHEDULE

Each loan payment consists partly of interest and partly of principal. The breakdown is often displayed in a loan amortization schedule. The interest component of the payment is largest in the first period (because the principal balance is the highest) and subsequently declines, whereas the principal portion is smallest in the first period (because of the high interest) and increases thereafter, as shown in the following example.

EXAMPLE 4.32

Using the same data as in Example 4.31, we set up the following amortization schedule:

Year	Payment	Interest	Repayment of Principal	Remaining Balance
0				$2,000.00
1	$832.64	$240.00(a)	$592.64(b)	$1,407.36
2	$832.64	$168.88	$663.76	$743.60
3	$832.64	$89.23	$743.41(c)	

(a) Interest is computed by multiplying the loan balance at the beginning of the year by the interest rate. Therefore, interest in year 1 is $2,000(0.12) = $240; in year 2 interest is $1,407.36(0.12) = $168.88; and in year 3 interest is $743.60(0.12) = $89.23. All figures are rounded.

(b) The reduction in principal equals the payment less the interest portion ($832.64 - $240.00 = $592.64)

(c) Not exact because of accumulated rounding errors.

ANNUAL PERCENTAGE RATE (APR)

Different types of investments use different compounding periods. For example, most bonds pay interest semiannually; banks generally pay interest quarterly. If a financial manager wishes to compare investments with different compounding periods, he or she needs to put them on a common basis. The annual percentage rate (APR), or effective annual rate, is used for this purpose and is computed as follows:

$$APR = \left(1 + \frac{i}{m}\right)^m - 1.0$$

where i = the stated, nominal or quoted rate and m = the number of compounding periods per year.

EXAMPLE 4.33

If the nominal rate is 6 percent, compounded quarterly, the APR is

$$APR = (1+\frac{i}{m})^{m}-1.0 = (1+\frac{0.06}{4})^{4}-1.0 = (1.015)^{4}-1.0 = 1.0614-1.0 = 0.0614 = 6.14\%$$

This means that if one bank offered 6 percent with quarterly compounding, while another offered 6.14 percent with annual compounding, they would both be paying the same effective rate of interest.

Annual percentage rate (APR) also is a measure of the cost of credit, expressed as a yearly rate. It includes interest as well as other financial charges such as loan origination and certain closing fees. The lender is required to tell you the APR. It provides you with a good basis for comparing the cost of loans, including mortgage plans.

RATES OF GROWTH

In finance, it is necessary to calculate the compound annual rate of growth, associated with a stream of earnings. The compound annual growth rate in earnings per share is computed as follows:

$$F_n = P \bullet T_1(i,n)$$

Solving this for T_1, we obtain

$$T_1(i,n) = \frac{F_n}{P}$$

EXAMPLE 4.34

Assume that your company has earnings per share of $2.50 in 2X10, and 10 years later the earnings per share has increased to $3.70. The compound annual rate of growth in earnings per share is computed as follows:

F_{10} = $3.70 and P = $2.50

Therefore,

$$T_1(i,10) = \frac{\$3.70}{\$2.50} = 1.48$$

From Table 4.1, an T_1 of 1.48 at 10 years is at i = 4%. The compound annual rate of growth is therefore 4 percent.

BOND VALUES

Bonds call for the payment of a specific amount of interest for a stated number of years and the repayment of the face value at the maturity date. Thus, a bond represents an annuity plus a lump sum. Its value is found as the present value of the payment stream. The interest is usually paid semiannually.

$$V = \sum_{t=1}^{n} \frac{I}{(1+i)^t} + \frac{M}{(1+i)^n}$$

$$= I \bullet T_4(i,n) + M \bullet T_3(i,n)$$

where I = interest payment per period

M = par value, or maturity value, usually $1,000

i = investor's required rate of return

n = number of periods

EXAMPLE 4.35

Assume there is a 10-year bond with a 10 percent coupon, paying interest semiannually and having a face value of $1,000. Since interest is paid semiannually, the number of periods involved is 20 and the semiannual cash inflow is $100/2 = $50.

Assume that you have a required rate of return of 12 percent for this type of bond. Then, the present value (V) of this bond is:

$$V = \$50 \bullet T_4(6\%, 20) + \$1{,}000 \bullet T_3(6\%, 20)$$

$$= \$50(11.470) + \$1{,}000(0.312) = \$573.50 + \$312.00 = \$885.50$$

NOTE*:* The required rate of return (12 percent) is higher than the coupon rate of interest (10 percent), and so the bond value (or the price investors are willing to pay for this particular bond) is less than its $1,000 face value.

Can a computer help?

Besides manual calculations using future and present value tables discussed so far, these calculations also can be done using:

(a) Financial calculators

(b) Spreadsheet software such as *Excel*.

NOTE: Depending on the method you use, rounding errors in answers are unavoidable. Computer software can be extremely helpful in making these calculations. For example, PV(rate,nper,pmt,fv,type) of Excel determines the present value of an investment, based on a series of equal payments, discounted at a periodic interest rate over the number of periods. To calculate the present value of an annuity due, use the following formula: PV(rate,nper,pmt,fv,type)*(1 + rate).

What are limitations of present and compound-value techniques?

What are some assumptions that underlie the present- and compound-value techniques? First, all the ingredients (or variables) used in the calculation of present or compound value (amounts being discounted or subject to growth, the interest rates used, and the discount or growth periods) are known with certainty. Second, the interest rate used for discounting or growth is constant over the given time period. Third, all amounts in a series are equal to each other. The second and third assumptions can be dropped, but doing so leads to an entirely new realm replete with difficulties. If the first assumption is dropped, then various statistical estimation techniques will be necessary and present and compound values become subject to statistical estimation rather than arithmetic calculation.

In the real world, you are always confronted with uncertainty. This means that appropriate statistical techniques should be used to determine best estimates for each variable.

TABLE 4.1

The Future Value of $1

(Compound Amount of $1.00) = (1 + i)n = T1(i, n)

Periods	4%	6%	8%	10%	12%	14%	20%
1	1.040	1.060	1.080	1.100	1.120	1.140	1.200
2	1.082	1.124	1.166	1.210	1.254	1.300	1.440
3	1.125	1.191	1.260	1.331	1.405	1.482	1.728
4	1.170	1.263	1.361	1.464	1.574	1.689	2.074
5	1.217	1.338	1.469	1.611	1.762	1.925	2.488
6	1.265	1.419	1.587	1.772	1.974	2.195	2.986
7	1.316	1.504	1.714	1.949	2.211	2.502	3.583
8	1.369	1.594	1.851	2.144	2.476	2.853	4.300
9	1.423	1.690	1.999	2.359	2.773	3.252	5.160
10	1.480	1.791	2.159	2.594	3.106	3.707	6.192
11	1.540	1.898	2.332	2.853	3.479	4.226	7.430
12	1.601	2.012	2.518	3.139	3.896	4.818	8.916
13	1.665	2.133	2.720	3.452	4.364	5.492	10.699
14	1.732	2.261	2.937	3.798	4.887	6.261	12.839
15	1.801	2.397	3.172	4.177	5.474	7.138	15.407
16	1.873	2.540	3.426	4.595	6.130	8.137	18.488
17	1.948	2.693	3.700	5.055	6.866	9.277	22.186
18	2.026	2.854	3.996	5.560	7.690	10.575	26.623
19	2.107	3.026	4.316	6.116	8.613	12.056	31.948
20	2.191	3.207	4.661	5.728	9.646	13.743	38.338
30	3.243	5.744	10.063	17.450	29.960	50.950	237.380
40	4.801	10.286	21.725	45.260	93.051	188.880	1469.800

TABLE 4.2

The Future Value of an Annuity of $1

(Compound Amount of an Annuity of $1) = T2(i,n)

Periods	4%	6%	8%	10%	12%	14%	20%
1	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	2.040	2.060	2.080	2.100	2.120	2.140	2.200
3	3.122	3.184	3.246	3.310	3.374	3.440	3.640
4	4.247	4.375	4.506	4.641	4.779	4.921	5.368
5	5.416	5.637	5.867	6.105	6.353	6.610	7.442
6	6.633	6.975	7.336	7.716	8.115	8.536	9.930
7	7.898	8.394	8.923	9.487	10.089	10.730	12.916
8	9.214	9.898	10.637	11.436	12.300	13.233	16.499
9	10.583	11.491	12.488	13.580	14.776	16.085	20.799
10	12.006	13.181	14.487	15.938	17.549	19.337	25.959
11	13.486	14.972	16.646	18.531	20.655	23.045	32.150
12	15.026	16.870	18.977	21.385	24.133	37.271	39.580
13	16.627	18.882	21.495	24.523	28.029	32.089	48.497
14	18.292	21.015	24.215	27.976	32.393	37.581	59.196
15	20.024	23.276	27.152	31.773	37.280	43.842	72.035
16	21.825	25.673	30.324	35.950	42.753	50.980	87.442
17	23.698	28.213	33.750	40.546	48.884	59.118	105.930
18	25.645	30.906	37.450	45.600	55.750	68.394	128.120
19	27.671	33.760	41.446	51.160	63.440	78.969	154.740
20	29.778	36.778	45.762	57.276	75.052	91.025	186.690
30	56.085	79.058	113.283	164.496	241.330	356.790	1181.900
40	95.026	154.762	259.057	442.597	767.090	1342.000	7343.900

*Payments (or receipts) at the *end* of each period.

TABLE 4.3

THE PRESENT VALUE OF $1 = T_3 (i,n)

Periods	*4%*	*6%*	*8%*	*10%*	*12%*	*14%*	*16%*	*18%*	*20%*	*22%*	*24%*	*26%*	*28%*	*30%*	*40%*
1	.962	.943	.926	.909	.893	.877	.862	.847	.833	.820	.806	.794	.781	.769	.714
2	.925	.890	.857	.826	.797	.769	.743	.718	.694	.672	.650	.630	.610	.592	.510
3	.889	.840	.794	.751	.712	.675	.641	.609	.579	.551	.524	.500	.477	.455	.364
4	.855	.792	.735	.683	.636	.592	.552	.516	.482	.451	.423	.397	.373	.350	.260
5	.822	.747	.681	.621	.567	.519	.476	.437	.402	.370	.341	.315	.291	.269	.186
6	.790	.705	.630	.564	.507	.456	.410	.370	.335	.303	.275	.250	.227	.207	.133
7	.760	.665	.583	.513	.452	.400	.354	.314	.279	.249	.222	.198	.178	.159	.095
8	.731	.627	.540	.467	.404	.351	.305	.266	.233	.204	.179	.157	.139	.123	.068
9	.703	.592	.500	.424	.361	.308	.263	.225	.194	.167	.144	.125	.108	.094	.048
10	.676	.558	.463	.386	.322	.270	.227	.191	.162	.137	.116	.099	.085	.073	.035
11	.650	.527	.429	.350	.287	.237	.195	.162	.135	.112	.094	.079	.066	.056	.025
12	.625	.497	.397	.319	.257	.208	.168	.137	.112	.092	.076	.062	.052	.043	.018
13	.601	.469	.368	.290	.229	.182	.145	.116	.093	.075	.061	.050	.040	.033	.013
14	.577	.442	.340	.263	.205	.160	.125	.099	.078	.062	.049	.039	.032	.025	.009
15	.555	.417	.315	.239	.183	.140	.108	.084	.065	.051	.040	.031	.025	.020	.006
16	.534	.394	.292	.218	.163	.123	.093	.071	.054	.042	.032	.025	.019	.015	.005
17	.513	.371	.270	.198	.146	.108	.080	.060	.045	.034	.026	.020	.015	.012	.003
18	.494	.350	.250	.180	.130	.095	.069	.051	.038	.028	.021	.016	.012	.009	.002
19	.475	.331	.232	.164	.116	.083	.060	.043	.031	.023	.017	.012	.009	.007	.002
20	.456	.312	.215	.149	.104	.073	.051	.037	.026	.019	.014	.010	.007	.005	.001
21	.439	.294	.199	.135	.093	.064	.044	.031	.022	.015	.011	.008	.006	.004	.001
22	.422	.278	.184	.123	.083	.056	.038	.026	.018	.013	.009	.006	.004	.003	.001
23	.406	.262	.170	.112	.074	.049	.033	.022	.015	.010	.007	.005	.003	.002	
24	.390	.247	.158	.102	.066	.043	.028	.019	.013	.008	.006	.004	.003	.002	
25	.375	.233	.146	.092	.059	.038	.024	.016	.010	.007	.005	.003	.002	.001	
26	.361	.220	.135	.084	.053	.033	.021	.014	.009	.006	.004	.002	.002	.001	
27	.347	.207	.125	.076	.047	.029	.018	.011	.007	.005	.003	.002	.001	.001	
28	.333	.196	.116	.069	.042	.026	.016	.010	.006	.004	.002	.002	.001	.001	
29	.321	.185	.107	.063	.037	.022	.014	.008	.005	.003	.002	.001	.001	.001	
30	.308	.174	.099	.057	.033	.020	.012	.007	.004	.003	.002	.001	.001		
40	.208	.097	.046	.022	.011	.005	.003	.001	.001						

TABLE 4.4

THE PRESENT VALUE OF AN ANNUITY OF $1 = $T_4(i,n)$

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

Chapter 4 Review Questions – Section 2

8. Future value is best described as

A. The compound value of cash inflows or cash outflows at a future time.
B. The sum of cash flows discounted to time zero.
C. Future cash inflows discounted to the present.
D. The fair market value.

9. On November 1, 2010, a company purchased a new machine that it does not have to pay for until November 1, 2012. The total payment on November 1, 2012 will include both principal and interest. Assuming interest at a 10% rate, the cost of the machine would be the total payment multiplied by what time value of money concept?

A. Present value of annuity of 1.
B. Present value of 1.
C. Future amount of annuity of 1.
D. Future amount of 1.

10. Pole Co. is investing in a machine with a 3-year life. The machine is expected to reduce annual cash operating costs by $30,000 in each of the first 2 years and by $20,000 in year 3. Using a 14% cost of capital (discount rate), what is the present value of these future savings? Present values of $1 at 14% are: Period 1 = 0.877; Period 2 = 0.769; Period 3 = 0.675.

A. $59,630
B. $69,630
C. $62,880
D. $69,380

11. The discount rate ordinarily used in present value calculations is the

A. Federal Reserve rate.
B. Treasury bill rate.
C. Minimum required rate of return set by the firm.
D. Prime rate.

12. John Watson's uncle recently passed away, and included in the property that he inherited is a bond that pays an 8% coupon, has a face value of $1,000, has 10 years to maturity, and the investors require a rate of return of 10%. Assuming annual coupon payments, what is the value of the bond?

A. $386
B. $491.60
C. $614.50
D. $877.60

Chapter 5:

Capital Budgeting

Learning Objectives:

After completing this section, you should be able to:

- Recognize the uses of capital budgeting.
- Identify the different techniques used to evaluate business investments and their applications.

Capital budgeting involves planning for the best selections and financing of long-term investments. In this chapter, the following six techniques are described to help you select the best long-term investment proposals:

- Payback period
- Discounted payback period
- Accounting (simple) rate of return (ARR)
- Net present value (NPV)
- Internal rate of return (IRR) (or time adjusted rate of return)
- Profitability index (or present value index)

Your selection will necessarily involve judgments about future events about which you have no direct knowledge. Your task will be to minimize your chances of being wrong. The risk-return trade-off method shown in this chapter is one way to help you come to grips with uncertainty.

5.1 Capital Budgeting

What is capital budgeting?

Capital budgeting is a plan that assesses the best selections and financing of long-term investments. It can be done in a number of ways, four of which are described in this chapter. Understanding these

techniques is important for managerial accountants and management executives in both for-profit and nonprofit industries. Mid-level managers should also be familiar with capital budgeting**,** because they are also concerned with investment and management of resources to a degree.

What are the uses of capital budgeting?

Whenever you are faced with a decision of how to grow you have a capital budgeting problem. Ask yourself these questions:

- Should I replace certain equipment?
- Should I expand facilities by renting additional space, buying an existing building, or constructing a new building?
- Should I invest in high-tech information technology (IT)?
- Should I launch on new product development?
- Do I have an opportunity to refinance an outstanding debt issue? Should I do it?
- I've been contemplating a merger. Should I go ahead with it?
- I've been thinking about adding a new product to our line. Should I?
- I'm considering a new major advertising campaign. Should I hold off?

What are the features of investment projects?

Long-term investments have three important features:

1. They typically involve a large amount of initial cash outlay which tend to have a long-term impact on the firm's future profitability. Therefore, this initial cash outlay needs to be justified on a cost-benefit basis.

2. There are expected recurring cash inflows (for example, increased revenues, savings in cash operating expenses, etc.) over the life of the investment project. This frequently requires considering the *time value of money*. 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.

3. Income taxes could make a difference in the accept or reject decision. Therefore, income tax factors must be taken into account in every capital budgeting decision.

5.2 Techniques for Evaluating Investment Proposals

What are the popular evaluation techniques?

Several methods of evaluating investment projects are as follows:

- Payback period
- Discounted payback period
- Accounting (simple) rate of return (ARR)
- Net present value (NPV)
- Internal rate of return (IRR) (or time adjusted rate of return)
- Profitability index (or present value index)

The NPV method and the IRR method are called *discounted cash flow (DCF) methods*. Each of these methods is discussed below.

How do you determine the payback period?

The payback period measures the length of time required to recover the amount of initial investment. When the annual cash flows are constant and of equal amounts, then the payback period can be calculated by dividing the initial investment by the cash inflows through increased revenues or cost savings.

EXAMPLE 5.1

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. NOTE: When periodic cash flows are not equal, then calculation of the payback period is more complex.

EXAMPLE 5.2

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

	Cash	Inflow
Year	A($)	B($)
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):

$$\text{2 years} + \frac{\$100}{\$300} = 2\,{}^{1}\!/_{3}\ \text{years}$$

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

What are the pros and cons of the payback period method?

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 inflow received after the payback period; essentially, cash flows after the payback period determine profitability of an investment.

How do you determine the 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 5.3

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

Year	Cash inflows	T1 factor	Present value	Accumulated present value
1	$15,000	.9091	$13,637	$13,637
2	20,000	.8264	16,528	30,165
3	28,000	.7513	21,036	51,201

Thus, it takes 2 years to get $30,165 plus an additional .47 years [($40,000-$30,165)/21,036], for a total of 2.47 years.

What is the accounting rate of return?

Accounting rate of return (ARR) 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 5.4

Consider the following investment:

Initial investment	$6,500
Estimated life	20 years
Cash inflows per year	$1,000
Depreciation per year (using straight line method)	$325

$$\text{ARR} = \frac{\text{Project's Average Annual Income}}{\text{Initial (or Average) Investment}}$$

Average investment is defined as follows:

$$\text{Average investment} = \frac{(I - S)}{2} + S$$

where I = initial (original) investment and S = salvage value.

When there is no salvage value, the average investment = $\frac{I}{2}$

DECISION RULE: Under the ARR method, choose the project with the higher rate of return.

What are the benefits and drawbacks of the ARR method?

The advantages of this method are that it is understandable, 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 income data instead of cash flow data.

What is internal rate of return?

Internal rate of return (IRR) is defined as the rate of interest that equates I with the PV of future cash inflows. In other words, at IRR

$$I = PV$$

or

$$NPV = 0$$

DECISION RULE: Accept the project if the IRR exceeds the cost of capital. Otherwise, reject it.

EXAMPLE 5.5

Consider the following investment:

Initial investment	$37,910
Estimated life	5 years
Annual cash inflows after taxes	$10,000
Cost of capital (minimum required rate of return)	8%

We set the following equality (I = PV):

$$\$37,910 = \$10,000 \,.\, T4(i,5 \text{ years})$$

$$T4(i,5 \text{ years}) = \$37,910 / \$10,000 = 3.791$$

which is right on 10% in the 5-year line of Table 4.4.

Since the IRR of the investment is greater than the cost of capital (8 percent), accept the project. Note that the cost of capital is also called as a hurdle rate or minima required rate of return.

What are the benefits and drawbacks of the IRR method?

The advantage of using the IRR method is that it considers 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 business calculators and spreadsheet software have a program to calculate IRR, and (2) it fails to recognize the varying sizes of investment in competing projects.

NOTE: When cash inflows are not even, IRR is computed by the trial and error method, which is not discussed here. Financial calculators such as Texas Instruments and Sharp have a key for IRR calculations.

What is 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):

$$NPV = PV - I$$

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. In the case of an annuity, the present value would be

$$PV = A \bullet T_4 (i, n)$$

where A is the amount of the annuity. The value of T_4 is found in Table 4.4 of Chapter 4.

DECISION RULE: If NPV is positive, accept the project. Otherwise reject it.

EXAMPLE 5.6

Assume the same data given in Example 5.5 and the net present value of the cash inflows is:

Present value of the cash inflows is:	
$PV = A \bullet T_4 (i, n)$	
= \$10,000. T4(8%,5 years)	
= \$10,000 (3.993)	\$39,930
Initial investment (I)	37,910
Net present value (NPV = PV - I)	\$ 2,020

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

What are the pros and cons of the NPV method?

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 are in the form of an annuity or vary from period to period. The drawback of this method is that it does not give a percentage gain relative to the investments for the project.

Using a spreadsheet to help

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 3, suppose you want to calculate the IRR of a $37,910 investment (the value --37910 entered in year 0 that is followed by 5 monthly cash inflows of $10,000). Using a guess of 8% (the value of 0.08), which is in effect the cost of capital, your formula would be @IRR(values, 0.08) and Excel would return 10%, as shown below.

Year 0	*1*	*2*	*3*	*4*	*5*
-37910	10000	10000	10000	10000	10000
IRR=	10%				
NPV=	$2,017.10				

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

How does the profitability index work?

The profitability index uses the same variables as NPV but combines them differently. Profitability index (P1) is defined as 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 PI is greater than 1, then the project is a good candidate for investment.

EXAMPLE 5.7

Using the data in Example 5.5, the profitability index is

PV/I = $39,930 / $37,910 = 1.05

Since this project generates $1.05 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.

What is capital rationing and how do you select the best mix of projects with a limited budget?

Capital rationing occurs whenever a company cannot or will not undertake all investment projects with NPV greater than or equal to zero. Usually the company has set an upper limit to its capital budget, thereby preventing it from undertaking all projects. 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. Normally, when comparing more than one project, the one with the highest PI is the more profitable. CAUTION: A higher PI does not always coincide with the project with the highest NPV.

EXAMPLE 5.8

A company with a fixed budget of $250,000 needs to select a mix of acceptable projects from the following:

Projects	*I($)*	*PV($)*	*NPV($)*	*Profitability Index*	*Ranking*
A	70,000	112,000	42,000	1.60	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.

	I	*PV*
A	$70,000	$112,000
B	100,000	145,000
D	60,000	79,000
	$230,000	$336,000

Therefore,

$$NPV = \$336,000 - \$230,000 = \$106,000$$

How do the projects relate to each other?

Investment projects are either independent or mutually exclusive. They are *independent* if both can be undertaken simultaneously. When this occurs, there's no need to rank one project over another. Projects are *mutually exclusive* when only one project can be carried out. Then it is necessary to rank the projects to determine which is most attractive.

How do you choose between 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 (for example, two alternative uses of a single plot of land). 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 assumes that cash flows are reinvested at the often unrealistic rate specified by the project's internal rate of return. Thus, the implied reinvestment rate will differ from project to project.

Thus, the relative desirability of mutually exclusive projects depends on what rate of return the subsequent cash flows can earn. The NPV method generally gives correct ranking, since the cost of capital is a more realistic reinvestment rate. The cost of capital tends to give a close approximation for the market rate of return.

EXAMPLE 5.9

Assume the following:

	Cash Flows					
	0	1	2	3	4	5
A	(100)	120				
B	(100)					201.14

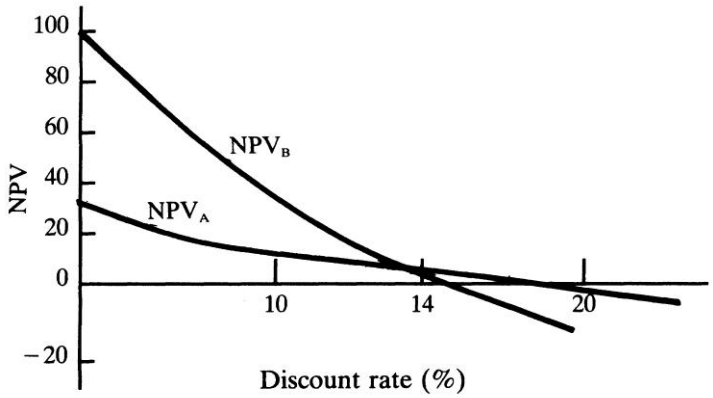
Computing IRR and NPV at 10 percent gives the following different rankings:

	IRR	NPV at 10%
A	20%	9.08
B	15%	24.90

The difference in ranking between the two methods is caused by the methods' reinvestment rate assumptions. The IRR method assumes Project A's cash inflow of $120 is reinvested at 20% for the subsequent 4 years and the NPV method assumes $120 is reinvested at 10%. The correct decision is to select the project with the higher NPV (that is, Project B), since the NPV method assumes a more realistic reinvestment rate, that is, the cost of capital (10% in this example).

The net present values plotted against various discount rates (costs of capital) results in the NPV profiles for projects A and B (Figure 5.1). An analysis of Figure 5.1 indicates that at a discount rate larger than 14 percent, A has a higher NPV than B. Therefore, A should be selected. At a discount rate less than 14 percent, B has the higher NPV than A, and thus should be selected.

FIGURE 5.1
THE NPV GRAPH



The correct decision is to select the project with the higher NPV, since the NPV method assumes a more realistic reinvestment rate, that is, the cost of capital.

Which is the preferable project if NPV and IRR do not give consistent signals?

In order to resolve this conflict, you need to know the interest rate or rates at which the company will be able to reinvest net cash inflows from the projects as these funds are generated. In other words, you need to forecast future or compound values of the net cash inflows as of the end of the expected life of the projects.

What is the use of Modified Internal Rate of Return?

The modified internal rate of return (MIRR) is defined as the discount rate which forces the Initial cash outlay = present value of terminal (future) value compounded at the cost of capital**.**

The MIRR forces cash flow reinvestment at the cost of capital rather than at the project's own IRR, which was the problem with the IRR. MIRR avoids the problem of multiple IRRs. However, conflicts can still occur in ranking mutually exclusive projects with differing sizes. NPV should again be used when this occurs.

EXAMPLE 5.10:

Refer back to Example 5.9, where computing IRR and NPV at 10% gives the following different rankings:

Projects	IRR	NPV at 10%
A	20%	$ 9.08
B	15%	24.90

As noted, the correct decision is to select the project with the higher NPV (Project B), since the NPV method assumes a more realistic reinvestment rate, that is, the cost of capital (10% in this example). The MIRR overcomes this problem.

Project A's MIRR:

First, compute the project's terminal value at a 10% cost of capital.

$$120 \times T1(10\%, 4 \text{ years}) = 120 \times 1.4641 = 175.69$$

Next, find the IRR by setting:

$$100 = 175.69\ T3(\text{MIRR}, 5 \text{ years})$$

$$T3 = 100/175.69 = 0.5692, \text{ which gives MIRR} = \text{about } 12\%$$

Now we see the consistent ranking from both the NPV and MIRR methods.

	MIRR	NPV at 10%
A	12%	$ 9.01
B	15%	24.90

Note: Microsoft Excel has a function MIRR(values, finance_rate, reinvest_rate).

Chapter 5 Review Questions – Section 1

1. The technique that reflects the time value of money and is calculated by dividing the present value of the future net after-tax cash inflows that have been discounted at the desired cost of capital by the initial cash outlay for the investment is the

A. Net present value method
B. Capital rationing method.
C. Accounting rate of return method.
D. Profitability index method.

2. A characteristic of the payback method is that it

A. Neglects total project profitability.
B. Uses accrual accounting income in the numerator of the calculation.
C. Uses the estimated expected life of the asset in the denominator.
D. Uses the minimum required rate of return in the calculation.

3. The internal rate of return (IRR) is the

A. Hurdle rate or minimum rate of return.
B. Rate of interest for which the net present value is greater than 1.0.
C. Rate of interest for which the net present value is equal to zero.
D. Accounting rate of return.

4. Which one of the following statements about the payback method of investment analysis is correct? The payback method

A. Does not consider the time value of money.
B. Considers cash flows after the payback has been reached.
C. Uses discounted cash flow techniques.
D. Is rarely used in practice.

5. The technique that recognizes the time value of money by discounting the cash flows for a project over its life to time period zero using the company's minimum required rate of return is the

A. Net present value method.
B. Capital rationing method.

C. Payback method.
D. Accounting rate of return method.

5.3 Effect of Income Taxes on Capital Budgeting Decisions

How do income tax factors affect investment decisions?

Income taxes make a difference in many capital budgeting decisions. In other words, the project which is attractive on a before-tax basis may have to be rejected on an after-tax basis. Income taxes typically affect both the amount and the timing of cash flows. Since net income, not cash inflows, is subject to tax, *after-tax cash inflows* are not usually the same as after-tax net income.

Let us define:

S = Sales
E = Cash operating expenses
d = Depreciation
t = Tax rate

Then, before-tax cash inflows (or before-tax *cash savings*) = S - E and net income = S - E - d.

By definition,

$$\text{After-tax cash inflows} = \text{Before-tax cash inflows} - \text{Taxes}$$

$$= (S - E) - (S - E - d)\,(t)$$

Rearranging gives the short-cut formula:

$$\text{After-tax cash inflows} = (S - E)\,(1 - t) + (d)(t)$$

As can be seen, the deductibility of depreciation from sales in arriving at net income subject to taxes reduces income tax payments and thus serves as a tax shield.

Tax shield = Tax savings on depreciation = (d)(t)

EXAMPLE 5.11

Assume:

S = $12,000
E = $10,000
d = $500 per year using the straight line method
t = 30%

Then,

After-tax cash inflow = ($12,000 - $10,000) (1 - 0.3) + ($500)(0.3)

= ($2,000)(.7) + ($500)(0.3)

= $1,400 + $150 = $1,550

Note that a tax shield = tax savings on depreciation = (d)(t)

= ($500)(.3) = $150

Since the tax shield is dt, the higher the depreciation deduction, the higher the tax savings on depreciation. Therefore, an accelerated depreciation method (such as double-declining balance) produces higher tax savings than the straight-line method. Accelerated methods produce higher present values for the tax savings which may make a given investment more attractive.

EXAMPLE 5.12

The Shalimar Company estimates that it can save $2,500 a year in cash operating costs for the next ten years if it buys a special-purpose machine at a cost of $10,000. No salvage value is expected. Assume that the income tax rate is 30%, and the after-tax cost of capital (minimum required rate of return) is 10%. After-tax cash savings can be calculated as follows:

Note that depreciation by straight-line is $10,000/10 = $1,000 per year. Here before-tax cash savings = (S - E) = $2,500. Thus,

After-tax cash savings = (S - E) (1 - t) + (d)(t)

= $2,500(1 - 0.3) + $1,000(0.3)

= $1,750 + $300 = $2,050

To see if this machine should be purchased, the net present value can be calculated.

PV = $2,050 T_4(10%, 10 years) = $2,050 (6.145) = $12,597.25

Thus, NPV = PV - I = $12,597.25 - $10,000 = $2,597.25

Since NPV is positive, the machine should be bought.

What is the effect of MACRS on investment decisions?

Although the traditional depreciation methods still can be used for computing depreciation for book purposes, 1981 saw a new way of computing depreciation deductions for tax purposes. The new rule is

called the *Modified Accelerated Cost Recovery System* (MACRS) rule, as enacted by Congress in 1981 and then modified somewhat in 1986 under the Tax Reform Act of 1986. This rule is characterized as follows:

1. It abandons the concept of useful life and accelerates depreciation deductions by placing all depreciable assets into one of eight age property classes. It calculates deductions, based on an allowable percentage of the asset's original cost (See Tables 5.1 and 5.2). With a shorter life than useful life, the company would be able to deduct depreciation more quickly and save more in income taxes in the earlier years, thereby making an investment more attractive. The rationale behind the system is that this way the government encourages the company to invest in facilities and increase its productive capacity and efficiency. (Remember that the higher d, the larger the tax shield (d)(t)).
2. Since the allowable percentages in Table 5.2 add up to 100%, there is no need to consider the salvage value of an asset in computing depreciation.
3. The company may elect the straight line method. The straight-line convention must follow what is called the half-year convention. This means that the company can deduct only half of the regular straight-line depreciation amount in the first year. The reason for electing to use the MACRS optional straight-line method is that some firms may prefer to stretch out depreciation deductions using the straight-line method rather than to accelerate them. Those firms are the ones that just start out or have little or no income and wish to show more income on their income statements.

EXAMPLE 5.13

Assume that a machine falls under a 3-year property class and costs $3,000 initially. The straight line option under MACRS differs from the traditional straight line method in that under this method the company would deduct only $500 depreciation in the first year and the fourth year ($3,000/3 years =$1,000; $1,000/2=$500). The table below compares the straight line with half-year convention with the MMACRS.

Year	Straight Line (half-year) depreciation	Cost		MACRS %	MACRS deduction
1	$500	$3,000	x	33.3%	$999
2	1,000	3,000	x	44.5	1,335
3	1,000	3,000	x	14.8	444
4	500	3,000	x	7.4	222
	$3,000				$3,000

EXAMPLE 5.14

A machine costs $10,000. Annual cash inflows are expected to be $5000. The machine will be depreciated using the MACRS rule and will fall under the 3-year property class. The cost of capital after taxes is 10%. The estimated life of the machine is 5 years. The tax rate is 30%. The salvage value of the machine at the end of the fifth year is expected to be $1,200. The tax rate is 30%. Should you buy the machine? Use the NPV method.

The formula for computation of after-tax cash inflows (S - E)(1 - t)+ (d)(t) needs to be computed separately. The NPV analysis can be performed as follows:

					Present value Factor @ 10%	*Present value*
(S-E)(1 -t):						
	$5,000	$5,000 (1 - .3) = **$3,500**				
	For 5 years	for **5** years		**$3,500**	3.791(a)	$13,268.50
(d)(t):						
Year	*Cost*	*MACRS %*	*d*	*(d)(t)*		
1	$10,000 x	33.3%	$3,330	**$999**	.909(b)	908.09
2	$10,000 x	44.5	4,450	**1,335**	.826(b)	1,102.71
3	$10,000 x	14.8	1,480	**444**	.751(b)	333.44
4	$10,000 x	7.4	740	**222**	. 683(b)	151.63
Salvage value:						
	$1,200 in year 5:	$1,200(1-.3) = **$840**(c) in year **5**		**$840**	.621(b)	521.64
		Present value (PV)				$16,286.01

(a) T4 (10%, 5 years) = 3.791 (from Table 4.4 in Chapter 4).

(b) T3 values (year 1, 2, 3, 4, 5) obtained from Table 4.3 in Chapter 4.

(c) Any salvage value received under the MACRS rules is a *taxable gain* (the excess of the selling price over book value, $1,200 in this example), since the book value will be zero at the end of the life of the machine.

Since NPV = PV - I = $16,286.01 - $10,000 = $6,286.01 is positive, the machine should be bought.

TABLE 5.1
MODIFIED ACCELERATED COST RECOVERY SYSTEM
CLASSIFICATION OF ASSETS

Property class

Year	*3-year*	*5-year*	*7-year*	*10-year*	*15-year*	*20-year*
1	33.3%	20.0%	14.3%	10.0%	5.0%	3.8%
2	44.5	32.0	24.5	18.0	9.5	7.2
3	14.8a	19.2	17.5	14.4	8.6	6.7
4	7.4	11.5a	12.5	11.5	7.7	6.2
5		11.5	8.9a	9.2	6.9	5.7
6		5.8	8.9	7.4	6.2	5.3
7			8.9	6.6a	5.9a	4.9
8			4.5	6.6	5.9	4.5a
9				6.5	5.9	4.5
10				6.5	5.9	4.5
11				3.3	5.9	4.5
12					5.9	4.5
13					5.9	4.5
14					5.9	4.5
15					5.9	4.5
16					3.0	4.4
17						4.4
18						4.4
19						4.4
20						4.4
21						2.2
Total	100%	100%	100%	100%	100%	100%

a. Denotes the year of changeover to straight-line depreciation.

TABLE 5.2
MACRS TABLES BY PROPERTY CLASS

Property Class & Depreciation Method	*Useful Life (ADR Midpoint Life) "a"*	*Examples of Assets*
3-year property 200% declining balance	4 years or less	Most small tools are included; the law specifically excludes autos and light trucks from this property class.
5-year property 200% computers, declining balance	More than 4 years to Less than 10 years	Autos and light trucks, typewriters, copiers, duplicating equipment, heavy general- purpose trucks, and research and experimentation equipment are included.
7-year property 200% and declining balance	10 years or more to less than 16 years	Office furniture and fixtures most items of machinery and equipment used in production are included
10-year property 200% declining balance	16 years or more to less than 20 years	Various machinery and equipment, such as that used in petroleum distilling and refining and in the milling of grain, are included.
15-year property 150% declining balance	20 years or more to less than 25 years	Sewage treatment plants telephone and electrical distribution facilities, and land improvements are included.
20-year property 150% declining balance	25 years or more	Service stations and other real property with an ADR midpoint life of less than 27.5 years are included.
27.5-year property Straight-line	Not applicable	All residential rental property is included
31.5-year property Straight-line	Not applicable	All nonresidential property is included.

"a" The term ADR midpoint life means the "useful life" of an asset in a business sense; the appropriate ADR midpoint lives for assets are designated in the tax Regulations.

5.4 The Lease - Purchase Decision

What is the lease-purchase decision?

Firms considering the acquisition of new assets commonly confront the lease-purchase decision. It is a hybrid capital budgeting decision that forces a company to compare the leasing and financing (purchasing) alternatives.

Can you describe some of the leasing benefits?

There are tax benefits from leasing equipment rather than financing it with a term loan. Depending upon one's needs and the nature of one's business, the entire lease payment may be fully deductible as a business expense, thereby reducing one's taxable income. With a loan, only the interest and depreciation can be used for deductions. Another benefit a lease offers is 100 percent financing plus additional amounts on the equipment's costs to cover "soft costs," such as taxes, shipping, and installation. Some term loans offer 100 percent financing but, typically, they cover the cost of equipment only.

A lease can help one manage one's cash flow. The payments are usually lower than for a term loan. Since a lease payment often requires no down payment or deposit, one can get the equipment one needs without depleting one's reserve capital. The types of businesses that most often lease equipment to generate revenue are manufacturing, transportation, printing, and professional corporations, such as medical, law, or accounting firms. Leasing works well for such companies since they can keep their equipment current without having to dip into capital to do it. Since the business' capital is not being used for equipment, they can use it for business development and expansion.

What are loan benefits?

A loan is one's best choice, however, if one wishes to keep the equipment and build equity quickly. Loans can be structured so one can own the equipment outright at the end of the term.

Note: If one is sure one wants to retain one's equipment beyond the lease term and prefers to know the full cost of the financing up front, one may choose a Lease Purchase option. As its name implies, this option requires no additional payment to own the equipment at the end of the lease.

Can you prepare a present value comparison?

To make an intelligent financial decision on a lease-purchase, an after-tax cash outflow, *present value* comparison is needed. There are special steps to take when making this comparison. When considering

a lease, take the following steps:

1. Find the annual lease payment. Since the annual lease payment is typically made in advance, the formula used is:

$$\text{Amount of lease} = A + A.T4(i,n-1) \text{ or } A = \frac{\text{Amount of lease}}{1 + T4\,(i,n-1)}$$

Notice we use n-1 rather than n.

2. Find the after-tax cash outflows.

3. Find the present value of the after-tax cash outflows.

When considering a purchase, take the following steps:

1. Find the annual loan amortization by using:

$$A = \frac{\text{Amount of loan for the purchase}}{T4\,(i,n-1)}$$

The step may not be necessary since this amount is usually available.

2. Calculate the interest. The interest is segregated from the principal in each of the annual loan payments because only the interest is tax-deductible.

3. Find the cash outflows by adding interest and depreciation (plus any maintenance costs), and then compute the after-tax outflows.

4. Find the present value of the after-tax cash outflows, using Table 3 in the Appendix.

EXAMPLE 5.15

A firm has decided to acquire a computer system costing $100,000 that has an expected life of 5 years, after which the system is not expected to have any residual value. The system can be purchased by borrowing or it can be leased. If leasing is used, the lessor requires a 12% return. As is customary, lease payments are made in advance, that is, at the end of the year prior to each of the 10 years. The tax rate is 50% and the firm's cost of capital, or after-tax cost of borrowing, is 8%.

First compute the present value of the after-tax cash outflows associated with the leasing alternative.

1. Find the annual lease payment:

$$A = \frac{\text{Amount of lease}}{1 + T4\,(i,n-1)}$$

= $100,000 / [1 + T4 (12%,4 years)] = $100,000 / [1 = 3.3073]
= $100,000/ 4.3073 = $23,216 (rounded)

Steps 2 and 3 can be done in the same schedule, as follows:

Year	(1) Lease Payment($)	(2) Tax Savings($)	(3)=(1)-(2) After-Tax Cash Outflow($)	(4) PV at 8%	(5)=(3) x (4) PV of Cash Out-flow($,Rounded)
0	23,216		23,216	1.000	23,216
1-4	23,216	11,608 a	11,608	3.3121 b	38,447
5		11,608	(11,608)	0.6806 c	(7,900)
					53,763

a $23,216 X 50%
b From Table 4.4 in Chapter 4.
c From Table 4.3 in Chapter 4.

If the asset is purchased, the firm is assumed to finance it entirely with a 10% unsecured term loan. Straight-line depreciation is used with no salvage value. Therefore, the annual depreciation is $20,000 ($100,000/5 years).

1. In this alternative, first find the annual loan payment by using:

A = Amount of loan / T4 (i,n)
A = $100,000 / T4(10%,5 years)
A = $100,000 / 3.7906
A = $26,381 (rounded)

2. Calculate the interest by setting up a loan amortization schedule.

Year	(1) Loan Payments	(2) Beginning of Year Principal	(3)=(2)x10% Interest	(4)=(1)-(3) Principal	(5)=(2)-(4) End of Year Principal
1	26,381	100,000	10,000	16,381	83,619
2	26,381	83,619	8,362	18,019	65,600
3	26,381	65,600	6,560	19,821	45,779
4	26,381	45,779,2,398	4,578	21,803	23,976
5	26,381		2,398	23,983a	

a Because of rounding errors, there is a slight difference between (2) and (4)

Steps 3 (cash outflows) and 4 (present values of those outflows) can be done as shown below.

The sum of the present values of the cash outflows for leasing and purchasing by borrowing shows that purchasing is preferable because the PV of borrowing is less than the PV of leasing ($52,087 versus $53,761). The incremental savings are $1,674. NOTE: The slight discrepancy is due to rounding errors.

Lease Versus Purchase Evaluation Report

	Leasing		Purchase/Borrow						
Year	Lease Payments	Net After-Tax Cash Flow	Loan Payments	Interest Expense	Depreciation Expense	Net After-Tax Cash Flow	Present Value Factor	Discounted Cash Flow Leasing	Discounted Cash Flow Purchase
0	$ 23,216	$ 23,216					1	$ 23,216	
1	23,216	11,608	$ 26,381	$ 10,000	$ 20,000	$ 11,381	0.9259	10,748	10,538
2	23,216	11,608	26,381	8,362	20,000	12,200	0.8573	9,952	10,459
3	23,216	11,608	26,381	6,560	20,000	13,101	0.7938	9,214	10,400
4	23,216	11,608	26,381	4,578	20,000	14,092	0.735	8,532	10,358
5		(11,608)	26,381	2,398	20,000	15,182	0.6806	(7,900)	10,333
	$ 116,080	$ 58,040	$ 131,905	$ 31,898	$ 100,000	$ 65,956		$ 53,761	$ 52,087

	Lease Proposal	Purchase Proposal
Cost of machine	$ 100,000	$ 100,000
Terms of payment	5 years	5 years
Interest rate	12%	10%
Dow npayment		
Monthly lease payment at the end of the year	$ 23,216	
Monthly loan payment		$ 26,381
Depreciation		Straight line
Residual purchase price	0%	0
Corporate tax bracket	50%	50%
After-tax cost of capital	8%	8%

5.5 Capital Budgeting and Inflation

How does inflation impact capital budgeting?

The accuracy of capital budgeting decisions depends on the accuracy of the data regarding cash inflows and outflows. For example, failure to incorporate price-level changes due to inflation in capital budgeting situations can result in errors in the predicting of cash flows and, thus, in incorrect decisions.

What are the ways in which to incorporate price-level changes into capital budgeting decision?

Typically, an analyst has two options when dealing with a capital budgeting situation with inflation: (1) either restate the cash flows in nominal terms and discount them at a nominal cost of capital (minimum required rate of return), or (2) restate both the cash flows and cost of capital in constant terms and discount the constant cash flows at a constant cost of capital. The two methods are basically equivalent.

EXAMPLE 5.16

A company has the following projected cash flows estimated in real terms:

Period	0	1	2	3
Real Cash Flows (000s)	(100)	35	50	30

The nominal cost of capital is 15%. Assume that inflation is projected at 10% a year. Then the first cash flow for year 1, which is $35,000 in current dollars, will be 35,000 x 1.10 = $38,500 in year 1 dollars. Similarly, the cash flow for year 2 will be 50,000 x $(1.10)^2$=$60,500 [NOTE: the "2" should be made as power, not a multiple] in year 2 dollars, and so on. If one discounts these nominal cash flows at the 15% nominal cost of capital, one has the following net present value (NPV) in thousands of dollars:

Period	Cash Flow	T3 (Table 8.3)	Present Values
0	(100.00)	1.000	(100.00)
1	38.50	.87	33.50
2	60.50	.756	45.74
3	39.90	.658	26.25
			5.49 or $5,490

Instead of converting the cash-flow forecasts into nominal terms, one could convert the cost of capital into real terms by using the following formula:

Real cost of capital = [(1 + nominal cost of capital) / (1 + inflation rate)] - 1

In the example, this gives:

Real cost of capital = (1 + .15)/(1 + .10) - 1
= 1.15/1.10 - 1
= 1.045 - 1
= .045 or 4.5%

One will obtain the same answer except for rounding errors ($5,490 vs. $5,580).

Period	**Cash Flow**	**T3 = $1/(1+.045)^n$**	**Present Values**
0	(100.00)	1.000	(100.00)
1	35	$1/(1+.045)^1$=.957	33.50
2	50	$1/(1+.045)^2$=.916	45.80
3	30	$1/(1+.045)^3$=.876	26.28
			5.58 or $5,580

Chapter 5 Review Questions – Section 2

6. If an investment project has a profitability index of 1.15, the

A. Project's internal rate of return is 15%.
B. Project's cost of capital is greater than its internal rate of return.
C. Project's internal rate of return exceeds its net present value.
D. Net present value of the project is positive.

7. Net present value (NPV) and internal rate of return (IRR) differ in that

A. NPV assumes reinvestment of project cash flows at the cost of capital, whereas IRR assumes reinvestment of project cash flows at the internal rate of return.
B. NPV and IRR make different accept or reject decisions for independent projects.
C. IRR can be used to rank mutually exclusive investment projects, but NPV cannot.
D. NPV is expressed as percentage, while IRR is expressed as a dollar amount.

8. The net present value (NPV) method of capital budgeting assumes that cash flows are reinvested at

A. The risk-free rate.
B. The cost of capital used in the analysis.
C. The cost of debt.
D. The internal rate of return.

9. Flex Corporation is studying a capital acquisition proposal in which newly acquired assets will be depreciated using the straight-line method. Which one of the following statements about the proposal would be INCORRECT if a switch is made to the Modified Accelerated Cost Recovery System (MACRS)?

A. The net present value will increase.
B. The internal rate of return will increase.
C. The payback period will be shortened.
D. The profitability index will decrease.

Chapter 6:

Assets Management, Financing Techniques, and Portfolio Theory

Learning Objectives:

After completing this section, you should be able to:

- Recognize key elements that affect working capital and cash management.
- Identify how different investment criteria affect managing assets, such as expected returns, risk and diversification.
- Apply the Capital Asset Pricing Model (CAPM) and the Arbitrage Pricing Model (APM).

In this chapter you will learn how to manage your company's assets and liabilities in order to generate the highest return at the lowest possible risk. Whether you are a financial manager, managerial accountant, or investment analyst, you should be concerned with

- Determining the proper mixture of assets in the total asset structure
- Receiving cash promptly while delaying its payment
- Selling to the right customers
- Formulating a sound investment strategy
- How to diversify to reduce risk

This chapter also helps you develop techniques for obtaining financing. If you're a financial manager, you'll learn how to go about raising funds on a short-, intermediate-, and long-term basis. Or, if you're an executive, the following factors will be very much your concern:

- The cost of capital for examining financing alternatives
- The appropriateness of your company's dividend policy

- The effects of inflation
- The effects of the business cycle
- Diversification

ECONOMISTS AND FINANCIAL MANAGERS: You'll learn how to use economic indicators of performance for purposes of evaluating your own company's financial health. All these techniques will help you cope with situations as they arise every day.

6.1 Managing Working Capital

What is working capital?

Working capital equals current assets less current liabilities. It is a measure of liquidity. CAUTION TO FINANCIAL MANAGERS: A higher balance in total current assets means greater ability to meet your debt. But it also means less return earned on total assets. Remember: Fixed assets generate a higher rate of return than current assets.

What is the risk-return trade-off in current versus fixed assets?

Fixed assets comprise the basic structure of a business, representing plant and manufacturing equipment. Assuming a viable business, you would expect a higher return on machinery than marketable securities which, in fact, usually come to less than the overall cost of capital. You can see a risk-return trade-off here, since current assets represent less risk but lower return. Note that risk and return are directly related. Similarly, financing with current liabilities rather than long-term debt typically involves lower cost (i.e., greater return) but greater liquidity risk. The greater the debt maturity, the more uncertainty and hence generally the greater the cost.

What approach should I use for financing assets?

FOR MANAGEMENT EXECUTIVES: It's probably best to use a hedging approach whereby assets are financed by liabilities of similar maturity. This will ensure that adequate funds are available to meet the debt when due.

6.2 Maximizing Your Return on Cash

What is necessary for good cash management?

If you're a financial manager or management executive, cash management is important to you. If you are holding on to cash unnecessarily, you are losing a return that could be earned by investing. The cash balance held should depend on forecasted cash flows, probability of running out of cash, maturity of debt, and ability to borrow. You'll need forecasting information to determine (1) the best time to incur and pay back debt and (2) the amount to transfer daily between accounts. Use such techniques as accounting budgets, zero base budgeting and quantitative models like time series and probabilities.

MANAGEMENT EXECUTIVES USE THIS RULE:

Required cash balance equals transaction balances (required for normal business activity) plus precautionary balances (needed for emergencies) plus compensating balances (needed for financing commitments).

How can I accelerate cash receipts?

Use the following techniques.

CHECKLIST OF WAYS TO ACCELERATE CASH RECEIPTS

- Lockbox. This is a location where customer payments are mailed, usually a strategic post office box. Payments are then picked up several times during the day by the bank.
- Concentration banking. Funds are collected in local banks and transferred to a main concentration account.
- Immediate transfer of funds between banks. Transfers would be accomplished through depository transfer checks or via wire.
- Cash discounts for early payment.
- Accelerated billing practices.
- Personal collection efforts.
- Cash-on-delivery.
- Postdated Customer checks.
- Depositing checks promptly.
- Obtaining cash tied up unnecessarily in other accounts (for example, loans to company officers).

WHAT TO DO: Compare the return earned from the newly acquired cash to the cost of implementing an accelerated cash management system. Lockbox services are primarily good for collecting large dollar, low-volume receipts. Because of its high per-item cost, a lockbox does not always provide net savings.

EXAMPLE 6.1

Akel Corporation is considering a lockbox arrangement costing $350,000 per year. Daily collections average $1,000,000. Mailing and processing time will be reduced by four days with the arrangement. The rate of return is 10%. The cost-benefit analysis is shown as follows:

Annual return on freed cash

10% x 4 x $1,000,000	$400,000
Annual cost	350,000
Savings	**$ 50,000**

CONCLUSION: The lockbox arrangement is profitable.

EXAMPLE 6.2

Loft Corporation presently has a lockbox with Colt Bank. The bank handles $1.5 million per day for $300,000 compensating balance. Loft is considering canceling this arrangement and instead dividing its western region through arrangements with two other banks. Most Bank will handle $1 million a day, with a compensating balance of $225,000, and Davis Bank will handle $500,000 a day, with a compensating balance of $200,000. In both instances, collections will improve by one half-day. The rate of return is 11%. A cost-benefit analysis shows the following:

Accelerated cash receipts of $1.5 million

per day x 1/2 day	$750,000
Increased compensating balance	125,000
Increased cash flow	$625,000
Return rate	x 11%
Net annual savings	**$ 68,750**

CONCLUSION: The new arrangement is financially feasible.

How can I delay cash payments?

Try these techniques:

CHECKLIST OF WAYS TO DELAY CASH PAYMENTS

- Centralize the payable operation. This enables you to meet obligations at the most profitable time. It also enhances your ability to predict disbursement float in the system.
- Use drafts. A draft is given to the bank for collection, which in turn goes to the issuer for acceptance. After that, the funds are deposited to pay the draft.
- Use a computer terminal to transfer funds between various bank accounts at opportune times.
- Draw checks on remote banks, for example, a New York company could use a California bank.
- Mail checks from post offices with limited services or where mail must go through several handling points.
- Use probability analysis to determine the expected time for checks to clear. For example, funds deposited on payday may not equal the entire payroll since not all checks will be cashed on that day.
- Make partial payments.

EXAMPLE 6.3

Company X writes checks averaging $50,000 per day; each check takes three days to clear. The company will have a checkbook balance $150,000 less than the bank's records.

How much cash do I need on hand?

You can predict the optimum amount of transaction cash needed under conditions of certainty. First, compute the sum of the fixed cost applicable to transactions and the opportunity cost of holding cash balances as follows:

$$\frac{F(T)}{C}+\frac{i(C)}{2}$$

where

C = given cash balance
F = fixed cost of transaction
T = *total* cash required for time period
i = interest rate on marketable securities

The following formula was developed by W. Baumol to compute the optimal cash level (K):

$$K=\sqrt{\frac{2FT}{i}}$$

Average cash balance equals

$$\frac{K}{2}$$

and the number of required transactions equals

$$\frac{\text{transaction cash}}{K}$$

EXAMPLE 6.4

Company B expects a cash need of $4,000,000 over a one-month period, to be paid out at a constant rate. The opportunity interest rate is 0.5% for one month. The cost for each transaction is $100. The optimal transaction size is computed as follows:

$$K = \sqrt{\frac{2FT}{i}} = \sqrt{\frac{2(100)(4{,}000{,}000)}{0.005}} = \$400{,}000$$

The average cash balance equals:

$$\frac{K}{2} = \frac{\$400{,}000}{2} = \$200{,}000$$

The number of transactions required equals:

$$\frac{\$400{,}000}{400{,}000} = 10$$

SUGGESTION FOR FINANCIAL MANAGERS: You can use a stochastic model for cash management when major uncertainty regarding cash payments exists. The Miller-Orr model places an upper ceiling (referred to as d dollars) and lower limit ("zero" dollars) for cash balances. When the upper limit is reached, a transfer takes place from cash to securities. The transaction will not occur as long as the cash balance falls within the limits of the model.

You should take the following factors into account when using the Miller-Orr model:

- Fixed costs of a securities transaction *(F)*
- The daily interest rate on marketable securities (t)
- The deviation in daily net cash flows (σ^2)

Your objective is to meet cash requirements at the lowest possible cost. When the cash balance reaches d, this amount less the cost of securities bought (z) reduces the balance to z dollars. When the cash balance equals zero, z dollars are sold and the new balance again reaches z. NOTE TO MANAGEMENT EXECUTIVES: The minimum cash balance is established at an amount greater than zero to act as a safety buffer as, for example, delays in transfer.

Use these formulas for optimal and average cash balance:

Optimal cash balance (z) = $\sqrt[3]{\frac{3F\sigma^2}{4i}}$

Optimal upper limit *(d)* = $3z$

Average cash balance = $\frac{\text{(illegible)} + d}{3}$

EXAMPLE 6.5

J Company wishes 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.

6.3 Managing Accounts Receivable

What can I do to manage receivables properly?

Whether you're a financial manager, managerial accountant, or management executive, you'll want to manage receivables in order to maximize return and minimize risk. Here are some of the many things you can do:

CHECKLIST OF APPROACHES TO THE MANAGEMENT OF ACCOUNTS RECEIVABLE

- Age accounts receivable for overdue balances and compare them to industry and competitive norms as well as your own prior years. The purpose of an aging of receivables is to classify receivables by due date. Those that are current (not past due) are listed in one column, those less than 30 days past due in another column, etc. The amount in each category can then be multiplied by an estimated bad debt percentage that is based on a company's credit experience and other factors. The theory is that the oldest receivables are the least likely to be collectible. Aging the receivables and estimating the uncollectible amounts is one method of arriving at the appropriate balance sheet valuation of the accounts receivable account. The average collection period measures the number of days between the date of sale and the date of collection. It should be related to a change in a firm's credit terms. For example, a change in credit terms has caused an increase in sales, an increase in discounts taken, a reduction in the investment in accounts receivable, and a reduction in the number of doubtful accounts. Based upon this information, we know that the average collection period has decreased.
- Periodically revise credit limits based on your customers' changing financial health.
- When there might be a problem with collection, obtain collateral at least equal in amount to the account balance.
- Use collection agencies when warranted.
- Factor (sell) accounts receivable when net savings occur.
- Bill large sales immediately.
- Employ cycle billing for uniformity in the billing process.
- Mail customer statements within one day of the period end.
- Offer delayed payment terms to stimulate demand.
- Carefully evaluate Customers' financial health before giving credit.

- Obtain credit insurance to guard against abnormal losses from bad debt.
- Avoid typically high-risk receivables, for example, customers in a financially troubled industry or country.

Should I consider cash discounts?

MANAGEMENT EXECUTIVES: You must decide whether cash discounts should be given for early payment. WHAT TO DO: Implement discount policy provided the return on funds obtained from early collection is greater than the cost of the discount.

EXAMPLE 6.6

Blake Company provides the following data:

Current annual credit sales	$8,000,000
Collection period	2 months
Terms	net/30
Minimum rate of return	15%

The financial manager is considering whether to offer a 2/10, net/30 discount. He anticipates that 25% of the customers will take advantage of it. The collection period should decline to 1.5 months.

The advantage of the policy is shown as follows:

Return

Average accounts receivable balance prior to change in policy:

= (credit sales) / (accounts receivable turnover) = $$8,000,000 / 6
= $1,333,333

Average accounts receivable balance subsequent to change in policy:

= $8,000,000 / 8
= $1,000,000

Decrease in average accounts receivable	$ 333,333
Rate of return	x 15%
Return	$ 50,000
Discount Cost of discount 0.02 x 0.25 x $8,000,000	$ 40,000
Net advantage of discount policy	$ 10,000

When should I give credit to marginal customers?

MANAGEMENT EXECUTIVES: You are often faced with a decision of whether to give credit to somewhat marginal customers. WHAT TO DO: Give credit when the profitability of the additional sales is greater than the additional cost associated with the discount. When idle capacity exists, this additional profitability equals the contribution margin (sales minus variable cost). But, remember to add these Costs, too: higher bad debts, opportunity cost of putting funds in receivables for a longer period of time, and increased clerical costs for servicing an additional customer base.

EXAMPLE 6.7

Long Corporation provides the following data:

Selling price per unit	$5
Variable cost per unit	$2
Fixed cost per unit	$2
Annual credit sales	600,000 units
Collection period	1 month
Minimum return	24%

The financial manager is considering a proposal to liberalize credit. He expects sales to increase by 20%. The collection period on total accounts will be two months. Bad debts will increase by $90,000.

The following calculations show that the policy should be implemented;

Additional profit on increased sales		
Additional units (600,000 x 20%)		120,000
Contribution margin per unit		
Selling price	$5	
Less variable cost	$2	x $3
Additional profitability		$360,000
Bad debts		
Higher bad debts		$90,000
Opportunity cost of increased balance in accounts receivable		
Current average investment in accounts receivable:		
Average accounts receivable		

$$\frac{\text{credit sales}}{\text{accounts receivable turnover}} \times \frac{\text{cost}}{\text{selling price}}$$

$$\frac{\$3{,}000{,}000^{a}}{12} \times \frac{\$4}{\$5} \qquad \$200{,}000$$

Average investment in accounts receivable after change in credit policy:

$$\frac{\$3{,}600{,}000^{b}}{6} \times \frac{\$3.67^{c}}{\$5} \qquad \$440{,}000$$

Increased average investment in accounts receivable		$240,000
Minimum rate		x 0.24
Opportunity cost		$ 57,696
Net advantage to policy		
Additional profitability		$360,000
Additional cost		
Bad debts	$90,000	
Opportunity cost	57,696	(147,696)
Savings		**$212,304**

Calculations

a) $5 x 600,000 units = $3,000,000
b) $3,000,000 + 0.20 ($3,000,000) = $3,600,000
c) New average unit cost:

	Units	x	*Unit Cost*	=	*Total Cost*
Current volume	600,000		$4		$2,400,000
Additional volume	120,000		2		240,000
After proposal	720,000				$2,640,000

New average unit cost = $2,640,000/720,000 units = $3.67

The new average unit cost went down from $4 to $3.67 because the fixed cost is spread over more units.

How much credit should I give?

MANAGEMENT EXECUTIVES: Sometimes you must decide whether to give full credit to presently limited- or no-credit customers. REMEMBER THIS: Use full credit only when it will lead to a net profit.

EXAMPLE 6.8

Company D classifies its customers by risk ratings:

Category	*Uncollectible Account(%)*	*Collection Period*	*Credit Policy*	*Increase in Annual Sales if Credit Restrictions Are Relaxed*
A	1	20 days	Unlimited	$50,000
B	4	40 days	Restricted	$500,000
C	18	70 days	No credit	$700,000

Gross profit averages 20% of sales. The minimum rate of return is 14%. Of course, Category A receives unlimited Credit. However, full credit should be extended only to Category B, and not Category C, as indicated in the following table.

		Category B		*Category C*
Gross profit				
500,000 x 0.2		$100,000		
700,000 x 0.2				$140,000
Less bad debts addition				
500,000 x 0.04		(20,000)		
700,000 x 0.18				(126,000)
Incremental average investment in accounts receivable				
(40/360) x (80% x 500,000) =	44,444			
(70/360) x (80% x 700,000) =			108,889	
Opportunity cost	x0.14	(6,222)	x 0.14	(15,244)
Net earnings		$73,778		($1,244)

6.4 Formulating the Best Investment Strategy

What factors should I consider when selecting an investment portfolio?

When you are selecting an investment portfolio, look at these factors:

- Financial
- Risk versus return
- Tax implications

A company's present financial picture governs the magnitude and type of risk you can undertake. For example, if liquidity is strong, you might choose long-term securities. Or, if you want to maintain needed liquidity, short-term bills (e.g., market certificates, treasury bills) might be better. REMEMBER THIS: With greater liquidity there is less return, because short-term Securities yield less.

What is return?

Return is the investment reward. You must compare expected return for an investment with the risk. *Total return on an investment* equals:

(1) Periodic cash payments (current income)

(2) Appreciation (or depreciation) in value (capital gains or losses).

Current income may be bond interest, cash dividends, rent, etc. *Capital gains* or *losses* are changes in market value. A capital gain is the excess of selling price over original cost. A capital loss is the opposite.

What are the various types of investments?

CHECKLIST OF INVESTMENT TYPES

- Direct equity claims
  - Common stock
  - Options
  - Warrants
- Indirect equity claims
  - Mutual funds
- Creditor claims
  - Savings accounts
  - Money market certificates

- Money market funds
- Treasury securities
- Commercial paper
- Bonds
- Preferred stock

How should I manage the investment portfolio?

FINANCIAL MANAGERS: Stagger the maturity dates of the securities. For example, if all the securities mature on a single date, your reinvestment may be subject to low returns if interest rates are low at that time.

MANAGEMENT EXECUTIVES: Examine the risk. Look at the degree of diversification and stability of the portfolio. INVESTMENT ANALYSTS: Consider securities with negative correlations to each other. BE ON GUARD: Declines in portfolio market values may not be entirely reflected in the accounts. Use the ratio of revenue (dividend income, interest income, etc.) to the carrying value as a clue. Also, examine the footnotes for subsequent event disclosure regarding any unrealized losses that have taken place in the portfolio. FINANCIAL MANAGERS: You may want to adjust downward the extent to which an investment account can be realized in the case of such declines. You should also appraise the riskiness of the portfolio by computing the standard deviation of its rate of return.

EXAMPLE 6.9

Winston Company reports the following data for year-ends 2X11 and 2X12:

	2X11	*2X12*
Investments	$30,000	$33,000
Income from investments(dividends and interest)	$4,000	$3,200

The 2X12 annual report has a footnote titled “Subsequent Events,” which indicates a $5,000 decline in the portfolio as of March 2, 20X3. The ratio of investment income to total investments went from 0.133 in 2X11 to 0.097 in 2X12, indicating a higher realization risk in the portfolio. Additionally, the post balance sheet disclosure of a $5,000 decline in value should prompt you to adjust downward the amount to which the year-end portfolio can be realized.

What kinds of risks are involved in investing?

CHECKLIST OF INVESTING RISKS

- *Business risk.* This relates to factors such as financial condition and product demand.

- *Liquidity risk.* This applies to the possibility that an investment may not be sold on short notice for its market value. A security sold at a high discount may have high liquidity risk.
- *Default risk.* This refers to the borrower's inability to make interest payments or principal repayments on debt. A bond issued by a company with significant financial problems might be a default risk.
- *Market risk.* This relates to changes in the stock price caused by changes in the market itself.
- *Purchasing power risk.* This applies to the likelihood of decreased purchasing power. Bonds are a good example of this because the issuer pays back in cheaper dollars.
- *Interest rate risk.* This refers to the variability in the value of an investment as interest rates, money market, or capital market conditions change. This factor applies to fixed-income securities such as bonds. As interest rates increase, bond prices decrease.
- *Concentration risk.* This reflects a lack of diversification in the portfolio.

What should 1 know about taxes?

FINANCIAL MANAGERS: When formulating an optimal investment strategy, tax aspects must be considered. For example, interest income on bonds is fully taxable; whereas dividend income has an 85 percent tax exclusion (only 15 percent of dividends are subject to tax). When securities held for more than one year are sold at a gain only 15 percent of the profit is taxable. Thus, you have an advantage in holding appreciated securities for longer than one year. REMEMBER THIS: Income from U.S. government securities are taxable for federal purposes but are exempt from local taxes. Income from municipals is exempt from both federal and local taxes.

What is a technical analysis?

A technical analysis looks at the direction and magnitude of the market in determining when or what to buy or sell. Technical analysts believe stock prices of individual companies tend to move with the market as they react to various supply and demand forces. Charts and graphs of internal market data, including prices and volume, are also helpful.

What are the key indicators of stock market performance?

A discussion of six major indicators of market performance follows.

Trading volume. This points to the health and trend of the market. Market volume of stocks depends on supply and demand relationships, which in turn point to market strength or weakness. For instance, you can expect higher prices when demand increases. An *upside-downside index* illustrates the difference between stock volume advancing and decreasing, typically based on a ten-day or thirty-day moving average. The index assists in identifying expected market turning points.

Market breadth. This relates to the dispersion of general price fluctuation and may be useful as an advance indicator of major price declines or advances. The *breadth index* involves computing daily the net advancing or declining issues of a broad range of securities from the New York Stock Exchange. The index is determined by dividing net advances (number of securities with price increases less declines) by the number of securities traded. This index differs from a limited stock market average (like the Dow Jones Industrial Average (DJIA) of 30 Stocks) by virtue of the greater spread between the number advances and declines.

EXAMPLE 6.10

Assume net declines equal 40, securities traded equals 1,100, and the breadth index equals - 3.6. This figure can be related to a base year or combined in a 150-day moving average. The figures obtained are then related to the Dow Jones Industrial Average. When the breadth index and DJIA are increasing, this indicates market strength.

You can also determine the market breadth for individual securities by computing net volume (up-ticks less down-ticks).

EXAMPLE 6.11

Bette Corporation trades 90,000 shares for the day with 60,000 on the upside, 20,000 on the downside, and 10,000 at no change. The net volume difference at day's end is 40,000 traded on up-ticks.

FINANCIAL MANAGERS: Look for any sign of divergence between the price trend and net volume. If one occurs, you can anticipate a reversal in the price trend.

The Barron's Confidence index. This is useful when evaluating the trading patterns of bond investors and helps determine when to buy and sell. The index assumes bond traders are more knowledgeable than stock traders and that they identify trends more quickly. The index equals

$$\frac{\text{Yield on Barron's 10 top-grade corporate bonds}}{\text{Yield on Dow Jones 40 bond average}}$$

The numerator reflects a lower yield than the denominator because it uses higher-quality bonds. For example, if the Dow Jones yield is 14 percent and the Barron's yield is. 11.5 percent, the confidence index is 0.82 1. RULE OF THUMB: When bond investors are bullish, yield differences between high-grade and low-grade bonds will be small.

Odd-lot trading. This refers to transactions of 100 shares or less and is used as a reflection of popular opinion. THE RULE OF CONTRARY OPINION: The investment analyst determines what small traders are doing and then does the opposite. An *odd-lot index* consists of the ratio of odd-lot purchases to odd-lot sales.

Charts. These are used to appraise market conditions and price behavior of individual securities. By looking at past trends, you can possibly predict the future.

Relative strength analysis. This relates to predicting individual stock prices and consists of computing a ratio of monthly average stock prices to a monthly average "market index" or "industry group index." Or, you can compute the ratios of specific industry group indexes to the total market index. OBSERVATION: If a stock or industry group outperforms the market, you may view this as a positive sign.

Chapter 6 Review Questions – Section 1

1. A typical firm doing business nationally cannot expect to accelerate its cash inflow by

A. Establishing multiple collection centers throughout the country.
B. Employing a lockbox arrangement.
C. Initiating controls to accelerate the deposit and collection of large checks.
D. Maintaining compensating balances rather than paying cash for bank services.

2. Determining the appropriate level of working capital for a firm requires

A. Evaluating the risks associated with various levels of fixed assets and the types of debt used to finance these assets.
B. Changing the capital structure and dividend policy for the firm.
C. Maintaining short-term debt at the lowest possible level because it is ordinarily more expensive than long-term debt.
D. Offsetting the profitability of current assets and current liabilities against the risk of running short of cash.

3. A lock-box system

A. Reduces the need for compensating balances.
B. Provides security for late night deposits.
C. Reduces the risk of having checks lost in the mail.
D. Accelerates the inflow of funds.

4. Crystal is a retail mail order firm that currently uses a central collection system that requires all checks to be sent to its Boston headquarters. An average of 5 days is required for mailed checks to be received, 4 days for Crystal to process them and 1½ days for the checks to clear through its bank. A proposed lockbox system would reduce the mail and process time to 3 days and the check clearing time to 1 day. Crystal has an average daily collection of $100,000. If Crystal should adopt the lockbox system, its average cash balance would increase by

A. $650,000.
B. $250,000.
C. $800,000.
D. $400,000.

5. A company uses the following formula in determining its optimal level of cash: K = square root of (2FT/i), 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, and K= optimal level of cash. Assume that the fixed cost of selling marketable securities is $10 per transaction and the interest rate on marketable securities is 6% per year. The company estimates that it will make cash payments of $12,000 over a one-month period. What is the average cash balance (rounded to the nearest dollar)?

A. $1,000.
B. $2,000.
C. $3,464.
D. $6,928.

6. An aging of accounts receivable measures the

A. Ability of the firm to meet short-term obligations.
B. Average length of time that receivables have been outstanding.
C. Percentage of sales that have been collected after a given time period.
D. Amount of receivables that have been outstanding for given lengths of time.

7. The average collection period for a firm measures the number of days

A. After a typical credit sale is made until the firm receives the payment.
B. For a typical check to "clear" through the banking system.
C. Beyond the end of the credit period before a typical customer payment is received.
D. Before a typical account becomes delinquent.

8. When a company analyzes credit applicants and increases the quality of the accounts rejected, the company is attempting to

A. Maximize sales.
B. Increase bad-debt losses.
C. Increase the average collection period.
D. Maximize profits.

6.5 How to Best Finance Your Business

What financing alternatives are available?

As a financial manager or executive, you should be familiar with three alternative sources of financing: short-term (less than one year), intermediate-term (one to five years), and long-term (longer than five years). To plan the best financing strategy, evaluate the risks and costs applicable to each alternative. Consider these factors:

- Your company's financial position (cash flow, debt position, etc.)
- Cost of alternative funding sources
- Availability of future financing
- Risk
- Inflation rate
- Expected money market trends
- Tax rate
- Stability of operations
- Overall management objectives

What type of financing should I select?

Here are some sources of short- and intermediate-term financing:

- *Trade credit.* Trade credit is easy to get, has no or minimal cost, and requires no collateral. Creditors tend to be more lenient when payment problems occur, too.

- *Bank* To obtain a bank loan, you must have a good financial position with sufficient stockholders' equity. Loans may be secured (collateralized) or unsecured. In a secured loan, you have to pledge an asset to back the security. Or you can obtain a line of credit that promises loans up to a maximum amount.

- *Finance company.* If a bank loan is unavailable, a finance company may be necessary. There will be a higher interest rate and required collateral.

- *Commercial paper.* This is a short-term, unsecured note issued by the highest-quality companies. Their interest rate is less than the prime rate charged by banks.

- *Receivable financing.* Accounts receivable may be sold outright (factored) or assigned to a bank or finance company in return for immediate cash. There's a high financing cost involved here.

- *Inventory financing.* This typically occurs when receivable financing has been used up. Inventory must be marketable.

- *Leasing.* By leasing property, only a minor cash outlay may be required. Usually, a purchase option accompanies the agreement.

NOTE: A small business would not have access to major capital markets. In fact, the only options available, outside of owner financing, are bank loans and a line of credit from suppliers. It is this latter alternative that is most often used because it permits the business to finance inventories for 30 to 60 days without incurring interest cost. A line of credit is an arrangement between a bank and a borrower in which the bank commits itself to lend up to a certain maximum amount to the borrower in a given period.

Here are some sources of long-term financing:

- *Mortgages.* These are notes payable to banks that are secured by real property. Mortgages have favorable interest rates, fewer financing restrictions, long payment schedules, and ready availability.

- *Bonds.* These are long-term debt issued to the public. Bonds offer some advantages over stocks. For instance, interest from bonds are tax deductible, whereas stock dividends are not; the payback is in cheaper dollars because of inflation; and equity interests (i.e., voting rights) remain intact. Also, call provisions enable you to buy back the bonds before maturity. On the other hand, you must accept certain risks, including the inability to meet debt payments as well as indenture restrictions. Indenture refers to the agreement between the bond issuer and the bond investor.

- *Equity securities (preferred and common stock).* Common stock refers to residual equity ownership in the business. Common stockholders have voting power but come after preferred stockholders in receiving dividends and in liquidation. Equity securities do not involve fixed charges, maturity dates, or sinking fund requirements. You need not pay dividends during periods of financial distress. However, dividend payments are not tax deductible and therefore will incur higher costs to the company. And since they also hold greatest risk to common stockholders, the cost of funds will be greater. Common stocks dilute ownership and voting rights as well.

Note: At the rapid growth stage, if a company is reasonably profitable, it will experience financing needs in excess of funds available either internally or from trade credit or bank credit. Additional debt financing often results in an unreasonable amount of financial leverage at this stage, and public equity financing ordinarily is not yet available. Hence, a rapidly growing firm is most likely to seek and obtain venture capital financing.

What is factoring?

A factor purchases a company's accounts receivable and assumes the risk of collection. The seller receives money immediately to reinvest in new inventories. The financing cost is usually high: about 2 points or more above prime, plus a fee for collection. Factoring has been traditional in the textile industry for years, and recently companies in many industries have found it an efficient means of operation. A company that uses a factor can eliminate its credit department, accounts receivable staff, and bad debts. These reductions in costs can more than offset the fee charged by the factor, which can often operate more efficiently than its clients because of the specialized nature of its service.

What is the cost of raising funds?

VITAL FOR FINANCIAL MANAGERS: The cost of capital is calculated from a weighted average of debt and equity security costs. Compare these averages under various alternative financing strategies. Your input will bear heavily when deciding the best source of financing in a given situation. REMEMBER THIS: The alternative with the least overall cost of capital is best.

What is the cost of short-term debt?

The cost of short-term debt applies to the interest rate on bank or finance company loans. Remember this: Interest is a tax-deductible expense.

$$\text{Cost of short-term debt} = \frac{\text{Interest}}{\text{Proceeds received}}$$

If a bank discounts a loan, interest is deducted from the face of the loan to get the proceeds. When a compensating balance is required (that is, a percent of the face loan is held by the bank as collateral), proceeds are also reduced. In either case, the effective or real interest rate on the loan is higher than the face interest rate owing to the proceeds received from the loan being less than the amount (face) of the loan.

EXAMPLE 6.12

Company A takes a $150,000, one-year, 13% loan. The loan is discounted, and a 10% compensating balance is required. The effective interest rate is computed as follows:

$$\frac{13\% \times \$150{,}000}{\$115{,}500^{a}} = \frac{\$19{,}500}{\$115{,}500} = 16.89\%$$

[a]Proceeds received =

Face of loan	$150,000
Less interest	(19,500)
Compensating balance (10% x $150,000)	(15,000)
Proceeds	$115,500

Notice how the effective cost of the loan is significantly greater than the stated interest rate.

What is the cost of long-term debt?

The real cost of bonds is obtained by computing two types of yield: simple (face) yield and yield to maturity (effective interest rate). The first involves an easy approximation, but the second is much more accurate.

WHAT YOU SHOULD KNOW: The nominal interest rate equals the interest paid on the face (maturity value) of the bond and is always stated on a per-annum basis. Bonds are always issued in $1,000 denominations and may be sold above face value (at a premium) or below (at a discount). A bond is sold at a discount when the interest rate is below the going market rate. In this case, the yield will be higher than the nominal interest rate. The opposite holds for bonds issued at a premium.

$$\text{Simple yield} = \frac{\text{nominal interest}}{\text{present value of bond}}$$

$$\text{Yield to maturity} = \frac{\text{nominal interest} + \dfrac{\text{discount}}{\text{years}}\left(\text{or } \dfrac{\text{premium}}{\text{years}}\right)}{\dfrac{\text{present value} + \text{maturity value}}{2}}$$

EXAMPLE 6.13

Prentice Corporation issues a $400,000, 12%, 10-year bond for 97% of face value. Yield computations follow:

Nominal annual payment	= 12% x $400,000
	= $48,000
Bond proceeds	=97% x $400,000
	=$388,000
Bond discount	=3% x $400,000
	= $12,000 or
	$400,000 - $388,000
	= $12,000

Simple yield $= \frac{12\% \times \$400{,}000}{97\% \times \$400{,}000} = \frac{\$48{,}000}{\$388{,}000} = 12.4\%$

Yield to maturity $= \frac{\$48{,}000 + \frac{\$12{,}000}{10}}{\frac{\$388{,}000 + \$400{,}000}{2}} = \frac{\$48{,}000 + \$1{,}200}{\$369{,}000} = \frac{449{,}200}{\$394{,}000} = 12.5\%$

NOTE: Because the bonds were sold at a discount, the yield exceeds the nominal interest rate (12%).

What is the cost of equity securities?

The cost of equity securities comes in the form of dividends, which are not tax deductible.

The cost of common stock = $\frac{D_1}{P_0}$ + g

where P_0 =net proceeds per share = market price per share - flotation costs (that is, cost of issuing securities, such as brokerage fees and, printing costs). *Note:* this formula is derived from

solving for r in the Gordon's valuation model or the dividend growth model.

$$P_0 = \frac{D_1}{r - g}$$

where P_0 = current price, D_1 = next dividend, r = required rate of return, and g = earnings growth rate.

The cost of preferred stock is stated in the dividend rate. If this is not given, the cost of preferred stock would be computed as for common stock.

EXAMPLE 6.14

ABC Company's dividend per share is $10, net proceeds per share are $70, and the dividend growth rate is 5%.

The cost of the stock = $\frac{\$10}{\$70}$ + 0.05 = 19.3%

How do I compute the weighted average cost of capital?

When computing the weighted average cost of capital, consider the percent of the total and after-tax cost of each financing alternative.

EXAMPLE 6.15

Bloated Company provides the following from its financial statements:

Bonds payable (16%)	$ 4 million
Preferred stock (dividend rate = 13%)	1 million
Common stock	5 million
Total	$10 million

Dividends per share on common stock are $11; net proceeds per share are $80; growth rate on dividends is 4%; and tax rate is 40%.

The weighted average cost of capital is computed as follows:

	Percent	*After-Tax Cost*	*Weighted Average Cost*
Bonds payable	0.40	0.096[a]	0.038
Preferred stock	0.10	0.130	0.013
Common stock	0.50	0.l78[b]	0.089
	1.00		0.140

[a]Cost of bonds payable: 16% x 60% = 0.096

[b]Cost of bonds payable = (dividends per share) / (net proceeds per share) + growth rate in dividends
= $11/$80 + 0.04 = 0.178

What is the cost of not taking a discount on accounts payable?

If you do not take a discount on accounts payable by paying earlier, you have lost an opportunity cost or the return foregone from an alternative use of funds or time. TAKE NOTICE: Financial managers who do not take the discount typically show a lack of financial astuteness. Why? The cost of paying is usually higher than the cost of borrowing money.

You can compute the opportunity cost with this formula:

$$\frac{\text{discount foregone}}{\text{use of proceeds}} \times \frac{360}{\text{days use of money}}$$

Note: If the discount period is longer, the days of extra credit obtained by forgoing the discount are fewer. Assuming other factors are constant, the result is that the cost of trade credit, that is, the cost of taking the discount, is greater.

EXAMPLE 6.16

XYZ Company purchases $500,000 of merchandise on credit terms of 2/10, net/30. The company does not pay within 10 days and thus loses the discount.

Opportunity cost = (0.02 x $500,000) / (.98 x $500,000) x 360/20 = $10,000/$490,000 x 180 = 36.7%

Surely management would have been better off to take advantage of the discount by borrowing $490,000 at the prime interest rate.

How do I evaluate a dividend policy?

FOR FINANCIAL MANAGERS: A dividend policy must be attractive to the investing public by satisfying current stockholders and prompting new investment. Psychologically, investors like to receive stable dividends. If you cut dividends, stockholders may become worried and sell. The result: Your stock price declines.

On the other hand, from a purely financial perspective, earnings should be retained by the business rather than distributed to stockholders, because the company typically earns a greater return than the individual stockholder does, and this will result in appreciation in the market price of the stock.

MANAGEMENT EXECUTIVES: If financial problems exist within your company, the distribution will seriously impair the company's health. By distributing earnings, you'll have to refinance, and cost of capital will be very high. YOUR DILEMMA: It's generally best to retain funds rather than distribute them in the form of dividends to the company or individual investor. But, since stockholders are basically unsophisticated in financial analysis, they will demand dividends.

WHAT TO DO: To satisfy stockholders while retaining as much as possible, you have two options. You can establish a minimum dividend base and give a bonus dividend during very good times, or you can create the impression of a growth company that typically retains earnings for expansion purposes.

FINANCIAL MANAGERS: Look at the trends in these dividend-related ratios:

Dividend payout = (dividend per share) / (earnings per share)

Dividend yield = (dividend per share) / (market price per share)

Investors generally favor increasing trends.

How does the business cycle affect a company?

One company or industry cannot control fundamental economic conditions. To the extent that you can insulate yourself from the effects of a broader economy, your corporate stability will be greater. HINT: Look for stability in operations because it enhances predictability and planning.

Companies having product lines with inelastic demand (such as food and medicine) are affected less by the business cycle. Companies with product lines or services correlated positively to changes in real gross domestic product (such as the airlines) have greater earnings instability.

6.6 How to Reduce Risk: Diversify

Diversification is usually an answer to reduction in risk. "Diversify" means "Don't Put All Your Eggs in One Basket." With a diversified portfolio (e.g., stocks, bonds, real estate, and savings accounts), the value of all these investments do not increase or decrease at the same time or in the same magnitude. Thus, you can protect yourself against fluctuations. Your company may diversify into different lines of businesses that are not subject to the same economic and political influences. Thus, it can protect itself against fluctuations in earnings.

What is portfolio theory?

The central theme of portfolio theory is that rational investors behave in a way that reflects their aversion to taking increased risk without being compensated by an adequate increase in expected return. Also, for any given expected return, most investors will prefer a lower risk, and for any given level of risk, they will prefer a higher return to a lower return. Harry Markowitz showed how to calculate a set of "efficient" portfolios. An investor then will choose among a set of efficient portfolios the best that is consistent with the risk profile of the investor.

Most financial assets are not held in isolation but rather are held as part of a portfolio. Therefore, the risk-return analysis should not be confined to single assets only. It is important to look at portfolios and the gains from diversification. What is important is the return on the portfolio, not just the return on one asset, and the portfolio's risk. 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.*

How do you compute portfolio return?

The expected return on a portfolio (rp) is simply the weighted average return of the individual sets in the portfolio, the weights being the fraction of the total funds invested in each asset:

$$r_p = w_1r_1 + w_2r_2 + \ldots + w_nr_n = \sum_{j=1}^{n} w_j r_j$$

where r_j = expected return on each individual asset
w_j = fraction for each respective asset investment
n = number of assets in the portfolio

$$\sum_{j=1}^{n} w_j = 1.0$$

EXAMPLE 6.17

A portfolio consists of assets A and B. Asset A makes up one-third of the portfolio and has an expected return of 18 percent. Asset B makes up the other two-thirds of the portfolio and is expected to earn 9 percent. The expected return on the portfolio is:

Asset	*Return (r_j)*	*Fraction (w_j)*	*$w_j r_j$*
A	18%	1/3	1/3 X 18% = 6%
B	9%	2/3	2/3 X 9% = 6%
	r_p =12%		

How do you calculate portfolio risk?

Unlike returns, the risk of a portfolio (σ_p) is not simply the weighted average of the standard deviations of the individual assets in the contribution, for a portfolio's risk is also dependent on the correlation coefficients of its assets. The correlation coefficient (ρ) is a measure of the degree to which two variables "move" together. It has a numerical value that ranges from -1.0 to 1.0. In a two-asset (A and B) portfolio, the portfolio risk is defined as:

$$\sigma_p = \sqrt{w_A^2 \sigma_A^2 + w_B^2 \sigma_B^2 + 2\rho_{AB} w_A w_B \sigma_A \sigma_B}$$

where σ_A and σ_B = standard deviations of assets A and B, respectively
w_A and w_B = weights, or fractions, of total funds invested in assets A and B
ρ_{AB} = the correlation coefficient between assets A and B.

Incidentally, the correlation coefficient is the measurement of joint movement between two securities.

How do you diversify?

As can be seen in the above formula, the portfolio risk, measured in terms of σ is not the weighted average of the individual asset risks in the portfolio. Note that in the formula, we have the third term, (ρ) which makes a significant contribution to the overall portfolio risk. What the formula basically shows is that portfolio risk can be minimized or completely eliminated by diversification. The degree of reduction in portfolio risk depends upon the correlation between the assets being combined. Generally speaking, by combining two *perfectly negatively* correlated assets (ρ =-1.0), we are able to eliminate the risk *completely*. In the real world, however, most securities are negatively, but *not* perfectly correlated. In fact, many assets are positively correlated. An example of the latter is ownership of two automobile stocks or two housing stocks.

EXAMPLE 6.18

Assume the following:

Asset	σ	*w*
A	20%	1/3
B	10%	2/3

The portfolio risk then is:

$$\sigma_p = \sqrt{w_A^2\sigma_A^2 + w_B^2\sigma_B^2 + 2\rho_{AB}w_A w_B\sigma_A\sigma_B}$$

$$=[(1/3)^2 (0.2)^2 + (2/3)^2(0.1)^2 + 2\rho_{AB} (1/3)(2/3)(0.2)(0.1)]^{1/2}$$

$$= (0.0089 + 0.0089\rho_{AB})^{1/2}$$

(a) Now assume that the correlation coefficient between A and B is +1 (a perfectly positive correlation). This means that when the value of asset A increases in response to market conditions, so does the value of asset B, and it does so at exactly the same rate as A. The portfolio risk when ρ_{AB} = +1 then becomes:

$$\sigma_p = (0.0089 + 0.0089\rho_{AB})^{1/2} = \sqrt{0.0089 + 0.0089(1)} = \sqrt{0.0178} = 0.1334 = 13.34\%$$

(b) If ρ_{AB} = 0, the assets lack correlation and the portfolio risk is simply the risk of the expected returns on the assets, i.e., the weighted average of the standard deviations of the individual assets

in the portfolio. Therefore, when ρ_{AB} = 0, the portfolio risk for this example is:

$$\sigma_p = (0.0089 + 0.0089\rho_{AB})^{1/2} = \sqrt{0.0089 + 0.0089(0)} = \sqrt{0.0089} = 0.0943 = 9.43\%$$

(c) If ρ_{AB} = -1 (a perfectly negative correlation coefficient), then as the price of A rises, the price of B declines at the very same rate. In such a case, risk would be completely eliminated. Therefore, when ρ_{AB} = -1, the portfolio risk is

$$\sigma_p = (0.0089 + 0.0089\rho_{AB})^{1/2} = \sqrt{0.0089 + 0.0089(-1)} = \sqrt{0} = 0 = 0\%$$

When we compare the results of (a), (b), and (c), we see that a positive correlation between assets increases a portfolio's risk above the level found at zero correlation, while a perfectly negative correlation eliminates that risk.

EXAMPLE 6.19

To illustrate the point of diversification, assume data on the following three securities are as follows:

Year	*Security X (%)*	*Security Y (%)*	*Security Z (%)*
20X1	10	50	10
20X2	20	40	20
20X3	30	30	30
20X4	40	20	40
20X5	50	10	50
r_j	30	30	30
σ_j	14.14	14.14	14.14

Note here that securities X and Y have a perfectly negative correlation, and securities X and Z have a perfectly positive correlation. Notice what happens to the portfolio risk when X and Y, and X and Z are combined. Assume that funds are split equally between the two securities in each portfolio.

Year	*Portfolio XY (50% - 50%)*	*Portfolio XZ (50% - 50%)*
20X1	30	10
20X2	30	20
20X3	30	30
20X4	30	40
20X5	30	50
r_p	30	30
σ_p	0	14.14

Again, see that the two perfectly negative correlated securities (XY) result in a zero overall risk.

6.7 Beta - The Capital Asset Pricing Model (CAPM)

What is beta?

Many investors hold more than one financial asset. A portion of a security's risk (called *unsystematic risk*) can be controlled through diversification. This type of risk is unique to a given security. Business, liquidity, and default risks, which were discussed earlier, fall in this category. *Non-diversifiable risk*, more commonly referred to as *systematic risk*, results from forces outside of the firm's control and are therefore not unique to the given security. Purchasing power, interest rate, and market risks fall into this category. This type of risk is measured by *beta*.

Beta (b) measures a security's volatility relative to an average security. A particular stock's beta is useful in predicting how much the security will go up or down, provided that you know which way the market will go. It does help you to figure out risk and expected return.

Most of the unsystematic risk affecting a security can be diversified away in an efficiently constructed portfolio. Therefore, this type of risk does not need to be compensated with a higher level of return. The only relevant risk is systematic risk or beta risk for which the investor can expect to receive compensation. You, as an investor, are compensated for taking this type of risk which cannot be controlled.

Under the *capital asset pricing model* (CAPM), in general, there is a relationship between a stock's expected (or required return) and its beta. The following formula is very helpful in determining a stock's expected return.

$$r_j = r_f + b(r_m - r_f)$$

In words, Expected return = risk-free rate + beta x (market risk premium)

where r_j = the expected (or required) return on security j; r_f = the risk-free rate on a security such as a T-bill; r_m = the expected return on the market portfolio (such as Standard and Poor's 500 Stock

Composite Index or Dow Jones 30 Industrials); and b = beta, an index of systematic (nondiversifiable, noncontrollable) risk.

The market risk premium ($r_m - r_f$) equals the expected market return (r_m) minus the risk-free rate (r_f). The market risk premium is the additional return above that which you could earn on, say a T-bill, to compensate for assuming a given level of risk (as measured by beta).

Thus, the formula shows that the required (expected) return on a given security is equal to the return required for securities that have no risk plus a risk premium required by the investor for assuming a given level of risk. The key idea behind the formula is that the relevant measure of risk is the risk of the individual security, or its beta. The higher the beta for a security, the greater the return expected (or demanded) by the investor.

EXAMPLE 6.20

Assume that r_f=6%, and r_m=10%. If a stock has a beta of 2.0, its risk premium should be 14%:

$$r_j = r_f + b(r_m - r_f)$$

$$6\% + 2.0 (10\% - 6\%) = 6\% + 8\% = 14\%$$

This means that you would expect (or demand) an extra 8% (risk premium) on this stock on top of the risk-free return of 6%. Therefore, the total expected (required) return on the stock should be 14%:

$$6\% + 8\% = 14\%$$

EXAMPLE 6.21

The higher a stock's beta, the greater the return expected (or demanded) by the investor as follows:

Stock	*Beta*	*Required return*
Mobil	.85	6% + .85(12% - 6%) = 11.1%
Bristol-Meyers	1.0	6% + 1.0(12% - 6%) = 12%
Neiman-Marcus	1.65	6% + 1.65(12% - 6%) = 15.9%

How do you read beta?

Beta (b) measures a security's volatility relative to an average security. Putting it another way, it is a measure of a security's return over time to that of the overall market. For example, if your company's beta is 2.0, it means that if the stock market goes up 10%, your company's common stock goes up 20%; if the market goes down 10%, your company's stock price goes down 20%. Here is how to read betas:

Beta	*Meaning*
0	The security's return is independent of the market. An example is a risk-free security (e.g., T-Bill).
0.5	The security is half as volatile as the market.
1.0	The security is as volatile or risky as the market (i.e., average risk). This is the beta value of the market portfolio (e.g., Standard & Poor's 500).
2.0	The security is twice as volatile or risky, as the market.

Figure 6.1 shows examples of betas for selected stocks.

Figure 6.1
Betas for some selected corporations

Company	November 2013
Boeing (BA)	1.26
Google (GOOG)	0.96
Toyota (TM)	0.79
Nordstrom (JWN)	1.5
Intel (INTC)	0.97
Wal Mart (WMT)	0.38

6.8 The Arbitrage Pricing Model (APM)

What is the difference between the CAPM and the arbitrage pricing model (APM)?

The CAPM assumes that required rates of return depend only on one risk factor, the stock's *beta*. The Arbitrage Pricing Model (APM) disputes this and includes any number of risk factors:

$$r = r_f + b_1 RP_1 + b_2 RP_2 + ... + b_n RP_n$$

where r = the expected return for a given stock or portfolio

r_f = the risk-free rate

b_i = the sensitivity (or reaction) of the returns of the stock to unexpected changes in economic forces i (i = 1,...n)

RP_i =the market risk premium associated with an unexpected change in the ith economic force

n = the number of relevant economic forces

The following five economic forces are often suggested:

1. Changes in expected inflation
2. Unanticipated changes in inflation
3. Unanticipated changes in industrial production
4. Unanticipated changes in the yield differential between low- and high-grade bonds (the default-risk premium)
5. Unanticipated changes in the yield differential between long-term and short-term bonds (the term structure of interest rates)

Some documented the importance of industry factors, investor confidence, exchange rates, oil prices, and a host of other variables. It appears, however, we are still a long way from being able to describe the underlying reasons for cross-sectional differences in average returns with confidence.

EXAMPLE 6.22

Suppose a three-factor APM holds and the risk free rate is 6 percent. You are interested in two particular stocks: A and B. The returns on both stocks are related to factors 1 and 2 as follows:

$$r = 0.06 + b_1(0.09) - b_2(0.03) + b_3(0.04)$$

The sensitivity coefficients for the two stocks are given below.

Stock	b_1	b_2	b_3
A	0.70	0.80	0.20
B	0.50	0.04	1.20

We can calculate the expected returns on both stocks as follows:

For stock A: $r = 0.06 + (0.70)(0.09) -(0.80)(0.03) + (0.20)(0.04)$

$= 10.70\%$

For stock B: $r = 0.06 + (0.50)(0.09) -(0.04)(0.03) + (1.20)(0.04)$

$= 14.10\%$

Stock B requires a higher return, indicating it is the riskier of the two. Part of the reason is that its return is substantially more sensitive to the third economic force than stock A's is.

Chapter 6 Review Questions – Section 2

9. A small retail business would most likely finance its merchandise inventory with

A. Commercial paper.
B. A terminal warehouse receipt loan.
C. A line of credit.
D. A chattel mortgage.

10. Short-term, unsecured promissory notes issued by large firms are known as

A. Agency securities.
B. Bankers' acceptances.
C. Commercial paper.
D. Repurchase agreements.

11. A compensating balance

A. Compensates a financial institution for services rendered by providing it with deposits of funds.
B. Is used to compensate for possible losses on a marketable securities portfolio.
C. Is a level of inventory held to compensate for variations in usage rate and lead time.
D. Is the amount of prepaid interest on a loan.

12. In which stage of a firm's development is it most likely to seek and obtain external equity financing in the form of venture capital?

A. Formation.
B. Rapid growth.
C. Growth to maturity.
D. Maturity and industry decline.

13. A company obtaining short-term financing with trade credit will pay a higher percentage financing cost, everything else being equal, when

A. The discount percentage is lower.
B. The items purchased have a higher price.

C. The items purchased have a lower price.
D. The supplier offers a longer discount period.

14. Factoring is the selling of accounts receivable by one company to another. True or False?

15. Assume that nominal interest rates just increased substantially but that the expected future dividends for a company over the long run were not affected. As a result of the increase in nominal interest rates, the company's share price should decrease. True or False?

16. Using a 360-day year, what is the opportunity cost to a buyer of not accepting terms 3/10, net 45?

A. 55.67%.
B. 31.81%.
C. 22.27%.
D. 101.73%.

17. A feasible portfolio that offers the highest expected return for a given risk or the least risk for a given expected return is a(n)

A. Optimal portfolio.
B. Desirable portfolio.
C. Efficient portfolio.
D. Investment portfolio.

18. The difference between the required rate of return on a given risky investment and that on a riskless investment with the same expected return is the

A. Risk premium.
B. Coefficient of variation.
C. Standard deviation.
D. Beta coefficient.

19. According to the capital asset pricing model (CAPM), the relevant risk of a security is its

A. Company-specific risk.

B. Diversifiable risk.
C. Systematic risk.
D. Total risk.

20. A measure that describes the risk of an investment project relative to other investments in general is the

A. Coefficient of variation.
B. Beta coefficient.
C. Standard deviation.
D. Expected return.

Chapter 7:

Decision Making with Statistics and Forecasting

Learning Objectives:

After completing this section, you should be able to:

- Recognize the different statistics used in business decisions.
- Identify techniques applied to forecasting, such moving averages and exponential smoothing.
- Recognize what statistics to use in regression analysis and how to apply them for trend projections.

As a decision maker, you'll find yourself in many situations in which large volumes of data need to be analyzed. These data could be sales figures, income, or a multitude of other possibilities. And they could be used for a variety of purposes, including risk analysis, figuring return on investments, or other financial decisions. Effective use of statistics and forecasting techniques will prove necessary as your company grows.

7.1 How to Use Basic Statistics

The most commonly used statistics that describe characteristics of data are the mean and the standard deviation.

What is a mean and how is it used?

The mean gives an average (or central) value of your data. Three such means are common. They are

- Arithmetic mean
- Weighted mean
- Geometric mean

What is an arithmetic mean?

The arithmetic mean is a simple average. To find it, sum the values of your data and divide by the number of data entries or observations:

$$\bar{x} = \frac{\sum x}{n}$$

where

$\bar{x}$ = the arithmetic mean (called x-bar)

x = the data values

n = number of observations

EXAMPLE 7.1

John Jay Lamp Company has a revolving credit agreement with a local bank. Last year, the loan showed the following month-end balances:

January	$18,500
February	21,000
March	17,600
April	23,200
May	18,600
June	24,500
July	60,000
August	40,000
September	25,850
October	33,100
November	41,000
December	28,400

The mean monthly balance is computed as follows;

= ($18,500 + $21,000 + $17,600 + $23,200 + $18,600 + $24,500 + $60,000 + $40,000

+ $25,850 + $33,100 + $41,000 + $28,400) / (12 months)

= $351,750/12 = $29,312.50

What is a weighted mean?

When your observations have different degrees of importance or frequency, a weighted mean enables you to account for this. The formula for a weighted mean is

Weighted mean = $\sum(w)(x)$

where

w = weight assigned to each observation, expressed as a percentage or relative frequency

EXAMPLE 7.2

Company J uses three grades of labor to produce a finished product as follows:

Grade of Labor	*Labor Hours per Unit of Labor*	*Hourly Wages (x)*
Skilled	6	$10.00
Semiskilled	3	8.00
Unskilled	1	6.00

The arithmetic mean (average cost) of labor per hour for this product can be computed as follows:

$$\text{Arithmetic mean} = \frac{\$10.00 + \$8.00 + \$6.00}{3} = \$8.00 \text{ per hour}$$

However, this implies that each grade of labor was used in equal amounts, and this is not the case. To calculate the average cost of labor per hour correctly, the weighted average should be computed as follows:

Weighted mean = **$** 10.00(6/10) + $8.00(3/10) + $6.00(l/10) = $9.00 per hour

NOTE: The weights equal the proportion of the total labor required to produce the product.

What is a geometric (compound) mean?

Sometimes quantities change over a period of time; for example, the rate of return on investment or rate of growth in earnings over a period of years. In such cases, you need to know the geometric mean, which uses the average rate or percentage of change. Use this formula:

$$\text{Geometric (compound) mean} = \sqrt[n]{(1+x_1)(1+x_2)\ldots(1+x_n)} - 1$$

where

x = the rate of change (in percent)
n = number of periods

EXAMPLE 7.3

A stock doubles during one period and then depreciates back to the original price, as shown in the following table. Dividend income (current income) is non-existent.

	Time Periods		
	t=0	*t=1*	*t=2*
Price (end of period)	$80	$160	$80
HPR	___	100%	-50%

The rate of return for periods 1 and 2 are computed as follows:

$$\text{Period 1 (t=1)} = \frac{\$160 - \$80}{\$80} = \frac{\$80}{\$80} = 100\%$$

$$\text{Period 2 (t=2)} = \frac{\$80 - \$160}{\$160} = \frac{-\$80}{\$160} = -50\%$$

The rate of return is the average of 100% and -50%, or 25%, as indicated below:

$$\frac{100\% + (-50\%)}{2} = 25\%$$

However, the stock bought for $40 and sold for the same price two periods later did not earn 25%; it earned zero. This can be illustrated by determining the compound average return.

Note that n = 2, x_1 = 100% = 1, and x_2 = -50% = -0.5

Then,

Geometric (compound) mean return == $\sqrt[2]{(1+x_1)(1+x_2)}$ -1 = $\sqrt{(1+1)(1-0.5)} - 1$

= $\sqrt{(2)(0.5)} - 1$

= $\sqrt{1} - 1 = 1 - 1 = 0$

where x_1 = 100% or 1

x_2 = -50% or -0.5

What is standard deviation?

The standard deviation measures the extent to which data spread out or disperse. MANAGERS: You can make important inferences from past data with this statistic, for example when measuring the risk of purchasing a financial asset. The standard deviation, denoted with the Greek letter σ, read as sigma, is defined as follows:

$$\sigma = \sqrt{\frac{\sum(x-\bar{x})^2}{n-1}}$$

where $\bar{x}$ is the mean (arithmetic average).

WHAT TO DO: Calculate the standard deviation using these five steps:

1. Subtract the mean from each element of the data.
2. Square each of the differences obtained in step 1.
3. Add together all the squared differences.
4. Divide the sum of all the squared differences by the number of values minus one.
5. Take the square root of the quotient obtained in step 4.

Example 7.4

One and one-half years of quarterly returns are listed below for ABC Mutual Fund.

Time period	x	$(x - \bar{x})$	$(x - \bar{x})^2$
1	10%	0	0
2	15	5	25
3	20	10	100
4	5	(5)	25
5	(10)	(20)	400
6	20	10	100
	60		650

The mean return and standard deviation over this period are computed as follows:

$\bar{x}$ =60/6=10%

$$\sigma = \sqrt{\frac{\sum(x-\bar{x})^2}{n-1}} = \sqrt{\frac{650}{6-1}} = \sqrt{130} = 11.40\%$$

CONCLUSION: ABC Fund has returned on the average 10 percent over the last six quarters and the variability about its average return was 11.40%. The high standard deviation (11.40%) relative to the average return of 10% indicates that the fund is very risky.

7.2 Using Forecasting Techniques

7.2.1 Moving Averages

How do I use moving averages?

With the moving average, simply take the most recent observations (n) to calculate an average. Then, use this as the forecast for the next period. Moving averages are updated as new data are received. NOTE: You can choose the number of periods to use on the basis of the relative importance you attach to old versus current data.

Example 7.5

Assume that the marketing manager has the following sales data.

Date	Actual Sales (Y_t)
Jan.1	46
2	54
3	53
4	46
5	58
6	49
7	54

In order for the marketing manager to predict the sales for the seventh and eighth days of January, she must pick the number of observations to be averaged. She used two possibilities: a six-day and a three-day period.

Case 1 – six day period

$$Y'_7 = \frac{46 + 54 + 53 + 46 + 58 + 49}{6} = 51$$

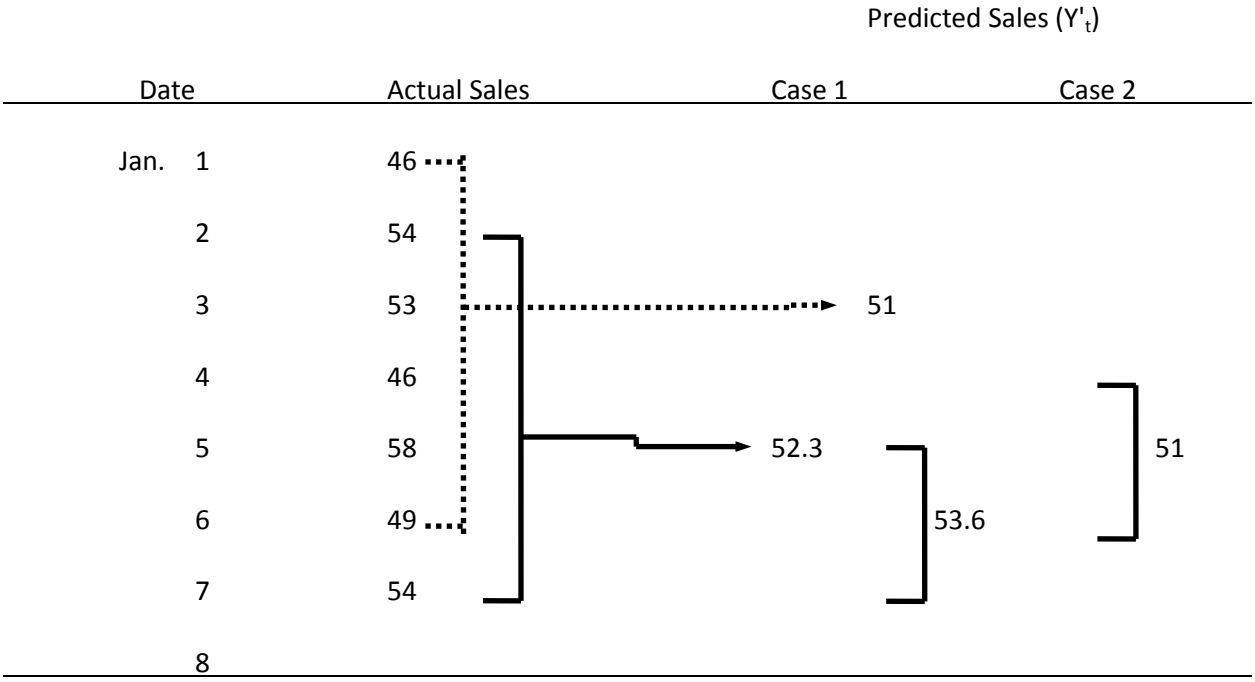
$$Y'_8 = \frac{54 + 53 + 46 + 58 + 49 + 54}{6} = 52.3$$

where Y' = predicted

Case 2 – three day period

$$Y'_7 = \frac{46 + 58 + 49}{3} = 51$$

$$Y'_8 = \frac{58 + 49 + 54}{3} = 53.6$$



In terms of the relative importance of new versus old data, in Case 1, the old data received a weight of 5/6 and current data 1/6. In Case 2, the old data received a weight of only 2/3, while current observation received 1/3 weight. 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.

What are the advantages and disadvantages of moving averages?

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.

7.2.2 Exponential Smoothing

What is the basis of exponential smoothing?

Exponential smoothing is a popular technique for short-run forecasting. It uses a weighted average of past data as the basis of the forecast. The procedure assumes the future is more dependent upon the recent past than on the distant past and thus gives heaviest weight to more recent data and smaller weights to those of the more distant past. WHEN TO USE IT: The method is most effective when there is randomness and no seasonal fluctuations. CAUTION: The method does not include industrial or economic factors such as market conditions, prices, or competitors' actions.

The model

The formula for exponential smoothing is:

$$Y'_{t+1} = \alpha Y_t + (1 - \alpha) Y'_t$$

or in words,

$$Y'_{new} = \alpha Y_{old} + (1 - \alpha) Y'_{old}$$

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.

REMEMBER THIS: The higher the α, the higher the weight given to the more recent data.

Example 7.6

YSY provides the following sales data:

Time period (t)	Actual sales (1000)(Y_t)
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
15	62.0

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

The manager decides to use a six-period average as the initial forecast Y'_7 with a smoothing constant of = 0.40.

Then $Y'_7 = (Y_1 + Y_2 + Y_3 + Y_4 + Y_5 + Y_6)/6 = (60 + 64 + 58 + 66 + 70 + 60)/6 = 63$

Note that $Y_7 = 70$. Then Y'_8 is computed as follows:

$$Y'_8 = \alpha Y_7 + (1 - \alpha) Y'_7$$
$$= (0.40)(70) + (0.60)(63)$$
$$= 28.0 + 37.80 = 65.80$$

Similarly,

$$Y'_9 = \alpha Y_8 + (1 - \alpha) Y'_8$$
$$= (0.40)(74) + (0.60)(65.80)$$
$$= 29.60 + 39.48 = 69.08$$

and

$$Y'_{10} = \alpha Y_9 + (1 - \alpha) Y'_9$$
$$= (0.40)(62) + (0.60)(69.08)$$
$$= 24.80 + 41.45 = 66.25$$

By using the same procedure, the values of Y'_{11}, Y'_{12}, Y'_{13}, Y'_{14}, and Y'_{15} can be calculated. The following shows a comparison between the actual sales and predicted sales by the exponential smoothing method.

COMPARISON OF ACTUAL SALES AND PREDICTED SALES

Time period (t)	Actual sales (Y_t)	Predicted sales (Y'_t)	Difference ($Y_t - Y'_t$)	Difference^2 ($Y_t - Y'_t)^2$
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
				307.27

How do I determine the best smoothing constant?

You can use a higher or lower smoothing constant (α), in order to adjust your prediction to large fluctuations in the data series. For example, if the forecast is slow in reacting to increased sales, (if the difference is negative), you 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 is the average sum of the variations between the historical data and forecast values for the corresponding periods. MSE is computed as follows:

$$MSE = \Sigma (Y_t - Y'_t)^2 / (n - i)$$

where i = the number of observations used to determine the initial forecast (in our example, i=6).

In the previous example, i=6 and

$$MSE = 307.27 / (15 - 6) = 307.27 / 9 = 34.14$$

WHAT TO DO: Try to select the α that minimizes MSE.

Can a computer help?

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. A computer can assist you here. Virtually all forecasting software has an exponential smoothing routine. To demonstrate, consider the following data.

Time Period	*Actual Sales (in Thousands of Dollars)*
1	117
2	120
3	132
4	141
5	140
6	156
7	169
8	171
9	174
10	182

Figure 7.1 is a printout of an exponential smoothing program. The best α for this particular example is 0.9, since it gives the least MSE.

FIGURE 7.1 EXPONENTIAL SMOOTHING PROGRAM

```
   PLEASE ENTER THE NUMBER OF OBSERVA-
TIONS.
?10
   ENTER YOUR DATA NOW.
   THE DATA SHOULD BE SEPARATED BY
COMMAS.
?117,120,132,141,140,156,169,171,174,182
   ENTER THE NUMBER OF PERIODS OVER
WHICH YOU COMPUTE THE AVERAGE TO BE
USED AS THE FIRST FORECAST VALUE.
?1
          **********EXPONENTIAL SMOOTHING
PROGRAM-SINGLE SMOOTHING**********

                JAE K. SHIM

                ACTUAL      ESTIMATED
PERIOD          VALUE       VALUE          ERROR

   1            117.00            .00
   2            120.00         117.00
THE VALUE OF THE EXPONENTIAL SMOOTHER
IS .1
   3            132.00         117.30        14.70
   4            141.00         118.77        22.23
   5            140.00         120.99        19.01
   6            156.00         122.89        33.11
   7            169.00         126.20        42.80
   8            171.00         130.48        40.52
   9            174.00         134.54        39.46
   10           182.00         138.48        43.52
   THE TOTAL ABSOLUTE ERROR IN ESTIMATE
IS 255.34
   THE MEAN SQUARED ERROR IS 1136.48
THE VALUE OF THE EXPONENTIAL SMOOTHER
IS .2
   3            132.00         117.60        14.40
   4            141.00         120.48        20.52
   5            140.00         124.58        15.42
   6            156.00         127.67        28.33
   7            169.00         133.33        35.67
   8            171.00         140.47        30.53
   9            174.00         146.57        27.43
   10           182.00         152.06        29.94
   THE TOTAL ABSOLUTE ERROR IN ESTIMATE
IS 202.24
   THE MEAN SQUARED ERROR IS 690.23
THE VALUE OF THE EXPONENTIAL SMOOTHER
IS .3
   3            132.00         117.90        14.10
   4            141.00         122.13        18.87
   5            140.00         127.79        12.21
   6            156.00         131.45        24.55
   7            169.00         138.82        30.18
   8            171.00         147.87        23.13
   9            174.00         154.81        19.19
   10           182.00         160.57        21.43
   THE TOTAL ABSOLUTE ERROR IN ESTIMATE
IS 163.66
   THE MEAN SQUARED ERROR IS 447.49
THE VALUE OF THE EXPONENTIAL SMOOTHER
IS .4
   3            132.00         118.20        13.80
   4            141.00         123.72        17.28
```

5	140.00	130.63	9.37
6	156.00	134.38	21.62
7	169.00	143.03	25.97
8	171.00	153.42	17.58
9	174.00	160.45	13.55
10	182.00	165.87	16.13

THE TOTAL ABSOLUTE ERROR IN ESTIMATE IS 114.16
THE MEAN SQUARED ERROR IS 308.97

THE VALUE OF THE EXPONENTIAL SMOOTHER IS .5

3	132.00	118.50	13.50
4	141.00	125.25	15.75
5	140.00	133.12	6.88
6	156.00	136.56	19.44
7	169.00	146.28	22.72
8	171.00	157.64	13.36
9	174.00	164.32	9.68
10	182.00	169.16	12.84

THE TOTAL ABSOLUTE ERROR IN ESTIMATE IS 114.16
THE MEAN SQUARED ERROR IS 226.07

THE VALUE OF THE EXPONENTIAL SMOOTHER IS .6

3	132.00	118.80	13.20
4	141.00	126.72	14.28
5	140.00	135.29	4.71
6	156.00	138.12	17.88
7	169.00	148.85	20.15
8	171.00	160.94	10.06
9	174.00	166.98	7.02
10	182.00	171.19	10.81

THE TOTAL ABSOLUTE ERROR IN ESTIMATE IS 98.13
THE MEAN SQUARED ERROR IS 174.23

THE VALUE OF THE EXPONENTIAL SMOOTHER IS .7

3	132.00	119.10	12.90
4	141.00	128.13	12.87
5	140.00	137.14	2.86
6	156.00	139.14	16.86
7	169.00	150.94	18.06
8	171.00	163.58	7.42
9	174.00	168.77	5.23
10	182.00	172.43	9.57

THE TOTAL ABSOLUTE ERROR IN ESTIMATE IS 85.76
THE MEAN SQUARED ERROR IS 140.55

THE VALUE OF THE EXPONENTIAL SMOOTHER IS .8

3	132.00	119.40	12.60
4	141.00	129.48	11.52
5	140.00	138.70	1.30
6	156.00	139.74	16.26
7	169.00	152.75	16.25
8	171.00	165.75	5.25
9	174.00	169.95	4.05
10	182.00	173.19	8.81

THE TOTAL ABSOLUTE ERROR IN ESTIMATE IS 76.05
THE MEAN SQUARED ERROR IS 117.91

THE VALUE OF THE EXPONENTIAL SMOOTHER IS .9

3	132.00	119.70	12.30
4	141.00	130.77	10.23
5	140.00	139.98	.02
6	156.00	142.25	3.75
7	169.00	154.40	14.60
8	171.00	167.54	3.46
9	174.00	170.65	3.35
10	182.00	173.67	8.33

THE TOTAL ABSOLUTE ERROR IN ESTIMATE IS 68.30
THE MEAN SQUARED ERROR IS 102.23

SUMMARY RESULTS

THE EXPONENTIAL SMOOTHER	.1	WITH A MEAN SQUARED ERROR OF	1136.48
THE EXPONENTIAL SMOOTHER	.2	WITH A MEAN SQUARED ERROR OF	690.23
THE EXPONENTIAL SMOOTHER	.3	WITH A MEAN SQUARED ERROR OF	447.49
THE EXPONENTIAL SMOOTHER	.4	WITH A MEAN SQUARED ERROR OF	308.97
THE EXPONENTIAL SMOOTHER	.5	WITH A MEAN SQUARED ERROR OF	226.07
THE EXPONENTIAL SMOOTHER	.6	WITH A MEAN SQUARED ERROR OF	174.23
THE EXPONENTIAL SMOOTHER	.7	WITH A MEAN SQUARED ERROR OF	140.55
THE EXPONENTIAL SMOOTHER	.8	WITH A MEAN SQUARED ERROR OF	117.91
THE EXPONENTIAL SMOOTHER	.9	WITH A MEAN SQUARED ERROR OF	102.23

7.3 Regression Analysis for Sales and Earnings Projections

What is regression analysis?

Regression analysis is a statistical procedure for estimating mathematically the average relationship between the dependent variable and the independent variable(s). For example, regression analysis is used to estimate a dependent variable (such as cash collections from customers) given a known independent variable (such as credit sales). *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.

First, we will discuss *simple (linear) regression,* defined by the following equation*:*

$$Y = a + bX$$

Where Y = dependent variable
X = independent (explanatory) variable
a = a constant or Y intercept of regression line
b = the slope of the regression line

How do I use the method of least squares?

The method of least squares attempts to fine a line of best fit for the graph of a regression equation. To better explain this, let us define error, or u, as the difference between the observed and estimated values of sales or earnings. Symbolically,

$$u = Y - Y'$$

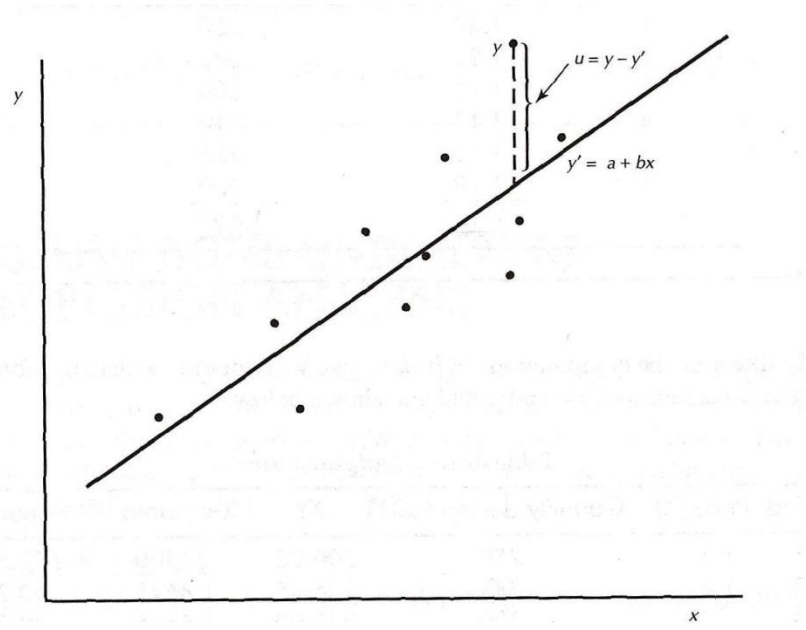
where Y = observed value of the dependent variable

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 7.2 from the observed data points to the line) is a minimum, i.e.,

$$\text{Mínimum: } \Sigma u^2 = \Sigma(Y-a-bX)^2$$

Figure 7.2
Actual (Y) versus estimated (Y')



Note: The objective of a scatter diagram is to demonstrate correlations. Each observation is represented by a dot on a graph corresponding to a particular value of X (the independent variable) and Y (the dependent variable). Also, you might want to make sure that a linear (straight-line) relationship existed between Y and X in the past sample.

Using differential calculus we obtain the following equations, called normal equations:

$$\Sigma Y = na + b\Sigma X$$

$$\Sigma XY = a\Sigma X + b\Sigma X^2$$

Solving the equations for b and a yields

$$b = \frac{n\sum XY - (\sum X)(\sum Y)}{n\sum X^2 - (\sum X)^2}$$

$$a = \overline{Y} - b\overline{X}$$

where $\overline{Y} = \frac{\sum Y}{n}$ and $\overline{X} = \frac{\sum X}{n}$

Example 7.7

To illustrate the computations of b and a, we will refer to the data in Table 7.1. All the sums required are computed and shown below.

Table 7.1
Original data and 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
17	18	306	289	324
$174	$225	3,414	2,792	4,359

From the table above:

$\Sigma X = 174$; $\Sigma Y = 225$; $\Sigma XY = 3{,}414$; $\Sigma X^2 = 2{,}792$.

$\overline{X} = \Sigma X/n = 174/12 = 14.5$; $\overline{Y} = \Sigma Y/n = 225/12 = 18.75$.

Substituting these values into the formula for b first:

$$b = \frac{n\sum XY - (\sum X)(\sum Y)}{n\sum X^2 - (\sum X)^2} = \frac{(12)(3{,}414) - (174)(225)}{(12)(2{,}792) - (174)^2} = \frac{1{,}818}{3{,}228} = 0.5632$$

$a = \overline{Y} - b\overline{X} = 18.75 - (0.5632)(14.5) = 18.75 - 8.1664 = 10.5836$

Thus, $Y' = 10.5836 + 0.5632\,X$

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:

$$Y' = 10.5836 + 0.5632\ X$$

$$= 10.5836 + 0.5632\ (10)$$

$$= \$16.2156$$

NOTE: ΣY^2 is not used here but rather is computed for r-squared (R^2).

How can I use 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. NOTE: 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 7.8

Case 1 (odd number)

	2X09	2X10	2X11	2X12
t =	-2	-1	0	+1

Case 2 (even number)

	2X07	2X08	2X09	2X10	2X11	2X12
t =	-3	-2	-1	+1	+2	+3

In each case $\Sigma t = 0$.

Example 7.9

Consider ABC Company, whose historical sales follows.

Year	Sales (in millions)
2X08	$ 10
2X09	12
2X10	13
2X11	16
2X12	17

Since the company has five years' data, which is an odd number, the year in the middle is assigned a zero value.

Year	t	Sales(in millions (Y)	tY	t^2
2X08	-2	$ 10	-20	4
2X09	-1	12	-12	1
2X10	0	13	0	0
2X11	+1	16	16	1
2X12	+2	17	34	4
	0	68	18	10

$$b = \frac{(5)(18)}{5(10)} = 90/50 = 1.8$$

$$a = \frac{68}{5} = 13.6$$

Therefore, the estimated trend equation is

Y' = $13.6 + $1.8 t

To project 2X13 sales, we assign +3 to the t value for the year 2X13.

Y' = $13.6 + $1.8 (3)

= $19

A summary of the four forecasting methods described in this chapter is provided in Figure 7.1.

REMEMBER THIS: Use this table as a guide for determining which method is best for your specific circumstance.

FIGURE 7.1
SUMMARY OF MORE 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 seasonals 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 are random demand and no seasonal fluctuations 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 year and over)	Very poor	Very poor	Good	Poor
Identification of turning point	Poor	Poor	Poor	Very good
Typical application	Inventory control for low-volume items	Production and inventory control, forecast 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
Is calculation possible without a computer?	Yes	Yes	Yes	Yes
Time required to develop an application and make forecasts	1 day–	1 day–	1 day–	Depends on ability to identify relationships

Chapter 7 Review Questions – Section 1

1. Which one of the following is a sales forecasting technique?

A. Linear programming (LP).
B. Moving average.
C. Queuing theory.
D. Economic order quantity (EOQ).

2. The moving-average method of forecasting

A. Is a cross-sectional forecasting method.
B. Includes each new observation in the average as it becomes available and discards the oldest observation.
C. Regresses the variable of interest on a related variable to develop a forecast.
D. Derives final forecasts by adjusting the initial forecast based on the smoothing constant.

3. As part of a risk analysis, a manager wishes to forecast the percentage growth in next month's sales for a particular plant using the past 30 month's sales results. Significant changes in the organization affecting sales volumes were made within the last 9 months. The most effective analysis technique to use would be

A. Unweighted moving average.
B. Queuing theory.
C. Exponential smoothing.
D. Linear regression analysis.

4. A regression equation

A. Estimates the dependent variables.
B. Encompasses factors outside the relevant range.
C. Is based on objective and constraint functions.
D. Estimates the independent variable.

5. Regression estimation programs employ many tools for problem definition and analysis. A scatter diagram is one of these tools. The objective of a scatter diagram is to

A. Demonstrate correlations that make sure a linear (straight-line) relationship existed between Y and X in the past sample.
B. Show frequency distribution in graphic form.
C. Divide a universe of data into homogeneous groups.
D. Show the vital trend and separate trivial items.

7.4 What Statistics to Look for in Regression Analysis

A variety of statistics can be used to tell you about the accuracy and reliability of the regression results. We describe three in this section:

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

How can I measure the goodness of fit for the regression equation?

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. RULE of THUMB: The higher the R^2, the more confidence we have in our estimated equation.

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 7.10

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 simple regression situation, you can use this short-cut formula:

$$R^2 = \frac{[n\sum XY - (\sum X)(\sum Y)]^2}{[n\sum X^2 - (\sum X)^2][n\sum Y^2 - (\sum Y)^2]}$$

Comparing this formula with the one for b, we see that the only additional information we need to compute R^2 is ΣY^2.

Example 7.11

Refer to the table in Example 7.7. With Y^2, you can compute R^2 using the short-cut formula as follows:

$$R^2 = \frac{(1{,}818)^2}{[3{,}228][(12)(4{,}359) - (225)^2]} = \frac{3{,}305{,}124}{[3{,}228][52{,}308 - 50{,}625]} = \frac{3{,}305{,}124}{(3{,}228)(1{,}683)}$$

$$= \frac{3{,}305{,}124}{5{,}432{,}724} = 0.6084 = 60.84\%$$

INTERPRETATION: 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.

REMEMBER: A low R2 is an indication that the model is inadequate for explaining the y variable.

The general causes for this problem are:

1. Use of a wrong functional form.
2. Poor choice of an X variable as the predictor.
3. The omission of some important variable or variables from the model.

How can I measure the accuracy of management predictions?

You can use the standard error of the estimate, designated Se, and defined as the standard deviation of the regression. The standard error of the estimate represents the variance of actual observations from the regression line. 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 7.12

Going back to our example data, S_e is calculated as :

$$S_e = \sqrt{\frac{\sum Y^2 - a\sum Y - b\sum XY}{n - 2}} = \sqrt{\frac{4{,}359 - (10.5836)(225) - (0.5632)(3414)}{12 - 2}} = \sqrt{\frac{54.9252}{10}} =$$

= 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.

$$Y' \pm t\, S_e \sqrt{1+\frac{1}{n}+\frac{(X_p - X)^2}{\sum X^2 - \frac{(\sum X)^2}{n}}}$$

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 7.3). As can be seen, the confidence interval is the linear distance bounded by limits on either side of the prediction.

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 ± (2.228)(2.3436) (1.0764)

= $16.2156 ± 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.

How can I test the appropriateness of the regression coefficient?

The standard error of the regression coefficient, designated S_b, and the t-statistic are closely related. S_b is calculated as:

$$S_b = \frac{S_e}{\sqrt{(X - \bar{X})^2}}$$

or in short-cut form

$$S_b = \frac{S_e}{\sqrt{X^2 - \bar{X}\sum X)}}$$

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 7.3). 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 7.13

The S_b for our example is:

$$S_b = \frac{S_e}{\sqrt{X^2 - \bar{X}\sum X)}} = \frac{2.3436}{\sqrt{2{,}792 - (14.5)(174)}} = \frac{2.3436}{\sqrt{2{,}792 - 2{,}523}} = 0.143$$

$$\text{Thus, t-statistic} = \frac{b}{S_b} = \frac{0.5632}{0.143} = 3.94$$

CONCLUSION: 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 7.3 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 7.3 shows an Excel regression output that contains the statistics we discussed so far.

FIGURE 7.3
EXCEL REGRESSION OUTPUT

SUMMARY OUTPUT

Regression Statistics		
Multiple R	0.77998	
R Square	0.60837	(R^2)
Adjusted R Square	0.56921	
Standard Error	2.34362	(S_e)
Observations	12	

ANOVA

	df	*SS*	*MS*	*Significance F*
Regression	1	85.32434944	85.3243	0.002769
Residual	10	54.92565056	5.49257	
Total	11	140.25		

	Coefficients	*Standard Error (S_b)*	*t Stat*	*Lower 95%*	*Upper 95%*	*Upper 95.0%*
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.

7.4.1 Statistics to Look For In Multiple Regressions

Multiple regressions are used to find the overall association between the dependent variable and explanatory (independent) variables. You need to take note of the following statistics when doing multiple regressions:

- t-statistics
- R-bar squared ($\overline{R}^2$) and F-statistic
- Multicollinearity
- Autocorrelation (or serial correlation)

What does the t-Statistics show?

Even though the t-statistic was discussed in the previous section, we take it up again because it is more valid in multiple regression. The t-statistic shows the significance of each explanatory variable in predicting the dependent variable. In a multiple regression situation, the t-statistic is defined as

$$\text{t-statistic} = \frac{b_i}{S_{b_i}}$$

where i = i_{th} independent variable RULE OF THUMB: 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. Table 7.2 provides t-value for a specified level of significance and degrees of freedom.

How do I measure goodness of fit?

For multiple regressions, goodness of fit is best represented by R-bar squared ($\overline{R}^2$):

$$\overline{R}^2 = 1 - (1 - R^2)\frac{n-1}{n-k}$$

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.

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. NOTE: Virtually all computer programs for regression analysis show $\bar{R}^2$ and F-statistic.

How can I be sure the independent variables are unrelated?

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

What is 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 7.2 at the end of the chapter provides the values of the Durbin-Watson statistic for specified sample sizes and explanatory variables. Table 7.2 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,

Durbin-Watson Statistic	*Autocorrelation*
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. WHAT TO DO: The best solution to this problem is to search for other explanatory variables to include in the regression equation.

An example showing applications of all the tests discussed in this section can be found in Section 7.6

7.5 Measuring the Accuracy of Your 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.

Error (e) = Actual A - Forecast (F)

What measures are commonly used for summarizing errors?

Two measures are commonly used for summarizing historical errors: 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 7.14

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
			-2	22	76

Using the figures,

MAD = Σ |e| /n = 22/8 = 2.75

MSE = Σe^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. *Note:* Forecasting control can be accomplished by comparing forecasting errors to predetermined values or limits. Errors that fall within the limits would be acceptable while errors outside of the limits would signal corrective action to be desired.

How do I 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 $\overline{R}^2$? The $\overline{R}^2$ can be used to rank the remaining equations in order to select the best candidates. A low $\overline{R}^2$ could mean:

    - A wrong functional form 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 ($\overline{R}^2$), F-statistic, and Durbin-Watson statistic. You have to go to regression packages such as Statistical Analysis System (SAS), MINITAB, and Statistical Packages for Social Scientists (SPSS), to name a few. These packages all have PC versions.

7.6 How to Use a Computer Statistical Package for Multiple Regressions

Are computers helpful for regression analyses?

Software packages can greatly assist decision makers and forecasters with a variety of statistical analyses.

How does the computer handle multiple regression?

Here is an example of how a computer handles multiple regression. REMEMBER THIS: Each software package is a little different. For this example, we use SPSS, one of the most popular programs. In Figure 7.5, you will find a computer listing containing the input data and output results using three independent variables. To help you, illustrative comments have been added where applicable.

EXAMPLE 7.15

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 that appear in the following table using three independent variables: sales of washers, disposable income, and savings.

Month	*Sales of Washers (X_1)*	*Disposable Income (X_2)*	*Savings (X_3)*	*Sales of Dryers (Y)*
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

Figure 7.5
SPSS Regression Output

Variables Entered/Removed[b]

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

$$Y' = -45{,}796.35 + 0.597(43{,}000) + 1.177(15{,}000) + 0.405(75{,}000)$$
$$= -45{,}796 + 25{,}671 + 17{,}655 + 30{,}375$$
$$= \$27{,}905.35$$

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.

$$\overline{R}^2 = 1 - (1 - R^2)\frac{n-1}{n-k}$$

$$= 1 - (1 - 0.983)\frac{10-1}{10-3} = 1 - 0.017\ (9/7)$$
$$= 1 - 0.025 = 0.975$$

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

	t-Statistic
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

$$F = \frac{(Y'-\overline{Y})^2/k}{(Y-Y')^2/(n-k-1)} = \frac{\text{Explained variation}/k}{\text{Unexplained variation}/(n-k-1)} = \frac{29.109/3}{0.491/6}$$

$$= 9.703/0.082 = 118.517 \text{ (which is given in the printout.)}$$

At a significance level of 0.01, our F-value is far above the value of 9.78 (which is from Table 7.4), 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 7.2

Values of the Durbin–Watson *d* for Specified Samples Sizes (*T*) and Explanatory Variables
Significance level = 0.01

Number of Residuals	$K = 1$		$K = 2$		$K = 3$		$K = 4$		$K = 5$	
T	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

TABLE 7.3

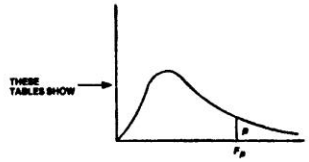
Critical Values for the *t* Statistic

Values of t						
d.f.	$t_{0.100}$	$t_{0.050}$	$t_{0.025}$	$t_{0.010}$	$t_{0.005}$	**d.f.**
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 $t \pm 2.306$.

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 = degrees of freedom for numerator = k						n_2 = 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**	**5,559**	**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**	**10.37**	**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
	11.26	**8.64**	**7.69**	**7.01**	**6.63**	**6.37**	**6.19**	**6.03**	**5.91**	**5.82**	**5.74**	**5.67**
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.13	3.10	3.07
	10.66	**8.02**	**6.99**	**6.42**	**6.06**	**5.30**	**5.62**	**5.47**	**5.35**	**5.26**	**5.18**	**5.11**
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.97	2.94	2.91
	10.04	**7.54**	**6.55**	**5.99**	**5.64**	**5.39**	**5.21**	**5.06**	**4.95**	**4.85**	**4.78**	**4.71**
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.86	2.82	2.79
	9.65	**7.20**	**6.22**	**5.67**	**5.32**	**5.07**	**4.88**	**4.74**	**4.63**	**4.54**	**4.46**	**4.40**
12	4.75	3.88	3.49	3.26	3.11	3.00	2.92	2.85	2.80	2.76	2.72	2.69
	9.33	**6.93**	**5.95**	**5.41**	**5.04**	**4.82**	**4.65**	**4.50**	**4.39**	**4.30**	**4.22**	**4.16**
13	4.67	3.80	3.41	3.18	3.02	2.02	2.84	2.77	2.72	2.67	2.63	2.60
	9.07	**6.70**	**5.74**	**5.20**	**4.86**	**4.62**	**4.44**	**4.30**	**4.19**	**4.10**	**4.02**	**3.96**
14	4.60	3.74	3.34	3.11	2.96	2.85	2.77	2.70	2.65	2.60	2.56	2.53
	8.86	**6.51**	**5.56**	**5.03**	**4.69**	**4.46**	**4.28**	**4.14**	**4.03**	**3.94**	**3.86**	**3.80**
15	4.54	3.68	3.29	3.06	2.90	2.79	2.70	2.64	2.59	2.55	2.51	2.48
	8.62	**6.36**	**5.42**	**4.89**	**4.56**	**4.32**	**4.14**	**4.00**	**3.89**	**3.80**	**3.73**	**3.67**
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.45	2.42
	8.53	**6.23**	**5.29**	**4.77**	**4.44**	**4.20**	**4.03**	**3.89**	**3.78**	**3.69**	**3.61**	**3.55**
17	4.45	3.59	3.20	2.96	2.81	2.70	2.62	2.55	2.50	2.45	2.41	2.38
	8.40	**6.11**	**5.18**	**4.67**	**4.34**	**4.10**	**3.93**	**3.79**	**3.68**	**3.59**	**3.52**	**3.45**
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.37	2.34
	8.26	**6.01**	**5.09**	**4.58**	**4.25**	**4.01**	**3.86**	**3.71**	**3.60**	**3.51**	**3.44**	**3.37**
19	4.38	3.52	3.13	2.90	2.74	2.63	2.55	2.48	2.43	2.38	2.34	2.31
	8.18	**5.98**	**5.01**	**4.50**	**4.17**	**3.94**	**3.77**	**3.63**	**3.52**	**3.43**	**3.36**	**3.30**
20	4.35	3.49	3.10	2.87	2.71	2.60	2.52	2.45	2.40	2.35	2.31	2.28
	8.10	**5.86**	**4.94**	**4.43**	**4.10**	**3.87**	**3.71**	**3.56**	**3.45**	**3.37**	**3.30**	**3.23**
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32	2.28	2.25
	8.02	**5.78**	**4.87**	**4.37**	**4.04**	**3.81**	**3.65**	**3.51**	**3.40**	**3.31**	**3.24**	**3.17**
22	4.30	3.44	3.05	2.82	2.66	2.55	2.47	2.40	2.35	2.30	2.26	2.23
	7.94	**5.72**	**4.82**	**4.31**	**3.99**	**3.76**	**3.69**	**3.45**	**3.35**	**3.26**	**3.18**	**3.12**
23	4.28	3.42	3.03	2.80	2.64	2.53	2.45	2.38	2.32	2.28	2.24	2.20
	7.88	**5.64**	**4.76**	**4.28**	**3.94**	**3.71**	**3.54**	**3.41**	**3.30**	**3.21**	**3.14**	**3.07**
24	4.26	3.40	3.01	2.78	2.62	2.51	2.43	2.36	2.30	2.26	2.22	2.18
	7.82	**5.61**	**4.72**	**4.22**	**3.90**	**3.67**	**3.50**	**3.36**	**3.25**	**3.17**	**3.09**	**3.03**
25	4.24	3.38	2.99	2.76	2.60	2.49	2.41	2.34	2.28	2.24	2.20	2.16
	7.77	**5.57**	**4.68**	**4.13**	**3.86**	**3.63**	**3.46**	**3.32**	**3.21**	**3.13**	**3.05**	**2.99**
26	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**

Chapter 7 Review Questions – Section 2

6. Correlation is a term frequently used in conjunction with regression analysis and is measured by the value of the coefficient of correlation, r. The best explanation of the value r is that it

A. Interprets variances in terms of the independent variable.
B. Is a measure of the relative relationship between two variables.
C. Ranges in size from negative infinity to positive infinity.
D. Is positive only for downward-sloping regression lines.

7. In regression analysis, the coefficient of determination is a measure of

A. The amount of variation in the dependent variable explained by the independent variables.
B. The amount of variation in the dependent variable unexplained by the independent variables.
C. The slope of the regression line.
D. The predicted value of the dependent variable.

8. In a simple linear regression model, the standard error of the estimate of Y represents

A. A range of values constructed from the regression equation results for a specified level of probability.
B. A variability about the least squares line that is uniform for all values of the independent variable in the sample.
C. A measure of variability of the actual observations from the regression line.
D. The proportion of the variance explained by the independent variable.

9. Multicollinearity occurs when

A. A proportion of the variance is explained by the independent variable.
B. Independent variables are correlated with each other.
C. Observations are not independent.
D. A random sample fails to represent the population.

10. Autocorrelation or serial correlation

A. Means that observations are not independent.

B. Defines the proportion of the variance explained by the independent variable.
C. Means that independent variables are correlated with each other.
D. Is the failure of random samples to represent the population.

11. Two measures are commonly used for summarizing historical errors: the *mean absolute deviation* (MAD) and the *mean.* True or False?

Chapter 8:

Making Use of Quantitative Decision Making

Learning Objectives:

After completing this section, you should be able to:

- Recognize the tools for decision making under conflict.
- Recognize the applications of linear programming to make optimize complex decisions.
- Identify techniques for inventory planning and control.

Quantitative methods (or models) are used in operations research or management science. They refer to sophisticated mathematical and statistical techniques for solving problems pertaining to managerial planning and decision making. Numerous such techniques are available, eight of which are discussed in this chapter. They are:

- Decision making under certainty and conflict
- Decision making under uncertain conditions
- Decision theory
- Linear programming and shadow prices
- Learning curve
- Inventory planning and control
- Queuing models

8. 1 Decision Making under Risk, Certainty, and Conflict

Decision making under risk involves decisions made when the probability of occurrence of the different states of nature is known. Decision making involves managing three major elements:

- *Decision strategy*. A decision maker implements a decision strategy which utilizes known existing organizational resources.
- *States of nature*. Elements of the environment over which the manager has little or no control. States of nature include the weather, political environment, economy, technological developments, etc. They can dramatically affect the outcome of any decision strategy.
- *Outcome*. The result of the interaction of the implementation of a decision strategy with the states of nature. Because of the variable nature of the states of nature, outcomes can be extremely difficult to forecast. Thus, outcomes of a decision strategy, *O,* the dependent variable, is a function of the interaction of the two independent variables, *D*, decision strategies and, *S*, the states of nature. Figure 8.1 shows a *decision matrix,* which is an approach to decision making under risk. Decision matrix, also called, payoff table, is a matrix consisting of the decision alternatives, the states of nature, and the decision outcomes. The rows are strategic choice a manager can make while the columns represent decision outcomes. An outcome O_{ij} is a function of a decision strategy D_i and state of nature S_j.

FIGURE 8.1 DECISION MATRIX

		States of Nature					
	Strategies	S_1	S_2	S_3	.	.	S_n
D_1	O_{11}	O_{12}	*	*	*	O_{1n}	
D_2	O_{21}	O_{22}	*	*	*	O_{2n}	
D_3	*	*				*	
.	*	*				*	
.							
D_m	O_{i1}	O_{i2}	*	*	*	O_{mn}	

Mathematically this relationship can be expressed as:

$$O_{ij} = f(D_i, S_j) \text{ where } i=1,2,\ldots m \text{ and } j=1,2,\ldots n.$$

What is decision making under certainty?

This is the simplest type of decision making since it has a known state of nature. Therefore, the outcomes are the direct result of the chosen decision strategy, and can be predicted with certainty. In reality, this situation rarely occurs.

The manager simply evaluates all the available decision strategies and then chooses the one best meeting the outcome criteria. Various optimization techniques can be utilized to maximize a decision strategy.

Decision making under certainty occurs with problems that can be analyzed using basic inventory models, break-even analysis, linear programming, incremental analysis, and other methods where an outcome having one state of nature can be determined.

What is decision making under conflict?

In this situation, the decision maker is opposed by another party who is designing states of nature strategies to offset the decision maker's strategy to gain a competitive advantage. The decision maker must develop decision strategies to defeat an opponent's state of nature control strategy.

This is the ideal setting for developing game strategies. Games are dependent on rules governing a competitive situation where the number of players, strategies, states of nature between the players, and degree of conflict control the outcomes.

What are the types of games?

Games are classified according to the degree of conflict of interest between the opponents. A zero sum game has a perfect inverse relationship between the gains and losses of the opponents. One opponent's gain is the other's loss. The total sum remains the same.

In nonzero-sum games, the gains of one participant do not necessarily represent a comparable loss for the other party to the game. In the business environment, most competitive situations are nonzero-sum games. The prisoner's dilemma is a special outcome of a partly competitive game. In these games, each player has a strategy that dominates all others, and the outcome from each player's choice of his/her dominant strategy is less favorable to both players than some other outcome.

How does a zero sum game work?

In a zero sum game the gains and losses are always equal. No player can gain more than the other player loses. Therefore, the game is always in equilibrium.

The simplest type of zero sum game is the two-person zero sum game. Each player has a choice of game strategies. Since each player's gain will equal the other's loss, the outcome for each game strategy is known to each player.

In the two-person zero sum game, the outcomes can be expressed numerically. A two-person zero sum game outcome matrix is show in Example 8.1. A positive number indicates a payoff to the player for rows A, and a negative number indicates a payoff to the player for columns B. In Example 8.1 the maximum any player can win/lose is 11.

EXAMPLE 8.1

Two-player zero sum game outcome matrix

Player A	*Player B*	
	Strategy F r_1	*Strategy H* r_2
Strategy D p_1	A wins 5	A wins 8
Strategy E p_2	A wins 6	B wins 2 (or A loses 2)

What is a pure strategy?

A pure strategy exists when there is one strategy for player A and one for player B that will be played every time. An equilibrium point is reached when it is at an optimum point for each respective player. This is termed a saddle point. A saddle point occurs where it is both the smallest numerical value in its row and the largest numerical value in its column.

EXAMPLE 8.2

Example 8.2 shows a sample saddle point in a two-person zero sum game. Since 13 is the row minimum and the column maximum that is the saddle point strategy. The value of this game is 13. As the first choice Player A gains 13 while Player B loses 13.

Saddle Point for two-person Zero Sum Game

	Player B		
Player A	20	13	18

8	4	7

What is a mixed strategy?

When no player has one strategy that will be used each time, then there is no pure strategy used in the zero sum game. In this case the optimum point, or saddle point, is found using a mixed strategy. In this case, each player's strategy is chosen using a random number process. Nonetheless, one player's gain is another player's loss.

EXAMPLE 8.3

Using the Two-Player Zero Sum Game Outcome Matrix in Example 8.1, it is possible to establish a mixed strategy. Assuming p_1 and p_2 are the probabilities for A's strategies, and n_1 and n_2 are the probabilities for B's strategies, their values can be determined using the following process in Section 8.2.

8.2 Decision Making Under Uncertain Conditions

Under what conditions are decisions made?

Decisions are made under certainty or under uncertainty (or risk). Under certainty implies that there is only one event and therefore only one outcome for each action. Under uncertainty, which is more common realistically, several events are involved for each action and with each a different probability of occurrence. WHAT TO DO: Under uncertainty, it is often helpful to compute the following:

- Expected value
- Standard deviation
- Coefficient of variation.

What does expected value tell me?

For decisions involving uncertainty, the concept of expected value ($\bar{r}$) provides a rational means for selecting the best course of action. Expected value is defined as a weighted average using the probabilities as weights. It is found by multiplying the probability of each outcome by its payoff:

$$\bar{r} = \sum r_i p_i$$

where r_i is the outcome for i_{th} possible event and p_i is the probability of occurrence of that outcome.

Note: A rational economic decision maker (one completely guided by objective criteria) will use expected monetary value to maximize gains under conditions of uncertainty because (s)he is risk-neutral. Expected value represents the long-term average payoff for repeated trials. The best choice is the one having the highest expected value (sum of the products of the possible outcomes and their respective probabilities).

What is the significance of the standard deviation?

Whenever we talk about the expected value, one statistic that goes with it is standard deviation. Standard deviation is a statistic that measures the tendency of data to be spread out or is also a measure of the dispersion of a probability distribution. The smaller the deviation, the tighter the distribution, and thus, the lower the riskiness of the project. It is intuitively a margin of error associated with a given expected value. MBAs can make important inferences from past data with this measure. It is the square root of the mean of the squared deviations from the expected value ($\bar{r}$). The standard deviation, denoted with the Greek letter σ , read as *sigma,* is calculated as follows:

$$\sigma = \sqrt{\sum (r_i - \bar{r})^2 p_i}$$

To calculate σ, we proceed as follows:

Step 1. First compute the expected rate of return ($\bar{r}$)

Step 2. Subtract each possible return from $\bar{r}$ to obtain a set of deviations ($r_i - \bar{r}$)

Step 3. Square each deviation, multiply the squared deviation by the probability of occurrence for its respective return, and sum these products to obtain the variance (σ^2):

$$\sigma^2 = \sum (r_i - \bar{r})^2 p_i$$

Step 4. Finally, take the square root of the variance to obtain the standard deviation (σ).

The standard deviation can be used to measure the variation of such items as the expected profits, expected contribution margin, or expected cash flows. It can also be used to assess the absolute risk associated with investment projects. RULE OF THE THUMB: The higher the standard deviation, the higher the risk.

What does the coefficient of variation mean?

The coefficient of variation is a popular measure of relative dispersion, or relative risk. It represents the degree of risk per unit of return. It is computed by dividing the standard deviation by the expected value.

$$\sigma / \bar{r}$$

EXAMPLE 8.4

Consider two investment proposals, A and B, with the following probability distribution of cash flows in each of the next five years:

	Cash Inflows		
Probability	(.2)	(.6)	(.2)
Project A	$200	300	400
Project B	$100	300	500

The expected value of the cash inflow is computed as follows:

Project A

$200(.2) + 300(.6) + 400(.2) = $300

Project B

$100(.2) + 300(.6) + 500(.2) = $300

The standard deviations are computed as follows:

$$\text{For A: } \sigma_A = \sqrt{(\$200-300)^2(.2) + (300-300)^2(.6) + (400-300)^2(.2)} = \$63.25$$

$$\text{For B: } \sigma_B = \sqrt{(\$100-300)^2(.2) + (300-300)^2(.6) + (500-300)^2(.2)} = \$126.49$$

The coefficients of variation are computed as follows:

For A: $63.25/$300=.21

For B: $126.49/$300=.42.

CONCLUSIONS: Proposal B is more risky than proposal A since its standard deviation is greater. And, because the coefficient is a relative measure of risk, the degree of risk is also greater for Project B.

8.3 Decision Theory

What is decision theory?

Decision theory refers to a systematic approach to making decisions, particularly under conditions of uncertainty. While statistics such as expected value and standard deviation are essential for making your best choice, the decision problem can best be approached by using decision theory . Decision theory utilizes an organized approach such as *a decision matrix (or payoff table).* It is characterized by:

- The *row*: Each row represents a set of available alternative courses of action.
- The *column*. Each column represents the "state of nature," or conditions that are likely to occur and over which you have no control.
- The *entries*. These appear in the body of the table and represent the outcome of the decision, known as payoffs. These may be in the form of costs, revenues, profits, contribution margins or cash flows.

By computing expected value of each action, we will be able to pick the best one.

EXAMPLE 8.5

Assume the following probability distribution of daily demand for strawberries:

Daily demand	0	1	2	3
Probability	.2	.3	.3	.2

Also assume that unit cost =$3, selling price=$5 (i.e., profit on sold unit = $2), and salvage value on unsold units =$2 (i.e., loss on unsold unit =$1). The company can stock either 0, 1, 2, or 3 units. The problem is: How many units should be stocked each day? Assume that units from one day cannot be sold the next day. The payoff table can be constructed as follows:

State of Nature

Demand	0	1	2	3	Expected value
Stock (probability)	(.2)	(.3)	(.3)	(.2)	
0	$0	0	0	0	$0
Actions 1	-1	2	2	2	1.40
2	-2	1*	4	4	1.90**
3	-3	0	3	6	1.50

*Profit for (stock 2, demand 1) equals (no. of units sold)(profit per unit) - (no. of units unsold)(loss per unit) = (1)($5 - 3) - (1)($3 - 2)= $2 - $1 = $1

**Expected value for (stock 2) is: -2(.2) + 1(.3) + 4 (.3) + 4 (.2) =$1.90

The optimal stock action is the one with the highest expected monetary value i.e., stock 2 units.

What is the role of perfect information in decision theory?

Suppose you can obtain a perfect prediction of which event (state of nature) will occur. The expected value with perfect information would be the total expected value of actions selected on the assumption of a perfect forecast. The expected value of perfect information (EVPI) can then be computed as:

EVPI = Expected value with perfect information minus the expected value with existing information.

EXAMPLE 8.6

From the payoff table in Example 8.5, with perfect information, you can make the following analysis:

State of Nature

	Demand	0	1	2	3	Expected value
	Stock	(.2)	(.3)	(.3)	(.2)	
	0	$0				$0
Actions	1		2			0.6
	2			4		1.2
	3				6	1.2
						$3.00

Alternatively,

$0 (.2) + 2 (.3) + 4 (.3) + 6 (.2) = $3.00

CONCLUSIONS: The optimal stock action is stock 2, with the highest expected value of $1.90. Thus, with existing information, the best that you can do is to select stock 2 units to obtain $1.90. With perfect information (forecast), you could make as much as $3. Therefore, the expected value of perfect information (EVPI) = $3.00 - $1.90, or $1.10. This is the maximum price you should be willing to pay for additional information.

Can you use a decision tree?

Decision tree is another approach used in discussions of decision making under uncertainty. It is a pictorial representation of a decision situation. As in the case of the decision matrix approach discussed, it shows decision alternatives, states of nature, probabilities attached to the state of nature, and conditional benefits and losses. The decision tree approach is most useful in a sequential decision situation.

EXAMPLE 8.7

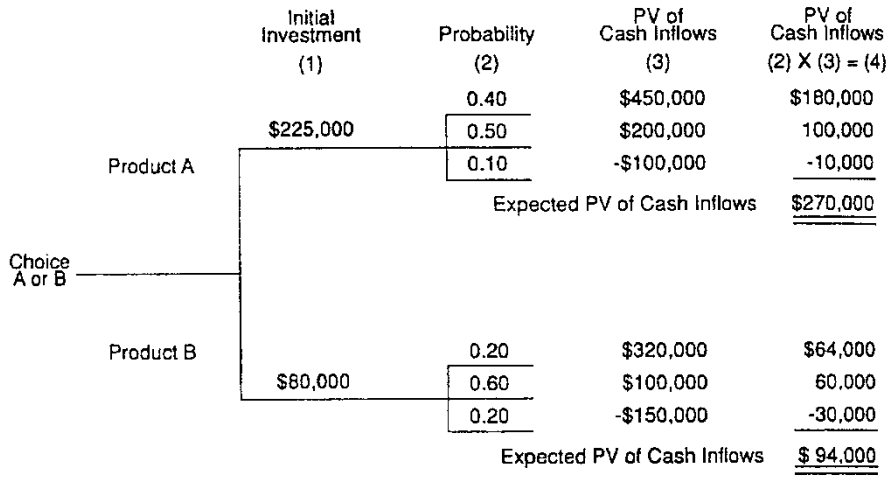
Assume XYZ Corporation wishes to introduce one of two products to the market this year. The probabilities and present values (PV) of projected cash inflows are given below:

Product	Initial investment	PV of cash inflows	Probabilities
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 8.2.

FIGURE 8.2

DECISION TREE



Based on the expected NPV, choose product A over product B. NOTE: This analysis fails to recognize the risk factor in project analysis.

8.4 Linear Programming and Shadow Prices

8.4.1 Linear Programming

What is 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), or revenue, or the lowest cost.

What does linear programming consist of?

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.

EXAMPLE 8.8

A firm wishes to find an optimal product mix. The optimal mix would be the one that maximizes its total profit or contribution margin (CM) within the allowed budget and production capacity. Or the firm may want to determine a least cost combination of input materials while meeting production requirements, employing production capacities, and using available employees.

What are applications of linear programming?

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.

What is involved in the formulation of LP?

To formulate an LP problem, certain steps are followed. They are:

1. Define what is called decision variables that you are trying to solve for.
2. Express the objective function and constraints in terms of these decision variables. NOTE: All the expressions must be in linear form.

In the following example, we will use this technique to find the optimal product mix.

EXAMPLE 8.9

The Omni Furniture Manufacturing Company produces two products: desk and table. Both products require time in two processing departments, Assembly Department and Finishing Department. Data on the two products are as follows:

	Products		Available
Processing	Desk	Table	Hours
Assembly	2	4	100 hours
Finishing	3	2	90
Contribution Margin Per Unit	$25	$40	

The company wants to find the most profitable mix of these two products.

Step 1: Define the decision variables as follows:

A = Number of units of desk to be produced

B = Number of units of table to be produced

Step 2: The objective function to maximize total contribution margin (CM) is expressed as:

Total CM = 25A + 40B

Then, formulate the constraints as inequalities:

$2A + 4B \leq 100$ (Assembly constraint)

$3A + 2B \leq 90$ (Finishing constraint)

In addition, implicit in any LP formulation are the constraints that restrict A and B to be nonnegative, i.e.,

$A, B \geq 0$

Our LP model is:

Maximize: Total CM = 25A + 40B

Subject to: $2A + 4B \leq 100$

$3A + 2B \leq 90$

$A, B \geq 0$

How do I solve LP problems?

There are several methods available to solve LP problems. Here are two common ones:

- The simplex method. This is the most commonly used method of solving LP problems. It uses an algorithm, which is an iteration method of computation, to move from one solution to another until it reaches the best one.
- The graphical method. This solution is easier to use but limited to the LP problems involving two (or at most three) decision variables.

To use the graphical method, follows these five steps:

Step 1: Change inequalities to equalities.

Step 2: Graph the equalities. To graph the equality, (1) set one variable equal to zero and find the value of the other and connect those two points on the graph and (2) mark these intersections on the axes and connect them with a straight line.

Step 3: Identify the correct side for the original inequalities by shading. Repeat steps 1-3 for each constraint.

Step 4: After all this, identify the feasible region, the area of feasible solutions.

Step 5: Solve the constraints (expressed as equalities) simultaneously for the various corner points of the feasible region. Determine the profit or contribution margin at all corners in the region.

EXAMPLE 8.10

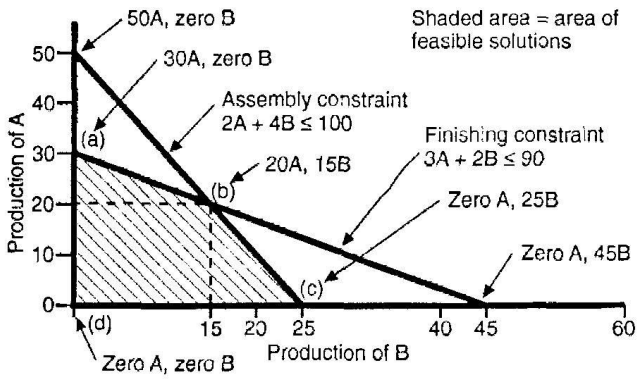
Using the data and the LP model from Example 8.9, obtain the feasible region (shaded area) by going through steps one through four. Then evaluate all of the corner points as follows:

	Corner Points		Contribution Margin
	A	B	$25A + $40B
(a)	30	0	$25(30) + $40(0) = $750
(b)	20	15	25(20) + 40(15) = 1,100
(c)	0	25	25(0) + 40(25)= 1,000
(d)	0	0	25(0) + 40(0) = 0

CONCLUSION: The corner, 20A, 15B produces the most profitable solution.

(see Figure 8.3).

FIGURE 8.3
THE FEASIBLE REGION AND CORNER POINTS



8.4.2 Shadow Prices (Opportunity Costs)

What are shadow prices (opportunity costs)?

If you have solved an LP problem, you might still wish to know whether it pays to add capacity in hours in a particular department. For example, you would be interested in the monetary value to the company by adding, say, an hour per week of assembly time. This monetary value is usually the additional contribution that could be earned. This amount is the shadow price of a given resource. Shadow prices constitute a form of *opportunity cost* if you consider it as the contribution margin that would be lost by not adding capacity.

To justify a decision in favor of a short-term capacity decision, you must be sure that the shadow price exceeds the actual price of that expansion. For example, suppose that the shadow price of an hour of assembly capacity is $6.50 while the actual market price is $8.00. That means it does not pay to obtain an additional hour of the assembly capacity.

Here is how to compute shadow prices (or opportunity cost):

1. 1. Add one hour (preferably, more than one hour to make it easier to show graphically) to the constraint of a given LP problem under consideration.
2. Resolve the problem and find the maximum CM.
3. Compute the difference between the CM of the original LP problem and the CM determined in step 2, which is the shadow price.

EXAMPLE 8.11

Using the data in Example 8.10, we compute the shadow price of the assembly capacity. To make it easier to show graphically, add 8 hours of capacity of the assembly department, rather than one hour. The new assembly constraint and the resulting feasible region is shown in Figure 8.4.

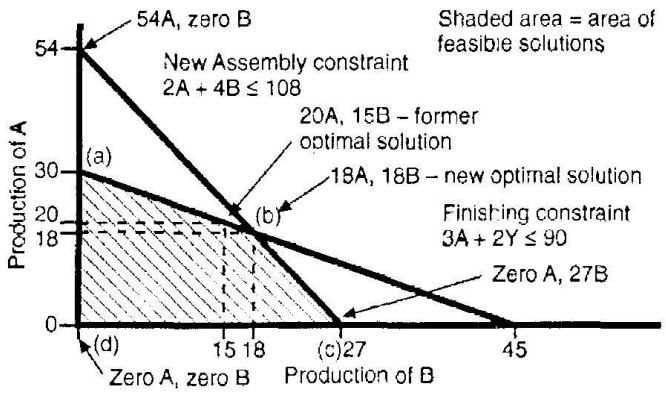
Then we evaluate all of the corner points in the new feasible region in terms of their CM, as follows:

	Corner Points		Contribution Margin	
	A	B	$25A + $40B	
(a)	30	0	$25(30) + $40(0) =	$750
(b)	18	18	$25(18) + 40(18)=	1,170
(c)	0	27	$25(0) + 40(227)=	1,080
(d)	0	0	$25(0) + 40(0) =	0

The new optimal solution, Corner b (18A, 18B) has total CM of $1,170 per week. The shadow price of the assembly capacity is $70 ($1,170 - $1,100 = $70), or $8.75 per hour ($70/8 hours = $8.75).

YOUR CONCLUSION: The company would be willing to pay up to $70 to obtain an additional 8 hours of the assembly capacity per week, or $8.75 per hour per week. In other words, the company's opportunity cost of not adding an additional hour is $8.75.

Figure 8.4
The Feasible Region And Corner Points



8.4.3 How to Use the Computer for Linear Programming

We can use a computer LP software package such as LINDO (Linear Interactive and Discrete Optimization) (www.lindo.com), What's Best! (www.AnalyCorp.com), or Microsoft Excel to quickly solve an LP problem. Figure 8.5 shows a computer output by an LP software program for out LP model. Figure 8.6 presents Excel LP solution.

NOTE: The printout shows the following optimal solution:

A = 20 units
B = 15 units
CM = $1,100

Shadow prices are:

Assembly capacity = $8.75
Finishing capacity = $2.50

Figure 8.5

The LP computer output

```
                **INFORMATION ENTERED**
NUMBER OF CONSTRAINTS          2
NUMBER OF VARIABLES            2
NUMBER OF ≦ CONSTRAINTS        2
NUMBER OF = CONSTRAINTS        0
NUMBER OF ≧ CONSTRAINTS        0

MAXIMIZATION PROBLEM

              25 X 1       +40 X 2

SUBJECT TO

              2 X 1        + 4 X 2       ≦ 100
              3 X 1        + 2 X 2       ≦ 90

  **RESULTS**

                VARIABLE      ORIGINAL      COEFF.
VARIABLE         VALUE         COEFF.       SENS.
X1                  20            25           0
X2                  15            40           0

CONSTRAINT   ORIGINAL      SLACK OR      SHADOW
NUMBER          RHS        SURPLUS       PRICE
1               100            0         8.75
2                90            0          2.5

OBJECTIVE FUNCTION VALUE: 1100 = CM

   SENSITIVITY ANALYSIS

   OBJECTIVE FUNCTION COEFFICIENTS

                LOWER        ORIGINAL       UPPER
VARIABLE        LIMIT     COEFFICIENT      LIMIT
X1                 20            25           60
X2              16.67            40           50

   RIGHT HAND SIDE

CONSTRAINT    LOWER        ORIGINAL       UPPER
NUMBER        LIMIT         VALUE         LIMIT
1                 60           100          180
2                 50            90          150
```

Note:
$X_1 = A$
$X_2 = B$

Solution:
$X_1 = A = 20$
$X_2 = B = 15$

Shadow price of the assembly capacity

Figure 8.6

The excel LP input and output

Target Cell (Max)

Cell	Name	Original Value	Final Value
$E$5	Unit Contribution Margin: TotalCM:	$0	$1,100

Adjustable Cells

Cell	Name	Original Value	Final Value
$B$4	Number to make: Desk	0	20
$C$4	Number to make: Table	0	15

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$D$8	Assembly Used	100	$D$8<=$E$8	Binding	0
$D$9	Finishing Used	90	$D$9<=$E$9	Binding	0
$B$4	Number to make: Desk	20	$B$4>=0	Not Binding	20
$C$4	Number to make: Table	15	$C$4>=0	Not Binding	15

Adjustable Cells

Cell	Name	Final Value	Reduced Gradient
$B$4	Number to make: Desk	20	0
$C$4	Number to make: Table	15	0

Constraints

Cell	Name	Final Value	Lagrange Multiplier
$D$8	Assembly Used	100	8.75
$D$9	Finishing Used	90	2.5

Cell	Target Name	Value
$E$5	Unit Contribution Margin: TotalCM:	$1,100

Cell	Adjustable Name	Value	Lower Limit	Target Result	Upper Limit	Target Result
$B$4	Number to make: Desk	20	0	600	20	1100
$C$4	Number to make: Table	15	0	500	15	1100

Chapter 8 Review Questions – Section 1

1. A decision maker is operating in an environment in which all the facts surrounding a decision are known exactly, and each alternative is associated with only one possible outcome. The environment is known as

A. Certainty.
B. Risk.
C. Uncertainty.
D. Conflict.

2. One of your firm's trucks was involved in an accident with a car, and both parties claimed the other was at fault. A court ruled that your firm was solely responsible for all damage. From a game theory perspective, this dispute can be described as

A. Prisoner's dilemma.
B. Zero-sum game.
C. Saddle point.
D. Nonzero-sum game.

3. The expected value of perfect information is the

A. Same as the expected profit under certainty.
B. Sum of the conditional profit (loss) for the best event of each act times the profitability of each event occurring.
C. Difference between the expected profit under certainty and the expected opportunity loss.
D. Expected value with perfect information minus the expected value with existing information.

4. Management of a company has asked the internal auditing department to assist in determining whether a new automated system should be implemented and whether the supporting software should be developed in-house, purchased, or leased. This will require evaluating a sequence of alternatives, each of which will result in different outcomes. The most effective tool the company can use to evaluate these choices would be

A. Ratio analysis.
B. Decision matrix (payoff tables).
C. Queuing theory.
D. Decision tree.

5. A firm must decide whether to introduce a new product A or B. There is no time to obtain experimental information; a decision has to be made now. Expected sales can be classified as weak, moderate, or strong. How many different payoffs are possible in a decision tree under these circumstances?

A. 2.
B. 6.
C. 3.
D. 5.

6. A firm wishes to find an optimal product mix. The optimal mix would be the one that maximizes its total profit or contribution margin (CM) within the allowed budget and production capacity. Or the firm may want to determine a least cost combination of input materials while meeting production requirements, employing production capacities, and using available employees. An appropriate technique for finding an optimal product mix is

A. Linear programming.
B. Capital budgeting.
C. Differential analysis.
D. Queuing theory.

7. Linear programming is an operating research technique that allocates resources. Mathematical expressions are used to describe the problem. The measure of effectiveness that is to be maximized or minimized is the

A. Constraints.
B. Set of decision variables.
C. Objective function.
D. Derivative of the function.

8. The constraints in a linear programming model are

A. Included in the objective function.
B. Costs.
C. Scarce resources.
D. Dependent variables.

9. Given the basic equations for the maximization of profits in a linear programming model, what quantitative technique is ordinarily employed to arrive at an optimal solution?

A. Regression analysis.
B. Markov analysis.
C. Monte Carlo analysis.
D. Simplex method analysis.

10. The graphic method as a means for solving linear programming problems

A. Is limited to the LP problems involving two (or at most three) decision variables.
B. Is limited to situations having two constraints.
C. Is limited to situations with one constraint.
D. Cannot be used with any constraints.

11. In linear programming, the shadow price refers to the

A. Measurement of the value of relaxing a constraint in a problem with dual variables.
B. Marginal change in profit associated with a change in the contribution margin of one of the variables.
C. Unused capacity available once the optimal solution is obtained.
D. Variables that are included in the final solution of the linear programming model.

8.5 Learning Curve

How does the learning curve work to estimate labor hours?

In manufacturing, labor hours are often observed to decrease in a definite pattern as labor operations are repeated. More specifically, as the cumulative production doubles, the cumulative average time required per unit will be reduced by some constant percentage, ranging typically from 10 percent to 20 percent. This reduction, and hence related costs, is referred to as the *learning curve effect*.

How do I properly express the learning curve relationship?

By convention, learning curves are referred to in terms of the complements of their improvement rates. For example, an 80 percent learning curve denotes a 20 percent decrease in unit time with each doubling of repetitions.

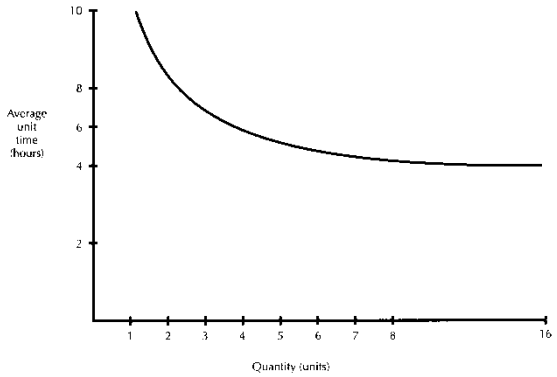
EXAMPLE 8.12

Suppose that a project is known to have an 80 percent learning curve. It has just taken a laborer 10 hours to produce the first unit. Then each time the cumulative output doubles, the time per unit for that amount should be equal to the previous time multiplied by the learning percentage. An 80 percent learning curve is shown in Figure 8.7.

Unit	Unit time (hours)		
1			10
2	0.8(10)	=	8
4	0.8(8)	=	6.4
8	0.8(6.4)	=	5.12
16	0.8(5.12)	=	4.096

TAKE NOTE: As production quantities double, the average time needed per unit reduces 20 percent from its immediately previous time.

FIGURE 8.7
AN 80% LEARNING CURVE



EXAMPLE 8.13

Big Mac Electronics Products, Inc. finds that new product production is affected by an 80 percent learning effect. The company has just produced 50 units of output at 100 hours per unit. Costs were as follows:

Materials 50 units @$20	$1,000
Labor and labor-related costs:	
Direct labor -- 100 hours @$8	800
Variable overhead -- 100 hours @$2	200
	$2,000

The company has just received a contract calling for another 50 units of production. It wants to add a 50 percent markup to the cost of materials and labor and labor-related costs. To determine the price for this job, the first step is to build up the learning curve table.

Quantity	Total time (hours)	Average time (per unit)
50	100	2 hours
100	160	1.6 (.8 x 2 hours)

Thus, for the new 50 unit job, it takes 60 hours in total. The contract price is:

Materials 50 units @$20	$1,000
Labor and labor-related costs:	
Direct labor -- 60 hours @$8	480

Variable overhead -- 60 hours @$2 120	
	$1,600
50 percent markup	800
Contract price	$2,400

In what other ways can I use the learning curve?

CHECKLIST OF APPLICATIONS FOR THE LEARNING CURVE

The learning curve theory has found useful applications in many areas, including:

1. Budgeting, purchasing, and inventory planning
2. Scheduling labor requirements
3. Setting incentive wage rates
4. Pricing new products
5. Negotiated purchasing
6. Evaluating suppliers' price quotations

8.6 Inventory Planning and Control

Why are inventory planning and control important?

One of the most common problems facing operations managers is inventory planning. This is understandable since inventory usually represents a sizable portion of a firm's total assets and, more specifically, on the average, more than 30% of total current assets in the U.S. industry. Excessive money tied up in inventory is a drag on profitability. The purpose of inventory planning is to develop policies which will achieve an optimal investment in inventory. You can do this by determining the optimal level of inventory necessary to minimize inventory related costs. *Note:* The ABC method of inventory control requires management to exert greatest control over the A classification items, which usually include a relatively small percentage of total items but a high percentage of the dollar volume. This method is analogous to the 80/20 rule, which says, for instance, that 20% of the customer's account for 80% of the profit.

What kinds of costs are associated with inventory?

Inventory costs fall into three categories. They are:

- *Ordering costs.* These include all costs associated with preparing a purchase order, such as purchasing costs, shipping costs, setup costs, and quality discounts lost.
- *Carrying (holding) costs*. These include storage costs, handling costs, interest on capital invested, and obsolescence..
- *Shortage (stockout) costs.* These are costs incurred when an item is out of stock. These include the lost contribution margin on sales plus lost customer goodwill.

When and how much should I order?

Several inventory planning models are available that try to answer these questions. Three such models are

- Economic order quantity (EOQ)
- Reorder point (ROP)
- Determination of safety stock.

How does the Economic Order Quantity (EOQ) model work?

The economic order quantity (EOQ) determines the order size that minimizes the sum of carrying and ordering costs.

ASSUMPTIONS: Demand is assumed to be known with certainty and to remain constant throughout the year. Order cost is also known to be fixed. Also, unit carrying costs are assumed be constant. Since demand and lead time (time interval between placing an order and receiving delivery) are assumed to be determinable, no shortage costs exist. No quantity discounts are allowed.

The EOQ is computed as:

$$\text{EOQ} = \sqrt{\frac{2\text{DO}}{\text{C}}}$$

where C = carrying cost per unit, O = ordering cost per order, D = annual demand (requirements) in units.

If the carrying cost is expressed as a percentage of average inventory value (say, 12 percent per year to hold inventory), then the denominator value in the EOQ formula would be 12 percent times the price of an item. NOTE: When an item is made instead of purchasing it, the EOQ model is used to determine the economic production run size where O = cost per setup.

EXAMPLE 8.14

Assume the Los Alamitos Store buys sets of steel at $40 per set from an outside vendor. It will sell 6,400 sets evenly throughout the year. The store's carrying cost is $8.00 per unit per year. The ordering cost is $100 per order. Therefore,

$$EOQ = \sqrt{\frac{2(6,400)(\$100)}{\$8.00}} = 160,000 = 400 \text{ sets}$$

Total number of orders per year = D/EOQ =6,400/400 = 16 orders

Total inventory costs = Carrying cost + Ordering cost

= C x (EOQ/2) + O (D/EOQ)

= ($8.00)(400/2) + ($100)(6,400/400)

= $1,600 + $1,600 = $3,200

Based on these calculations, the Los Alamitos Store's inventory policy should be the following:

(1) The store should order 400 sets of steel each time it places an order and order 16 times during a year.

(2) This policy will be most economical and cost the store $3,200 per year.

How do I determine the reorder point?

Reorder point (ROP) tells you when to place a new order. However, this requires that you know the lead time from placing to receiving an order. Reorder point (ROP) is calculated as follows:

Reorder point = (average demand per unit of lead time x lead time) + safety stock

This tells you the level of inventory at which a new order should be placed. First, multiply average daily (or weekly) demand by the lead time in days (or weeks) yielding the lead time demand. Then add safety stock to this to provide for the variation in lead time demand to determine the reorder point. NOTE: If average demand and lead time are both certain, no safety stock is necessary and should be dropped from the formula.

EXAMPLE 8.15

Using the previous example, assume lead time is constant at one week. There are 50 working weeks in the year.

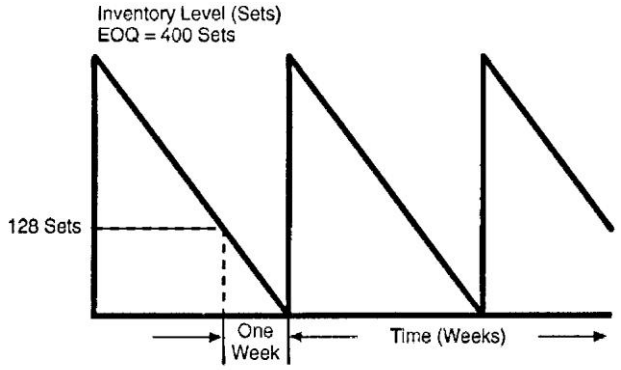
Then the reorder point is 128 sets = (6,400 sets/50 weeks) x 1 week.

CONCLUSION: When the inventory level drops to 128 sets, a new order should be placed. Suppose, however, that the store is faced with variable demand for its steel and requires a safety stock of 150 additional sets to carry. Then the reorder point will be 128 sets plus 150 sets, or 278 sets.

Figure 8.8 shows this inventory system when the order quantity is 400 sets and the reorder point is 128 sets.

FIGURE 8.8

BASIC INVENTORY SYSTEM WITH EOQ AND REORDER POINT



When are these models realistic to use?

The EOQ model described here is appropriate for a pure inventory system; that is, for single-item, single-stage inventory decisions for which joint costs and constraints can be ignored. EOQ and ROP assume that lead time and demand rates are constant and known with certainty. CAUTION: This may be unrealistic. Still, these models have been proved useful in inventory planning for many companies. There are, for instance, many businesses for which these assumptions hold to some extent. They include:

- Subcontractors who must supply parts on a regular basis to a primary contractor.
- Automobile dealerships, in which demand varies from week to week, but tends to even out over a season.

CAVEAT: When demand is not known precisely and/or other complications arise, you should not use these models. You should instead refer to probabilistic models.

What about Quantity Discounts?

EOQ does not take quantity discounts into account, which is often unrealistic in actual practice. Usually, the more you order, the lower the unit price you pay. A typical price discount schedule follows:

Order quantity (Q)	Unit price (P)
1 to 499	$40.00
500 to 999	39.90
1000 or more	39.80

WHAT TO DO: If quantity discounts are offered, you must weigh the potential benefits of reduced purchase price and fewer orders that will result from buying in large quantities against the increase in carrying costs caused by higher average inventories. Hence, the buyer's goal in this case is to select the order quantity which will minimize total costs, where total cost is the sum of carrying cost, ordering cost, and product cost:

$$\text{Total cost} = \text{Carrying cost} + \text{Ordering cost} + \text{Product cost}$$

$$= C \times (Q/2) + O \times (D/Q) + PD$$

where P = unit price, and Q = order quantity.

Use these steps to find economic order size with price discounts:

- Compute the common EOQ when price discounts are ignored and the corresponding costs using the new cost after discount.
- Compute the costs for those quantities greater than EOQ at which price reductions occur.
- Select the value of Q which will result in the lowest total cost.

EXAMPLE 8.16

Using the information from the previous examples and the discount schedule shown previously, try to determine the EOQ. Recall that EOQ = 400 sets without discount. The total cost for this is:

$$\text{Total cost} = \$8.00(400/2) + \$100(6{,}400/400) + \$40.00(6{,}400)$$

$$= \$1{,}600 + 1{,}600 + 256{,}000 = \$259{,}200$$

The further we move from the point 400, the greater will be the sum of the carrying and ordering costs. Thus, 400 is obviously the only candidate for the minimum total cost value within the first price range. Q=500 is the only candidate within the $39.90 price range and Q=1,000 is the only candidate within the $39.80 price bracket. These three quantities are evaluated below and pictured in Figure 8.9.

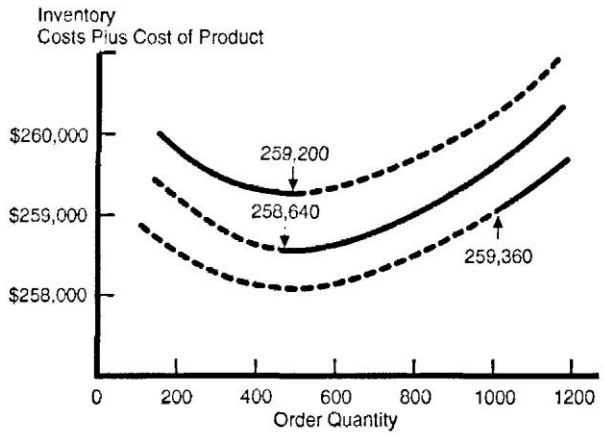
ANNUAL COSTS WITH VARYING ORDER QUANTITIES

Order Quantity (Q)	*400*	*500*	*1,000*
Purchase price (P)	$40	$39.90	$39.80
Carrying cost (C x Q/2) $8 x (order quantity/2)	$1,600	$2,000	$4,000
Ordering cost (O x D/Q)			
$100 x (6,400/order quantity)	1,600	1,280	640
Product cost (PD) Unit price x 6,400	256,000	255,360	254,720
Total cost	$259,200	$258,640	$259,360

Note that C = $8.00, O = $100, and D = 6,400 for all possible orders.

FIGURE 8.9

COSTS WITH QUANTITY DISCOUNT PROBLEM



CONCLUSION: The EOQ with price discounts is 500 sets. The manufacturer is justified in going to the first price break but the extra carrying cost of going to the second price break more than outweighs the savings in ordering and in the cost of the product itself.

What can I do when lead time and demand are uncertain?

When lead time and demand are not certain, you must carry extra units of inventory, called safety stock, as protection against possible stockouts. To determine the appropriate level of safety stock size, you must consider the service level or stockout costs.

Service level can be defined as the probability that demand will not exceed supply during the lead time. Thus, a service level of 90 percent implies a probability of 90 percent that demand will not exceed supply during lead time. Figure 8.10 shows a service level of 90%.

Here are three cases for computing the safety stock. The first two do not recognize stockout costs; the third does.

Case 1: Variable demand rate, constant lead time

ROP = Expected demand during lead time + safety stock

$= \bar{u}\ LT + z\ \sqrt{LT}\ (\sigma_u)$

where

$\bar{u}$ = average demand

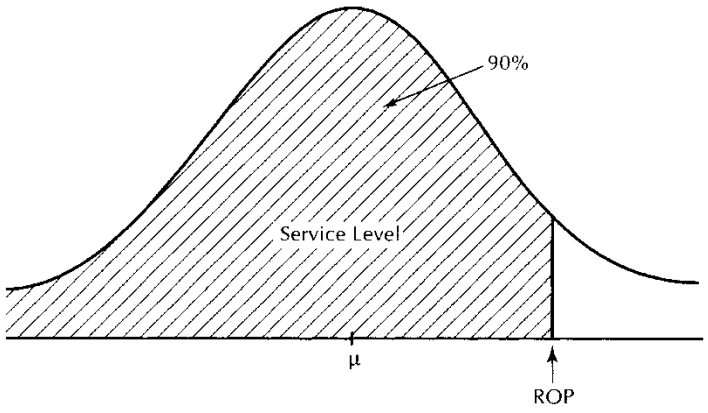
LT=lead time

σ_u =standard deviation of demand rate

z = standard normal variate as defined in Table 8.1 - Normal Distribution table.

For a normal distribution, a given service level amounts to the shaded area under the curve to the left of ROP in Figure 8.10.

FIGURE 8.10
SERVICE LEVEL OF 90 PERCENT



EXAMPLE 8.17

Norman's Pizza uses large cases of tomatoes at an average rate of 50 cans per day. The demand can be approximated by a normal distribution with a standard deviation of 5 cans per day. Lead time is 4 days. Thus,

$\bar{u}$ = 50 cans per day.

LT= 4 days

σ_u = 5 cans

How much safety stock is necessary for a service level of 99%? And what is the ROP?

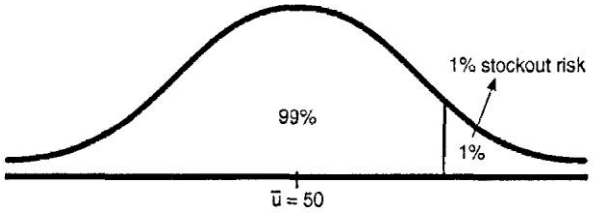
For a service level of 99%, z = 2.33 (from Table 8.1). Thus,

Safety stock = 2.33 $\sqrt{}$ 4 (5) = 23.3 cans

ROP = 50(4) + 23.3 = 223.3 cans

FIGURE 8.11

SERVICE LEVEL OF 99 PERCENT



Case 2: Constant demand, variable lead time

ROP = Expected demand during lead time + safety stock

= u $\overline{LT}$ + z u (σ_{LT})

where

u = constant demand

$\overline{LT}$ = average lead time

σ_{LT} =standard deviation of lead time

EXAMPLE 8.18

SVL's Hamburger Shop uses 10 gallons of cola per day. The lead time is normally distributed with a mean of 6 days and a standard deviation of 2 days. Thus,

u = 10 gallons per day.

$\overline{LT}$ = 6 days

σ_{LT} = 2 days

How much safety stock is necessary for a service level of 99%? And what is the ROP?

For a service level of 99%, z = 2.33. Thus,

Safety stock = 2.33 (10)(2) = 46.6 gallons

ROP = 10(6) + 46.6 = 106.6 gallons

(note: z = 2.33 at 99% service kevel)

Case 3: Incorporation of stockout costs

This case specifically recognizes the cost of stockouts or shortages, which can be quite expensive. Lost sales and disgruntled customers are examples of external costs. Idle machine and disrupted production

scheduling are examples of internal costs. WHAT TO DO: You can use the probability approach to determine the optimal safety stock size in the presence of stockout costs. Here is an example.

EXAMPLE 8.19

Refer to Example 8.15. The total demand over a one-week period is estimated as follows:

Total demand	Probability
78	0.2
128	0.4
178	0.2
228	0.1
278	0.1
	1.00

A stockout cost is estimated at $12.00 per set. Recall that the carrying cost is $8.00 per set.

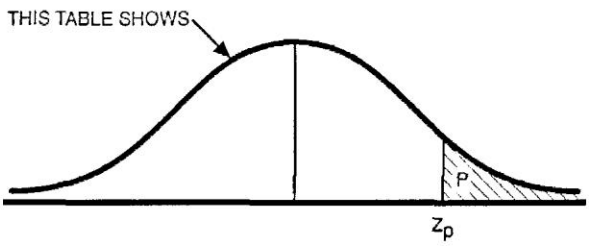
Figure 8.12 shows the computation of safety stock. CONCLUSION: The computation shows that the total costs are minimized at $1,200, when a safety stock of 150 sets is maintained. Thus, the reorder point is: 128 sets + 150 sets = 278 sets.

FIGURE 8.12
COMPUTATION OF SAFETY STOCK

Safety stock levels in units	Stockout and probability	Average stockout in units	Average stockout costs	No. of orders	Total annual stockout costs	Carrying costs	Total
0	50 with .2 100 with .1 150 with .1	35*	$420**	16	$6,720***	0	$7,140
50	50 with .1 100 with .1	15	180	16	2,880	400****	3,280
100	50 with .1	5	60	16	960	800	1,760
150	0	0	0	16	0	1,200	1,200

*50(.2) + 100(.1) + 150(.1) = 10 + 10 + 15 = 35 units.
**35 units × $12.00 = $420.
***$420 × 16 times = $6,720.
****50 units × $8.00 = $400.

TABLE 8.1
VALUES OF Z_P FOR SPECIFIED PROBABILITIES P



P	z_P	P	z_P	P	z_P
0.0005	3.29053	0.005	2.57583	0.11	1.22653
0.0010	3.09023	0.010	2.32635	0.12	1.17499
0.0015	2.96774	0.015	2.17009	0.13	1.12639
0.0020	2.87816	0.020	2.05375	0.14	1.08032
0.0025	2.80703	0.025	1.95996	0.15	1.03643
0.0030	2.74778	0.030	1.88079	0.16	0.99446
0.0035	2.69684	0.035	1.81191	0.17	0.95417
0.0040	2.65207	0.040	1.75069	0.18	0.91537
0.0045	2.61205	0.045	1.69540	0.19	0.87790
0.0050	2.57583	0.050	1.64485	0.20	0.84162
0.006	2.51214	0.06	1.55477	0.25	0.67449
0.007	2.45726	0.07	1.47579	0.30	0.52440
0.008	2.40892	0.08	1.40507	0.35	0.38532
0.009	2.36562	0.09	1.34076	0.40	0.25335
0.010	2.32635	0.10	1.28155	0.45	0.12566

8.7 Queuing (Waiting Line) Models

What is the purpose of queuing theory?

Queuing, or waiting line, theory investigates the everyday hassle of waiting in line. If you are an operating, marketing or production manager, you could apply this tool should waiting time involve you.

Like EOQ, queuing theory involves minimization of overall costs; that is, the sum of waiting costs borne by customers or businesses and the cost of providing extra service facilities and/or attendants.

What are the applications of queuing theory?

The applications of queuing theory are numerous. For example, you may want to determine the number of doctors that should be on call at a clinic. Some examples of waiting for a service are:

1. Out-of-service industrial equipment waiting for a repairman.
2. Patients waiting in clinics.
3. Computer jobs waiting for processing
4. Airplane waiting for a runway.
5. Cars waiting at toll booths.

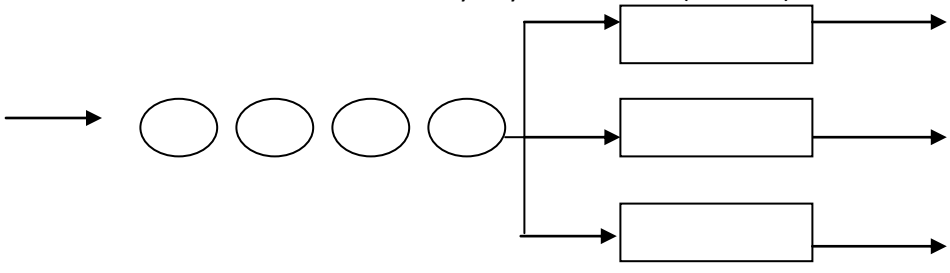
What are the types of queuing (Waiting Line) Models

There are four basic structures that describe the general conditions at the service facility:

1. The single-channel, single-phase case is the one in which arrival units form a waiting line and are serviced by a single service facility. The one-clerk parts department is illustrative.

waiting line service facility

2. The multiple-channel, single-phase case is illustrated by a two-or-more-clerks parts department since customers can be serviced by any of the clerks (channel).

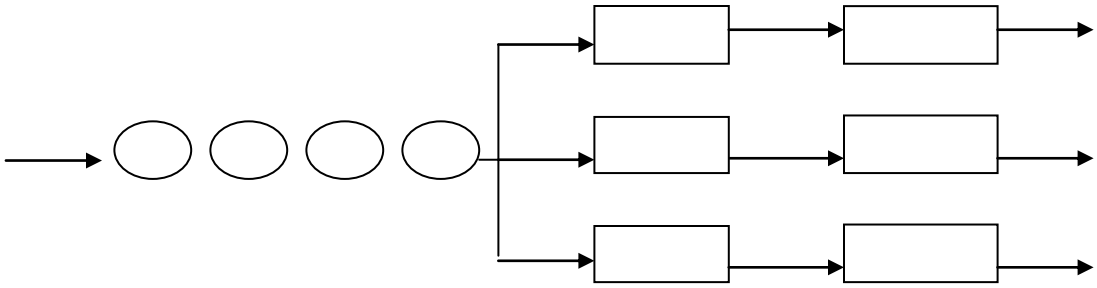


waiting line service facility

3. The single-channel, multiple-phase case is illustrated by a simple production line where there are a series of operations (phases) and the unit to be processed goes through the series for complete processing.

waiting line service facility

4. The multiple-channel, multiple phase case is illustrated by duplicate production lines in parallel



waiting line service facility

Of course, a complex network of waiting lines could involve combinations of any or all of the four basic structures.

What are some queuing models?

Before investigating queuing models, you need to know three things. They are

- Your company's experience with the daily ebb and flow of customers
- The probability assumptions as the nature of this process unfolds; for example, what are the chances of experiencing an unusually large bunching of arrivals
- Determination of costs associated with waiting and improving the rate of service

There are many queuing models from which you can choose. One, called the Single Channel Exponential Service Time Model, assumes a Poisson arrival rate and infinite source. For this model, use the following symbols:

A = mean arrival rate

S = mean service rate

Queuing experts have developed the following equations for this single-channel model:

- System utilization = probability that the servers are busy $= \frac{A}{S}$. If S<A, the queue will expand indefinitely during peak periods.
- Average number in the system = number of units in the queue plus number being served $= \frac{A}{(S - A)}$
- Average number waiting for service to begin = number of units in the queue $= \frac{A^2}{S(S - A)}$
- Average time spent waiting in the system = queue time plus service time = $\frac{1}{S - A}$
- Average time spent waiting before service begins = time in queue $= \frac{A}{S(S - A)}$
- Percent of idle time $= 1 - \frac{A}{S}$

EXAMPLE 8.17

Los Alamitos Car Wash is an automatic operation with a single bay. On a typical Saturday morning, cars arrive at a mean rate of nine per hour, with arrivals tending to follow a Poisson distribution. Service time, including manual drying time, is assumed to be exponentially distributed. Past experience suggests that the mean service time should average five minutes. Thus

A = 9 cars per hour

S = 1 per 5 minutes or 12 per hour

You can determine the following:

- System utilization $= \frac{9}{12} = 75\%$. This means the system is busy 75% of time.

- Average number of cars in line and service $= \frac{9}{12-9} = 3 \text{ cars}$
- Average number of cars in line $= \frac{9^2}{12(12-9)} = \frac{81}{36} = 2.25 \text{ cars}$
- Average time cars spend waiting in line and for service $= \frac{1}{12-9} = 1/3 \text{ hour or } 20 \text{ minutes}$
- Average time cars spend waiting for service $= \frac{9}{12(12-9)} = 9/36 = 1/4 \text{ or } 15 \text{ minutes}$
- Percent of idle time $= 1 - 0.75 = 0.25 \text{ or } 25\%$

The following is Microsoft Excel's queuing output for this example.

M/M/s queuing computations

Arrival rate 9

Service rate 12

Number of servers 1 (max of 40)

Assumes Poisson process for arrivals and services

Utilization	75.000%	System utilization
P (0), probability that the system is empty	0.2500	Percent of idle time
Lq, expected queue length	2.2500	Average # of cars in line
L, expected number in system	3.0000	Average # of cars in line and service
Wq, expected time in queue	0.2500	Average time cars spending waiting for service
W, expected total time in system	0.3333	Average time cars spending waiting in line and for service
Probability that a customer waits	0.7500	

Chapter 8 Review Questions – Section 2

12. The inventory model that follows the concept that 80% of the value of an inventory is in 20% of the inventory items is the

A. ABC systems.
B. Economic order quantity (EOQ) model.
C. Just-in-time inventory system.
D. Materials requirements planning (MRP) system.

13. The purpose of the economic order quantity model it to

A. Minimize the safety stock.
B. Minimize the sum of the order costs and the holding costs.
C. Minimize the inventory quantities.
D. Minimize the sum of the demand cost and the backlog costs.

14. A company has several departments that conduct technical studies and prepare reports for clients. Recently, there have been long delays in having these reports copied at the company's centralized copy center because of the dramatic increase in business. Management is considering decentralizing copy services to reduce the turn-around and provide clients with timely reports. An appropriate technique for minimizing turnaround time and the cost of providing copy services is

A. Queuing theory.
B. Linear programming.
C. Regression analysis.
D. Game theory.

15. Queuing models are concerned with balancing the cost of waiting in the queue with the

A. Cost of providing service.
B. Number of customers in the queue.
C. Average waiting time in the queue.
D. Percentage of capacity utilized, known as system utilization.

16. A bank has changed from a system in which lines are formed in front of each teller to a one-line, multiple-server system. When a teller is free, the person at the head of the line goes to that teller. Implementing the new system will

A. Decrease the bank's wage expenses because the new system uses fewer tellers.
B. Decrease time customers spend in the line.
C. Increase accuracy in teller reconciliations at the end of the day because fewer customers are served by each teller.
D. Improve on-the-job training for tellers because each will perform different duties.

17. The drive-through service at a fast-food restaurant consists of driving up to place an order, advancing to a window to pay for the order, and then advancing to another window to receive the items ordered. This type of waiting-line system is

A. Single channel, single phase.
B. Single channel, multiple phase.
C. Multiple channel, single phase.
D. Multiple channel, multiple phase.

18. A post office serves customers in a single line at one service window. During peak periods, the rate of arrivals has a Poisson distribution with an average of 100 customers per hour and service times that are exponentially distributed with an average of 60 seconds per customer. From this, one can conclude that the

A. Queue will expand to indefinitely.
B. Server will be idle one-sixth of the time.
C. Average rate is 100 customers per hour.
D. Average customer waiting time is 2.5 minutes.

Glossary

ABC Analysis: Inventory control system that divides the inventory into three classes.

Accelerated Depreciation Method: Depreciation method that allow the owner of the asset to take greater amounts of depreciation during the early years of its life, thereby deferring some of the taxes until later years.

Accounting Rate of Return: A capital-budgeting criterion that relates the returns generated by the project, as measured by average accounting profits after tax, to the average dollar size of the investment required; also called *simple rate of return* or *unadjusted rate of return*.

Accounts Receivable Turnover: Annual credit sales divided by average accounts receivable.

Acid Test Ratio: (Currents assets - inventories)/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*.

Activity-Based Costing (ABC): System that accumulates costs on the basis of production or service activities at a firm. Basically it assigns costs by activity and links them to specific products.

Activity-Based Management (ABM): A system-wide, integrated approach that focuses management's attention on activities with the objectives of improving customer value and the profit achieved by providing this value. Activity-based costing (ABC) is the major source of information for activity-based management.

After-Tax Cash Flow: The net cash flow (cash revenue less cash expenses) after taxes have been subtracted. It is the cash flow generated from operations.

Amortized Loan: A loan that is paid off in periodic equal installments and includes varying portions of principal and interest during its term.

Analysis of Variances (variance analysis): An 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

Annual Report: An audited document issued annually by all publicly listed corporations to their shareholders in accordance with SEC regulation. Contains information on financial results and overall performance of the previous fiscal year and comments on future outlook.

Arbitrage-Pricing Model (APM): A theory that relates stock returns and risk. The theory maintains that security returns vary from their expected amounts when there are unanticipated changes in basic

economic forces. Such forces would include unexpected changes in industrial production, inflation rates, term structure of interest rates, and the difference between interest rates of high-and-low risk bonds.

Asset Turnover: Sales divided by assets. A measure of the efficiency of asset management.

Balanced Scorecard: Approach using multiple measures to evaluate managerial performance. These measures may be financial or nonfinancial, internal or external, and short-term or long-term. The scorecard allows a determination as to whether a manager is achieving certain objectives at the expense of others that may be equally or more important. There are four different perspectives: (1) the financial perspective, (2) the customer perspective, (3) the process perspective, and (4) the learning and growth perspective.

Bankruptcy: (1) A legal procedure through which the ownership of a firm's assets is transferred to debt holders. (2) the inability to pay debts when due. A business is insolvent in a legal sense when its financial condition is such that total liabilities exceed the fair market value of the assets.

Benchmarking: Searching for new and better procedures by comparing your own procedures to that of the very best.

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.

Bond Rating: Rating assigned by an agency (such as Standard and Poor's or Moody's Investors Service) that provides an assessment of the bond's credit risk.

Book Value : The depreciated value of a company's assets (original cost less accumulated depreciation) less the outstanding liabilities.

Break-even point: Level of sales revenue that equals the total of the variable and fixed costs for a given volume of output at a particular capacity use rate.

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. At the break-even point, there is no profit or loss.

Business Process Reengineering (BPR): Approach aiming at making revolutionary changes as opposed to evolutionary changes by eliminating non-value added steps in a business process and computerizing the remaining steps to achieve desired outcomes.

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 Budgeting: Process of making long-term planning and capital expenditure decisions.

Capital Rationing : The placing of a limit by the firm on the dollar size of the capital budget.

Capital Structure: Composition of common stock, preferred stock, retained earnings, and long-term debt maintained by the business entity in financing its assets.

Cash Flow Statement: A statement showing from what sources cash has come into the business and on what the cash has been spent. Cash flow is broken down into operating, investing, and financing activities.

Channels: Number of waiting lines in a service system.

Classical Decomposition: Approach to forecasting that seeks to decompose the underlying pattern of a time series into cyclical, seasonal, trend, and random sub-patterns.

Coefficient of Determination: Proportion of the total variation in the dependent variable that is explained by the regression equation.

Coefficient of Variation: A measure of the relative dispersion of a probability distribution -that is, the risk per unit of return. Mathematically it is defined as the standard deviation divided by the expected value.

Compensating Balance: A deposit that a bank can use to offset an unpaid loan. No interest is earned on the compensating balance, which is stated as a percentage of the loan. It increases the effective interest rate on the loan.

Continuous Improvement (ci): also called *Kaizen* in Japanese, never-ending effort for improvement in every part of the firm relative to all of its deliverables to its customers.

Contribution (margin) Income Statement: An income statement that organizes the cost by behavior. It shows the relationship of variable costs and fixed costs, regardless of the functions a given cost item is associated with.

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.

Corporate Bylaws: Regulations that govern the internal affairs of the corporation, designating such items as the time and place of the shareholders' meetings, voting rights, the election process for selecting members of the board of directors, the procedures for issuing and transferring stock certificates, and the policies relating to the corporate records.

Corporate Governance: The system of checks and balances designed to ensure that corporate managers are just as vigilant on behalf of long-term shareholder value as they would be if it was their own money at risk. It is also the process whereby shareholders—the actual owners of any publicly traded firm—assert their ownership rights, through an elected board of directors and the CEO and other officers and managers they appoint and oversee.

Cost Center: The unit within the organization in which the manager is responsible only for costs. A cost center has no control over sales or over the generating of revenue. An example is the production department of a manufacturing company. The performance of the cost center is evaluated by comparing actual costs to budgeted costs.

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 Formula: A cost function in the form of y = a + bx. For example, the cost-volume formula for factory overhead is y=$200 + $10x where y=estimated factory overhead and x=direct labor hours, which means that the factory overhead is estimated to be $200 fixed, plus $10 per hour of direct labor. Cost analysts use the formula for cost prediction and flexible budgeting purposes.

Cost-Volume-Profit (CVP) analysis: An 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 variables costs, fixed costs, selling prices, volume, and mix of products sold.

Current Ratio : Current assets divided by current liabilities.

Current Yield: A bond's coupon payment divided by its price.

Debt-to-equity ratio: Total interest-bearing debt divided by owners' equity. It is a measure of financial leverage.

Decision Making Under Risk: decision made when the probability of occurrence of the different states of nature is known.

Decision Matrix: also called, payoff table, matrix consisting of the decision alternatives, the states of nature, and the decision outcomes.

Decision Theory: systematic approach to making decisions especially under uncertainty.

Decision Tree: graphical method of showing the sequence of possible decision alternatives.

Delphi Method: qualitative forecasting technique for arriving at group consensus in an anonymous fashion.

Deseasonalized Data: removal of the seasonal pattern in a data series. Deseasonalizing facilitates the comparison of month-to-month changes.

Discounted Cash Flow (DCF) Techniques: methods of selecting and ranking investment proposals such as the net present value (NPV) and internal rate of return (IRR) methods where time value of money is taken into account.

Earnings per share (EPS): Earnings after tax divided by the total number of shares outstanding.

Economic Order Quantity (Eoq): Amount that should be ordered to minimize the total ordering and carrying costs.

Economic Value Added (EVA): Net operating profit after tax (NOPAT) for a particular period (such as a year) minus the annual cost of *all* the capital a firm uses. EVA is a measure of economic profit, but not the accounting profit we are accustomed to seeing in a corporate profit and loss statement.

Equity Multiplier: Invested capital divided by owners' equity. It is a measure of financial leverage.

Exponential Smoothing: forecasting technique that uses a weighted moving average of past data as the basis for a forecast.

External Funds Need: Internally generated funds less funding needs.

Financial Leverage: A portion of a firm's assets financed with debt instead of equity.

Flexible Budget: A budget based on cost-volume relationships and developed for the actual level of activity. It is an extremely useful tool for comparing the actual cost incurred to the cost allowable for the activity level achieved.

Internal Rate Of Return (IRR): Rate earned on a proposal. It is the rate of interest that equates the initial investment with the present value of future cash inflows.

Inventory turnover: The number of times inventory is sold during the year. It equals cost of goods sold divided by the average dollar balance. Average inventory equals the beginning and ending balances divided by two.

Just-In-Time (JIT): A demand-pull system where demand for customer output (not plans for using input resources) triggers production. Production activities are "pulled", not "pushed," into action.

Lead Time: Time between the placing of an order and its receipt in the inventory system.

Learning Curve Effect: Reduction in labor hours as the cumulative production doubles, ranging typically from 10 percent to 20 percent.

Least-Squares Method: 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.

Life-Cycle Costing: Estimates of a product's revenues and expenses over its expected life cycle. The result is to highlight upstream and downstream costs in the cost planning process that often receive insufficient attention. Emphasis is on the need to price products to cover all costs, not just production costs.

Linear Programming (LP): Mathematical technique designed to determine an optimal decision (or an optimal plan) chosen from a large number of possible decisions.

Linear Regression: Regression that deals with a straight line relationship between variables.

Lockbox: A box in a U.S. Postal Service facility, used to facilitate collection of customer remittances. The use of a lockbox reduces processing float. The recipient's local bank collects from these boxes periodically during the day and deposits the funds in the appropriate corporate account.

Make-Buy (Outsource) Decision: Decision as to whether a given item should be manufactured internally or purchased outside.

Mean Absolute Deviation (MAD): Mean or average of the sum of all the forecast errors with regard to sign.

Mean Squared Error (MSE): Average sum of the variations between the historical sales data and the forecast values for the corresponding periods.

Modified Accelerated Cost Recovery System (MACRS): The system used in computing annual depreciation for assets acquired in 1987.

Modular Design: Design of components that can be assembled in a variety of ways to meet individual consumer needs.

Monte Carlo technique: A simulation method to generate random values for a variable.

Multiple Regression Analysis: Statistical procedure that attempts to assess the relationship between the dependent variable and two or more independent variables.

Multiple-Channel Line: Waiting line with two or more parallel identical servers.

Mutually Exclusive Projects: A set of projects that perform essentially the same task, so that acceptance of one will necessarily mean rejection of the others.

Net Present Value (NPV): A capital-budgeting concept defined as the present value of the project's annual net cash flows after tax less the project's initial outlay.

Operating Cycle: The average time period between buying inventory and receiving cash proceeds from its eventual sale. It is determined by adding the number of days inventory is held and the collection period for accounts receivable.

Operating Leverage: The degree to which the firm chooses to lock in fixed costs other than financing costs.

Opportunity Cost: The revenue forfeited by rejecting an alternative use of time or facilities.

Payback Period: Length of time required to recover the amount of an initial investment.

Portfolio: A group of securities held in order to reduce risk by diversification.

Price/earnings ratio (P/E): The price the market places on $1 of a firm's earnings. For example, if a firm has an earnings per share of $2, and a stock price of $30, its price/earnings ratio is 15 ($30 + $2).

Price-To-Book Ratio (P/B): Share price divided by book value of equity per share.

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.

Public Company Accounting Oversight Board (PCAOB): (www.pcaobus.com) Established in 2002 as a result of the Sarbanes-Oxley Act, a private sector, non-profit corporation set up to oversee the audits of public companies and ensure that accountancy firms should no longer derive non-audit revenue streams, such as consultancy, from their audit clients.

Quantity discount model: Inventory model that takes into account the price varying with the order size.

Queue Discipline: Rules that determines the order in which arrivals are serviced.

Queue: Waiting line that forms wherever there is more than one user of a limited resource.

Queuing (or waiting line) theory: Operations research term for the study of waiting lines.

Quick ratio: Quick assets divided by current liabilities, also called *acid test.* It is a measure of liquidity.

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: 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).

Reorder Point: Inventory level that triggers a new order.

Residual income (RI): The operating income which an investment center is able to earn above some minimum return on its assets. It equals operating income less the minimum rate of return times total 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.

Return on equity (ROE): Earnings after tax (EAT) divided by owners' equity. A measure of the firm's profitability to shareholders.

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 difference between the expected return on a security and the risk-free rate. *See also* capital asset pricing model.

Risk-return trade-off: A comparison of the expected return from an investment with the risk associated with it. The higher the risk undertaken, the more ample the return. Conversely, the lower the risk, the more modest the return.

R-Squared: see *coefficient of determination*.

Safety Stock: Inventory carried to assure that the desired service level is met.

Sales mix: The relative proportions of the product sold.

Sarbanes-Oxley (SOX) Act: Wide-ranging U.S. corporate reform legislation, coauthored by the Democrat in charge of the Senate Banking Committee, Paul Sarbanes, and Republican Congressman Michael Oxley. The Act, which became law in July 2002, lays down stringent procedures regarding the accuracy and reliability of corporate disclosures, places restrictions on auditors providing non-audit services and obliges top executives to verify their accounts personally. Section 409 is especially tough and requires that companies must disclose information on material changes in the financial condition or operations of the issuer on a rapid and current basis.

Segment margin: Contribution margin less direct (traceable) fixed costs.

Segmental reporting: The presentation of financial information, such as profitability, by a major business segment, including the product, major customer, division, department, and responsibility centers within the department.

Service Level: Probability of no stockouts during the lead time.

Service rate: Number of customers or units that can be serviced by one server in a given period of time.

Simple Regression: Regression analysis which involves one independent variable.

Simulation: Technique to describe the behavior of a real-life system over time.

Single-channel line: Waiting line with only one server.

Sinking fund: A required annual payment that allows for the periodic retirement of debt.

Standard Cost System: A system by which production activities are recorded at standard costs and variances from actual costs are isolated.

Static (fixed) budget: A budget based on the anticipated output level rather than on the actual attained output level.

Stock dividend: A distribution of shares of up to 25 percent of the number of shares currently

Stock split: A stock dividend exceeding 25 percent of the number of shares currently outstanding.

Supply Chain Management: Management of the integration of the functions, information, and materials that flow across multiple firms in a supply chain—i.e., buying materials, transforming materials, and shipping to customers.

Systematic risk: Risk that remains despite the risk-reduction property of diversification. Measured with the beta coefficient; also called *market risk, nondiversiflable,* or *undiversifiable risk. See also* capital asset pricing model.

Target Costing: A method of determining the cost of a product or service based on the price that the customers are willing to pay. It is a Japanese method of determining the maximum available cost of a product before it is designed, engineered, or produced by subtracting an acceptable rate of profit margin from a projected selling price.

Term structure of interest rates: The relationship between interest rates and the term to maturity, where the risk of default is held constant.

The Du Pont formula: The breakdown of return on investment (ROI) into profit margin and asset turnover.

The graphical method: Graphical approach to solving a linear programming (LP) problem. It is easier to use but limited to the LP problems involving two (or at most three) decision variables.

The simplex method: Linear programming algorithm, which is an iteration method of computation, to move from one corner point solution to another until it reaches the best solution.

Time value of money: The 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.

Trend Analysis: Special form of simple regression in which time is the independent variable.

Unit Contribution Margin: Selling price minus average variable cost.

Variance: In cost analysis, the deviation between the actual cost and the standard cost.

Weighted cost of capital: A composite of the individual costs of financing incurred by each capital source. A firm's weighted cost of capital is a function of (1) the individual costs of capital, (2) the capital structure mix, and (3) the level of financing necessary to make the investment.

Working Capital: A concept traditionally defined as a firm's investment in current assets. Net working capital refers to the difference between current assets and current liabilities.

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Review Question Answers

Chapter 1 Review Questions – Section 1

1. Financial decisions are typically based on three reports: Gant Load Chart, Gant scheduling chart, and the Program Evaluation and Review Technique (PERT). True or False?

True is incorrect. The balance sheet shows assets, liabilities, and equity (net worth). The income statement shows revenues, expenses, and net income or net loss. The cash flows statement presents sources and uses of cash and is a basis for cash flow analysis for external use such as lenders and investors.

False is correct. Financial decisions are generated from the company's annual report that includes the balance sheet, income statement, and statement of cash flows. Gant load chart, Gant scheduling chart, and the Program Evaluation and Review Technique are tools used for operational decisions.

2. An objective of financial reporting is

A. **Correct.** The objectives of financial reporting are concerned with the underlying goals and purposes of accounting. They are to provide information that (1) is useful to those making investment and credit decisions, assuming that those individuals have a reasonable understanding of business and economic activities; (2) is helpful to current and potential investors, creditors and other users, such as labor and government agencies, in assessing the amount, timing, and uncertainty of future cash flows; and (3) discloses economic resources, claims to those resources, and the changes therein.
B. Incorrect. Assessing the adequacy of internal control is a function of internal auditing, not financial reporting.
C. Incorrect. Evaluating management results compared with standards is a function of internal auditing, not financial reporting.
D. Incorrect. Providing information on compliance with established procedures is a function of internal auditing, not financial reporting.

3. The primary purpose of the balance sheet is to reflect

A. Incorrect. The measurement attributes of assets include, but are not limited to, fair value.
B. Incorrect. Financial statements reflect the going concern assumption. Hence, they usually do not report forced liquidation values.

C. **Correct.** The balance sheet presents three major financial accounting elements: assets, liabilities, and equity. Assets are probable future economic benefits resulting from past transactions or events. Liabilities are probable future sacrifices of economic benefits arising from present obligations as a result of past transactions or events. Equity is the residual interest in the assets after deduction of liabilities.

D. Incorrect. The future value of a company's stock is more dependent upon future operations and investors' expectations than on the data found in the balance sheet.

4. Revenue always means receipt of cash, and expenses automatically implies cash payment. True or False?

True is incorrect. Revenue does not necessarily mean receipt of cash, and expense does not automatically imply a cash payment. Earned revenue is a result of an increase in cash or accounts receivable, expenses result from performing activities necessary to generate revenue.

False is correct. GAAP requires the use of accrual basis of accounting (rather than the cash basis) for financial reporting. Under GAAP, revenues are recognized when earned and expenses as incurred. Hence, net income and net cash flow (cash receipts less cash payments) are different.

5. Intangible assets are often called fixed assets that are employed in the production of goods and/or services that have a life greater than one year. True or False?

True is incorrect. Assets with long-term life that lack physical substance and arise from grants by the government such as patents, copyrights, and trademarks or franchise licenses are considered lacking physical substance.

False is correct. Fixed assets are tangible and have a physical substance such as property, plant, and equipment. Fixed assets are actually being used in the course of the business.

6. The amount received by a company over par value for stock is paid-in capital. True or False?

True is correct. Capital stock describes the ownership of the corporation in terms of number of shares outstanding. Capital stock is represented on the balance sheet at total par value. *Paid-in capital* shows the amount received by the company over the par value for the stock issued. This helps keep track of the par value of issued shares and the excess over par value paid for it.

False is incorrect. The total stockholders' equity is the sum of capital stock, paid-in capital, and retained earnings.

7. The statement of cash flows is required in annual reports since it is for external use only. True or False?

True is correct. A statement of cash flows contains useful information for external users such as lenders and investors who make economic decisions about a company.

False is incorrect. The statement of cash flows classifies cash receipts and cash payments arising from investing activities, financing activities, and operating activities. Neither the balance sheet nor the income statement provides any information about the company's cash position.

8. A financial statement includes all of the following items: operating activities, financial activities and investing activities. What financial statement is this?

A. **Correct.** A statement of cash flows is a required financial statement. Its primary purpose is to provide information about cash receipts and payments by reporting the cash effects of an enterprise's operating, investing, and financing activities. Because the statement or a separate schedule reconciles net income and net operating cash flow, depreciation which is a noncash expense, is included in the presentation.
B. Incorrect. The balance sheet does not include periodic net income or depreciation expense.
C. Incorrect. The income statement does not have captions for operating and financing activities.
D. Incorrect. Retained earnings does not include captions for operating and investing activities, depreciation, and net income.

Chapter 1 Review Questions – Section 2

9. The annual report, in addition to the financial statements, is helpful in understanding the company's financial health. True or False?

True is correct. The sections in the annual report that are useful in assessing an entity's financial fitness include: highlights, review of operations, footnotes, supplementary schedules, and auditors report.

False is incorrect. The independent CPA renders four types of audit opinions: a qualified opinion, an unqualified opinion, a disclaimer opinion, and an adverse opinion. The auditor's opinion is heavily relied upon since she is knowledgeable, objective, and independent.

10. An audit of the financial statements of Camden Corporation is being conducted by an external auditor. The external auditor is expected to

A. **Correct.** The auditor is required to express an opinion regarding the financial statements taken as a whole or to assert that an opinion cannot be expressed. The opinion concerns the fairness with which the statements have been presented in conformity with GAAP.
B. Incorrect. The external auditor does not interpret the financial statement data for investment purposes.
C. Incorrect. The external audit normally cannot be so thorough as to permit a guarantee of correctness.
D. Incorrect. The independent audit attests to the fair presentation of the date in the financial statements, not an evaluation of management decisions.

11. The auditor's opinion refers to generally accepted accounting principles (GAAP). Which of the following best describes GAAP?

A. Incorrect. Interpretations of GAAP made by CPAs on audit engagements are judgments about the application of GAAP to particular circumstances.
B. Incorrect. GAAP include but are not limited to pronouncements of the APB and FASB.
C. Incorrect. Although the federal government can require disclosures by public companies, for example, through regulations of the SEC, GAAP are much broader. They apply to all entities, whether public or private and regardless of size.
D. **Correct.** GAAP are the "conventions, rules, and procedures necessary to define accepted accounting at a particular time." They include both the broad guidelines and the detailed practices and procedures promulgated by the profession that provide uniform standards to measure financial presentations.

12. The Management's Discussion and Analysis (MD&A) section of an annual report

A. Incorrect. The MD&A section may be separate from the president's letter.
B. **Correct.** The MD&A section is included in SEC filings. It addresses in a nonquantified manner the prospects of the company. The SEC examines it with care to determine that management has disclosed material information affecting the company's future results. Disclosures about commitments and events that may affect operations or liquidity are mandatory. Thus, the MD&A section pertains to liquidity, capital resources, and results of operations.
C. Incorrect. A technical analysis and a defense are not required in the MD&A section; it is more forward looking.
D. Incorrect. The MD&A section does not have to include marketing and product line issues.

13. The content of the Management's Discussion and Analysis (MD&A) section of an annual report is

A. Incorrect. The MD&A is mandated by the SEC.
B. **Correct.** The content of the MD&A section is mandated by regulations of the SEC. The MD&A standard financial statements, summarized financial data for at least 5 years, and other matters must be included in annual reports to shareholders and in Form 10-K filed with the SEC. Forward-looking information in the form of forecasts is encouraged in the MD&A but not required.
C. Incorrect. Auditors are expected to read (not review or audit) the contents of the MD&A to be certain it contains no material inconsistencies with the financial statements.
D. Incorrect. The IRS is the taxing authority and does not mandate the MD&A.

14. Under the "Sarbanes-Oxley Act" (SOX), CEOs and CFOs must personally vouch for the truth and fairness of their company's disclosures. True or False?

True is correct. The SOX Act changes how publicly traded companies are audited and reshapes the financial reporting system. The act adopts tough new provisions to deter and punish corporate and accounting officers engaged in fraud and corruption, to ensure justice for wrongdoers, and to protect the interest of workers and shareholders

False is incorrect. One of the major provisions of the SOX Act is that the CEO and CFO must certify that the financial statements fairly present the company's operations and financial condition.

Chapter 2 Review Questions – Section 1

1. In financial statement analysis, expressing all financial statement items as a percentage of base-year amounts is called

A. **Correct.** Expressing financial statement items as percentages of corresponding base-year figures is a horizontal form of common-size (percentage) analysis that is useful for evaluating trends. The base amount is assigned the value of 100%, and the amounts for other years are denominated in percentages compared to the base year.
B. Incorrect. Vertical common-size (percentage) analysis presents figures for a single year expressed as percentages of a base amount on the balance sheet (e.g., total assets) and on the income statement (e.g., sales).
C. Incorrect. The term "trend analysis" is most often applied to the quantitative techniques used in forecasting to fit a curve to given data.
D. Incorrect. Ratio analysis is a general term covering both horizontal and vertical analyses.

2. In assessing the financial prospects for a firm, financial analysts use various techniques. An example of vertical, common-size analysis is

A. Incorrect. Vertical integration occurs when a corporation owns one or more of its suppliers or customers.
B. **Correct.** Vertical, common-size analysis compares the components within a set of financial statements. A base amount is assigned a value of 100%. For example, total assets on a common-size income statement are valued at 100%. Common-size statements permit evaluation of the efficiency of various aspects of operations. An analyst who states that advertising expense is 2% of sales is using vertical, common-size analysis.
C. Incorrect. Vertical, common-size analysis restates financial statements amounts as percentages.
D. Incorrect. A statement that advertising expense is 2% greater than in the previous year results from horizontal analysis.

3. A firm's average collection period is equal to

A. **Correct.** The average collection period may be stated as the accounts receivable balance divided by average credit sales per day or as days in the year divided by the receivables turnover. It is the average time required to convert the enterprise's receivables into cash.
B. Incorrect. The inventory conversion period (days of inventory) is the average time required to convert materials into finished goods and then to sell them. This process typically occurs before the receivables collection period, and the amount of time in one period does not necessarily bear any relationship to the other.
C. Incorrect. The cash conversion cycle equals the inventory conversion period, plus the receivables collection period, minus the payables deferral period (average time between resource purchases and payment of cash for them). It estimates the time between when the enterprise makes payments and when it receives cash inflows.
D. Incorrect. The inventory divided by the sales per day is the inventory conversion period (days of inventory).

4. To determine the operating cycle for a retail department store, which one of the following pairs of items is needed?

A. Incorrect. The cost of sales must be known to calculate days' sales in inventory.
B. Incorrect. They are insufficient to permit determination of the operating cycle.
C. **Correct.** 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. Inventory turnover equals cost of goods sold divided by average inventory. The days' sales in inventory

equals 365 (or another period chosen by the analyst) divided by the inventory turnover. Accounts receivable turnover equals net credit sales divided by average receivables. The days' sales in receivables equals 365 (or other number) divided by the accounts receivable turnover.

D. Incorrect. Return on investment (ROI) is expressed as the product of asset turnover and return on sales.

5. A measure of long-term debt-paying ability is a company's

A. Incorrect. The length of the operating cycle does not affect long-term debt-paying ability. By definition, long-term means longer than the normal operating cycle.
B. Incorrect. Return on assets measures only how well management uses the assets that are available. It does not compare the return with debt service costs.
C. Incorrect. Inventory turnover is a measure of how well a company is managing one of its assets—that is, inventory.
D. **Correct.** The times-interest-earned ratio is one measure of a firm's ability to pay its debt obligations out of current earnings. This ratio equals earnings before interest and taxes divided by interest expense.

6. The times-interest-earned ratio is primarily an indication of

A. Incorrect. Liquidity ratios, e.g., the current ratio, indicate the relationship of current assets to current liabilities.
B. Incorrect. Asset management ratios indicate how effectively the enterprise is using its assets.
C. **Correct.** The times-interest-earned ratio equals (Income from operations) / (Interest expense). It measures the extent to which operating profit can decline before the enterprise is unable to meet its annual interest cost. Thus, it is a measure of debt-paying capacity (solvency).
D. Incorrect. Profitability ratios measure operating results.

7. What type of ratio is profit margin ratio?

A. Incorrect. Activity ratios measure management's efficiency in using specific resources.
B. **Correct.** Profit margin is a profitability ratio. Profit margin = (net income) / (net sales).
C. Incorrect. Liquidity ratios indicate the ability of a company to meet short-term obligations.
D. Incorrect. Leverage or equity ratios concern the relationship of debt to equity ratios concern the relationship of debt to equity and measure the impact of the debt on profitability and risk.

8. What type of ratio is earnings per share (EPS)?

A. **Correct.** Earnings per share (EPS) is a market value ratio. It measures the level of profitability of the firm on a per share basis.
B. Incorrect. Activity ratios measure management's efficiency in using specific resources.
C. Incorrect. Liquidity ratios indicate the ability of a company to meet short-term obligations.
D. Incorrect. Leverage or equity ratios concern the relationship of debt to equity and measure the impact of the debt on profitability and risk.

9. A company has 100,000 outstanding common shares with a market value of $20 per share. Dividends of $2 per share were paid in the current year, and the enterprise has a dividend-payout ratio of 40%. The price-to-earnings ratio of the company is

A. Incorrect. 2.5 equals EPS divided-by dividends per share.
B. Incorrect. 10 equals share price divided by dividends per share.
C. **Correct.** The P-E ratio equals the share price divided by EPS. If the dividends per share equaled 2 and the dividend-payout ratio was 40%, EPS must have been 5 (2/0.4). Accordingly, the P-E ratio is 4 (20 share price/5 EPS).
D. Incorrect. 50 equals price per share divided by the dividend-payout percentage.

10. Which combination of changes in asset turnover and profit margin on sales will maximize the return on investment?

A. Incorrect. A decrease in margin lowers the return on investment.
B. **Correct.** Asset turnover measures how efficiently assets are used to produce revenues by dividing sales by the average total assets. The profit margin measures the net income produced by each dollar of revenues. As assets are used more efficiently and as each dollar of revenues produces more income, the return on investment is maximized.
C. Incorrect. As assets are used less efficiently, the return on investment decreases.
D. Incorrect. As assets are used less efficiently and as profit margin on sales decreases, the return on investment decreases.

Chapter 2 Review Questions – Section 2

11. An investor has been given several financial ratios for a firm but none of the financial reports. Which combination of ratios can be used to derive return on equity?

A. Incorrect. The market-to-carrying-amount ratio and the total-debt-to-total-assets ratio do not provide any information about net profit available to shareholders.

B. **Correct.** The net profit margin equals the net profit available to common shareholders divided by sales. The total assets turnover equals sales divided by total assets and the product of these two ratios is the return on investment (ROI). This result is the basic Du Pont formula. In the extended Du Pont equation, the ROI is multiplied by the leverage factor, also called the equity multiplier (total assets/common equity). The extended Du Pont equation gives the return on common equity. This result is obtained because the total assets and sales factors cancel in the multiplication of the three ratios. ROE = Net profit margin x Total asset turnover x Equity multiplier.
C. Incorrect. The price-to-earnings ratio, EPS, and the net profit margin do not provide information about the carrying amount of common equity.
D. Incorrect. The price-to-earnings ratio and the return-on-assets ratio do not provide information about the carrying amount of common equity.

12. The following ratios relate to a company's financial situation compared with that of its industry: The company has an ROI of 7.9% and an ROE of 15.2%. The industry has an ROI of 9.2% and an ROE of 12.9%. What conclusion could a financial analyst validly draw from these ratios?

A. Incorrect. The question gave no information about market share.
B. **Correct.** The use of financial leverage has a multiplier effect on the return on assets. The extended Du Pont formula illustrates this point by showing that the return on equity equals the ROI times the leverage factory, also called the equity multiplier (total assets/common equity). Thus, greater use of debt increases the equity multiplier and the return on equity. In this example, the equity multiplier is 1.92 (15.2% ROE/7.9% ROI), and the industry average is 1.40 (12.9% ROE/9.2% ROI). The higher equity multiplier indicates that the company uses more debt than the industry average.
C. Incorrect. This comparison is with an industry average, not over time.
D. Incorrect. Share valuation is a response to many factors. The higher-than-average return on equity does not mean that the company has a more favorable market-to-carrying-amount ratio.

13. If a company is profitable and is effectively using leverage, return on total assets is likely to be the largest. True or False?

True is incorrect. Effective use of leverage will enhance stockholders' return—return on common equity. Return on total assets will be lower than the return on common equity if the firm is profitable and using leverage effectively.

False is correct. The purpose of leverage is to use creditor capital to earn income for shareholders. If the return on the resources provided by creditors exceeds the cost of debt, leverage is used effectively, and the return to common equity will be higher than the other

measures. The reason is that common equity provides a smaller proportion of the investment than in an unleveraged company.

14. When you establish a price, you should also consider the customer's perception of prestige—higher may suggest a "quality" image to the consumer. True or False?

True is correct. Factors used in determining price include: return on sales, share of market, age category, economic breakdown, regional location, social aspects and ethic wants.

False is incorrect. You should determine different prices based on the segment involved; whether manufacturer, wholesaler, retailer, or consumer. The price of each segment will differ depending on the applicable marketing costs, such as advertising and distribution.

15. Marketing effectiveness can be measured by examining the number of product warranty complaints and their disposition. True or False?

True is incorrect. Financial managers prepare new product evaluations in terms of risk and profitability. Marketing managers appraise strengths and weaknesses of competition as well as promotional effectiveness to measure marketing effectiveness.

False is correct. Managerial accountants will determine revenue, cost, and earnings by product line, customer, industry segment, geographic area, distribution channel, type of marketing effort, and average size of order to measure marketing effectiveness.

16. Life-cycle costing tracks and accumulates all production costs in the value chain from research and development and design of products and processing through production, marketing, distribution, and customer service. True or False?

True is correct. The term "cradle to grave costing" conveys the sense of fully capturing all costs associated with a product. It focuses on minimizing lock-in costs by reducing the number of parts, promoting standardization of parts, and using equipment that can make more than one product.

False is incorrect. Product life cycle is simply the time a product exists from conception to abandonment. Life cycle costs include development, planning design, testing, manufacturing (conversion activities), and logistic support (advertising, distribution, warranty, etc.)

Chapter 3 Review Questions – Section 1

1. Decentralized firms can delegate authority and yet retain control and monitor managers' performance by structuring the organization into responsibility centers. Which one of the following organizational segments is most like an independent business?

A. Incorrect. A revenue center is responsible only for revenue generation, not for costs or capital investment.
B. Incorrect. A profit center is responsible for revenues and costs but not for invested capital.
C. Incorrect. A cost center is evaluated only on the basis of costs incurred. It is not responsible for revenues or invested capital.
D. **Correct.** An investment center is the organizational type most like an independent business because it is responsible for its own revenues, costs incurred, and capital invested. The other types of centers do not incorporate all three elements.

2. Responsibility accounting defines an operating center that is responsible for revenue and costs as a(n)

A. **Correct.** A profit center is responsible for both revenues and costs, whereas a cost center is responsible only for costs.
B. Incorrect. A revenue center is responsible only for revenues, not costs.
C. Incorrect. A division can be any type of responsibility center.
D. Incorrect. An operating unit can be organized as any type of center.

3. The least complex segment or area of responsibility for which costs are allocated is a(n)

A. Incorrect. A profit center is a segment responsible for both responsible for both revenues and costs. A profit center has the authority to make decisions concerning markets and sources of supply.
B. **Correct.** A cost center is a responsibility center that is accountable only for costs. The cost center is the least complex type of segment because it has no responsibility for revenues or investments.
C. Incorrect. An investment center is a responsibility center that is accountable for revenues (markets), costs (sources of supply), and invested capital.
D. Incorrect. A contribution center is responsible for revenues and variable costs, but not invested capital.

4. Which of the following techniques would be best for evaluating the management performance of a department that is operated as a cost center?

A. **Correct.** A cost center is a responsibility center that is responsible for costs only. Of the alternatives given, variance analysis is the only one that can be used in a cost center. Variance analysis involves comparing actual costs with predicted or standard costs.
B. Incorrect. Return on assets cannot be computed for a cost center. The manager is not responsible for revenue (return) for the assets available.
C. Incorrect. Return on investment (ROI) is used to measure performance of an investment center. The cost center manager is not responsible for revenue (return) for the investment.
D. Incorrect. The payback method is a method of evaluating alternative investment proposals.

5. Division A of a company is currently operating at 50% capacity. It produces a single product and sells all its production to outside customers for $13 per unit. Variable costs are $7 per unit, and fixed costs are $6 per unit at the current production level. Division B, which currently purchases this product from an outside supplier for $12 per unit, would like to purchase the product from Division A. Division A will operate at 80% capacity to meet outside customers' and Division B's demand. What is the minimum price that Division A should charge Division B for this product?

A. **Correct.** From the seller's perspective, the price should reflect at least its incremental cash outflow (outlay cost) plus the contribution from an outside sale (opportunity cost). Because A has idle capacity, the opportunity cost is $0. Thus, the minimum price Division A should charge Division B is $7.00.
B. Incorrect. $6.00 is the unit fixed cost.
C. Incorrect. Division A should not include any fixed costs in its transfer price because Division A has idle capacity.
D. Incorrect. Since Division A has idle capacity, the minimum transfer price should recover Division A's variable (outlay) costs.

6. Residual income (RI) is a performance evaluation that is used in conjunction with, or instead of, return on investment (ROI). In many cases, RI is preferred to ROI because

A. Incorrect. Both measures represent the results for a single period.
B. **Correct.** Residual income equals earnings in excess of a minimum desired return. Thus, it is measured in dollars. If performance is evaluated using ROI, a manager may reject a project that exceeds the minimum return if the project will decrease overall ROI. For example, given a target rate of 20%, a project with an ROI of 22% might be rejected if the current ROI is 25%.
C. Incorrect. The target rate for ROI is the same as the imputed interest rate used in the residual income calculation.
D. Incorrect. The same investment base should be employed by both methods.

7. Economic value added (EVA) is a measure of managerial performance. EVA equals

A. Incorrect. Interest should not be subtracted twice. The weighted-average cost of capital includes interest.
B. **Correct.** Economic value added (EVA) is also called residual income. EVA represents the business unit's true economic profit; that is, the return that could have been obtained on the best alternative investment of similar risk. Hence, the EVA measures the managerial benefit obtained by using resources in a particular way. It is useful for determining whether a segment of a business is increasing shareholder value.
C. Incorrect. EVA is residual income.
D. Incorrect. Operating income divided by operating assets is return on assets (ROA).

8. When only differential manufacturing costs are taken into account for special-order pricing, an essential assumption is that

A. Incorrect. The differential analysis of a special order considers total marginal costs. Thus, unit variable costs and total fixed costs need not be constant, and any changes need not be in direct proportion to the measure of activity.
B. Incorrect. The assumption is that selling and administrative costs are not relevant.
C. **Correct.** A company should accept an order at below-normal selling price when idle capacity exists (since fixed cost remains constant), as long as there is a contribution margin on that order.
D. Incorrect. The assumption is that acceptance of the order will not cause total selling and administrative costs to change.

Chapter 3 Review Questions - Section 2

9. The major objectives of any budget system are to

A. Incorrect. Budgets assume the creation of responsibility centers, but do not ensure goal congruence.
B. Incorrect. A budget is also a control tool because it establishes standards and facilitates comparison of actual and budgeted performance, but does not make sure goal congruence.
C. **Correct.** A budget is a financial plan to control future operations and results. Budgeting facilitates control and communication and provides motivation to employees. The process of budgeting forces a company to establish goals, determine the resources necessary to achieve those goals, and anticipate future difficulties in their achievement. A budget is also a control tool because it establishes standards and facilitates comparison of actual and budgeted

performance. Thus, it motivates good performance by highlighting the work of effective managers. Moreover, the nature of budgeting fosters communication of goals to company subunits and coordination of their efforts. Budgeting activities must be coordinated because they are interdependent.

D. Incorrect. Budgets follow the creation of responsibility centers, measure performance; and promote, but do not ensure goal congruence.

10. Which one of the following budgeting methodologies would be most appropriate for a firm facing a significant level of uncertainty in unit sales volumes for next year?

A. Incorrect. Top-down budgeting entails imposition of a budget by top management on lower-level employees. It is the antithesis of participatory budgeting.
B. Incorrect. Life-cycle budgeting estimates a product's revenues and costs for each link in the value chain from R&D and design to production, marketing, distribution, and customer service. The product life cycle ends when customer service is withdrawn.
C. Incorrect. A static budget is for only one level of activity.
D. **Correct.** A flexible budget is a tool that is extremely useful in cost control. In contrast to a static budget, 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. A flexible budget is designed to allow adjustment of the budget to the actual level of activity before comparing the budget activity with actual results.

11. The master budget

A. Incorrect. The master budget does not contain actual results.
B. Incorrect. The master budget reflects all applicable expected costs, whether or not controllable by individual managers.
C. Incorrect. The master budget, which is fixed or static in nature, is not structured to allow determination of manufacturing cost variances, which requires using the flexible budget and actual results.
D. **Correct.** All other budgets are subsets of the master budget. Thus, quantified estimates by management from all functional areas are contained in the master budget. These results are then combined in a formal quantitative plan recognizing the organization's objectives, inputs, and outputs.

12. The use of different capacity levels in the budgeting process signifies that an organization has most likely implemented a

A. **Correct.** A flexible budget is a series of budgets prepared for different capacity levels. Choose the best expected (normal) capacity level (100 percent) and assign pessimistic (80-percent), optimistic (110-percent), and full (150-percent) capacity levels.
B. Incorrect. A capital budget is a means of evaluating long-term investments and has nothing to do with standard costs.
C. Incorrect. A static budget is for one level of activity. It can be based on expected actual or standard costs.
D. Incorrect. A strategic budget is a long-term budget.

13. Which of the following is a purpose of standard costing?

A. Incorrect. A standard costing system is not needed to perform breakeven CVP analysis.
B. **Correct.** Standard costing is used to isolate the variances between expected costs and actual costs. It allows management to measure performance and to correct inefficiencies, thereby helping to control costs.
C. Incorrect. Standard costs are used by management as an aid for control and decision making.
D. Incorrect. Standard costing does not allocate costs more accurately, especially when variances exist.

14. An efficiency variance equals

A. Incorrect. A flexible budget amount minus a static budget amount is a volume variance.
B. Incorrect. An efficiency variance cannot be determined using only income amounts.
C. Incorrect. Actual unit price minus budgeted unit price, times the actual units produced, is a price variance.
D. **Correct.** An efficiency (quantity, or usage) variance compares the actual use of inputs with the standard quantity of inputs allowed for the activity level achieved. The variance equals this difference multiplied by the standard unit price. The result is to isolate the cost effect of using more or fewer units of input than budgeted.

15. Which of the following factors should *not* be considered when deciding whether to investigate a variance?

A. Incorrect. Only material variances should be investigated. Also, the benefits of each step in the entire standard cost process must be cost effective.
B. Incorrect. The trend of variances over time should be considered. A negative variance that has been getting progressively smaller may not need investigating, whereas a variance that is increasing should be investigated promptly.
C. Incorrect. The objective of variance investigation is pinpointing responsibility and taking corrective action.

D. **Correct.** A variance shows a deviation of actual results from the expected or budgeted results. All material variances should be investigated, whether favorable or unfavorable.

16. Which department is customarily held responsible for an unfavorable materials quantity (usage) variance?

A. Incorrect. Quality control is responsible for quality standards, not material usage during production.
B. Incorrect. Purchasing usually is responsible for a materials price variance.
C. Incorrect. Engineering is responsible for design, engineering, and quality standards.
D. **Correct.** Responsibility for variances should bear some relationship to the decision and control processes used. Materials quantity or usage should be the primary responsibility of the production management personnel.

17. The benchmarking organization against which a firm is comparing itself must be a direct competitor. True or False?

True is incorrect. Benchmarking involves continuously evaluating the practices of the best-in-class organizations and adapting company processes to incorporate the best of these practices. Benchmarking is an ongoing process that entails quantitative and qualitative measurement of the difference between the company's performance of an activity, the performance of an activity, and the performance by the best in the world or the best in the industry.

False is correct. The benchmarking organization against which a firm is comparing itself need not be a direct competitor. The important consideration is that the benchmarking organization be an outstanding performer in its industry.

18. An example of a nonfinancial benchmark is

A. Incorrect. The labor rate of a competitor is a financial benchmark.
B. **Correct.** Benchmarking is a continuous evaluation of the practices of the best organization in their class and the adaptation of processes to reflect the best of these practices. It entails analysis and measurement of key outputs against those of the best organizations. This procedure also involves identifying the underlying key actions and causes that contribute to the performance difference. The percentage of orders delivered on time at the company's most efficient plant is an example of a nonfinancial benchmark.
C. Incorrect. The cost per pound of a product at the company's most efficient plant should be a financial standard.
D. Incorrect. The cost of a training program is a benchmark from a financial perspective.

19. Which of the following would be a reasonable basis for assigning the materials handling cost to the units produced in an ABC system?

A. Incorrect. The number of production runs per year is a batch-level driver. It is not well correlated with materials handling.
B. **Correct.** Two major factors should be considered in selecting cost drivers: (1) the cost of measurement and (2) the degree of correlation between the cost driver and the actual consumption of overhead. The relationship between the number of components in a finished product (the unit-level driver of the activity) and materials handling (the activity the costs of which are to be reassigned to products) is direct and causal.
C. Incorrect. The time to produce one unit is traditionally used to assign overhead to units produced in a labor-intensive process.
D. Incorrect. Machine hours is a base used to assign volume-based factory overhead costs, such as depreciation and repairs and maintenance.

20. The use of activity-based costing normally results in

A. **Correct.** ABC differs from traditional product costing because it uses multiple allocation bases and therefore allocates overhead more accurately. The result is that ABC often changes low-volume products with more overhead than a traditional system. For example, the cost of machine setup may be the same for production runs of widely varying sizes. This relationship is reflected in an ABC system that allocates setup costs on the basis of the number of setups. However, a traditional system using an allocation base such as machine hours may underallocate setup costs to low-volume products. Many companies adopting ABC have found that they have been losing money on low-volume products because costs were actually higher than originally thought.
B. Incorrect. Low-volume products are usually charged with greater unit costs under ABC.
C. Incorrect. Greater setup costs are usually charged to low-volume products under ABC.
D. Incorrect. Setup costs will not be equalized unless setup time is equal for all products.

21. Multiple or departmental overhead rates are considered preferable to a single or plant-wide overhead rate when

A. Incorrect. One rate may be cost beneficial when a single product proceeds through homogeneous processes.
B. **Correct.** Multiple rates are appropriate when a process differs substantially among departments or when products do not go through all departments or all processes. The trend in cost accounting is toward activity-based costing, which divides production into numerous activities

and identifies the cost driver(s) most relevant to each. The result is a more accurate tracing of costs.

C. Incorrect. If cost drivers are the same for all processes, multiple rates are unnecessary.
D. Incorrect. Individual cost drivers for all relationships must be known to use multiple application rates.

Chapter 4 Review Questions – Section 1

1. Contribution margin is the excess of revenues over

A. Incorrect. Revenues minus cost of goods sold is gross profit (margin).
B. Incorrect. Variable costs coming from manufacturing, selling, and administrative categories are also part of the calculation.
C. Incorrect. A direct cost is a cost that can be associated with a single cost object.
D. **Correct.** Contribution margin is the excess of revenues over all variable costs (including both manufacturing and nonmanufacturing variable costs) that vary with an output-related cost driver. The contribution margin equals the amount of margin that contribute toward covering the fixed costs and providing a net income.

2. Which of the following will result in raising the breakeven point (BEP)?

A. Incorrect. If other factors are constant, an increase in sales price or a decrease in unit variable cost increases the CM and lowers the BEP.
B. **Correct.** The break-even point (BEP) equals fixed cost divided by the unit CM (selling price - unit variable cost). An increase in fixed costs increases fixed costs and/or variable costs. An increase in either will raise the BEP. If fixed costs increase, more units must be sold, assuming the same unit CM, to cover the greater fixed costs. If variable costs increase, the unit CM will decrease and again more units must be sold to cover the fixed costs.
C. Incorrect. An increase in the CM decreases the BEP.
D. Incorrect. If income taxes are taken into account, they are treated as variable costs. A decrease in variable costs lowers the BEP.

3. The ratio of fixed costs to the unit contribution margin gives

A. **Correct.** The breakeven point is the level of sales at which revenues equal the sum of variable and fixed costs. Consequently, the contribution margin equals fixed costs at the breakeven point. Because this relationship is true, the breakeven point in units sold can be determined by dividing fixed costs by the difference between unit selling price and unit variable cost (unit contribution margin).

B. Incorrect. The profit margin is the difference between revenues and cost of goods sold.
C. Incorrect. Operating profit is the difference between operating revenues and expenses.
D. Incorrect. The contribution margin ratio (CMR) = (unit CM) / p = (p – v) /p. Dividing fixed costs by the CMR yields the breakeven point in dollars.

4. In using cost-volume-profit analysis to calculate expected unit sales, which of the following should be added to fixed costs in the numerator?

A. Incorrect. Predicted operating loss would be subtracted from fixed costs, not added.
B. **Correct.** When a targeted income (TI) is desired, it is treated as a fixed cost (FC). Consequently, target income sales units = (FC + TI) / Unit CM.
C. Incorrect. The unit CM is the denominator.
D. Incorrect. Variable costs are a component of unit CM.

5. When an organization is operating above the breakeven point, the degree or amount that sales may decline before losses are incurred is called the

A. Incorrect. Residual income is the excess of earnings over an imputed charge for the given investment base.
B. Incorrect. A marginal rate of return is the return on the next investment.
C. **Correct.** The margin of safety is the excess of budgeted revenues over breakeven revenues. It is considered in sensitivity analysis.
D. Incorrect. A target or hurdle rate of return is the required rate of return. It is also known as the discount rate of the opportunity cost of capital.

6. The percentage change in earnings before interest and taxes (EBIT) associated with the percentage change in sales volume is the degree of

A. **Correct.** Operating leverage is based on the degree to which fixed costs are used in production. Firms may increase fixed costs, such as by automation, to reduced variable costs. The result is a greater degree of operating leverage (DOL), which is the percentage change in unit sales. Thus, operating leverage is related to the price elasticity concept in economics. It can also be determined from dividing the total contribution margin by operating income as expressed in the following formula, given that x is quantity of units sold, p is unit price, v is unit variable cost, and FC is fixed cost: (Percentage change in operating income) / (Percentage change in sales) = (p - v)x / (p - v)x – FC.
B. Incorrect. The degree of financial leverage equals the percentage change in net income divided by the percentage change in operating income.
C. Incorrect. The breakeven point is the sales volume at which total revenue equals total costs.

D. Incorrect. The degree of total (combined) leverage equals the percentage change in net income divided by the percentage change in sales.

7. A higher degree of operating leverage (DOL) compared with the industry average implies that the firm

A. Incorrect. A firm with higher operating leverage has higher fixed costs and lower variable costs.
B. **Correct.** Operating leverage is a measure of the degree to which fixed costs are used in the production process. A company with a higher percentage of fixed costs (higher operating leverage) has greater risk than one in the same industry that relies more heavily on variable costs. The DOL equals the percentage change in operating income divided by the percentage change in sales. Thus, profits become more sensitive to changes in sales volume as the DOL increases.
C. Incorrect. A firm with higher leverage will be relatively more profitable than a firm with lower leverage when sales are high. The opposite is true when sales are low.
D. Incorrect. A firm with higher leverage is more risky. Its reliance on fixed costs is greater.

Chapter 4 Review Questions – Section 2

8. Future value is best described as

A. **Correct.** The future value of a dollar is its value at a time in the future given its present sum. The future value of a dollar is affected both by the interest rate and the time at which the dollar is received.
B. Incorrect. Discounting to time zero is a present value calculation.
C. Incorrect. The present value is the sum of future cash inflows discounted to the present.
D. Incorrect. The fair market value is the value a buyer is willing to pay at arm's length.

9. On November 1, 2010, a company purchased a new machine that it does not have to pay for until November 1, 2012. The total payment on November 1, 2012 will include both principal and interest. Assuming interest at a 10% rate, the cost of the machine would be the total payment multiplied by what time value of money concept?

A. Incorrect. The present value of an annuity determines the value today of a series of future payments (not merely one payment).

B. **Correct.** The cost of the machine to the company on November 1, 2010 is the present value of the payment to be made on November 1, 2012. To obtain the present value, i.e., today's price, the future payment is multiplied by the present value of $1 for two periods at 10%.
C. Incorrect. The future value of an annuity determines the amount available at a specified time in the future after a series of deposits (investments).
D. Incorrect. The future value of a dollar determines how much will be available at a specified time in the future based on the single investment (deposit) today.

10. Pole Co. is investing in a machine with a 3-year life. The machine is expected to reduce annual cash operating costs by $30,000 in each of the first 2 years and by $20,000 in year 3. Using a 14% cost of capital (discount rate), what is the present value of these future savings? Present values of $1 at 14% are: Period 1 = 0.877; Period 2 = 0.769; Period 3 = 0.675.

A. Incorrect. $58,400 equals the present value of a 3-year annuity for $30,000, minus $10,000.
B. Incorrect. $69,630 is the present value of a 3-year annuity for $30,000.
C. **Correct.** $62,880 = ($30,000 x 0.877) + ($30,000 x 0.769) + ($20,000 x 0.675) = $26,310 + $23,070 + $13,500
D. Incorrect. $69,380 equals the present value of a 2-year annuity for $30,000, plus $20,000.

11. The discount rate ordinarily used in present value calculations is the

A. Incorrect. The Federal Reserve rate may be considered; however, the firm will set its minimum desired rate of return in view of its needs.
B. Incorrect. The Treasury bill rate is a riskless rate. The firm will set its minimum desired rate of return in view of the project's risk levels.
C. **Correct.** The discount rate most often used in present value calculations is the minimum desired rate of return as set by management. The NPV arrived at in this calculation is a first step in the decision process. It indicates how the project's return compares with the minimum desired rate of return.
D. Incorrect. The firm will set the prime rate plus risk premium as the discount rate.

12. John Watson's uncle recently passed away, and included in the property that he inherited is a bond that pays an 8% coupon, has a face value of $1,000, has 10 years to maturity, and the investors require a rate of return of 10%. Assuming annual coupon payments, what is the value of the bond?

A. Incorrect. $386 results from only taking into account the present value of the lump sum principal of the bond.
B. Incorrect. $491.60 results from only taking into account the annuity of coupon payments.

C. Incorrect. $614.50 results from incorrectly multiplying the bond's $1,000 face value by the annuity interest factor, 6.145, instead of the interest factor for the present value of the lump sum, 0.386.
D. **Correct.** The value of the bond is equal to the sum of (1) the product of the coupon payments and the correct annuity factor, and (2) the product of the face value of the bond and the correct present value factor. Because the bond has 10 periods to maturity and the effective interest rate is 10%, the interest factor for the present value of the lump sum is 0.386, and the interest factor for the present value of the annuity is 6.145. Therefore, multiplying the $80 annual interest payment by its interest factor of 6.145 equals a present value of $491.60. Also, the present value of the lump sum is equal to the $1,000 face value of the bond multiplied by 0.386, which equals $386.00. Thus, the total value of the bond is the sum of these two present values, or $877.60.

Chapter 5 Review Questions – Section 1

1. The technique that reflects the time value of money and is calculated by dividing the present value of the future net after-tax cash inflows that have been discounted at the desired cost of capital by the initial cash outlay for the investment is the

A. Incorrect. The NPV method does not divide the future cash flows by the cost.
B. Incorrect. Capital rationing is not a technique but rather a condition that characterizes capital budgeting when insufficient capital is available to finance all profitable investment opportunities.
C. Incorrect. The accounting rate of return method does not discount cash flows.
D. **Correct.** The profitability index measures the ratio of the present value of future net cash flows to the original investment. This index is used as a means of ranking projects in a capital rationing situation.

2. A characteristic of the payback method is that it

A. **Correct.** The payback method calculates the time required to complete the return of the original investment. 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 inflow received after the payback period; essentially, cash flows after the payback period determine profitability of an investment.
B. Incorrect. The net investment is the numerator.
C. Incorrect. The uniform expected net cash inflow is the denominator.
D. Incorrect. No hurdle rate or minimum rate of return is used as a discount rate.

3. The internal rate of return (IRR) is the

A. Incorrect. The hurdle rate is the discount rate used to calculate the NPV; it is determined by management prior to the analysis.
B. Incorrect. The IRR is the rate at which the NPV is zero.
C. **Correct.** The IRR is the interest rate at which the PV of the expected future cash inflows is equal to the initial investment for a project. Thus, the IRR is the interest rate that will produce the NPV equal to zero.
D. Incorrect. The accounting rate of return does not incorporate the time value of money.

4. Which one of the following statements about the payback method of investment analysis is correct? The payback method

A. **Correct.** The payback method calculates the amount of time required for an investment to recoup the original investment. Although the payback method is easy to use, it has inherent problems. The time value of money and returns after the payback period are not considered.
B. Incorrect. The payback method ignores cash flows after payback.
C. Incorrect. The payback method does not use discounted cash flow techniques.
D. Incorrect. The payback method is often used, given its simplicity and effectiveness in risk management and cash conservation.

5. The technique that recognizes the time value of money by discounting the cash flows for a project over its life to time period zero using the company's minimum required rate of return is the

A. **Correct.** 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): NPV = PV – I. If NPV>0, the investment is considered to be acceptable.
B. Incorrect. Capital rationing is not a technique but rather a condition that characterizes capital budgeting when the limited amount of capital available is insufficient to fund all profitable investments.
C. Incorrect. The payback method does not consider the time value of money.
D. Incorrect. The accounting rate of return method fails to consider the time value of money. Further, it uses accounting income data rather than cash flows.

Chapter 5 Review Questions – Section 2

6. If an investment project has a profitability index of 1.15, the

A. Incorrect. The IRR is the discount rate at which the NPV is $0, which is also the rate at which the profitability index is 1.0. The IRR cannot be determined solely from the index.
B. Incorrect. If the index is 1.15 and the discount rate is the cost of capital, the NPV is positive, and the IRR must be higher than the cost of capital.
C. Incorrect. The IRR is a discount rate, whereas the NPV is an amount.
D. **Correct.** The profitability index is the ratio of the present value of future net cash inflows to the initial net cash investment. It is a variation of the NPV method that facilitates comparison of different-sized investments. A profitability index greater than 1.0 indicates a profitable investment or one that has a positive net present value.

7. Net present value (NPV) and internal rate of return (IRR) differ in that

A. **Correct.** NPV assumes that cash inflows from the investment project can be reinvested at the cost of capital, whereas IRR assumes that cash inflows from each project can be reinvested at the IRR for that particular project. This underlying assumption is considered to be a weakness of the IRR technique. The cost of capital is the appropriate reinvestment rate because it represents the opportunity cost for a project at a given level of risk. The problem with the IRR method is that it assumes a higher discount rate even through a project may not have a greater level of risk.
B. Incorrect. NPV and IRR make consistent accept/reject decisions for independent projects. When NPV is positive, IRR exceeds the cost of capital and the project is acceptable.
C. Incorrect. The NPV method can be used to rank mutually exclusive projects, whereas IRR cannot. The reinvestment rate assumption causes IRR to make faulty project rankings under some circumstances.
D. Incorrect. IRR is expressed as a percentage and NPV in dollar terms.

8. The net present value (NPV) method of capital budgeting assumes that cash flows are reinvested at

A. Incorrect. The NPV method assumes that cash inflows are reinvested at the discount rate (cost of capital) used in the NPV calculation. Usually the cost of capital is risk-free rate plus risk premium.
B. **Correct.** 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.
C. Incorrect. The NPV method assumes that cash inflows are reinvested at the discount rate used in the NPV calculation. The cost of debt is not the cost of capital in many cases.
D. Incorrect. The IRR method assumes a reinvestment rate equal to the IRR.

9. Flex Corporation is studying a capital acquisition proposal in which newly acquired assets will be depreciated using the straight-line method. Which one of the following statements about the proposal would be INCORRECT if a switch is made to the Modified Accelerated Cost Recovery System (MACRS)?

A. Incorrect. The NPV will increase. The present value of the net inflows will increase with no change in the investment.
B. Incorrect. The IRR will increase. Deferring expenses to later years increases the discount rate needed to reduce the NPV to $0.
C. Incorrect. The payback period will be shortened. Switching to MACRS defers expenses and increases cash flows early in the project's life.
D. **Correct.** MACRS is an accelerated method of depreciation under which depreciation expense will be greater during the early years of an asset's life. Thus, the outflows for income taxes will be less in the early years, but greater in the later years, and the NPV (present value of net cash inflows-investment) will be increased. The profitability index (present value of net cash inflows / the investment) must increase if the NPV increases.

Chapter 6 Review Questions – Section 1

1. A typical firm doing business nationally cannot expect to accelerate its cash inflow by

A. Incorrect. Multiple collection centers throughout the country will reduce the time required to receive cash in the mail. For example, California customers of a New York firm would make payment to a West Coast center. Thus, the company would receive the cash two or three days sooner.
B. Incorrect. Direct deposit by customers into a lock-box also speeds cash into company accounts.
C. Incorrect. Special handling of large checks is a cost-effective way to deposit large amounts.
D. **Correct.** 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.

2. Determining the appropriate level of working capital for a firm requires

A. Incorrect. Management of fixed assets is not a factor in working capital management.
B. Incorrect. Capital structure and dividend policy are factors involved in capital structure finance, not in working capital financial management.
C. Incorrect. Short-term debt is usually less expensive than long-term debt.
D. **Correct.** A company must maintain a level of working capital sufficient to pay bills as they come due. Failure to do so is technical insolvency and can result in involuntary bankruptcy.

Unfortunately, holding current assets for purposes of paying bills is not profitable for a company because they usually offer a low return compared with longer-term investments. Thus, the skillful management of working capital requires a balancing of a firm's desire for profit with its need for adequate liquidity.

3. A lock-box system

A. Incorrect. A lock-box system is not related to compensating balances; a compensating balance may be required by a covenant in a loan agreement that requires a company to maintain a specified balance during the term of the loan.
B. Incorrect. A lock-box system is a process by which payments are sent to a bank's mailbox, which is checked during normal post office hours.
C. Incorrect. The use of a lock-box system entails sending checks through the mail to a post office box. Thus, it does not reduce the risk of losing checks in the mail.
D. **Correct.** A lock-box system accelerates the inflow of funds. A company maintains mail boxes, often in numerous locations around the country, to which customers send payments. A bank checks these mailboxes several times a day, and funds received are immediately deposited to the company's account without first being processed by the company's accounting system, thereby hastening availability of the funds.

4. Crystal is a retail mail order firm that currently uses a central collection system that requires all checks to be sent to its Boston headquarters. An average of 5 days is required for mailed checks to be received, 4 days for Crystal to process them and 1½ days for the checks to clear through its bank. A proposed lockbox system would reduce the mail and process time to 3 days and the check clearing time to 1 day. Crystal has an average daily collection of $100,000. If Crystal should adopt the lockbox system, its average cash balance would increase by

A. **Correct.** Checks are currently tied up for 10½ days (5 for mailing, 4 for processing, and 1½ for clearing). If that were reduced to 4 days, Crystal's cash balance would increase by $650,000 (6.5 days x $100,000 per day).
B. Incorrect. $250,000 is calculated by assuming the collection process would be shortened by 2½ days.
C. Incorrect. $800,000 is calculated by assuming the collection process would be shortened by 8 days.
D. Incorrect. $400,000 is calculated by assuming the collection process would be shortened by 4 days.

5. A company uses the following formula in determining its optimal level of cash: K = square root of (2FT/i), 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, and K= optimal level of cash. Assume that the fixed cost of selling marketable securities is $10 per transaction and the interest rate on marketable securities is 6% per year. The company estimates that it will make cash payments of $12,000 over a one-month period. What is the average cash balance (rounded to the nearest dollar)?

A. Incorrect. $1,000 results from using 24% in the denominator.
B. Incorrect. $2,000 results from using 6% in the denominator.
C. **Correct.** 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. Substituting in the formula yields an optimal cash balance of about $6,928 (the square root of [(2x$10x$12,000) / (6%/12 months)] = $6,928.) Thus, the average cash balance is $3,464 ($6,928 ÷ 2).
D. Incorrect. $6,928 is the optimal cash balance.

6. An aging of accounts receivable measures the

A. Incorrect. An aging schedule is used for receivables, not liabilities.
B. Incorrect. An aging schedule concerns specific accounts, not averages.
C. Incorrect. An aging schedule focuses on uncollected receivables.
D. **Correct.** The purpose of an aging of receivables is to classify receivables by due date. Those that are current (not past due) are listed in one column, those less than 30 days past due in another column, etc. The amount in each category can then be multiplied by an estimated bad debt percentage that is based on a company's credit experience and other factors. The theory is that the oldest receivables are the least likely to be collectible. Aging the receivables and estimating the uncollectible amounts is one method of arriving at the appropriate balance sheet valuation of the accounts receivable account.

7. The average collection period for a firm measures the number of days

A. **Correct.** The average collection period measures the number of days between the date of sale and the date of collection. It should be related to a firm's credit terms. For example, a firm that allows terms of 2/15, net 30, should have an average collection period of somewhere between 15 and 30 days.
B. Incorrect. It describes the concept of float.
C. Incorrect. The average collection period includes the total time before a payment is received, including the periods both before and after the end of the normal credit period.
D. Incorrect. It describes the normal credit period.

8. When a company analyzes credit applicants and increases the quality of the accounts rejected, the company is attempting to

A. Incorrect. Tightening credit will reduce sales.
B. Incorrect. Tightening credit will reduce bad debt losses.
C. Incorrect. Most likely, higher quality accounts will mean a shorter average collection period.
D. **Correct.** Increasing the quality of the accounts rejected means that fewer sales will be made. The company is, therefore, not trying to maximize its sales or increase its bad debt losses. The objective is to reduce bad debt losses and thereby maximize profits.

Chapter 6 Review Questions – Section 2

9. A small retail business would most likely finance its merchandise inventory with

A. Incorrect. Only large companies with excellent credit ratings have access to the commercial paper market.
B. Incorrect. A retail store must have instant access to its inventory to provide continuous services to customers. Thus, a loan on a terminal warehouse receipt loan would not be suitable because the inventory would not be in the immediate possession of the seller.
C. **Correct.** A small retail store would not have access to major capital markets. In fact, the only options available, outside of owner financing, are bank loans and a line of credit from suppliers. It is this latter alternative that is most often used because it permits the store to finance inventories for 30 to 60 days without incurring interest cost. A line of credit is an arrangement between a bank and a borrower in which the bank commits itself to lend up to a certain maximum amount to the borrower in a given period.
D. Incorrect. A chattel mortgage is most often used for financing moveable equipment. It is not well-suited to financing inventory of a small retailer with high turnover because of the difficulty of identification.

10. Short-term, unsecured promissory notes issued by large firms are known as

A. Incorrect. An agency security is issued by a corporation or agency created by a government. Examples are government securities issued by the bodies that finance mortgages, such as the Federal National Mortgage Association (Fannie Mae) in the U.S.
B. Incorrect. Bankers' acceptances are drafts drawn on deposits at a bank. The acceptance by the bank guarantees payment at maturity. They are normally used to finance a specific transaction.

C. **Correct.** Commercial paper is the term for the short-term (typically less than 9 months), unsecured, large denomination (often over $100,000) promissory notes issued by large, creditworthy companies to other companies and institutional investors. In many instances, the maturity date is only a few days after issuance.
D. Incorrect. A repurchase agreement involves a secured loan to a government securities dealer. It allows the buyer to retain interest income although the seller-dealer can repurchase after a specified time.

11. A compensating balance

A. **Correct.** Banks sometimes require a borrower to keep a certain percentage of the face amount of a loan in a noninterest-bearing checking account as collateral. This requirement raises the effective rate of interest paid by the borrower. Cash in some bank accounts may not be available for investment. For example, when a bank lends you money, it may require you to retain funds on hand as collateral. This deposit is referred to as a compensating balance, which in effect represents restricted cash.
B. Incorrect. In financial accounting, a valuation allowance is used to reflect losses on marketable securities.
C. Incorrect. Safety stock is held for such purposes.
D. Incorrect. Interest deducted in advance is discount interest.

12. In which stage of a firm's development is it most likely to seek and obtain external equity financing in the form of venture capital?

A. Incorrect. During the formation stage, personal savings, trade credit, and government agencies are the main sources of financing. Prior to demonstrating initial success, a firm is not likely to attract venture capital financing easily.
B. **Correct.** At the rapid growth stage, if a company is reasonably profitable, it will experience financing needs in excess of funds available either internally or from trade credit or bank credit. Additional debt financing often results in an unreasonable amount of financial leverage at this stage, and public equity financing ordinarily is not yet available. Hence, a rapidly growing firm is most likely to seek and obtain venture capital financing.
C. Incorrect. In the growth to maturity stage of development the firm is able to access formal markets for debt and equity. It has a record of success and a better balance between cash inflows and outflows than in the rapid growth stage. Formal capital markets provide financing at lower cost than venture capitalists, so venture capital is not likely to be sought at this stage.
D. Incorrect. The decline phase is characterized by more than adequate cash flows, relative to available investment opportunities, so venture capital is not likely to be sought at this stage of development.

13. A company obtaining short-term financing with trade credit will pay a higher percentage financing cost, everything else being equal, when

A. Incorrect. The lower the discount percentage, the lower the opportunity cost of forgoing the discount and using the trade credit financing.
B. Incorrect. Percentage financing cost is unaffected by the purchase price of the items.
C. Incorrect. Whether the purchase price of the items is higher or lower will not affect percentage financing cost
D. **Correct.** If the discount period is longer, the days of extra credit obtained by forgoing the discount are fewer. Assuming other factors are constant, the result is that the cost of trade credit, that is, the cost of taking the discount, is greater.

14. Factoring is the selling of accounts receivable by one company to another. True or False?

True is correct. A factor purchases a company's accounts receivable and assumes the risk of collection. The seller receives money immediately to reinvest in new inventories. The financing cost is usually high; about 2 points or more above prime, plus a fee for collection. Factoring has been traditional in the textile industry for years, and recently companies in many industries have found it an efficient means of operation. A company that uses a factor can eliminate its credit department, accounts receivable staff, and bad debts. These reductions in costs can more than offset the fee charged by the factor, which can often operate more efficiently than its clients because of the specialized nature of its service.

False is incorrect. Factoring is a source of short-term funds through sale of receivables.

15. Assume that nominal interest rates just increased substantially but that the expected future dividends for a company over the long run were not affected. As a result of the increase in nominal interest rates, the company's share price should decrease. True or False?

True is correct. Gordon's valuation model or the dividend growth model is used to calculate the price of a share. $P0 = D1/(r-g)$, where P0 = current price, D1 = next dividend, r = required rate of return, and g = earnings growth rate. Assuming that D1 and g remain constant, an increase in r resulting from an increase in the nominal interest rate will cause P0 to decrease.

False is incorrect. A higher interest rate raises the required return of investors, which results in a lower share price.

16. Using a 360-day year, what is the opportunity cost to a buyer of not accepting terms 3/10, net 45?

A. Incorrect. 55.67% is based on terms of 3/10, net 30.
B. **Correct.** Payments should be made within discount periods if the return is more than the firm's cost of capital. With terms of 3/10, net 45, the buyer is earning a 3% savings for paying on the tenth day, or 35 days earlier than would otherwise be required. For example, on a $1,000 invoice, the payment would be only $970. The $30 savings is comparable to interest earned on a $970 loan to the vendor (the payment is not due for another 35 days). The interest rate on this hypothetical loan is 3.09278% ($30/$970). That return is for a 35-day period. Annualizing the return requires determining the number of 35-day periods in a year. Multiplying the return for 35 days times the periods in a year results in an annual rate of return of about 31.81% [3.09278% x (360 days/35 days)].
C. Incorrect. 22.27% is based on an earning period of 50 days.
D. Incorrect. 101.73% is based on a discount of 9%.

17. A feasible portfolio that offers the highest expected return for a given risk or the least risk for a given expected return is a(n)

A. Incorrect. An optimal portfolio is a portfolio selected from the efficient set of portfolios because it is tangent to the investor's highest indifference curve.
B. Incorrect. A desirable portfolio is not a professional term. It does not specify the level of risk and return.
C. **Correct.** 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.
D. Incorrect. An investment portfolio is mix of investments that meets an investor's return and risk profile. A mutual fund is an example.

18. The difference between the required rate of return on a given risky investment and that on a riskless investment with the same expected return is the

A. **Correct.** The capital asset pricing model (CAPM) states: rj = rf + b(rm – rf). In words, the expected return = risk-free rate + beta x (market risk premium), where rj = the expected (or required) return on security j; rf = the risk-free rate on a security such as a T-bill; rm = the expected return on the market portfolio (such as Standard and Poor's 500 Stock Composite Index or Dow Jones 30 Industrials); and b = beta, an index of systematic (nondiversifiable, noncontrollable) risk. The market risk premium is the amount above the risk-free rate that will induce investment in the market. The beta coefficient of an individual stock is the correlation between the price volatility of the stock market and that of the price of the individual stock.
B. Incorrect. The coefficient of variation is the standard deviation of an investment's returns divided by the average return.
C. Incorrect. The standard deviation is a measure of the variability of an investment's returns.

D. Incorrect. The beta coefficient measures the sensitivity of the investment's returns to market volatility.

19. According to the capital asset pricing model (CAPM), the relevant risk of a security is its

A. Incorrect. Company-specific risk can be eliminated through portfolio diversification.
B. Incorrect. Diversifiable risk can be eliminated through diversification.
C. **Correct.** The relevant risk of a security is its contribution to the portfolio's risk. It is the risk that cannot be eliminated through diversification. The relevant risk results from factors, such as recession, inflation, and high interest rates that affect all stocks.
D. Incorrect. Only the systematic component of total risk is relevant to security valuation.

20. A measure that describes the risk of an investment project relative to other investments in general is the

A. Incorrect. The coefficient of variation compares risk with expected return (standard deviation/expected return).
B. **Correct.** The capital asset pricing model (CAPM) states: Expected return = risk-free rate + beta x (market risk premium)
C. The beta coefficient of an individual stock is the correlation between the price volatility of the stock market and that of the price of the individual stock. For example, if an individual stock goes up 20% and the market only 10% beta is 2.0.
D. Incorrect. Standard deviation measures risk of project returns.
E. Incorrect. Expected return does not describe risk.

Chapter 7 Review Questions – Section 1

1. Which one of the following is a sales forecasting technique?

A. Incorrect. LP is a method of minimizing or maximizing a function given certain constraints.
B. **Correct.** With the moving average, simply take the most recent observations (n) to calculate an average. Then, use this as the forecast for the next period. Moving averages are updated as new data are received.
C. Incorrect. Queuing theory is a method of determining the appropriate number of service stations (such as teller windows or cash registers) to minimize the sum of service and waiting costs.
D. Incorrect. EOQ attempts to determine the order quantity that results in the lowest ordering and carrying costs .

2. The moving-average method of forecasting

A. Incorrect. Cross-sectional regression analysis examines relationships among large amounts of data (e.g., many or different production methods or locations) at a particular moment in time.
B. **Correct.** 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.
C. Incorrect. Regression analysis relates the forecast to changes in particular variables.
D. Incorrect. Under exponential smoothing, each forecast equals the sum of the last observation times the smoothing constant, plus the last forecast times one minus the constant.

3. As part of a risk analysis, a manager wishes to forecast the percentage growth in next month's sales for a particular plant using the past 30 month's sales results. Significant changes in the organization affecting sales volumes were made within the last 9 months. The most effective analysis technique to use would be

A. Incorrect. An unweighted average will not give more importance to more recent data.
B. Incorrect. Queuing theory is used to minimize the cost of waiting lines.
C. **Correct.** 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.
D. Incorrect. Linear regression analysis determines the equation for the relationship among variables. It does not give more importance to more recent data.

4. A regression equation

A. **Correct.** Regression analysis is a statistical procedure for estimating mathematically the average relationship between the dependent variable and the independent variable(s). For example, regression analysis is used to estimate a dependent variable (such as cash collections from customers) given a known independent variable (such as credit sales).
B. Incorrect. Regression results are limited to observations within the relevant range.
C. Incorrect. Regression analysis does not use constraint functions.
D. Incorrect. The dependent variable is estimated using regression analysis.

5. Regression estimation programs employ many tools for problem definition and analysis. A scatter diagram is one of these tools. The objective of a scatter diagram is to

A. **Correct.** The objective of a scatter diagram is to demonstrate correlations. Each observation is represented by a dot on a graph corresponding to a particular value of X (the independent variable) and Y (the dependent variable). Also, you might want to make sure that a linear (straight-line) relationship existed between Y and X in the past sample.
B. Incorrect. The objective of a histogram is to show frequency distribution in graphic form.
C. Incorrect. The objective of stratification is to divide a universe of data into homogeneous groups.
D. Incorrect. Regression analysis is used to find trend lines.

Chapter 7 Review Questions – Section 2

6. Correlation is a term frequently used in conjunction with regression analysis and is measured by the value of the coefficient of correlation, r. The best explanation of the value r is that it

A. Incorrect. The coefficient of correlation (r) relates the two variables to each other.
B. **Correct.** The coefficient of correlation (r) measures the strength of the linear relationship between the dependent and independent variables. The magnitude of r is independent of the scales of measurement of x and y. The coefficient lies between –1.0 and +1.0. A value of zero indicates no relationship between the x and y variables. A value of +1.0 indicates a perfectly direct relationship, and a value of –1.0 indicates a perfectly inverse relationship.
C. Incorrect. The coefficient of correlation (r) lies between –1.0 and +1.0.
D. Incorrect. A downward-sloping regression line indicates a negative correlation. A downward slope means that y decreases as x increases.

7. In regression analysis, the coefficient of determination is a measure of

A. **Correct.** Squaring the coefficient of correlation gives the coefficient of determination, which is a measure of the amount of variation in a dependent variable that can be explained by independent variables.
B. Incorrect. The complement of the coefficient of determination is the unexplained variation.
C. Incorrect. The slope is the change in the dependent variable in relation to the change in independent variable.
D. Incorrect. The predicted value of the dependent variable is calculated by the regression formula (y=a + bx for simple regression).

8. In a simple linear regression model, the standard error of the estimate of Y represents

A. Incorrect. It describes a confidence interval.
B. Incorrect. It describes constant variance.
C. **Correct.** The standard error of the estimate represents the variance of actual observations from the regression line. This statistic can be used to gain some idea of the accuracy of our predictions.
D. Incorrect. It describes the coefficient of determination.

9. Multicollinearity occurs when

A. Incorrect. The coefficient of determination is a measure of the amount of variation in a dependent variable that can be explained by independent variables.
B. **Correct.** Multicollinearity occurs when independent variables are correlated with each other.
C. Incorrect. Autocorrelation is a major pitfall often encountered in regression analysis. Autocorrelation usually indicates that an important part of the variation of the dependent variable has not been explained. The best solution to this problem is to search for other explanatory variables to include in the regression equation.
D. Incorrect. Bias occurs when a random sample parameters fails to represent the population parameters (for example, mean).

10. Autocorrelation or serial correlation

A. **Correct.** Autocorrelation and serial correlation are synonyms meaning that the observations are not independent. For example, certain costs may rise with an increase in volume but not decline with a decrease in volume.
B. Incorrect. This is the definition of the coefficient of determination.
C. Incorrect. This is the definition of multicollinearity.
D. Incorrect. This is the definition of bias.

11. Two measures are commonly used for summarizing historical errors: the *mean absolute deviation* (MAD) and the *mean.* True or False?

True is incorrect. Two measures are commonly used for summarizing historical errors: the *mean absolute deviation* (MAD) and the *mean squared error* (MSE).

False is correct. Mean is not used for forecasting accuracy. Mean is a measure of central tendency.

Chapter 8 Review Questions – Section 1

1. A decision maker is operating in an environment in which all the facts surrounding a decision are known exactly, and each alternative is associated with only one possible outcome. The environment is known as

A. **Correct.** This is the simplest type of decision making since it has a known state of nature. Therefore, the outcomes are the direct result of the chosen decision strategy, and can be predicted with certainty. In reality, this situation rarely occurs.
B. Incorrect. Decision making under risk involves decisions made when the probability of occurrence of the different states of nature is known.
C. Incorrect. Under uncertainty, several events are involved for each action and with each a different probability of occurrence.
D. Incorrect. In this situation, the decision maker is opposed by another party who is designing states of nature strategies to offset the decision maker's strategy to gain a competitive advantage.

2. One of your firm's trucks was involved in an accident with a car, and both parties claimed the other was at fault. A court ruled that your firm was solely responsible for all damage. From a game theory perspective, this dispute can be described as

A. Incorrect. The prisoner's dilemma is a special outcome of a partly competitive game. In these games, each player has a strategy that dominates all others, and the outcome from each player's choice of his/her dominant strategy is less favorable to both players than some other outcome.
B. **Correct.** Game (or decision) theory is a mathematical approach to decision making when confronted with an "enemy" or competitor. Games are classified according to the number of players and the algebraic sum of the payoffs. In a two-person game, if the payoff is given by the loser to the winner, the algebraic sum is zero, and the game is called a zero-sum game. If it is possible for both players to profit, however, it is called a positive-sum game.
C. Incorrect. A saddle point is an optimal strategy point.
D. Incorrect. In nonzero-sum games, the gains of one participant do not necessarily represent a comparable loss for the other party to the game. In the business environment, most competitive situations are nonzero-sum games.

3. The expected value of perfect information is the

A. Incorrect. The expected value of perfect information is the difference between the expected profit under certainty and the profit from the best decision under uncertainty.

B. Incorrect. The expected value of perfect information is the excess of the total conditional profits under certainty over the profit from the best decision under uncertainty.
C. Incorrect. There is no expected opportunity loss under conditions of certainty.
D. **Correct.** Perfect information permits certainty that a future state of nature will occur. The expected value of perfect information determines the maximum amount a decision maker is willing to pay for information. It is the difference between expected value with perfect information and the expected value with existing information.

4. Management of a company has asked the internal auditing department to assist in determining whether a new automated system should be implemented and whether the supporting software should be developed in-house, purchased, or leased. This will require evaluating a sequence of alternatives, each of which will result in different outcomes. The most effective tool the company can use to evaluate these choices would be

A. Incorrect. Ratio analysis considers only one part of the decision to be made. Ratio analysis is useful when analyzing costs and efficiencies.
B. Incorrect. Payoff tables are useful in assessing an individual decision.
C. Incorrect. Queuing theory is an approach to minimize the costs of waiting lines.
D. **Correct.** The decision tree approach shows decision alternatives, states of nature, probabilities attached to the state of nature, and conditional benefits and losses. The decision tree approach is most useful in a sequential decision situation. The possible decisions for each decision point, the events that might follow from each decision, the probabilities of these events, and the quantified outcomes of the events should be known.

5. A firm must decide whether to introduce a new product A or B. There is no time to obtain experimental information; a decision has to be made now. Expected sales can be classified as weak, moderate, or strong. How many different payoffs are possible in a decision tree under these circumstances?

A. Incorrect. 2 equals the number of decisions.
B. **Correct.** A decision tree represents the possible decisions, the events or states of nature that might follow from each decision, the probabilities of these events, and the quantified outcomes (payoffs) of the events. Given two possible decisions (A or B) and three events (low, medium, or high demand) that might follow each decision, six outcomes or payoffs are possible.
C. Incorrect. 3 equals the possible states of nature.
D. Incorrect. 5 equals the sum of 2 decisions and 3 states of nature.

6. A firm wishes to find an optimal product mix. The optimal mix would be the one that maximizes its total profit or contribution margin (CM) within the allowed budget and production capacity. Or the firm may want to determine a least cost combination of input materials while meeting production requirements, employing production capacities, and using available employees. An appropriate technique for finding an optimal product mix is

A. **Correct.** 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),,revenue, or the lowest cost.
B. Incorrect. Capital budgeting is used to analyze and evaluate long-term capital investments.
C. Incorrect. Differential analysis is used for decision making when differences in costs (revenues) for two or more options are compared.
D. Incorrect. Queuing theory is used to minimize the sum of the costs of waiting lines and servicing waiting lines when items arrive randomly and are serviced sequentially.

7. Linear programming is an operating research technique that allocates resources. Mathematical expressions are used to describe the problem. The measure of effectiveness that is to be maximized or minimized is the

A. Incorrect. Constraints are the resource limitations and other conditions within which the objective function is to be optimized.
B. Incorrect. Variables are the unknowns used to construct the objective function and constraints.
C. **Correct.** The objective function in a linear programming model symbolically represents the outcome to be optimized. (e.g., total contribution margin, net income, or total cost.)
D. Incorrect. It is a calculus term that is irrelevant in this context.

8. The constraints in a linear programming model are

A. Incorrect. The objective function incorporates the variables to be optimized.
B. Incorrect. Costs are included in the objective function.
C. **Correct.** LP models are mathematical techniques in which an objective function is maximized or minimized subject to constraints. Constraints are mathematical statements expressed as equalities or inequalities. They describe conditions, usually resource limitations, to which values of the variables are subject. These constraints must be specified before a linear programming problem can be solved.
D. Incorrect. The constraints are given and are independent.

9. Given the basic equations for the maximization of profits in a linear programming model, what quantitative technique is ordinarily employed to arrive at an optimal solution?

A. Incorrect. Regression analysis measures the relationship among variables.
B. Incorrect. Markov analysis is used in decision problems in which the probability of the occurrence of a future state depends only on the current state.
C. Incorrect. The Monte Carlo technique is used in a simulation to generate random values for a variable.
D. **Correct.** The simplex method is the technique most commonly used to solve linear programming problems. It is an algorithm used to move from a possible solution to a better solution. The mathematical constraint equations are arranged in a matrix of coefficients and manipulated as a group by means of matrix algebra. Because of its complexity when numerous products and constraints are involved, the simplex method is used primarily with computers.

10. The graphic method as a means for solving linear programming problems

A. **Correct.** LP problems assume linearity of relationships, and the solutions may be examined by plotting a solution (feasibility) region on a two-dimensional graph. The solution region is formed or bounded by the constraints lines. Multiple relationships and multiple constraints may be examined. But the graphical method is limited to the LP problems involving two (or at most three) decision variables.
B. Incorrect. More than two constraints are possible.
C. Incorrect. No graph is needed if only one constraint exists. The optimal solution is either all of one product, item, etc., or all of another unless the slope of the constraint line equals the slope of the objective function.
D. Incorrect. All LP problems by definition have constraints.

11. In linear programming, the shadow price refers to the

A. **Correct.** A shadow price is the amount by which the value of the optimal solution of the objective function will change if a one-unit change is made in a binding constraint. The calculation of a shadow price is an example of sensitivity analysis, which is any procedure that tests the responsiveness of a solution to changes in variables.
B. Incorrect. The change is in the limited resource, not in the contribution margin of one of the variables.
C. Incorrect. Shadow prices are concerned with binding constraints, not nonbinding constraints. The shadow price of unused capacity (or a nonbinding constraint) is zero.
D. Incorrect. Shadow prices are not used in the final solution of a linear programming model.

Chapter 8 Review Questions – Section 2

12. The inventory model that follows the concept that 80% of the value of an inventory is in 20% of the inventory items is the

A. **Correct.** The ABC method of inventory control requires management to exert greatest control over the A classification items, which usually include a relatively small percentage of total items but a high percentage of the dollar volume. This method is analogous to the 80/20 rule, which says, for instance, that 20% of the customers' account for 80% of the profit.
B. Incorrect. The EOQ model is intended to minimize the sum of holding and ordering costs.
C. Incorrect. A just-in-time system attempts to reduce holding costs by scheduling deliveries of materials as closely as possible to when they are needed in production.
D. Incorrect. An MRP system recognizes that the demand for one inventory item creates a dependent demand for the components of that item.

13. The purpose of the economic order quantity model it to

A. Incorrect. The basic EOQ model does not include safety stock since the lead time is assumed to be known with certainty.
B. **Correct.** The EOQ model is a deterministic model that calculates the ideal order (or production lot) quantity given specified periodic demand, the cost per order or production run, and the periodic cost of carrying one unit in stock. The model minimizes the sum of inventory carrying costs and either ordering or production setup costs.
C. Incorrect. In the EOQ model, costs, not quantities, are to be minimized.
D. Incorrect. Quantity demanded is a variable in the model, but order costs, not demand costs, are relevant. Backlogs are customer orders that cannot be filled immediately because of stockouts. Backlog costs are not quantified in the model.

14. A company has several departments that conduct technical studies and prepare reports for clients. Recently, there have been long delays in having these reports copied at the company's centralized copy center because of the dramatic increase in business. Management is considering decentralizing copy services to reduce the turn-around and provide clients with timely reports. An appropriate technique for minimizing turnaround time and the cost of providing copy services is

A. **Correct.** Queuing theory is a group of mathematical models for systems involving waiting lines. In general, a queuing system consists of a waiting line and a service facility (a copy center in this

case). The objective is to minimize total costs, including both service and waiting costs (turnaround time), for a given rate of arrivals.

B. Incorrect. Linear programming optimizes a given objective function subject to constraints.
C. Incorrect. Regression analysis estimates the relation among variables.
D. Incorrect. Game theory is an approach to decision making that considers the actions of competitors.

15. Queuing models are concerned with balancing the cost of waiting in the queue with the

A. **Correct.** Queuing (waiting-line) models minimize, for a given rate of arrivals, the sum of (1) the cost of providing service (including facility costs and operating costs) and (2) the cost of idle resources waiting customers. The latter may be a direct cost, if paid employees are waiting or an opportunity cost in the case of waiting customers. This minimization occurs at the point where the cost of waiting is balanced by the cost of providing service.
B. Incorrect. The number of customers in the queue is not one of the concerns of the queuing models in that only one customer is enough to provide a waiting period and cost the company money.
C. Incorrect. The average waiting time in the queue is not concern when using a queuing model because if a customer waits any amount of time at all before they receive service then it could cost money in lost sales and/or personnel to eliminate the wait.
D. Incorrect. The percentage of capacity utilized is not a concern because increases in system utilization are achieved at the expense of increases in both the length of the waiting line and the average waiting time. In fact, these values become exceedingly large as utilization approaches 100 percent. The implication is that under normal circumstances, 100 percent utilization is not a realistic goal. Instead, the manager should try to achieve a system that minimizes the sum of waiting costs and capacity costs.

16. A bank has changed from a system in which lines are formed in front of each teller to a one-line, multiple-server system. When a teller is free, the person at the head of the line goes to that teller. Implementing the new system will

A. Incorrect. The number of employees is unlikely to change due to the new system.
B. **Correct.** When all customers must wait in a single queue, a decrease in waiting time is possible given multiple servers. An added effect is to increase customer satisfaction.
C. Incorrect. Assuming a Poisson process, the number of customers per teller will not change.
D. Incorrect. Tellers' duties will not change, so on-the-job training will not improve.

17. The drive-through service at a fast-food restaurant consists of driving up to place an order, advancing to a window to pay for the order, and then advancing to another window to receive the items ordered. This type of waiting-line system is

A. Incorrect. Service by one ticket-seller at a movie theater is an example of a single-channel, single-phase system.
B. **Correct.** The drive-through represents a single queue (channel). Because this waiting line has three services in series, it may be said to be multiple phase. Another example is the typical factory assembly line. This terminology (channel, phase), however, is not used by all writers on queuing theory.
C. Incorrect. Supermarket checkout lines are a common example of multiple single-phase servers servicing multiple lines.
D. Incorrect. An example of a multiple-channel, multiple-phase system is a set of supermarket checkout lines each of which is served in sequence by a cashier and a person who packs grocery bags.

18. A post office serves customers in a single line at one service window. During peak periods, the rate of arrivals has a Poisson distribution with an average of 100 customers per hour and service times that are exponentially distributed with an average of 60 seconds per customer. From this, one can conclude that the

A. **Correct.** 100 customers arrive in line per hour and only 60 are serviced per hour. Accordingly, the queue will expand indefinitely during peak periods.
B. Incorrect. Insufficient information is given to determine overall idle time. The question gives only peak period data.
C. Incorrect. Peak customer service is only 60 per hour.
D. Incorrect. Insufficient information is given to determine average customer waiting time. The question gives only peak period data.