

### Example 2      Dividend Discount Model

**Facts:** Baker Corporation pays a current dividend per share of \$5 per year and is projected to grow at 4 percent per year. Able wants to invest in Baker and earn a 20 percent return.

**Required:** Calculate the value of Baker's stock today.

**Solution:**

$$\begin{aligned} P_t &= D_{(t-1)} / (R - G) \\ D_{(t-1)} &= \$5 \times 1.04 \\ D_{(t-1)} &= \$5.20 \\ P_t &= \$5.20 / (0.20 - 0.04) \\ P_t &= \$5.20 / (0.16) \\ P_t &= \$32.50 \end{aligned}$$

The intrinsic value of Baker's stock today is \$32.50.

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### Example 3      Dividend Discount Model

**Facts:** Baker Corporation pays a current dividend per share of \$5 per year and is projected to grow at 4 percent per year. Able wants to invest in Baker and earn a 20 percent return.

**Required:** Calculate the amount that Able will pay for Baker's stock three years from today.

**Solution:**

$$\begin{aligned} P_t &= D_{(t+1)} / (R - G) \\ D_{(t+1)} &= \$5 \times 1.04 \times 1.04 \times 1.04 \times 1.04, \text{ or} \\ D_{(t+1)} &= \$5 \times (1.04)^4 \\ D_{(t+1)} &= \$5 \times 1.1698586 \\ D_{(t+1)} &= \$5.85 \\ P_t &= D_{(t+1)} / (R - G) \\ P_t &= (\$5.85) / (0.20 - 0.04) \\ P_t &= \$5.85 / (0.16) \\ P_t &= \$36.56 \end{aligned}$$

In order to value Baker in three years, the dividend to be paid in the fourth year is required. Able should pay \$36.56 for Baker in three years.

#### 1.1.4 Introduction to Discounted Cash Flow Analysis

Discounted cash flow (DCF) analysis attempts to determine the intrinsic (true) value of an equity security by determining the present value of its expected future cash flows. To apply DCF analysis, an analyst takes the following steps:

- Choose an appropriate model.
  - Dividend discount models (DDM) use the stock's expected dividends as the relevant cash flows. The Gordon constant growth model is an example of a simple dividend discount model.
  - Free cash flow models including free cash flow to the firm (FCFF) and free cash flow to equity (FCFE). The free cash flow models discount the cash flow left over by the firm after satisfying certain required obligations including working capital needs and fixed capital investment.
  - Residual income models represent the income left over after the firm satisfies the investor's required return.
- Forecast the security's cash flows using one of the model approaches above.
- Select a discount rate methodology. The CAPM is a popular method used to estimate the required return for an equity security.
- Estimate the discount rate and apply to the appropriate DCF model.
- Calculate the equity security's intrinsic value and compare to its current market value.

### 1.2 Relative Valuation Models

Relative valuation models use the value of comparable stocks to determine the value of similar stocks. Price multiples are useful metrics in relative valuation.

Price multiples represent ratios of a stock's market price to another measure of fundamental value per share. Investors use price multiples to determine if a stock is undervalued, fairly valued, or overvalued.

#### 1.2.1 Price-Earnings (P/E) Ratio

The P/E ratio is the most widely used multiple when valuing equity securities. The rationale for using this measure is that earnings are a key driver of investment value (stock price). This multiple is widely used by the investment community and empirical research has shown that changes in a company's P/E are tied to the long-run stock performance of that company.

##### ■ Calculating the P/E Ratio

$$\text{P/E ratio} = P_0 / E_i$$

Terms are defined as follows:

$P_0$  = Stock price or value today

$E_i$  = EPS expected in one year (next four quarters)

**Note:** The above formula is termed the "forward P/E" as the denominator is based on expected earnings over the next year or four quarters.

■ **Valuing Equity With the P/E Ratio**

The P/E ratio, once calculated, can be multiplied by anticipated future earnings in order to determine the current stock price. It requires that earnings be greater than zero.

**Example 4 P/E Ratio**

**Facts:** Assume that Baker Corporation has current-year earnings per share of \$1.50 and anticipates earnings per share in the coming year of \$2.

**Required:** If the P/E ratio is 7.5x, calculate the expected value of Baker's shares.

**Solution:**

$$\begin{aligned} (P_0) &= (P_0/E_t) \times E_t \\ (P_0) &= 7.5 \times \$2 \\ (P_0) &= \$15 \end{aligned}$$

The P/E ratio of 7.5x implies that the current stock price should be 7.5x the anticipated earnings per share of \$2. An investor would expect the current stock price to therefore be \$15.

■ **Trailing vs. Forward P/E**

The numerator in the P/E ratio is unambiguous, as the stock price for publicly traded companies is readily available. This is not the case for the denominator of the ratio, as the earnings used in the P/E ratio can either be past earnings or expected future earnings.

When past earnings are used in the P/E ratio, such as earnings for the past four quarters or trailing 12-month EPS, the ratio calculated is the *trailing P/E*. When expected earnings of the company next year is used in the denominator, the ratio is the *forward P/E*.

The trailing P/E is the preferred calculation method when a company's forecasted earnings are unavailable, while the forward P/E is the preferred method when the company's historical earnings is not representative of its future earnings. The formula for the trailing P/E ratio is as follows:

$$\text{Trailing P/E ratio} = P_0 / E_t$$

Terms are defined as follows:

$P_0$  = Stock price or value today

$E_t$  = EPS for the past year (past four quarters)

**1.2.2 PEG Ratio**

The PEG ratio is a measure that shows the effect of earnings growth on a company's P/E, assuming a linear relationship between P/E and growth. Generally, stocks that have lower PEG ratios are more attractive to investors than stocks that have higher PEG ratios.

**■ Calculating the PEG Ratio**

$$\text{PEG} = (P_0/E_i)/G$$

Terms are defined as follows:

$P_0$  = Stock price or value today

$E_i$  = Expected EPS

$G$  = Growth rate =  $100 \times$  Expected growth rate

**■ Valuing Equity With the PEG Ratio**

The PEG ratio calculates the P/E ratio per unit of growth. The PEG ratio can be multiplied by both forecasted future earnings and the growth rate to determine the current price of the stock.

$$(P_0) = \text{PEG} \times E_i \times G$$

Terms are defined as follows:

$P_0$  = Stock price or value today

$E_i$  = Expected EPS

$G$  = Growth rate =  $100 \times$  Expected growth rate

**Example 5 PEG Ratio**

**Facts:** Baker wants to use the PEG ratio to estimate the price of its stock. The company's PEG ratio is 2.5x and its current earnings per share is \$5. The growth rate for earnings is anticipated to be 4 percent.

**Required:** Calculate the current price of Baker's stock.

**Solution:**

$$E_i = 5.00 \times 1.04 = \$5.20$$

$$(P_0) = \text{PEG} \times E_i \times G$$

$$(P_0) = 2.5 \times \$5.20 \times 4$$

$$(P_0) = \$52.00$$

### 1.2.3 Price-to-Sales Ratio

Similar to the P/E ratio, this price multiple ratio can be used to estimate the current stock price. The rationale for using the price-to-sales ratio is that sales are less subject to manipulation than earnings or book values; sales are always positive so this multiple can be used even when EPS is negative; and this ratio is not as volatile as the P/E ratio, which includes the effect of financial and operating leverage. Empirical studies have shown that P/S is an appropriate measure to value stocks that are associated with mature or cyclical companies.

#### ■ Calculating the Price-to-Sales Ratio

$$\text{Price-to-sales ratio} = P_0/S_1$$

Terms are defined as follows:

$P_0$  = Stock price or value today

$S_1$  = Expected sales in one year

#### ■ Valuing Equity With the Price-to-Sales Ratio

The value of equity can then be calculated as follows:

$$(P_0) = (P_0/S_1) \times S_1$$

### 1.2.4 Price-to-Cash-Flow Ratio

The price-to-cash-flow ratio may also be used to calculate the current stock price. The rationale for using this price multiple is that cash flow is harder for companies to manipulate than earnings; P/CF is a more stable measure than P/E, and empirical research has shown that changes in a company's P/CF ratios over time are positively related to changes in a company's long-term stock returns.

#### ■ Calculating the Price-to-Cash-Flow Ratio

$$\text{Price-to-cash-flow ratio} = P_0/CF_1$$

Terms are defined as follows:

$P_0$  = Stock price or value today

$CF_1$  = Expected cash flow in one year

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#### ■ Valuing Equity With the Price-to-Cash-Flow Ratio

The value of equity can then be calculated as follows:

$$(P_0) = (P_0/CF_1) \times CF_1$$

### 1.2.5 Price-to-Book Ratio

The price-to-book (P/B) ratio is another price multiple used by analysts that focuses on the balance sheet rather than the income statement or statement of cash flows. The rationale for using this multiple is that a firm's book value of common equity (assets minus liabilities and preferred stock) is more stable than earnings per share, especially when a firm's EPS is extremely high or low for a given period. Because P/B is usually positive, this multiple can be used even when a firm's EPS is negative or zero. Research indicates that the P/B ratio can explain a firm's average stock returns over the long run.

#### ■ Calculating the P/B Ratio

$$P/B \text{ ratio} = P_0/B_0$$

Terms are defined as follows:

$P_0$  = Stock price or value today

$B_0$  = Book value of common equity

#### ■ Valuing Equity With the P/B Ratio

The value of equity can then be calculated as follows:

$$(P_0) = (P_0/B_0) \times B_0$$

### Example 6 Price-to-Book Ratio

**Facts:** An analyst assembles the following financial and market data for Bolden Corporation's most recent year-end. The analyst projects that the firm's operating cash flow will increase 20 percent in the upcoming year.

#### Market Data

Common stock price	\$18
Common shares outstanding	10,000,000

#### Financial Data

Total assets	\$250,000,000
Total liabilities	110,000,000
Preferred stock	20,000,000
Common stock	25,000,000
Additional paid-in capital	45,000,000
Retained earnings	50,000,000
Total stockholders' equity	140,000,000
Cash flow from operations	25,000,000

**Required:** Using the previous data, calculate the P/B and P/CF multiples.

(continued)

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(continued)

**Solution:**

The P/B multiple for Bolden Corporation's current year is derived as follows:

1. Determine book value of common equity  
$$\$25,000,000 (\text{CS}) + \$45,000,000 (\text{APIC}) + \$50,000,000 (\text{RE}) = \$120,000,000$$
2. Determine book of common equity per share  
$$\$120,000,000 / 10,000,000 \text{ shares} = \$12$$
3. Calculate P/B multiple  
$$\frac{P_0}{B_0} = \$18/\$12$$
  
$$= 1.5$$

Based on the previous data and the analyst's operating cash flow forecast, the P/CF multiple is derived as follows:

1. Determine the firm's expected cash flow per share  
$$CF_1 = \$25,000,000 \times 1.20 = \$30,000,000$$
  
$$CF_1/\text{Sh.} = \$30,000,000 / 10,000,000 \text{ shares} = \$3$$
2. Calculate P/CF multiple  
$$\frac{P_0}{CF_1} = \$18/\$3$$
  
$$= 6.0$$

#### 1.2.6 Assumptions

The price multiple ratios have similar assumption requirements, each of which can be influenced by management behaviors, including:

- Future earnings
- Future cash flows
- Future sales
- Future growth rate
- The duration of sales, earnings, or cash flow trends

#### 1.2.7 Relative Valuation

Once an analyst calculates a set of price multiple ratios for a given company (stock), these ratios are used as a method of comparison to the same corresponding ratios calculated for similar companies (stocks) within that industry sector to determine a ranking for each price multiple ratio and ultimately provide important input into a particular company's stock valuation.

**Example 7**    **Relative Valuation Models**

**Facts:** An investor is comparing market ratios for the XLX Company to those of its industry. The following ratios were calculated at the end of the current fiscal year:

Ratio	XLX Company	Industry
P/E	16.2	14.9
PEG	4.8	5.3
P/S	18.1	19.4
P/CF	13.6	13.7
P/B	19.2	17.8

**Required:** Discuss what each ratio indicates regarding XLX stock valuation and how the numbers can be interpreted.

**Solution:**

- **P/E Ratio:** XLX has a higher P/E ratio than its industry peer group. This measure, on its own, would indicate that the stock price for XLX is overvalued relative to that of its peers. Investors would expect the price of XLX stock to decline in order to align the P/E ratio with that of its peers.
- **PEG Ratio:** XLX has a lower PEG ratio than its industry. For XLX, the growth rate is equal to 3.38 percent (PE of 16.2 divided by PEG of 4.8). For the industry, the growth rate is equal to 2.81 percent (PE of 14.9 divided by PEG of 5.3). Given the higher level of growth for XLX versus its industry, the PEG ratio indicates that XLX stock may actually be undervalued relative to that of its peers.
- **P/S Ratio:** This is another indicator that XLX stock may actually be undervalued relative to that of its peers. However, this ratio alone does not account for cost structure, capital structure, or tax effects that should be evaluated before determining whether a stock is relatively overvalued or undervalued.
- **P/CF Ratio:** XLX and the industry have very similar P/CF ratios. This metric alone would indicate that the stock price for XLX is fairly valued.
- **P/B Ratio:** Relative to the value of its equity, XLX's stock price is higher than that of its peers. The stock may not necessarily be overvalued, as a higher P/B may indicate that the market thinks that XLX's net assets are undervalued.

**Question 1****CPA-06137**

Fernwell wants to buy shares of Gurst Company in two years. Fernwell uses a constant growth dividend discount model with a presumed dividend growth rate of 5 percent. If Fernwell's discount rate is 10 percent and Gurst's current year dividend is \$20, what is the approximate price Fernwell will pay?

- a. \$400
- b. \$420
- c. \$441
- d. \$463

[Answer Explanation](#)**Question 2****CPA-06131**

Coldwell is using a constant growth dividend discount model to forecast the value of a share of common stock. Inherent in Coldwell's assumptions is the idea that:

- a. Compounding growth is linear.
- b. Dividends will grow at a rate faster than the presumed discount rate.
- c. Stock price will grow at the same rate as the dividend.
- d. Stock price will grow at the same amount as the dividend.

[Answer Explanation](#)**Question 3****CPA-06133**

Investors are likely to view a high price-earnings (P/E) ratio as an indication that:

- a. Earnings have growth potential.
- b. Earnings have peaked and will remain flat.
- c. Earnings have peaked and will likely fall.
- d. There is no logical conclusion to reach about the relationship between price and earnings.

[Answer Explanation](#)

Module 7 Financial Valuation Methods: Part 2 BEC 2

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## 1 Option Pricing Models

1.1 Definition of an Option

An option is a contract that entitles the owner (holder) to buy (call option) or sell (put option) a stock (or some other asset) at a given price within a stated period of time. American-style options can be exercised at any time prior to their expiration. European-style options can be exercised only at the expiration or maturity date of the option.

1.2 Valuing Options: The Black-Scholes Model

Different factors enter into the determination of the value of an option. A commonly used method for option valuation is the Black-Scholes model. The calculation is extremely complex and beyond the scope of the CPA Exam. However, you do need a high-level understanding of the concepts and assumptions that underlie Black-Scholes. Accountants may use this method in valuing stock options when accounting for share-based payments. Option price calculators are widely available, so you do not need to understand the complexity of the actual calculations to apply this method.

- Inputs into the Black-Scholes model (determinants of the call option value)
  - Current price of the underlying stock (higher price → higher option value)
  - Option exercise price
  - Risk-free interest rate (higher rate → higher option value)
  - Current time until expiration (longer time → higher call option value)
  - Some measure of risk for the underlying stock (higher risk → higher option value)
- Assumptions underlying the Black-Scholes model
  - Stock prices behave randomly.
  - The risk-free rate and volatility of the stock prices are constant over the option's life.
  - There are no taxes or transaction costs.
  - The stock pays no dividends, although the model can be adapted to dividend-paying stock.
  - The options are European-style (exercisable only at maturity).
- Limitations of the Black-Scholes model
  - Despite its current use, the Black-Scholes model does have several limitations:
    - Due to the model's assumptions, results generated from the Black-Scholes model may differ from real prices.
    - It assumes instant, cost-less trading, which is unrealistic in today's markets.
    - The model tends to underestimate extreme price movements.
    - The model is not applicable to pricing American-style options.

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### 1.3 Valuing Options: Binomial Model

Another option pricing model is the binomial or Cox-Ross-Rubinstein model. It is a variation of the original Black-Scholes model. The binomial model considers the underlying security over a period of time, as compared to the value at one point in time under the Black-Scholes model. This model is useful for valuing American-style options, which can be exercised over a period of time.

- The assumptions of the binomial model are:
  - a perfectly efficient stock market; and
  - the underlying security price will move up or down at certain points in time (called nodes) during the life of the option.
- The result of applying the model is a tree diagram showing the possible values of the options at different points in time or nodes. The math for this approach is also beyond the scope of the CPA Exam.
- The benefits of the binomial method are:
  - it can be used for American-style options; and
  - it can be used for stocks that pay dividends without modifying the model, as is necessary with Black Scholes.

## 2 Valuing Debt Instruments

The value of a bond is equal to the present value of its future cash flows (which consist of interest payments and the principal payment at maturity). The cash flows may be discounted using a single interest rate or multiple interest rates aligned with the degree of risk for each cash flow.

Bonds paying a fixed coupon rate equal to the market rate for comparable bonds are issued at par (face) value. If a bond's coupon rate at issuance is less (more) than the market rate, the bond will be issued at a discount (premium). As market interest rates change, the market value of the bond will also change. For fixed-rate bonds, when market interest rates rise the market value of the bond falls, and vice versa.

### Example 1 Debt Instruments

**Facts:** A \$1,000 face value bond maturing in three years pays annual interest of 4 percent.

**Required:** Calculate the bond's price if the market rate at the time of issuance is 5 percent.

**Solution:** Because the bond pays a lower coupon rate than market rate, it will be issued at a discount to par. The calculation for the bond's price is as follows:

$$\text{Year 1 payment: } 40 / 1.05 = \$38.10$$

$$\text{Year 2 payment: } 40 / (1.05)^2 = \$36.28$$

$$\text{Year 3 payment: } (40 + 1,000) / (1.05)^3 = \$898.39$$

$$\text{Total value: } \$38.10 + \$36.28 + \$898.39 = \$972.77$$



### 3 Valuing Tangible Assets

Fixed assets represent the property (land), plant (buildings), and equipment (PP&E) held by a company to provide the infrastructure needed to support operations. GAAP and IFRS dictate how PP&E is reported on the balance sheet; the actual value of these assets can be determined using the following methods:

#### 3.1 Cost Method

The value of the assets is based on the original cost paid to acquire the asset. Adjustments may be made for depreciation in order to reduce the value of the asset to reflect current utility.

#### 3.2 Market Value Method

This method requires that similar assets be available in the marketplace in order to find a comparable value. Two iterations of the market value method are the replacement cost method (what it would cost to replace the valued asset) and the net realizable value method (the price at which the asset could be sold in the marketplace, reduced by any costs associated with selling the asset).

#### Illustration 1 Market Value Method

A company is assessing the value of the equipment at its headquarters. Using the market value method, the company determines that it would cost \$6,200,000 today to replace all of its equipment. The company also determines that selling its equipment in the marketplace would generate \$5,900,000 after accounting for selling/disposal costs. Either value may be used as a reasonable proxy for market value.

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#### 3.3 Appraisal Method

Under this method, a professional appraiser determines the value of the asset, assuming that the company can find an appraiser with knowledge and experience working with the specific asset(s) in question.

#### 3.4 Liquidation Value

If the asset had to be sold today, the liquidation value represents the amount that the company would get upon sale assuming that there is an active market for the asset.

### 4 Valuing Intangible Assets

Intangible assets do not have a physical form, but like any asset, they provide probable future economic benefit to the entity that owns them. Intangible assets include patents, trademarks, intellectual property, copyrights, etc. The following methods may be used to value intangible assets.

#### 4.1 Market Approach

This approach requires that actual arm's-length transactions (sales, transfers, licenses) in similar markets be used as a reference for the asset to be valued. Although this is a preferred approach to valuation, the unique nature of individual intangible assets and relative trading infrequency present challenges.

**Illustration 2 Market Approach**

A company has a patent in its intangibles portfolio that it is looking to monetize. In looking at recent transactions for comparable patent sales, the company discovers four within the last couple of years.

- Sale 1: \$18.5 million
- Sale 2: \$16.2 million
- Sale 3: \$16.8 million
- Sale 4: \$15.1 million

The company will look to assign a value within a range of \$15.1 million to \$18.5 million, perhaps using the median value of \$16.5 million; or, the company may identify the transaction involving the asset that is closest to the nature of the patent the company is looking to sell and use that value.

**4.2 Income Approach**

Using this approach, future expected cash flows over the estimated useful life of the intangible asset are discounted to present value using discount rates reflecting the level of risk (including asset risk, industry risk, and market risk) associated with the income stream.

**Illustration 3 Income Approach**

Eagle Road Enterprises owns a patent that is expected to generate \$4 million each year for the next 10 years. Using a discount rate of 5.5 percent and a discounting factor of 7.5376, the patent is worth \$30.15 million today ( $\$4 \text{ million} \times 7.5376 = \$30.15 \text{ million}$ ).

**4.3 Cost Approach**

When there are no similar assets or transactions involving similar assets, and no reasonable estimates of future income, the cost approach can be used. Iterations of the cost approach include replacement cost (expenses required to create a similar asset) and reproduction cost (the expenses needed to reproduce the same asset). Costs incorporated will include materials, labor, overhead, legal and other fees, development costs, production costs, and opportunity costs.

**Illustration 4 Cost Approach**

Alpine Inc. looks to establish a value for the copyrights in its intangible asset portfolio. Using a valuation date of today, Alpine determines the following values for the costs associated with reproducing the same copyrights:

- |                                  |                               |
|----------------------------------|-------------------------------|
| • Labor: \$15,000                | • Development costs: \$16,000 |
| • Materials: \$9,000             | • Production costs: \$13,000  |
| • Overhead: \$11,000             | • Opportunity costs: \$26,000 |
| • Legal and other fees: \$22,000 | • Total cost: \$112,000       |

## 5 Valuation Using Accounting Estimates

Certain financial statement line items are valued using accounting estimates. For example:

- Accounts receivable is presented net of an allowance for uncollectible accounts.
- Inventory is reported at the lower of cost or market, or lower of cost and net realizable value, including write-downs of obsolete inventory.
- Fixed assets are offset by accumulated depreciation.
- Contingent liabilities are based on the best estimate of probable future losses.

### 5.1 Preparing Accounting Estimates

When preparing accounting estimates, management must consider the following data and factors:

- **Historical Information:** GAAP requires that the allowance for uncollectible accounts be estimated using historical information regarding the collectibility of a company's receivables from its customers. Historical patterns of fixed-asset usage may be used to justify the method used to depreciate fixed assets.
- **Market Information:** Information on the current value of inventory items should be used to determine the lower of cost or market and lower of cost and net realizable value, and should also be used to determine whether inventory should be written down or written off due to obsolescence.
- **Expected Usage:** Depreciation methods may be based on expected patterns of fixed-asset usage.
- **Estimates From Experts:** Attorneys are often used to provide estimates of probable future losses on pending or threatened litigation.

### 5.2 Review and Approval of Accounting Estimates

Accounting estimates should be supported by documentation that shows the assumptions and calculations upon which the estimates are based. Management should regularly review the support for material accounting estimates and should approve each estimate when reviewed.

Companies that use accounting estimates should expect their auditors to closely scrutinize the assumptions and support underlying the estimates. Auditors expect accounting estimates to be reasonable and look closely at any information that contradicts the assumptions made by management when preparing the estimates.

Module 8 Financial Decision Models: Part 1

BEC 2

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## 1 Cash Flows Related to Capital Budgeting

Capital budgeting is a process for evaluating and selecting the long-term investment projects of the firm. Proper capital budgeting is crucial to the success of an organization. The amount of cash the company takes in and pays out for an investment affects the amount of cash the company has available for operations and other activities of the company.

**1.1 Cash Flow Effects**

**1.1.1 Direct Effect**  
When a company pays out cash, receives cash, or makes a cash commitment that is directly related to the capital investment, that effect is termed the direct effect. It has an immediate effect on the amount of cash available.

**1.1.2 Indirect Effect**  
Transactions which are indirectly associated with a capital project or which represent noncash activity that produces cash benefits or obligations are termed indirect cash flow effects.

**Illustration 1 Cash Flow Effects**

Depreciation is a noncash expense taken as a tax deduction. Depreciation reduces the amount of taxable income and, consequently, the related taxes. The reduced tax bill resulting from increased depreciation expense associated with a new project decreases the cash paid out. This type of effect is termed an indirect effect (or tax effect) of capital budgeting.

**1.1.3 Net Effect**  
The total of the direct and indirect effects of cash flows from a capital investment is called the net effect.

**1.2 Stages of Cash Flows**  
Cash flows exist throughout the life cycle of a capital investment project. Cash flows are categorized in three general stages.

**1.2.1 Inception of the Project (Time Period Zero)**  
Both direct cash flow effects (the acquisition cost of the asset) and indirect cash flow effects (working capital requirements or disposal of the replaced asset) occur at the time of the initial investment. The initial cash outlay for the project is often the largest amount of cash outflow of the investment's life.

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- **Working Capital Requirements:** Working capital is defined as current assets minus current liabilities. When a capital project is implemented, the firm may need to increase or decrease working capital to ensure the success of the project.
  - **Additional Working Capital Requirements:** A proposed investment may be expected to increase payroll, expenses for supplies, or inventory requirements. This may result in an indirect cash outflow that is recognized at the inception of the project because part of the working capital of the organization will be allocated to the investment project and will be unavailable for other uses in the organization.
  - **Reduced Working Capital Requirements:** Implementing a just-in-time inventory system (in which the amount of inventory required to be on hand is reduced) represents a decrease in current assets and is recognized as an indirect cash inflow at the inception of the project.
- **Disposal of the Replaced Asset**
  - **Asset Abandonment:** If the replaced asset is abandoned, the net salvage value is treated as a reduction of the initial investment in the new asset. The abandoned asset's book value is considered a sunk cost, and therefore not relevant to the decision-making process. The remaining book value (for tax purposes) is deductible as a tax loss, which reduces the liability in the year of abandonment. This tax liability decrease is considered a reduction of the new asset's initial investment.
  - **Asset Sale:** If a new asset acquisition requires the sale of old assets, the cash received from the sale of the old asset reduces the new investment's value. If a gain or loss (for tax purposes) exists, there is also a corresponding increase or decrease in income taxes. The amount of income tax paid on a sale is treated as a reduction of the sales price (which increases the initial expenditure). Conversely, a reduction in tax resulting from a loss on a sale is treated as a reduction of the new investment.

#### 1.2.2 Operations

The ongoing operations of the project will affect both direct and indirect cash flows of the company.

- The cash flows generated from the operations of the asset occur on a regular basis. These cash flows may be the same amount every year (an annuity) or may differ.
- Depreciation tax shields create ongoing indirect cash flow effects.

#### 1.2.3 Disposal of the Project

Disposal of the investment at the end of the project produces direct or indirect cash flows.

- If the asset is sold, there is a direct effect for the cash inflow created on the sale and an indirect effect for the taxes due (in the case of a gain) or saved (in the case of a loss).
- Certain direct expenses may be incurred for the disposal (e.g., severance pay).
- If the asset is scrapped or donated, there may be a tax savings (an indirect effect) if the net tax basis is greater than zero (i.e., the asset has not been fully depreciated).
- There may be indirect effects associated with changes in the amount of working capital committed once the project is disposed of (e.g., employees who worked on the project may no longer be needed). A working capital commitment that was recognized as an indirect cash outflow at the inception of a project is recognized as an indirect cash inflow at the end of the project when the working capital commitment is released.

### 1.3 Calculation of Pretax and After-Tax Cash Flows

#### 1.3.1 Pretax Cash Flows

The traditional computation of an asset's value is based on the cash flows it generates. Thus an investment's value is often based on the present value of the future cash flows that investors expect to receive from the investment. Larger cash outflows than inflows may indicate that a project is unprofitable.

#### 1.3.2 After-Tax Cash Flows

After-tax cash flows are relevant to capital budgeting decisions and are computed using either of the following methods. Operating cash flow differs from net income because noncash expenses like depreciation must be added-back to net income to get to cash flow.

##### Method 1

1. Estimate net operating cash inflows (cash inflows minus cash outflows).
2. Subtract noncash tax deductible expenses to arrive at taxable income.
3. Compute income taxes related to a project's income (or loss) for each year of the project's useful life.
4. Subtract tax expense from net cash inflows to arrive at after tax cash flows.

##### Method 2

1. Multiply net operating cash inflows by (1 – Tax rate).
2. Add the tax shield associated with noncash expenses such as depreciation (depreciation multiplied by the tax rate).
3. The sum of these two amounts will equal the after-tax cash flows.

#### Illustration 2 Methods of Calculating After-Tax Cash Flows

Compute after-tax cash flows based on the following facts:

Annual cash inflows	\$40,000
Depreciation	\$10,000
Tax rate	40%

Transaction Data	Method 1	Method 2
Cash inflows	\$ 40,000 × (1 – 40%) = \$24,000	
Depreciation	<u>–10,000</u> × 40% = + 4,000	
Pretax income	30,000	<u>\$28,000</u>
Tax rate	(12,000)	
Net income	<u>\$ 18,000</u>	
<b>After-Tax Cash Flows</b>		
Cash inflows	\$ 40,000	
Taxes	<u>(12,000)</u>	
<b>After-Tax Cash Flows</b>	<u>\$ 28,000</u>	

### Example 1 Cash Flows for Capital Budgeting

**Facts:** The divisional management of Carlin Company has proposed the purchase of a new machine that will improve the efficiency of the operations in the company's manufacturing plant. The purchase price of the machine is \$425,000. Costs associated with putting the machine into service include \$10,000 for shipping, \$15,000 for installation, and \$6,000 for the initial training.

Carlin expects the machine to last six years and to have an estimated salvage value of \$7,000. The machine is expected to produce 4,000 units a year with an expected selling price of \$800 per unit and prime costs (direct materials and direct labor) of \$750 per unit. Tax depreciation will be computed under the accelerated straight-line rules (not MACRS) for five-year property with no consideration for salvage value (i.e., the entire asset amount capitalized will be depreciated). Carlin has a marginal tax rate of 40 percent.

**Required:** Calculate cash flows at the beginning of the first year (Year 0), for Years 1–5, and for Year 6, which is the final year.

#### Solution: Cash flow at the beginning of the first year for capital budgeting analysis

The net cash outflow at the beginning of the first year is calculated as follows:

Initial investment	\$425,000	
Shipping	(10,000)	
Installation	(15,000)	
Training	(6,000)	
Total	<u>\$456,000</u>	[Outflow]

#### Sample year: Net cash flow for Years 1–5 for capital budgeting analysis

Net cash flow from sales	\$ 200,000	[4,000 × (\$800 – \$750)]
Less: taxes on net sales	(80,000)	[\$200,000 × 0.40]
Add: net indirect effect of depreciation on machine	<u>36,480</u>	[(\$456,000 / 5) × 0.40]
Total	<u>\$ 156,480</u>	[Inflow]

#### Net cash flow for the final year (Year 6) for capital budgeting analysis

Net cash flow from sales	\$200,000	[per above]
Less: taxes on net sales	(80,000)	[per above]
Add: net indirect effect of depreciation on machine	-0-	No depreciation in Year 6
Salvage value	4,200	[\$7,000 gain × 0.60, which is net of tax]
Total	<u>\$ 124,200</u>	[Inflow]

## 2 Discounted Cash Flow (DCF)

DCF valuation methods (including the net present value and the internal rate of return methods) are techniques that use time value of money concepts to measure the present value of cash inflows and cash outflows expected from a project.

### 2.1 Objective and Components of Discounted Cash Flow as Used in Capital Budgeting

The objective of the discounted cash flow (DCF) method is to focus the attention of management on relevant cash flows appropriately discounted to present value. The factors used to evaluate capital investments under discounted cash flow include the dollar amount of the initial investment, the dollar amount of future cash inflows and outflows, and the rate of return desired for the project.

#### 2.1.1 Rate of Return Desired for the Project

The rate used to discount future cash flows may be set by management using several different approaches. Management may use a weighted average cost of capital (WACC) method, a specific target rate assigned to new projects, or a rate that relates to the risk specific to the proposed project. If the proposed project is similar in risk to the ongoing projects of the company, WACC is appropriate because it reflects the market's assessment of the average risk of the company's projects.

#### 2.1.2 Limitation of Discounted Cash Flow: Simple Constant Growth Assumption

Discounted cash flow methods are widely viewed as superior to methods that do not consider the time value of money. However, discounted cash flow methods do have an important limitation—they frequently use a single interest rate assumption. This assumption is often unrealistic because, over time, as management evaluates its alternatives, actual interest rates or risks may fluctuate.

## 3 Net Present Value Method (NPV)

### 3.1 Objective

The objective of the net present value method is to focus decision makers on the initial investment amount that is required to purchase (or invest in) a capital asset that will yield returns in an amount in excess of a management designated hurdle rate.

NPV requires managers to evaluate the dollar amount of return rather than either percentages of return (as with the internal rate of return method) or years to recover principal (as with the payback methods) as a basis for screening investments.

### 3.2 Calculation of Net Present Value

Net present value is calculated as follows:

#### 1. Estimate the Cash Flows

Estimate all direct and indirect after-tax cash flows (both inflows and outflows) related to the investment.

##### ▪ Ignore Depreciation (Unless a Tax Shield)

As with DCF methods, depreciation is ignored except to the extent that it reduces tax payments (i.e., a tax shield). Use of accelerated (instead of straight-line) depreciation methods increases the present value of the depreciation tax shield.

##### ▪ Ignore Interest Expense

The discounting process itself deals with the cost of financing the project, and therefore finance costs are excluded from the cash flow forecast.

#### 2. Discount the Cash Flows

Discount all cash flows (both inflows and outflows) to present value using the appropriate discount factor based on the hurdle rate and the timing of the cash flow. The net present value method assumes that the cash flows are reinvested at the same rate used in the analysis.

#### 3. Compare

Compare the present values of inflows and outflows.

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### Pass Key

Discounted cash flow is the basis for net present value methods:

- **Step 1:** Calculate after-tax cash flows = Annual net cash flow  $\times (1 - \text{Tax rate})$
- **Step 2:** Add depreciation benefit = Depreciation  $\times$  Tax rate
- **Step 3:** Multiply result by appropriate present value of an annuity (assuming cash flows are an annuity)
- **Step 4:** Subtract initial cash outflow

*Result:* Net present value

### 3.3 Interpreting the NPV Method

The investment decision is based on whether the net present value is positive or negative. Note that if the net present value is equal to zero, management would be indifferent about accepting or rejecting the project. NPV is the theoretical dollar change in the market value of the firm's equity due to the project.

### 3.3.1 Positive Result = Make Investment

If the result is positive (greater than zero), the rate of return for the project is greater than the hurdle rate (the discount percentage rate used in the net present value calculation) and the investment should be made. If the company has unlimited funds, all projects with a net present value greater than zero should be accepted. Project ranking and acceptance techniques in circumstances involving limited capital are described below.

### 3.3.2 Negative Result = Do Not Make Investment

If the result is negative (less than zero), the rate of return for the project is less than the hurdle rate and the investment should not be made because it does not meet management's minimum rate of return. A negative NPV means that the internal rate of return on the investment is less than management's hurdle rate for the project.

## 3.4 Interest Rate Adjustments for Required Return

Net present value analysis may incorporate many types of hurdle rates, such as the cost of capital (the average rate of return demanded by investors), the interest rate of the opportunity cost, or some other minimum required rate of return. All rates are determined by management.

### 3.4.1 Adjustments to Rate

Rates may be modified (generally increased) to adjust for:

- **Risk:** Discount rates may be increased to further factor differences in risk into the analysis.

### Illustration 3 Interest Rate Adjustment for Risk

Management would select a high hurdle rate for certain projects to factor risk into its consideration of acceptance of those projects. The higher hurdle rate discounts (reduces) future cash flows more, creating a smaller present value, which stands a larger chance of yielding an NPV below zero, with the project not being selected. By "devaluing" the cash flows for a project, the NPV model compensates for risk.

- **Inflation (Also Affects Cash Flows):** Rates may be raised to compensate for expected inflation.

### Illustration 4 Interest Rate Adjustment for Inflation

Assume that management anticipates higher-than-normal inflation. To compensate for the falling value of the dollars it anticipates from its cash flows, the interest rate (discount factor) may be increased. In addition, the future cash flows also should be increased to the extent of predicted inflation. If management anticipates no change in tax rates, cash flows generated from the effects of depreciation would not be adjusted because they relate to the original investment.

### 3.4.2 Differing Rates

Different rates may be used for different time periods using the NPV method. For example, 12 percent might be the rate for the first three years, and 15 percent (which reflects a greater risk) might be the rate for subsequent years. If the NPV is greater than zero, the project will be acceptable.



#### Pass Key

The NPV method of capital investment valuation is considered to be superior to the internal rate of return (IRR) method because it is flexible enough to handle inconsistent rates of return for each year of the project.

### 3.4.3 Discount Rate Applied to Qualitatively Desirable or Non-optimal Investments

A project that meets qualitative management criteria for investment (e.g., mandated technology investments) is subject to financing, rather than capital budgeting, considerations. In this case, the discount rate used for NPV evaluation should be the after-tax cost of borrowing, sometimes called the incremental borrowing rate.

#### Example 2 Net Present Value

**Facts:** McLean Inc. is considering the purchase of a new machine, which will cost \$150,000. The machine has an estimated useful life of three years. Assume for simplicity that the equipment will be fully depreciated for tax purposes 30 percent, 40 percent, and 30 percent in each of the three years, respectively. The new machine will have a \$10,000 resale value at the end of its estimated useful life. The machine is expected to save the company \$85,000 per year in operating expenses. McLean uses a 40 percent estimated income tax rate and a 16 percent hurdle rate to evaluate capital projects.

Discount rates for a 16 percent rate are as follows:

	Present Value of \$1	Present Value of an Ordinary Annuity of \$1
Year 1	0.862	0.862
Year 2	0.743	1.605
Year 3	0.641	2.246

**Required:** Calculate the net present value of the proposed purchase of the new machine.

(continued)

(continued)

**Solution:****1. Annual Depreciation Shield**

First, calculate the annual depreciation tax shield as follows (Depreciation × Tax rate):

	<b>Years 1 and 3 (30%)</b>	<b>Year 2</b>
Cost of asset	\$150,000	\$150,000
Depreciation %	$\times \quad 30\%$	$\times \quad 40\%$
Annual depreciation	\$ 45,000	\$ 60,000
Tax rate	$\times \quad 40\%$	$\times \quad 40\%$
Tax shield	<u><u>\$ 18,000</u></u>	<u><u>\$ 24,000</u></u>

**2. Annual Savings**

Calculate the after-tax annual savings as follows [Savings × (1 – Tax rate)]:

$$\text{Annual savings} = \$85,000 [\text{savings per year}] \times (1 - 0.40)$$

$$\text{Annual savings} = \$85,000 \times 0.60$$

$$\text{Annual savings} = \$51,000$$

**3. Salvage Value Inflow**

Calculate the salvage value inflow as follows:

Proceeds from salvage	\$10,000
Less: Basis of machine	— [fully depreciated]
Gain on salvage	\$10,000
Less: Taxes	<u>(4,000)</u> [\$10,000 × 40%]
Cash inflow	<u><u>\$ 6,000</u></u> [\$10,000 × (1 – 0.40)]

**4. Net Present Value Schedule and Calculation**

	<b>Year 0</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>
Equipment cost	\$(150,000)			
Depreciation tax shield		\$18,000	\$24,000	\$18,000
Annual savings		\$51,000	\$51,000	\$51,000
Salvage value inflow				6,000 [from 3, above]
After-tax cash flow	(150,000)	69,000	75,000	75,000
Discount rate	$\times \quad 1.00$	$\times \quad 0.862$	$\times \quad 0.743$	$\times \quad 0.641$
Present value	(150,000)	59,478	55,725	48,075 = <u><u>\$13,278</u></u>

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### 3.5 Advantages and Limitations of the Net Present Value Method

#### 3.5.1 Advantages

The net present value method is flexible and can be used when there is no constant rate of return required for each year of the project.

#### 3.5.2 Limitations

Even though NPV is considered the *best* single technique for capital budgeting, the net present value method of capital budgeting is limited by not providing the true rate of return on the investment. The NPV purely indicates whether an investment will earn the "hurdle rate" used in the NPV calculation.

### 3.6 Capital Rationing

The concept of capital rationing describes how limited investment resources are considered as part of investment ranking and selection decisions.

#### 3.6.1 Unlimited Capital

Ideally, a company has virtually unlimited resources at its disposal, so the company may do everything (or nearly everything) that meets the company's screening criteria. Investments are undertaken in the order that they are ranked. If a company has unlimited capital, all investment alternatives with a positive NPV should be pursued.

#### 3.6.2 Limited Capital

Realistically, a company has extremely limited resources that make its investment choices mutually exclusive (i.e., if one investment is chosen over another, the company does not have the option of "hedging its bet" with the second alternative because resources are entirely committed).

■ **Importance:** Capital budgeting decisions involve a tremendous amount of money, time, and risk. If the company is down to two mutually exclusive choices, the importance of clearly defined calculations is just that much more critical.

■ **Ranking and Acceptance:** If capital is limited and must be rationed, managers will allocate capital to the combination of projects with the maximum net present value. The ranking of projects from a group of qualifying investments (those that exceed the hurdle rate) is best accomplished using the profitability index (described below) and becomes especially important when projects are independent (i.e., mutually exclusive).

### 3.7 Profitability Index

The profitability index is the ratio of the present value of net future cash inflows to the present value of the net initial investment. The profitability index is also referred to as the excess present value index, or simply the present value index. Ranking and selection of investment alternatives anticipate positive net present values for all successfully screened investments. The profitability ratio likely will be over 1.0, which means that the present value of the inflows is greater than the present value of the outflows.

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$$\text{Profitability index} = \frac{\text{Present value of net future cash inflow}}{\text{Present value of net initial investment}}$$

### 3.7.1 Application

The profitability index measures cash-flow return per dollar invested; the higher the profitability index, the more desirable the project. Projects that meet the screening criteria (e.g., positive NPV) are ranked in descending order by their profitability index. Limited capital resources are applied in the order of the index until resources are either exhausted or the investment required by the next project exceeds remaining resources.

#### Example 3 Capital Rationing

**Facts:** Beaman Enterprises has \$50,000 of capital to invest in new projects for the coming fiscal year. The company must decide which projects to invest in given its budget constraints. The chart below shows the initial cost of the five investment options, along with the calculated present value of the future cash inflows.

Project	Initial Investment	PV Future Inflows
A	\$16,000	\$25,000
B	4,000	7,000
C	30,000	38,000
D	8,000	11,000
E	25,000	42,000

**Required:** Rank the investments using the profitability index and determine which project options Beaman should choose to pursue.

**Solution:** The first step is to calculate the profitability index for each project, which is done by dividing the present value of future inflows by the present value of the initial investment.

Project	PV Future Inflows	Initial Investment	Profitability Index
A	\$25,000	\$16,000	1.5625
B	7,000	4,000	1.75
C	38,000	30,000	1.267
D	11,000	8,000	1.375
E	42,000	25,000	1.68

The second step is to rank the projects from highest profitability index to lowest. The order would then be: Projects B, E, A, D, C.

The third and final step is to add the initial investments until the company's \$50,000 threshold is reached.

$$B + E + A = \$4,000 + \$25,000 + \$16,000 = \$45,000$$

The next best project, which is D, would cost Beaman \$8,000 and would push the company over the threshold of \$50,000. Therefore, the projects Beaman will choose are projects B, E, and A.



<b>Question 1</b>	<b>CPA-03283</b>
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In equipment-replacement decisions, which one of the following does *not* affect the decision-making process?

- a. Current disposal price of the old equipment.
- b. Original fair market value of the old equipment.
- c. Cost of the new equipment.
- d. Operating costs of the new equipment.

[Answer Explanation](#)

<b>Question 2</b>	<b>CPA-03358</b>
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When the risks of the individual components of a project's cash flows are different, an acceptable procedure to evaluate these cash flows is to:

- a. Compute the net present value of each cash flow using the firm's cost of capital.
- b. Compare the internal rate of return from each cash flow to its risk.
- c. Utilize the accounting rate of return.
- d. Discount each cash flow using a discount rate that reflects the degree of risk.

[Answer Explanation](#)

<b>Question 3</b>	<b>CPA-03337</b>
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If the net present value of a capital budgeting project is positive, it would indicate that the:

- a. Present value of cash outflows exceeds the present value of cash inflows.
- b. Internal rate of return is equal to the discount percentage rate used in the net present value computation.
- c. Present value index would be less than 100 percent.
- d. Rate of return for this project is greater than the discount percentage rate used in the net present value computation.

[Answer Explanation](#)

**Question 4****CPA-06644**

Salem Co. is considering a project that yields annual net cash inflows of \$420,000 for Years 1 through 5, and a net cash inflow of \$100,000 in Year 6. The project will require an initial investment of \$1,800,000. Salem's cost of capital is 10 percent. Present value information is presented below:

Present value of \$1 for five years at 10 percent is 0.62.  
Present value of \$1 for six years at 10 percent is 0.56.  
Present value of an annuity of \$1 for five years at 10 percent is 3.79.

What was Salem's expected net present value for this project?

- a. \$83,000
- b. \$(108,200)
- c. \$(152,200)
- d. \$(442,000)

[Answer Explanation](#)

Module 9 Financial Decision Models: Part 2 BEC 2

**1 Application of NPV: Lease-vs.-Buy Decisions**

RT Click to view

**1.1 The Issue**

A company may acquire an asset by purchasing the asset or through a leasing arrangement. There are two main types of leases:

- Operating Lease:** Property is rented over an insignificant portion of the asset's useful life with no obligation (or opportunity) to assume ownership of the property.
- Capital Lease:** Analogous to a lessee buying an asset and financing it with debt. The important issue for financial decision-making is the *cash flows* created by a lease, as compared with purchasing the asset.

**1.2 Decision-Making**

```

graph TD
    TD(TWO DECISIONS) --> ID(1. Investment Decision)
    TD --> FD(2. Financing Decision)
    ID --> IOBQ{Does the asset give operational benefits?}
    IOBQ --> FNPV{Focus on the NPV of the after-tax operating cash inflows.}
    FNPV --> DCB[Discount cash flows using a rate which reflects the operating risk of investment (e.g. average cost of capital)]
    FD --> ICBLQ{Is it cheaper to buy or lease?}
    ICBLQ --> FBD{Focus on the relative benefits of tax-allowable depreciation from buying versus the tax savings from the lease payments.}
    FBD --> DCOD[Discount these cash outflows using the after-tax cost of debt.]
  
```

**1.2.1 Investment Decision**

- Discount the after-tax operating cash inflows at the firm's weighted average cost of capital (WACC).

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### 1.2.2 Financing Decision

- Discount the cash flows specific to each financing option at the after-tax cost of debt.
- The preferred financing option is that with the lowest NPV of cost.
- The relevant cash flows to consider include:
  - Buy asset or capital lease (same tax treatment—depreciation is tax deductible)
    - Purchase cost or present value of lease payments
    - Tax savings from depreciation
    - Scrap proceeds
  - Operating lease (lease payments are tax deductible)
    - Lease payments
    - Tax savings on lease payments



### Pass Key

If the PV of the cost of the best source of financing is less than the PV of the operating cash flows, then the project should be undertaken.

#### Example 1      Lease or Buy

**Facts:** Boulder Inc. is considering the acquisition of a new machine, either through an operating lease or by purchasing the asset.

The asset will cost \$200,000 on January 1, Year 1, and will have a scrap value of \$25,000 at the end of Year 2.

Operating inflows are \$150,000 for two years.

The tax rate is 30 percent and the company's weighted average cost of capital is 9 percent. The machine is fully depreciated on a straight-line basis over two years for both book and tax purposes.

Boulder's financing options for the asset are:

- using a bank loan at a 10 percent interest rate; or
- leasing for \$92,500 a year, with lease payments due on January 1 of each year.

Relevant PV factors include the following:

PV of ordinary annuity at 9%	1.759
PV of annuity due at 7%	1.935
<b>PV of \$1 at 7%</b>	
Year 1	0.935
Year 2	0.873

(continued)

(continued)

**Required:**

1. Determine the operational benefit of the project.
2. Determine how the project should be financed.
3. Determine the NPV of the investment.

**Solution:**

1. Operational Benefit

$$\begin{aligned} \text{PV of annual after-tax cash inflow} &= [\$150,000 \times (1 - 30\%)] \times 1.759 \\ \text{PV of annual after-tax cash inflow} &= \$105,000 \times 1.759 = \$184,695 \end{aligned}$$

2. Financing Decision

$$\text{After-tax cost of debt} = 10\% \times (1 - 30\%) = 7\%$$

- a. Borrow and buy asset

$$\begin{aligned} \text{Annual depreciation tax shield} &= \$100,000 \times 30\% = \$30,000 \\ \text{After-tax cash inflow from scrap} &= \$25,000 \times (1 - 30\%) = \$17,500 \end{aligned}$$

	Year 0	Year 1	Year 2
Cost of machine	\$200,000		
Depreciation tax shield		\$30,000	\$30,000
Scrap	—	—	17,500
After-tax cash flow	(200,000)	30,000	47,500
Discount rate	1	0.935	0.873
Present value	\$200,000	\$28,050	\$41,468 = <u><math>\\$(130,483)</math></u>

- b. Operating lease

$$\begin{aligned} \text{PV of annual after-tax cash outflow} &= [\$92,500 \times (1 - 30\%)] \times 1.935 \\ \text{PV of annual after-tax cash outflow} &= \$64,750 \times 1.935 =  $\$(125,291)$  \end{aligned}$$

Project should be financed using the operating lease because the NPV of the cost is lower.

3. Net Present Value

PV of operating inflows	\$184,695
PV of lease financing	<u><math>\\$(125,291)</math></u>
Net present value	<u><math>\\$ 59,404</math></u>

### 1.3 Effect on the Financial Statements

Financial accounting implications must be considered when making a lease-versus-buy decision. This is certainly relevant for the managers of a public company as key ratios may be influenced—particularly financial risk indicators such as the firm's debt-to-equity ratio and interest coverage ratio.

The implications of each financing option can be summarized as follows:

- **Borrow to Buy**

The bank loan will be recorded in non-current liabilities and will increase the firm's debt-to-equity ratio. Interest on the debt will reduce the firm's interest coverage ratio. However, the overall effect also depends on the profits generated by the asset as these will increase earnings and equity.

- **Operating Lease**

Neither the asset nor any related liability is shown in the statement of financial position. Operating leases are a form of off-balance sheet financing (although commitments under operating leases would be disclosed in the notes to the financial statements). Although rental expense decreases earnings, this should be offset by the returns generated by operating the asset.

- **Capital Lease**

Both the asset and a related liability are recognized in the balance sheet (similar to the borrow to buy option). Therefore, the debt-to-equity ratio would initially rise. Lease payments are split between interest expense and repayment of principal and therefore the liability is amortized over time and ultimately falls to zero. Interest expense in early years is relatively high, decreasing the interest coverage ratio, but interest expense falls in later years as the liability decreases.

## 2 Internal Rate of Return (IRR)

The internal rate of return (IRR) is the expected rate of return of a project and is sometimes called the time-adjusted rate of return.

### 2.1 Objective

The IRR method determines the present value factor (and related interest rate) that yields an NPV equal to zero. (The present value of the after-tax net cash flows equals the initial investment on the project.)

The IRR method focuses the decision maker on the discount rate at which the present value of the cash inflows equals the present value of the cash outflows (usually the initial investment).



### Pass Key

Although the NPV method highlights dollar amounts, the IRR method focuses decision makers on percentages.

## 2.2 Interpreting IRR for Investment Decisions

The targeted rate of return or hurdle rate is predetermined and is compared with the computed IRR. Note that management would be indifferent about accepting or rejecting the project if the IRR were equal to the hurdle rate.

- **Accept When IRR > Hurdle Rate:** Projects with an IRR greater than the hurdle rate will be accepted.
- **Reject When IRR < Hurdle Rate:** Projects with an IRR less than the hurdle rate will be rejected.

## 2.3 Limitations of IRR

### 2.3.1 Unreasonable Reinvestment Assumption

Cash flows generated by the investment are assumed in the IRR analysis to be reinvested at the internal rate of return. If internal rates of return are unrealistically high or unrealistically low, assumed returns on reinvested cash flows based on IRR rates could lead to inappropriate conclusions.

### 2.3.2 Inflexible Cash Flow Assumptions

The timing or the amount of cash flows used to determine IRR can be misleading when compared with the NPV method. The IRR method is less reliable than the NPV method when there are several alternating periods of net cash inflows and net cash outflows or the amounts of the cash flows differ significantly.

### 2.3.3 Evaluates Alternatives Based Entirely on Interest Rates

The IRR method evaluates investment alternatives based on the achieved IRR and does not consider the dollar impact of the project.

#### Illustration 1 Limitations of IRR

If an investment of \$50 earns \$100, then there is a 200 percent return ( $100 / 50 = 200\%$ ). If an investment of \$50,000 earns \$25,000, then there is a 50 percent return ( $25 / 50 = 50\%$ ). The IRR method would suggest that it would be best to invest \$50 to earn \$100 and receive a 200 percent return, while the NPV method would favor the larger \$25,000 NPV on the \$50,000 investment.

## 3 Payback Period Method

The payback period is the time required for the net after-tax operating cash inflows to recover the initial investment in a project.

### 3.1 Objective

The payback period method focuses decision makers on both liquidity and risk. The payback period method measures the time it will take to recover the initial investment in the project, thereby emphasizing the project's liquidity and the time during which return of principal is at risk. The payback method is often used for risky investments. The greater the risk of the investment, the shorter the payback period that is expected (tolerated) by the company.

### 3.2 Calculation

The formula for calculating the payback period is as follows, assuming equal annual cash flows:

$$\text{Payback period} = \frac{\text{Net initial investment}}{\text{Annual net after-tax cash flow}}$$

### 3.3 Cash Flow Assumptions

#### 3.3.1 Uniform Cash Inflows

The net cash inflows are generally assumed to be constant for each period during the life of the project. The payback period is computed at the point of initial investment using after-tax cash flows. Cash flows involve the following factors:

- **Project Evaluation:** In the case of a project, the net annual cash inflow would be the net cash receipts associated with the project.
- **Asset Evaluation:** In the case of the purchase of equipment, the net annual cash inflow will be the savings generated by use of the new equipment.
- **Depreciation Tax Shield:** Depreciation expense is not considered, except to the extent that it is a tax shield.

#### Example 2 Uniform Cash Flows

**Facts:** Helena Company is planning to acquire a \$250,000 machine that will provide increased efficiencies, thereby reducing annual operating costs by \$80,000. The machine will be depreciated by the straight-line method over a five-year life with no salvage value at the end of five years.

**Required:** Assuming a 40 percent income tax rate, calculate the machine's payback period.

**Solution:**

1. Calculate the annual net cash savings (also referred to as the average expected cash flows) as follows:

Expected cash flow savings	\$ 80,000
Net income increase	\$ 80,000
Less: annual depreciation	<u>(50,000)</u>
Net income before income taxes	\$ 30,000
Multipplied by 40% tax rate	<u>× 40%</u>
Net cash savings	<u><u>(12,000)</u></u> <u>\$ 68,000</u>

2. Calculate the payback period, as follows:

$$\frac{\text{Investment}}{\text{Net cash savings}} = \frac{\$250,000}{\$68,000} = 3.68 \text{ years}$$

### 3.3.2 Non-Uniform Cash Flows (Use Cumulative Approach)

The standard payback formula shown above applies to uniform annual cash inflows. If cash flows are not uniform (i.e., they vary from period to period over the life of the project), a cumulative approach (rather than the standard payback formula) to determine the payback period is used. Net after-tax cash inflows are accumulated until the time they equal the initial net investment (at which point the end of the payback period is reached).

#### Example 3    Non-Uniform Cash Flows

**Facts:** Radon Technologies is considering the purchase of a new machine costing \$200,000 for its surfboard manufacturing plant in San Diego, CA. The management of Radon estimates that the new machine will last approximately four years and will be directly responsible for efficiencies that will increase the company's after-tax cash flows by the following amounts (non-uniform cash flow):

Cumulative Amounts		
Year 1	\$90,000	\$ 90,000
Year 2	80,000	170,000
Year 3	75,000	245,000
Year 4	60,000	305,000

**Required:** Calculate the payback period for this investment.

**Solution:** The cumulative cash flows reach the initial investment amount of \$200,000 sometime in Year 3.

Therefore, the payback period would be more than two years and less than three years. Assume that the cash flow is earned evenly throughout the year. The payback period is then calculated as follows:

1. Amount of cash flow in Year 3 needed to attain \$200,000 cumulative cash flows:  
$$\$200,000 - \$170,000 \text{ (Year 2's cumulative amount)} = \$30,000$$
2. Percentage of Year 3 until cumulative amount of \$200,000 is attained:  
$$\frac{\$30,000}{\$75,000} = 40\%$$
3.  $2 + 0.40 = 2.40$  years payback

### 3.4 Advantages and Limitations of Payback

#### 3.4.1 Advantages of the Payback Method

- **Easy to Use and Understand:** The simplicity of the objective and the absence of complex formulas or multiple steps make the payback method easy to use and understand.
- **Emphasis on Liquidity:** The computation focuses management on return of principal. The method's emphasis on liquidity is a very important consideration when making capital budgeting decisions (e.g., most companies will prefer shorter payback periods, all other factors being equal).

### 3.4.2 Limitations of the Payback Method

- The time value of money is ignored.
- Project cash flows occurring after the initial investment is recovered are not considered.
- Reinvestment of cash flows is not considered.
- Total project profitability is neglected.

## 4 Discounted Payback Method

Companies may use the discounted payback method as an alternative to the nondiscounted payback method. This variation computes the payback period using expected cash flows that are discounted by the project's cost of capital (the method considers the time value of money). Discounted payback is also referred to as the break-even time method (BET).

### 4.1 Objective

The objective of the discounted payback method (or BET) is to evaluate how quickly new ideas are converted into profitable ideas.

- **Focus on Liquidity and Profit:** The measure focuses decision makers on the number of years needed to recover the investment from discounted net cash flows.
- **Evaluation Term:** The computation begins when the project team is formed and ends when the initial investment has been recovered (based on cumulative discounted cash flows).
- **Using Discounted Payback:** Discounted payback (or BET) is often used to evaluate new product development projects of companies that experience rapid technological changes. These companies want to recoup their investment quickly, before their products become obsolete.

### 4.2 Advantages and Limitations of Discounted Payback

The advantages and limitations of discounted payback are the same as the payback method (except that discounted payback incorporates the time value of money, a feature ignored by the payback method). Both focus on how quickly the investment is recouped rather than overall profitability of the entire project.

**Example 4      Discounted Payback**

**Facts:** Radon Technologies is considering the purchase of a new machine costing \$200,000 for its surfboard manufacturing plant in San Diego, CA. The company's discount rate for projects of this type is 10 percent. The management of Radon estimates that the new machine will last approximately four years and will be directly responsible for efficiencies that will increase the company's after-tax cash flows by the following amounts (non-uniform cash flow):

Year 1	\$90,000
Year 2	80,000
Year 3	75,000
Year 4	60,000

The present value interest factors for 10 percent are as follows:

Year 1	0.909
Year 2	0.826
Year 3	0.751
Year 4	0.683

**Required:** Calculate the discounted payback period for this investment.

**Solution:**

- Calculate the present value of the future cash flows:

Year	Cash Flow Increase	Discount Factor	10% PV of Cash Flow	Cumulative PV
Year 1	\$ 90,000	0.909	\$ 81,810	\$ 81,810
Year 2	80,000	0.826	66,080	147,890
Year 3	75,000	0.751	56,325	204,215
Year 4	60,000	0.683	-40,980	245,195
	<u>\$305,000</u>		<u>\$245,195</u>	

- Determine the discounted payback period:

The cumulative present value reaches the initial investment amount of \$200,000 in Year 3. Therefore, the discounted payback period would be more than two years and less than three years. Assume that the cash flow is earned evenly throughout the year. The discounted payback period is then calculated as follows:

- Amount of cash flow in Year 3 needed to attain \$200,000 cumulative cash flows:  

$$\$200,000 - \$147,890 \text{ (Year 2's cumulative amount)} = \$52,110$$
- Percentage of Year 3 until cumulative amount of \$200,000 is attained:  

$$\frac{\$52,110}{\$56,325} = 92.5\%$$
- $2 + 0.925 = 2.925$  years discounted payback

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## Pass Key

### Calculating Time Value of Money Without Factors

Although the CPA Exam often will provide factors for use in time value of money calculations, it is very helpful for candidates to understand how to calculate these factors in the event that they are not given on the exam.

#### Present Value of \$1

The formula to calculate present value is as follows:

$$PV = FV / (1 + r)^n$$

Where:

- PV = Present value
- FV = Future value
- r = Interest rate
- n = Number of years

Example: What is the factor for the present value of \$1 to be received two years in the future at an interest rate of 6 percent?

$$\begin{aligned} PV &= \frac{FV}{(1 + r)^n} \\ &= \frac{1}{(1.06)^2} \\ &= 0.890 \end{aligned}$$

#### Present Value of Annuity

The formula to calculate the present value of an annuity is as follows:

$$PV = PMT \times \left[ \frac{1 - \frac{1}{(1 + r)^n}}{r} \right]$$

Where:

- PMT = Annuity payment

Example: What is the factor for the present value of \$1 to be received in each of the next three years at an interest rate of 6 percent?

$$\begin{aligned} PV &= 1 \times \left[ \frac{1 - \frac{1}{(1.06)^3}}{0.06} \right] \\ &= 2.673 \end{aligned}$$

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**Question 1****CPA-05785**

Which of the following statements about investment decision models is true?

- a. The discounted payback rate takes into account cash flows for all periods.
- b. The payback rule ignores all cash flows after the end of the payback period.
- c. The net present value model says to accept investment opportunities when their rates of return exceed the company's incremental borrowing rate.
- d. The internal rate of return rule is to accept the investment if the opportunity cost of capital is greater than the internal rate of return.

[Answer Explanation](#)**Question 2****CPA-04836**

Which of the following statements is true regarding the payback method?

- a. It does not consider the time value of money.
- b. It is the time required to recover the investment and earn a profit.
- c. It is a measure of how profitable one investment project is compared to another.
- d. The salvage value of old equipment is ignored in the event of equipment replacement.

[Answer Explanation](#)**Question 3****CPA-05309**

In considering the payback period for three projects, Fly Corp. gathered the following data about cash flows:

	<i>Cash Flows by Year</i>				
	<i>Year 1</i>	<i>Year 2</i>	<i>Year 3</i>	<i>Year 4</i>	<i>Year 5</i>
Project A	\$(-10,000)	\$ 3,000	\$ 3,000	\$ 3,000	\$ 3,000
Project B	(25,000)	15,000	15,000	(10,000)	15,000
Project C	(10,000)	5,000	5,000		

Which of the projects will achieve payback within three years?

- a. Projects A, B, and C.
- b. Projects B and C.
- c. Project B only.
- d. Projects A and C.

[Answer Explanation](#)

**NOTES**



Module 1 Cost Accounting: Part 1 BEC 3

**1 Cost Objects (or Objectives)**

RT Click to view

Cost objects (or cost objectives) are defined as resources or activities that serve as the basis for management decisions. Cost objects require separate cost measurement and may be products, product lines, departments, geographic territories, or any other classification that aids in decision making.

**1.1 Focus of Cost Objectives**

Integration of product costing with cost control measurement and assignment objectives maximizes the effectiveness of management accounting systems. Cost measurement and assignment may focus on valuation of product or inventory (i.e., product costing) or cost control (i.e., cost comparison to standards and budgets).

**Pass Key**

A single cost object can have more than one measurement. Inventory (product) costs for financial statements are usually different from costs reported for tax purposes. Both inventory (product) costs and costs reported for tax purposes are different from costs used by management to make decisions.

**Common Flow of Costs Identified by Cost Objects**

```

graph TD
    PC[Product costs] --> DM[Direct materials]
    PC --> DL[Direct labor]
    PC --> FO[Factory overhead]
    DM --> WIW[Work-in-process]
    DL --> WIW
    FO --> WIW
    WIW --> FG[Finished goods]
    FG --> CGS[Cost of goods sold]
    
```

1.2 Common Cost Objects and Their Definitions

**1.2.1 Product Costs**

*Product costs* are all costs related to the manufacture of the product.

- **Inventory and Cost of Goods Manufactured and Sold:** Product costs are inventoriable (i.e., considered as assets before the product is sold). These costs attach to the units of output.

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- **Components:** Product costs consist of direct materials, direct labor, and manufacturing overhead applied.

#### 1.2.2 Period Costs

*Period costs* are expensed in the period in which they are incurred and are not inventoriable.

- **Expenses:** Period costs include selling, general, and administrative expenses as well as interest (financing) expense.
- **Components:** Period costs are the costs of selling the product and administering and managing the operations of the firm.

#### 1.2.3 Manufacturing Costs (Treated as Product Costs)

*Manufacturing costs* include all costs associated with the manufacture of a product.

- **Inventory and Cost of Goods Manufactured and Sold:** Manufacturing costs are specifically capitalized to the cost of the manufactured product.
- **Components:** Manufacturing costs consist of both direct and indirect costs (described later).

#### 1.2.4 Nonmanufacturing Costs (Treated as Period Costs)

*Nonmanufacturing costs* are costs that do not relate to the manufacture of a product. These costs (e.g., selling, general, and administrative expenses) are expensed in the period incurred.



#### Pass Key

Cost accounting systems are designed to meet the goal of measuring cost objects or objectives. The most frequent objectives include:

- Product costing (inventory and cost of goods manufactured and sold)
- Income determination (profitability)
- Efficiency measurements (comparisons to standards)

#### Example 1

#### Product Costs and Period Costs

**Facts:** Thompson Manufacturing incurred the following costs during its recent fiscal year:

Wages for factory employees	\$ 5,700,000
Wages for accounting department	840,000
Sales and promotion expense	325,000
Raw materials purchased	4,950,250
General and administrative costs	675,500
Manufacturing overhead	1,100,000
Interest expense	195,000

(continued)

(continued)

**Required:** Compute Thompson's product costs and period costs for the year.**Solution:**

Product costs:

Wages for factory employees	\$ 5,700,000
Raw materials purchased	4,950,250
Manufacturing overhead	<u>1,100,000</u>
Total product costs	<u><u>\$11,750,250</u></u>

Period costs:

Wages for accounting department	\$ 840,000
Sales and promotion expense	325,000
General and administrative costs	675,500
Interest expense	<u>195,000</u>
Total period costs	<u><u>\$ 2,025,500</u></u>

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## 2 Tracing Costs to Cost Objects

### 2.1 Direct Costs

A *direct cost* can be easily (i.e., without excessive cost and without significant effort) traced to a cost pool or object, as the cost directly relates to that item. Common direct costs include:

#### 2.1.1 Direct Raw Materials

*Direct raw materials* are the costs of materials purchased to be used in production (including freight-in net of any applicable purchase discounts) plus a reasonable amount for normal scrap created by the process.

#### 2.1.2 Direct Labor

*Direct labor* is the cost of the labor that is directly related to the production of a product or the performance of a service plus a reasonable amount of expected "downtime" for the labor (e.g., breaks, setup, training, etc.).

#### Illustration 1 Direct Costs

Spud Furnishings Inc. manufactures custom couches. Raw materials (fabric or leather) used in the production process of a custom order (a couch) are considered direct materials and are easily traced to the cost object, the custom order. The time spent by the upholsterer to make the couch is considered direct labor and is also easily traced to the cost object, the custom order.

## 2.2 Indirect Costs

An *indirect cost* is not easily traceable to a cost pool or cost object. Indirect costs are typically incurred to benefit two or more cost pools or objects. The specific benefit each cost gives to the cost pool or object cannot be determined without making some sort of reasonable estimate or using an allocation methodology. Indirect costs are known as *overhead*. In the manufacturing business, such costs are classified as *manufacturing overhead*.

### 2.2.1 Indirect Materials

The category *indirect materials* covers the cost of materials that were not used specifically or could not be traced to the completed product with ease.

#### Illustration 2 Indirect Materials

Spud Furnishings Inc. manufactures custom couches. In addition to the direct material for fabric, wood for framing, and springs it uses in the couches, the company purchases cleaning supplies used in the manufacturing area and small replacement parts for the manufacturing machines. These items are *indirect materials* that do not directly benefit any specific cost object. These costs are included in overhead.

### 2.2.2 Indirect Labor

*Indirect labor* is the cost of labor that is not easily traceable to a particular product, service, etc. Most often, this type of labor supports the manufacturing process but does not work directly on the specific job, etc.

#### Illustration 3 Indirect Labor

Spud Furnishings Inc. manufactures custom couches. In addition to upholsterers, Spud Furnishings employs forklift drivers, maintenance workers, shift supervisors, workers in the receiving department, janitorial staff, inspectors, engineers, training, and other human resources staff. These costs are *indirect labor* and are included in *manufacturing overhead*.

### 2.2.3 Other Indirect Costs

*Other indirect costs* are indirect costs other than those for materials or labor.

#### Illustration 4 Other Indirect Costs

Spud Furnishings Inc. incurs costs for depreciation of the facility and machinery, rent of the production warehouse, machine maintenance, property taxes on the building, insurance, rent, utilities, etc. These miscellaneous facility costs are *other indirect costs* and are included in *manufacturing overhead*.



### Pass Key

*Prime cost = Direct labor + Direct material  
Conversion cost = Direct labor + Manufacturing overhead*

#### 2.3 Overhead Allocation Using Cost Drivers

Indirect costs are allocated (assigned) to benefiting cost pools or cost objects using cost drivers that are considered to have a strong relationship to the incurrence of these costs.

- **Allocation bases**

The cost drivers that are used to allocate indirect costs are referred to as allocation bases.

- **Accounting for Overhead**

When traditional costing is used, all indirect costs are allocated to a single cost pool (or account) called "overhead" and allocated as a single pool. Overhead may also be allocated using activity-based costing.



### Pass Key

When traditional costing is used, the application of overhead is accomplished in two steps:

**Step 1:** Overhead rate = Budgeted overhead costs ÷ Estimated cost driver

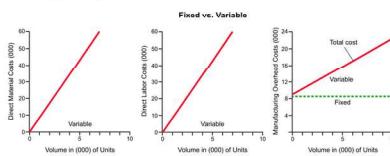
**Step 2:** Applied overhead = Actual cost driver × Overhead rate (from Step 1)

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### 3 Cost Behavior (Fixed vs. Variable)

Costs can be classified by their behavior, the degree to which the costs are either fixed or variable. Direct material and direct labor are generally variable costs, and indirect costs consist of both fixed and variable components.

Cost behaviors are graphically illustrated as follows:



### 3.1 Variable Cost

- **Behavior:** A variable cost changes proportionally with the cost driver (e.g., typical cost drivers include sales volume and production volume).
- **Amount (Constant per Unit, Total Varies):** Variable costs change in total, but they remain constant per unit. As production volume increases (or decreases), the total variable cost will increase (or decrease), but the variable cost per unit will always remain the same.
- **Long-Run Characteristics:** The short-run and long-run effects of variable costs are the same within relevant ranges (the range of production over which cost behavior assumptions are valid).

### 3.2 Fixed Cost

- **Behavior:** In the short term and within a relevant range, a fixed cost does not change when the cost driver changes.
- **Amount (Varies per Unit, Total Remains Constant):** Fixed costs remain constant in total, but they vary per unit. As production volume increases (or decreases), fixed costs remain the same, but the cost per unit will decrease (or increase), respectively.



#### Pass Key

The distinction between variable costs and fixed costs allows managers to determine the effect of a given percentage change in production output on costs. *Be careful!* The examiners often attempt to trick candidates by providing a fixed cost per unit for a given volume of production. As fixed costs are "fixed," the candidate must convert this format to a dollar amount that will not change as production volume changes within a relevant range.

- **Long-Run Characteristics:** Given enough time (and a long enough relevant range), any cost can be considered variable.

#### Illustration 5 Long-Run Characteristics

Depreciation is typically a fixed cost in a relevant manufacturing range of units or up to production capacity but can be considered variable in the long run. A new building will have to be purchased if the production levels exceed plant capacity (thus possibly increasing depreciation expense, depending on the extent to which other facilities have been depreciated).

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### 3.3 Semi-variable Costs (Mixed Costs)

Costs frequently contain both fixed and variable components. Costs that include components that remain constant over the relevant range and include components that fluctuate in direct relation to production are classified as *semi-variable*.

**Example 2 Cost Behavior**

**Facts:** Quality Ornaments Inc. (QOI) manufactures collector porcelain figurines and holiday ornaments in its single manufacturing facility. During the recently completed operating year, the company incurred manufacturing labor costs of \$3,200,000 (including indirect labor of \$200,000, which includes a base annual contractual amount and a variable rate amount for hours worked above a contractual threshold), raw material costs of \$6,000,000, plant depreciation costs of \$440,000 (straight-line method used), electricity costs of \$250,000 (directly tied to hours of production), heating costs of \$100,000 (annual rate), and delivery expenses of \$25,000 (based on a formula per customer order). Additionally, QOI incurred \$10,000 in building and equipment maintenance and repair expense that includes both a fixed contractual amount for weekday maintenance and a variable rate amount for maintenance performed on Saturdays and holidays.

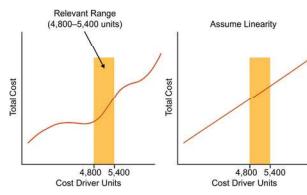
**Required:** Based on the above scenario, calculate the company's variable costs, fixed costs, and semi-variable costs for the year.

**Solution:**

Cost Item	Variable Costs	Fixed Costs	Semi-variable Costs
Direct labor	\$3,000,000		
Indirect labor		\$200,000	
Raw materials	6,000,000		
Depreciation		\$440,000	
Electricity	250,000		
Heating		100,000	
Maintenance and Repair			10,000
Deliveries	25,000		
<b>Total Costs</b>	<b>\$9,275,000</b>	<b>\$540,000</b>	<b>\$210,000</b>

### 3.4 Relevant Range

The *relevant range* is the range for which the assumptions of the cost driver (i.e., linear relationship with the costs incurred) are valid. When the cost driver activity is no longer within the relevant range, the variable and fixed cost assumptions for that cost driver cannot be used to allocate costs to cost objects. Relevant range is graphically illustrated as follows:



**Illustration 6 Cost Behaviors**

<b>Sales</b>	x		
Less: returns and allowances	x		
<b>Cost of sales</b>			
Direct material	x		
Direct labor	x		
Indirect labor			x
Fringe benefits (15% of labor)	x		x
Royalties (1% of product sales)	x		
Maintenance and repairs of building			x
Factory production supplies	x		
Depreciation: straight-line		x	
Electricity: used in the mfg. process	x	x	
Scrap and spoilage (normal)	x		
<b>Selling, general, and administrative expense</b>			
Sales commissions	x		
Officers' salaries		x	
Fringe Benefits (relative to labor)	x	x	
Delivery expenses	x		
Advertising expenses (annual contract expenses)		x	

**Question 1**

CPA-07083

If a product required a great deal of electricity to produce, and crude oil prices increased, which of the following costs most likely increased?

- a. Direct materials.
- b. Direct labor.
- c. Prime costs.
- d. Conversion costs.

[Answer Explanation](#)

Module 2 Cost Accounting: Part 2 BEC 3

RT Click to view

## 1 Cost Accumulation Systems

*Cost accumulation systems* are used to assign costs to products. The system used is driven by the cost object involved. If the cost object is a custom order, job costing is used. If the cost object is a mass-produced, homogeneous product (e.g., steel), process costing is used.

 Pass Key

Although the most commonly tested cost accumulation systems are job-order costing and process costing, there are many variations of cost accumulation systems that may appear on your examination:

- Operations costing uses components of both job-order costing and process costing.
- Backflush costing accounts for certain costs at the end of the process in circumstances in which there is little need for in-process inventory valuation.

Life-cycle costing seeks to monitor costs throughout the product's life cycle and expand on the traditional costing systems that focus only on the manufacturing phase of a product's life.

## 2 Cost of Goods Manufactured and Sold

Production costs may be summarized in a cost of goods manufactured statement and a cost of goods sold statement. These statements may be prepared separately or combined as a cost of goods manufactured and sold statement.

### 2.1 Cost of Goods Manufactured

The *cost of goods manufactured* statement accounts for the manufacturing costs of the products completed during the period. These costs consist of direct material, direct labor, and manufacturing overhead costs. The manufacturing costs incurred during the period are increased or decreased by the net change in work-in-process inventory (beginning WIP minus ending WIP) to equal cost of goods manufactured.

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Module 2 B3-11

XYZ Company <b>Cost of Goods Manufactured</b> For the Month Ended November 30, Year 1	
Work-in-process inventory, beginning	\$ 40,000
Add: direct material used	\$ 30,000
Direct labor	50,000
Manufacturing overhead applied	-40,000
Total manufacturing costs incurred	<u>120,000</u>
Total manufacturing costs available	160,000
Less: work-in-process inventory, ending	(10,000)
Cost of goods manufactured	<u>\$ 150,000</u>

## 2.2 Cost of Goods Sold

A cost of goods sold statement for a manufacturer is very similar to one prepared for a retailer except that cost of goods manufactured is used in place of purchases made during the period.

XYZ Company <b>Cost of Goods Sold</b> For the Month Ended November 30, Year 1	
Finished goods inventory, beginning	\$ 20,000
Add: cost of goods manufactured	<u>150,000</u>
Cost of goods available for sale	170,000
Less: finished goods inventory, ending	(50,000)
Cost of goods sold	<u>\$ 120,000</u>

## 3 Job-Order Costing

*Job-order costing* (or job costing) is the method of product costing that identifies the job (or individual units or batches) as the cost objective and is used when relatively few units are produced and when each unit is unique or easily identifiable.

### 3.1 Cost Objective Is the Job (or Unit)

Under job-order costing, cost is allocated to a specific job as it moves through the manufacturing process. Record keeping for job costing emphasizes the job as the cost objective.

### 3.2 Job-Cost Records

*Job-cost records* are maintained for each product, service, or batch of products, and they serve as the primary records used to accumulate all costs for the job. Job-cost records are also referred to as job-cost sheets or job orders. Job-cost records accumulate data from the following internal documents:

- **Materials Requisitions:** Materials requisitions are documents showing materials requested for use on the job.
- **Labor Time Tickets (Time Cards):** Labor time tickets (time cards) are documents that show the labor hours and labor rate associated with the time applied to the job.
- **Overview of Job-Order Costing:** Job-costing systems require a limited number of work-in-process accounts.



#### Pass Key

Job-costing systems are best suited for customized production environments such as construction, aircraft assembly, printing, etc. A new job-cost record would be started every time a new job (building project, airplane, or print job) is started.

#### Question 1

CPA-05321

Jonathon Manufacturing adopted a job-costing system. For the current year, budgeted cost driver activity levels for direct labor hours and direct labor costs were 20,000 and \$100,000, respectively. In addition, budgeted variable and fixed factory overhead were \$50,000 and \$25,000, respectively.

Actual costs and hours for the year were as follows:

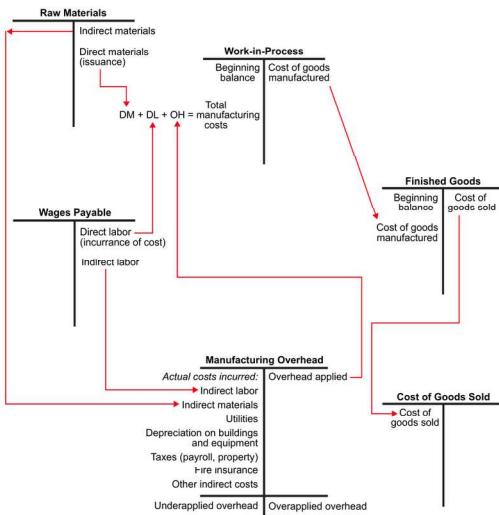
Direct labor hours	21,000
Direct labor costs	\$110,000
Machine hours	35,000

For a particular job, 1,500 direct-labor hours were used. Using direct-labor hours as the cost driver, what amount of overhead should be applied to this job?

- a. \$3,214
- b. \$5,357
- c. \$5,625
- d. \$7,500

[Answer Explanation](#)

### Overview: Job-Order Costing



4



## 4 Process Costing

*Process costing* is a method of product costing that averages costs and applies them to a large number of homogeneous items using the following steps:

1. Summarize the flow of physical units (beginning with the production report).
2. Calculate "equivalent unit" output.
3. Accumulate the total costs to be accounted for (production report).
4. Calculate the average unit costs based on total costs and equivalent units.
5. Apply the average costs to the units completed and the units remaining in ending work-in-process inventory.

### 4.1 Units and Costs Collected on a Production Report

Costs incurred for a period as well as all units produced during that period are accumulated on a production report that accounts for the physical flow of units. The report includes the beginning inventory, the number of units started, the number of units completed, and the number of units remaining in inventory.

#### ■ Unit (Quantity) Accounting

The number of units accounted for must equal the number of units charged to the department (or separate process).

#### ■ Cost Accounting

The amount of costs accounted for must also equal the amount of costs charged to the department (or separate process).

Pass Key		
The following shows the flow of inventory from beginning raw materials to ending finished goods inventory:		
Inventory: Raw Materials	Inventory: Work-in-Process	Inventory: Finished Goods
Beginning inventory of raw materials	Beginning inventory of work-in-process	Beginning inventory of finished goods
Add: purchases of raw materials	Add: raw materials used plus direct labor and overhead used	Add: inventory transferred from work-in-process
Raw materials available for use	Work-in-process inventory available to be finished	Finished goods inventory available-for-sale
Subtract: raw materials used	Subtract: Inventory transferred to finished goods	Subtract: cost of goods sold
Ending inventory of raw materials	Ending inventory of work-in-process	Ending inventory of finished goods

### Illustration 1 Production Report

**Quantities**

Charged to department:	
In process, beginning	5,000
Transferred in	<u>20,000</u>
Total units charged to department	<u>25,000</u>
Units accounted for:	
Transferred out	15,000
In process, end	<u>10,000</u>
Total units accounted for	<u>25,000</u>

**Costs**

Charged to department:	
In process, beginning	\$12,000
During the period	<u>.85,000</u>
Total units charged to department	<u>\$97,000</u>
Costs accounted for:	
Transferred out	\$60,000
In process, end	<u>.37,000</u>
Total costs accounted for	<u>\$97,000</u>

6

#### 4.2 Equivalent Units

Costs must be attached to the completed units as well as to the units that are partially complete at the end of each period. This calculation is made by taking into account the partially completed units and by making use of equivalent units.



#### Pass Key

Accounting for the physical flow of units is an important step in process costing. Remember, however, that the pure physical flow of units will be different from the equivalent units of production.

##### 4.2.1 Equivalent Unit Defined

An equivalent unit of direct material, direct labor, or conversion costs (direct labor plus factory overhead) is equal to the amount of direct material, direct labor, or conversion costs necessary to complete one unit of production.

**ILLUSTRATION 2    Equivalent Units**

Company X would like to produce 10,000 units during the first quarter. The company obtains the raw material inputs prior to the production of each unit and has applied the necessary direct labor and manufacturing overhead to complete 75 percent of the production during the first two months (with the remaining production process to be performed during the third month).

When preparing its internal monthly production reports, Company X would indicate that it has 10,000 units 100 percent complete as to direct materials and 7,500 equivalent units of production as to direct labor and overhead at the February 28 month end.

**4.2.2 Process Costing Assumptions****■ Transfers In Are 100 Percent Complete**

*Transfers in* from other departments are always considered 100 percent complete. The transfer in costs of direct material from a previous department are treated as direct materials (DM), even though they are called "transfer in" costs or "previous department" costs.

**■ Timing of Addition of Direct Material****▪ Addition at the Beginning or During a Process**

Direct material added at the beginning of or during a second or later process may either be 100 percent complete or "partially complete," depending on how much work has been done on that component of the process.

**▪ Addition at the End of a Process**

Any material added at the (very) end of a process will not be in work-in-process inventory at the month end.

**4.3 Calculations of Average Unit Costs**

The calculation of average unit costs and the application of those costs to various segments of the process is complicated by a number of issues.

**4.3.1 Averaging of Costs From Prior Month's WIP**

Frequently, costs from the previous month's work-in-process inventory are different from costs of the current month. These costs must be averaged.

**4.3.2 Cost Flow Assumptions**

Cost averaging computations depend on FIFO and/or weighted (or moving) average cost flow assumptions. These computations require a well-labeled account analysis format for each unit of direct material, direct labor, or overhead.

**4.4 Calculation Using First In, First Out (FIFO)**

Under FIFO accounting, the ending inventory is priced at the cost of manufacturing during the period, assuming that the beginning inventory was completed during the period.

#### 4.4.1 Equivalent Unit Components

The *equivalent units* are composed of three elements:

1. Completion of units on hand at the beginning of the period
2. Units started and completed during the period (Units completed – Beginning WIP)
3. Units partially complete at the end of the period

#### 4.4.2 Cost Components

Current costs incurred during the period are allocated to the equivalent units produced during the period.

#### 4.5 Calculation Using Weighted Average

The weighted average cost method averages the cost of production during the period with the costs in the beginning work-in-process inventory.

##### 4.5.1 Equivalent Unit Components

The *equivalent units* are composed of two elements:

1. Units completed during the month (Beginning WIP + Units started and completed during the month)
2. Units partially complete at the end of the period

##### 4.5.2 Cost Components

Total costs, including both the costs of beginning inventory and current costs, are allocated to equivalent units to arrive at a weighted average unit cost.

#### Example 1      Equivalent Units of Production

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**Facts:** Assume the following information:

Work-in-process, beginning	100 units, 25% complete
Units completed and transferred out	600 units
Work-in-process, ending	200 units, 40% complete

**Required:** Compute the equivalent units of production using the FIFO method and the weighted average cost method.

**Solution:**

##### Weighted average equivalent units of production

Units completed and transferred out (always 100%)	600
Work-in-process, ending	<u>80</u>
200 units × 40%	<u>80</u>
Equivalent units of production	<u>680</u>

(continued)

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**FIFO equivalent units of production**

Work-in-process, beginning	75
100 units × 75% (to complete)	
Units started and completed this period	
Units completed and transferred out	600
Units in beginning inventory	<u>(100)</u>
Work-in-process, ending	500
200 units × 40%	80
Equivalent units of production	<u>655</u>

**4.6 Comparison of FIFO and Weighted Average****4.6.1 Equivalent Unit Calculation**

Equivalent unit calculation under FIFO consists of three elements representing current period production, whereas the calculation under the weighted average method consists of only two elements, units completed and units available in beginning inventory.

**4.6.2 Cost Components**

FIFO represents only costs incurred in the current period. The weighted average approach includes both current period units plus prior period units.

**Pass Key**

Equivalent units of production may be computed using either the FIFO or weighted average methods. The FIFO method specifically accounts for work to be completed, and the weighted average method blends the units, as follows:

1. Weighted average (two steps)
 

Units completed	XXX
Ending WIP × % completed	+ <u>XXX</u>
<i>Equivalent units</i>	<u>XXX</u>
2. FIFO (three steps)
 

Beginning WIP × % to be completed	XXX
Units completed—Beginning WIP	+ XXX
Ending WIP × % completed	+ <u>XXX</u>
<i>Equivalent units</i>	<u>XXX</u>

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**Pass Key**

Cost per equivalent unit is computed by dividing total costs by equivalent units. FIFO uses only current costs, and the weighted average method uses both beginning inventory and current costs.

## 1. Weighted average

$$\text{Weighted average} = \frac{\text{Beginning cost} + \text{Current cost}}{\text{Equivalent units}}$$

## 2. FIFO

$$\text{FIFO} = \frac{\text{Current cost only}}{\text{Equivalent units}}$$

**Example 2 Process Costing****Facts:**

Comprehensive Example  
Process Costing Under FIFO and Weighted Average

May of Year 1

	Percent Complete	Materials	Conversion	Total
1. Units in process, May 1				
Materials	100%	4,000		
Conversion	40%		4,000	
2. Units started and completed in May				
Materials	100%	10,000		
Conversion	100%		10,000	
3. Units in process, May 31				
Materials	100%	2,000		
Conversion	80%		2,000	
4. Costs associated with May 1 WIP				
Materials		\$ 1,000		\$ 1,000
Conversion			\$ 3,000	3,000
5. Costs associated with May production				
Materials		\$24,000		\$24,000
Conversion			\$49,000	49,000
6. Total Costs				<u>\$77,000</u>

(continued)

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(continued)

**Required:**

1. Compute equivalent units of production using FIFO and weighted average.
2. Compute production costs using FIFO and weighted average.
3. Compute equivalent cost per unit using FIFO and weighted average.

**Solution:**

1. Equivalent units of production

	<i>First In, First Out</i>		<i>Weighted Average</i>	
	Materials (%)	Conversion (%)	Materials (%)	Conversion (%)
Units in process, May 1	– (0%)	2,400 (60%)	4,000 (100%)	4,000 (100%)
Units started and completed in May	10,000 (100%)	10,000 (100%)	10,000 (100%)	10,000 (100%)
Units in process, May 31	<u>2,000</u> (100%)	<u>1,600</u> (80%)	<u>2,000</u> (100%)	<u>1,600</u> (80%)
Total Units	<b><u>12,000</u></b>	<b><u>14,000</u></b>	<b><u>16,000</u></b>	<b><u>15,600</u></b>

2. Production costs

Costs in WIP, May 1	\$ –	\$ –	\$ 1,000	\$ 3,000
Costs during May	24,000	49,000	24,000	49,000
Total Costs	<b><u>\$24,000</u></b>	<b><u>\$49,000</u></b>	<b><u>\$25,000</u></b>	<b><u>\$52,000</u></b>

3. Equivalent cost per unit

Equivalent cost per unit	<b><u>\$ 2.00</u></b>	<b><u>\$ 3.50</u></b>	<b><u>\$ 1.56</u></b>	<b><u>\$ 3.33</u></b>
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**4.7 Spoilage (or Shrinkage)**

*Spoilage* (or shrinkage) is generally taken care of automatically because the equivalent units added for the month are generally less than the actual units added during the month due to problems with the production process.

**4.7.1 Normal Spoilage (Inventory Cost)**

*Normal spoilage* occurs under regular operating conditions and is included in the standard cost of the manufactured product.

**Computation**

For normal spoilage (or shrinkage), per unit cost is automatically increased as a result of spoilage because actual costs are spread over fewer equivalent good units rather than actual units produced.

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**Accounting Treatment**

Normal spoilage is capitalized as part of inventory cost. Normal spoilage costs, if accounted for separately, are allocated to good units produced.

**4.7.2 Abnormal Spoilage (Period Expense)**

*Abnormal spoilage* should not occur under normal operating conditions and is excluded from the standard cost of a manufactured product.

■ **Computation**

For abnormal spoilage (or shrinkage), the per unit cost is based on actual units. Equivalent units of production include spoiled units.

■ **Accounting Treatment**

The cost of abnormal spoilage is normally expensed separately on the income statement as a period expense.

**Example 3 Spoilage Application**

**Facts:** Fresh Baked Company produces ready-to-serve fruit pies for local restaurants and supermarkets. During the month of April, the company had the following costs related to the production of 20,000 pies:

Pie ingredients	\$45,000
Baking labor	24,000
Plant production overhead	11,000
Sales and marketing expenses	500
General and administrative expenses	1,200
Normal spoilage	400
Abnormal spoilage	200

**Required:**

- What is the per unit cost of the pies assigned to inventory for April?
- What amount will the company assign as a period expense for April?

**Solution:**

1. Unit cost

Step 1: Determine inventory costs.	Step 2: Determine per unit cost.
Pie ingredients \$45,000	Per unit cost $\$80,400 \div 20,000 \text{ pies}$ $\$4.02$
Baking labor 24,000	
Plant production overhead 11,000	
Normal spoilage 400	
Total inventory costs <u><u>\$80,400</u></u>	

2. Period expense

The period expenses assigned to April are as follows:	
Sales and marketing expenses	\$ 500
General and administrative expenses	1,200
Abnormal spoilage	200
Total period expenses	<u><u>\$ 1,900</u></u>

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**Question 2****CPA-05798**

Merry Co. has two major categories of factory overhead: material handling and quality control. The costs expected for these categories for the coming year are as follows:

Material handling	\$120,000
Quality inspection	200,000

The plant currently applies overhead based on direct labor hours. The estimated direct labor hours are 80,000 per year. The plant manager is asked to submit a bid and assembles the following data on a proposed job:

Direct materials	\$4,000
Direct labor (2,000 hours)	6,000

What amount is the estimated product cost on the proposed job?

- a. \$8,000
- b. \$10,000
- c. \$14,000
- d. \$18,000

**Answer Explanation****Question 3****CPA-03601**

Kerner Manufacturing uses a process costing system to manufacture laptop computers. The following information summarizes operations relating to laptop computer model No. KJK20 during the quarter ending March 31:

	<i>Units</i>	<i>Direct Materials</i>
Work-in-process inventory, January 1	100	\$ 70,000
Started during the quarter	500	
Completed during the quarter	400	
Work-in-process inventory, March 31	200	
Costs added during the quarter		\$750,000

Beginning work-in-process inventory was 50 percent complete for direct materials. Ending work-in-process inventory was 75 percent complete for direct materials. What were the equivalent units of production using the FIFO method, with regard to materials for the quarter ended March 31?

- a. 450
- b. 500
- c. 550
- d. 600

**Answer Explanation**

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**Question 4**

CPA-03644

Kimbeth Manufacturing uses a process cost system to manufacture Dust Density Sensors for the mining industry. The following information pertains to operations for the month of May:

	<i>Units</i>
Beginning work-in-process inventory, May 1	16,000
Started in production during May	100,000
Completed production during May	92,000
Ending work-in-process inventory, May 31	24,000

The beginning inventory was 60 percent complete for materials and 20 percent complete for conversion costs. The ending inventory was 90 percent complete for materials and 40 percent complete for conversion costs.

Costs pertaining to the month of May are as follows:

- Beginning inventory costs are: materials, \$54,560; direct labor, \$20,320; and factory overhead, \$15,240.
- Costs incurred during May are: materials used, \$468,000; direct labor, \$182,880; and factory overhead, \$391,160.

Using the weighted average method, the equivalent unit cost of materials for May is:

- a. \$4.50
- b. \$4.60
- c. \$5.03
- d. \$5.46

[Answer Explanation](#)

Module 3 Cost Accounting: Part 3 BEC 3

RT Click to view

## 1 Activity-Based Costing (ABC)

1.1 Types of Operational Cost Drivers

1.1.1 Volume-Based

Traditional costing systems assign overhead as a single cost pool with a single plant-wide overhead application rate using a single allocation base. These rates generally use volume-based cost drivers such as direct labor hours or machine hours. Assigning overhead costs based on volume can distort the amount of costs assigned to various product lines because all overhead costs do not fluctuate with volume.

1.1.2 Activity-Based

*Activity-based costing (ABC) refines traditional costing methods and assumes that the resource-consumption activities (tasks, units of work, etc.) with specific purpose cause costs. ABC assumes that the best way to assign indirect costs to products (cost objects) is based on the product's demand for resource-consuming activities (i.e., costs are assigned based on the consumption of resources). Application of activity-based costing techniques attempts to improve cost allocation by emphasizing long-term product analysis.*

1.2 Introduction to Activity-Based Costing

1.2.1 Terminology

- **Activity:** An activity is any work performed inside a firm. Activities are identified for ABC.
- **Resource:** A resource is an element that is used to perform (or applied to perform) an activity.
- **Cost Drivers:** Cost drivers used in ABC are activity bases that are closely correlated with the incurrence of manufacturing overhead costs in an activity center, and they are often used as allocation bases for applying overhead costs to cost objects.

 Pass Key

A cost driver is a factor that has the ability to change total costs. Cost drivers (including nonfinancial, statistical measurements of activities such as sales or production volume) are identified by ABC and are related to one of multiple cost pools for cost allocation.

- **Resource Cost Driver:** A resource cost driver is the amount of resources that will be used by an activity.
- **Activity Cost Driver:** An activity cost driver is the amount of activity that a cost object will use, and it is used to assign the costs to the cost objects.
- **Activity Centers:** An operation necessary to produce a product is an activity center.

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**ILLUSTRATION 1 ABC Terminology**

Hope Hospital applies ABC to costing its services. The surgical unit is identified as an activity center that includes various professional service (surgeon and nurse) functions as well as facilities (operating room) functions. Resources used include hours of staff time for surgery and operating room preparation as well as for facilities maintenance. Resource drivers may include the complexity of surgical procedures (including setup time) and activity drivers may be purely admissions or scheduled surgeries.

- **Cost Pool:** A cost pool is a group of costs (e.g., raw material or direct labor) or a specially identified cost center (e.g., a department or a manager) in which costs are grouped, assigned, or collected.

#### 1.2.2 Characteristics of ABC

ABC applies a more focused and detailed approach than using a department or plant as the level for gathering costs. ABC focuses on multiple causes (activities) and effects (costs) and then assigns costs to them. The cost of activities is used to "build up" the engineered cost of products using increased cost pools and allocations.

- ABC can be part of a job order system or a process cost system.
- ABC can be used for manufacturing or service businesses.
- ABC takes a long term viewpoint and treats production costs as variable.
- The cost driver is often a nonfinancial variable.
- ABC may be used for internal but not for external purposes.

#### 1.2.3 Transaction-Based Costing

Activity-based costing is also referred to as *transaction-based costing*. The cost driver is typically the number of transactions involved in a particular activity.

#### 1.2.4 Focuses on Cost/Benefit of Activities

ABC focuses management on the cost/benefit of activities. Value-added activities increase the product value or service.

- **Value Chain (Value-Added Activities):** A value chain is a series of activities in which customer usefulness is added to the product. Support activities directly support value-added activities.

- **Non-Value-Added Activities:** Non-value-added activities do not increase product value or service and are targeted for elimination. Often, these types of activities (e.g., warehousing) should be eliminated.

#### 1.3 Basic Operation of Activity-Based Costing

Activity-based costing is done using the following steps:

1. **Identify the Cost Drivers**  
Identify the activity centers and the activities that drive the costs in each activity center.
2. **Accumulate the Costs in Cost Pools**  
Many small cost pools are accumulated.
3. **Trace Indirect Costs to Activity Centers**  
Trace any indirect costs to the activity centers that can be assigned without allocation.

**4. Allocate Remaining Indirect Cost Pools**

Costs of each activity are applied to cost objects based on the most appropriate cost drivers.

**5. Divide Assigned Costs by Level of Activity for the Cost Center**

Divide the costs assigned to the activity center by the estimated level of activity for the center to derive an application rate for that center.

**6. Cost the Product**

Cost the product by multiplying its demand for the resources of an activity center by the rate for that activity center.

**1.4 Effects of Activity-Based Costing**

An ABC system will apply high amounts of overhead to a product that places high demands on expensive resources. If a product places few demands on expensive resources, the system will assign little of that cost to the product. This will remove much of the cost distortion caused by traditional, volume-based overhead systems.

**1.5 ABC and Standard Cost Systems**

*Standard cost systems* are a natural extension of activity-based costing. Standards are set at activity levels based on cost drivers. Useful variances are calculated by comparing actual and standard costs that consider levels of activity. These variances can be due to price (rate for labor), usage (efficiency), or other factors. Further, flexible budgets are derived at the activity level.

- Normal and abnormal scrap or spoilage is estimated for activity levels.
- Standards may be difficult to set on a per unit basis.
  - Per unit costs are often inversely proportional to volume.
  - Assumption of a relevant range may be necessary to set a per unit standard.

**Illustration 2 ABC Costing**

Iowa Products makes two products at its Boone factory. The company has used a traditional cost accounting system for the application of overhead to the products. Currently it uses direct labor hours as an application base. One product, Can, incurred 150,000 direct labor hours, and the other product, Bottle, incurred 45,000 direct labor hours. The company is considering converting to an activity-based costing system. The estimated data for its Year 1 operations is summarized below:

Activity Center	Costs	Cost Driver	Activity Level	
			Cans	Bottles
Units			500,000	150,000
Material handling	\$ 480,000	Pounds	100,000	60,000
Production orders	90,000	Number of production orders	100	100
Product redesign	250,000	Number of changes	50	200
Plant utilities	2,300,000	Machine hours	150,000	80,000

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1. Illustration of the overhead application rate under a *traditional system* using direct labor hours as an application base:

Material handling	\$ 480,000
Production orders	90,000
Product redesign	250,000
Plant utilities	2,300,000
Total overhead costs	<b>\$3,120,000</b>

$$\begin{aligned} \text{Overhead application rate} &= \frac{\text{Total overhead costs}}{\text{Total direct labor hours}} \\ &= \$3,120,000 / (150,000 + 45,000) \\ &= \$16 \text{ per direct labor hour} \end{aligned}$$

**Cans:** 150,000 direct labor hours  $\times \$16 = \$2,400,000$   
 $\$2,400,000 / 500,000 cans = \$4.80 \text{ per can}$

**Bottles:** 45,000 direct labor hours  $\times \$16 = \$720,000$   
 $\$720,000 / 150,000 bottles = \$4.80 \text{ per bottle}$

2. Illustration of the overhead application rate under an *activity-based costing system* using each activity as a cost pool:

Material handling:	\$480,000 / 160,000 pounds	= \$3 per pound
Production orders:	\$90,000 / 200 orders	= \$450 per order
Product redesign:	\$250,000 / 250 changes	= \$1,000 per change
Plant utilities:	\$2,300,000 / 230,000 machine hr.	= \$10 per machine hour

<b>Cans:</b>	Material handling, 100,000 lb. $\times \$3$	\$ 300,000
	Production orders, 100 orders $\times \$450$	45,000
	Product redesign, 50 changes $\times \$1,000$	50,000
	Plant utilities, 150,000 machine hr. $\times \$10$	1,500,000
	Total overhead costs	<b>\$1,895,000</b>

$\$1,895,000 / 500,000 cans = \$3.79 \text{ per can}$

<b>Bottles:</b>	Material handling, 60,000 lb. $\times \$3$	\$ 180,000
	Production orders, 100 orders $\times \$450$	45,000
	Product redesign, 200 changes $\times \$1,000$	200,000
	Plant utilities, 80,000 machine hr. $\times \$10$	800,000
	Total overhead costs	<b>\$1,225,000</b>

$\$1,225,000 / 150,000 bottles = \$8.167 \text{ per bottle}$

Bottle cost significantly increased with activity-based costing. This resulted because bottles required a large amount of the redesign resource. Redesign is a very costly resource and not related to volume. Because bottles required a large amount of this resource, a high amount of indirect cost was assigned to bottles. The cost of cans decreased significantly because that used comparatively little redesign resource.

## 1.6 Service Costs Allocation Using ABC

Companies in all sectors of the economy allocate service department costs to production or user departments and ultimately the final products produced.

### Illustration 3 Service Cost Allocation

Hospitals use complex methods to allocate service-related costs such as patient admissions or housekeeping to the various hospital departments that ultimately affect patient billing. By allocating these service department costs to the individual production departments and the final product, the entity is recognizing that these service costs are an input into the production process.

#### 1.6.1 Direct Method

- The *direct method* is the most widely used (and least complex) method to allocate service costs.
- Each service department's total costs are directly allocated to the production departments without recognizing that service departments themselves may use the services from other service departments.

#### 1.6.2 Step-Down Method

- The *step-down method* or sequential method is a more sophisticated approach to allocate service costs in more complex situations.
- Service department costs are also allocated to other service departments as well as production departments.
- Step-down allocations assume that once a service department's costs have been allocated to another service department, there can be no subsequent costs allocated back to the other service department(s).

### Example 1 Direct Method

**Facts:** Remington Company has two production departments, Division A and Division B. The company also has two service departments, which consist of Information Systems (IS) and Human Resources (HR). During the most recently completed operating year, the IS and HR departments had total service costs of \$2,220,000 and \$975,000, respectively.

Dept.	Activity Center	Cost Driver	Division A	Division B
IS	Planning and reporting	Computing hours	9,000	6,000
HR	Division administration	Performance appraisals	2,800	2,200

**Required:** Allocate the IS and HR departments' service costs to the two production divisions.

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**Solution:****Application rate using ABC system**

Planning and reporting	$\$2,220,000 \div 15,000 \text{ hours} = \$148/\text{hr.}$
Division administration	$\$975,000 \div 5,000 \text{ appraisals} = \$195/\text{appraisal}$

**Division A: Service cost allocation**

IS—Planning and reporting: 9,000 hours × \$148	$\$1,332,000$
HR—Division administration: 2,800 appraisals × \$195	$\underline{\underline{\$546,000}}$
<b>Total service costs</b>	

**Division B: Service cost allocation**

IS—Planning and reporting: 6,000 hours × \$148	$\$ 888,000$
HR—Division administration: 2,200 appraisals × \$195	$\underline{\underline{\$429,000}}$
<b>Total service costs</b>	

**Example 2 Step-Down Method**

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**Facts:** Assume the same facts as the Remington Company direct-method example, above, with the exception that the Information Systems (IS) department also uses the services of the Human Resources (HR) department. Specifically, performance appraisals administered by the HR department to the IS department account for an additional 200 appraisals during the recent operating year. Further, assume that because of data privacy issues, the HR department uses an outside contractor for its information technology needs instead of the IS department.

**Note:** The allocation of IT computing service hours to the other two production divisions remains the same as above, as there is no IT service allocation to HR.

Dept.	Activity Center	Cost Driver	Division A	Division B
HR	Division administration	Performance appraisals	2,800	2,200

**Required:** Allocate the service costs for performance appraisals from HR to IT and the two production divisions using ABC.

**Solution:****HR application rate using ABC system**

HR—Division administration	$\$975,000 \div 5,200 \text{ appraisals} = \$187.50/\text{appraisal}$
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**IT service department: Service cost allocation (of HR)**

HR—Division administration	$200 \text{ appraisals} \times \$187.50 = \$37,500$
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<b>IT application rate using ABC system</b>		
IT—Planning and reporting	$(\$2,220,000 + \$37,500) \div 15,000 \text{ hours} = \$150.50 \text{ per hour}$	
<b>Division A: Service cost allocation</b>		
IT—Planning and reporting: 9,000 hours × \$150.50	\$1,354,500	
HR—Division administration: 2,800 appraisals × \$187.50	525,000	
<b>Total service costs</b>	<b><u>\$1,879,500</u></b>	
<b>Division B: Service cost allocation</b>		
IT—Planning and reporting: 6,000 hours × \$150.50	\$ 903,000	
HR—Division administration: 2,200 appraisals × \$187.50	412,500	
<b>Total service costs</b>	<b><u>\$1,315,500</u></b>	

It should be noted that under the step-down method, the HR (performance appraisal) allocation is lower to both Division A and Division B under ABC costing, given that HR costs are also allocated to the IS department.

## 2 Joint Product Costing and By-product Costing (Common Cost Allocation)

Accountants face the problem of allocating the cost of a single process (*joint costs*) among several final products (or by-products) if two or more final products are produced from the same raw material or input.

### Illustration 4 Joint Costing

The meat packing industry takes a single input, a steer, and produces many final products. Each product must be assigned a cost, including the different cuts of meat for human consumption, different food products for animal consumption (pet food), and basic ingredients for glue (by-product).

#### 2.1 Terminology

- **Joint Products:** *Joint products* are two or more products that are generated from a common input.
- **By-products:** *By-products* are minor products of relatively small value that incidentally result from the manufacture of the main product.
- **Split-off Point:** The *split-off point* is the point in the production process at which the joint products can be recognized as individual products.

- **Joint Product Costs (or Joint Costs):** *Joint product costs* are costs incurred in producing products up to the split-off point.
- **Separable Costs:** *Separable costs* are costs incurred on a product after the split-off point.
- **Joint Products:** *Joint products* represent outputs of significant value that are the object of a manufacturing process.

## 2.2 Allocation by Unit Volume Relationships

### Example 3      Joint Cost Allocation by Unit Volume

**Facts:** Simple Manufacturing Company produces two products, Product A and Product B. Direct costs associated with manufacturing Product A and Product B were \$25,000 and \$50,000, respectively, with joint costs of production representing \$10,000. In order to allocate joint costs, the company used the proportional gallons of production for its two products as follows:

	Volume
Product A	10,000 gal
Product B	20,000 gal
<b>Total</b>	<b>30,000 gal</b>

**REQUIRED:** Determine the portion of *joint* costs that will be allocated to each product and the total cost of each product.

**Solution:**

**Joint cost allocation**

Product A:	$(10,000/30,000) \times \$10,000$	=	\$ 3,333
Product B:	$(20,000/30,000) \times \$10,000$	=	<u>6,667</u>
			<u><b>\$10,000</b></u>

**Total cost**

Product A:	$\$25,000$ (direct) + $\$3,333$ (joint)	=	\$28,333
Product B:	$\$50,000$ (direct) + $\$6,667$ (joint)	=	\$56,667

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### 2.3 Relative Net Realizable Values at Split-off Point

Net realizable value equals sales value less cost of completion and disposal. Relative sales value at split-off point is used purely for inventory costing and is of little use for cost planning and control purposes.

#### 2.3.1 Sales Price Quotations Available at Split-off

The relative sales value at split-off point can be used to allocate joint costs if sales price quotations are known or can be determined. The relative sales value approach assigns costs to the separate joint products in relation to their market values.

#### Example 4

#### Joint Cost Allocation: Sales Values Known at Split-off

**Facts:** Brown Company produces two products, A and B. Joint production costs incurred in the production of A and B totaled \$1,000. At the split-off point, 100 units of A had a sales value of \$20/unit and 400 units of B had a sales value of \$15/unit.

**Required:** Compute the joint costs to be allocated to A and B using relative sales values at split-off.

#### Solution:

Allocation based on relative sales value:

Product A: 100 units @ \$20	\$2,000
Product B: 400 units @ \$15	6,000
	<b>\$8,000</b>

$$\begin{array}{lcl} \text{Joint cost allocated to A: } \$1,000 \times (\$2,000 / \$8,000) & = & \$ 250 \\ \text{Joint cost allocated to B: } \$1,000 \times (\$6,000 / \$8,000) & = & \underline{\underline{750}} \\ \text{Total allocated joint cost} & & \underline{\underline{1,000}} \end{array}$$

#### 2.3.2 Sales Values Not Available at Split-off

If sales values at split-off are not available because there are no markets for the joint products at split-off, then sales values at split-off must be derived using the following formula:

$$\text{Sales value at split-off} \approx \text{Final selling price} - \text{Identifiable costs incurred after split-off}$$

**Example 5      Joint Cost Allocation: No Sales Value at Split-off**

**Facts:** Smith Company produces two joint products: F and G. Joint production costs for October were \$30,000. During October, further processing costs beyond the split-off point (separable costs), needed to convert the products into saleable form, were \$16,000 and \$24,000 for 1,600 units of F and 800 units of G, respectively. F sells for \$25 per unit and G sells for \$50 per unit. Smith uses the net realizable value method for allocating joint product costs.

**Required:** Determine the joint costs to be allocated to F and G during October.

**Solution:**

Product F: Net realizable value		
Sales value, \$25 per unit × 1,600 units	\$40,000	
Further processing costs	(16,000)	
Net realizable value		\$24,000
Product G: Net realizable value		
Sales value, \$50 per unit × 800 units	\$40,000	
Further processing costs	(24,000)	
Net realizable value		16,000
Total net realizable value		<u><b>\$40,000</b></u>
Joint costs allocated to F: $\$30,000 \times (\$24,000 / \$40,000)$	\$18,000	
Joint costs allocated to G: $\$30,000 \times (\$16,000 / \$40,000)$	12,000	
Total joint costs	<u><b>\$30,000</b></u>	

**2.4      Service Departments Cost Allocation to Joint Products**

The allocation of service department costs to joint products can be accomplished by using the joint products unit-volume relationship.

**Example 6      Service Department Joint Cost Allocation**

**Facts:** Simple Manufacturing Company manufactures two products (Product A and Product B) and allocates its joint costs using the proportional gallons of production for its two products as follows:

	Volume
Product A	10,000 gal
Product B	20,000 gal
Total	<u><b>30,000 gal</b></u>

The company's lone service department is Janitorial Services. Costs incurred for this department were \$6,000 for the operating year.

**Required:** Determine the portion of service department costs that will be allocated to each product based on the joint products unit-volume relationships.

**Solution:**

Product A: $(10,000/30,000) \times \$6,000$	=	\$ 2,000
Product B: $(20,000/30,000) \times \$6,000$	=	4,000
		<u><b>\$ 6,000</b></u>

## 2.5 By-products

*By-products* represent outputs of relatively minor value that are incidental to a manufacturing process. By-products have relatively low sale values that are not sufficient to cover their share of common costs (otherwise, they would be joint products). Revenue accounting can take one of two forms:

### 1. Applied to Main Product

Any proceeds from the sale of by-products are a reduction to common costs for joint product costing. The revenue earned from their sale is credited to joint costs incurred either at the time of production or the time of sale.

### 2. Miscellaneous Income

As an alternative, revenue from the sale of by-products may be credited to miscellaneous income.

## 2.6 By-product Costing vs. Joint Costing

Decisions regarding whether to use by-product costing or joint costing are practical ones, and they depend on relative demand.

### ILLUSTRATION 5 Joint vs. By-product Costing

Before the invention of the automobile, gasoline produced when oil was refined had no value and was scrap for disposal. After the invention of the automobile, gasoline was first priced as a by-product and then priced as a joint product (when demand for gasoline increased).

#### Question 1

CPA-08307

A manufacturing company has several product lines. Traditionally, it has allocated manufacturing overhead costs between product lines based on total machine hours for each product line. Under a new activity-based costing system, which of the following overhead costs would be most likely to have a new cost driver assigned to it?

- a. Electricity expense
- b. Repair and maintenance expense
- c. Employee benefits expense
- d. Depreciation expense

[Answer Explanation](#)

**Question 2**

CPA-03477

A processing department produces joint products Ajac and Bjac, each of which incurs separable production costs after split-off. The following details pertain to a batch produced at a \$60,000 joint cost before split-off:

<i>Product</i>	<i>Separable costs</i>	<i>Sales value</i>
Ajac	\$ 8,000	\$ 80,000
Bjac	22,000	40,000
	<b>\$30,000</b>	<b>\$120,000</b>

What is the joint cost assigned to Ajac if costs are assigned using the relative net realizable value?

- a. \$16,000
- b. \$40,000
- c. \$48,000
- d. \$52,000

[Answer Explanation](#)

Module 4 Performance Management: Part 1

BEC 3

RT Click to view

## 1 Financial and Nonfinancial Performance Measures

Both financial and nonfinancial measures are ultimately designed to provide feedback that will motivate appropriate employee behaviors. Feedback tied to self-interest is most effective. The issue associated with any performance measurement system is the appropriate linkage of measures, incentives, and goals.

**1.1 Financial Measures**

Financial measures of performance include financial scorecards (including the balanced scorecard), costs of quality, return on investment, return on assets, return on equity, residual income, and economic value added.

**1.2 Nonfinancial Measures**

**1.2.1 External Benchmarks: Productivity Measures**

Productivity is defined as the measure of the ratio of the outputs achieved to the inputs of production. Productivity is a measure of efficiency and uses the relationships derived from actual performance in comparison to similar organizations over time. Two types of productivity ratios are generally recognized.

- **Total Factor Productivity Ratios (TFPs)**  
*Total factor productivity ratios (TFPs) reflect the quantity of all output produced relative to the costs of all inputs used. This ratio can be used to compare actual cost per unit production levels to budgeted (or a prior year's) production levels.*
- **Partial Productivity Ratios (PPRs)**  
*Partial productivity ratios (PPRs) reflect the quantity of output produced relative to the quantity of individual input(s) used. This ratio can be used to compare the actual levels of a production input needed to produce a given output, which may be used for a comparison with a budgeted (or a prior year's) input level. It is the most frequently used productivity measure.*

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Module 4 B3-37

**Example 1 Productivity Ratios**

**Facts:** Garden Furnishings Inc. produces outdoor garden sculptures for its high-end niche market. Each garden sculpture manufactured by the company includes two raw materials, with plastic being the largest product input. During the previous month, the company used 20,000 pounds of plastic and 5,000 pounds of cement to produce 1,000 garden sculptures. Material prices at time of production were \$1.25/lb. and \$1.75/lb. for plastic and cement, respectively.

**Required:** Calculate the partial productivity ratio for plastic and the total factor productivity ratio.

**Solution:**

Based on the above, the direct material (plastic) *partial productivity ratio* is calculated as follows:

$$\begin{aligned} \text{PPR} &= \text{Quantity of output produced} / \text{Quantity of input used} \\ &= 1,000 \text{ units of garden sculptures} / 20,000 \text{ lb. of plastic} \\ &= 0.05 \text{ sculpture units per lb. of plastic} \end{aligned}$$

Using the above, the *total factor productivity ratio* is calculated as follows:

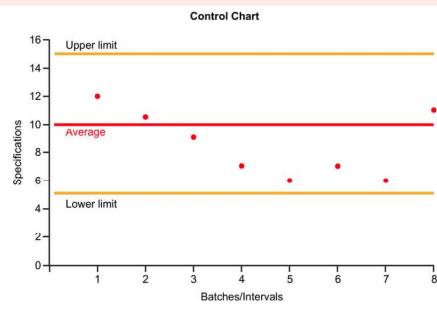
$$\begin{aligned} \text{TFP} &= \text{Quantity of output produced} / \text{Costs of all inputs used} \\ &= 1,000 \text{ garden sculptures} / (20,000 \times \$1.25) + (5,000 \times \$1.75) \\ &= 1,000 \text{ garden sculptures} / \$33,750 \\ &= 0.02963 \text{ units of output per dollar of input cost} \end{aligned}$$

**1.2.2 Internal Benchmarks: Techniques to Find and Analyze Problems**

Internal benchmarks include a variety of techniques to find and analyze problems or measure performance. Among the most common quality-monitoring and investigative techniques are the procedures described below.

**Control Charts**

*Control charts* are an important tool used in statistical quality control (SQC). This graphical tool is used to plot a comparison of actual results by batch or other suitable constant interval to an acceptable range. Control charts show whether there is a trend toward improved quality conformance or deteriorating quality conformance.

**ILLUSTRATION 1 Control Chart**

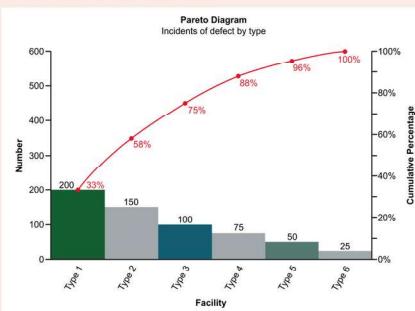
1. The control chart above demonstrates how individual batches/intervals of production fall within a range of quality specifications, from an acceptable upper limit of 15 occurrences to an acceptable lower limit of 5 occurrences, with production management establishing an average quality specification of 10 occurrences per batch/interval.
2. To further extrapolate the results of the control chart above, assume that the company's machine makes batches of rubber tires, with each batch consisting of 10,000 truck tires. Given management's historical experience with this production line, the company has set an upper-end defect rate of 15 tires per batch. The company has also established a lower-end defect rate of 5 tires per batch, as any amount set lower could result in production machine breakdown and repairs.
3. The results graphically displayed on the control chart above indicate that the individual tire production batches/intervals are all within the upper (15) and lower (5) limit tire defect specifications for production. Furthermore, the pattern of production shows a general decline in defects as more batches were produced for each subsequent monthly time interval; the very last batch (No. 8) is an outlier with more tire defects (11) than the average of 10.

■ **Pareto Diagrams**

*Pareto diagrams* are used to determine the quality-control issues that are most frequent and often demand the greatest attention. A Pareto diagram demonstrates the frequency of defects from highest to lowest frequency.

**Illustration 2 Pareto Diagram**

The Pareto diagram below shows the individual and cumulative frequency of six types of quality issues. Addressing half of the types of defects (Type 3, Type 2, and Type 1) would address three quarters (75 percent) of all defects.



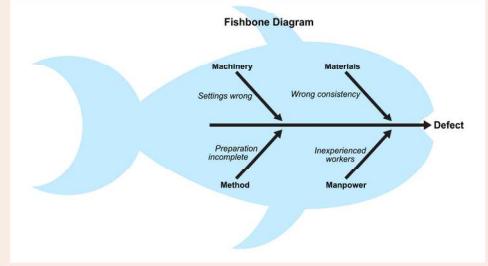
■ **Cause-and-Effect (Fishbone) Diagram**

Once the most frequently recurring and costly defects/problems are identified by the Pareto diagram, a cause-and-effect diagram may be used to further analyze the defect.

Cause-and-effect diagrams provide a framework for managers to analyze the problems that contribute to the occurrence of defects. Production processes that lead to the manufacture of an item are displayed along a production line in a manner that looks like a fishbone. Managers use the diagram to identify the sources of problems in the production process by resource and take corrective action.

**Illustration 3 Fishbone Diagram**

This fishbone diagram indicates that the main categories of potential causes of the defect (called "large bones") are machinery, method used, materials, and use of manpower. Individual factors under each primary factor can be added on ("bones") and provide more detailed reasons for the higher-level ("large bone") cause of the defect. For example, under "machinery," the diagram indicates that incorrect settings may be a specific cause for the defect. Although not shown here, additional "bones" may be added to the machinery "large bone," such as functional obsolescence and lack of sufficient machine downtime.



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**2 Financial Scorecards**

Financial scorecards take many forms, including budget versus actual and other variance reports, as well as overall analysis of business performance. Financial performance is often a function of organizational decisions and the performance objectives given to each segment.

**2.1 Types of Responsibility Segments**

Responsibility segments, sometimes referred to as strategic business units (SBUs), are generally classified by four financial measures (performance objectives) for which managers may be held accountable. SBUs are highly effective in organizing performance requirements and in establishing accountability for financial responsibility.

1. **Cost SBU**  
Managers are held responsible for controlling costs.
2. **Revenue SBU**  
Managers are held responsible for generating revenues.

**3. Profit SBU**

Managers are held responsible for producing a target profit (accountability for both revenues and costs).

**4. Investment SBU**

Managers are held responsible for return on the assets invested to produce the earnings generated by the SBU.

**2.2 Areas of Accountability in Financial Scorecards**

The effectiveness of each strategic business unit is often subdivided into additional areas of accountability, including:

**■ Product Lines**

Some strategic business units involve multiple products. Costs, sales, profits, or returns associated with each of these products can be analyzed for further insight into the sources of profits or losses.

**■ Geographic Areas**

Strategic business units also cross geographic boundaries. Performance can generally be traced by geographic location or geographic market to provide additional insight into results.

**■ Customer**

Often the most significant segment classification is a classification by major customer. The relative profitability or losses associated with any one customer may influence management's decisions to either drop the customer or to reevaluate the relationship in regard to any marginal benefits to the business (e.g., contribution of the customer to fixed costs, etc.).

**2.3 Contribution Reporting**

Profit SBUs are normally responsible for generating a level of profit in relation to controllable costs. Contribution reporting formats are generally used to clearly show the degree to which the profit that strategic business units have generated has covered variable or controllable costs.

**2.3.1 Contribution Margin**

Contribution margin measures the excess of revenues over variable costs (or the contribution to fixed costs) for a company or division.

**2.3.2 Controllable Margin**

Contribution by SBU is a refinement of contribution margin reporting and represents the difference between contribution margin and controllable fixed costs. Controllable fixed costs are costs that managers can influence in less than one year (e.g., advertising and sales promotion).

**2.3.3 Allocation of Common Costs**

Managers have control over variable costs and over controllable fixed costs. Financial scorecards that use contribution reporting factor in these costs. Common costs are not controllable. Approaches to the rational allocation of central or corporate costs must be understood by responsible managers and must be fair and logical. Employees are more motivated to achieve corporate goals if they believe that common costs do not represent an arbitrary burden.

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#### Illustration 4 Contribution Reporting

Delta Manufacturing has four regions that it has organized into profit strategic business units. Delta's management has designed a financial performance evaluation report that focuses on contribution margin and controllable margins. The report is designed as follows:

*Delta Manufacturing Performance Evaluation*

	Region 1	Region 2	Region 3	Region 4	Costs	Untraceable Total
Revenues	\$ 200	\$ 300	\$ 150	\$ 450	\$ -	\$ 1,100
Variable costs	(150)	(250)	(125)	(350)	-	(875)
Contribution margin	50	50	25	100	-	225
Controllable fixed costs	(25)	(25)	(10)	(50)	-	(110)
Controllable margin	25	25	15	50	-	115
Noncontrollable fixed costs	(15)	(15)	(6)	(44)	-	(80)
Contribution by SBU	10	10	9	6	-	35
Untraceable costs	-	-	-	-	(20)	(20)
Operating Income	<u>\$ 10</u>	<u>\$ 10</u>	<u>\$ 9</u>	<u>\$ 6</u>	<u><u>\$ (20)</u></u>	<u><u>\$ 15</u></u>

#### 2.4 Balanced Scorecard

The *balanced scorecard* gathers information on multiple dimensions of an organization's performance defined by critical success factors necessary to accomplish the firm's strategy. Critical success factors are classified as:

- Financial
- Internal business processes
- Customer satisfaction
- Advancement of innovation and human resource development (learning and growth)

Typically, the scorecard describes the classifications of critical success factors, the strategic goals, the tactics, and the related measures associated with strategic and tactical goals.

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### Illustration 5    Balanced Scorecard

Instafab Manufacturing is building its business using a cost leadership strategy. The management of Instafab has identified four strategic goals, one associated with each classification of critical success factors, to help its business grow. The strategic goals are:

1. Capturing additional market share
2. Maintaining low costs that are supported by low prices
3. Becoming a low-price leader
4. Linking strategy with reward and recognition

Help Instafab design tactics to achieve its strategic goals, define measures it might use, and organize them in the manner of a balanced scorecard.

**Legend:**

	Tactics	Measures
<b>Financial Perspective</b>		
<i>Strategic goals</i>	Capture increasing market share	Company vs. industry growth
<i>Critical success factors</i>	Maintain customer base	Volume trend line
<i>Tactics and measures</i>	Steadily expand services	Percentage of sales from new products
<b>Internal Business Processes</b>		
<i>Strategic goals</i>	Maintain low costs that are supported by low prices	Costs compared to competitor
<i>Critical success factors</i>	Maintain consistent production	First pass rates
<i>Tactics and measures</i>	Improve distribution efficiency	Percentage of perfect orders
<b>Customer Perspective</b>		
<i>Strategic goals</i>	Become a low-price leader	Our cost vs. competition
<i>Critical success factors</i>	Anticipate customer needs before competitors	Percentage of products in R&D being test-marketed
<i>Tactics and measures</i>	Increase customer satisfaction	Customer surveys
<b>Advance Learning and Innovation (Human Resources)</b>		
<i>Strategic goals</i>	Link strategy with reward and recognition	Net income per dollar of variable pay
<i>Tactics and measures</i>	Promote entrepreneurial culture	Annual reports

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### 3 Costs of Quality

*Quality* is broadly defined by the marketplace as a product's ability to meet or exceed customer expectations.

The cost of quality includes costs associated with activities related to conformance with quality standards and opportunity costs or activities associated with correcting nonconformance with quality standards.

#### 3.1 Conformance Costs

The costs of ensuring *conformance* with quality standards are classified as prevention and appraisal costs.

##### 3.1.1 Prevention Costs

*Prevention costs* are incurred to prevent the production of defective units. This includes such cost elements as:

- Employee training
- Inspection expenses
- Preventive maintenance
- Redesign of product
- Redesign of processes
- Search for higher-quality suppliers

##### 3.1.2 Appraisal Costs

*Appraisal costs* are incurred to discover and remove defective parts before they are shipped to the customer or the next department. These costs include:

- Statistical quality checks
- Testing
- Inspection
- Maintenance of the laboratory

#### 3.2 Nonconformance Costs

The costs of nonconformance with quality standards are classified as internal and external costs. *Nonconformance costs* are often difficult to compute because most of these costs are in the form of opportunity costs (e.g., lost sales or reputation damage).

##### 3.2.1 Internal Failure

*Internal failure costs* are the costs to cure a defect discovered before the product is sent to the customer. These costs include:

- Rework costs
- Scrap
- Tooling changes
- Costs to dispose
- Cost of the lost unit
- Downtime

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### 3.2.2 External Failure

*External failure costs* are the costs to cure a defect discovered after the product is sent to the customer. These costs include:

- Warranty costs
- Cost of returning the good
- Liability claims
- Lost customers
- Reengineering an external failure

### 3.3 Quality Reporting

"Cost of quality" reports display the financial result of quality. An inverse relationship between conformance and nonconformance costs exists. Increased investment in conformance costs should result in decreases in nonconformance costs, while the consequence of reduced investment in conformance costs may result in increased nonconformance costs.

- Appraisal** includes the costs incurred (e.g., statistical quality control, inspection, and testing) to identify defective products or services.
- Prevention** includes the costs incurred (e.g., engineering or training) to prevent the production or delivery of defective products or services.
- Internal failure** is the cost of defective parts or lost production time (e.g., scrap and rework).
- External failure** is the cost of returns and lost customer loyalty due to defective products or services.

#### ILLUSTRATION 6 Costs of Quality

Glass Products Inc. (GPI) experienced several internal failure costs in the past operating year, including significant production downtime and batch rework costs. Additionally, GPI had external failure costs after shipping glass products to its customers, including material costs pertaining to product returns and lost customers.

At the beginning of the current operating year, the company's production manager was replaced. The new manager, in his first week on the job, hired a statistical quality technician to test the products as they exited the production line. The new production manager then implemented quarterly employee training, preventive maintenance measures, and weekly inspections by independent auditors. Through the first half of the year, these aggressive prevention measures have reduced production downtime by 90 percent and have reduced the company's scrap costs by 50 percent. As a result of these prevention measures, the company has also experienced fewer glass product returns and has lost no customers in the current operating year.

**Question 1****CPA-03883**

Listed below are selected line items from the Cost of Quality Report for Watson Products for last month.

<i>Category</i>	<i>Amount</i>
Rework	\$ 725
Equipment maintenance	1,154
Product testing	786
Product repair	695

What is Watson's total prevention and appraisal cost for last month?

- a. \$786
- b. \$1,154
- c. \$1,849
- d. \$1,940

[Answer Explanation](#)**Question 2****CPA-03890**

In a quality control program, which of the following is (are) categorized as internal failure costs?

- I. Rework.
  - II. Responding to customer complaints.
  - III. Statistical quality control procedures.
- a. I only.
  - b. II only.
  - c. III only.
  - d. I, II, and III.

[Answer Explanation](#)

Module 5 Performance Management: Part 2

**BEC 3**

**1 Return on Investment**

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Return on investment (ROI) provides for the assessment of a company's percentage return relative to its capital investment risk. The ROI is an ideal performance measure for investment strategic business units (SBUs). In simplest terms, ROI is expressed as income divided by invested capital; however, ROI is also expressed as a product of profit margin and investment turnover.

$\text{ROI} = \text{Income} / \text{Investment capital}$   
*Or:*  
 $\text{ROI} = \text{Profit margin} \times \text{Investment turnover}$

**1.1 Components of ROI**

Return on investment (ROI) can be disaggregated as indicated in the following flowchart, in which income is expressed as a percentage of sales (i.e., the profit margin calculation) and sales are expressed as a percentage of invested capital (i.e., the investment turnover calculation). The higher the percentage return, the better.

**ROI Flowchart**

```

graph TD
    ROI[Return on investment (ROI)] --> ProfitMargin[Profit margin]
    ROI --> InvestmentTurnover[Investment turnover]
    ProfitMargin --> Income[Income]
    ProfitMargin --> Sales[Sales]
    Sales --- Income
    Sales --- Plus1[+]
    InvestmentTurnover --> Sales2[Sales]
    InvestmentTurnover --> InvestedCapital[Invested capital]
    Sales2 --- InvestedCapital
    Sales2 --- Plus2[+]
  
```

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Module 5 B3-49

**Example 1      ROI**

**Facts:** Assume that sales are \$1,000,000, net income is \$40,000, and invested capital is \$250,000. The organization's required rate of return (hurdle rate) is 12 percent.

**Required:** Determine whether the organization is meeting performance expectations using ROI.

**Solution:**

$$\frac{\$40,000}{\$1,000,000} \times \frac{\$1,000,000}{\$250,000} = \frac{\$40,000}{\$250,000} = 16\%$$

The organization is meeting its requirements based on ROI computations. The ROI of 16 percent exceeds the required rate of return of 12 percent.

## 1.2    Return on Assets

Return on assets (ROA) is similar to ROI, except that ROA uses average total assets in the denominator rather than invested capital.

$$\text{ROA} = \frac{\text{Net income}}{\text{Average total assets}}$$

## 1.3    ROI/ROA Issues

### 1.3.1    Variations on Asset Valuation

Asset valuations used in the ROI and ROA computations affect the results. The appropriate asset valuation depends on the strategic objectives of the company and the direction that leadership wants to give its managers. The following terms define different asset valuations.

- **Net Book Value:** Assets valued at net book value represent historical cost less accumulated depreciation.
- **Gross Book Value:** Assets valued at gross book value represent historical cost prior to the reduction for accumulated depreciation.
- **Replacement Cost:** Assets valued at replacement cost represent the cost to replace assets at their current level of utility.
- **Liquidation Value:** Assets valued at liquidation value represent the selling price of productive assets.



### Pass Key

Adjustments to the ROI denominator raise the bar on asset, project, or company performance. The higher the denominator used in the ROI computation, the lower the return.

3

#### 1.3.2 Limitations of ROI

ROI, like any performance measure, is designed to direct managers to achieve corporate objectives and provide a basis for incentives. ROI computations have the following limitations:

- **Short-Term Focus:** Use of ROI exclusively as a measure of the performance can inadvertently focus managers purely on maximizing short-term returns. The overemphasis of managers on investment return targets is referred to as investment myopia.
- **Disincentive to Invest:** Profitable units are reluctant to invest in additional productive resources because they could reduce ROI in the short term.

## 2 Return on Equity and the DuPont Model

### 2.1 Return on Equity

A critical measure for determining a company's effectiveness is its return on equity (ROE).

$$\text{ROE} = \frac{\text{Net income}}{\text{Equity}}$$

The advantage of this ROE formula is that it is simple to compute. However, additional breakdowns of the components of ROE provide management with a much clearer picture of the efficiencies and leverage of a given company's operations.

### 2.2 DuPont Analysis

#### 2.2.1 Components of DuPont ROE

The three-step DuPont model breaks ROE into three distinct components: Net profit margin, asset turnover, and financial leverage.

- **Net Profit Margin:**

Net profit margin is a measure of operating efficiency.

$$\text{Net profit margin} = \frac{\text{Net income}}{\text{Sales}}$$

**■ Asset Turnover**

Asset turnover is a measure of the degree of efficiency with which a company is using its assets.

$$\text{Asset turnover} = \frac{\text{Sales}}{\text{Assets}}$$

**■ Financial Leverage**

Financial leverage measures the extent to which a company uses debt in its capital structure.

$$\text{Financial Leverage} = \frac{\text{Assets}}{\text{Equity}}$$

**2.2.2 Calculating DuPont ROE**

The formula for DuPont ROE is:

$$\begin{aligned}\text{DuPont ROE} &= \text{Net profit margin} \times \text{Asset turnover} \times \text{Financial leverage} \\ &= \frac{\text{Net income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Assets}} \times \frac{\text{Assets}}{\text{Equity}}\end{aligned}$$

Note that net profit margin and asset turnover can be multiplied to calculate return on assets (ROA). Therefore, DuPont ROE can also be calculated as:

$$\text{DuPont ROE} = \text{ROA} \times \text{Financial leverage}$$

**2.2.3 Extended DuPont Model**

The extended DuPont model further breaks out net profit margin into three distinct components: Tax burden, interest burden, and the operating income margin.

**■ Tax Burden**

The tax burden is the extent to which a company retains profits after paying taxes.

$$\text{Tax burden} = \frac{\text{Net income}}{\text{Pretax income}}$$

■ **Interest Burden**

The *interest burden* reflects how much in pretax income a company retains after paying interest to debt holders.

$$\text{Interest burden} = \frac{\text{Pretax income}}{\text{Earnings before interest and taxes (EBIT)}}$$

■ **EBIT Margin**

The *EBIT margin* is a measure of company profits earned on sales after paying operating and nonoperating costs (other than interest and taxes).

$$\text{EBIT margin} = \frac{\text{EBIT}}{\text{Sales}}$$

■ **Extended DuPont ROE Formula**

The last two components of the ROE calculation remain the same, with the extended model shown below:

$$\begin{aligned} \text{Extended DuPont ROE} &= \frac{\text{Tax burden}}{\text{Net income}} \times \frac{\text{Interest burden}}{\text{Pretax income}} \times \frac{\text{EBIT margin}}{\text{EBIT}} \times \frac{\text{Asset turnover}}{\text{Sales}} \times \frac{\text{Financial leverage}}{\text{Assets}} \\ &= \frac{\text{Pretax income}}{\text{EBIT}} \times \frac{\text{Pretax income}}{\text{EBIT}} \times \frac{\text{EBIT}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Assets}} \times \frac{\text{Assets}}{\text{Equity}} \end{aligned}$$

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**Pass Key**

Average assets and average equity should be used when calculating ROE. However, if a CPA Exam question only gives ending assets and/or ending equity, these amounts may be used to calculate ROE.

### Example 2      ROE

**Facts:** Blake Co. reports the following in its Year 5 financial statements:

Sales	\$500,000	Assets	\$900,000
COGS	<u>275,000</u>	Liabilities	300,000
Gross profit	225,000	Equity	600,000
SG&A	<u>150,000</u>		
EBIT	75,000		
Interest expense	<u>15,000</u>		
Pretax income (EBT)	60,000		
Tax (30% rate)	<u>18,000</u>		
Net income	<u>\$ 42,000</u>		

**Required:** Calculate each of the individual component ratios for Blake, as well as the ROE for Blake using both the DuPont model and the extended DuPont model.

**Solution:**

$$\begin{aligned} \text{Net profit margin} &= \text{Net income} / \text{Sales} \\ &= \$42,000 / \$500,000 \\ &= \mathbf{0.084} \end{aligned}$$

$$\begin{aligned} \text{Tax burden} &= \text{Net income} / \text{Pretax income} \\ &= \$42,000 / \$60,000 \\ &= \mathbf{0.70} \end{aligned}$$

$$\begin{aligned} \text{Interest burden} &= \text{Pretax income} / \text{EBIT} \\ &= \$60,000 / \$75,000 \\ &= \mathbf{0.80} \end{aligned}$$

$$\begin{aligned} \text{EBIT margin} &= \text{EBIT} / \text{Sales} \\ &= \$75,000 / \$500,000 \\ &= \mathbf{0.15} \end{aligned}$$

$$\begin{aligned} \text{Asset turnover} &= \text{Sales} / \text{Assets} \\ &= \$500,000 / \$900,000 \\ &= \mathbf{0.56} \end{aligned}$$

$$\begin{aligned} \text{Financial leverage} &= \text{Assets} / \text{Equity} \\ &= \$900,000 / \$600,000 \\ &= \mathbf{1.50} \end{aligned}$$

$$\begin{aligned} \text{DuPont ROE} &= \text{Net profit margin} \times \text{Asset turnover} \times \text{Financial leverage} \\ &= 0.084 \times 0.56 \times 1.50 \\ &= \mathbf{0.07 \text{ or } 7\%} \end{aligned}$$

$$\begin{aligned} \text{Extended DuPont ROE} &= \text{Tax burden} \times \text{Interest burden} \times \text{EBIT margin} \times \text{Asset turnover} \\ &\quad \times \text{Financial leverage} \\ &= 0.70 \times 0.80 \times 0.15 \times 0.56 \times 1.50 \\ &= \mathbf{0.07 \text{ or } 7\%} \end{aligned}$$



### Pass Key

It is important to note that both methods of calculating ROE (DuPont and extended DuPont) produce the same number. By breaking out the calculation into different components, management can get a better understanding of what factors are driving ROE and how those factors compare relative to competing companies and to the industry overall.

## 3 Residual Income

The residual income method measures the excess of actual income earned by an investment over the return required by the company. The rate of return/hurdle rate for the company may be its WACC, cost of equity, or it may simply be the return established by management as a target rate. Although ROI provides a percentage measurement, residual income provides an amount. Like ROI, residual income is a performance measure for investment SBUs.

### 3.1 Formula

The formula for residual income is as follows:

$$\text{Residual income} = \text{Net income (from the income statement)} - \text{Required return}$$

Where:

$$\text{Required return} = \text{Net book value (Equity)} \times \text{Hurdle rate}$$

### 3.2 Interpretation

A positive residual income indicates that performance is meeting standards, and a negative residual income indicates that performance is not meeting standards.

#### Example 3 Residual Income

**Facts:** Instafab Manufacturing has an investment in its Southeast regional plant with a net book value of \$200,000. Instafab's expected hurdle rate is 10 percent, and the division produces net income of \$30,000.

**Required:** Calculate residual income.

**Solution:**

Net income	\$ 30,000
Net book value	\$200,000
Hurdle rate	× 10%
Required return	(20,000)
Residual income	<b>\$ 10,000</b>

### 3.3 Benefits of Residual Income Performance Measures

Advantages of using residual income include the ease of measurement of actual dollars earned by an investment above its required amount.

#### 3.3.1 Realistic Target Rates

Usually, the target rate in the residual income method will be less than the highest return rates actually earned by the best-performing investment centers in a company. Historical weighted average cost of capital is often used as the target or hurdle rate; however, the rate optimally used is the target return set by the company's management.

#### 3.3.2 Focus on Target Return and Amount

Residual income controls and performance measures encourage managers to invest in projects that generate income in excess of the target or calculated rate, thereby improving company profits and promoting the congruence of individual and corporate goals. Divisions with high rates of return do not fear dilution of their rates and, therefore, do not avoid investments that demonstrate strong residual income performance.

### 3.4 Weaknesses of Residual Income Performance Measures

#### 3.4.1 Reduced Comparability

Use of an absolute amount to compute performance distorts comparison of units with unequal size. Larger units of an organization may produce larger dollar volumes of residual income even though their performance is identical to a smaller unit on a percentage basis.

#### 3.4.2 Target Rates Require Judgment

Reliance on computing a target rate of return may sometimes be difficult to establish.

## 4 Economic Value Added

The Economic Value Added™ (EVA™) method of performance evaluation is very similar to the residual income method. The residual income method computes required return based on a hurdle rate determined by management, and the EVA measures the excess of income after taxes (not counting interest expense) earned by an investment over the return rate defined by the company's overall cost of capital (WACC). The amount used to represent income after taxes is the firm's net operating profit after taxes (NOPAT), and it often incorporates several accounting adjustments prior to application into the model. Economic value added ensures that performance is measured in comparison to changes associated with all capital, debt, and equity. EVA is expressed as an amount and is considered a form of economic profit.

#### 4.1 Formula

The formula for EVA is:

$$\text{Economic value added} = \text{Net operating profit after taxes (NOPAT)} - \text{Required return}$$

Where:

$$\text{Required return} = \text{Investment} \times \text{WACC}$$

#### 4.2 Interpretation

- **Positive EVA:** A positive EVA indicates that performance is meeting standards.
- **Negative EVA:** A negative EVA indicates that performance is not meeting standards.

#### 4.3 Economic Value Added Component Issues

*Economic value added* can be refined using investment or income adjustments to produce a more accurate analysis of economic profit (value added).

##### 4.3.1 Investment Valuation Issues

- **Capitalization of Research and Development:** The organization may *capitalize research and development* costs as part of its asset base along with other value-adding investments in advertising and training.
- **Current Valuation of the Balance Sheet:** Balance sheet accounts are generally revalued to represent current cost.

##### 4.3.2 Income Determination

NOPAT may be adjusted to eliminate the effect of certain transactions and thereby create a nearly cash basis income statement.

- Adjustments to the balance sheet affect the income statement.
- Deferred taxes are ignored.

#### Example 4      EVA

**Facts:** Instafab Manufacturing has an investment in its Southeast regional plant with an investment of \$300,000 after adjustments for capitalization of research and development costs and revaluation of certain assets. The company's cost of capital is 12 percent, and its division produces a net operating profit after taxes of \$50,000 after adjustments for current-year research and development, asset revaluations, and other accounting considerations.

**Required:** Calculate the economic value added.

**Solution:**

NOPAT	\$50,000
Investment	\$300,000
Cost of capital	× 12%
Required return	(36,000)
Economic value added	<b>\$14,000</b>

Instafab's economic value added is positive. Instafab has added to shareholder value.

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**Question 1 CPA-06645**

SkyBound Airlines provided the following information about its two operating divisions:

	<i>Passenger</i>	<i>Cargo</i>
Operating profit	\$ 40,000	\$ 50,000
Investment	250,000	500,000
External borrowing rate	6%	8%

Measuring performance using return on investment (ROI), which division performed better?

- a. The Cargo division, with an ROI of 10 percent.
- b. The Passenger division, with an ROI of 16 percent.
- c. The Cargo division, with an ROI of 18 percent.
- d. The Passenger division, with an ROI of 22 percent.

[Answer Explanation](#)
**Question 2 CPA-04809**

Minon Inc. purchased a long-term asset on the last day of the current year. What are the effects of this purchase on return on investment and residual income?

*Return on Investment    Residual Income*

- |                          |          |          |
|--------------------------|----------|----------|
| <input type="radio"/> a. | Increase | Increase |
| <input type="radio"/> b. | Decrease | Decrease |
| <input type="radio"/> c. | Increase | Decrease |
| <input type="radio"/> d. | Decrease | Increase |

[Answer Explanation](#)
**Question 3 CPA-08378**

Spear Corp. had sales of \$2,000,000, a profit margin of 11 percent, and assets of \$2,500,000. Spear decided to reduce its debt ratio to 0.40 from 0.50 by selling new common stock and using the proceeds to repay principal on some outstanding long-term debt. After the refinancing, what is Spear's return on equity?

- a. 3.5 percent
- b. 5.3 percent
- c. 14.7 percent
- d. 22.9 percent

[Answer Explanation](#)

Question 4	CPA-04818
Zig Corp. provides the following information:	
Pretax operating profit	\$ 300,000,000
Tax rate	40%
Capital used to generate profits 50% debt, 50% equity	1,200,000,000
Cost of equity	15%
Cost of debt (after tax)	5%
Which of the following represents Zig's year-end economic value-added amount?	
<input type="radio"/> a. \$0	
<input type="radio"/> b. \$60,000,000	
<input type="radio"/> c. \$120,000,000	
<input type="radio"/> d. \$180,000,000	

[Answer Explanation](#)

Module 1 Projection and Forecasting Techniques: Part 1 BEC 4

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## 1 Projection Techniques

Projections are prepared to show multiple, hypothetical ("what-if") scenarios and courses of action that a business might follow. Projections serve as the precursor to actual forecasts. Projections are typically prepared for internal use and can assist managers in making decisions regarding products, acquisitions, revenues, expenses, etc.

Sensitivity and scenario analyses are frequently used to project revenues, costs, and profitability.

### 1.1 Sensitivity Analysis

*Sensitivity analysis* is the process of experimenting with different parameters and assumptions regarding a model and cataloging the range of results to view the possible consequences of a decision. Sensitivity models often use probabilities to approximate reality.

Also called "what-if" analysis, sensitivity analysis is a risk management tool that is used to test the effect of specific variables on overall profitability. Managers incorporate sensitivity analysis into the budgeting process to determine which variables are the most sensitive to change and therefore will have the biggest effect on the bottom line.

The biggest drawback of sensitivity analysis is the implicit assumption that variables are independent. The reality is that variables do not typically operate in a vacuum, and a change in one will often result in changes in others that are difficult to predict with accuracy.

**Example 1 Sensitivity Analysis**

**Facts:** July sales for Besser Company are projected to be \$100,000, with cost of goods sold of \$60,000 and general/administrative expenses of \$25,000. The CFO has determined that variability in sales has the biggest impact on profitability and she wants to determine the effect on operating income if sales dollars are over-/underestimated by 25 percent.

In order to estimate the change in operating income, the CFO assumes that cost of goods sold will consistently be 60 percent of sales and general/administrative expenses will stay constant at \$25,000.

**Required:** Project operating income using the assumptions that sales at \$100,000 are overestimated by 25 percent, correct, or underestimated by 25 percent.

(continued)

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(continued)

**Solution:**

	Sales Overestimated by 25%	Sales Correctly Estimated	Sales Underestimated by 25%
Sales	\$75,000	\$100,000	\$125,000
Cost of goods sold	(45,000)	(60,000)	(75,000)
General/administrative	(25,000)	(25,000)	(25,000)
Operating Income	<u>\$ 5,000</u>	<u>\$ 15,000</u>	<u>\$ 25,000</u>

Because cost of goods sold remains a fixed percentage of sales, and general/administrative expenses remain constant (and therefore independent of sales), the biggest impact on operating income will result from sales being different from estimates.

2

**1.2 Scenario Analysis**

In preparing models for future periods, managers may prepare multiple different scenarios which represent alternative possible outcomes. Budgets will be prepared under each scenario and then probabilities may be assigned in order to come up with weighted totals.

**Example 2 Scenario Analysis**

**Facts:** In preparing its budgets for the coming year, Ridge Company projects three scenarios for revenues:

- Optimistic scenario (30 percent likelihood): 5 percent sales growth
- Pessimistic scenario (20 percent likelihood): 5 percent sales decline
- Most likely scenario (50 percent likelihood): No sales growth/decline

**Required:** If sales in the previous fiscal year were \$40 million, project sales for next year.

**Solution:**

- Expected sales growth/decline:  $(30\% \times 5\%) + (20\% \times -5\%) + (50\% \times 0\%) = 0.5\%$  growth.
- $\$40 \text{ million} \times (1.005) = \$40.2 \text{ million}$  in projected sales for next year.



## 2 Forecasting Techniques

Forecasting is driven by historical data and actual expectations rather than hypothetical scenarios. Projections are typically used internally, and forecasts are prepared for both internal and external audiences.

Forecasting techniques generally can be broken out into qualitative and quantitative methods. Qualitative forecasts are based on the opinions and judgment of management and other experts, and do not require historical data. Quantitative forecasts use historical data and are categorized as either time series methods or causal methods. Time series methods use past trends to predict future variables, and causal methods are based on cause-and-effect relationships between variables.

### 2.1 Forecasting Analysis

*Forecasting (probability/risk) analysis* is an extension of sensitivity analysis.

#### 2.1.1 Purpose

Forecasting involves predicting future values of a dependent variable (the variable that one is trying to explain) using information from previous time periods. Historical relationships may be examined in order to use predictions about independent variables to forecast changes in dependent variables.

- **Forecasting Revenues:** On the revenue side, sales are a dependent variable that may be a product of independent variables such as expectations regarding the economy, personal income, product competition, growth of the industry, etc.
- **Forecasting Expenses:** On the expense side, total costs are a by-product of specific independent variables such as overall fixed costs and per-unit variable costs.

#### 2.1.2 Application

Various quantitative methods (including regression analysis, explained below) are used in forecasting.

## 3 Regression Analysis

Linear regression is a method for studying the relationship between two or more variables. One use of linear regression is to predict the value of a dependent variable [e.g., total cost ( $y$ )] corresponding to given values of the independent variables [e.g., fixed costs ( $a$ ), variable cost per unit ( $B$ ), and production expressed in units ( $x$ )].

### 3.1 Simple Linear Regression Model

Regression analysis explains variation in a dependent variable as a linear function of one or more independent variables. Simple regression involves only one independent variable. Multiple regressions involve more than one independent variable.



- **Components of the Simple Linear Regression Model:** The simple linear regression model takes the following form:

$$y = a + Bx$$

Where:

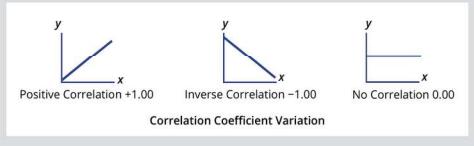
- $y$  = The dependent variable (the variable we are trying to explain). For example,  $y$  might be total costs measured in dollars for a cost function.
- $x$  = The independent variable (the regressor). The variable that explains  $y$ . For example, in a cost function,  $x$  would be total activity (or output).
- $a$  = The y-axis intercept of the regression line. For example, if  $y$  is total costs,  $a$  would measure total fixed costs.
- $B$  = The slope of the regression line. For example, if  $y$  is total costs, and  $x$  is output,  $B$  measures the change in total costs due to a one-unit change in output (variable cost per unit).

- **Application:** If  $y$  is total costs and  $x$  is total activity or output, one goal of regression analysis would be to predict total costs ( $y$ , the dependent variable) based on observed total activity or output. Questions on the CPA Exam expect you to predict total cost.

### 3.2 Statistical Measures to Evaluate Regression Analysis

#### 3.2.1 The Coefficient of Correlation ( $r$ )

- **Definition:** The coefficient of correlation measures the strength of the linear relationship between the independent variable ( $x$ ) and the dependent variable ( $y$ ). In standard notation, the coefficient of correlation is " $r$ ."
- **Interpretation:** The range of " $r$ " is from  $-1.00$  to  $+1.00$ , as follows:



- **Perfect Positive Correlation (+1.00):** The dependent and independent variables move together in the same direction. An increase (decrease) in the independent variable produces an equivalent increase (decrease) in the dependent variable.
- **Perfect Inverse Correlation (-1.00):** The dependent and independent variables move in equivalent opposite directions. An increase (decrease) in the independent variable produces an equivalent decrease (increase) in the dependent variable.
- **No Correlation (0.00):** The dependent and independent variables are not related in a linear fashion. Movement in the independent variable cannot be used to predict the movement in the dependent variable.

- **Projecting Total Cost:** When predicting total cost (the dependent variable) as a function of fixed costs, variable costs, and volume (the independent variable), management's expectation is that the correlation coefficient will be somewhere between 0.00 and 1.00. As more units of a given product are produced, a reasonable expectation is that total costs will increase.

### 3.2.2 The Coefficient of Determination ( $R^2$ )

- **Definition:** The coefficient of determination ( $R^2$ ) is the proportion of the total variation in the dependent variable ( $y$ ) explained by the independent variable ( $x$ ). Its value lies between zero and one.
- **Interpretation:** The higher the  $R^2$ , the greater the proportion of the total variation in  $y$  that is explained by the variation in  $x$ . That is, the higher the  $R^2$ , the better the fit of the regression line.

#### Illustration 1      Coefficient of Determination

Based on looking at five years of data on fixed costs and variable costs per unit, Raxan Inc. determines that its fixed and variable costs in the next year will be \$16,000 and \$4.50 per unit, respectively. Raxan has determined that the correlation coefficient between the independent and dependent variable is equal to 0.90. The  $R^2$  for the regression equation  $y$  (total costs) =  $\$16,000 + \$4.50x$ , with  $x$  being volume, is equal to 0.81. An  $R^2$  of 0.81 means that 81 percent of the change in total cost during a period can be attributed to changes in volume.

## 4    High-Low Method

The *high-low method* is a simple technique that is used to estimate the fixed and variable portions of cost, usually production costs.

### 4.1   Procedures

#### 4.1.1   Gather Data

Compare the high and low volumes and costs (ignoring any obvious aberrations). Outliers, which are unusually high or low volumes, are eliminated.

#### 4.1.2   Analyze Data

- Divide the difference between the high and low dollar total costs by the difference in high and low volumes to obtain the variable cost per unit.
- Use either the high volume or the low volume to calculate the variable costs by multiplying the volume times the variable cost per unit.
- Subtract the total calculated variable cost from total costs to obtain fixed costs.

#### 4.1.3   Formulate Results

The result enables preparation of a flexible/performance budget by identifying total fixed costs and variable costs per unit. This may be used to estimate total costs at any volume.

## 4.2 Flexible Budget Formula

The result of the high-low method is called a total cost formula and, sometimes, a flexible budget formula (or equation).

### 4.2.1 Flexible Budget

A *flexible budget* is a series of budgets that are prepared for a range of activity levels rather than a single activity (in which variable costs are adjusted to the level of activity and fixed costs are held constant).

### 4.2.2 Formula

This formula defines total costs as equal to the fixed costs plus the variable costs per unit times the units. The flexible budget formula is then used to estimate total cost at any volume.

$$\text{Total cost} = \text{Fixed cost} + [\text{Variable cost per unit} \times \text{Number of units}]$$

**Illustration 2 High-Low Method**

Period	Units/Volume	Cost
January	1,200	\$9,000
February	1,000	8,450
March	1,050	8,600
April	1,130	8,750
May	1,400	9,550
June	1,200	9,000
High	1,400	9,550
Low	(1,000)	(8,450)
Difference between high and low	<u>400</u>	<u>\$1,100</u>

Variable cost per unit = \$1,100 / 400 units = \$2.75 per unit

Using either the high or the low will produce the same total fixed-cost result:

	High	Or:	Low
Units	<u>1,400</u>		<u>1,000</u>
Total cost of units	\$9,550		\$8,450
Variable costs @ \$2.75 per unit	(3,850)		(2,750)
Total fixed costs	<u>\$5,700</u>	=	<u>\$5,700</u>

Total costs = Fixed costs + [Variable costs per unit × Number of units]

Total costs = \$5,700 + [\$2.75 × Number of units]