Chapter 3

Using Costs in Decision Making

After completing this chapter, you will be able to:

1. Understand and be able to explain the important cost-related concepts in management accounting.
2. Understand how cost information supports important management activities such as product pricing, product planning, budgeting, and performance evaluation.
3. Be able to model, interpret, and evaluate the effect of volume changes on costs and profits in simple organizations.
4. Understand the important role of, and be able to use, the relevant cost concept in make-or-buy, product and department abandonment, costing orders, and product mix decisions and be able to apply the relevant cost concept in simple situations.

Nolan Industries

Nolan Industries manufactures control units that are used in high-speed production systems such as pulp and paper manufacturing. The company has two major products: the XR244 and the XR276. Punit Shah, the sales manager at Nolan Industries, is preparing a production plan for the upcoming year and is evaluating a new product opportunity.

Punit is studying the following summary information provided by the finance group at Nolan Industries.

	XR244	XR276
Selling price	$785.00	$955.00
Total costs	470.00	595.00
Profit	$315.00	$360.00
Maximum sales (units)	10,000	15,000
Machine hours (per unit)	2.50	3.00

In recent years the sales mix has been 40% XR244 and 60% XR276 and Punit is wondering, given that XR276 is more profitable, whether a better production mix would include more sales of the XR276. Nolan

Industries has 48,000 machine hours available for the production of these two products. A conversation with the plant accountant suggests to Punit that about 65% of product costs vary with the level of production and that Nolan Industries' total fixed costs amount to $7,500,000.

As he was considering these opportunities, Punit received an e-mail from a customer offering to buy 2,000 units of a specialty product that would sell for $1,200 per unit, have a cost of $820 per unit, and would require 3.5 hours per unit of production time to produce.

Excluding the new product opportunity, Punit is wondering:

1. How many units of each product would he have to sell to break even given the 40/60 mix?
2. What is the maximum number of units he can sell given the machine hours constraint that he faces and given the 40/60 sales mix, and what is the profit at that sales level?
3. Is there a better product mix than the 40/60 split?
4. Finally, considering the new product opportunity, should Punit accept the offer and, if so, what would be the resulting production levels and profit?

HOW MANAGEMENT ACCOUNTING SUPPORTS INTERNAL DECISION MAKING

Chapter 2 identified the role of management accounting in supporting strategy development and in evaluating the results of operations. The balance of this book will develop the various roles of management accounting in supporting the development, implementation, monitoring, and revision of strategy.

In this chapter we discuss cost information and the important role it plays in strategy development and in monitoring the results of implementing the strategy. The use of cost information is pervasive throughout decision-making situations.

Pricing

Organizations use cost information in the pricing decision in two ways. In markets where the organization faces a market-determined price, the organization will use product cost information to decide whether its cost structure will allow it to compete profitably. In markets where the organization can set its price, organizations will often set a price that is an increment of its product's cost—an approach called *cost plus pricing*.

Product Planning

In product planning, organizations use a tool called *target costing* to focus efforts in product and process design on developing a product that has a good profit potential in view of market requirements.

Budgeting

Perhaps the most widespread use of cost information is in budgeting, which is a management accounting tool that projects or forecasts costs for various levels of production and sales activity. Budgets are important in planning, which sets the organization's direction for the budget period. Budgets provide the basis for earnings forecasts that senior executives issue to the stock market.

Performance Evaluation

In performance evaluation, managers compare the actual results from the budget period with expectations that were reflected in the budget to assess how well the organization did in light of its expectations.

Contracting

In cost reimbursement contracts organizations are reimbursed their cost plus an increment for the goods or service they provide under the contract. Governments are frequent and large-scale users of cost reimbursement contracts. Because of the potential for cost manipulation, governments will often prescribe the costing standards that organizations must use when computing reimbursement costs.

VARIABLE AND FIXED COSTS

Variable Costs

A **variable cost** is one that increases proportionally with changes in the activity level of some variable. For example, the activity of making a chair in a furniture factory consumes the wood that goes into the chairs. The acquisition and consumption of the wood creates a cost for wood that increases proportionately with the number of chairs made.

Because there are many possible types of variables, for convenience, a common term used for a variable that causes a cost is **cost driver**.[1] Therefore, the variable cost formula is

$$\text{Variable cost} = \text{Variable cost per unit of the cost driver} \times \text{Cost driver units}$$

Note that the convention is to use variable cost to refer to the total variable cost and variable cost per unit as the variable cost per unit of the cost driver.

The Rose Furniture Company manufactures a single product—a rocking chair. Based on past results, the cost of the wood used to make each rocking chair is estimated as $25. Noting that the cost driver here is rocking chairs, the variable cost equation for wood would be

$$\text{Variable cost of wood} = \$25 \times \text{Number of rocking chairs made}$$

The variable cost of wood graph would look like that shown in Exhibit 3-1. Note that the variable cost line is a straight line that starts at the origin and has a constant slope that equals the variable cost of wood per unit of the cost driver, which is the number of rocking chairs made.

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[1] As we will see in Chapter 4, the term *cost driver* is also commonly used to describe the method by which indirect costs are assigned to cost objects, such as products, departments, or customers.

Exhibit 3-1
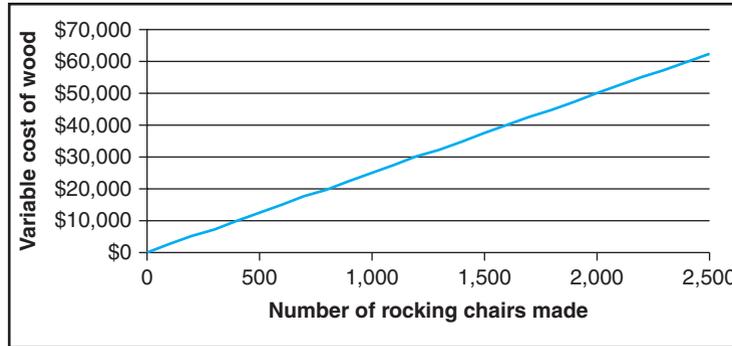
Two other manufacturing costs at the Rose Furniture Company vary with (i.e., are driven by) the number of rocking chairs made:

- The wages paid to the workers who shape and assemble the various pieces that make up the rocking chairs.
- The cost of supplies such as nails, glue, and stain that are consumed in proportion to the number of rocking chairs made.

Past results indicate that the cost of labor needed for each rocking chair is $30 and the cost of the supplies is $5. Therefore,

$$\text{Variable cost for each rocking chair} = \text{Variable cost of wood} + \text{Variable cost}$$
$$\text{of labor} + \text{Variable cost of supplies}$$
$$= \$25 + \$30 + \$5 = \$60$$

The variable cost equation for rocking chairs will be

$$\text{Variable cost of rocking chairs} = \$60 \times \text{Number of rocking chairs made}$$

Finally the Rose Furniture Company incurs variable selling and shipping costs of $20 for each rocking chair sold. This brings the total variable cost of making and selling a rocking chair to $80 (the variable manufacturing cost of $60 plus the variable selling and shipping cost of $20). The equation for all variable costs associated with making, selling, and shipping rocking chairs then becomes

$$\text{Variable cost of rocking chairs} = \$80 \times \text{Number of rocking chairs made}$$

Exhibit 3-2 provides the variable cost graph for all variable costs in the Rose Furniture Company.

Exhibit 3-2
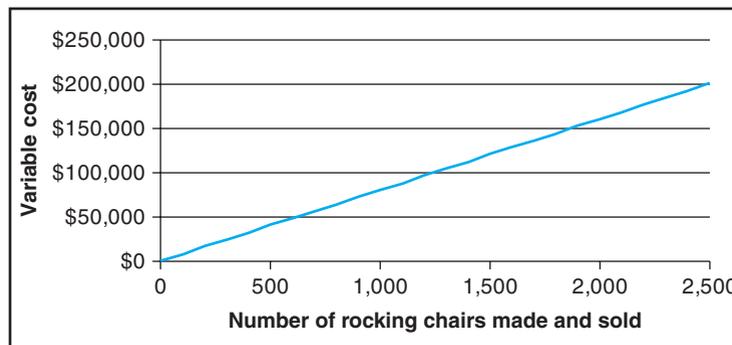
Exhibit 3-3

Exhibit 3-3
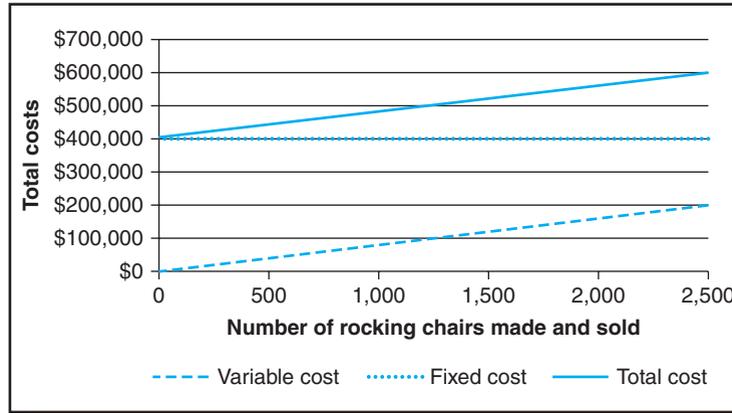
Fixed Costs

A **fixed cost** is a cost that does not vary in the short run with a specified activity. The defining characteristic of a fixed cost is that it depends on the amount of a resource that is acquired rather than the amount that is used. For this reason fixed costs are often called **capacity-related costs**.

Examples of fixed manufacturing costs at the Rose Furniture Company are depreciation on factory equipment and wages paid to production supervisors. These costs do not depend on how much of the available machine time or supervisory time is used—they depend only on the amount of capacity that was acquired.

The Rose Furniture Company also has fixed selling and administrative costs. An example of a fixed selling cost is the salary paid to a sales manager. (Note that commissions paid to sales staff are variable costs.) Examples of fixed administrative costs include the salaries paid to head office staff and depreciation on the head office building.

Fixed costs per year amount to $400,000 at the Rose Furniture Company. The total cost equation at the Rose Furniture Company is

Total cost = Variable cost + Fixed cost
= ($80 × Number of rocking chairs made and sold) + $400,000

Exhibit 3-3 shows the graph of total costs at the Rose Furniture Company.

COST–VOLUME–PROFIT ANALYSIS

Planners and decision makers like to know the risk associated with the decisions that they make. Many decision makers use the probability of at least breaking even or earning a target profit as a measure of a project's risk. For example, a movie producer might wonder how many showings of a new movie will be required so that the producer can recover her total investment in the movie and earn a required target profit. A good understanding of cost and revenue behavior is critical in providing decision makers with an understanding of the relationship between a project's revenues, costs, and profits.

Cost–volume–profit (CVP) analysis uses the concepts of variable and fixed costs to identify the profit associated with various levels of activity. Suppose that the Rose Furniture Company sells its rocking chairs for $300 apiece. The revenue equation for the Rose Furniture Company will be

Revenue = $300 × Number of rocking chairs sold

Exhibit 3-4
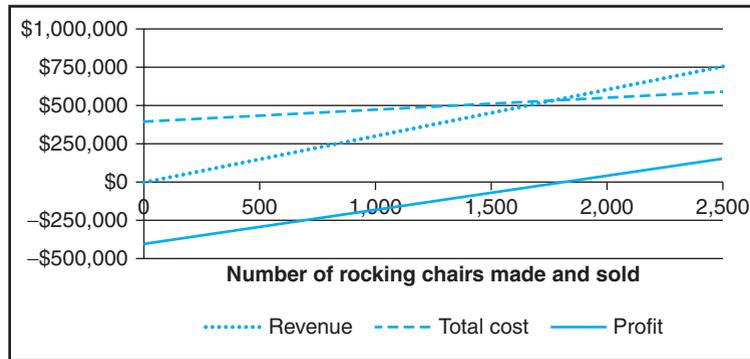
For the sake of convenience, in what follows we will assume that all rocking chairs made in any period are sold. We will simply refer to the cost driver as number of rocking chairs. Therefore, the profit equation for the Rose Furniture Company is as follows:

Profit = Revenue − Total costs = Revenue − Variable costs − Fixed costs
Profit = $300 × Number of rocking chairs
      − $80 × Number of rocking chairs
      − $400,000

Exhibit 3-4, called the CVP chart, shows the revenue, total cost, and profit associated with various levels of rocking chairs made and sold.

Developing and Using the CVP Equation

Recall that earlier we had the following profit equation for the Rose Furniture Company:

Profit = $300 × Number of rocking chairs
      − $80 × Number of rocking chairs
      − $400,000

The difference between total revenue and total variable cost is called the **contribution margin**. The **contribution margin per unit** is the contribution that each unit makes to covering fixed costs and providing a profit. The contribution margin per unit for the Rose Furniture Company is $220 ($300 − $80). Finally, we often have use for the **contribution margin ratio**, which is the ratio of contribution margin per unit to selling price per unit. In the case of Rose Furniture Company, the contribution margin ratio is 73.33% ($300 − $80)/$300. The contribution margin ratio is the fraction of each sales dollar that is available to cover fixed expenses and produce a profit.

We can rewrite this profit equation as

Profit = ($300 − $80) × Number of rocking chairs − Fixed cost

We can write the general CVP equation for a single product company as

Profit = Unit sales × (Price per unit − Variable cost per unit) − Fixed cost

or

Profit = Contribution margin per unit × Units produced and sold
      − Fixed costs

For the Rose Furniture Company,

Profit = $220 × Number of rocking chairs sold − $400,000

IN PRACTICE
Introducing Uncertainty into Cost Volume Profit Analysis

Decision makers like Julie Rose, the owner manager of the Rose Furniture Company, often like to associate the break-even sales level with their beliefs about product sales potential. For example, suppose that Julie believes that sales are uncertain but lie between 1,500 and 3,000 units with all values on this interval equally likely.

You may remember from a statistics course that this means that Julie believes that demand for her chairs is well represented by the uniform distribution and the probability that she will sell at least 1,819 chairs given her beliefs is 78.73% = (3,000 − 1,819)/(3,000 − 1,500).

Planners are often interested in determining the unit sales required to produce a target profit. To see this, we can rearrange the general profit equation to get the following:

$$\text{units needed to be sold} = \frac{\text{target profit} + \text{fixed cost}}{\text{contribution margin per unit}}$$

For the Rose Furniture Company, we have

$$\text{rocking chairs needed to be sold} = \frac{\text{target profit} + \$400,000}{220}$$

The most common use of this equation occurs when the planner calculates the breakeven volume. For example, suppose that Julie is worried about the risk associated with her business and wonders how many rocking chairs must be made to break even (i.e., to achieve a profit of 0 by having the contribution margin just equal the fixed costs). We compute the breakeven level of unit sales for Julie as follows:

$$\begin{aligned}\text{rocking chairs needed to be sold} &= \frac{\text{target profit} + \$400,000}{220}\\ &= \frac{0 + \$400,000}{220} = 1,819\end{aligned}$$

Note that by convention we always round up when finding the required unit sales with this type of analysis.

Because of the huge cost of developing new products in some industries, particularly aircraft and pharmaceutical industries, executives and market analysts pay close attention to the required breakeven sales on new projects and will often use the estimate of the required breakeven sales as a measure of a project's risk.

Variations on the Theme

Suppose that Julie has set the target profit as 20% of revenues. How many rocking chairs will have to be sold to earn this target profit? We have

$$\text{Target profit} = \text{Contribution margin per unit} \times \text{Required unit sales} - \text{Fixed cost}$$

$$20\% \times \text{Revenues} = \text{Contribution margin per unit} \times \text{Required unit sales} - \text{Fixed cost}$$

$$20\% \times \text{Price per unit} \times \text{Required unit sales} = \text{Contribution margin per unit} \times \text{Required unit sales} - \text{Fixed cost}$$

$$(\text{Contribution margin per unit} - 20\% \times \text{Price per unit}) \times \text{Required unit sales} = \text{Fixed costs}$$

$$\text{required unit sales} = \frac{\text{fixed costs}}{\text{contribution margin per unit} - 20\% \times \text{price per unit}}$$

Breakeven on a Development Project

Because of the huge costs of developing new aircraft, airplane manufacturers, and analysts who follow these companies, focus considerable attention on the unit sales required to break even on a new aircraft as a measure of organization risk created by the introduction of a new type of aircraft. In 2010, EADS (the parent of Airbus) CFO Hans Peter Ring said that breakeven on the huge Airbus A380-800, which was introduced in 2007, could be achieved by 2015. The reason it takes so long to break even is because of how many airplanes must be built and sold to recover the development costs and annual fixed production, selling, and distribution costs.

For the Rose Furniture Company, this will be

$$\text{required units sales} = \frac{400{,}000}{220 - 20\% \times 300} = \frac{400{,}000}{220 - 60} = 2{,}500$$

Until now, we have assumed that Rose Furniture Company pays no taxes. We can easily add to the equation to reflect the impact of income taxes. Suppose the Rose Furniture Company pays a marginal tax rate of 30%. How does this affect the CVP and target profit equations? Suppose Julie wants to know how many rocking chairs must be made and sold to generate a net (after-tax) profit of $100,000 when facing a tax rate of 30%? Here is the equation:

$$\text{Target profit} = [(\text{Contribution margin per unit} \times \text{Required unit sales}) - \text{Fixed cost}] \times (1 - \text{Tax rate})$$

Rearranging we find

$$\text{required unit sales} = \frac{\dfrac{\text{target profit}}{1 - \text{tax rate}} + \text{fixed costs}}{\text{contribution margin per unit}}$$

For the Rose Furniture Company the required unit sales would be

$$\text{required unit sales} = \frac{\dfrac{100{,}000}{1 - 0.3} + 400{,}000}{220} = \frac{142{,}857.15 + 400{,}000}{220} = 2{,}468$$

Financial Modeling and What-If Analysis

The CVP analysis that we studied above is an example of financial modeling. The organization's financial circumstances are modeled by an equation that can be manipulated when answering the questions used in a **what-if analysis**. Decision makers can use their understanding about cost behavior to answer important strategic decisions.

Cost–Volume–Profit Analysis

Consider the business of developing applications for the iPhone. This is an interesting business because the variable cost is essentially zero. Suppose that it costs you $20,000 to hire the programmer and the graphic designer to develop the application. If the application sells for $0.99 and Apple takes 30%, the contribution margin is $0.693 ($0.99 × 70%) per application sold. This means that you will need to sell $28,861 applications to recover your initial investment.

To illustrate, suppose John Jones, the sales manager at the Rose Furniture Company, believes that a $25,000 advertising campaign will increase rocking chair sales by 5% over the current level of 3,000 units. Is this advertising campaign financially attractive?

The incremental cost related to this initiative is $25,000. The incremental benefit will equal the rocking chair's contribution margin per unit of $220 multiplied by the sales increase of 150 (3,000 × 5%) rocking chairs. Therefore, the expected incremental effect on profits at the Rose Furniture Company of undertaking the advertising campaign will be:

$$\text{Incremental profit} = \text{Incremental contribution margin} - \text{Incremental cost}$$
$$= 150 \times \$220 - \$25,000 = \$8,000$$

This sounds like an attractive proposition for John because the expected return is 32% ($8,000/$25,000) on the initial investment. Once again, however, all investments have associated risks and John would need to consider the likelihood of attaining the expected sales increase of 150 chairs.

The Multiproduct Firm

Suppose now that the Rose Furniture Company has expanded and, in addition to making rocking chairs, it is making a kitchen chair. The kitchen chair has variable costs totaling $60 per chair and it sells for $200 per chair, yielding a contribution margin of $140 per kitchen chair. Fixed costs in the Rose Furniture Company have increased by $200,000 to $624,000 with the addition of the chair operations since the kitchen chairs required the acquisition of some new machinery and equipment and production supervisors.

Once again, Julie is wondering about the sales required to break even. With these two products the CVP equation is

$$\text{Profit} = \text{Rocking chair contribution margin} \times \text{Rocking chair sales}$$
$$+ \text{Kitchen chair contribution margin} \times \text{Kitchen chair sales} - \$624,000$$

$$\text{Profit} = (\$220 \times \text{Rocking chair sales}) + (\$140 \times \text{Kitchen chair sales})$$
$$- \$624,000$$

We have one equation in two unknowns, which means that there are infinitely many combinations of rocking chair sales and kitchen chair sales that will allow the company to break even.

Faced with how to deal with the problem of multiple breakeven pairs, developers of CVP analysis used a practical tool to extend their analysis to a multiproduct firm. To illustrate, we continue the example of the Rose Furniture Company supposing that Julie has decided on a target mix of 20% rocking chairs and 80% kitchen chairs.

IN PRACTICE
Estimating the Effect of Unit Sales on Share Price

Some organizations and analysts take volume profit analysis one step further. Instead of stopping with the estimate of sales levels changes on profit, these organizations take the next step of predicting the effect of the resulting profit increase on share price. For example, in April 2010 Apple introduced the iPad. In late June 2010, Apple announced that iPad sales had averaged about 1 million units for the first three months. Some market analysts estimated that every 100,000 units sold of the iPad added 1 cent to Apple's share price.

Exhibit 3-5

ROCKING CHAIRS		KITCHEN CHAIRS		BUNDLE	
Price	$300	Price	$200		
Variable cost	80	Variable cost	60		
Contribution margin	$220	Contribution margin	$140		
Number in bundle	20	Number in bundle	80		
Total contribution margin	$4,400	Total contribution margin	$11,200	Total contribution margin	$15,600

This product mix requires setting the number of kitchen chairs produced to be four times the number of rocking chairs produced. We can now substitute kitchen chairs out of the Rose Furniture Company's profit equation as follows:

$$\text{Profit} = (\$220 \times \text{Rocking chair sales}) + [\$140 \times (4 \times \text{Rocking chair sales})] - \$624,000$$

Rearranging we get

$$\text{rocking chair sales} = \frac{\text{profit} + \text{fixed cost}}{220 + (140 \times 4)} = \frac{\text{profit} + \$624,000}{780}$$

The **breakeven point** is found when the profit is 0, meaning rocking chair sales at breakeven will be 800 (624,000/780). Because kitchen chair sales are four times rocking chair sales, the breakeven kitchen chair sales with this ratio of chairs will be 3,200 (4 × 800).

Although several approaches have been used to handle the multiproduct CVP analysis, the following approach, called the *bundle approach*, is the most direct and intuitive.

With a constant product mix, the Rose Furniture Company will sell rocking chairs and kitchen chairs in bundles of 20 rocking chairs and 80 kitchen chairs with each bundle generating a contribution margin of $15,600 as shown in Exhibit 3-5.

With fixed costs of $624,000, the Rose Furniture Company will have to sell 40 ($624,000/15,600) bundles to break even. Remember that the products are not actually sold in bundles—that is just a computational convenience. This results in the following unit sales for each product.

Rocking chairs made and sold 40 × 20 = 800
Kitchen chairs made and sold 40 × 80 = 3,200

Exhibit 3-6 contains a small income statement showing that these, indeed, are the breakeven quantities for the two products with this product mix.

Exhibit 3-6

ROCKING CHAIRS		KITCHEN CHAIRS		TOTAL	
Units	800	Units	3,200	Units	4,000
Revenue	$240,000	Revenue	$640,000	Revenue	$880,000
Variable costs	64,000	Variable costs	192,000	Variable costs	256,000
Contribution margin	$176,000	Contribution margin	$448,000	Contribution margin	$624,000
				Fixed cost	624,000
				Profit	$0

The Assumptions Underlying CVP Analysis

Many students will complain that there are too many unrealistic assumptions underlying CVP analysis to be practical in most organizations. These assumptions are as follows:

1. The price per unit and the variable cost per unit (and therefore the contribution margin per unit) remain the same over all levels of production.
2. All costs can be classified as either fixed or variable or can be decomposed into a fixed and variable component.
3. Fixed costs remain the same over all contemplated levels of production.
4. Sales equal production.

Note that all these assumptions can be relaxed if the CVP analysis is undertaken in a computer spreadsheet. Indeed, financial modeling that relies on cost and revenue estimates is one of the most valuable and widely used management accounting tools.

OTHER USEFUL COST DEFINITIONS

As you may expect, there are other cost definitions that are important for decision making. We begin our discussion of these other cost definitions by expanding on fixed and variable costs, and then turn to further cost concepts that are useful in decision making.

Mixed Costs

A **mixed cost** is a cost that has a fixed component and a variable component. For example, your mobile telephone bill may have a fixed component that you pay each month, independent of how many calls you make, and a variable component that depends on the quantity of calls you make.

Suppose that the bill for heating costs in Julie's factory equals $500 per month plus $16 per million British thermal units (BTUs) used. Exhibit 3-7 shows the picture of Julie's factory heating costs for various levels of BTUs used.

Organizations face many types of mixed costs. Examples include the cost of electricity, the cost of labor (where workers are paid a salary plus overtime), and the cost of shipping (where there is a fixed component per shipment and a variable amount that depends on the weight of the shipment).

Exhibit 3-7
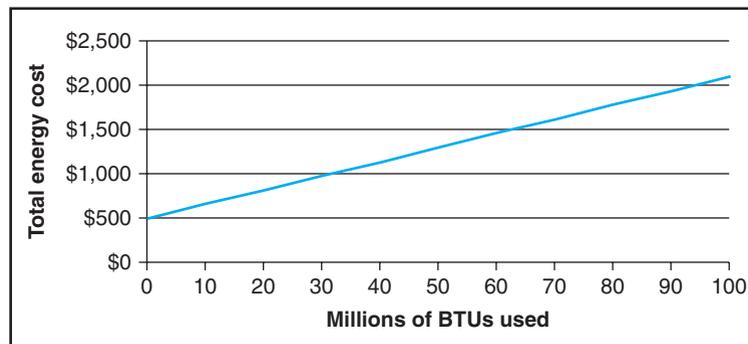
Exhibit 3-8
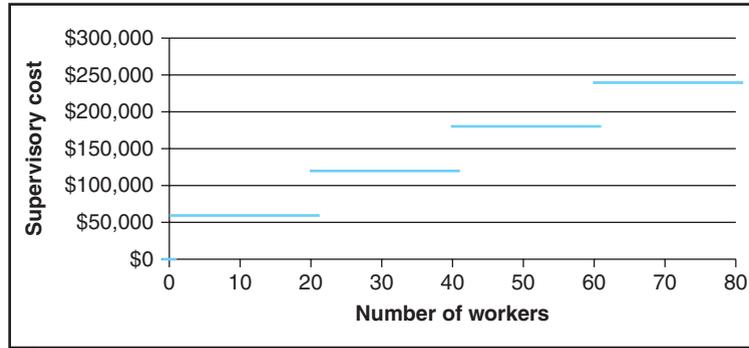
Step Variable Costs

We often observe step variable costs. A **step variable cost** increases in steps as quantity increases. For example, suppose that a company has a policy of hiring one factory supervisor for every 20 factory workers. If each factory supervisor is paid $60,000, the total cost of supervisory salaries increases in a series of steps with the number of workers as shown in Exhibit 3-8.

Although this type of cost behavior can be modeled directly in any spreadsheet, it is often approximated as if it were a variable cost. Exhibit 3-9 shows what the actual cost looks like and also shows that the linear approximation will sometimes over- and underrepresent costs but, on average, will be correct.

Incremental Costs

An **incremental cost** is the cost of the next unit of production and is similar to the economist's notion of marginal cost. In a manufacturing setting, incremental cost is generally defined as the variable cost of a unit of production. However, the concept is not quite that simple for two reasons.

First, the variable cost per unit may change as production volume changes. For example, in the presence of a learning effect, the variable cost of labor will decrease as cumulative production increases. Also, if a firm operates using overtime, the variable cost of units produced during the overtime period could increase by 50% (time-and-a-half).

Second, if the cost is a step variable, treating the cost as a variable cost will lead to estimation errors as shown in Exhibit 3-9. In that example the incremental supervisory cost is $60,000 as the number of production workers moves from 0 to 1 and is

Exhibit 3-9

— Actual supervisory cost   — Approximate supervisory cost
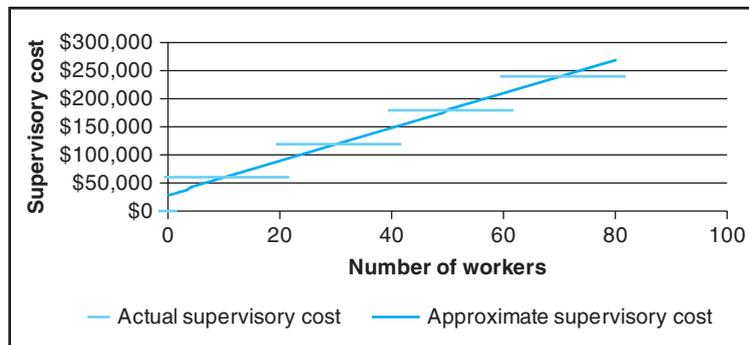
Just about all of the costs associated with building and operating this dam are fixed costs; the incremental cost of generating an extra unit of electricity is virtually zero.

Shutterstock

zero for all increases in production workers until the number of production workers changes from 10 to 11.

Consider the incremental cost of carrying passengers on a train. Suppose that each railroad car can accommodate 50 passengers. For a particular trip, the incremental cost of adding an additional car is $2,400 and the incremental fuel cost for adding a passenger is $0.05.

Suppose that the railroad company expects 1,825 passengers on the train. The company will provide a train with 37 (1,825/50) cars for a total cost of $88,800 (37 × $2,400) to handle this expected demand. Once this decision is made, this cost becomes fixed. The variable cost will equal the number of passengers that show up multiplied by the variable cost per passenger of $0.05.

Sunk Costs

A **sunk cost** is a cost that results from a previous commitment and cannot be recovered. For example, depreciation on a building reflects the historical cost of the building, which is a sunk cost. Another example of a sunk cost is a lease payment required by a long-term lease.

IN PRACTICE

Sunk Costs

The sunk cost effect is a maladaptive economic behavior that is manifested in a greater tendency to continue an endeavor once an investment in money, effort, or time has been made. [The authors] present evidence that young children, when placed in an economic situation akin to a sunk cost one, exhibit more normatively correct behavior than do adults.

Source: Hal Arks and Peter Ayton, "The Sunk Cost and Concorde Effects: Are Humans Less Rational Than Lower Animals?" *Psychological Bulletin,* Vol. 125, No. 5 (1999): 591–600.

Overcoming the Sunk Cost Effect

Goldman Sachs works to overcome the sunk cost effect by marking all of its holdings to fair value every day. It doesn't want a trader holding on to a position just to defer the recognition of a loss. It forces the daily recognition of a gain or loss, and then leaves it up to the trader to decide whether to continue to hold that position.

For airplane production or building a new weapon system, a company incurs a huge cost before the first one can be built. By adding the development cost to a projected number of planes produced and sold, the company may be attempting to recover what has become a sunk cost. Another example could be a pharmaceutical company that incurs expenses of, say, $1 billion to produce the first pill and then $0.01 for each incremental pill. As it contemplates how much to price, how should it consider the recovery of the $1 billion? Of course, this decision must be much much earlier, before the $1 billion or the airplane's product development cost has been spent.

The notion is that sunk costs should not be considered in subsequent decisions because they cannot be changed. However, because sunk costs so often affect managerial decisions, in practice, the term **sunk cost phenomenon** has evolved. Some people refer to the sunk cost phenomenon as the *Concorde effect* or the *Concorde fallacy*. This is because even though it was apparent that the Concorde, a supersonic passenger jet that was a joint project of England and France, would be unprofitable, the two countries kept investing money because they had already invested huge sums of money. Psychologists attribute this behavior in part to the feeling that people should not waste money.

Consider the plight of Pat Toste who is managing the construction of a new warehouse. Construction is well under way and the construction costs to date amount to $2,500,000. A structural engineer has just discovered a major design flaw. The flaw in the current design can be corrected and the project completed for an additional $4,000,000 or the current construction can be demolished and a new warehouse built for a total of $3,000,000. Pat plans to take the option of correcting the design flaw even though that will cost the company $1,000,000 more than starting over. Pat may not want to look bad in the eyes of the company (assuming that the start-over option is known only to him) or Pat may feel that he does not want to "waste" the sunk costs of $2,500,000.

Studies of practice often attribute the sunk cost phenomenon to a continuing belief in the potential for success despite overwhelming evidence to the contrary. Another popular explanation is that decision makers will often cover up a cost resulting from a bad decision—therefore, the sunk cost becomes a factor in the decision not to address the problem caused by the decision.

IN PRACTICE

Human Behavior and Sunk Costs

Dan Lovallo and Daniel Kahneman argue that successful executives "routinely" engage in "delusional" behavior causing them to overestimate their ability to see a project through to a successful conclusion even in the face of mounting evidence that the project is failing. This behavioral characteristic may be one explanation for the sunk cost effect.

Source: Dan Lovallo and Daniel Kahneman, "Delusions of Success—How Optimism Undermines Executives' Decisions." *Harvard Business Review*, Vol. 81, No. 7 (July 2003): 56–67.

Relevant Cost

A **relevant cost** is a cost that will change as a result of some decision. Suppose you are thinking about going to a concert this evening. You purchased the $100 ticket several weeks ago. If you go to the concert, you will likely spend $50 on transportation and parking and $70 on snacks and refreshments. You are thinking you really cannot afford the $120 that you will spend this evening but you don't want to "waste" the $100 you already spent. The total cost if you go to the concert is $220 ($100 + $50 + $70). However, the $100 ticket price is sunk and not relevant in the decision you are making today about whether or not to go tonight. The relevant cost is $120 (which is also called the incremental cost).

Richard Thaler, an economist who studies decision-making behavior, provides an interesting example on the other side of this concert story. Suppose in this case there are only immaterial costs of attending the concert and you have lost the ticket; would you buy another ticket to go to the concert? You have already signaled that you get more than $100 of pleasure from the concert, so you should be willing to repurchase the ticket (the loss of the ticket is a sunk cost), but many people would choose not to go to the concert.

Opportunity Cost

Organizations rarely have unlimited amounts of any resource to use when pursuing their activities. For this reason decision makers use various tools, some of which we discuss later in this text, to identify the best uses of limited resources. The notion of opportunity cost arises in this context. **Opportunity cost** is the maximum value forgone when a course of action is chosen.

To illustrate the idea of opportunity cost, consider the decision facing Lois Leung, a production supervisor at Rubinoff Manufacturing. Lois is wondering how to use the time remaining on a machine that is the bottleneck in the production process. The machine currently has the capacity to handle one more order and Lois must decide between two orders: Order X133 will provide a contribution margin of $12,000, whereas order M244 will provide a contribution margin of $15,000.

If Lois uses the machine time to accept order X133 she will forego the opportunity to accept order M244 and forego a contribution margin of $15,000, which is the opportunity cost of accepting order X133. If Lois uses the machine time to accept order M244 she will forego the opportunity to accept order X133 and forego a contribution margin of $12,000, which is the opportunity cost of accepting order M244.

Choosing the project that provides the highest contribution margin (in this case order M244) will always lead to the same choice as choosing the project that provides the lowest opportunity cost (in this case order M244).

Note that if Lois has the machine capacity to accept both orders, the opportunity cost of each is $0. The opportunity cost of capacity is always zero when there is enough capacity to handle all available demand.

Suppose now that there is a third order, N766, that would provide a contribution margin of $9,000. Since this is not the next best alternative when considering order X133 or M244, it would not change the opportunity cost of accepting either of those orders.

Opportunity cost also provides important insights at the individual product level. Tim Manufacturing produces plastic novelties that are primarily used by customers for promotional purposes. After developing a schedule to produce the orders on hand, Margaret Pierce, the production supervisor, finds that she has 500 hours of molding machine production time still available. Margaret is wondering how to use that time.

Exhibit 3-10

	DESK ORGANIZER	PENCIL/PEN HOLDER
Incremental contribution to profit	$2.05	$0.56
Minutes of molding machine time required per unit	2	0.5

After speaking with Mark Thompson, the sales manager, Margaret has identified production opportunities for two products: a desk organizer or a pencil/pen holder. Exhibit 3-10 provides the information that has been identified for the two products.

Mark is enthusiastic about the desk organizer because it provides a higher contribution to the organization than the pencil/pen holder. However, Margaret is more cautious and given her production experience realizes that many more pencil/pen holders could be produced in the 500 molding machine hours available than desk organizers. Margaret quickly determines that with the 500 hours she could produce 15,000 desk organizers [(500 × 60 minutes)/2], providing a total contribution of $30,750 (15,000 × $2.05), or 60,000 [(500 × 60 minutes)/0.5] pencil/pen holders, providing a total contribution of $33,600 (60,000 × $0.56). The opportunity cost of using the machine time to produce the desk organizer is $33,600 and the opportunity cost of using the machine time to produce the pencil/pen holder is $30,750.

The key to evaluating these alternatives is to focus on the contribution that each product makes to the organization in view of its consumption of the molding machine hours. We will return to this idea later in the chapter after we have developed some more management accounting tools and language.

The need to consider opportunity costs is pervasive in decision making. However, opportunity costs are often overlooked. Most students, when considering attending college, will consider the out-of-pocket costs such as tuition and books. Some may even consider the opportunity cost of wages that would otherwise be earned while attending college. However, few students consider the opportunity cost of the four years of working experience forgone while attending college. (As a counterpoint, some college students might point out that the opportunity cost of not attending college is the college experience forgone.) The popularity of part-time college and online university programs may reflect students' desires to avoid some or all of the opportunity costs of getting an education.

Avoidable Cost

A cost that can be avoided by undertaking some course of action is called an **avoidable cost**. The most obvious avoidable costs are variable costs. If production ceases all variable costs associated with that production process are avoided. Less obvious and more problematic in practice are fixed costs that can be avoided as a result of a course of action.

For example, John Darke, a product manager at Russell Company, is thinking about eliminating a product. All of the variable costs associated with dropping the product will not be incurred (that is, they are avoidable) as well as the salary of the product's sales manager, which is a fixed cost. However, many product costs, such as machine depreciation, are the result of sunk costs that often remain in whole or in part after the product is discontinued. John wonders what costs are avoidable such as depreciation on the machines used to produce the product and depreciation on the factory and warehouse space the product occupies. Estimating these latter avoidable

When companies moved to producing products only when they are demanded rather than stocking inventory, a significant amount of factory floor space was idled. A question facing organizations moving to this production approach was how to measure the cost avoided by moving to just in time manufacturing.

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costs is quite difficult in practice because some machines and factory space may be used by other products or sold.

With these ideas in mind, we now turn to consider how these various cost concepts (sunk, relevant, opportunity, and avoidable) occur in common management decisions. We will look at four types of decisions where these concepts provide useful insights:

1. Make versus buy decisions and outsourcing.
2. Decision to drop a product.
3. Costing order decisions—the floor price.
4. Short-term product mix decisions (with constraints).

MAKE-OR-BUY—THE OUTSOURCING DECISION

As organizations rationalize their operations and focus on exploiting their core competencies, they contract out activities that they believe outsiders can do better or less expensively. Examples include contracting out information technology, housekeeping, laundry, and payroll processing. These outsiders generally focus on a limited set of activities, thereby developing the expertise to perform these activities at consistently high quality and low cost. Deciding whether to contract out for a product or service is known as the **make-or-buy decision**.

Many qualitative considerations go into a make-or-buy decision. These include the reliability of the supplier in meeting quality and delivery requirements and the strategic importance of the activity being outsourced. (For example, any activity that is outsourced could also be purchased from the same vendor by a competitor. So this activity cannot be a source of competitive advantage.) Here we will focus only on the financial considerations of outsourcing.

Consider an organization that is currently making the part or product being considered for outsourcing. What costs should it consider? The following table summarizes the typical relevant costs in the make-or-buy decision. The financial focus in the make-or-buy decision is whether the costs avoided internally are greater than the external costs that will be incurred when purchasing from a supplier.

INTERNAL COSTS AVOIDED	EXTERNAL COSTS INCURRED
• All variable costs • Any avoidable fixed costs such as the cost of supervisory personnel who would be laid off or machinery that would be sold	• The cost of purchasing the part • Any transportation costs • Any other costs involved in dealing with the outside supplier, ordering the product, and receiving and inspecting it

The following examples illustrate the idea, but first we define some commonly used manufacturing cost categories that are useful in our examples.

Manufacturing Costs

In a typical manufacturing cost system, manufacturing costs are classified into three groups: direct materials, direct labor, and manufacturing overhead. **Direct materials costs** include materials that can be traced easily to a unit of output and are of significant economic consequence to the final product. Similarly, **direct labor costs** are those labor costs that can be traced easily to the creation of a unit of output. Direct laborers are those who physically construct a unit of output. **Manufacturing overhead costs** are all costs incurred by a manufacturing facility that are not direct materials costs or direct labor costs. In particular, materials (such as thread or glue) that are not of significant economic consequence to the final product are treated as indirect materials and their cost is included in manufacturing overhead costs.

Chaps Company

Chaps Company currently makes a component used in one of its major products. The factory accountant has reported the following per unit costs associated with making this component:

Direct materials	$12.54
Direct labor	5.77
Manufacturing overhead	10.00
Total	$28.31

Based on a study of past data, the factory accountant believes that 30% of the manufacturing overhead associated with this product is variable. Moreover, of the fixed costs allocated to this product, about 10% are avoidable if production of this part is discontinued.

Rosa Company has offered to supply this part under a long-term contract for $21.80 per unit. Shipping costs to the Chaps Company factory would be about $0.12 per unit. Rosa Company would require a machine tool to make the part. Chaps Company owns the tool, which cost $25,000 to make. The tool would require rework costing $5,000, which Rosa Company expects Chaps Company to pay for. At the end of the part's life, the tool will have no value. Future demand for this part is expected to be 250,000 units.

Is the Offer from Rosa Company Financially Attractive?

Exhibit 3-11 shows that the total savings per part would be $0.07 per unit or $17,500 (250,000 × $0.07) over the remaining life of the part. The only cost that is not relevant is the $25,000 historical cost of the tool, which is a sunk cost. Note that parts of the fixed costs associated with this product are relevant because they are avoidable. These relevant fixed costs relate to supervisory personnel who would not be needed or a machine that can be sold if the part is discontinued.

This analysis only considers the financial aspects of this decision. Chaps Company would also consider whether Rosa Company could supply a high-quality part and meet production schedules.

Anjlee's Catering Services

Anjlee Desai is the owner-manager of Anjlee's Catering Services. Anjlee's services include planning, preparing, delivering, and serving meals at catered events. Anjlee's unique skill and competitive advantage is her ability to design innovative and tasty meals that can be adapted to meet most cultural requirements.

Demand has increased so much that Anjlee has had to turn down business and this has caused her to think about contracting out some of the activities that, in the past, she has done herself. In particular, Anjlee is considering contracting out the food preparation services. This would allow Anjlee to spend more time with customers taking orders and planning and serving meals. In addition, contracting out the food preparation services will allow Anjlee to expand into providing meals that meet religious requirements by contracting with certified kosher and halal suppliers.

Exhibit 3-11

Cost Item	Amount	Relevant?	Why
Direct materials	$12.54	Yes	Avoided if purchased externally
Direct labor	5.77	Yes	Avoided if purchased externally
Variable manufacturing overhead (30% × $10.00)	3.00	Yes	Avoided if purchased externally
Fixed manufacturing overhead (70% × 10% × $10)	0.70	Yes	Avoided if purchased externally
Supply price	(21.80)	Yes	Incurred if purchased externally
Shipping	(0.12)	Yes	Incurred if purchased externally
Tool rework cost per unit ($5,000/250,000)	(0.02)	Yes	Incurred if purchased externally
Total savings (additional cost)	$0.07		

Currently the cost of sourcing and purchasing food is about $180,000 per year. The total cost of running her kitchen is $15,000 per month. Anjlee rents her store location and all the equipment in the store for $9,000 per month. If she contracts out the food preparation costs, Anjlee would operate instead from a small office in a building owned by her uncle, which he currently rents for $2,500 per month. The office is currently under a municipal rent control; however, when the lease for the current tenant expires in two months the rent control limit will be increased by 12%. Anjlee pays a driver $60,000 per year to drive the van used to pick up food from supplies and deliver the meals to customers. Depreciation on the van amounts to $3,500 per year and the annual operating costs for fuel and maintenance are $7,500 per year. The van has a residual value of $1,000. Anjlee long ago promised to give the van to her current driver when it is no longer needed.

Based on her current volume of operations, Anjlee's prospective external suppliers have quoted her a cost of $500,000 per year for preparing and delivering the meals to her customers' sites. Based on preliminary discussions with potential customers Anjlee believes that by freeing up her time to concentrate more on sales she can increase her sales by $150,000 per year. Anjlee has estimated that with the prospective suppliers the contribution margin ratio of any new business would be about 20%. Fixed costs would increase by a negligible amount as sales increase.

Should Anjlee Contract with the External Suppliers?

The financial analysis shown in Exhibit 3-12 indicates that, based on Anjlee's estimates, income would increase by $31,900 per year by contracting with the external suppliers. Note that neither the depreciation on the van nor its salvage value is relevant. Depreciation is based on historical cost, which is a sunk cost, and she will not realize the residual value of the van since she has previously promised to give the van to the driver when she no longer needs it. So the residual value of the van is not relevant to this decision. Note, also, that the cost of the van was a sunk cost for this decision; it would not change as a result of whatever action Anjlee takes. An important relevant item is the contribution margin of new business that Anjlee expects to earn from freeing up her food sourcing and food preparation time. Other important considerations in this decision for Anjlee would be her faith that her suppliers would provide quality and timely work.

Exhibit 3-12

ITEM	ANNUAL AMOUNT	RELEVANT?	WHY
Source and purchase food	$180,000	Yes	Avoided if purchased externally
Kitchen costs ($15,000 × 12)	180,000	Yes	Avoided if purchased externally
Rent for current store ($9,000 × 12)	108,000	Yes	Avoided if purchased externally
Driver's salary	60,000	Yes	Avoided if purchased externally
Delivery van operating costs	7,500	Yes	Incurred if purchased externally
External supply price	(500,000)	Yes	Incurred if purchased externally
Rent for new office ($2,500 × 1.12 × 12)	(33,600)	Yes	Incurred if purchased externally
Contribution provided by new business ($150,000 × 20%)	30,000	Yes	Earned if purchased externally
Total savings (additional cost)	$31,900		

THE DECISION TO DROP A PRODUCT

Organizations abandon a product when it is unprofitable either because revenues no longer exceed costs or because another organization offers to buy the rights to the product at a favorable price. For example, in a bid to improve profitability in 2009 General Motors announced that it would drop several of its brands including Pontiac and Hummer. In 2010 General Motors was in talks with a number of prospective buyers to sell its Saturn brand.

Because the focus is on product profitability, the relevant cost analysis involves comparing the costs saved by abandoning the product with the revenues forgone. The analysis of what costs are avoided when a product is dropped can be very difficult. For example, computing General Motors' cost savings from dropping the Pontiac brand is very complex because it involves closing some plants, paying workers severance pay, and incurring environmental cleanup and many other costs.

Messi Company

Messi Company manufactures industrial lathes. The most recent income statement appears in Exhibit 3-13.

The fixed costs allocated to each product include both the fixed costs that are directly attributable to the product and those that could be avoided if the product were discontinued and also corporate fixed costs that would continue if the product were discontinued. The amount of avoidable fixed costs included in the fixed costs for Models X355, X655, and X966 are 55%, 40%, and 20%, respectively.

Messi Company is considering dropping Model X966, which shows chronic losses.

Would Dropping Model X966 Improve the Company's Overall Profitability?

Using the information relating to the avoidable fixed costs, we can produce the income statement shown in Exhibit 3-14. We can now see that, in fact, Model X966 provides the highest contribution of all the products and dropping this product would decrease Messi Company's profitability by $31,548.

In this case sales, variable costs, and avoidable fixed costs are all relevant when evaluating the profitability of each product. The allocated fixed costs that are not avoidable do not change as a result of dropping the product and, therefore, are not relevant to the decision.

Difficulties arise in practice when costs that are attributable to a product (i.e., they reflect the costs of resources that are used exclusively by that product) are only avoidable in the intermediate or long run. Suppose that General Motors

Exhibit 3-13

	MODEL X355	MODEL X655	MODEL X966	TOTAL
Sales	$23,445	$49,288	$54,677	$127,410
Variable costs	4,722	10,001	14,987	29,710
Fixed costs	14,233	29,722	40,711	84,666
Operating income	$4,490	$9,565	−$1,021	$13,034

All Values in Thousands

Exhibit 3-14

	MODEL X355	MODEL X655	MODEL X966	TOTAL
Sales	$23,445	$49,288	$54,677	$127,410
Variable costs	4,722	10,001	14,987	29,710
Avoidable fixed costs	7,828	11,889	8,142	27,859
Product contribution	$10,895	$27,398	$31,548	69,841
Fixed costs				56,807
Operating income				$13,034

All Values in Thousands

IN PRACTICE
Be Wary When Labeling Departments Losers

In many convention hotels, the exercise room, pool amenities, and sometimes food operations operate at losses to support the core product—the sale of room services. Grocery stores often use staples such as milk and bread as loss leaders to attract customers to the store. For this reason milk and bread are often located at the back of stores.

operated a plant that only produced Pontiac automobiles. Since the plant is used exclusively by the Pontiac brand, all of its costs are attributable to that brand. However, not all of the plant's costs are avoidable in the short run if the Pontiac brand is abandoned. In the short run, the buildings must be maintained and taxes and insurance must be paid. In the intermediate or longer run, the plant may be sold or reconditioned to produce another vehicle, thus saving some costs relative to building a new plant. At that point the value to General Motors of the abandoned plant would be a relevant amount to consider in the decision to abandon the Pontiac brand. Also, when closing a plant, some new costs have to be paid (e.g., environmental cleanup costs) that are deferred indefinitely as long as the plant continues to operate.

Organizations often sell an integrated product line where sales of one product affect the sales of others. In this setting additional considerations arise when deciding whether to drop a product.

Buddy's Bar and Grill

Buddy's Bar and Grill is organized into three operating units: a restaurant, a bar, and a games room. Exhibit 3-15 summarizes the results for the most recent year. Buddy is concerned about the continuing losses being reported by the games room and is considering closing it and reallocating the floor space occupied by the games room to the restaurant and bar.

A study of operations yielded the following results:

1. The fixed costs have two components:

   a. The first component is an allocation of the organization's general business costs of $340,000. These costs are allocated in proportion to the floor space occupied by each unit. The floor space occupied by the restaurant, bar, and games room is 1,000, 400, and 600 square meters, respectively.

Exhibit 3-15

	RESTAURANT	BAR	GAMES ROOM	TOTAL
Sales	$1,200,000	$800,000	$100,000	$2,100,000
Variable costs	700,000	375,000	50,000	1,125,000
Fixed cost	320,000	118,000	202,000	640,000
Profit	$180,000	$307,000	($152,000)	$335,000

   b. The second component of fixed costs for each unit is the attributable fixed cost relating to rented equipment that can be avoided in full if the unit is closed.

2. If the games room is closed, 400 square meters of the freed up space will be allocated to the restaurant and 200 square meters will be allocated to the bar. Attributable fixed costs in the restaurant and in the bar will not increase if the area is expanded.

3. If the games room is closed and the restaurant is expanded, sales in the restaurant will increase by 10% primarily because the decrease in noise coming from the games room will attract more customers. Variable costs will increase in the same proportion.

4. A study of the bar customers suggests that the patrons of the games room account for about 50% of the bar sales and that half of these sales will be lost if the games room is closed. Variable costs will decrease in the same proportion.

Should the Games Room Be Closed?

We can approach this question in two steps. First, eliminate the allocated costs from the contribution of each of the business units. For example, the allocated cost to the restaurant will be $170,000 {$340,000 × [1,000/(1,000 + 400 + 600)]}. This means that $150,000 ($320,000 − $170,000) is the amount of attributable and avoidable costs associated with the restaurant. We can use the same approach to identify the effect of removing the allocated costs from the bar and games room. The result is shown in Exhibit 3-16.

With the games room closed, restaurant sales will increase to $1,320,000 [$1,200,000 × (1 + 10%)] and variable costs will increase to $770,000 [$700,000 × (1 + 10%)]. In addition, sales in the bar will decrease to $600,000 [$800,000 × (1 − 25%)] and variable costs will decrease to $281,250 [$375,000 × (1 − 25%)]. Exhibit 3-17 summarizes the result.

The result of closing the games room has decreased corporate profit by $6,250 ($335,000 − $328,750). Although this difference is not significant, the analysis does

Exhibit 3-16

	RESTAURANT	BAR	GAMES ROOM	TOTAL
Sales	$1,200,000	$800,000	$100,000	$2,100,000
Variable costs	700,000	375,000	50,000	1,125,000
Attributable fixed	150,000	50,000	100,000	300,000
Profit	$350,000	$375,000	($50,000)	$675,000
Corporate fixed				340,000
Profit				$335,000

Exhibit 3-17

	RESTAURANT	BAR	TOTAL
Sales	$1,320,000	$600,000	$1,920,000
Variable costs	770,000	281,250	1,051,250
Attributable fixed	150,000	50,000	200,000
Profit	$400,000	$268,750	$668,750
Corporate fixed			340,000
Profit			$328,750

illustrate a situation in which the sales by one organizational unit can affect sales in another organizational unit and that these relationships need to be evaluated when consideration is given to dropping an apparently unprofitable product or line of business.

COSTING ORDERS

The order costing problem deals with estimating the cost of unique orders. For example, the manager of an organization that manufactures clothes washers may be asked to quote a price on a one-time order for 10,000 washing machines. Computing the **floor price**, or the minimum price that a company would normally consider for the order, exploits the relevant cost idea by considering the costs that will change as a result of taking the order.

Pepper Industries

Pepper Industries manufactures a wide line of pottery coffee cups that it sells to specialty gift stores. The sales manager has received a request to price a special order from a large consultancy offering to purchase 50,000 mugs that it plans to use for promotional purposes.

The sales manager asked the factory accountant to develop an estimate of the cost to fill this order. The production manager advises that there is plenty of idle capacity to fill this order. The factory accountant replied by submitting Exhibit 3-18.

The following additional information was provided. All variable costs are incremental costs relating to this order. The charge for fixed manufacturing overhead is the standard fixed overhead amount that Pepper Industries allocates to all cups it produces. The fixed manufacturing overhead relates to factory equipment that is used to make the

Exhibit 3-18

ITEM	COST
Direct materials − 50,000 @ $0.66 each	$33,000
Direct labor − 50,000 @ $0.23 each	11,500
Variable manufacturing overhead − 50,000 @ $0.15 ea	7,500
Fixed manufacturing overhead − 50,000 @ $0.10 each	5,000
Design costs	1,800
Shipping costs	3,600
Other administrative costs	1,500
Total order cost	$63,900

Exhibit 3-19

ITEM	COST	INCREMENTAL
Direct materials − 50,000 @ $0.66 each	$33,000	$33,000
Direct labor − 50,000 @ $0.23 each	11,500	11,500
Variable manufacturing overhead − 50,000 @ $0.15 each	7,500	7,500
Fixed manufacturing overhead − 50,000 @ $0.10 each	5,000	0
Design costs	1,800	900
Shipping costs	3,600	3,600
Other administrative costs	1,500	0
Total order cost	$63,900	$56,500
Cost per cup		$1.13

various products. It will not change in the short run. Design costs are the estimated costs of designing the product for this customer. They reflect a cost of $900 to which is added the standard 100% markup to cover fixed overhead in the design department. The shipping costs are the estimated costs of shipping the completed product to the customer. The other administrative costs represent the cost that is added to each order to reflect fixed administrative costs at Pepper Industries that will not change in the short run.

What Minimum Price per Cup Should Pepper Industries Consider Quoting on This Order?

As shown in Exhibit 3-19, the relevant (incremental) costs to fill this order total $56,500 or $1.13 per cup. This is the minimum, or floor, price that Pepper Industries should consider when quoting on this order. The actual price charged will reflect strategic factors such as the amount of competition (the more unique the organization, the higher the price it likely can charge), the amount of idle capacity, how eager the organization is for new business, the possibility of the price quoted for this business affecting relationships with current customers, and the possibility of future orders. (The opportunity to develop a long-term relationship with the customer will affect the price charged for this order; however, in the long run the organization will need to cover the estimated full costs of filling orders like this.)

Costing Orders and Opportunity Cost Considerations

When there is insufficient capacity to fill an order, costing the order must consider the opportunity cost of accepting the order.

Maggie Company

Maggie Company manufactures a line of backpacks specifically designed for school children ages 8 to 12 years. The backpacks feature licensed graphics of characters popular with this age group. The products sell very well and despite expansion for several years, the company continues to operate at capacity. Exhibit 3-20 summarizes the per unit information relating to this product.

Exhibit 3-20

Price	$45.99
Variable costs	24.78
Fixed manufacturing cost	4.33
Profit per unit	$16.88

Exhibit 3-21

Total variable costs ($24.78 + $10.00 + $5.00)	$39.78
Opportunity cost	3.03
Floor price	$42.81

Recently Maggie Company received an order from a large mail-order company asking for a quote to supply it with 10,000 backpacks made to the mail-order company's specifications. The product needed by the company, tentatively called "The Sack," incorporates the design of Maggie Company's current product but includes several additional features. The total incremental costs per unit of The Sack's additional features, relative to Maggie's current product, are $10 for materials and $5 for labor. Because of the additional demand on capacity to add the features needed by The Sack, Maggie Company will have to give up producing and selling one unit of its current product for every seven of the special order product that it produces. Current fixed costs, however, will not change.

What Is the Minimum Price (Floor Price) per Unit That Maggie Company Should Consider Charging for The Sack?

The contribution margin per unit for Maggie Company's current product is $21.21 ($45.99 − $24.78). Therefore, for every seven units of The Sack that Maggie Company makes, it will give up a contribution of $21.21 on the lost unit of its existing product. Expressed on a per unit basis, producing The Sack has an opportunity cost of $3.03 ($21.21 ÷ 7) per unit.

The total relevant cost, or floor price, of The Sack will be $42.81 as shown in Exhibit 3-21.

RELEVANT COST AND SHORT-TERM PRODUCT MIX DECISIONS

Organizations like machine shops and consultancies often face competing demands for their limited production resources. Choices have to be made among the various opportunities that present themselves. Making these choices involves the application of the relevant cost concept.

Fred's Wood Products

Fred manufactures a number of wood products including a cutting board that is sold by several large department stores. The sales manager believes that the product should be upgraded and sold exclusively in high-end stores that focus on kitchenware. Per unit characteristics of the existing product and new product are shown in Exhibit 3-22. The significantly higher profit per unit of the proposed product is what has caused the sales manager to promote the change.

Exhibit 3-22

	EXISTING PRODUCT		PROPOSED PRODUCT	
Price		$20.00		$35.00
Direct materials	$3.00		$5.00	
Labor	6.00		12.00	
Selling	1.00		1.75	
Manufacturing overhead	4.50	14.50	7.50	26.25
Per unit profit		$5.50		$8.75

Additional information provided by Fred's accountant indicates that all workers are paid a flat wage irrespective of the number of hours that they work. Labor costs are charged to products at the rate of $24 per hour. Selling costs are 5% of the product price and overhead is charged to products at 150% of direct materials costs. Variable manufacturing overhead costs are about 10% of direct materials costs. Because of commitments to make other products, the maximum number of labor hours that can be used to produce cutting boards is 10,000.

Should Fred Abandon Production of the Existing Product in Favor of the Proposed Product?

Relevant cost analysis suggests that only costs that will change as a result of changing from the existing product to the proposed product should be considered in this decision. Labor costs are not relevant since they are fixed and will not change as a result of this decision. Similarly only variable overhead, which is 10% of the direct materials costs, should be considered in the decision. Finally, selling costs, which are variable and equal 5% of the selling price, are relevant and must be considered. With this information in mind, we can compute the incremental contributions of the existing product and the proposed product, which are $15.70 and $27.75, respectively, as shown in Exhibit 3-23. The proposed product still looks like the preferred alternative.

However, recall that the amount of labor hours available is 10,000 and that the accountant indicated that labor costs are allocated to the products at the rate of $24 per labor hour used by each product. The data in the exhibit provided by the accountant indicate that the existing product uses 0.25 (6.00/24.00) labor hours per unit and the proposed product uses 0.50 labor hours per unit (12.00/24.00).

Put another way this means that the existing product provides a contribution of $62.80 ($15.70/0.25) per labor hour and the proposed product provides a contribution of $55.50 ($27.75/0.50) per labor hour. This means that if the 10,000 labor hours are allocated to the production of the existing product the total contribution to fixed costs will be $628,000 (10,000 × $62.80). Alternatively if the 10,000 labor hours are allocated to the production of the proposed product, the total contribution will be $555,000 (10,000 × $55.50). Clearly, based on the relevant cost analysis the existing product provides the most profitable alternative. Exhibit 3-24 shows the calculation of each product's contribution margin per labor hour.

In this case labor is the constraining factor of production. The approach is to allocate production capacity to the product with the highest contribution margin per unit of the constraining factor of production, which in this situation is the existing product.

Note that in this case Fred will produce 40,000 (10,000/0.25) of the existing boards. Suppose the company can only sell 30,000 boards. In that case Fred would allocate the first 7,500 (30,000 × 0.25) labor hours to the existing product and the remaining 2,500 (10,000 − 7,500) labor hours to the proposed board. This will mean that Fred will produce 30,000 of the existing boards and 5,000 (2,500/0.50) of the proposed boards.

Exhibit 3-23

	EXISTING PRODUCT		PROPOSED PRODUCT	
Price		$20.00		$35.00
Direct materials	$3.00		$5.00	
Selling	1.00		1.75	
Variable overhead	0.30	4.30	0.50	7.25
Contribution		$15.70		$27.75

Exhibit 3-24

	EXISTING PRODUCT		PROPOSED PRODUCT	
Price		$20.00		$35.00
Direct materials	$3.00		$5.00	
Selling	1.00		1.75	
Variable overhead	0.30	4.30	0.50	7.25
Contribution		$15.70		$27.75
Labor hours		0.25		0.5
Contribution per LH		$62.80		$55.50

Multiple Resource Constraints

When a company faces multiple resource constraints, the approach described in the previous section for allocating resource capacity will no longer work. We begin our discussion of the alternative approach by illustrating how to solve a simple two-constraint problem and then we turn to consideration of a more general approach.

Harris Chemical

Harris Chemical produces two products, X544 and X588, that are used in the metal coating industry. The two products are made in batches of 1,000 gallons. The company blends two input chemicals Argo and Nevex in a blender to produce the two products. Exhibit 3-25 summarizes the amount of each of the input chemicals required by each of the two products and the amount of blender time required by each product batch as well as the costs of the input chemicals and the cost of operating the blender per hour.

Further analysis reveals that fixed costs comprise two-thirds of the reported blender cost per hour. Each period a maximum of 47,800 gallons of Nevex is available for purchase and a maximum of 900 hours of blender use. There is no limit on the amount of Argo available for purchase each period.

As before, we begin by computing the contribution provided by each product, as summarized in Exhibit 3-26. Note that only the variable hourly cost of $400 ($1,200 $\times$ 1/3) for operating the blender is included in computing the contribution of each batch.

We are now at an impasse if we try to apply the approach we considered when there was only one constraining factor of production. We now have two constraining factors of production and must consider them simultaneously. At this point we need to turn to a tool called *linear programming*.

Exhibit 3-25

	PRODUCT	
	X544	X588
Gallons of Argo per batch	700	400
Gallons of Nevex per batch	500	300
Revenue per batch	$33,000	$24,000
Cost per gallon of Argo	12	
Cost per gallon of Nevex	18	
Hours of blender time	6	10
Blender cost per hour	$1,200	

IN PRACTICE

Choosing the Least Cost Materials Mix

You might be interested to know that one of the first decision-making applications of computers in business was to solve the problem of minimizing the cost of dairy feed. Given the various nutritional constraints and the costs of the various ingredients that could be used in the feed, a linear program identified the least cost mix of ingredients that met the nutritional requirements.

Exhibit 3-26

	PRODUCT			
	X544		X588	
Revenue per batch		$33,000		$24,000
Nevex				
Gallons used per batch	500		300	
Cost per gallon	18	9,000	18	5,400
Argo				
Gallons used per batch	700		400	
Cost per gallon	12	8,400	12	4,800
Blender				
Time (hours)	6		10	
Cost per hour	400	2,400	400	4,000
Contribution per batch		$13,200		$9,800

Building the Linear Program

A linear program has three components that we discuss in terms of the Harris Chemicals case:

1. *Objective function*—The objective function is to maximize the contribution margin by producing the best mix of products X544 and X588. Total fixed costs will remain unchanged regardless of the production plan and therefore are not relevant and they are ignored.
2. *Decision variables*—The decision variables are the batches of products X544 and X588 that will be produced.
3. *Constraints*—The two constraints are hours in the blender (900 hours are available) and gallons of Nevex (47,800 gallons are available).

With this information we can construct the linear program. For discussion convenience we will let A be the number of batches of product X544 produced and B be the number of batches of product X588 produced. We then have

$$\text{Maximize } \$13{,}200A + \$9{,}800B$$

(This is the objective function, which is the total contribution margin of the production plan.) It is subject to the following constraints:

1. $6A + 10B \leq 900$—This is the blender hours constraint—the left-hand side is the number of blender hours consumed producing X544 and X588, and the right-hand side is the number of blender hours available. The constraint specifies that the amount of blender hours used by the production plan cannot exceed the amount available.

2. *500A + 300B ⩽ 47,800*—This is the Nevex constraint—the left-hand side is the gallons of Nevex consumed producing X544 and X588, and the right-hand side is the gallons of Nevex available. The constraint specifies that the amount of Nevex used by the production plan cannot exceed the amount available.

3. *A, B ⩾ 0*—This is the non-negativity constraint, which says that production cannot be negative.

In practice, linear programs are solved using computers and specialized software packages. There is a tool in Microsoft Excel and Open Office Calc called *Solver* that can be used to solve linear programs. However, here we will focus on manual solutions to simple linear programs so that you can develop the intuition relating to how linear programs find optimal solutions. The approach we will use is graphical.

## The Graphical Approach to Solving Linear Programs

Step 1: Draw the Constraints on a Graph

Exhibit 3-27 graphs the blender constraint. The number of batches of product X588 produced is shown on the vertical (Y) axis and the number of batches of product X544 produced is shown on the horizontal (X) axis. Since each batch of X544 uses 6 blender hours, we can produce 150 (900/6) batches of X544 if we use all 900 blender hours to produce X544. Since each batch of product X588 uses 10 blender hours, we can produce 90 (900/10) batches of X588 if we use all 900 blender hours to produce X588. The line joining these two points on the graph represents the boundary of the area denoting the feasible set of (X544, X588) production pairs. Any combination of batches of production of X544 and X588 that lie on this line or below is feasible since it does not require more blender hours than the 900 hours available.

We can use the same approach to find the end points of the constraint for Nevex availability. The end points are 95.6 (47,800/500) batches of X544 and 159.33 (47,800/300) batches of X588. Exhibit 3-28 graphs both constraints. We have now completed the process of adding constraints.

Remember that for an (X544, X588) production pair to be feasible, it has to lie on or below both lines. In other words for a production pair to be possible, it must be jointly feasible to all the constraints. The area that is jointly feasible to all constraints is called the *feasible production set* or simply the *feasible set*. Exhibit 3-29 shows the feasible set for this problem. The feasible set includes any point on or below the constraint lines shown in the diagram.

Exhibit 3-27
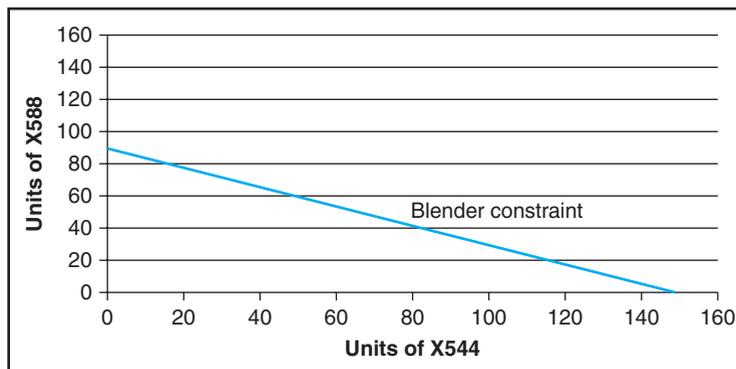
Exhibit 3-28
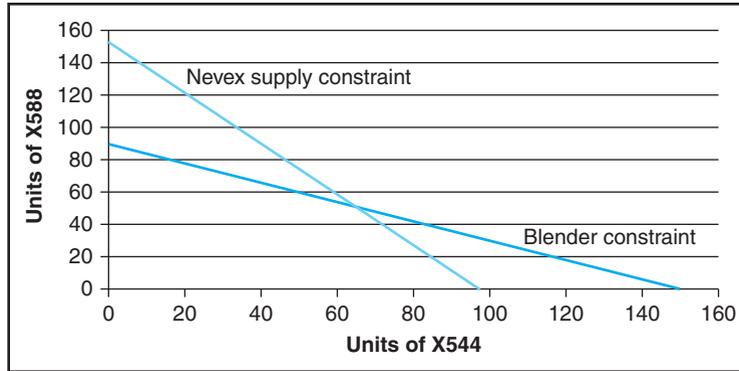
Exhibit 3-29
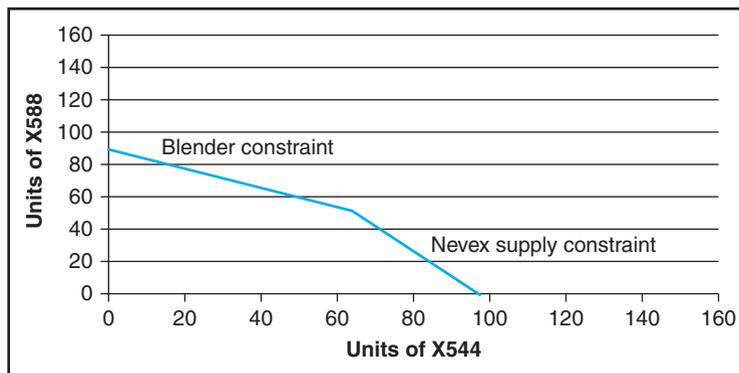
Step 2: Finding the Optimal Solution on the Graph

The trick in linear programming is that the best solution will always be found on the boundary of the feasible set. Moreover, there is no production pair on the boundary of the feasible set that will provide a better solution than a production pair at one of the corners of the feasible set. This means that we only need to look at the corners of the feasible set to find a best solution.

In this case we have four corners:

1. Produce 0 batches of X544 and 0 batches of X588.
2. Produce 95.6 batches of X544 and 0 batches of X588.
3. Produce 65 batches of X544 and 51 batches of X588.[2]
4. Produce 0 batches of X544 and 90 batches of X588.

Because we know the contribution margins of X544 and X588 we can compute the contribution margin of each production pair to determine that the best solution is to produce 65 batches of X544 and 51 batches of X588 as shown in Exhibit 3-30.

The decision maker can add various constraints and multiple decision variables to the linear program but this problem illustrates the basic idea. The linear program will find the feasible set and will hunt around the corners of the feasible set to find the best solution.

---

[2] We have two equations in two unknowns: $6A + 10B = 900$ and $500A + 300B = 47,800$. Multiply the first equation by 30 and subtract the resulting equation from the second equation to get $320A = 20,800$. Therefore, $A = 65$. Substitute $A = 65$ in either of the original constraint equations to find $B = 51$.

Exhibit 3-30

	X544	X588	TOTAL CM
Contribution margin per batch	$13,200	$9,800	
Batches			
Corner 1	0	0	$0
Corner 2	95.6	0	$1,261,920
Corner 3	65	51	$1,357,800
Corner 4	0	90	$882,000

EPILOGUE TO NOLAN INDUSTRIES

With the tools from this chapter in mind, we can return to the issues Punit was considering at the beginning of the chapter.

Recalling our discussion of both CVP analysis and relevant costs, we know that Punit should begin by computing the contribution margins of the two products. Recognizing that variable costs are 65% of total costs, Punit can compute the contribution margin of the two existing products as shown in Exhibit 3-31.

With this information and recalling that the sales mix is 60% XR276 and 40% XR244, Punit can undertake the breakeven analysis he was wondering about by employing the profit equation we developed in this chapter. If we assume that sales are in batches of 100, then

$$\text{Profit} = (40 \times \text{Contribution margin XR244}) + (60 \times \text{Contribution margin XR276}) \times \text{Batches of 100 sold} - \$7,500,000$$

Noting that profit = 0 at breakeven and rearranging, we have

Batches of 100 sold = 7,500,000/[(40 × 479.50) + (60 × 568.25)] = 140.779
Units of XR244 sold = 5,631.16 (140.779 × 40)
Units of XR276 sold = 8,446.74 (140.779 × 60)

Therefore, with a 40/60 split, Nolan Industries will have to sell 5,632 units of XR244 and 8,447 units of XR276.

You may have realized that a shorter, and perhaps more intuitive, approach to solving this problem is to compute a hypothetical product with a contribution margin that is a weighted average of the two existing products. In this case the hypothetical product would have a contribution margin of $532.75 [(40% × 479.50) + (60% × 568.25)]. Therefore, the number of units of this hypothetical product that would have to be sold to break even would be 14,077.9 (7,500,000/532.75). Therefore, unit sales of XR244 would be 5,631.16 (40% × 14,077.9), and unit sales of XR276 would be 8,446.74 (60% × 14,077.9), which, of course, is the answer we already have.

Exhibit 3-31

	XR244	XR276
Selling price	$785.00	$955.00
Variable cost	305.50	386.75
Contribution margin	$479.50	$568.25

Exhibit 3-32

	XR244	XR276	TOTAL
Sales units	5,632	8,447	14,079
Selling price	$785.00	$955.00	
Variable cost	305.50	386.75	
Contribution margin per unit sold	$479.50	$568.25	
Total contribution margin			$7,500,552
Fixed cost			7,500,000
Profit			$552

Exhibit 3-32 provides a profit summary. Recall that by convention all breakeven calculations are rounded up—therefore the profit reported will be slightly greater than the target of 0.

This answers Punit's question about breakeven sales assuming the 40/60 split. Punit now wants to know the maximum sales levels while maintaining the 40/60 split. In this case sales are constrained by the 48,000 machine hours available. If we tackle this problem using the batch approach, we first note that every batch of 100 products will use 280 [(40 × 2.50) + (60 × 3)] hours. Therefore, the maximum number of batches that can be produced will be 171.43 (48,000/280). This means that the maximum number of XR244s that can be produced will be 6,857.14 (171.43 × 40) and the maximum number of XR276s that can be produced will be 10,285.71 (171.43 × 60). As shown in Exhibit 3-33, various combinations of rounding suggest that the best production plan to maintain an approximate 40/60 mix is to produce 6,856 units of XR244 and 10,286 units of XR276 with a resulting profit of $1,632,472.

Note that tackling this problem using the hypothetical product would follow this path. The hypothetical product would require 2.8 hours per [(0.4 × 2.5) + (0.6 × 3)] hours per unit meaning that a maximum of 17,142.86 (48,000/2.8) units of the hypothetical product could be produced. At this point you should be able to complete the analysis to show that this results in the same solution as the batch approach.

Now Punit wants to know whether the 40/60 mix is really the best. From the discussion in the chapter you should recall that what we need to do, since there is only one production constraint in this problem, is to compute each product's contribution per machine hour. Exhibit 3-34 shows these calculations.

Exhibit 3-33

	XR244	XR276	TOTAL
Sales units	6,856	10,286	17,142
Selling price	$785.00	$955.00	
Variable cost	305.50	386.75	
Contribution margin per unit sold	$479.50	$568.25	
Total contribution margin			$9,132,472
Fixed cost			7,500,000
Profit			$1,632,472
Machine hours (per unit)	2.50	3.00	
Total machine hours used	17,140	30,858	47,998

Exhibit 3-34

	XR244	XR276
Sales units	6,857	10,285
Selling price	$785.00	$955.00
Variable cost	305.50	386.75
Contribution margin per unit sold	$479.50	$568.25
Machine hours (per unit)	2.50	3.00
Contribution margin per machine hour	$191.80	$189.42

Exhibit 3-35

	XR244	XR276	TOTAL
% of Total sales	56.61%	43.39%	
Sales units	10,000	7,666	17,666
Selling price	$785.00	$955.00	
Variable cost	305.50	386.75	
Contribution margin per unit sold	$479.50	$568.25	
Total contribution margin	$4,795,000	$4,356,205	$9,151,205
Fixed cost			7,500,000
Profit			$1,651,205
Machine hours used per unit	2.50	3.00	
Total machine hours	25,000	22,998	47,998

Exhibit 3-36

	XR244	XR276	NEW
Selling price	$785.00	$955.00	$1,200.00
Variable cost	305.50	386.75	533.00
Contribution margin per unit	$479.50	$568.25	$667.00
Machine hours per unit	2.5	3	3.5
Contribution per machine hour	$191.80	$189.42	$190.57

Since XR244 has the highest contribution per machine hour, we now know that we should make as many XR244s as we can. We have the capacity to produce 19,200 (48,000/2.5) units of XR244, but we can only sell 10,000 units. Therefore, we should allocate 25,000 (10,000 × 2.5) hours of machine time to produce 10,000 units of XR244. That will leave us with 23,000 (48,000 − 25,000) hours of machine time to produce 7,666 (23,000/3) units of XR276. This results in a 56.6/43.4 split and produces a profit of $1,651,205 as shown in Exhibit 3-35.

Finally Punit wants to know whether the new product offering is a good deal. Once again we need to compute each product's contribution margin per machine hour. Exhibit 3-36 shows this calculation.

IN PRACTICE

Excel's *Goal Seek* and *Solver*

Punit's questions can easily be answered using Excel tools. If interested, in Excel set up a spreadsheet that identifies the total contribution associated with a production plan. Then you can use Excel's *Goal Seek* tool to answer a question like finding the breakeven point and Excel's *Solver* tool to find the best production plan. Exhibit 3-37 presents the optimal production plan found by Solver.

Exhibit 3-37

	XR244	XR276	NEW	TOTAL
Units sold	10,000	5,333	2,000	17,333
Selling price	$785.00	$955.00	$1,200.00	
Variable cost	305.50	386.75	533.00	
Contribution margin per unit	$479.50	$568.25	$667.00	
Total contribution margin	4,795,000	3,030,477	1,334,000	$9,159,477
Fixed cost				7,500,000
Profit				$1,659,477
Machine hours per unit	2.5	3	3.5	
Machine hours used	25,000	15,999	7,000	47,999

If we follow the rule of allocating machine time in order of contribution per machine hour, we will produce XR244 first, then the new product, and finally XR276. Given that the maximum number of units of the new product we can sell is 2,000, you should be able to show that the production plan shown in Exhibit 3-37 is the best one.

SUMMARY

This chapter provided a review of many of the cost concepts in management accounting and provides an important foundation for the remaining chapters in this book.

The chapter stressed that the primary role of management accounting is to support decision making inside the organization. Therefore, unlike financial accounting, which is driven by reporting requirements specified by accounting bodies and governments, management accounting is driven by the information needs of decision makers inside the organization.

The chapter provided an introduction to CVP analysis, which forms the basis for the spreadsheet-based financial modeling that is used by virtually all organizations. Indeed, many analysts attribute the explosive growth in sales of personal computers in the late 1970s and early 1980s to the development of spreadsheet software, such as VisiCalc and Lotus 1-2-3, which could be used for financial modeling. The basic CVP analysis reviewed in this chapter classifies costs as variable, fixed, and mixed. More complex cost behavior is easily modeled using spreadsheets.

The chapter also introduced the decision-making principle that the only relevant items in a decision are those costs that change as a result of the decision. The relevant cost concept was explored in the context of the make-or-buy decision, the decision to drop a product or department, the order decision, and the short-term product mix decision.

The discussion in the chapter pointed out that practice frequently witnesses violations of the relevant cost principle—one of the most common violations being the sunk cost phenomenon. The consequence is that decision makers need to avoid introducing irrelevant data into their decision making.

KEY TERMS

avoidable cost, 77
breakeven point, 71
capacity-related cost, 66
contribution margin, 67
contribution margin per unit, 67
contribution margin ratio, 67
cost driver, 64
cost–volume–profit (CVP)
  analysis, 66

direct labor cost, 79
direct materials cost, 79
fixed cost, 66
floor price, 85
incremental cost, 73
make-or-buy decision, 78
manufacturing overhead cost, 79
mixed cost, 72

opportunity cost, 76
relevant cost, 76
step variable cost, 73
sunk cost, 74
sunk cost phenomenon, 75
variable cost, 64
what-if analysis, 69

ASSIGNMENT MATERIALS

Questions

3-1 What are some different managerial uses of cost information? **(LO 2)**

3-2 Explain the difference between variable costs and fixed costs. **(LO 1, 2, 3)**

3-3 What does the term *contribution margin per unit* mean? How is the contribution margin used in cost analysis to support managerial decisions? **(LO 1, 2, 3)**

3-4 Explain the difference between the *contribution margin ratio* and *contribution margin per unit*. **(LO 1, 2, 3)**

3-5 What does the term *breakeven point* mean? **(LO 1, 2, 3)**

3-6 How are *mixed costs* and *step variable costs* similar and different? **(LO 1, 2, 3)**

3-7 How do *step variable costs* differ from *fixed costs*? **(LO 1, 2, 3)**

3-8 What does the term *incremental cost* mean? **(LO 1, 2, 3)**

3-9 Why should decision makers focus only on the relevant costs for decision making? **(LO 1, 2, 3, 4)**

3-10 What are *sunk costs*? Explain whether they are relevant costs. **(LO 1, 2, 3, 4)**

3-11 What behavioral factors may influence some managers to consider sunk costs as being relevant in their decisions? **(LO 1, 2, 3, 4)**

3-12 Are fixed costs always irrelevant? **(LO 1, 2, 3, 4)**

3-13 What is an opportunity cost? **(LO 1, 2, 3, 4)**

3-14 Are avoidable costs relevant? Explain. **(LO 1, 2, 3, 4)**

3-15 Provide an example of a fixed cost that would be relevant to a make-or-buy decision, and an example of a fixed cost that would not be relevant to such a decision. **(LO 3, 4)**

3-16 What qualitative considerations are relevant in a make-or-buy decision? **(LO 4)**

3-17 What is an opportunity cost that is relevant in a make-or-buy decision? **(LO 1, 4)**

3-18 In analyzing whether to drop a product or department, what are two difficulties that arise related to the impact on costs or revenues? **(LO 3, 4)**

3-19 "Prices must cover both variable and fixed costs of production." Do you agree with this statement? Explain. **(LO 3, 4)**

3-20 "When production capacity is constrained, determine what products to make by ranking them in order of their contribution per unit." Do you agree with this statement? Explain. **(LO 3, 4)**

3-21 "When production capacity is limited and it is possible to obtain additional customer orders, a firm must consider its opportunity costs to evaluate the profitability of these new orders." Do you agree with this statement? If so, what are the opportunity costs in this context? **(LO 3, 4)**

3-22 What are the three components of a linear program? **(LO 4)**

Exercises

LO 3 **3-23** *Classification of variable and fixed costs* Classify each of the following as a variable or fixed cost with respect to a unit of production:

a. Salaries of production supervisors.
b. Steel used in automobile production.
c. Wood used in furniture production.
d. Salaries for factory custodial staff.

e. Depreciation of factory equipment.
f. Lubricants for machines.
g. Electricity used to operate a specific machine.
h. Wages of production workers.
i. Rent for a factory building.
j. Glue used in furniture production.
k. Maintenance for production equipment, performed every month.
l. Paper used in newspaper production.

LO 3   **3-24** *Classification of variable and fixed costs*   Classify each of the following as a variable or fixed cost with respect to a unit of product that is sold:
a. Commissions paid to sales personnel.
b. Advertising expenses.
c. Salaries of staff processing orders.
d. Salary of the chief executive officer.
e. Depreciation of a shipping truck.
f. Protective packaging for each unit of product.
g. Insurance for corporate headquarters.
h. Gasoline used to deliver products.

LO 3   **3-25** *Cost classification*   Percy's is a small hamburger shop catering mainly to students at a nearby university. It sells hamburgers and vegetarian burgers and is open for business from 11:00 A.M. until 11:00 P.M., Monday through Friday. The owner, Percy Luk, employs two cooks, one server, and a part-time janitor. Because there is no space for dining inside the shop, all orders are takeout orders. Moreover, almost all orders are for one burger. Percy prepared the following partial list of costs incurred last month:

Burger ingredients
Cooks' wages
Server's wages
Janitor's wages
Depreciation on cooking equipment
Paper supplies (wrapping, napkins, and bags)
Rent
Advertisement in local newspaper

Required

Classify these costs as variable or fixed with respect to the number of burgers served.

LO 3   **3-26** *Breakeven analysis*   Klear Camera Company is considering introducing a new video camera. Its selling price is projected to be $1,000 per unit. Variable manufacturing costs are estimated to be $500 per unit. Variable selling costs are 10% of sales dollars. The company expects the annual fixed manufacturing costs for the new camera to be $3,500,000.

Required

(a) Compute Klear's contribution margin per unit and contribution margin ratio.
(b) Determine the number of units Klear must sell to break even.
(c) Klear is considering a design modification that would reduce the variable cost of the camera by $50 per unit. Explain whether this change will cause Klear's breakeven point to increase or decrease, compared to the initial plans.

LO 3   **3-27** *Breakeven analysis and target profit for a hospital*   Morton Medical Institute operates a 300-bed hospital and offers a number of specialized

medical services. Morton's hospital facility and equipment are leased on a long-term basis. The hospital charges $2,000 per patient day. On the basis of past cost data, Morton has estimated its variable costs as $500 per patient day. Fixed costs are $2,000,000 per month. The hospital's administrator has estimated that the hospital will average 5,400 patient days per month.

Required

(a) How much will the hospital need to charge per patient day to break even at this level of activity?
(b) Refer to the original data in the problem. How many patient days must Morton average each month to earn a target profit of $45,000 per month?

> **LO 3** **3-28** *Breakeven analysis and target profit, taxes* Patterson Parkas Company's sales revenue is $30 per unit, variable costs are $19.50 per unit, and fixed costs are $147,000.

Required

(a) Compute Patterson's contribution margin per unit and contribution margin ratio.
(b) Determine the number of units Patterson must sell to break even.
(c) Determine the sales revenue required to earn (pretax) income equal to 20% of revenue.
(d) How many units must Patterson sell to generate an after-tax profit of $109,200 if the tax rate is 35%?
(e) Patterson is considering increasing its advertising expenses by $38,500. How much of an increase in sales units is necessary from expanded advertising to justify this expenditure (generate an incremental contribution margin of $38,500)?

> **LO 3** **3-29** *Breakeven analysis, target profit* Last year, Able Co. recorded sales revenues of $1,260,000, variable costs of $570,000, and fixed costs of $480,500.

Required

(a) At what sales dollar level will Able earn a before-tax target profit of $250,000?
(b) At what sales dollar level will Able break even?

> **LO 3** **3-30** *Multiple-product target profit* A&Z Company sells products both domestically and internationally. Fixed costs totaled $5,000,000 last year. In an effort to increase its total sales volume, A&Z plans to spend an additional $1,280,000 in advertising next year. Expected average prices and variable costs appear below.

	DOMESTIC	INTERNATIONAL
Price per unit	$50	$40
Variable costs per unit	$30	$16

Because of the increased advertising, A&Z expects to sell 300,000 units domestically and 200,000 units internationally next year.

Required

Using the expected sales mix, determine the number of units that A&Z must sell in each market in order to earn income of $200,000 next year.

3-31 *Multiple-product breakeven analysis*   Florida Favorites Company produces toy alligators and toy dolphins. Fixed costs are $1,290,000 per year. Sales revenue and variable costs per unit are as follow:

	ALLIGATORS	DOLPHINS
Sales price	$20	$25
Variable costs	8	10

Required

(a) Suppose the company currently sells 140,000 alligators per year and 60,000 dolphins per year. Assuming the sales mix stays constant, how many alligators and dolphins must the company sell to break even per year?

(b) Suppose the company currently sells 60,000 alligators per year and 140,000 dolphins per year. Assuming the sales mix stays constant, how many alligators and dolphins must the company sell to break even per year?

(c) Explain why the total number of toys needed to break even in part a is the same as or different from the number in part b.

LO 2, 3   **3-32** *Pricing and impact on demand*   Andrea Kimball has recently acquired a franchise of a well-known fast-food restaurant chain. She is considering a special promotion for a week during which hamburger prices would be reduced $0.40 from the regular price of $1.09 to $0.69. Local advertising expenses for this special promotion will amount to $4,500. Andrea expects the promotion to increase sales of hamburgers by 20% and French fries by 12%, but she expects the sales of chicken sandwiches to decline by 8% (because some customers, who otherwise may have ordered a chicken sandwich, will order a hamburger instead because of its attractive low price). The following data have been compiled for sales prices, variable costs, and weekly sales volumes:

PRODUCT	SALES PRICE	VARIABLE COSTS	SALES VOLUME
Hamburgers	$1.09	$0.51	20,000
Chicken sandwiches	1.29	0.63	10,000
French fries	0.89	0.37	20,000

Required

Evaluate the expected impact of the special promotion on sales and profits. Should Andrea go ahead with this special promotion? What other considerations are relevant in this decision?

LO 1, 2, 3, 4   **3-33** *Variable and fixed costs, profitability of order, opportunity cost*   Healthy Hearth specializes in lunches for health-conscious people. The company produces a small selection of lunch offerings each day. The menu selections may vary from day to day, but Healthy Hearth charges the same price per menu selection because it adjusts the portion sizes according to the cost of producing the selection. Healthy Hearth currently sells 5,000 meals per month. Variable costs are $3 per meal, and fixed costs total $5,000 per month. A government agency has recently proposed that Healthy Hearth provide 1,000 meals next month for senior citizens at $3.50 per meal. Volunteers will deliver the meals to the senior citizens at no charge.

(a) Suppose Healthy Hearth has sufficient idle capacity to accommodate the government order for next month. What will be the impact on Healthy Hearth's operating income if it accepts this order?

(b) Suppose that Healthy Hearth would have to give up regular sales of 500 meals, at a price of $4.50 each, to accommodate the government order for next month. What will be the impact on Healthy Hearth's operating income if it accepts the government order?

LO 1, 4   **3-34**   *Relevant and sunk costs*   Don Baxter's 6-year-old Impala requires repairs estimated at $5,400 to make it roadworthy again. His friend Aaron Bloom suggested that he buy a 6-year-old Ford Escort instead for $5,400 cash. Aaron estimated the following costs for the two cars:

COSTS	IMPALA	ESCORT
Acquisition cost	$24,000	$5,400
Repairs	5,400	0
Annual operating costs: gas, maintenance, insurance	2,900	1,800

Required

(a) What costs are relevant and what costs are not relevant to this decision? Why?
(b) What should Don do? Explain.
(c) What quantitative and qualitative factors are relevant to his decision? Why?

LO 1, 2, 4   **3-35**   *Relevant and sunk costs*   Gilmark Company has 10,000 obsolete lamps carried in inventory at a cost of $12 each. They can be sold as they are for $4 each. They can be reworked, however, at a total cost of $55,000 and sold for $10 each.

Required

Determine whether it is worthwhile to rework these lamps.

LO 1, 2, 4   **3-36**   *Relevant and sunk costs*   McKinnon Company's plant manager is considering buying a new grinding machine to replace an old grinding machine or overhauling the old one to ensure compliance with the plant's high-quality standards. The following data are available:

OLD GRINDING MACHINE	
Original cost	$50,000
Accumulated depreciation	40,000
Annual operating costs	18,000
Current salvage value	4,000
Salvage value at the end of 5 years	0

NEW GRINDING MACHINE	
Cost	$70,000
Annual operating costs	13,000
Salvage value at the end of 5 years	500

OVERHAUL OF OLD GRINDING MACHINE	
Cost of overhaul	$25,000
Annual operating costs after overhaul	14,000
Salvage value at the end of 5 years	200

Required

(a) What costs should the decision maker consider as sunk costs?
(b) List all relevant costs and when they are incurred.
(c) What should the plant manager do? Why?

3-37 *Relevant costs and revenues: replacement decision*   Joyce Printers, Inc., is considering replacing its current printing machines with newer, faster, and more efficient printing technology. The following data have been compiled:

CATEGORY	EXISTING MACHINES	NEW MACHINES
Original cost	$80,000	$120,000
Annual operating costs	$50,000	$30,000
Remaining useful life	5 years	5 years
Salvage value after 5 years	$5,000	$10,000

The existing machines can be disposed of now for $40,000. Keeping them will cost $20,000 for repair and upgrading.

Required

Should Joyce Printers keep the existing printing machines? Explain.

LO 1, 2, 4   **3-38** *Make-or-buy and relevant costs*   The assembly division of Davenport, Inc., is bidding on an order of 50,000 smart phones. The division is eager to get this order because it has a substantial amount of unused plant capacity. The variable cost for each smart phone is $140 in addition to the cost of the display and touchscreen component. The divisional purchasing manager has received two bids for the component. One is from Davenport's electronics division. This bid is for $35 per unit, although its variable cost is only $30 per unit. The other is from an outside vendor for $34 per unit. Davenport's electronics division has sufficient unused capacity for this order.

Required

(a) Determine the relevant costs for this order for the assembly division under both internal and outsourcing arrangements.
(b) Determine the relevant costs for this order for Davenport as a company under each of the sourcing arrangements.

LO 1, 2, 4   **3-39** *Make-or-buy*   Kane Company is considering outsourcing a key component. A reliable supplier has quoted a price of $64.50 per unit. The following costs of the component when manufactured in-house are expressed on a per unit basis:

Direct materials	$23.40
Direct labor	16.10
Variable overhead	26.70
Fixed overhead	6.90
Total costs	$73.10

Required

(a) What assumptions need to be made about the behavior of overhead costs for Kane in order to analyze the outsourcing decision?
(b) Should Kane Company outsource the component?
(c) What other factors are relevant to this decision?

LO 1, 2, 4   **3-40** *Make-or-buy and opportunity cost*   Premier Company manufactures gear model G37, which is used in several of its farm-equipment products. Annual production volume of G37 is 20,000 units. Unit costs for G37 are as follow:

Direct materials costs	$55
Direct labor costs	30
Variable overhead costs	25
Fixed overhead costs	15
Total costs	$125

Alternatively, Premier can purchase gear model G37 from an outside supplier for $120 per unit. If G37 is outsourced, Premier can use the facility where G37 is currently manufactured for production of another gear—model G49. This would save Premier $113,000 in facility rental and other costs presently incurred.

Required

Should Premier make or buy G37? By how much will Premier be better off by choosing your decision rather than the alternative?

LO 1, 2, 4　**3-41　*Make-or-buy, relevant costs, and opportunity cost*** Fab Motors has manufactured compressor parts at its plant in Pitcairn, Indiana, for the past 25 years. An outside supplier, Superior Compressor Company, has offered to supply compressor model C38 at a price of $200 per unit. Current unit manufacturing costs for C38 are as follows:

Direct materials	$80
Direct labor	60
Variable overhead	56
Fixed overhead	17
Total costs	$213

Required

(a) Should Superior Compressor's offer be accepted if the Pitcairn plant is presently operating below capacity?
(b) What is the maximum acceptable purchase price if the plant facilities are fully utilized at present and if any additional available capacity can be deployed for the production of other compressors?

LO 2, 4　**3-42　*Dropping a segment*** George's Grill analyzes profitability of three operating units: restaurant, bar, and billiards room. Revenues, variable costs, and attributable fixed costs (which can be avoided if the unit is eliminated) for each unit are as follows:

	RESTAURANT	BAR	BILLIARDS ROOM
Revenue	$320,000	$150,000	$40,000
Variable costs	120,000	35,000	10,000
Attributable fixed costs	80,000	25,000	15,000

George, the owner, is considering converting the billiards area into an expanded bar area.

Required

(a) Ignoring remodeling costs, by how much will the bar segment margin have to increase for the grill's income to be at least as high as it is now?
(b) What other considerations will George want to consider before making the decision to eliminate the billiards unit to expand the bar area?

3-43 *Special order pricing*   McGee Corporation's Olympia plant produces a module used in automobile manufacturing. The company's practical capacity is 4,000 modules per week. The selling price is $900 per module. Production this quarter is 3,000 modules per week, and all of the modules produced are sold each week. Demand is expected to remain steady. Total costs of production this week at the level of 3,000 modules were $300,000 of fixed costs plus $2,400,000 of variable costs.

Suppose that a new customer's supplier has an emergency need for 1,500 modules to be delivered next week and that the plant cannot schedule overtime production. Consequently, McGee would have to give up some of its current sales to fill the new order. Total selling and administrative costs would not change if McGee accepts the order.

Required

What is the minimum (floor) price that McGee should charge for the new order?

LO 2   **3-44** *Special order pricing*   Shorewood Shoes Company makes and sells a variety of leather shoes for children. For its current mix of different models and sizes, the average selling price and costs per pair of shoes are as follows:

ITEM	AMOUNT
Price	$20
Costs:	
Direct materials	$6
Direct labor	4
Variable manufacturing overhead	2
Variable selling costs	1
Fixed overhead	3
Total costs	$16

Shoes are manufactured in batch sizes of 100 pairs. Each batch requires 5 machine hours to manufacture. The plant has a total capacity of 4,000 machine hours per month, but current monthly production consumes only about 80% of the capacity.

A discount store has approached Shorewood to buy 10,000 pairs of shoes next month. It has requested that the shoes bear its own private label. Embossing the private label will cost Shorewood an additional $0.50 per pair. However, no variable selling costs will be incurred for fulfilling this special order.

Required

Determine the minimum (floor) price that Shorewood Shoes should charge for this order. What other considerations are relevant in this decision?

LO 2, 4   **3-45** *Export order*   Berry Company produces and sells 30,000 cases of fruit preserves each year. The following information reflects a breakdown of its costs:

COST ITEM	COSTS PER CASE	TOTAL COSTS
Variable production costs	$16	$480,000
Fixed production costs	8	240,000
Variable selling costs	5	150,000
Fixed selling and administrative costs	3	90,000
Total costs	$32	$960,000

Berry marks up its prices 40% over full costs. It has surplus capacity to produce 15,000 more cases. A French supermarket company has offered to purchase 10,000 cases of the product at a special price of $40 per case. Berry will incur additional shipping and selling costs of $3 per case to complete this order.

Required

What will be the effect on Berry's operating income if it accepts this order?

LO 2, 4 **3-46** *Profitability of order and extra shift decisions* The manufacturing capacity of Ritter Rotator Company's plant facility is 60,000 rotators per quarter. Operating results for the first quarter of this year are as follows.

Sales (36,000 units at $10)	$360,000
Variable manufacturing and selling costs	198,000
Contribution margin	162,000
Fixed costs	99,000
Operating income	$ 63,000

A foreign distributor has offered to buy 30,000 units at $9 per unit during the second quarter of this year. Domestic demand is expected to remain the same as in the first quarter.

Required

(a) Determine the impact on operating income if Ritter accepts this order. Assume that if the company accepts the order, it foregoes sales to regular domestic customers. What other considerations are relevant in this decision?

(b) Assume that Ritter decides to run an extra shift so that it can accept the foreign order without forgoing sales to its regular domestic customers. The proposed extra shift would increase capacity by 25% and increase fixed costs by $25,000. Determine the impact on operating income if Ritter operates the extra shift and accepts the export order. What other considerations are relevant in this decision?

LO 2, 4 **3-47** *Shelf mix decision* Superstore is a large discount supermarket. Profits have declined, so the manager has collected data on revenues and costs for different food categories. The following data pertain to some of the frozen foods that Superstore sells. To facilitate comparisons, the manager has listed average price and cost information for each category in equivalent square-foot packages:

	ICE CREAM	JUICES	FROZEN DINNERS	FROZEN VEGETABLES
Selling price per unit (square-foot package)	$12.00	$13.00	$24.00	$9.00
Variable costs per unit (square-foot package)	$8.00	$10.00	$20.50	$7.00
Minimum square footage required	24	24	24	24
Maximum square footage allowed	100	100	100	100

The manager wants a maximum of 250 square feet devoted to the four categories in this table.

Required

(a) Given the manager's constraints, and assuming that the store can sell whatever is displayed on the shelves, what shelf mix (i.e., what number of square feet for each category in the table) will maximize Superstore's contribution margin from these four categories?

(b) What other factors might the manager consider in deciding on the amount of shelf space per category?

3-48 *Product mix decision*   Boyd Wood Company makes a regular and a deluxe grade of wood floors. Regular grade is sold at $16 per square yard, and the deluxe grade is sold at $25 per square yard. The variable cost of making the regular grade is $10 per square yard. It costs an extra $5 per square yard to make the deluxe grade. It takes 15 labor hours to make 100 square yards of the regular grade, and 20 labor hours to make 100 square yards of the deluxe grade. There are 4,600 hours of labor time available for production each week. The maximum weekly sales for the regular and the deluxe model are 30,000 and 8,000 square yards, respectively. Fixed production costs total $600,000 per year. All selling costs are fixed.

Required

What is the optimal production level in number of square yards for each product?

Problems

3-49 *Cost classification and target profit*   Walt's Woodwork Company makes and sells wooden shelves. Walt's carpenters make the shelves in the company's rented building. Walt has a separate office at another location that also includes a showroom where customers can view sample shelves and ask questions of salespeople. The company sells all the shelves it produces each year and keeps no inventories. The following information pertains to Walt's Woodwork Company for the past year:

a.	Units produced and sold	50,000
b.	Sales price per unit	$70
c.	Carpenter labor to make shelves	600,000
d.	Wood to make the shelves	450,000
e.	Sales staff salaries	80,000
f.	Office and showroom rental expenses	150,000
g.	Depreciation on carpentry equipment	50,000
h.	Advertising	200,000
i.	Sales commissions based on number of units sold	180,000
j.	Miscellaneous fixed manufacturing overhead	150,000
k.	Rent for the building where the shelves are made	300,000
l.	Miscellaneous variable manufacturing overhead	350,000
m.	Depreciation for office equipment	10,000

Required

Make appropriate assumptions about cost behavior and assume that direct labor costs vary directly with the number of units produced. How many units must the company sell in order to earn a pre-tax profit of $500,000?

3-50 *Introducing a new product, profitability*   Santos Company is considering introducing a new compact disc player model at a price of $105 per unit. Santos's controller has compiled the following incremental cost

information based on an estimate of 120,000 units of sales annually for the new product:

Direct materials cost	$3,600,000
Direct labor cost	$2,400,000
Variable manufacturing overhead	$1,200,000
Sales commission	10% of sales
Fixed cost	$2,000,000

The sales manager expects the introduction of the new model to result in a reduction in sales of the existing model from 300,000 to 240,000 units. The contribution margin for the existing model is $20 per unit.

Required

(a) Determine the total impact on Santos's profit from the introduction of the new model.
(b) Should Santos introduce the new model? Explain.

LO 3   **3-51** *Cost behavior and cost classifications*   Shannon O'Reilly is trying to decide whether to continue to take public transportation to work or to purchase a car. Before making her decision, she would like to compare the cost of using public transportation and the cost of driving a car.

Required

(a) What activity measure should Shannon use as she estimates the cost of driving?
(b) What should Shannon view as incremental (variable or out-of-pocket) costs of driving from home to work?
(c) What are some fixed costs of driving a car?
(d) Suppose that if Shannon purchased a car, she would use it to take a 2-week scenic vacation by car. What activity measures might Shannon use to estimate her vacation and lodging expenses?

LO 1, 3   **3-52** *Cost behavior and decisions*   Second City Airlines operates 35 scheduled round-trip flights each week between New York and Chicago. It charges a fixed one-way fare of $200 per passenger. Second City Airlines can carry 150 passengers per one-way flight. Fuel and other flight-related costs are $5,000 per one-way flight. On-flight meal and refreshment costs average $5 per passenger. Flight crew, ground crew, advertising, and other administrative expenditures for the New York–to–Chicago route amount to $400,000 each week.

Required

(a) How many passengers must each of the 70 one-way flights have on average to break even each week?
(b) If the load factor is 60% on all flights (that is, the flights are 60% full), how many flights must Second City Airlines operate on this route to earn a total profit of $500,000 before taxes per week?
(c) Are fuel costs variable or fixed?
(d) What is the variable cost to Second City Airlines for one additional passenger on a flight if the passenger takes a seat that would otherwise go empty?

LO 2, 3   **3-53** *Breakeven point and competitive contribution margin analysis*   Johnson Company and Smith Company are competing firms that offer limousine service from the Charlesburg airport. While Johnson pays most of its employees on a per-ride basis, Smith prefers to pay its employees fixed

salaries. Information about the selling prices per ride and cost structures of the two firms is given below.

COST CATEGORY	JOHNSON COMPANY	SMITH COMPANY
Selling price per ride	$30	$30
Variable cost per ride	24	15
Contribution margin per ride	6	15
Fixed costs per year	$300,000	$1,500,000

Required

(a) Calculate the breakeven point in the number of rides for both firms.
(b) Draw two graphs plotting profit as a function of the number of rides for the two firms.
(c) Explain which firm's cost structure is more profitable.
(d) Explain which firm's cost structure is riskier.

LO 3 **3-54** *Multiple breakeven points*   Last month, Capetini Capacitor Company sold capacitors to its distributors for $250 per capacitor. The sales level of 3,000 capacitors per month was less than the single-shift capacity of 4,400 capacitors at its plant located in San Diego. Variable production costs were $100 per capacitor, and fixed production costs were $200,000 per month. In addition, variable selling and distribution costs are $20 per capacitor, and fixed selling and distribution costs are $62,500 per month. At the suggestion of the marketing department, this month Capetini reduced the sales price to $200 and increased the monthly advertising budget by $17,500. Sales are expected to increase to 6,800 capacitors per month. If the demand exceeds the single-shift capacity of 4,400 capacitors, the plant needs to be operated in two shifts. Two-shift operation will increase monthly fixed production costs to $310,000.

Required

(a) Determine the contribution margin per capacitor last month.
(b) Determine the sales level in number of capacitors at which the profit-to-sales ratio would be 10% for last month.
(c) Determine the two breakeven points for this month.
(d) Determine the sales level in number of capacitors at which the profit-to-sales ratio this month is the same as the actual profit-to-sales ratio last month. Is there more than one possible sales level at which this equality would occur?

LO 2, 3 **3-55** *Effect on costs of volume changes*   Capilano Containers Company specializes in making high-quality customized containers to order. Its agreement with the labor union ensures employment for all its employees and a fixed payroll of $80,000 per month, including fringe benefits. This payroll makes available 4,000 labor hours each month to work on orders the firm receives. The monthly wages must be paid even if the workers remain idle because of a lack of work. If additional labor hours are required to complete jobs, overtime costs $30 per labor hour.

Each job requires 4 labor hours for machine setup and 0.05 labor hour per container. Variable costs are $1.60 per container for materials and $8.00 per labor hour for manufacturing overhead expenses. In addition, the firm must pay $20,000 per month for selling, general, and administrative expenses, and $36,000 per month lease payments for machinery and physical facilities.

In April, the firm won 90 orders, of which 60 were for 800 containers each and 30 for 1,600 containers each.

Required

Determine the total costs for April.

LO 1, 2, 3, 4   **3-56** *Profitability of orders and opportunity cost*   Dawson Company produces and sells 80,000 boxes of specialty foods each year. Each box contains the same assortment of food. The company has computed the following annual costs:

Cost Item	Total Costs
Variable production costs	$400,000
Fixed production costs	480,000
Variable selling costs	320,000
Fixed selling and administrative costs	200,000
Total costs	$1,400,000

Dawson normally charges $25 per box. A new distributor has offered to purchase 8,000 boxes at a special price of $22 per box. Dawson will incur additional packaging costs of $1 per box to complete this order.

Required

(a) Suppose Dawson has surplus capacity to produce 8,000 more boxes. What will be the effect on Dawson's income if it accepts this order?

(b) Suppose that instead of having surplus capacity to produce 8,000 more boxes, Dawson has surplus capacity to produce only 3,000 more boxes. What will be the effect on Dawson's income if it accepts the new order for 8,000 boxes?

LO 1, 2, 3, 4   **3-57** *Costing orders, profitability, and opportunity cost*   Wedmark Corporation's Cupertino, California, plant manufactures chips used in personal computers. Its practical capacity is 2,000 chips per week, and fixed costs are $75,000 per week. The selling price is $500 per chip. Production this quarter is 1,600 chips per week. At this level of production, variable costs are $720,000 per week.

Required

(a) What will the plant's profit per week be if it operates at practical capacity?

(b) Suppose that a new customer offers $480 per chip for an order of 200 chips per week for delivery beginning this quarter. If this order is accepted, production will increase from 1,600 chips at present to 1,800 chips per week. What is the estimated change in the company's profit if it accepts the order?

(c) Suppose that the new customer in part b offered $480 per chip for an order of 600 chips per week and that Wedmark cannot schedule overtime production. Consequently, it would have to give up some of its current sales to fill the new order for 600 chips per week. What is the estimated change in Wedmark's profit if it accepts this order for 600 chips per week?

LO 1, 4   **3-58** *Relevant costs and equipment replacement decision*   Anderson Department Stores is considering the replacement of the existing elevator system at its downtown store. A new system has been proposed that runs faster than the existing system, experiences few breakdowns, and as a result promises considerable savings in operating costs. Information on the existing system and the proposed new system follow:

Category	Existing System	New System
Original cost	$300,000	$875,000
Remaining life	6 years	6 years
Annual cash operating costs	$150,000	$8,000
Salvage value at present	$100,000	—
Salvage value in 6 years	$25,000	$100,000

Required

(a) What costs are not relevant to this decision?
(b) What are the relevant costs?

3-59 *Incremental revenues and costs, special order* Genis Battery Company is considering accepting a special order for 50,000 batteries that it received from a discount retail store. The order specified a price of $4 per unit, which reflects a discount of $0.50 per unit relative to the company's regular price of $4.50 per unit. Genis's accounting department has prepared the following analysis to show the cost savings resulting from additional sales:

Costs	Cost per Unit without the Additional Sales (100,000 Units)	Cost per Unit with the Additional Sales (150,000 Units)
Variable	$3.30	$3.30
Fixed	$0.90	$0.60

No additional fixed costs will be incurred for this order because the company has surplus capacity. Because the average cost per unit will be reduced from $4.20 to $3.90, Genis's president believes that a reduction in the price to $4 is justified for this order.

Required

(a) Should the order for the 50,000 units at a price of $4 be accepted? What will be the impact on Genis's operating income?
(b) Is the accounting department's analysis the best way to evaluate this decision? If not, what alternative method can you suggest?
(c) What other considerations are important in this case? Why?

3-60 *Relevant costs, sunk costs, product replacement decisions* Syd Young, the production manager at Fuchow Company, purchased a cutting machine for the company last year. Six months after the purchase of the cutting machine, Syd learned about a new cutting machine that is more reliable than the machine that he purchased. The following information is available for the two machines:

Category	Old Machine	New Machine
Acquisition cost	$300,000	$360,000
Remaining life	4 years	4 years
Salvage value now	$100,000	—
Salvage value at the end of 4 years	$4,000	$6,000

Annual operating costs for the old machine are $140,000. The new machine will decrease annual operating costs by $60,000. These amounts do not include any charges for depreciation. Fuchow Company uses the straight-line depreciation method. These estimates of operating costs exclude rework costs. The new machine will also result in a reduction in the defect rate from the current 5% to 2.5%. All defective units are reworked at a cost of $1 per unit. The company, on average, produces 100,000 units annually.

(a) Should Syd Young replace the old machine with the new machine? Explain, listing all relevant costs.

(b) What costs should be considered as sunk costs for this decision?

(c) What other factors may affect Young's decision?

LO 1, 4   **3-61 *Make-or-buy***   Beau's Bistro has a reputation for providing good value for its menu prices. The desserts, developed by the pastry chef, are one of the distinctive features of the menu. The pastry chef has just given notice that he will relocate to another city in a month and has volunteered to share some of the dessert recipes with the next pastry chef. Beau has been concerned about the Bistro's declining profits but is reluctant to raise prices because of the competition he faces. He decided this was an opportune time to consider outsourcing dessert production. Beau solicited bids for dessert production and delivery and is evaluating two bids as well as the alternative of hiring a new pastry chef who would make the desserts in-house. The first bid is from a gourmet dessert provider who would fill the Bistro's current dessert demand for $5,500 per month and would periodically introduce new gourmet desserts. The second bid is from a dessert provider who would provide high-quality, traditional desserts to fill Bistro's current demand (in terms of servings) for $5,000 per month. Beau has identified the following costs per month if the desserts are made in-house:

Ingredients	$500
Pastry chef labor	3,500
Assistants' labor	1,500
Variable overhead	200
Total	$5,700

Required

(a) What qualitative factors are relevant for this decision?

(b) Would you advise Beau to outsource dessert production? Provide reasons for your decision.

LO 1, 4   **3-62 *Outsourcing and ethics***   Hollenberry, Inc., is a successful mail-order catalog business with customers worldwide. The company's headquarters is in a small town some distance from any major metropolitan area. Sales have grown steadily over the years, and the call center facilities are currently inadequate for the sales volume. Management is deciding whether to outsource the call center operations to a company specializing in such operations. If the call center is outsourced, most of the current employees would lose their jobs because they do not wish to relocate to the new call center location, close to a major metropolitan area. Many of the employees have been with Hollenberry for more than 20 years. Regardless of where the call center is located, customers will call a toll-free phone number. If the call center is outsourced, however, more multilingual operators would be available. Hollenberry has identified the following costs of operating the call center in-house:

Labor	$650,000
Building rent	60,000
Phone charges	35,000
Other overhead costs	42,000

If the call center is outsourced, the related office equipment would be sold to the new call center operations for $20,000. The equipment was originally purchased at a cost of $100,000. The building will no longer be rented, and call center employees will have the opportunity to transfer to the outside call center, in which case their salaries will be paid by the outside call center. The other overhead costs are associated with maintaining the building and office equipment for the current call center.

If Hollenberry outsources the call center and the same number and pattern of calls occur next year, Hollenberry will pay the new call center firm $700,000 for the year.

Required

(a) What costs are relevant to the decision to outsource the call center?
(b) What qualitative factors are important in this decision?
(c) What should Hollenberry do? Provide reasons for your recommendation.

LO 1, 4　**3-63** *Dropping a product*　Merchant Company manufactures and sells three models of electronic printers. Ken Gail, president of the company, is considering dropping model JT484 from its product line because the company has experienced losses for this product during the past three quarters. The following product-level operating data have been compiled for the most recent quarter:

CATEGORY	TOTAL	JT284	JT384	JT484
Sales	$1,000,000	$500,000	$200,000	$300,000
Variable costs	600,000	300,000	100,000	200,000
Contribution margin	$400,000	$200,000	$100,000	$100,000
Fixed costs:				
Rent	$50,000	$25,000	$10,000	$15,000
Depreciation	60,000	30,000	12,000	18,000
Utilities	40,000	20,000	5,000	15,000
Supervision	50,000	15,000	5,000	30,000
Maintenance	30,000	15,000	6,000	9,000
Administrative	100,000	30,000	20,000	50,000
Total fixed costs	$330,000	$135,000	$58,000	$137,000
Operating income (loss)	$70,000	$65,000	$42,000	($37,000)

In addition, the following information is also available:

- Factory rent and depreciation will not be affected by a decision to drop model JT484.
- Quarterly utility bills will be reduced from $40,000 to $31,000 if JT484 isdropped.
- Supervision costs for JT484 can be eliminated if dropped.
- The maintenance department will be able to reduce quarterly costs by $7,000 if JT484 is dropped.
- Elimination of JT484 will make it possible to eliminate two administrative staff positions with combined salaries of $30,000 per quarter.

Required

(a) Should Merchant Company eliminate JT484?
(b) Merchant's sales manager believes that it is important to continue to produce JT484 to maintain a full product line. He expects the elimination of JT484 will reduce sales of the remaining two products by 5% each. Will this information change your answer to part a? Explain.

3-64 ***Drop unprofitable product or department*** Perform an Internet or electronic library search on "close underperforming departments," "unprofitable products," or a similar phrase to locate an example of a company that has closed unprofitable stores or dropped unprofitable products or services. Describe the cost, revenue, and other issues that the company considered in making the decision.

LO 2, 4 **3-65** ***Product mix and overtime decisions*** Excel Corporation manufactures three products at its plant. The plant capacity is limited to 120,000 machine hours per year on a single-shift basis. Direct material and direct labor costs are variable. The following data are available for planning purposes:

PRODUCT	TOTAL UNIT DEMAND FOR NEXT YEAR	SALES PRICE PER UNIT	DIRECT MATERIALS COST PER UNIT	DIRECT LABOR COST PER UNIT	VARIABLE OVERHEAD COST PER UNIT	MACHINE HOURS PER UNIT
XL1	200,000	$10.00	$4.00	$2.00	$2.00	0.20
XL2	200,000	14.00	4.50	3.00	3.00	0.35
XL3	200,000	12.00	5.00	2.50	2.50	0.25

Required

(a) Given the capacity constraint, determine the production levels for the three products that will maximize profits.

(b) If the company authorizes overtime in order to produce more units of XL3, the direct labor cost per unit will be higher by 50% because of the overtime premium. Materials cost and variable overhead cost per unit will be the same for overtime production as regular production. Is it worthwhile operating overtime?

LO 1, 2 3, 4 **3-66** ***Profitability of order, opportunity cost, and capacity*** Hudson Hydronics, Inc., is a corporation based in Troy, New York, that sells high-quality hydronic control devices. It manufactures two products, HCD1 and HCD2, for which the following information is available:

COSTS PER UNIT	HCD1	HCD2
Direct materials	$60	$75
Direct labor	80	100
Variable overhead	100	125
Fixed overhead	80	100
Total costs per unit	$320	$400
Price	$400	$500
Units sold	2,000 units	1,200 units

The average wage rate including fringe benefits is $20 per hour. The plant has a capacity of 15,000 direct labor hours, but current production uses only 14,000 direct labor hours of capacity. Hudson can, if desired, hire additional direct labor up to its capacity of 15,000 direct labor hours.

Required

(a) A new customer has offered to buy 200 units of HCD2 if Hudson lowers its price to $400 per unit. How many direct labor hours will be required to produce 200 units of HCD2? How much will Hudson Hydronic's profit increase or decrease if it accepts this proposal? (Assume all other prices will remain as before.)

(b) Suppose the customer has offered instead to buy 300 units of HCD2 at $400 per unit. How much will the profits increase or decrease if Hudson accepts this proposal? Assume that the company cannot increase its production capacity beyond 15,000 direct labor hours.

(c) Answer the question in part b assuming that the plant can work overtime. Direct labor costs for the overtime production increase to $30 per hour. Variable overhead costs for overtime production are 50% more than for normal production.

3-67 *Capacity and product mix decisions, linear programming* Xu Company makes two types of wood doors: standard and deluxe. The doors are manufactured in a plant consisting of three departments: cutting, assembly, and finishing. Both labor and machine time are spent on the two products as they are worked on in each department.

    In planning the production schedule for the next month, management is confronted with a labor shortage and the knowledge that some machines must be shut down for major maintenance and repair. The following information pertains to the estimated levels of capacity of direct labor hours and machine hours available next month in the three departments:

	DEPARTMENTS		
CAPACITY AVAILABLE	CUTTING	ASSEMBLY	FINISHING
Machine hours	40,000	40,000	15,000
Labor hours	8,000	17,500	8,000

Direct labor and machine hours required per unit of each product are as follows:

	DEPARTMENTS		
PRODUCT HOURS	CUTTING	ASSEMBLY	FINISHING
Standard:			
Direct labor hours	0.5	1	0.5
Machine hours	2	2	1
Deluxe:			
Direct labor hours	1	1.5	0.5
Machine hours	3	3	1.5

The estimated demand for the next month is 13,000 units of standard doors and 5,000 units of deluxe doors. Unit cost and price information are as follows:

ITEM	STANDARD DOORS	DELUXE DOORS
Unit selling price	$150	$200
Unit costs:		
Direct materials	$60	$80
Direct labor	40	60
Variable overhead	10	15
Fixed overhead	10	5

The average wage rate is $20 per hour and variable overhead cost is 25% times direct labor cost. Direct labor and machine availability in individual departments cannot be switched from one department to another.

Required

(a) Determine whether the direct labor hour and machine hour capacities are adequate to meet the next month's demand.
(b) How many units of each product should the company produce to maximize its profits?
(c) Suppose that as a result of process improvements, the deluxe model only requires 1.2 machine hours in finishing and 0.8 labor hour in cutting. How many units of each product should the company produce to maximize its profits?
(d) Suggest other alternatives the company might consider to satisfy the estimated demand for both products.

3-68 *Client mix decision*   Spencer Grant, a financial planner, contacts and meets with local individuals to assist with financial planning and investments in Spencer's employer's investment services company. Spencer receives no fee for financial planning advice, but in addition to his salary, he receives commissions on client investments in the investment services company. Commission rates vary across different investment products. Spencer's employer pays office and phone costs and also reimburses Spencer for business-related travel. Satisfied clients have recommended Spencer to their friends, and Spencer now finds himself with more clients than he can handle in the 40 hours per week he would like to work. To analyze where to most profitably spend his time, Spencer has classified his current set of customers into the three groups listed here. The hours devoted per customer include direct contact time, travel time, and research and follow-up time for the clients. Spencer will introduce clients he is unable to serve to one of his colleagues.

	CUSTOMER GROUP		
	A	B	C
Average investment in company products per month	$900	$600	$200
Hours devoted per customer per month	3	1.5	0.5
Average commission percentage	6%	5%	4%
Current number of customers	20	60	120

Clients in group A are generally interested in hearing about new investment products that Spencer's company is offering and will usually invest sizable amounts in new products after meeting with Spencer or conversing with him on the phone. Clients in group B will also invest but generally in smaller amounts than clients in group A. Clients in group C appreciate meeting with Spencer because of the excellent advice he provides in planning for retirement and other future expenses but have little discretionary income to invest. Group C clients also generally invest in products with a lower commission rate for Spencer. However, Spencer maintains contact with these clients because he anticipates they will become more profitable as their careers develop.

Required

(a) Based on the data given, what client mix will maximize Spencer's monthly commissions, assuming he works 160 hours per month?

(b) What other factors should Spencer consider as he makes his decisions about his client mix?

Cases

3-69 *Estimating total labor costs*   Dr. Barbara Benson is the head of the pathology laboratory at Barrington Medical Center in Mobile, Alabama. Dr. Benson estimates the amount of work for her laboratory staff by classifying the pathology tests into three categories: simple routine, simple nonroutine, and complex. She expects a simple routine test to require 2 hours, a simple nonroutine test to require 2.5 hours, and a complex test to require

4 hours of staff time. She estimates the demand for each type of test for June through August to be the following:

MONTH	SIMPLE ROUTINE	SIMPLE NONROUTINE	COMPLEX
June	800	250	450
July	600	200	400
August	750	225	450

Laboratory staff salaries, including fringe benefits, average $3,600 per month. Each worker works 150 hours per month. If the hospital workload exceeds the available staff time, Dr. Benson has the tests performed at a neighboring private pathology laboratory that charges $80 for a simple routine test, $100 for a simple nonroutine test, and $160 for a complex test.

Dr. Benson is thinking of employing 20 to 27 workers. Because of the difficulty in hiring reliable workers, Barrington's chief administrator has instructed her to employ laboratory staff for no shorter a period than one quarter.

Required

(a) Determine how many workers Dr. Benson should employ over the quarter to minimize the costs of performing the tests. What is the minimum cost?

(b) Suppose the easy availability of experienced laboratory staff allows Barrington Medical Center to change staffing loads each month. Determine the number of workers Dr. Benson should hire each month in these circumstances to minimize the costs of performing tests. What is the minimum cost?

LO 1, 2, 4   **3-70** *Value proposition, CVP analysis, fixed costs, and opportunity costs*   Nordstrom, Inc. (http://www.nordstrom.com) and Saks Fifth Avenue (http://www.saksfifthavenue.com) are upscale retailers. Using the following sources, answer the questions below.

- Each company's history reported on its web page (from "About Us" at the company's home page, link to the company's history).
- Statements of each company's vision or mission.
- "Nordstrom Accelerates Plans to Straighten Out Business," *Wall Street Journal* (October 19, 2001).
- "Nordstrom Regains Its Luster," *Wall Street Journal* (August 19, 2004).
- "Struggling Saks Tries Alterations in Management," *Wall Street Journal* (January 10, 2006).

Required

(a) What is each company's value proposition as defined in Chapter 2 of this textbook?

(b) What measures did Nordstrom take to reduce costs? How might these reductions affect Nordstrom's ability to fulfill its value proposition?

(c) What fixed costs did Nordstrom incur in hopes of long-term benefits? Have these benefits been realized?

(d) How did Nordstrom's efforts affect the cost–volume–profit elements of sales prices, variable costs, fixed costs, and volume of sales?

(e) How did each company attempt to expand its customer base and how successful were the efforts? Were any opportunity costs associated with Nordstrom's "Reinvent Yourself" campaign or Saks Fifth Avenue's "Wild about Cashmere" campaign?

LO 1, 2, 3, 4   **3-71** *Product mix decision*   Aramis Aromatics Company produces and sells its product AA100 to well-known cosmetics companies for $940 per ton. The marketing manager is

considering the possibility of refining AA100 further into finer perfumes before selling them to the cosmetics companies. Product AA101 is expected to command a price of $1,500 per ton and AA102 a price of $1,700 per ton. The maximum expected demand is 400 tons for AA101 and 100 tons for AA102.

The annual plant capacity of 2,400 hours is fully utilized at present to manufacture 600 tons of AA100. The marketing manager proposed that Aramis sell 300 tons of AA100, 100 tons of AA101, and 75 tons of AA102 in the next year. It requires 4 hours of capacity to make 1 ton of AA100, 2 hours to refine 1 ton of AA100 further into AA101, and 4 hours to refine 1 ton of AA100 into AA102 instead. The plant accountant has prepared the following information for the three products:

	COSTS PER TON		
COST ITEM	AA100	AA101	AA102
Direct materials:			
Chemicals and fragrance	$560	$400	$470
AA100	0	800	800
Direct labor	60	30	60
Manufacturing overhead:			
Variable	60	30	60
Fixed	120	60	120
Total manufacturing costs	$800	$1,320	$1,510
Selling costs:			
Variable	20	30	30
Fixed	10	10	10
Total cost	$830	$1,360	$1,550
Proposed sales level	300 tons	100 tons	75 tons
Maximum demand	600 tons	400 tons	100 tons

Required

(a) Determine the contribution margin for each product.

(b) Determine the production levels for the three products under the present constraint on plant capacity that will maximize total contribution.

(c) Suppose a customer, Cosmos Cosmetics Company, is very interested in the new product AA101. It has offered to sign a long-term contract for 400 tons of AA101. It is also willing to pay a higher price if the entire plant capacity is dedicated to the production of AA101. What is the price for AA101 at which Aramis is indifferent between its current production of AA100 and dedicating its entire capacity to the production of AA101 for Cosmos?

(d) Suppose, instead, that the price of AA101 is $1,500 per ton and that the capacity can be increased temporarily by 600 hours if the plant is operated overtime. Overtime premium payments to workers and supervisors will increase direct labor and variable manufacturing overhead costs by 50% for all products. All other costs will remain unchanged. Is it worthwhile operating the plant overtime? If the plant is operated overtime for 600 hours, what are the optimal production levels for the three products?

LO 1, 2, 4   **3-72** *Variable and fixed costs in the wine industry, decision making*   A Votre Santé: Product Costing and Decision Analysis in the Wine Industry[3]

Background

A Votre Santé (AVS) is a small, independent winery owned by Kay Aproveche. Kay has a relationship with a grower who grows two types of wine grapes, a Chardonnay and a generic white grape. AVS buys the grapes at the point at which they have ripened on the vine. AVS is responsible for harvesting the grapes and all further processing of the grapes into wine. In 2010,

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AVS earned an operating margin of almost $100,000 on sales of $848,000, for an 11.6% margin (see Exhibit 3-38).

The process of winemaking is fairly simple, yet requires much attention to process details. After the grapes are harvested, they are brought to the winery for washing and crushing. The crushing process separates the juice from the pulp, skin, and stems. The juice is used to make the wine; the pulp, skin, and stems are recycled back onto the fields whenever possible or otherwise disposed of. The amount of wine generated from the grapes is dependent each year on a number of climatic and growing factors such as temperature, length of growing season, rootstock, and fertilizers used.

Once the juice is extracted, it moves into the fermenting process. The Chardonnay wine grape is fermented using oak barrels; the oak in the barrels gives flavor to the Chardonnay wine. The barrels are expensive ($500 each), but are sold after four years for $200 apiece to another smaller winery. The juice fermenting in each barrel results in the production of 40 cases of wine. The generic white grape juices are fermented in a holding tank; a full tank would result in the production of 1,500 cases of wine. The fermenting process takes place in a temperature-controlled environment; however, each fermenting method results in some wine loss through evaporation. Kay Aproveche estimates that the Chardonnay will lose approximately 10% of its volume through the fermentation process, while the generic white will lose approximately 5% of its volume. Harvest takes place in the late summer and early fall months; typically, the time elapsed from harvest to final sale is about 11 months.

Exhibit 3-38

Sales	Price	# Bottles		
Chardonnay-Estate	$22	24,000	$528,000	
Chardonnay (non-Estate)	$16	9,000	$144,000	
Blanc de Blanc	$11	16,000	$176,000	
Total revenues		49,000	$848,000	
Product costs				
Grapes			$124,000	
Bottle, labels, corks			122,500	
Harvest labor			14,500	
Crush labor			2,400	
Indirect materials			6,329	
Depreciation			8,100	
Lab expenses			8,000	
Production office			12,000	
Utilities			5,500	
Waste treatment			2,000	
Wine master			15,000	
Supervisor			55,000	
Barrels			4,725	
Total product costs			$380,054	44.8%
Gross margin			$467,946	55.2%
Administrative & sales costs				
Administrative rent & office			$20,000	
Liquor taxes			147,000	
Sales commissions			98,000	
Sales manager			30,000	
Administrative salary			75,000	
Total fixed costs			$370,000	
Operating margin			$97,946	11.6%

Product Information

AVS bottles three wines: a Chardonnay-Estate, a regular Chardonnay, and a Blanc de Blanc. Data related to the three wines is as follows:

- Chardonnay-Estate contains only Chardonnay grapes that are grown for AVS; the expected sales price is $22/bottle. The market demand for Chardonnay-Estate wine is estimated to be 24,000 bottles for 2010.
- Regular Chardonnay is blended by combining the Chardonnay wine left over after bottling the Chardonnay-Estate with the fermented generic wine; the blend mixture is two parts Chardonnay grapes (after fermentation) and one part generic grapes (after fermentation). The different grapes are fermented separately and blended at the end. The expected sales price is $16/bottle.
- Blanc de Blanc wine is made from all remaining generic white grapes; the expected sales price is $11/bottle.

All three wines are bottled at AVS using one bottling line. In a typical year, AVS bottles enough Chardonnay-Estate to meet the predicted market demand, then bottles the regular Chardonnay after blending all remaining Chardonnay wine with the necessary amount of generic grapes. The Blanc de Blanc is the last wine to be bottled, using all remaining generic white grapes. Kay again expects the wines from this harvest year to sell out.

Additional Operational and Cost Data

Chardonnay Grapes

- 2009 harvest: 100,000 pounds
- Purchase price of $85,500
- Expected loss in volume through fermentation and bottling: 10%

Generic White Grapes

- 2009 harvest: 60,000 pounds
- Purchase price of $38,500
- Expected loss in volume through fermentation and bottling: 5%

Winemaking

- Chardonnay grapes are fermented in oak barrels; each barrel results in the production of 40 cases of wine.
- Barrels cost $500 apiece, and can be used for four years and sold for $200 each at the end of four years; assume that you have to purchase all new barrels for the 2009 harvest. The barrels are depreciated over 4 years.
- Generic white grapes are fermented in the holding tank; the tank can hold up to the equivalent of 1,500 cases of wine.

Bottling

- Requires 36 pounds of grapes (post-fermenting) for one case (12 bottles) of wine.
- In the bottling process, the wine is put into bottles, with both corks and labels added during this process. The materials costs associated with the bottles, corks, and labels are estimated to be $2.50/bottle.

Direct Labor

- Harvest labor is paid an average of $7.25/hour. It is estimated that 80 pounds of grapes can be harvested each hour.
- Crush labor is paid an average of $8.00/hour. It is estimated that it will take 300 hours to crush the grape harvest.

Overhead Expenses

- Administrative rent and office expenses: estimated to be $20,000/year.
- Depreciation is charged based on the following equipment schedule:

EQUIPMENT	COST	ESTIMATED LIFE
Tractors	$15,000	10 years
Crushers	$6,000	10 years
Holding tank	$40,000	20 years
Bottle lines	$10,000	10 years
Other production equipment	$15,000	5 years

- *Indirect materials:* Part of the winemaking process involves introducing yeasts and other additives into the wine to help the fermentation process and to help balance the flavors in the wine. Indirect production materials average $1.55 per case of wine.
- *Lab expenses:* Lab expenses of $8,000 are incurred for lab supplies and equipment. The lab is used by the production supervisor and the winemaster to test the grapes and wine at various stages of production.
- *Liquor taxes:* AVS is required to pay a liquor excise tax of $3/bottle on every bottle of wine sold.
- *Production office:* AVS pays a part-time person to help administer the production function. This person orders supplies, reviews and approves production invoices, and performs other administrative functions. The production office budget is estimated to be a flat rate of $12,000.
- *Sales and related:* Kay's sister, Maria, is paid $30,000/year on a contract basis to sell AVS wines. She works through distributors, who are paid $2/bottle for each bottle sold.
- *Supervision:* Kay's brother, Luis, supervises the production of wine from the harvest through the bottling processes. His salary and benefits total $55,000 annually.
- *Utilities:* Utility costs are incurred primarily to maintain a constant temperature in the fermenting process. These are expected to be $5,500.
- *Waste treatment:* After crushing, the pulp, skins, and stems that are left over must be disposed of. One-half of the waste can be recycled back onto the fields as a compost material; the other one-half must be disposed of at a landfill dumping cost of $2,000.
- A winemaster is employed to help formulate and test the wines. This is done on a contract basis; AVS pays the winemaster $5,000 for each type of wine that is formulated.
- Kay's role is to manage the AVS business. Her annual salary and benefits total $75,000.

Required

(a) Create a single company-wide contribution margin income statement (as in the "Total" column in Exhibit 3-6) for AVS that includes each expense category. Also calculate the average revenue and net income for one bottle of wine. (*Note:* Do not break out the variable or fixed costs by type of wine.)

(b) Another grower has available 20,000 pounds of Chardonnay grapes from the 2009 harvest. AVS has the opportunity to buy the juice from these grapes (they have already been harvested and crushed). If AVS could blend these grapes with the generic white grapes (using the 2:1 blend formula) to produce a new Chardonnay wine to be priced at $14/bottle, and require a 15% return on sales for this wine, what is the maximum amount that AVS would pay for a pound of Chardonnay grapes?

(c) Other than the cost of the grapes seen in part b, what factors would you consider to support your purchase of the grapes, and what factors would cause you to reject buying the grapes?