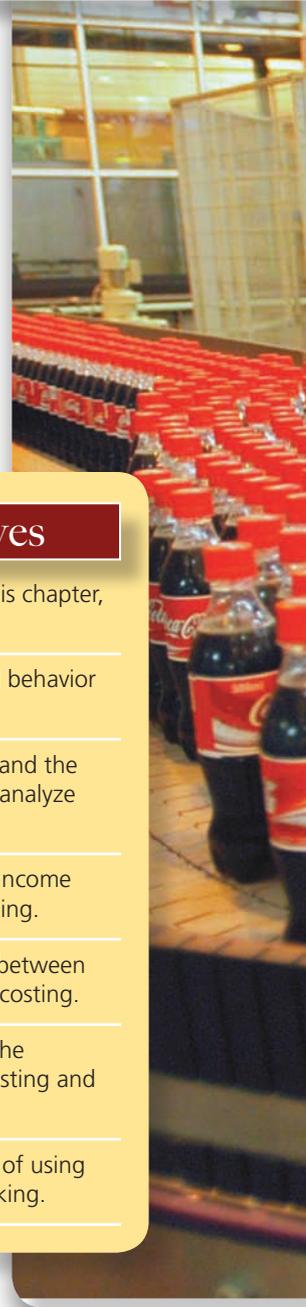# Cost Behavior

Introduction

In Chapter 5, we focus our attention on the behavior of costs. As production volume changes, some costs may increase or decrease and other costs may remain stable, but specific costs behave in predictable ways as volume changes. This concept of predictable **cost behavior** based on volume is very important to the effective use of accounting information for managerial decision making.

LO1 Fixed and Variable Costs

Fixed costs are costs that remain the same in total, but vary per unit, when production volume changes. Facility-level costs, such as rent, depreciation of a factory building, the salary of a plant manager, insurance, and property taxes, are likely to be fixed costs. Summarizing this cost behavior, fixed costs stay the same in total but vary when expressed on a per-unit basis.

Learning Objectives

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

LO1 Describe the nature and behavior of fixed and variable costs.

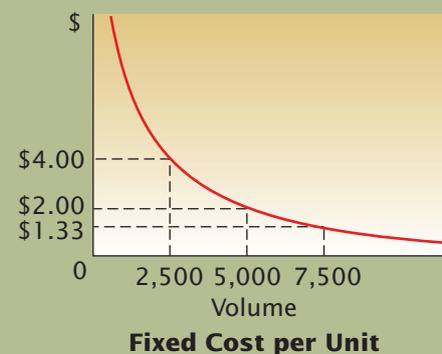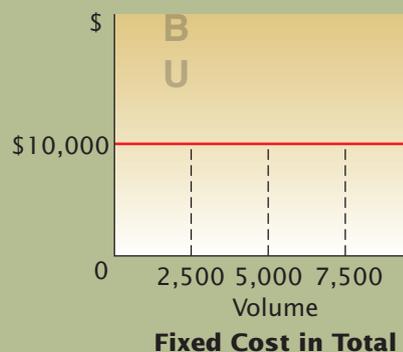**LO2** Use regression analysis and the high/low method to define and analyze mixed costs.

LO3 Illustrate the impact of income taxes on costs and decision making.

LO4 Identify the difference between variable costing and absorption costing.

LO5 Identify the impact on the income statement of variable costing and absorption costing.

LO6 Recognize the benefits of using variable costing for decision making.

Cost behavior How costs react to changes in production volume or other levels of activity.

Fixed costs Costs that remain the same in total when production volume increases or decreases but that vary per unit.

Exhibit 5-1 The Behavior of Fixed Costs

Fixed Cost in Total

Fixed Cost per Unit

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Understanding how costs behave with changes in production is crucial for managers of an organization.

© Henner Frankenfeld/Bloomberg via Getty Images

Rent is a good example. If the cost to rent a factory building is $10,000 per year and 5,000 units of product are produced, the rent per unit is $2.00 ($10,000 ÷ 5,000). If production volume decreases to 2,500 units per year, the cost per unit will increase to $4.00 ($10,000 ÷ 2,500). If production volume increases to 7,500 units, the cost per unit decreases to $1.33 ($10,000 ÷ 7,500). However, the total rent remains $10,000 per year (see Exhibit 5-1).

On the other hand, **variable costs** vary in direct proportion to changes in production volume but are constant when expressed as per-unit amounts. As production increases, variable costs increase in direct proportion to the change in volume; as production decreases, variable costs decrease in direct proportion to the change in volume. Examples include direct material, direct labor (if paid per unit of output), and other unit-level costs, such as factory supplies, energy costs to run factory machinery, and so on.
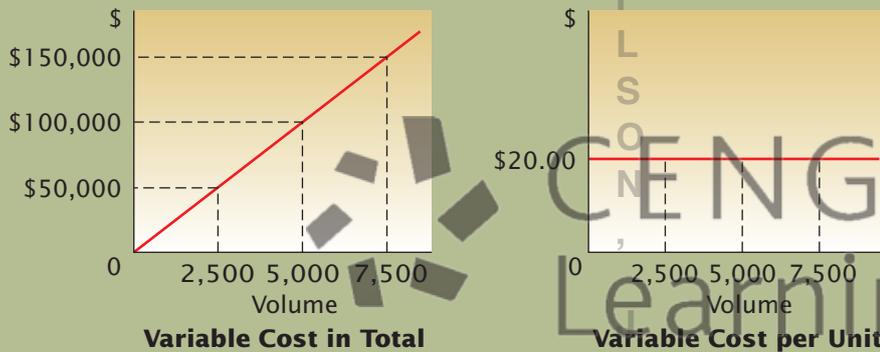
> **Variable costs** Costs that stay the same per unit, but change in total, as production volume increases or decreases.

Chapter 5: Cost Behavior **93**

Consider the behavior of direct material costs as production increases and decreases. If the production of a standard classroom desk requires $20 of direct materials (wood, hardware, and so on), the total direct material costs incurred will increase or decrease proportionately with increases and decreases in production volume. If 5,000 desks are produced, the total direct material cost will be $100,000 (5,000 × $20). If production volume is increased to 7,500 units (a 50 percent increase), direct material costs will also increase 50 percent, to $150,000 (7,500 × $20). However, the cost per unit is still $20. Likewise, if production volume is decreased to 2,500 desks, direct material costs will decrease by 50 percent, to $50,000. But once again, the cost per unit remains $20 (see Exhibit 5-2).

> *Within the relevant range, fixed costs are constant in total and vary per unit, and variable costs vary in total and are constant per unit.*


Exhibit 5-2 The Behavior of Variable Costs

A current trend in manufacturing is to automate—to replace direct factory labor with robotics and other automated machinery and equipment. This trend has the effect of increasing fixed costs (depreciation) and decreasing variable costs (direct labor). Although there are many advantages to automation, the impact of automation on the employee work force and on day-to-day decisions made by managers must not be ignored.

Strictly speaking, a cost that varies in direct proportion to changes in volume requires a linear (straight-line) relationship between the cost and volume. However, in reality, costs may behave in a curvilinear fashion. Average costs or cost per unit may increase or decrease

as production increases. For example, utility costs per kilowatt-hour may decrease at higher levels of electricity use (and production). Managerial accountants typically get around this problem by assuming that the relationship between cost and volume is linear within the relevant range of production. In other words, the cost per unit is assumed to remain constant over the relevant range. The **relevant range** is the normal range of production that can be expected for a particular product and company. The relevant range can also be viewed as the volume of production for which the fixed and variable cost relationships hold true. As you can see in Exhibit 5-3, within this narrower range of production, a curvilinear cost can be approximated by a linear relationship between the cost and volume.

Exhibit 5-3 Curvilinear Costs and the Relevant Range
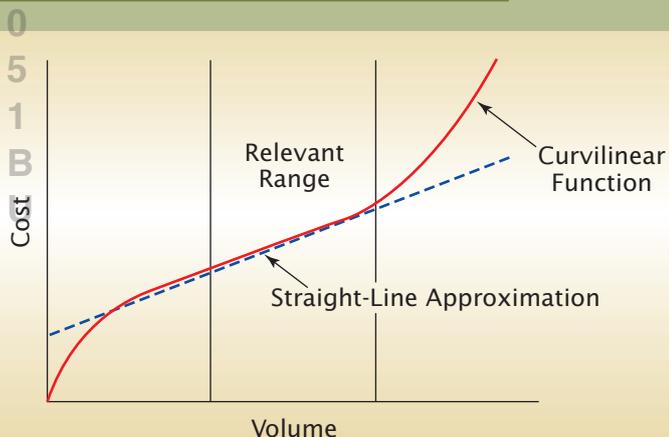
Relevant range The normal range of production that can be expected for a particular product and company.

Direct Labor as a Fixed Cost

For years, U.S. car manufacturers have had contracts with their workers' unions that require the companies to pay their assembly-line workers even when they are not on the assembly line. These contracts essentially transform direct labor costs into fixed costs. More recently, as the recession has resulted in idle assembly lines, Toyota has done likewise. However, unlike the U.S. companies, which often send their workers home, at Toyota the workers might attend training classes, repair and maintain equipment, or brainstorm in an effort to identify new cost-savings or quality-improvement initiatives.

Step Costs

The classification of costs is not always a simple process. Some costs vary but only with relatively large changes in production volume. Batch-level costs related to moving materials may vary with the number of batches of product produced but not with every unit of product. Product-level costs associated with quality control inspections may vary when new products are introduced. Costs like these are sometimes referred to as **step costs**. In practice, step costs may look like and be treated as either variable costs or fixed costs. Although step costs are technically not fixed costs, they may be treated as such if they remain constant within a relatively wide range of production. Consider the costs of janitorial services within a company. As long as production is below 7,500 desks, the company will hire one janitor with salary and fringe benefits totaling $25,000. The cost is fixed as long as production remains below 7,500 units. But if desk production exceeds 7,500, increasing the amount of waste and cleanup needed, it may be necessary to hire a second janitor at a cost of another $25,000. However, within a relevant range of production between 7,501 and 15,000 units, the cost is essentially fixed ($50,000).

Relevant Costs and Cost Behavior

As mentioned in Chapter 1, relevant costs are those which are avoidable or can be eliminated by choosing one alternative over another. Relevant costs are also known as differential, or incremental, costs. In general, variable costs are relevant in production decisions because they vary with the level of production. Likewise, fixed costs are generally not relevant, because they typically do not change as production changes. However, variable costs can remain the same between two alternatives, and fixed costs can vary between alternatives. For example, if the direct material cost of a product is the same for two competing designs, the material cost is not a relevant factor in choosing a design. However, other qualitative factors relating to the material, such as durability, may still be relevant. Likewise, fixed costs can be relevant if they vary between alternatives. Consider rent paid for a facility to store inventory. Although the rent is a fixed cost, it is relevant to a decision to reduce inventory storage costs through just-in-time production techniques if the cost of the rent can be avoided (by subleasing the space, for example) by choosing one alternative over another.

The Cost Equation

Expressing the link between costs and production volume as an algebraic equation is useful. The equation for a straight line is
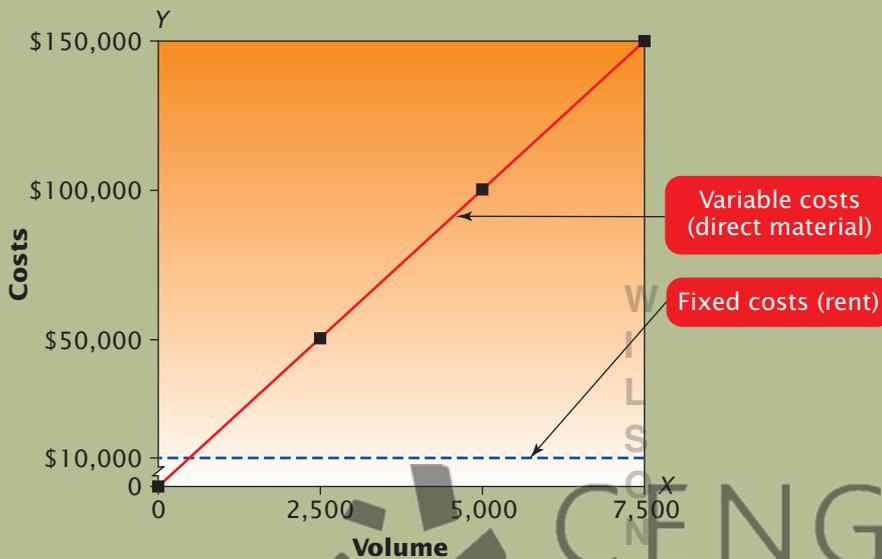
$$y = a + bx$$

Step costs Costs that vary with activity in steps and may look like and be treated as either variable costs or fixed costs; step costs are technically not fixed costs but may be treated as such if they remain constant within a relevant range of production.

The *a* in the equation is the point where the line intersects the vertical (*y*) axis (the *y*-intercept), and *b* is the slope of the line. In Exhibit 5-4, if *y* = total direct material costs and *x* = units produced, then *y* = $0 + $20*x*. The *y*-intercept is zero and the slope of the line is 20. For

Exhibit 5-4 Fixed and Variable Costs

every one-unit increase (decrease) in production (*x*), direct material costs increase (decrease) by $20. You can see that direct material costs are variable because they stay the same on a per-unit basis but increase in total as production increases. Likewise, we can express the fixed-cost line as an equation. If *y* = cost of rent and *x* = units produced, then *y* = $10,000 + $0*x*. In this case, the *y*-intercept is $10,000 and the slope is zero. In other words, fixed costs are $10,000 at any level of production within the relevant range.
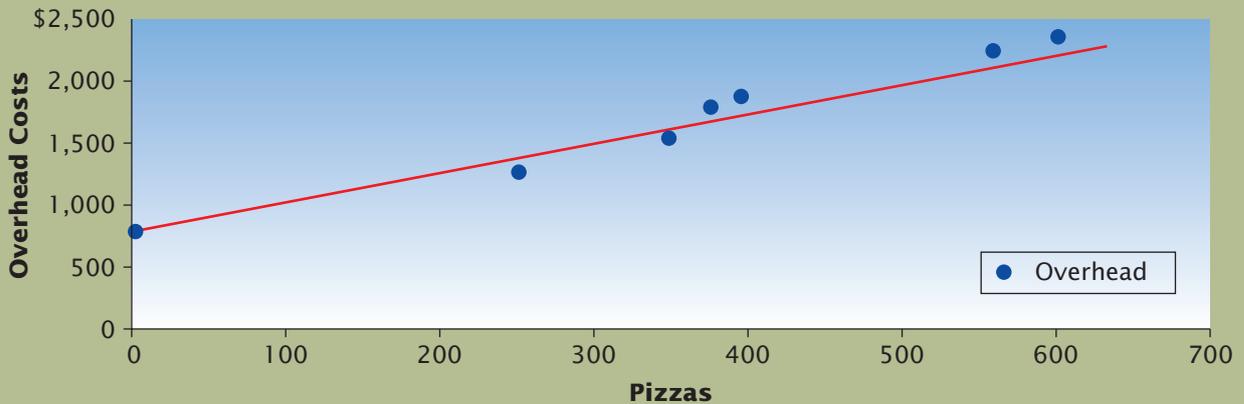
LO₂ **Mixed Costs**

The presence of **mixed costs** presents a unique challenge because they include both a fixed and a variable component. Consequently, it is difficult to predict

> **Mixed costs** Costs that include both a fixed and a variable component, making it difficult to predict the behavior of a mixed cost as production changes, unless the cost is first separated into its fixed and variable components.

the behavior of a mixed cost as production changes, unless the cost is first separated into its fixed and variable components. A good example of a mixed cost is the overhead costs of KenCor Pizza Emporium. Overhead typically has both a fixed and a variable component. For example, rent and insurance paid by KenCor would be fixed components of overhead, whereas utilities and supplies would likely be variable costs.

In the first seven weeks of operations, KenCor incurred the following overhead costs:

Week	Pizzas	Total Overhead Costs	Cost per Unit
1 (Start-up)	0	$ 679	N/A
2	423	1,842	$4.35
3	601	2,350	3.91
4	347	1,546	4.46
5	559	2,250	4.03
6	398	1,769	4.44
7	251	1,288	5.13

Is the overhead cost a fixed, variable, or mixed cost? Clearly, the cost is not fixed, because it changes each week. However, is it a variable cost? Although the cost changes each week, it does not vary in direct proportion to changes in production. In addition, remember that variable costs remain constant when expressed per unit. In this case, the amount of overhead cost per pizza changes from week to week. A cost that changes in total and also changes per unit is a mixed cost. As you can see in Exhibit 5-5, a mixed cost looks somewhat like a variable cost. However, the cost does not vary in direct proportion to changes in the level of production (you can't draw a straight line through all the data points), and if

Exhibit 5-5 Mixed Costs

Exhibit 5-5 Mixed Costs

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a line were drawn through the data points back to the *y*-axis, we would still incur overhead cost at a production volume of zero. Like a fixed cost, a mixed cost has a component that is constant regardless of production volume.

Once we know that a cost is mixed, we are left with the task of separating the mixed cost into its fixed and variable components. However, it is not clear how much of the overhead cost is fixed and how much is variable. In the next section, we will demonstrate the use of a statistical tool called regression analysis to estimate the fixed and variable components of a mixed cost.

A variety of tools can be used to estimate the fixed and variable components of a mixed cost. When we separate a mixed cost into its variable and fixed components, what we are really doing is generating the equation for a straight line, with the *y*-intercept estimating the fixed cost and the slope estimating the variable cost per unit.

Continuing our example of KenCor Pizza Emporium, we see that after the initial seven-week start-up period, the company's accountant compiles data regarding the total overhead cost

and the number of pizzas produced in the next 12 months (see Exhibit 5-6). As you can see, because the overhead cost varies in total and on a per-unit basis, it must be a mixed cost. A graph of the data is shown in Exhibit 5-7.

Exhibit 5-6 Overhead Costs per Pizza

Month	Pizzas	Overhead	Per Pizza
1	2,100	$ 8,400	$4.00
2	2,600	10,100	3.88
3	2,300	8,800	3.83
4	2,450	9,250	3.78
5	2,100	8,050	3.83
6	2,175	8,200	3.77
7	1,450	6,950	4.79
8	1,200	6,750	5.63
9	1,350	7,250	5.37
10	1,750	7,300	4.17
11	1,550	7,250	4.68
12	2,050	7,950	3.88

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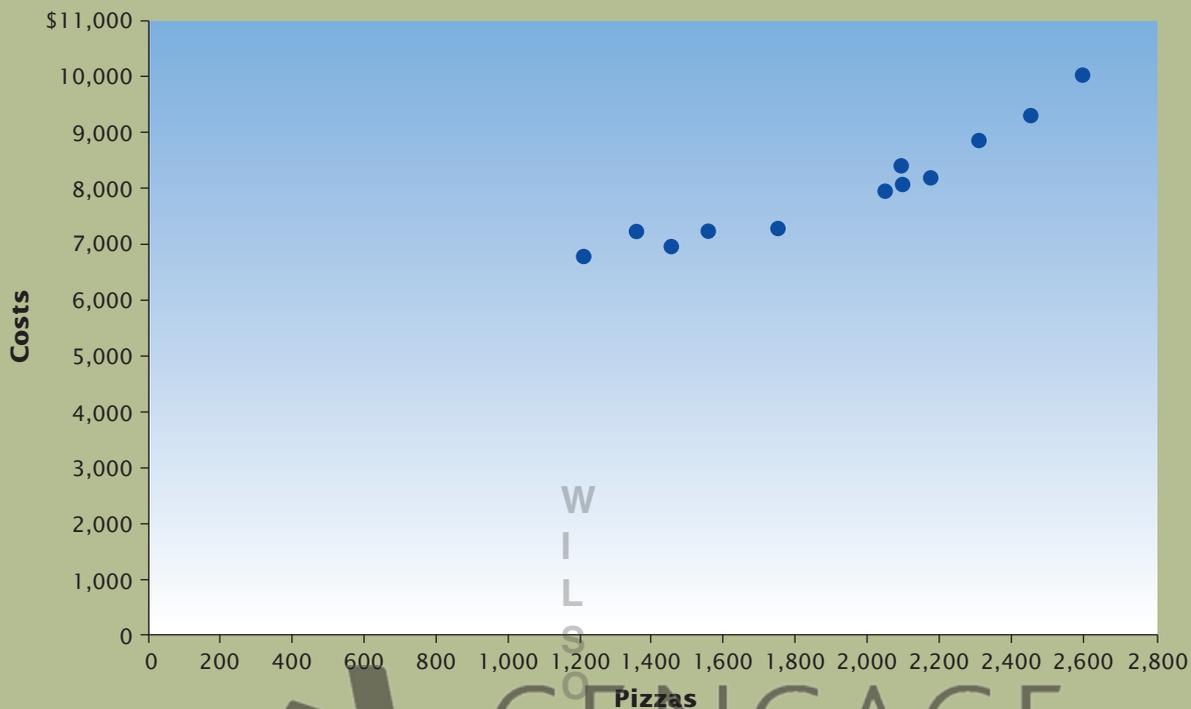## Regression Analysis

A statistical technique used to estimate the fixed and variable components of a mixed cost is called least squares regression. **Regression analysis** uses statistical

> **Regression analysis** The procedure that uses statistical methods (least squares regression) to fit a cost line (called a regression line) through a number of data points.

Exhibit 5-7 Overhead Costs for KenCor Pizza

methods to fit a cost line (called a regression line) through a number of data points. Note that although the data points in our example do not lie along a straight line, regression analysis statistically finds the line that minimizes the sum of the squared distances from each data point to the line (hence the name *least squares regression*).

Using a Spreadsheet Program to Perform Regression Analysis Using a spreadsheet program to produce regression results is a relatively simple process. We are going to use Microsoft Excel in this example, but all spreadsheet programs are similar. The first step is to enter the actual values for our mixed cost (called the **dependent variable** in regression analysis because the amount of cost is dependent on production) and the related volume of production (called the **independent variable** because it drives the cost of the dependent

Dependent variable The variable in regression analysis that is dependent on changes in the independent variable.

Independent variable The variable in regression analysis that drives changes in the dependent variable.

variable) into a spreadsheet, using one column for each variable. Employing data from KenCor Pizza Emporium for overhead costs incurred and pizzas produced for the first 12 months of operations, we see the data shown in the Excel spreadsheet in Exhibit 5-8.

The next step in Excel (see Exhibit 5-9) is to click on the Data tab and choose *data analysis* from the Analysis ribbon. From the data analysis screen, scroll down, highlight *regression,* and either double-click or choose OK.

The regression screen will prompt you to choose a number of options. The first step is to input the *y* range. The *y* range will be used to identify the dependent variable (overhead costs), found in column C of your spreadsheet. You can either type in the range of cells or simply highlight the cells in the spreadsheet (be sure not to include the column heading), and click on the icon in the *y*-range box. The next step is to select the *x* range for the independent variable (volume of pizzas). Once again, you can enter the cells directly or highlight the cells in the second column of your spreadsheet.

After inputting the appropriate *y* and *x* ranges, your Excel spreadsheet should look like the example shown in Exhibit 5-10. Click OK, and the regression model summary output appears as shown in Exhibit 5-11.

Exhibit 5-8 Regression Analysis—Step 1

	A	B	C
1	Month	Pizzas	Overhead
2	1	2,100	$8,400.00
3	2	2,600	$10,100.00
4	3	2,300	$8,800.00
5	4	2,450	$9,250.00
6	5	2,100	$8,050.00
7	6	2,175	$8,200.00
8	7	1,450	$6,950.00
9	8	1,200	$6,750.00
10	9	1,350	$7,250.00
11	10	1,750	$7,300.00
12	11	1,550	$7,250.00
13	12	2,050	$7,950.00
14			
15			
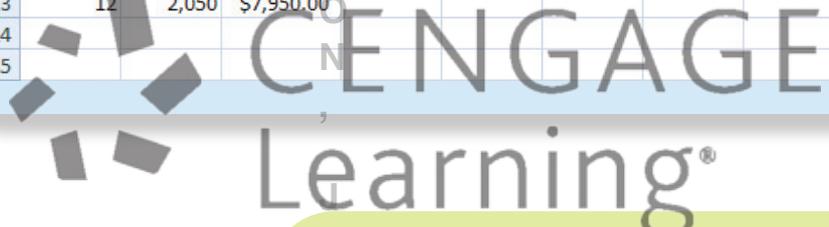
Exhibit 5-9 Regression Analysis—Step 2

Exhibit 5-10 Regression Analysis—Step 2 (continued)

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Exhibit 5-11 Regression Analysis—Summary Output


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How is the summary output interpreted? First, note toward the bottom of Exhibit 5-11 that the estimated coefficient (value) of the intercept (the *y*-intercept) is 3,998.25 and the estimated coefficient (value) of the *x* variable (the slope) is 2.09. This means that the fixed-cost component of our mixed overhead cost is estimated to be $3,998.25 and the variable-cost component is estimated to be $2.09 per pizza.

Using the least squares regression results, we can compute the regression line for overhead costs at KenCor Pizza Emporium:

Total overhead cost = Fixed cost + (Variable cost/unit × Volume)
Total overhead cost = $3,998.25 + ($2.09 × Volume)

Graphically, the line for the total overhead costs can be expressed as shown in the following illustration:
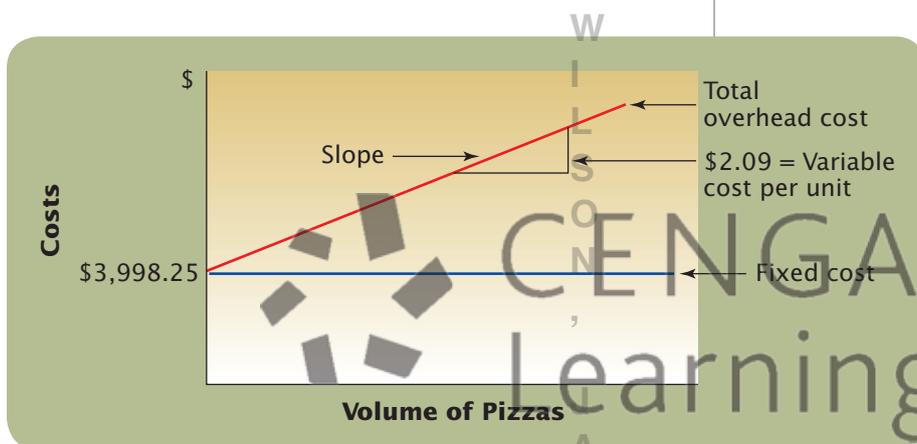
We can use the preceding equation to help predict the total amount of overhead costs that will be incurred for any number of pizzas within the relevant range. The relevant range is that range of activity within which management expects to operate, or the range in which the equation in question is useful or meaningful. Our predictions should be limited to those activity levels within the relevant range. On the basis of last year's data, KenCor expects to produce between 1,200 and 2,600 pizzas each month. Next month, KenCor expects to produce 1,750 pizzas. Using the regression equation, KenCor estimates total overhead costs to be $7,655.75 ($3,998.25 + [$2.09 × 1,750 pizzas]).

Regression Statistics   The regression statistics section at the top of Exhibit 5-11 provides useful diagnostic tools. The multiple *R* (called the *correlation coefficient*) is a measure of the proximity of the data points to the regression line. In addition, the sign of the statistic

(+ or −) tells us the direction of the correlation between the independent and dependent variables. In this case, there is a positive correlation between the number of pizzas produced and the total overhead costs. **R square** (often represented as **R^2** and called the *coefficient of determination*) is a measure of goodness of fit (how well the regression line "fits" the data). An R^2 of 1.0 indicates a perfect correlation between the independent and dependent variables in the regression equation; in other words, 100 percent of the data points are on the regression line. R^2 can be interpreted as the proportion of dependent-variable variation that is explained by changes in the independent variable. In this case, the R^2 of 0.8933 indicates that over 89 percent of the variation in overhead costs is explained by increasing or decreasing pizza production.

A low value of R^2 may indicate that the chosen independent variable is not a very reliable predictor of the dependent variable or that other independent variables may have an impact on the dependent variable. For example, the outside temperature and other environmental factors might affect overhead costs incurred by KenCor.

The presence of outliers in the data may also result in low R^2 values. Outliers are simply extreme observations—that is, observations so far from the normal activity that they may not be representative of normal business levels (they are outside of the relevant range). Under the least squares method, a regression line may be pulled disproportionately toward the outlier and result in misleading estimates of fixed and variable costs and measures of goodness of fit.

Estimating Regression Results with the High/Low Method

If we did not have access to a computer regression program or for some reason did not want to use this tool, we could estimate the regression equation by using a simpler technique called the high/low method. The

> **R square (R^2)** A measure of goodness of fit (how well the regression line "fits" the data).

high/low method uses only two data points (related to the high and low levels of activity) and mathematically derives an equation for a straight line intersecting those two data points. Though technically inferior to regression analysis (which uses all the data points), from a practical perspective the high/low method can often provide a reasonable estimate of the regression equation.

In Exhibit 5-6, the high level of activity occurred in month 2, when 2,600 pizzas were produced and $10,100 of overhead cost was incurred. The low level of activity occurred in month 8, when only 1,200 pizzas were produced and overhead costs totaled $6,750. The slope of the line connecting those two points can be calculated by dividing the difference between the costs incurred at the high and low levels of activity by the difference in volume (number of pizzas) at those levels. Remember, the slope of a line is calculated as the change in cost over the change in volume, in this case the difference in cost to produce pizzas over the difference in volume of pizzas made. As with the regression equation, the slope of the line is interpreted as the variable-cost component of the mixed cost:

$$\frac{\text{Change in cost}}{\text{Change in volume}} = \text{Variable cost per unit}$$

Inserting the data for KenCor Pizza Emporium, we find that the variable cost is $2.39 per unit ($10,100 − $6,750) ÷ (2,600 − 1,200). This result compares with our regression estimate of $2.09. We then solve for the fixed-cost component by calculating the total variable cost incurred at either the high or the low level of activity and subtracting the variable costs from the total overhead cost incurred at that level. Mathematically, if

$$\text{Total overhead costs} = \text{Fixed costs} + (\text{Variable cost per unit} \times \text{number of pizzas})$$

then

$$\text{Total overhead costs} - \text{Variable costs} = \text{Fixed costs}$$

At the high level of activity, total overhead costs are $10,100 and variable costs equal $6,214 (2,600 pizzas × $2.39 per pizza). Therefore, the fixed-cost component of overhead costs is estimated to be $3,886 (total overhead costs of $10,100, less variable costs of

$6,214), and the total overhead cost is estimated to be $3,886 + ($2.39 × number of pizzas produced).

Why is this equation different from the least squares regression equation? Regression is a statistical tool that fits the "best" line through all 12 data points, whereas the high/low method mathematically derives a straight line between just two of the data points. By using the two points at the highest and lowest levels of activity, we are forcing a line between those points without regard to the remaining data points. If one or both of the points we selected is unusual (an outlier), the result will be a cost line that is skewed and therefore may not be a good measure of the fixed and variable components of the mixed cost.

In the case of KenCor Pizza Emporium, let's see how the high/low estimate would affect our prediction of total overhead costs next month, when 1,750 pizzas will be produced. Using the high/low estimate of the cost equation, we would predict total overhead costs of $8,068.50 ($3,886 + [$2.39 × 1,750 pizzas]). This result compares with our estimate of $7,655.75 using the cost equation generated from the regression analysis.

Given the simplicity of generating regression equations with spreadsheet packages and handheld calculators, the need for using the high/low method for computing cost equations in practice is questionable. However, it remains an easy-to-use tool for estimating cost behavior.

LO3 The Impact of Income Taxes on Costs and Decision Making

We always need to consider tax laws and the impact income and other taxes have on costs, revenues, and decision making. Just as an individual should consider the impact of income taxes on a decision whether to hold or sell a stock, managers must consider the impact of taxes for a variety of decisions. The first key to understanding the impact of taxes on costs and revenues is the recognition that many costs of operating businesses are deductible for income tax purposes and that most business revenues are taxable.

After-Tax Costs and Revenues

Consider an example in which your current taxable cash revenue is $100 and tax-deductible cash expenses equal $60. As shown in Exhibit 5-12, taxable income therefore equals $40. If the income tax rate is 40 percent, $16 of income taxes will be paid, leaving you with

> **Managers must consider the impact of taxes when making decisions.**

the "real" cost of a tax-deductible expense to the business and to increase cash flow.

Income taxes also have an impact on cash revenues received by a business. Continuing our original example in Exhibit 5-12, if taxable cash revenue increases by $20, taxable income will increase to $60 ($120 − $60). After payment of $24 of income taxes, you will be left with $36 of cash. An increase in revenue of $20 increases your cash flow by only $12 ($36 − $24). Why? Because the $20 is taxable and results in the payment of an additional $8 of income tax ($20 × 0.40). Mathematically, the formula to find the after-tax benefit associated with a taxable cash revenue is analogous to the formula for after-tax cost. The after-tax benefit of a taxable cash receipt can be found by subtracting the additional income tax to be paid from the before-tax receipt or by simply multiplying the pretax receipt by (1 − tax rate):

Exhibit 5-12 The Impact of Income Taxes on Cash Flow

	Current	Increase Spending by $20	Increase Revenue by $20
Revenue	$100	$100	$120
Expense	− 60	− 80	− 60
Taxable income	$ 40	$ 20	$ 60
Tax (rate = 40%)	− 16	− 8	− 24
After-tax cash flow	$ 24	$ 12	$ 36

$24 cash after tax. Now consider the impact of spending an additional $20 on tax-deductible expenditures. This reduces your taxable income to $20. With a 40 percent income tax rate, $8 of income taxes will be paid instead of $16 (you saved $8 of income tax) and you will be left with $12 after tax. Even though you spent an additional $20, your cash flow decreased by only $12 ($24 less $12). Mathematically, the after-tax cost of a tax-deductible cash expenditure can be found by subtracting the income tax savings from the before-tax cost or by simply multiplying the before-tax amount by (1 − tax rate):

> After-tax cost = Pretax cost × (1 − tax rate)

So, if the before-tax cost is $20 and the income tax rate is 40 percent, the after-tax cost is $12 ($12 = $20 × [1 − 0.40]). In this case, the impact of income taxes is to reduce

> After-tax benefit = Pretax receipts × (1 − tax rate)

So, if the before-tax receipt is $20 and the tax rate is 40 percent, the after-tax benefit is $12 ($12 = $20 × [1 − 0.40]). In this case, the impact of income taxes is to decrease cash flow to the business.

Before- and After-Tax Income

In a similar fashion, managers can calculate the impact of income taxes on income. If we have an income tax rate of 40 percent and operating income of $1,000,000, we will have a tax liability of $400,000 (40 percent of the $1,000,000) and be left with $600,000 of after-tax income. This is exactly the same thing that happens

to our paychecks as individuals. If an individual earns $1,000 per week and faces a 30 percent income tax rate, the individual's take-home pay (after considering income tax withholding) is only $700. Mathematically,

$$\text{After-tax income} = \text{Pretax income} \times (1 - \text{tax rate})$$

Although tax laws are highly complex and computing tax due is rarely as simple as applying one rate to income, estimating the impact of income tax and other taxes on cash receipts and disbursements is important in managerial decision making.

LO4 A Comparison of Absorption Costing and Variable Costing

Earlier in this chapter, we introduced the concept of cost behavior—that is, how costs behave in relation to production volume—and described the behavior of fixed and variable costs.

Absorption Costing

In Chapter 2, a system of product costing was introduced in which all manufacturing costs, fixed and variable, were treated as product costs. Product costs include the costs of direct materials, direct labor, and all manufacturing overhead (both fixed and variable). You will recall that product costs attach to the product and are expensed only when the product is sold. Commonly called **absorption costing**, or **full costing**, this method is required both for external financial statements prepared under generally accepted accounting principles (GAAP)

and for income tax reporting. Selling, general, and administrative costs, also called period costs, are expensed immediately in the period in which they are incurred.

In contrast, **variable costing**, or **direct costing**, treats only variable product costs (the costs of direct materials, direct labor, and variable manufacturing overhead) as product costs and treats fixed manufacturing overhead as a period cost (along with selling, general, and administrative costs). Variable costing is more consistent with the focus of cost–volume–profit analysis (discussed in Chapter 6) on differentiating fixed from variable costs, and it provides useful information for internal decision making that is often not apparent when using absorption costing.

Variable Costing

Exhibit 5-13 provides a summary of the two costing methods. As you can see, *the only difference between absorption and variable costing is the treatment of fixed overhead.* Under absorption costing, fixed overhead is treated as a product cost, added to the cost of the product and expensed only when the product is sold. Under variable costing, fixed overhead is treated as a period cost and is expensed when incurred. The impact of this difference on reported income becomes evident when a company's production and sales are different (that is, when the number of units produced is greater than or less than the number of units sold).

Because absorption costing treats fixed overhead as a product cost, if units of production remain unsold at year's end, fixed overhead remains attached to those units and is included on the balance sheet as an asset as part of the cost of inventory. With variable costing, all fixed overhead is expensed each period, regardless of the level of production or sales. Consequently, when production is greater than sales and inventories increase, absorption costing will result in higher net income than variable costing.

Absorption (full) costing A method of costing in which product costs include the costs of direct materials, direct labor, and fixed and variable overhead; required for external financial statements and for income tax reporting.

Variable (direct) costing A method of costing in which product costs include the costs of direct materials, direct labor, and variable overhead; fixed overhead is treated as a period cost; variable costing is consistent with CVP's focus on cost behavior.

Exhibit 5-13 Absorption and Variable Costing

Absorption Costing		Variable Costing	
Product Costs	**Period Costs**	**Product Costs**	**Period Costs**
Direct materials		Direct materials	
Direct labor	Selling, general, and administrative costs	Direct labor	Selling, general, and administrative costs
Variable overhead		Variable overhead	
Fixed overhead			*Fixed overhead*

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LO5 The Impact of Absorption Costing and Variable Costing on the Income Statement

The only difference between absorption and variable costing is the treatment of fixed overhead.

LuLu's Lockets is a custom jeweler manufacturing unique lockets. LuLu's CFO, Elise, is concerned about choosing the best costing method (variable vs. absorption) to allow her to make the best decision regarding management compensation and to more easily understand the impact of production volume on the income statement. LuLu's Lockets produces 100,000 units each year, with the following per-unit costs: direct material of $0.30, direct labor of $0.35, and variable overhead of $0.10 per unit. Fixed manufacturing overhead costs are $30,000. The company also has variable selling and administrative costs of $0.05 per unit sold and fixed selling and administrative costs of $10,000.

The selling price of each locket is $2. The cost of one unit of product under absorption costing and variable costing is calculated as follows:

Product Costs			
Absorption Costing		**Variable Costing**	
Direct material	$0.30	Direct material	$0.30
Direct labor	0.35	Direct labor	0.35
Variable overhead	0.10	Variable overhead	0.10
Fixed overhead	0.30		
Total per unit	$1.05	Total per unit	$0.75

The only difference between the two methods is $0.30 of fixed overhead ($30,000 ÷ 100,000 units), which is treated as a product cost under absorption costing and a period cost under variable costing.

Year 1 Income Comparison

Let's assume that in year 1 all 100,000 units that are produced are sold. Then how much income would be reported under each method? To answer this question, remember that, under absorption costing, fixed manufacturing overhead costs are expensed as part of cost of goods sold. Under variable costing, fixed manufacturing overhead costs are deducted as a fixed period cost. Regardless, when all units produced are sold, the net operating income reported under each method would be the same.

Year 1 Comparison of Absorption and Variable Costing			
(100,000 Units Produced and Sold)			
Absorption Costing		**Variable Costing**	
Sales	$200,000	Sales	$200,000
Less: Cost of goods sold	105,000	Less: Variable costs	80,000
Gross profit	$ 95,000	Contribution margin	$120,000
Less: S&A costs	15,000	Less: Fixed costs	40,000
Net operating income	$ 80,000	Net operating income	$ 80,000

Year 2 Income Comparison

Let's suppose that in the next year LuLu's Lockets produces 100,000 units (for the same costs) but, because of a very slow Christmas season, sells only 80,000 units. In this case, the variable-costing method would expense the entire $30,000 of fixed manufacturing overhead as a period cost, whereas the absorption-costing method would expense only $24,000 (80,000 units sold × $0.30 per unit). When production exceeds sales, absorption costing will report higher net operating income than variable costing will. Part of the $30,000 of fixed overhead (20,000 unsold units × $0.30 per unit, or $6,000) remains in inventory until those units are sold. The question for Elise is which method more closely represents what actually happened in the second year, when production exceeded sales. Fixed overhead does not change with changes in sales volume, so variable costing seems to report a more accurate picture of the company's actual costs. Variable costing allows Elise to look at the contribution of each item sold to the
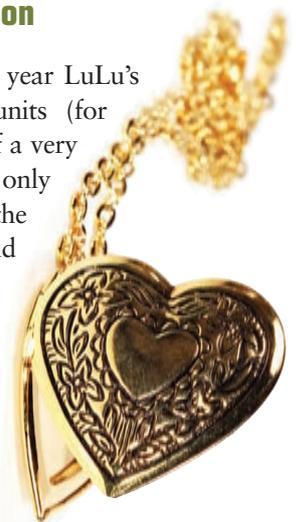
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Year 2 Comparison of Absorption and Variable Costing

(100,000 Units Produced and 80,000 Units Sold)

Absorption Costing		Variable Costing	
Sales	$160,000	Sales	$160,000
Less: Cost of goods sold*	84,000	Less: Variable costs	64,000
Gross profit	$ 76,000	Contribution margin	$ 96,000
Less: S&A costs	14,000	Less: Fixed costs†	40,000
Net operating income	$ 62,000	Net operating income	$ 56,000

*Cost of goods sold includes $24,000 (80,000 × $0.30) of fixed manufacturing overhead.
†Fixed costs include $30,000 of fixed manufacturing overhead.

company's overall profit, whereas absorption costing distorts that analysis by including fixed manufacturing overhead in the sales data when, in fact, that cost is incurred regardless of the sales volume.

Year 3 Income Comparison

In Year 3, LuLu's Lockets holds production constant at 100,000 units, but increases sales to 120,000 units (the 20,000 units left over from Year 2 were sold, in addition to all of the production for the third year). In this case, under variable costing, $30,000 of fixed manufacturing overhead would be expensed as a period cost. Under absorption costing, the $30,000 would be expensed along with an additional $6,000 related to the 20,000 units produced in Year 2 and sold in Year 3 (20,000 units × $0.30 per unit = $6,000). When units sold exceed units produced, variable costing will report higher net operating income than will absorption costing. Remember from our previous discussion of cost behavior that fixed costs

Year 3 Comparison of Absorption and Variable Costing

(100,000 Units Produced and 120,000 Units Sold)

Absorption Costing		Variable Costing	
Sales	$240,000	Sales	$240,000
Less: Cost of goods sold*	126,000	Less: Variable costs	96,000
Gross profit	$114,000	Contribution margin	$144,000
Less: S&A costs	16,000	Less: Fixed costs†	40,000
Net operating income	$ 98,000	Net operating income	$104,000

*Cost of goods sold includes $36,000 (120,000 × $0.30) of fixed manufacturing overhead.
†Fixed costs include $30,000 of fixed manufacturing overhead.

remain constant from year to year regardless of sales volume. Absorption costing delays the expensing of a portion of the fixed cost incurred in Year 2 until all units are sold in Year 3. By contrast, variable costing results in the expensing of fixed costs in the year in which they are incurred.

Note that, over the three-year period, the total income is the same under each method. Why? Because when units produced are equal to units sold, the net operating income reported under each method is the same. Although production was greater than sales in Year 2 and sales were greater than production in Year 3, over the three-year period the company produced and sold 300,000 units.

	Year 1	Year 2	Year 3	Total
Production	100,000	100,000	100,000	300,000
Sales	100,000	80,000	120,000	300,000
Absorption Costing				
Sales	$200,000	$160,000	$240,000	$600,000
Less: Cost of goods sold	105,000	84,000	126,000	315,000
Gross margin	$ 95,000	$ 76,000	$114,000	$285,000
Less: S&A costs	15,000	14,000	16,000	45,000
Net operating income	$ 80,000	$ 62,000	$ 98,000	$240,000
Variable Costing				
Sales	$200,000	$160,000	$240,000	$600,000
Less: Variable costs	80,000	64,000	96,000	240,000
Contribution margin	$120,000	$ 96,000	$144,000	$360,000
Less: Fixed costs	40,000	40,000	40,000	120,000
Net operating income	$ 80,000	$ 56,000	$104,000	$240,000

To summarize (see Exhibit 5-14), in Year 1, when *units sold equaled units produced,* net operating income was the same under both costing methods. In Year 2, when *units produced exceeded units sold,* absorption costing reported higher net operating income than variable costing did. In Year 3, when *units sold exceeded units produced,* variable costing reported higher net operating income than absorption costing did.

Exhibit 5-14 Production, Sales, and Income Under Absorption Costing and Variable Costing

When Production = Sales	Absorption Income = Variable Income
When Production > Sales	Absorption Income > Variable Income
When Production < Sales	Absorption Income < Variable Income

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LO6 Variable Costing and Decision Making

> *Variable costing is consistent with CVP's focus on differentiating fixed and variable costs and provides useful decision-making information that is often not apparent when using absorption costing.*

The use of absorption costing for internal decision making can result in less-than-optimal decisions. For example, consider the case of the unemployed executive who offered his services to a manufacturing company for only $1 per year in salary and a bonus equal to 50 percent of any increase in net income generated for the year. Reviewing the absorption-costing income statement for the previous year, he learned that although 10,000 units of product were produced and sold, the company had the capacity to produce 20,000 units. In addition, variable production costs were $40 per unit, variable selling and administrative (S&A) costs were $10 per unit sold, fixed manufacturing overhead costs were equal to $300,000 ($30 per unit produced), and fixed selling and administrative costs were equal to $100,000. As shown here, the previous year's net operating income was $100,000:

Absorption Costing Income (10,000 Units Produced)	
Sales (10,000 units)	$1,000,000
Less: Cost of goods sold*	700,000
Gross profit	$ 300,000
Less: S&A costs	200,000
Net operating income	$ 100,000

*Includes $300,000 (10,000 units × $30) of fixed manufacturing overhead.

By increasing production to 20,000 units, the allocation of fixed manufacturing overhead is reduced to $15 per unit ($300,000 ÷ 20,000 units = $15). Remember that, under absorption costing, fixed overhead is a product cost and is expensed only when the product is sold. Therefore, only $150,000 of fixed overhead costs will be expensed. The remaining $150,000 of fixed manufacturing overhead costs is included in inventory and is reported as an asset on the balance sheet. The cost of goods sold is reduced to $550,000, and net income is increased by $150,000, to $250,000. The manager is entitled to a bonus of $75,000, whereas the company is saddled with 10,000 units of unsold inventory and the attendant costs of storing and insuring it!

Absorption Costing Income (20,000 Units Produced)	
Sales (10,000 units)	$1,000,000
Less: Cost of goods sold*	550,000
Gross profit	$ 450,000
Less: S&A costs	200,000
Net operating income	$ 250,000

*Includes $150,000 (10,000 units × $15) of fixed costs.

If income had been measured with a variable costing approach, net operating income would be the same each year and the manager would not have been able to pull off his scheme.

Variable Costing Income			
(10,000 units produced)		**(20,000 units produced)**	
Sales (10,000 units)	$1,000,000	Sales (10,000 units)	$1,000,000
Variable costs	500,000	Variable costs	500,000
Contribution margin	$ 500,000	Contribution margin	$ 500,000
Fixed costs	400,000	Fixed costs	400,000
Net operating income	$ 100,000	Net operating income	$ 100,000

So, where are the costs that resulted from the increased production? Under variable costing, those production costs are attached to the inventory and are on the balance sheet as inventory. The fixed costs, under variable costing, are expensed each period in total, regardless of the level of production.

Problems like these are less common in a just-in-time (JIT) environment, in which inventory levels are minimized and companies strive to produce only enough products to meet demand.

Choosing the Best Method for Performance Evaluation

For external reporting purposes, managers have no choice but to use absorption costing, as it is required by GAAP. Managers are also required to use absorption costing for filing annual income tax returns. However, for internal decision making, variable costing is often the best choice. If income is used to evaluate the performance of a manager of a division or segment of a company, it seems logical that the measure of income should reflect managerial effort and skill. If sales decrease from one period to another with no changes in production or other factors, it seems logical that income should decrease as it does under variable costing. In contrast, increasing income by increasing production with no corresponding increase in sales (as is possible with absorption costing) is counterintuitive. All other things being equal, increases in sales should result in increases in income and decreases in sales should result in decreases in income.

So, using variable costing for internal decision making removes the impact of changing production levels on income. Accordingly, calculations of income are more likely to reflect managerial skill rather than simply an increase in production. If a manager's compensation package is based on net income, using absorption costing may motivate that manager to increase production simply to increase income. Under variable costing, managers are more likely to make optimal production volume decisions.

> Variable costing offers many benefits that focus on managerial performance and cost behavior.

Advantages of Variable Costing

Absorption costing is required by GAAP and must be used whenever a company provides financial statements to individuals outside the company. However, for internal management purposes, variable costing would seem to be a better choice. Variable costing has the following advantages:

- Changes in production and inventory levels do not affect the calculation of profits.
- Variable costing focuses attention on relevant product costs. That is, attention is focused on variable product costs, which can be avoided, rather than on fixed product costs, which are often unavoidable.
- Under variable costing, cost behavior is emphasized and fixed costs are separated from variable costs on the income statement.
- Variable costing is consistent with variance analysis, an important tool used to manage a business.
- Variable costing income is more closely aligned with a company's cash flows.

STUDY TOOLS 5

Chapter review card

- ❯ Learning Objective and Key Concept Reviews
- ❯ Key Definitions and Formulas

Online (Located at www.cengagebrain.com)

- ❯ Flash Cards and Crossword Puzzles
- ❯ Games and Quizzes
- ❯ Zingerman's Deli Video and E-Lectures
- ❯ Homework Assignments (as directed by your instructor)

BRIEF EXERCISES

1. Understanding Fixed Costs and Variable Costs LO1

Cost behavior is fundamentally important concept to managerial accounting. The following statements describe various aspects of cost behavior:

a. Facility-level costs include production labor, raw materials, and utilities.
b. Fixed costs vary in direct proportion to changes in production volume, but are constant when expressed on a per-unit basis.
c. The normal range of production expected for a particular product and company is called the relevant range.
d. Assumptions about the behavior of fixed and variable costs are expected to hold inside and outside the relevant range.
e. Costs that vary, but only with relatively large changes in production volume, are often called step costs.
f. The cost equation $y = a + bx$ can be used to describe fixed costs, but not variable costs.

Required
Indicate whether each of the preceding statements is true or false.

2. Mixed Costs Using High/Low Method LO2

PG Phones accumulated the following production and overhead cost data for the past five months related to its production of cell phones:

	Production (cell phones)	Overhead Cost
January	13,600	$34,500
February	11,500	29,500
March	12,750	30,100
April	14,300	35,940
May	13,250	32,650

Required
A. Use the high/low method to calculate the variable cost per unit and fixed costs for PG Phones.
B. What are estimated total costs for production of 13,000 cell phones?

3. The Impact of Income Taxes LO3

Decisions frequently have income tax implications for a business. The following table includes data about mutually exclusive income tax scenarios:

Before-Tax Revenue	Tax Rate	After-Tax Revenue
?	30%	$63,000
$78,000	?	58,500
125,000	20%	?

Before-Tax Cost	Tax Rate	After-Tax Cost
$60,000	15%	?
?	25%	$60,000
96,000	?	62,400

Required
Calculate the missing values for each of the preceding transactions.

4. Absorption Costing vs. Variable Costing LO4

The difference between absorption costing and variable costing is relatively straightforward, but students often have difficulty mastering the material.

Item	Absorption Costing	Variable Costing
Direct materials		
Variable manufacturing overhead		
Fixed selling and administrative costs		
Direct labor		
Fixed manufacturing overhead		
Variable selling and administrative costs		

Required
Label each of the preceding items as to whether it is treated as a *product cost* or a *period cost* for absorption costing and variable costing.

5. Calculating Unit Cost under Absorption Costing and Variable Costing LO5

Companies use absorption costing and variable costing for different purposes. Understanding the difference in unit cost that results from these methods is necessary for sound decision making. The following production, cost, and pricing data are available:

Units in beginning inventory	0
Units produced	12,000
Units sold	10,500
Sales price per unit	$22
Variable costs per unit:	
Direct materials	$7
Direct labor	4
Manufacturing overhead	2
Selling and administrative	1
Fixed costs in total:	
Manufacturing overhead	$36,000
Selling and administrative	50,000

Required
Calculate the cost per unit, using absorption costing and variable costing.

6. Comparing Income under Absorption and Variable Costing LO6

Refer to the data in Brief Exercise 5.

Required
Calculate the net operating income for the company, using absorption costing and variable costing.

7. Cost Behavior LO1

Baby Toys Co. produces fine porcelain dolls that are sold in exclusive gift shops. The controller and sales manager are discussing possible price increases and have started looking at various costs to consider their potential impact on price. The following are several of the costs they are discussing:

a. Advertising
b. Packaging (each doll is carefully packaged in a nicely designed collectible carton)
c. Supervisors' salaries
d. Fabric used in production (each doll is adorned in unique fabrics)
e. Assembly labor
f. Mortgage payment on the production facility
g. Production facility utilities
h. Quality assurance (each doll is carefully inspected)

Required

Assist the controller and sales manager by indicating whether each of the preceding costs is most likely a fixed cost (FC) or a variable cost (VC).

8. Calculation of Total Costs LO1

Doors and Keys, Inc., provides custom creation of door locks for expensive homes. The company has recently become concerned about its ability to plan and control costs. Howard Lockwood, the company's founder, believes that he can summarize the company's monthly cost with a simple formula that appears as "Cost = $12,800 + $25.00 per labor hour."

Required

If Doors and Keys's employees work 850 hours in a single month, calculate an estimate of the company's total costs.

9. Cost Behavior Analysis LO1

Sisters Erin Joyner and Teresa Hayes have started separate companies in the same city. Each company provides party-planning services for weddings, birthday parties, holiday parties, and other occasions. Erin and Teresa graduated from Upper State University and completed a managerial accounting course, so they both understand the importance of managing their company's costs. On the one hand, Erin has estimated her cost equation to be "Total cost = $4,000 + $40 per planning hour." On the other hand, Teresa has estimated her cost equation to be "Total cost = $250 + $60 per planning hour."

Required

A. What could explain such a difference in the cost equations?
B. If each sister works a total of 135 planning hours, what total costs would each report?

10. Mixed Costs and the Cost Equation LO1

Carla Janes and Associates incurred total costs of $10,000 to produce 500 custom mirrors. A total of 550 direct labor hours was required for the production of the mirrors. Direct labor is variable and costs $10 per hour.

Required

How much fixed cost did Carla Janes and Associates incur?

11. Cost Behavior: Step Costs LO1

Sara Ouellette has leased a new automobile under a special lease plan. If she drives the car 1,000 miles or less during a one-month period, the lease payment is $250. If the mileage ranges between 1,001 and 1,500 miles, the lease payment becomes $300. If the mileage ranges between 1,501 and 2,000 miles, the lease payment rises to $350.

Required

A. What type of cost is the lease?
B. If Sara drives the car only between 1,200 and 1,400 miles per month, then what type of cost does the lease effectively become?

12. Fixed and Variable Cost Behavior LO1

Killy's Baskets has the following current-year costs:

Variable costs	$6 per unit
Fixed costs	$7,000

Killy and a key supplier have entered into an arrangement that will result in a per-unit decrease in Killy's variable cost of $0.50 next year. Rental space will also be reduced, thereby decreasing fixed costs by 10 percent.

Required

A. If the company makes these changes, what is the new cost equation?
B. Given the new cost equation, determine estimated total costs if production remains at 12,000 units.

13. Regression Analysis: Calculation of Total Cost LO2

Valentine is a manufacturer of fine chocolates. Recently, the owner, Melinda Gross, asked her controller to perform a regression analysis on production costs. Melinda believes that pounds of chocolate produced drive all of the company's production costs. The controller generated the following regression output:

	R Square	0.50688
	Standard Error	1.43764

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	418.52992	481.52992
Residual	197	407.16375	2.06682
$F = 202.49935$	Signif. $F = 0.0000$		

Variables in the Equation

Variable	Coefficients	Standard Error	t Stat	P-Value
Pounds	7.940	0.055794	14.230	0.0000
Intercept	204.070	0.261513	20.780	0.4361

Required

Calculate an estimated total cost, assuming that Valentine manufactures 5,000 pounds of chocolate.

14. Mixed Costs Using High/Low Method LO2

Gregory's Gems accumulated the following production and overhead cost data for the past five months:

	Production (units)	Overhead Cost
January	10,600	$40,250
February	10,500	40,000
March	11,500	44,250
April	12,500	45,500
May	11,000	43,750

Required

A. Use the high/low method to calculate the variable cost per unit and fixed costs for Gregory's Gems.
B. What are estimated total costs for production of 12,000 units?

15. Mixed Costs Using High/Low Method LO2

Captain Co. used the high/low method to derive the cost formula for electrical power cost. According to the cost formula, the variable cost per unit of activity is $3 per machine hour. Total electrical power cost at the high level of activity was $7,600 and was $7,300 at the low level of activity. The high level of activity was 1,200 machine hours.

Required

Calculate the low level of activity.

16. Calculate Variable Cost Using High/Low Method LO2

Delia, Inc., is preparing a budget for next year and requires a breakdown of the cost of steam used in its factory into fixed and variable components. The following data on the cost of steam used and direct labor hours worked are available for the last six months:

	Cost of Steam	Direct Labor Hours
July	$ 15,850	3,000
August	13,400	2,050
September	16,370	2,900
October	19,800	3,650
November	17,600	2,670
December	18,500	2,650
	$101,520	16,920

Required

A. Use the high/low method to calculate the estimated variable cost of steam per direct labor hour.
B. Prepare a graph of the cost of steam and the direct labor hours. Show labor hours on the *x*-axis and cost on the *y*-axis. What can you observe from the graph you prepared? (Hint: Set the minimum *y*-axis value to $11,000.)

17. Impact of Income Taxes LO3

Ben Rakusin is contemplating an expansion of his business. He believes he can increase revenues by $9,000 each month if he leases 1,500 additional square feet of showroom space. Rakusin has found the perfect showroom. It leases for $4,000 per month. Ben's tax rate is 30 percent.

Required

What estimated after-tax income will Rakusin earn from his expansion?

18. Impact of Income Taxes LO3

Most business transactions have tax consequences. Understanding the after-tax effects of transactions is fundamentally important. Consider the following:

Before-Tax Revenue	Tax Rate	After-Tax Revenue
$100,000	40%	?
200,000	20%	?
135,000	35%	?

Before-Tax Cost	Tax Rate	After-Tax Cost
$25,000	40%	?
50,000	20%	?
35,000	35%	?

Required

Calculate the after-tax revenue or after-tax cost for each of the preceding transactions.

19. Impact of Income Taxes LO3

Barnett Corporation anticipates net operating income (before tax) of $1,200,000 this year. The company is considering signing an equipment lease that would result in a $175,000 deductible expense this year. The company's tax rate is 35 percent.

Required

A. What are the tax expense and net income after taxes for the anticipated net income without the lease of the equipment?
B. What are the tax expense and net income after taxes if the equipment is leased?

20. Variable Costing: Calculation of Unit Variable Cost LO4, 5

Yankee Doodle Dandy Candy Company manufactures a single product, an awesome chocolate bar. Last year, the company produced 4,000 bars and sold 3,500 of them. Yankee Doodle Dandy had no candy bars at the beginning of the year. The company has the following costs:

Variable costs per unit:	
Production	$ 4.00
Selling and administrative	$ 1.00
Fixed costs in total:	
Production	$12,000
Selling and administrative	$ 8,000

Required

Calculate the unit product cost, assuming that the company uses variable costing.

21. Absorption Costing vs. Variable Costing LO4, 5, 6

Munn Bicycle Company manufactures bicycles specifically for college campuses. The bicycles sell for $100 and are very sturdy, with built-in saddlebags on the rear designed to carry backpacks. Selected data for last year's operations are as follows:

Units in beginning inventory	0
Units produced	20,000
Units sold	18,000
Units in ending inventory	2,000
Variable costs per unit:	
Direct materials	$40
Direct labor	20
Variable manufacturing overhead	5
Variable selling and administrative	2
Fixed costs:	
Fixed manufacturing overhead	$250,000
Fixed S&A	$100,000

Required

A. What is the product cost per bicycle if the company uses absorption costing?
B. What is the product cost per bicycle if the company uses variable costing?

22. Absorption Costing: Calculation of Unit Variable Cost LO5

Lisa's Lockets manufactures a single product, a diamond locket. Last year, the company produced 4,000 lockets and sold 3,500 of them. They had no lockets at the beginning of the year. The company has the following costs:

Variable costs per unit:	
Production	$ 4.00
Selling and administrative	$ 1.00
Fixed costs in total:	
Production	$12,000
Selling and administrative	$ 8,000

Required

Calculate the unit product cost, assuming that the company uses absorption costing.

23. Absorption Costing vs. Variable Costing: Calculation of Net Operating Income LO4, 5, 6

Refer to the data in Exercise 21.

Required

A. Prepare income statements for each costing method.
B. Explain the difference between the two income statements.
C. If, in the next year of operation, 20,000 units are produced and 21,000 units are sold, what would the net operating income be under each costing method? Explain the difference. (Assume that there is no change in the variable cost per unit or the fixed costs.)

24. Absorption Costing vs. Variable Costing: Calculation of Net Operating Income LO4, 5, 6

Posey Manufacturing has the following cost information available for the most current year.

Direct materials	$6.00 per unit
Direct labor	$4.00 per unit
Variable manufacturing overhead	$2.00 per unit
Variable S&A costs	$1.00 per unit
Fixed manufacturing overhead	$80,000
Fixed S&A costs	$25,000

During the year, Posey produced 12,500 units, out of which 11,000 were sold for $60 each.

Required

A. Produce an income statement using variable costing.
B. Produce an income statement using absorption costing.
C. If Posey needs to take one of these income statements to the bank to apply for a loan, which one should he use? Why?
D. For internal decision making, which income statement would be more useful? Why?

25. Absorption Costing vs. Variable Costing LO4, 5

McIntyre Manufacturing produces a single product. Last year, the company produced 20,000 units, out of which 18,000 were sold. There were no units in

beginning inventory. The company had the following costs:

Variable costs per unit:	
Production	$ 10.00
S&A	$ 4.00
Fixed costs (total):	
Production	$40,000
S&A	$20,000

Required
A. Calculate McIntyre's product cost per unit, assuming that the company uses variable costing.
B. Calculate McIntyre's product cost per unit, assuming that the company uses absorption costing.
C. Calculate McIntyre's total period cost, assuming that the company uses variable costing.
D. Calculate McIntyre's total period cost, assuming that the company uses absorption costing.
E. Explain the differences in product cost and period cost between the two costing methods.

26. Variable Costing: Calculation of Net Operating Income LO5

Kristi Bostock started Bostock Boutique three years ago. Her business has grown handsomely, and she now produces and sells thousands of items each year. Selected operational and financial data are as follows:

Units in beginning inventory	0
Units produced	20,000
Units sold	19,000
Selling price per unit	$ 100
Variable costs per unit:	
Direct materials	$ 12.00
Direct labor	25.00
Manufacturing overhead	3.00
Selling and administrative	2.00
Fixed costs in total:	
Manufacturing overhead	$500,000
Selling and administrative	$600,000

Required
Calculate Bostock Boutique's net operating income, assuming that the company uses variable costing.

27. Absorption Costing: Calculation of Net Operating Income LO5

Refer to the data in Exercise 26.

Required
Calculate Bostock Boutique's net operating income, assuming that the company uses absorption costing.

28. Absorption Costing vs. Variable Costing: Calculation of Net Operating Income LO5, 6

Simmons Products has the following cost information available for the most recent year.

Direct materials	$4.00 per unit
Direct labor	$3.00 per unit
Variable manufacturing overhead	$2.00 per unit
Variable S&A costs	$1.00 per unit
Fixed manufacturing overhead	$25,000
Fixed S&A costs	$10,000

During the year, Simmons produced 5,000 units, out of which 4,600 units were sold for $30 each.

Required
A. Calculate Simmons's net operating income, assuming that the company uses variable costing.
B. Calculate Simmons's net operating income, assuming that the company uses absorption costing.

29. Variable Costing and Absorption Costing: Calculation of Net Operating Income LO5, 6

Graham Warner started Warner's Watches four years ago. His business has grown handsomely, and he now produces and sells thousands of watches each year. Selected operational and financial data are as follows:

Units in beginning inventory	0
Units produced	25,000
Units sold	20,000
Selling price per unit	$ 100
Variable costs per unit:	
Direct materials	$ 10.00
Direct labor	30.00
Manufacturing overhead	4.00
Selling and administrative	1.00
Fixed costs in total:	
Manufacturing overhead	$400,000
Selling and administrative	$300,000

Required
A. Calculate Warner's Watches's net operating income, using variable costing.
B. Calculate Warner's Watches's net operating income, using absorption costing.

30. Variable Costing and Absorption Costing: Calculation of Net Operating Income LO5, 6

Gumby's Gum produces large amounts of gum each year. This year, Gumby's produced 45,000 packs of gum but sold only 42,000 of the packs. Each pack sells for $1.50. Selected operational and financial data are as follows:

Variable costs per unit:	
Production	$ 0.50
S&A	0.10
Fixed costs in total:	
Production	$6,000
S&A	$3,000

Required

A. Calculate Gumby's net operating income, using variable costing.
B. Will operating income be higher or lower if calculated with absorption costing?
C. By how much?

31. Variable Costing and Absorption Costing: Calculation of Net Operating Income LO5, 6

Entel Corporation creates an accounting computer program. This year, Entel Corporation produced 20,000 units of its program and sold 22,000 units. Each unit sells for $250. Selected operational and financial data are as follows:

Variable costs per unit:	
Direct materials	$ 15.00
Direct labor	40.00
Manufacturing overhead	5.00
Selling and administrative	2.00
Fixed costs per unit:	
Manufacturing overhead	$200,000
Selling and administrative	$150,000

Required

A. Calculate Entel's net operating income, using absorption costing.
B. Will operating income be higher or lower if calculated with variable costing?
C. By how much?

32. Absorption Costing vs. Variable Costing: Benefits and Calculation of Net Operating Income LO5, 6

Tammond Tire Manufacturing produces truck tires. Current market conditions indicate a significant increase in demand in 2013 for their tires. In anticipation of that increase, the CEO has ordered the production plants to increase production by 25 percent in 2012. Because sales are projected to remain stable in 2012, that will result in a 25 percent increase in inventory levels by the end of 2012.

Required

Discuss the impact on operating income in 2012, using variable and absorption costing. What causes the difference? Tammond Tire is required to provide the bank with financial statements at the end of each year. What do you think the bank will think of the 2012 income statement? If the market projections prevail and sales increase by 25 percent in 2013, what will be the impact on the 2013 income statement, using both costing methods?

PROBLEMS

33. Regression vs. High/Low Method LO1, 2

Tools Are Us Corporation produces toolboxes used by construction professionals and homeowners. The company is concerned that it does not have an understanding of its utility consumption. The company's president, George, has asked the plant manager and cost accountant to work together to get information about utilities cost. The two of them accumulated the following data for the past 14 months (production volume is presented in units):

	Production	Utility Cost
January	113,000	$1,712
February	114,000	1,716
March	90,000	1,469
April	110,000	1,600
May	112,000	1,698
June	101,000	1,691
July	104,000	1,700
August	105,000	1,721
September	115,000	1,619
October	97,000	1,452
November	98,000	1,399
December	98,000	1,403
January	112,000	1,543
February	107,000	1,608

Required

A. Use the high/low method to determine the company's utility cost equation.
B. What would be the expected utility cost of producing 120,000 units? (The relevant range is 85,000 to 125,000 units of production.)
C. Using the data shown and a spreadsheet program, perform a regression analysis. Discuss any differences in the results and the potential impact on decision making.

34. Regression Analysis Interpretation LO1, 2

Global Office Services & Supplies sells various products and services in the greater Wentworth area. Duplicating is one of its most popular services for corporate customers and individuals alike. Selected data from the Duplicating Department for the previous six months are as follows:

	Number of Copies Made	Duplicating Department's Costs
January	20,000	$1,700
February	25,000	1,950
March	27,000	2,100
April	22,000	1,800
May	24,000	1,900
June	30,000	2,400

Regression output based on the previous data is as follows:

Coefficient of intercept	280.79
R square	0.967696
Number of observations	6
X coefficient (independent variable)	0.0687

Required
A. What is the variable cost per copy for Global Office Services & Supplies?
B. What is the fixed cost for the Duplicating Department?
C. Given the limited regression output shown, what cost formula should be used to compute an estimate of future total costs in the Duplicating Department?
D. If 26,000 copies are made next month, what total cost would be predicted?
E. On the basis of the information given, how accurate will the cost formula developed in response to question C be at predicting total Duplicating Department costs each month?

35. Basic Cost Behavior, High/Low Method LOI, 2

Simon and Garfunkel operate separate, but related, businesses in the same town. The two have been debating which of them has the least amount of fixed costs. Simon, because he has always come first, believes his business has lower fixed costs than Garfunkel's business. Of course, Garfunkel disagrees, saying that his business has lower fixed costs. The two have accumulated the following activity and cost data and have asked that you help them resolve their debate:

Simon's Business Data

Units Produced	Utilities	Rent	Indirect Labor
1,000	$10,000	$15,000	$13,000
1,500	12,500	15,000	15,600

Garfunkel's Business Data

Units Produced	Utilities Expense	Rent	Indirect Labor
2,000	$24,250	$21,000	$22,000
8,000	66,250	21,000	88,000

Required
A. Classify each of Simon's and Garfunkel's expenses as a fixed, variable, or mixed cost.
B. Calculate the total-cost formula for each business. Which business has lower fixed costs?
C. If Simon produces 1,300 units, what would his total costs be?
D. If Garfunkel produces 1,300 units, what would his total costs be?

36. Regression Analysis LOI, 2

Same Day Delivery wants to determine the cost behavior pattern of maintenance costs for its delivery vehicles. The company has decided to use linear regression to examine the costs. The previous year's data regarding maintenance hours and costs are as follows:

	Hours of Activity	Maintenance Costs
January	480	$4,200
February	320	3,000
March	400	3,600
April	300	2,820
May	500	4,350
June	310	2,960
July	320	3,030
August	520	4,470
September	490	4,260
October	470	4,050
November	350	3,300
December	340	3,160

Required
A. Perform a regression analysis on the given data. What maintenance costs should be budgeted for a month in which 420 maintenance hours will be worked?
B. What is the percentage of the total variance that can be explained by your analysis?
C. Use the high/low method to estimate a cost formula for Same Day. How similar is your high/low solution to the regression solution?

37. Regression Analysis LOI, 2

Pine Side Hospital wants to determine the cost behavior pattern of maintenance costs for its X-ray machines. The hospital has decided to use linear regression to examine the costs. The previous year's data regarding maintenance hours and costs are as follows:

	Hours of Activity	Maintenance Costs
January	500	$3,950
February	450	3,800
March	300	3,220
April	375	3,380
May	425	3,700
June	520	4,000
July	410	3,650
August	380	3,400
September	440	3,780
October	390	3,470
November	400	3,590
December	330	3,310

Required

A. Perform a regression analysis on the given data. What maintenance costs should be budgeted for a month in which 430 maintenance hours will be worked?
B. What is the percentage of the total variance that can be explained by your analysis?
C. Use the high/low method to estimate a cost formula for Pine Side. How similar is your high/low solution to the regression solution?

38. Regression Analysis: Impact of Outliers LO1, 2

Chris Gill founded Gill's Grill over 20 years ago. The business has grown so much and been so successful that Chris is now considering selling franchises. Chris knows that potential franchisees will want access to certain operational data. Gill's Grill is probably best known for its incredible "potato flats," a french fry–like item served with a special secret sauce. Chris is concerned that some of the potato flats data are unusual and out of the ordinary. The following production data related to "potato flats" have been compiled:

	Pounds of Potatoes	Food Preparation Costs
January	20,000	$17,000
February	25,000	11,000
March	27,000	27,000
April	22,000	18,000
May	24,000	30,000
June	30,000	24,000
July	22,000	18,000
August	23,000	18,500
September	34,000	26,000
Regression Output		
Coefficient of intercept	4,104.372	
R square	0.244367	
X coefficient	0.672073	

Required

A. Should Chris remove some of the data? In other words, are any of the months unusual relative to the others? If so, identify likely outliers from the data and state reasons that you would remove them.
B. Do you think removing the data points would change the regression output? Perform a regression analysis to find out the correct answer.

39. Cost Behavior, High/Low Method LO1, 2

Ullrich Framing is well known for the quality of its picture framing. Lucinda Ullrich, the company's president, believes that the number of linear feet of framing used is the best predictor of framing costs for her company. She asked her assistant to look into the matter, and he accumulated the following data:

	Linear Feet of Framing	Number of Mats	Framing Costs
January	20,000	7,100	$17,000
February	25,000	8,120	19,500
March	27,000	8,500	21,000
April	22,000	8,400	18,000
May	24,000	8,300	19,000
June	30,000	10,600	24,000

Required

A. Use the high/low method to develop a total cost formula for Ullrich Framing. You will need to perform two separate calculations, one for number of feet of framing and one for number of mats.
B. Compare the cost formulas developed in question A. Why are there differences?
C. On what basis should Ullrich select a formula to predict framing costs? Would you recommend that Ullrich rely on the results of the high/low method?

40. Absorption Costing vs. Variable Costing: Benefits and Calculation of Net Operating Income LO4, 5, 6

HD Inc. produces a variety of products for the computing industry. CD burners are among its most popular products. The company's controller, Katie Jergens, spoke to the company's president at a meeting last week and told her that the company was doing well, but that the financial picture depended on how product costs and net operating income were calculated. The president did not realize that the company had options in regard to calculating these numbers, so she asked Katie to prepare some information and be ready to meet with her to talk more about this issue. In preparing for the meeting, Katie accumulated the following data:

Units produced	100,000
Units sold	95,000
Fixed manufacturing overhead	$300,000
Direct materials per unit	$55.00
Direct labor per unit	$25.00
Variable manufacturing overhead per unit	$15.00

Required

A. Compute the cost per unit, using absorption costing.
B. Compute the cost per unit, using variable costing.
C. Compute the difference in net operating income between the two methods. Which costing method results in the higher net operating income?
D. Assume that production was 100,000 units and sales were 100,000 units. What would be the difference in net operating income between the two methods?

E. Which method is required by generally accepted accounting principles?

41. Absorption Costing vs. Variable Costing: Benefits and Calculation of Net Operating Income   LO4, 5, 6

Boots R Us produces a variety of products for the fashion industry. Cowboy-type boots are among its most popular products. The company's controller spoke to the company's president at a meeting last week and told her that the company was doing well, but that the financial picture depended on how product costs and net operating income were calculated. The president did not realize that the company had options with regard to calculating these numbers, so she asked the controller to prepare some information and be ready to meet with her to talk more about this issue. In preparing for the meeting, the controller accumulated the following data:

Beginning inventory	25,000
Units produced	100,000
Units sold	105,000
Fixed manufacturing overhead	$400,000
Direct materials per unit	$25.00
Direct labor per unit	$35.00
Variable manufacturing overhead per unit	$15.00

Required
A. Compute the cost per unit, using absorption costing.
B. Compute the cost per unit, using variable costing.
C. Compute the difference in net operating income between the two methods. Which costing method results in the higher net operating income?
D. Assume that production was 100,000 units and sales were 70,000 units. What would be the difference in net operating income between the two methods? Which costing method shows the greater net operating income?
E. Assume that production was 100,000 units and sales were 100,000 units. What would be the difference in net operating income between the two methods?
F. Which method is required by generally accepted accounting principles?

42. Absorption vs. Variable Costing: Benefits and Calculation of Net Operating Income   LO4, 5, 6

Oliver, Inc., produces an oak rocking chair that is designed to ease back problems. The chairs sell for $200 each. Results from last year's operations are as follows:

Inventory and production data:

Units in beginning inventory	0
Units produced during the year	20,000
Units sold during the year	18,000

Variable costs (unit):

Direct materials	$ 70.00
Direct labor	20.00
Variable manufacturing overhead	15.00
Variable selling and administrative	10.00

Fixed costs:

Fixed manufacturing overhead	$500,000
Fixed selling and administrative	$530,000

Required
A. Compute the unit product cost for one rocking chair, assuming that the company uses variable costing.
B. Prepare an income statement based on variable costing.
C. Compute the unit product cost for one rocking chair, assuming that the company uses absorption costing.
D. Prepare an income statement based on absorption costing.
E. Compare the two income statements. What causes the net operating income to differ?
F. If the company produced 18,000 chairs and sold 20,000 chairs (assume that the additional 2,000 chairs were in the beginning inventory), what would be the impact on the two income statements? In other words, which method provides the higher net operating income?

CASES

43. Decision Focus: Comprehensive Regression Analysis   LO1, 2

Last Minute Cruise Co. has been operating for more than 20 years. The company has recently undergone several major management changes and needs accurate information to plan new cruises. You have been retained as a consultant to provide a cruise-planning model. The company's accounting department provided you with the data that follow regarding last year's average costs for 12 cruises on the MS *Robyn*, a cruise ship that has a maximum capacity of 525 passengers and a crew of 250. All cruises on the MS *Robyn* are for either 7 or 10 days. The total cost shown includes all costs of operating the ship (fuel, maintenance, depreciation, etc.) as well as meals, entertainment, and crew costs.

Cruise	Days	Passengers	Total Cost
1	7	455	$315,010
2	7	420	297,525
3	7	473	317,595
4	7	510	326,615
5	7	447	314,510
6	7	435	310,015
7	10	445	365,015
8	10	495	370,015
9	10	480	367,035
10	10	505	375,000
11	10	471	367,500
12	10	439	365,090

Required

A. Using the number of passengers as the independent variable, perform a regression analysis to develop the total-cost formula for a cruise.

B. How accurate is the model calculated in question A? (Hint: Look at how much variance in total cost is explained by the number of passengers.)

C. What are the total fixed costs per cruise? (Round your answer to the nearest cent.)

D. What are the variable costs per passenger? (Round your answer to the nearest cent.)

E. What other independent variable might Last Minute Cruise Co. use to predict total cruise costs? Using regression analysis, develop another total-cost formula based on the new independent variable.

F. Using the best planning model you can develop from the data provided, what is the estimated cost of a 10-day cruise at full capacity of 525 passengers? (Round your answer to the nearest cent.)

44. Decision Focus: Comprehensive Regression Analysis LO1, 2, 3

Perlman-Douglas, a major retailing and mail-order operation, has been in business for the past 10 years. During that time, the mail-order operations have grown from a sideline to more than 80 percent of the company's annual sales. Of course, the company has suffered growing pains. There were times when overloaded or faulty computer programs resulted in lost sales. And, hiring and scheduling temporary employees to augment the permanent staff during peak periods has always been a problem.

Gail Lobanoff, manager of mail-order operations, has developed procedures for handling most problems. However, she is still trying to improve the scheduling of temporary employees to take telephone orders from customers. Under the current

system, Lobanoff keeps a permanent staff of 60 employees who handle the basic workload. On the basis of her estimate of the upcoming week's telephone volume, she determines the number of temporary employees needed. The permanent employees are paid an average of $10 per hour plus 30 percent fringe benefits. The temporary employees are paid $7 per hour with no fringe benefits. The full-time employees are seldom sent home when volume is light, and they are not paid for hours missed. Temporary employees are paid only for their hours worked. Perlman-Douglas normally has three supervisors who earn $1,000 per month, but one additional supervisor is hired when temporary employees are used.

Lobanoff has decided to try regression analysis as a way to improve the prediction of total costs of processing telephone orders. By summarizing the daily labor hours into monthly totals for the past year, she was able to determine the number of labor hours incurred each month. In addition, she summarized the number of orders that had been processed each month. After entering the data into a spreadsheet, Lobanoff ran two regressions. Regression 1 related the total hours worked (permanent and temporary employees) to the total cost of operating the phone center. Regression 2 related the number of orders taken to the total cost. The data used and regression output are as follows:

Month	Total Cost	Total Hours	Number of Orders
January	$134,000	9,600	10,560
February	133,350	9,550	10,450
March	132,700	9,500	10,200
April	134,000	9,600	10,700
May	133,675	9,575	10,400
June	139,900	10,100	10,700
July	143,820	10,500	11,100
August	140,880	10,200	10,450
September	137,940	9,900	10,200
October	153,620	11,500	12,200
November	163,420	12,500	12,900
December	150,680	11,200	11,490

Regression equation: TC = FC + VC (hours) or TC = FC + VC (orders), where TC = total cost, FC = fixed cost, and VC = variable cost per hour or order.

	Regression 1	Regression 2
Intercept (FC)	36,180.42	21,595.15
X Variable (VC)	10.21475	10.95427
R square	0.997958	0.890802

Required

A. What is the total-cost formula for each of the preceding regressions? State each formula, using costs that are rounded to the nearest cent.

B. Gail Lobanoff estimates that 12,470 orders will be received and 12,000 hours will be worked during January. Use each cost formula you developed in question A to predict the total cost of operating the phone center. Round your answers to the nearest dollar.

C. Gail needs to select one of the models for use in predicting total phone center costs for next year's monthly budget.
   (1) What are the objectives in selecting a prediction model?
   (2) What options are available to Gail? That is, what other independent variables might be used to predict the costs of the phone center?

45. Absorption Costing versus Variable Costing: Benefits and Calculation of Net Operating Income LO4, 5, 6

Crystal Glass is a producer of heirloom-quality glassware. The company has a solid reputation and is widely regarded as a model corporate citizen. You have recently been hired as a staff accountant at a time when the company is experiencing rapid growth and is looking for a substantial increase in its line of credit at the local bank. Crystal Glass also is planning on trying to take the company public in the next three to five years. At the present time, the company is a closely held family-owned business. One of your first jobs is to review the current month's income statement for accuracy. The income statement appears as follows:

Crystal Glass, Inc. Statement of Income For the Year Ended October 31, 2011	
Sales revenue	$12,008,450
Variable costs	8,475,361
Contribution margin	3,533,089
Fixed costs	1,845,902
Net operating income	$ 1,687,187

You are given the following additional information:

Variable costs:	
Manufacturing	$6,356,521
S&A	$2,118,840
Fixed costs:	
Manufacturing	$1,476,722
S&A	$369,180
Beginning inventory	250,000 units
Production	500,000 units
Sales	600,000 units

Required

A. What type of costing method is used by Crystal Glass?

B. Does the method comply with GAAP? If not, what costing method should be used? What would net operating income be?

C. Could the statements be misleading to the bank? Why or why not?

D. What are your options as the new staff accountant? Who are the stakeholders affected?