

Relevant Costs and Benefits for Decision Making

Learning Objectives

- LO1** Distinguish between relevant and irrelevant revenues and costs. (p. 17-3)
- LO2** Analyze relevant costs and indicate how they differ under alternative decision scenarios. (p. 17-7)
- LO3** Apply differential analysis to evaluate changes in profit plans. (p. 17-9)
- LO4** Apply differential analysis to evaluate whether to accept a special order. (p. 17-10)
- LO5** Apply differential analysis to evaluate outsourcing decisions. (p. 17-13)
- LO6** Apply differential analysis to evaluate whether to sell or further process a product. (p. 17-17)
- LO7** Allocate limited resources for purposes of maximizing short-run profit. (p. 17-19)



www.uber.com

Every day companies, both large and small, are faced with making critical decisions that can drastically alter their likelihood of success. Some of these decisions are long term in nature, such as where a company should invest in property, plant, and equipment. Others are short-run decisions, such as whether or not to sell product or service to a new customer at a price that is below the normal market price.

San Francisco startup company **Uber** got its start from pondering a common dilemma: how to get home from the club late at night. CEO Travis Kalanick explains that he and friend joked, "... let's go buy 10 **Mercedes** S-Classes, let's go hire 20 drivers, let's get parking garages and let's make it so we could push a button and an S-Class would roll up, for only us, in the city of San Francisco, where you cannot get a ride." Shortly thereafter, an iPhone application called Uber was launched in 2010. Uber has now expanded to 551 cities in 81 countries.

Uber's intent was to act as a broker by matching riders to available drivers with a summons via smartphones. But the company first had to decide whether it should purchase cars and pay for insurance, storage, and other associated costs or whether to contract with existing drivers, either limousine companies or individual drivers. In the end, Uber decided to contract with partners (limo companies or individuals) who had their own vehicles. These partners take responsibility for licensing, vehicle cost and maintenance, gas, auto insurance, and storage. In return, Uber trains the drivers on the software platform and pays them 80 percent of the fare.

By acting as a broker instead of owning its own vehicles, Uber was able to minimize its fixed costs. This "operating leverage" results in a greater benefit from increases in customers, because the fixed costs don't need to increase to handle the higher capacity. However, the company's capacity is limited by how many drivers it has on contract. This limited resource can be maximized by minimizing the downtime of its drivers. Uber invested in engineers to build algorithms to manage its supply of drivers and demand of riders. The efficient management of this limited resource benefits both drivers (who are more likely to be engaged in fare-generating activity) and riders, who can use the software's tracking feature to see their car's progress toward the predetermined pickup destination.

Uber has successfully changed the way people think about transportation. It is expected to achieve greater than \$5.5 billion in net revenue in 2016. However it also spent approximately \$1.55 for every \$1.00 of revenue it earned, with total losses for the year expected to amass approximately \$3 billion.

As Uber emphasizes growth over profits, the company is betting that investing in areas such as mapping technology, food delivery, and autonomous vehicles will reduce the real cost of transportation.

In this module, we will learn how to incorporate the relevant revenues and costs to simplify decision making, even when operating in a complex, changing environment.



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Road Map

LO	Learning Objective Topics	Page	eLecture	Guided Example	Assignments
17-1	Distinguish between relevant and irrelevant revenues and costs. Future Revenues :: Outlay Costs :: Sunk Costs :: Disposal and Salvage Values :: Opportunity Costs	17-3	e17-1	Review 17-1	11, 12, 13, 14, 15, 16, 17, 18, 21, 23, 24, 27, 28, 29, 30, 31, 32, 33, 34, 35
17-2	Analyze relevant costs and indicate how they differ under alternative decision scenarios. Differential Costs	17-7	e17-2	Review 17-2	15, 16, 17, 18, 21, 23, 24, 27, 28, 29, 30, 31, 32, 33, 34, 35
17-3	Apply differential analysis to evaluate changes in profit plans. Multiple Changes in Profit Plans	17-9	e17-3	Review 17-3	27, 28, 32, 33, 35
17-4	Apply differential analysis to evaluate whether to accept a special order. Special Orders :: Time Span and Opportunity Costs :: Qualitative Considerations	17-10	e17-4	Review 17-4	16, 18, 30, 31, 32, 33
17-5	Apply differential analysis to evaluate outsourcing decisions. Make or Buy :: Opportunity Costs :: Qualitative Risk Factors	17-13	e17-5	Review 17-5	21, 22, 23, 32, 33
17-6	Apply differential analysis to evaluate whether to sell or further process a product. Single Product Decisions :: Joint Product Decisions	17-17	e17-6	Review 17-6	17, 24
17-7	Allocate limited resources for purposes of maximizing short-run profit. Single Constraint :: Multiple Constraints :: Theory of Constraints :: Limitations of Decision Analysis Models	17-19	e17-7	Review 17-7	25, 26

Identifying Relevant Costs	Differential Analysis of Relevant Costs	Applying Differential Analysis	Use of Limited Resources
<ul style="list-style-type: none"> ■ Relevance of Future Revenues ■ Relevance of Outlay Costs ■ Irrelevance of Sunk Costs ■ Sunk Costs Can Cause Ethical Dilemmas ■ Relevance of Disposal and Salvage Values ■ Relevance of Opportunity Costs 	<ul style="list-style-type: none"> ■ Differential Cost Analysis 	<ul style="list-style-type: none"> ■ Multiple Changes in Profit Plans ■ Special Orders ■ Outsourcing Decisions ■ Sell or Process Further 	<ul style="list-style-type: none"> ■ Single Constraint ■ Multiple Constraints ■ Theory of Constraints ■ Limitations of Decision Analysis Models

The purpose of this module is to examine approaches to identifying and analyzing revenue and cost information for specific decisions, such as the decision to outsource. Our emphasis is on identifying **relevant costs** (future costs that differ among competing decision alternatives) and distinguishing relevant costs from **irrelevant costs** that do not differ among competing decision alternatives. We consider a number of frequently encountered decisions: to make multiple changes in profit plans, to accept or reject a special order, to acquire a component or service internally or externally, to sell a product or process it further, and how to best use limited capacity. These decision situations are not exhaustive; they only illustrate relevant cost concepts. Once we understand these concepts, we can apply them to a variety of decision scenarios.

Although our focus in this module is on profit maximization, decisions should not be based solely on this criterion, especially maximizing profit in the short run. Managers must consider the implications decision alternatives have on long-run profit, as well as legal, ethical, social, and other nonquantitative factors. These factors can lead management to select a course of action other than that selected by financial information alone.

Identifying Relevant Costs



For a specific decision, the key to relevant cost analysis is first to identify the relevant costs (and revenues) and then to organize them in a manner that clearly indicates how they differ under each alternative. Consider the following equipment replacement decision.

Beats by Dr. Dre (Beats), a subsidiary of **Apple Inc.**, produces headphones and supplies high-quality components and equalizer software to HP for its line of personal computers. Assume that one of its components used in wireless headsets is forecasted to sell 10,000 units during the coming year at a price of \$20 per unit. Further assume that each of Beats' components is manufactured with separate machines in a shared plant.

The machine used in the manufacture of headset components is two years old and has a remaining useful life of four years. Its purchase price was \$90,000 (new), and it has an estimated salvage value of zero dollars at the end of its useful life. Its current book value (original cost less accumulated depreciation) is \$60,000, but it could be sold today for only \$35,000.

Headset Component Costs:	
Direct materials.....	\$3.00 per unit
Conversion.....	5.00 per unit
Selling and distribution.....	1.00 per unit
Inspection and adjustment	\$500 per batch (1,000 units)

continued

Depreciation on machines.....	\$15,000 per year
Machine maintenance.....	\$200 per month
Advertising.....	\$5,000 per year
Common Costs:	
Administrative salaries.....	\$65,000 per year
Building operations	23,000 per year
Building rent.....	24,000 per year

Management is evaluating the desirability of replacing the machine with a new machine. The new machine costs \$80,000, has a useful life of four years, and a predicted salvage value of zero dollars at the end of its useful life. Although the new machine has the same production capacity as the old machine, its predicted operating costs are lower because it consumes less electricity. Further, because of a computer control system, the new machine allows production of twice as many units between inspections and adjustments, and the cost of inspections and adjustments is lower. The new machine requires only annual, rather than monthly, overhauls. Hence, machine maintenance costs are lower. Costs for the new machine are predicted as follows:

Conversion costs	\$4.00 per unit
Inspection and adjustment	\$ 300 per batch (2,000 units)
Machine maintenance.....	\$ 200 per year

All other costs and all revenues remain unchanged.

The decision alternatives are to keep the old machine or to replace it with a new machine. An analysis of how costs and revenues differ under each alternative assists management in making the best choice. The first objective of this module is to study the distinction between relevant and irrelevant items. After evaluating the relevance of each item, we develop an analysis of relevant costs.

Relevance of Future Revenues

Revenues, which are inflows of resources from the sale of goods and services, are relevant to a decision only if they differ between alternatives. In this example, revenues are not relevant because they are identical under each alternative. They would be relevant if the new machine had greater capacity or if management intended to change the selling price should it acquire the new machine. (The \$35,000 disposal value of the old machine is an inflow. However, *revenues* refer to resources from the sale of goods and services to customers in the normal course of business. We include the sale of the old machine under disposal and salvage values.)

The hypothetical keep-or-replace decision facing Beats' management might be called a **cost reduction proposal** because it is based on the assumption that the organization is committed to an activity and that management desires to minimize the cost of activities. Here, the two alternatives are either to continue operating with the old machine or to replace it with a new machine.

Although this approach is appropriate for many activities, managers should remember that they have another alternative—discontinue operations. To simplify the analysis, managers normally do not consider the alternative to discontinue when operations appear to be profitable. However, if there is any doubt about an operation's profitability, this alternative should be considered. Because revenues change if an operation is discontinued, revenues are relevant whenever this alternative is considered.

Relevance of Outlay Costs

Outlay costs are costs that require future expenditures of cash or other resources. Outlay costs that differ under the decision alternatives are relevant; outlay costs that do not differ are irrelevant. Assume Beats' relevant and irrelevant outlay costs for the equipment replacement decision follow.

Relevant Outlay Costs	Irrelevant Outlay Costs
Conversion Costs	Direct Materials
Inspection and Adjustment Costs	Selling and Distribution
Cost of New Machine	Advertising
Machine Maintenance	Common Outlay Costs

Irrelevance of Sunk Costs

Sunk costs result from past decisions that cannot be changed. Suppose we purchased a car for \$30,000 five years ago. Today we must decide whether to purchase another car or have major maintenance performed on our current car. In making this decision, the purchase price of our current car is a sunk cost.

Although the relevance of outlay costs is determined by the decision scenario, sunk costs are never relevant. The cost of the old machine is a sunk cost, not a future cost. This cost and the related depreciation result from the past decision to acquire the old machine. Even though all the outlay costs discussed earlier would be relevant to a decision to continue or discontinue operations, the sunk cost of the old machine is not relevant even to this decision.

If management elects to keep the old machine, its book value will be depreciated over its remaining useful life of four years. However, if management elects to replace the old machine, its book value is written off when it is replaced. Even if management elects to discontinue operations, the book value of the old machine must be written off.

Sunk Costs Can Cause Ethical Dilemmas

Although the book value of the old machine has no economic significance, the accounting treatment of past costs may make it psychologically difficult for managers to regard them as irrelevant. If management replaces the old machine, a \$25,000 accounting loss is recorded in the year of replacement:

Book value	\$60,000
Disposal value	(35,000)
Loss on disposal	<u><u>\$25,000</u></u>

The possibility of recording an accounting loss can create an ethical dilemma for managers. Although an action may be desirable from the long-run viewpoint of the organization, in the short run, choosing the action may result in an accounting loss. Fearing the loss will lead superiors to question her judgment, a manager might prefer to use the old machine (with lower total profits over the four-year period) as opposed to replacing it and being forced to record a loss on disposal. Although this action may avoid raising troublesome questions in the near term, the cumulative effect of many decisions of this nature is harmful to the organization's long-run economic health.

From an economic viewpoint, the analysis should focus on future costs and revenues that differ. The decision should not be influenced by sunk costs. Although there is no easy solution to this behavioral and ethical problem, managers and management accountants should be aware of its potential impact.

Managerial Decision ■ You are the Vice President of Manufacturing

You recently made the decision to purchase a very expensive machine for your manufacturing plant that used technology that was well established over several years. The purchase of this machine was a major decision supported by the chief financial officer, based solely on your recommendation. Shortly after making the purchase, you were attending a trade convention where you learned of new technology that is now available that essentially renders obsolete the machine you recently purchased. You feel that it may be best for the company to acquire the new technology since most of your competitors will be using it soon; however, you feel that this cannot be done now that you have recently purchased the new machine. What should you do? [Answer, p. 17-22]

Relevance of Disposal and Salvage Values

Beats' assumed revenues (inflows of resources from operations) from the sale of headset components were discussed earlier. The sale of fixed assets is also a source of resources. Because the sale of fixed assets is a nonoperating item, cash inflows obtained from these sales are discussed separately.

The disposal value of the old machine is a relevant cash inflow. It is obtained only if the replacement alternative is selected. Any salvage value available at the end of the useful life of either machine is also relevant. A loss on disposal can have a favorable tax impact if the loss can be offset against taxable gains or taxable income. To simplify the analysis, we ignore any tax implications at this point. The tax effects related to capital asset transactions are discussed in Module 25.

Relevance of Opportunity Costs

When making a decision between alternative courses of action, accepting one alternative results in rejecting the other alternative(s). Any benefit foregone as a result of rejecting one opportunity in favor of another opportunity is described as an **opportunity cost** of the accepted alternative. For example, if you are employed at a salary of \$40,000 per year and you have the opportunity to continue to work or the opportunity to go back to school full-time for two years to earn a graduate degree, the cost of getting the degree includes not only all the outlay costs for tuition, books, and so forth, it also includes the salary foregone (or opportunity cost) of \$40,000 per year. So, if your tuition and other outlay costs are going to be \$25,000 per year for two years, the cost of earning the degree will be \$50,000 of outlay costs and \$80,000 of opportunity costs, for a total cost of earning the degree of \$130,000. Opportunity costs are always relevant in making decisions among competing alternatives.

The following is a summary of all the relevant and irrelevant costs discussed in this section.

Relevant Costs		Irrelevant Costs	
Opportunity Costs	Relevant Outlay Costs	Irrelevant Outlay Costs	Sunk Costs
Future costs that differ among competing alternatives	Net benefits foregone of rejected alternatives	Future costs requiring future expenditures that do not differ	Historical costs resulting from past decisions

Research Insight ■ Why Don't Managers Always Ignore Sunk Costs?

For decades, business school students have learned that sunk costs are irrelevant to decision making; however, managers still find these costs difficult to ignore. Researchers have shown that, far from ignoring sunk costs, many managers increase commitment to a project as sunk costs increase. Recent experimental research from a team at the University of Melbourne in Australia sheds more light on the precise motivations of managers who choose not to ignore sunk costs. The researchers found that the managers' personal motivations interact with the context of the specific project and the related sunk costs. Their study found that individuals who are focused on promotion become increasingly fixated on completion as the end of the project nears. While other managers are able to ignore fixed costs more consistently throughout the project life cycle, those who are focused on promotion are most likely to continue to invest in a project that should be abandoned when the project is close to completion. As managerial accountants advise executive teams, this type of bias should be kept in mind.

Source: Adam P. Barsky, and Michael J. Zyphur, "Disentangling sunk-costs and completion proximity: The role of regulatory focus," *Journal of Experimental Social Psychology* 65 (2016): 105-108.



TaylorMade-Adidas Golf Company, a subsidiary of Adidas, manufactures golf clubs using “adjustable weight technology” or AWT. Suppose a European machine company has proposed to sell TaylorMade a new highly automated machine that would reduce significantly the labor cost of producing its golf clubs. The cost of the machine is \$1,000,000, and would have an expected life of 5 years, at the end of which it would have a residual value of \$100,000. It has an estimated operating cost of \$10,000 per month. The direct labor cost savings per club from using the machine is estimated to be \$5 per club. In addition, one monthly salaried manufacturing manager, whose salary is \$6,000 per month would no longer be needed. Assume the Vice President of Manufacturing earns \$10,000 per month. Also, the new machine would free up about 5,000 square feet of space from the displaced workers. Assume TaylorMade’s building is held under a 10-year lease that has eight years remaining. The current lease cost is \$1 per square foot per month. TaylorMade may be able to use the space for other purposes, and it has received an offer to rent it to a nearby related company for \$3,500 per month.

Required

Identify all of the costs described above as either “relevant” or “irrelevant” to the decision to acquire the new

Solution on p. 17-37. machine.

Differential Analysis of Relevant Costs



LO2
Analyze relevant costs and indicate how they differ under alternative decision scenarios.

Differential cost analysis is an approach to the analysis of relevant costs that focuses on the costs that differ under alternative actions. A differential analysis of relevant costs for Beats’ equipment replacement decision is in Exhibit 17.1. Replacement provides a net advantage of \$17,800 over the life of both machines versus keeping the old machine.

An alternative analysis to that presented in Exhibit 17.1 is to present all revenues and costs (relevant and irrelevant) for each alternative in separate columns, such that the bottom line of the analysis is the total profit or loss for each alternative. This method is preferred if the goal is to determine the total profitability of each alternative. If the goal is to determine which of the two alternatives is most profitable, then a differential analysis is preferred.

Assuming the organization is committed to providing a particular product or service, a differential analysis of relevant costs (as shown in Exhibit 17.1) is preferred to a complete analysis of all costs and revenues for a number of reasons:

- A differential analysis focuses on only those items that differ, providing a clearer picture of the impact of the decision. Management is less apt to be confused by this analysis than by one that combines relevant and irrelevant items.
- A differential analysis contains fewer items, making it easier and quicker to prepare.
- A differential analysis can help to simplify complex situations (such as those encountered by multiple-product or multiple-plant firms), when it is difficult to develop complete firmwide statements to analyze all decision alternatives.

Before preparing a differential analysis, it is always desirable to reassess the organization’s commitment to a product or service. This helps avoid “throwing good money after bad.” If Beats currently had large annual losses, acquiring the new machine would merely reduce total losses over the next four years by \$17,800. In this case, discontinuing operations (a third alternative) should also be considered.

Exhibit 17.1 Differential Analysis for Beats' Equipment Replacement

	Four-Year Totals		
	Replace with New Machine	Keep Old Machine	Difference (effect of replacement on income)
Conversion:			
Old machine (10,000 units $\times \$5 \times 4$ years)		\$200,000	
New machine (10,000 units $\times \$4 \times 4$ years)	\$160,000		(\$40,000)
Inspection and adjustment:			
Old machine (10* setups $\times \$500 \times 4$ years)		20,000	
New machine (5** setups $\times \$300 \times 4$ years)	6,000		(14,000)
Machine maintenance:			
Old machine (\$200 per month $\times 12$ months $\times 4$ years)....		9,600	
New machine (\$200 per year $\times 4$ years).....	800		(8,800)
Disposal of old machine	(35,000)		(35,000)
Cost of new machine	80,000		80,000
Totals	<u>\$211,800</u>	<u>\$229,600</u>	<u>(\$17,800)</u>
Advantage of replacement.....		<u><u>\$17,800</u></u>	

* Old machine: 10,000 units \div 1,000 units per batch

** New machine: 10,000 units \div 2,000 units per batch

LO2 Review 17-2

TaylorMade-Adidas Golf Company, a subsidiary of Adidas, manufactures golf clubs using “adjustable weight technology” or AWT. Suppose a European machine company has proposed to sell TaylorMade a new highly automated machine that would reduce significantly the labor cost of producing its golf clubs. The cost of the machine is \$1,000,000, and would have an expected life of 5 years, at the end of which it would have a residual value of \$100,000. It has an estimated operating cost of \$10,000 per month. The direct labor cost savings per club from using the machine is estimated to be \$5 per club. In addition, one monthly salaried manufacturing manager, whose salary is \$6,000 per month would no longer be needed. Assume the Vice President of Manufacturing earns \$10,000 per month. Also, the new machine would free up about 5,000 square feet of space from the displaced workers. Assume TaylorMade’s building is held under a 10-year lease that has eight years remaining. The current lease cost is \$1 per square foot per month. TaylorMade may be able to use the space for other purposes, and it has received an offer to rent it to a nearby related company for \$3,500 per month.


Required

- Assuming the new machine would be used to produce an average of 5,000 clubs per month, prepare a differential analysis of the relevant costs of buying the machine and using it for the next five years, versus continuing to use hand labor.
- In addition to the quantitative analysis in requirement b., what qualitative considerations are important for making the right decision?

Solution on p. 17-37.

Applying Differential Analysis

Differential analysis is used to provide information for a variety of planning and decision-making situations. This section illustrates some of the more frequently encountered applications of differential analysis. To focus on differential analysis concepts, we will continue with the **Uber** discussion introduced in the opening vignette of this module. For the purposes of our example, we assume a simplified financial model, which consists of variable costs based on number of miles driven and costs that are fixed in the short run. As Uber is primarily a technology company, other than driver fees, its costs are generally related to the processing, storage, and communication of information. Also, for this example,

we assume that the entire amount of the customer fees collected by the drivers is categorized as revenue for Uber and the fees paid out to the drivers are categorized as variable driver fees.

Assume Uber collects an average of \$45 for every ten miles of customer rides. Variable costs per every ten miles and fixed costs per month are as follows:

	Variable Costs*		Fixed Costs per Month
Driver fees.....	\$35.00	Platform and cloud based data storage.....	\$ 40,000
Platform and cloud-based data storage.....	1.50	Mapping technology	75,000
Mapping technology	2.00	Advertising	<u>5,000</u>
Customer service	0.50	Total	\$120,000
Total	<u>\$39.00</u>		<u>=====</u>

*Per every ten miles

Assume the contribution margin per every ten miles driven is \$6 (\$45 customer collection less \$39 variable costs). Uber's hypothetical contribution income statement for April 2017 is presented in Exhibit 17.2. Assume the April operations are typical and monthly miles driven average 300,000 miles, with monthly profits averaging \$60,000.

Management wants to know the effect that each of the following three mutually exclusive alternatives would have on monthly profits.

The introduction of a bonus program. For every 500 miles a driver completes within a month, the driver receives an additional \$25. The bonus program is expected to result in a 10% increase in miles per month and a bonus payout of \$10,000 per month.

Increasing the cost of the rides to the customers by an average of \$1 per every ten miles. The average payout to the drivers will remain constant at \$35 per every ten miles driven. This should result in a decrease of 50,000 in monthly miles.

Decreasing the cost of the rides to the customers by an average of \$1 per every ten miles. The average payout to the drivers will remain constant at \$35 per every ten miles driven. This should result in an increase of 60,000 in monthly miles. Uber faces a constraint of driver availability. To encourage its drivers to work more, Uber is offering to pay an extra \$1 for every ten miles, after a driver completes 1,200 miles within a one-week period. Assume that 30,000 miles will be paid out at the higher rate.

It is possible to develop contribution income statements for each alternative and then determine the profit impact of the proposed change by comparing the new income with the current income. A more direct approach is to use differential analysis and focus on only those items that differ under each alternative.

Alternative 1

Profit increase from increased miles ($3,000^* \times \$6$)	\$18,000
Profit decrease from bonus.....	<u>(10,000)</u>
Increase in monthly profit	<u>\$ 8,000</u>

$*(300,000 \times 10\%)$ divided by 10

Alternative 2

Profit decrease from reduced miles ($5,000^* \times \$6$).....	\$(30,000)
Profit increase from increased price**.....	<u>25,000</u>
Decrease in monthly profit	<u>\$ (5,000)</u>

*50,000 divided by 10

$^{**}[(300,000 \text{ current miles} - 50,000 \text{ lost miles}) \div 10] \times \1

Alternative 3

Profit increase from increase in miles ($6,000^* \times \$6$).....	\$36,000
Profit decrease from reduced selling price ($36,000^{**} \times \$1$).....	(36,000)
Profit decrease from increased driver fees ($3,000^{***} \times \$1$).....	(\$3,000)
Decrease in monthly profit	<u><u>(\$3,000)</u></u>

*60,000 divided by 10

**(300,000 current miles + 60,000 increased miles) divided by 10

***30,000 divided by 10

Alternatives 2 and 3 are undesirable because they would each result in a decrease in monthly profit. Because Alternative 1 results in an increase in monthly profit, it is preferred to both Alternatives 2 and 3.

LO3 Review 17-3

Epson produces color cartridges for inkjet printers. Suppose cartridges are sold to mail-order distributors for \$4.80 each and that manufacturing and other costs are as follows:



Variable Costs per Unit	Fixed Costs per Month		
Direct materials.....	\$2.00	Factory overhead	\$15,000
Direct labor.....	0.20	Selling and administrative	5,000
Factory overhead	0.25	Total	<u><u>\$20,000</u></u>
Distribution.....	<u><u>0.05</u></u>		
Total	<u><u>\$2.50</u></u>		

The variable distribution costs are for transportation to mail-order distributors. Also assume the current monthly production and sales volume is 15,000 and monthly capacity is 20,000 units.

Required

Determine the effect of the following independent situations on monthly profits.

- A \$1.50 increase in the unit selling price should result in an 1,800 unit decrease in monthly sales.
- A \$1.80 decrease in the unit selling price should result in a 6,000 unit increase in monthly sales. However, because of capacity constraints, the last 1,000 units would be produced during overtime, when the direct labor costs increase by 50 percent.

Solution on p. 17-37.

Special Orders

Assume that a not-for-profit is hosting a fundraising dinner, and it would like to offer its attendees Uber rides home from the event at a reduced rate of \$40 for every ten miles. The total expected miles related to the fundraiser are 3,000. Uber drivers will not be called to the site via the online app as the drivers will be ready and waiting at the event when it is over. Therefore, the mapping technology fees can be reduced to \$1.50 per every ten miles. Also assume that the driver fees will remain constant at \$35 per every ten miles. Uber has sufficient driver capacity to handle the event without reducing its rides to other customers. Uber's management wants to know the profit impact of accepting the offer. The following analysis focuses on those costs and revenues that will differ if the offer is accepted.

**LO4**

Apply differential analysis to evaluate whether to accept a special order.

Increase in revenues ($300^* \times \$40$)	\$12,000
Increase in costs	
Driver fees ($300^* \times \$35$).....	\$10,500
Platform and cloud-based data storage ($300^* \times \$1.50$).....	450
Mapping technology ($300^* \times \$1.50$).....	450
Customer service ($300^* \times \$0.50$)	150
	<u><u>11,550</u></u>
Increase in profits	<u><u>\$□ □ 450</u></u>

*3,000 divided by 10

Accepting the offer will result in a profit increase of \$450. Although this is not a significant increase, management might consider this to be a great marketing opportunity and a chance to convert the attendees into future customers.

If management were unaware of relevant cost concepts, they might be tempted to compare the special event price of \$40 to the average cost per every ten miles as developed from the accounting reports. Based on Uber's hypothetical April contribution income statement in Exhibit 17.2, the average cost per every ten miles was \$43, calculated as follows.

Total variable costs.....	\$1,170,000
Total fixed costs.....	120,000
 Total costs.....	 1,290,000
Total miles divided by 10 (300,000/10)	30,000
Average cost per every 10 miles.....	\$43

Comparing the special event price of \$40 per ten miles to the average cost of \$43, management might conclude the event would result in a loss of \$3 per ten miles.

It is apparent that the \$43 figure encompasses variable costs of \$39 per ten miles (including irrelevant variable mapping technology costs of \$0.50 per ten miles) and irrelevant fixed costs of \$120,000 spread over 3,000 miles. But remember, management may not have detailed cost information. To obtain appropriate information for decision-making purposes, management must ask its accounting staff for the specific information needed. Different configurations of cost information are provided for different purposes. In the absence of special instructions, the accounting staff might not supply relevant cost information.

Exhibit 17.2 ■ Contribution Income Statement

UBER Contribution Income Statement For the Month of April 2017		
Revenue (30,000* × \$45.00).....		\$1,350,000
Less variable costs		
Driver fees (30,000* × \$35.00).....	\$1,050,000	
Platform and cloud-based data storage (30,000* × \$1.50)	45,000	
Mapping technology (30,000* × \$2.00).....	60,000	
Customer service (30,000* × \$0.50).....	15,000	(1,170,000)
Contribution margin.....		180,000
Less fixed costs		
Platform and cloud-based data storage	40,000	
Mapping technology	75,000	
Advertising	5,000	(120,000)
Profit.....		\$60,000

*300,000 divided by 10

Importance of Time Span and Opportunity Costs

The special event is a one-time contract for 3,000 miles that will use current excess driver capacity. Because no special setups or technology are required to manage the event, it is appropriate to consider only variable costs in computing the event's profitability.

But what if the not-for-profit wanted Uber to sign a multiyear contract to provide 3,000 miles per month at \$40 per every ten miles? Under these circumstances, management would be well advised to reject the contract because there is a high probability that cost increases would make the order unprofitable in later years. At the very least, management should insist that a cost escalation clause be added to the agreement, specifying that the customer price would increase to cover any cost increases and detailing the cost computation.

Of more concern is the variable nature of all long-run costs. Given adequate time, management must replace fixed assets and may have to adjust the amount and quality of its equipment and technology. Accordingly, *in the long run, all costs (including costs classified as fixed in a given period) are relevant*. To remain in business in the long run, Uber must replace equipment, pay taxes, pay administrative salaries, and so forth. Consequently, management should consider *all costs*, fixed and variable, in evaluating a long-term contract.

Full costs include all costs, regardless of their behavior pattern or activity level. The average full cost per unit is sometimes used to approximate long-run variable costs. If accepting a long-term contract increases the monthly miles to 303,000, the average full cost per every ten miles will be \$42.97.

Driver fees.....	\$35.00
Platform and cloud-based data storage	1.50
Mapping technology	2.00
Customer service support	0.50
Platform and cloud-based data storage (40,000/30,300*).....	1.32**
Mapping technology (75,000/30,300*)	2.48**
Advertising (5,000/30,300*)	0.17**
Average full cost per every 10 miles	<u><u>\$42.97**</u></u>

*303,000 divided by 10

**Rounded

In this case, the estimated long-run variable costs are \$42.97 per every ten miles. Many managers would say this is the minimum acceptable selling price, especially if the order extends over a long period of time.

Because Uber has excess productive driver capacity, no opportunity cost is associated with accepting the not-for-profit's one-time offer. There is no alternative use of the driving time related to the event, in the short run, so there is no opportunity cost.

But what if Uber was operating at driver capacity? In that case, accepting the special offer would require reducing regular miles. Assume hiring new drivers is not a possibility in the short run and there are safety concerns with having the current drivers driving too many miles. With an alternative use of the drivers' time, an opportunity cost is associated with using the drivers to drive for the fundraising event.

Every ten miles driven at the event could otherwise generate a \$6 contribution from regular customers. Accepting the special event would cause Uber to incur an opportunity cost of \$1,800 for the contribution margin lost from foregoing rides to regular customers.

Lost fees to regular customers (3,000 miles/10)	300
Regular contribution margin per ten miles	<u> × \$6</u>
Opportunity cost of accepting special event	<u><u>\$1,800</u></u>

Because this opportunity cost exceeds the \$450 contribution derived from the special event, management might reject the special event. Accepting the event will reduce profits by \$1,350 (\$450 contribution – \$1,800 opportunity cost). As discussed previously, there are also qualitative considerations. Even though there is a loss expected from accepting the special event, management might consider this a great marketing opportunity to reach out to new customers and decide that it is worthwhile to accept the order.

Qualitative Considerations

Although an analysis of cost and revenue information may indicate that a special order is profitable in the short run, management might still reject the order because of qualitative considerations. Any concerns regarding the order's impact on regular customers might lead management to reject the order even if there is excess capacity. If the order involves a special low price, regular customers might demand a similar price reduction and threaten to take their business elsewhere. Alternatively, management might accept the special order while operating at capacity if they believed there were long-term benefits associated with penetrating a new market. Legal factors must also be considered if the special order is from a buyer who competes with regular customers.



Epson produces color cartridges for inkjet printers. Suppose cartridges are sold to mail-order distributors for \$4.80 each and that manufacturing and other costs are as follows:

	Variable Costs per Unit		Fixed Costs per Month
Direct materials.....	\$2.00	Factory overhead	\$15,000
Direct labor.....	0.20	Selling and administrative.....	5,000
Factory overhead	0.25	Total	<u>\$20,000</u>
Distribution.....	0.05		
Total	<u>\$2.50</u>		

The variable distribution costs are for transportation to mail-order distributors. Also assume the current monthly production and sales volume is 15,000 and monthly capacity is 20,000 units.

Required

Determine the effect of the following independent situations on monthly profits.

- A Russian distributor has proposed to place a special, one-time order for 4,000 units next month at a reduced price of \$4.00 per unit. The distributor would pay all transportation costs. There would be additional fixed selling and administrative costs of \$500.00.
- An Austrian distributor has proposed to place a special, one-time order for 8,000 units at a special price of \$4.00 per unit. The distributor would pay all transportation costs. There would be additional fixed selling and administrative costs of \$500.00. Assume overtime production is not possible.

Solution on p. 17-38.



Outsourcing Decisions (Make or Buy)

One of the most common applications of relevant cost analysis involves the make-or-buy decision. Virtually any service, product, or component that can be produced or manufactured internally can also be acquired from an external source. The procurement of services, products or components from an external source is called **outsourcing**. For example, the management of the bookstore at your college or university is likely outsourced to **Barnes and Noble** or **Follett**, and the dining facilities may be outsourced to **Compass Group North America** or **Aramark Corporation**. Similarly, **HP** and more recently, **Samsung**, actually manufacture very few of the components of their computers. Instead the manufacture of components is outsourced to other firms such as **Intel** for computer chips and **Seagate** for storage devices. Virtually all computer manufacturers, with the exception of **Apple**, outsource their operating systems to **Microsoft**.

Any time you call a customer support call center, the representative reached is likely to be working in a different country. A growing number of companies even outsource employees from employee leasing companies. In the past 25 years, outsourcing of goods and services has expanded exponentially with the emergence of well-trained, low-cost labor forces in China and India and other parts of the world.

As the above discussion reveals, the decision to outsource rather than to produce a service or product internally involves a vast array of qualitative issues. The quantitative issues surrounding the outsourcing (or make-or-buy) decision are often less challenging. To illustrate, we continue the Uber example. Suppose a technology firm, DataTech, offers Uber a one-year contract to manage all of Uber's data storage service at a cost of \$15,000 per month. Uber is now faced with the decision to continue to supply the data storage service internally or outsource the technology to DataTech. An analysis of the decision reveals that if Uber accepts the offer, it will be able to reduce the following:

- Variable platform and data storage costs by \$0.20 per ten miles.
- Fixed platform and data storage costs by \$5,000.

Comcast wants to be loved. After years of being enthusiastically anchored to the bottom of customer satisfaction surveys, Comcast is changing strategies. Finally faced with competition from on-demand services such as Netflix, Hulu, and Amazon, Comcast has decided that it is time to court its customers. This initiative has two parts. First, the company has begun to improve customer service by redesigning physical locations to feel more welcoming and Apple-like. Second, it has developed a new app to help customers plan around service visits, tracking the technician's estimated time of arrival to make the visit convenient for customers.

The second part of this effort also takes a page from the Apple playbook: make Internet, TV, and home-security devices that people can connect with. Fraser Stirling, head of hardware development at Comcast, says, "we are genuinely trying to create an emotional experience, whether that's love, or whatever, like you have with your phone. We want people to be able to put something from Comcast in their study or their living room and people can look at it and go 'Oof, what is that? It's amazing."

Differential analysis helps a company like Comcast weigh the increased costs associated with customer satisfaction and hardware design against the forecasted loss of customers to on-demand entertainment. This sort of analysis helps companies deal with the changing realities of their markets. For years Comcast had significant market power and, thus, sought to deliver cable at the lowest possible cost; now facing competition, the company finds it profitable to invest in the customer's experience. Ultimately, it may be the answer to managerial accounting questions that drive increased satisfaction.

Source: Felix Gillette, "Can a Company You Hate Make a Cable Box You Love?" *Bloomberg Businessweek*, June 23, 2016.

A differential analysis of Uber's decision to supply storage service internally or to outsource it is presented in Exhibit 17.3. Continuing to provide the service internally has a net advantage of \$4,000.

Exhibit 17.3 ■ Differential Analysis of Outsourcing Decision

	Cost to do Internally	Cost to Outsource	Difference (income effect of outsourcing)
Cost to outsource data storage		\$15,000	\$(15,000)
Cost to do internally			
Variable costs related to data storage (\$0.20 × 30,000*).....	\$□6,000		6,000
Fixed costs related to data storage.....	5,000		5,000
Total	<u>\$11,000</u>	<u>\$15,000</u>	<u>\$(4,000)</u>
Advantage of providing service internally.....	<u>\$4,000</u>		

*300,000 miles divided by 10

But what if the data storage capacity created by outsourcing to DataTech can be used to provide storage services to another company for \$7,000 per month? In this case, the storage capacity has an alternative use, and the net cash flow from this alternative use is an opportunity cost of providing the service internally. Treating the revenue Uber will not receive if it continues to source data storage internally as an opportunity cost, the analysis in Exhibit 17.4 indicates that outsourcing now has a net advantage of \$3,000.

Although outsourcing has become widely accepted across virtually all industries, the results of outsourcing are not uniformly positive. Some companies that made a strong commitment to extensive outsourcing have discovered that there are many problems that can occur when they shift key processes and functions to other companies. It is usually easier to make major changes and to correct problems related to in-house functions and processes than for those outsourced to other companies, especially if they are located offshore. The following Business Insight discusses the outsourcing experience of Boeing.

Exhibit 17.4 Differential Analysis of Outsourcing Decision with Opportunity Cost

	Cost to do Internally	Cost to Outsource	Difference (income effect of outsourcing)
Cost to outsource data storage		\$15,000	\$ ^(15,000)
Cost to do internally			
Variable costs related to data storage ($\$0.20 \times 30,000^*$).....	\$ ^{6,000}		6,000
Fixed costs related to data storage.....	5,000		5,000
Opportunity cost of lost subscription revenue.....	<u>7,000</u>		7,000
Total	<u>\$18,000</u>	<u>\$15,000</u>	<u>\$^{3,000}</u>
Advantage of providing service internally.....	<u><u>\$3,000</u></u>		

*300,000 miles divided by 10

Business Insight ■ **Boeing Rethinks Outsourcing**

Boeing made headlines in 2007 when aggressive outsourcing led to unanticipated delays in the launch of their new flagship aircraft, the 787 Dreamliner. At the time, the company believed that the radically outsourced production process would eventually be "more efficient and profitable than existing construction methods." However, under pressure from customers the airline has moved more and more production back in-house. In fact, upon ordering the 777x, Emirates Airline publicly asked Boeing not to outsource production of the planes to avoid the delays faced by Dreamliner customers.

Boeing's enthusiasm for outsourcing the Dreamliner and other planes was quickly tempered as language barriers, further outsourcing by contractors, and poor communication across the production process led to issues of quality and schedule delays. Now even more production is being moved back in-house, as Boeing reconsiders the costs and benefits of outsourcing parts of its complex design, production, and manufacturing processes.

Sources: Jon Ostrower, "Boeing Insources Jumbo Work," *The Wall Street Journal*, September 17, 2015; David Kesmodel and Daniel Michaels, "For Boeing, It's Been a Long, Strange Trip," *The Wall Street Journal*, September 23, 2011; and Lynn Lunsford "Boeing Scratches to Repair Problems With New Plane," *The Wall Street Journal*, December 7, 2007.

Even if outsourcing appears financially advantageous in the short run, management should not decide to outsource before considering a variety of qualitative risk factors. Is the outside supplier interested in developing a long-term relationship or merely attempting to use some temporarily idle capacity? If so, what will happen at the end of the contract period? What impact would a decision to outsource have on the morale of a company's employees? Will it have to rehire laid-off employees after the contract expires? Will the outside supplier meet delivery schedules? Does the supplied part meet quality standards? Will it continue to meet them? Organizations often manufacture products or provide services they can obtain elsewhere in order to control quality, to have an assured supply source, to avoid dealing with a potential competitor, or to maintain a core competency. Some of these issues are discussed in the Business Insight that follows.

The qualitative risk factors discussed above are often magnified when a company goes global, either as an outsourcing buyer or provider. Global outsourcing is often motivated by the desire to get projects completed "on time" and "within budget." In the following Research Insight, PricewaterhouseCoopers views outsourcing as a way to focus resources on operations that truly differentiate the firm.

Business Insight ■ Outsourcing Changes Cost Structure, Brings New Risks

Firms are finding that flexibility from outsourcing can come with significant costs, largely in holding the supplier to quality standards. Bert Ahill, who advises firms on outsourcing, feels that companies regularly forget the risks that they are exposing themselves to when outsourcing. Often firms forget to account for economic, political, and weather hazards that affect their international suppliers. Firms should take care to build redundancy into outsourced supply chains to control disruptions that could come from these sources.

Some firms are finding that the costs of monitoring outsourced contractors outweigh the benefits of outsourcing. **Boston Scientific**, a maker of medical devices, has been manufacturing its own batteries for 10 years. While companies like **Boeing** were making radical moves in the opposite direction, Boston Scientific found it more cost-effective to keep battery production in-house, as the quality and longevity of a battery implanted in a patient is of paramount importance. In addition to quality and stability, other supply chain issues arise with outsourcing. **Taylor Guitars** uses exotic woods in its products, and when concerns arose about the sustainability of its suppliers' practices it chose to purchase a Cameroonian mill to improve sourcing. The organic soap maker **Dr. Bronner's** ran into similar issues with its palm oil supply, so it formed a company to manage sustainable sourcing of palm oil in Ghana.

Careful analysis of the costs and benefits of both outsourcing and vertical integration should be undertaken on an ongoing basis to make sure that the company chooses the correct supply chain.

Sources: Alexis Bateman, "Guest Voices: New Supplier Strategies Revive Important Corporate Questions," *The Wall Street Journal*, March 7, 2016 and Ben DiPietro, "When Manufacturing Means Building Supply-Chain Resilience," *The Wall Street Journal*, October 21, 2015.

Research Insight ■ Role of Outsourcing in Operations

PricewaterhouseCoopers's latest Global Operations Survey offers a new, narrower view of the role of outsourcing in operations. Rather than recommending outsourcing as a way to change the firm's cost structure, PwC views outsourcing as a way to focus on operations that truly differentiate the firm. The PwC study divides a company's capabilities into four groups:

1. Differentiating capabilities,
2. Competitive necessities,
3. Basic capabilities, and
4. Other activities.

PwC recommends focusing resources on those activities where being best-in-category offers greatest returns (item 1). Investments in attention, staff, and capital should center on these differentiating operations. PwC recommends aggressive cost management and efficiency in activities that are required for participation in the market sector, where excellence in these areas offers no advantage, but is required for participation in a market (item 2). For example, consumers expect all banks to have excellent security; thus, banks should find ways to meet the excellent security standards with the greatest efficiency. PwC recommends outsourcing basic capabilities (item 3). As there is no return for excelling in these areas, they are the areas in which cost minimization is the best strategy. Most firms outsource facilities maintenance and other operations that are unrelated to success in their sector but are required to function. All other activities that do not fit into the first three groups and deviate from the core business should be eliminated if possible (item 4).

Source: "2015 Global Operations Survey: Reimagining Operations," *PricewaterhouseCoopers*, 2015, p. 17. Link: <http://operationssurvey.pwc.com/PwC-2015-Global-Operations-Survey.pdf>



Epson produces color cartridges for inkjet printers. Suppose cartridges are sold to mail-order distributors for \$4.80 each and that manufacturing and other costs are as follows:

	Variable Costs per Unit		Fixed Costs per Month
Direct materials.....	\$2.00	Factory overhead	\$15,000
Direct labor.....	0.20	Selling and administrative.....	5,000
Factory overhead	0.25	Total	<u><u>\$20,000</u></u>
Distribution.....	<u>0.05</u>		
Total	<u><u>\$2.50</u></u>		

The variable distribution costs are for transportation to mail-order distributors. Also assume the current monthly production and sales volume is 15,000 and monthly capacity is 20,000 units.

Required

Determine the effect of the following situation on monthly profits.

A Mexican manufacturer has offered a one-year contract to supply ink for the cartridges at a cost of \$1.00 per unit. If Epson accepts the offer, it will be able to reduce variable manufacturing costs by 40 percent and

Solution on p. 17-38. rent some of its factory space to another company for \$1,000.00 per month.



Sell or Process Further

When a product is salable at various stages of completion, management must determine the product's most advantageous selling point. As each stage is completed, management must determine whether to sell the product then or to process it further. For example, petroleum companies have to determine how much crude oil to refine as diesel fuel and how much to process further as gasoline. We consider two types of sell or process further decisions: (1) for a single product and (2) for joint products.

Single Product Decisions

Assume that **Scandinavian Furniture Inc.** manufactures modular wood furniture from precut and shaped wood. Although all units are salable before they are sanded and painted, Scandinavian Furniture Inc. sands and paints all units before they are sold. Management wishes to know if this is the optimal selling point.

A complete listing of unit costs and revenues for the alternative selling points for a low-end storage cabinet follows:

	Per Cabinet		
	Sell after Assembly	Sell after Painting	Difference (income effect of painting)
Selling price	\$40	\$75	\$35
Assembly costs	(25)	(25)	
Sanding and painting costs.....		<u>(12)</u>	<u>(12)</u>
Contribution margin.....	<u>\$15</u>	<u>\$38</u>	<u>\$23</u>
Advantage of painting.....		<u><u>\$23</u></u>	<u><u></u></u>

The sanding and painting operation has an additional contribution of \$23 per unit. The storage cabinets should be sold after they are painted.

The assembly costs are the same under both alternatives. This illustrates that *all costs incurred prior to the decision point are irrelevant*. Given the existence of an assembled chair, the decision

alternatives are to sell it now or to process it further. A differential analysis for the decision to sell or process further should include only revenues and the incremental costs of further processing as follows.

Increase in revenues		
Sell after painting	\$75	
Sell after assembly.....	(40)	\$35
Additional costs of sanding and painting		(12)
Advantage of sanding and painting		\$23
		<hr/>

The identical solution is obtained if the selling price without further processing is treated as an opportunity cost as follows.

Revenues after painting	\$75	
Additional costs of sanding and painting	\$12	
Opportunity cost of not selling after assembly	40	(52)
Advantage of sanding and painting		\$23
		<hr/>

By processing a chair further, Scandinavian Furniture has foregone the opportunity to receive \$40 from its sale. Since the chair is already assembled, and the cost of assembly is an irrelevant sunk cost, this \$40 is the net cash inflow from the most desirable alternative; it is the opportunity cost of painting.

Joint Product Decisions

Two or more products simultaneously produced by a single process from a common set of inputs are called **joint products**. Joint products are often found in basic industries that process natural raw materials such as dairy, chemical, meat, petroleum, and wood products. In the petroleum industry, crude oil is refined into fuel oil, gasoline, kerosene, diesel, lubricating oil, and other products.

The point in the process where the joint products become separately identifiable is called the **split-off point**. Materials and conversion costs incurred prior to the split-off point are called **joint costs**. For external reporting purposes, a number of techniques are used to allocate joint costs among joint products. We do not discuss these techniques here (interested students should consult a cost accounting textbook), except to note that none of the methods provide information useful for determining what to do with a joint product once it is produced. Because joint costs are incurred prior to the decision point, they are sunk costs. Consequently, *joint costs are irrelevant to a decision to sell a joint product or to process it further*. The only relevant factors are the alternative costs and revenues subsequent to the split-off point.

Business Insight ■ Product Mix Decisions in Consumer Electronics

The changing consumer electronics landscape is driving changes in product mix at companies like **Apple** and **Microsoft**. Microsoft, long a software company, is aggressively shifting its product mix to include smartphones, laptops, and a smart watch. This shift to hardware alongside software is a product mix similar to Apple's. There is a notable exception—desktop computers. Apple will need to rethink its commitment to the desktop computer to keep pace with customers' changing preferences for devices.

Apple's Mac line is estimated to be the most profitable product in its class, and this year Apple reported its highest ever revenue from its desktop computer business. At the same time, Mac revenue is at its lowest ebb as a share of Apple's total revenue. This suggests that while Apple is clearly successful in the PC space, changes will be required in the future. The product mix decisions that Apple and Microsoft are making rely on the decision relevance framework introduced in this module.

Sources: Shira Ovide, "Microsoft Pushes Deeper Into Hardware," *The Wall Street Journal*, October 6, 2015 and Christopher Mims, "Why Apple Should Kill Off the Mac," *The Wall Street Journal*, June 14, 2015.



Epson produces color cartridges for inkjet printers. Suppose cartridges are sold to mail-order distributors for \$4.80 each and that manufacturing and other costs are as follows:

	Variable Costs per Unit		Fixed Costs per Month
Direct materials.....	\$2.00	Factory overhead	\$15,000
Direct labor.....	0.20	Selling and administrative	<u>5,000</u>
Factory overhead	0.25	Total	<u>\$20,000</u>
Distribution.....	0.05		
Total	<u>\$2.50</u>		

The variable distribution costs are for transportation to mail-order distributors. Also assume the current monthly production and sales volume is 15,000 and monthly capacity is 20,000 units.

Required

Determine the effect of the following situation on monthly profits.

The cartridges are currently unpackaged; that is, they are sold in bulk. Individual packaging would

Solution on p. 17-38. increase costs by \$0.10 per unit. However, the units could then be sold for \$5.05.

Use of Limited Resources



All of us have experienced time as a limiting or constraining resource. With two exams the day after tomorrow and a paper due next week, our problem is how to allocate limited study time. The solution depends on our objectives, our current status (grades, knowledge, skill levels, and so forth), and available time. Given this information, we devise a work plan to best meet our objectives.

Managers must also decide how to best use limited resources to accomplish organizational goals. A supermarket may lose sales because limited shelf space prevents stocking all available brands of soft drinks. A manufacturer may lose sales because limited machine hours or labor hours prevent filling all orders. Managers of for-profit organizations will likely find the problems of capacity constraints less troublesome than the problems of excess capacity; nonetheless, these problems are real. Ultimately, the problem often boils down to a product-mix decision, in which we must decide the mix of products or services we are going to offer our customers with the limited resources available to us.

If the limited resource is not a core business activity, it may be appropriate to outsource additional units of the limited resource externally. For example, many organizations have a small legal staff to handle routine activities; if the internal staff becomes fully committed, the organization seeks outside legal counsel.

The long-run solution to the problem of limited resources to perform core activities may be to expand capacity. However, this is usually not feasible in the short run. Economic models suggest that another solution is to reduce demand by increasing the price. Again, this may not be desirable. A hotel, for example, may want to maintain competitive prices. A manufacturer might want to maintain a long-run price to retain customer goodwill to avoid attracting competitors, or to prevent accusations of “price gouging.”

Single Constraint

The allocation of limited resources should be made only after a careful consideration of many qualitative factors. The following rule provides a useful starting point in making short-run decisions of how to best use limited resources: *To achieve short-run profit maximization, a for-profit organization should allocate limited resources in a manner that maximizes the contribution per unit of the limited resource.* The application of this rule is illustrated in the following example.

Assume **Snap Fitness** offers three different personal training packages (A, B, and C) to its customers. These packages vary from a personalized nutrition and exercise training to a one-time consultation. Suppose a limitation of 120 labor hours per week prevents Snap from meeting the demand for its services. Information for the three service packages is as follows:

	A	B	C
Unit selling price	\$100	\$80	\$50
Unit variable costs	(60)	(35)	(25)
Unit contribution margin.....	\$□40	\$45	\$25
Hours per unit	4	3	1

Package A has the highest selling price and Package B has the highest unit contribution margin. Package C is shown below to have the highest contribution per hour.

	A	B	C
Unit contribution margin.....	\$40	\$45	\$25
Hours per unit	÷ 4	÷ 3	÷ 1
Contribution per hour	\$10	\$15	\$25

Following the rule of maximizing the contribution per unit of a single constraining factor (labor hours), Snap should use its limited labor hours to sell Package C. As shown in the following analysis, any other plan would result in lower profits:

	A Highest Selling Price per Unit	B Highest Contribution per Unit	C Highest Contribution per Constraining Factor
Hours available	120	120	120
Hours per unit	÷ 4	÷ 3	÷ 1
Weekly production in units	30	40	120
Unit contribution margin.....	× \$40	× \$45	× \$25
Total weekly contribution margin....	\$1,200	\$1,800	\$3,000

Despite this analysis, management may decide on a product mix that includes some units of A or B or both to satisfy the requests of some “good” customers or to offer a full product line. However, such decisions sacrifice short-run profits.

Multiple Constraints

Continuing our illustration, assume a second constraint; that is, the maximum weekly demand for C is only 90 units, although the company is capable of producing 120 units of C each week. In this case, the limited labor resource should first be used to satisfy the demand for Package C, with any remaining capacity going to produce Package B, which has the next highest contribution per unit of constraining factor. This allocation provides a total weekly contribution of \$2,700 as follows.

Available hours	120
Required for C (90 units × 1 hour).....	(90)
Hours available for B	30
Labor hours per unit	÷ 3
Production of B in units.....	10
Unit contribution margin of B	× \$45
Contribution from B	\$□ 450
Contribution from C (\$25 per unit × 90 units).....	2,250
Total weekly contribution margin.....	\$2,700

When an organization has alternative uses for several limited resources, such as limited labor hours and limited space, the optimal use of those resources cannot be determined using the rule for short-run profit maximization. In these situations, techniques such as linear programming can be used to assist in determining the optimal mix of products or services.

Theory of Constraints

The **theory of constraints** states that every process has a bottleneck (constraining resource) and that production cannot take place faster than it is processed through that bottleneck. The goal of the theory of constraints is to maximize **throughput** (defined as sales revenue minus direct materials costs) in a constrained environment.¹ The theory has several implications for management.

- Management should identify the bottleneck. This is often difficult when several different products are produced in a facility containing many different production activities. One approach is to walk around and observe where inventory is building up in front of workstations. The bottleneck will likely have the largest piles of work that have been waiting for the longest time.
- Management should schedule production to maximize the efficient use of the bottleneck resource. Efficiently using the bottleneck resource might necessitate inspecting all units before they reach the bottleneck rather than after the units are completed. The bottleneck resource is too valuable to waste on units that may already be defective.
- Management should schedule production to avoid a buildup of inventory. Reducing inventory lowers the cost of inventory investments and the cost of carrying inventory. It also assists in improving quality by making it easier to identify quality problems that might otherwise be hidden in large piles of inventory. Reducing inventory will require a change in the attitude of managers who like to see machines and people constantly working. To avoid a buildup of inventory in front of the bottleneck, it may be necessary for people and equipment to remain idle until the bottleneck resource calls for additional input.
- Management should work to eliminate the bottleneck, perhaps by increasing the capacity of the bottleneck resource, redesigning products so they can be produced with less use of the bottleneck resource, rescheduling production procedures to substitute nonbottleneck resources, or outsourcing work performed by bottleneck resources.

The theory of constraints has implications for management accounting performance reports. Keeping people and equipment working on production full-time is often a goal of management. To support this goal, management accounting performance reports have traditionally highlighted underutilization as an unfavorable variance (see Module 23). This has encouraged managers to have people and equipment producing inventory, even if the inventory is not needed or cannot be further processed because of bottlenecks. The theory of constraints suggests that it is better to have non-bottleneck resources idle than it is to have them fully utilized. To support the theory of constraints, performance reports should:

- Measure the utilization of bottleneck resources
- Measure factory throughput
- Not encourage the full utilization of nonbottleneck resources
- Discourage the buildup of excess inventory

While the theory of constraints is *similar* to our general rule for how to best use limited resources, it emphasizes throughput (selling price minus direct materials) rather than contribution (selling price minus variable costs) in allocating the limited resource. The exclusion of direct labor and variable manufacturing overhead yields larger unit margins, and it may affect resource allocations based on throughput rankings. The result will likely be a reduction in profits from those that could be achieved

¹ *The Goal*, by Eliyah M. Goldratt and Jeff Cox, presents the concepts underlying the theory of constraints in the form of a novel.

using our general rule for how to allocate limited resources. Although the theory of constraints has not been widely embraced by companies, many of its users are enthusiastic about its benefits.

Limitations of Decision Analysis Models

Analytical models, such as the relevant cost analysis model and applications presented in this module, are very useful in organizing information for purposes of determining the economics of a decision. However, it is important always to keep in mind that models do not make decisions—managers make decisions. The results of analytical models are an essential and necessary starting point in many decisions, but often there are other factors that weigh heavily on a decision that may cause the manager to go against the most economical alternative. There may be human resource, marketing, cultural, logistical, technological, or other factors that outweigh the analytics of a decision situation. It is in these situations where managers demonstrate leadership, problem-solving, and executive skill and potential, or the lack thereof.

LO7 Review 17-7

Assume that **Innovative Components Inc.** produces only three different types of injection-molded knobs. They produce the Pointer Knob which is used for on/off devices, the Instrument Knob which is used for precision adjustment, and the Star Knob which is used for snowblowers and lawnmowers. The factory machine capacity is the company's constraining resource. It operates at 90% capacity and management wants to devote the unused capacity to one of the products. The following data represents their current operations:



	Pointer Knob	Instrument Knob	Star Knob
Per-case data:			
Sales price	\$20	\$22	\$6
Variable cost	<u>8</u>	<u>16</u>	<u>2</u>
Contribution margin	\$12	\$16	\$4
Fixed costs*	<u>6</u>	<u>2</u>	<u>1</u>
Net income	\$6	\$4	\$3
*Allocated on basis of machine hours at \$1 per hour.			

Required

Which product should management produce with its extra capacity?

Solution on p. 17-39.

Guidance Answers

You are the Vice President of Manufacturing

Pg. 17-5 This is a decision that has both economic and ethical dimensions. Economically, the cost of the old machine is a sunk cost, since the expenditure to acquire it has already been made. If it can be sold to another company to recover part of the initial cost, that amount would be relevant to the decision regarding the new technology. However, you should ignore the cost of the recently purchased machine and consider only the outlay costs that will differ between keeping the recently purchased machine and purchasing the new technology, plus any opportunity costs that may be involved with disposing of the existing machine and acquiring the new machine. From an ethical standpoint, managers are often hesitant to recommend an action that reflects poorly on their past decisions. The temptation is to try to justify the past decision. If you have evaluated all of the relevant costs and have considered all of the qualitative issues associated with upgrading the machine, these should be the basis for making your recommendation, not what it will do to your reputation with your superiors.

Questions

- Q17-1.** Distinguish between relevant and irrelevant costs.
- Q17-2.** In evaluating a cost reduction proposal, what three alternatives are available to management?
- Q17-3.** When are outlay costs relevant and when are they irrelevant?
- Q17-4.** Relate the manufacturing cost hierarchy discussed in Module 15 to the concept of relevant costs. Under what conditions would product-level costs be relevant?
- Q17-5.** Why is a differential analysis of relevant items preferred to a detailed listing of all costs and revenues associated with each alternative?
- Q17-6.** When are opportunity costs relevant to the evaluation of a special order?
- Q17-7.** Identify some important qualitative considerations in evaluating a decision to make or buy a part.
- Q17-8.** In a decision to sell or to process further, of what relevance are costs incurred prior to the decision point? Explain your answer.
- Q17-9.** How should limited resources be used to achieve short-run profit maximization?
- Q17-10.** What should performance reports do in support of the theory of constraints?

Assignments with the  logo in the margin are available in  My Business Course. See the Preface of the book for details.

Mini Exercises

LO1 M17-11. Relevant Cost Terms: Matching



SoundBite produces three different versions of portable digital music players, the Deluxe, Sport and Zip. SoundBite is evaluating a proposal that will result in doubling the production of Sport and discontinuing the production of Zip. The facilities currently used to produce Zip will be devoted to the production of Sport. Furthermore, additional machinery will be acquired to produce Sport. The production of Deluxe will not be affected. All products have a positive contribution margin.

Required

Presented below are a number of phrases related to the proposal followed by a list of cost terms. For each phrase, select the most appropriate cost term. Each term is used only once.

Phrases

- 1. Cost of equipment to produce Zip
- 2. Increased variable costs of Sport
- 3. Property taxes on the new machinery
- 4. Revenues from the sale of Deluxe
- 5. Increased revenue from the sale of Sport
- 6. Contribution margin of Zip
- 7. Variable costs of Deluxe
- 8. Company president's salary

Cost terms

- a. Opportunity cost
- b. Sunk cost
- c. Irrelevant variable outlay cost
- d. Irrelevant fixed outlay cost
- e. Relevant variable outlay cost
- f. Relevant fixed outlay cost
- g. Relevant revenues
- h. Irrelevant revenues

LO1 M17-12. Relevant Cost Terms: Matching



Studio produces and sells 4,000 specialty handbags per month and has the capacity to produce 5,000 units per month. Studio is evaluating a one-time, special order for 2,000 units from a Bloomingdales. Accepting the order will increase variable manufacturing costs and certain fixed selling and administrative costs. It will also require the company to forego the sale of 1,000 units to regular customers.

Required

Required

Presented below are a number of statements related to the proposal followed by a list of cost terms. For each statement, select the most appropriate cost term. Each term is used only once.

Statements

1. Increased revenues from special order
2. Lost contribution margin from foregone sales to regular customers
3. Revenues from 4,000 units sold to regular customers
4. Variable cost of 4,000 units sold to regular customers
5. Increase in fixed selling and administrative expenses
6. Cost of existing equipment used to produce special order
7. Salary paid to current supervisor who oversees manufacture of special order
8. Increased variable costs of special order

Cost terms

- a. Irrelevant variable outlay cost
- b. Irrelevant fixed outlay cost
- c. Sunk cost
- d. Relevant variable outlay cost
- e. Relevant fixed outlay cost
- f. Opportunity cost
- g. Relevant revenues
- h. Irrelevant revenues

M17-13. Identifying Relevant Costs and Revenues**LO1**

The Village of Bomont operates a power plant on a river that flows through town. The village uses some of this generated electricity to operate a water treatment plant and sells the excess electricity to a local utility. The city council is evaluating two alternative proposals:

- *Proposal A* calls for replacing the generators used in the plant with more efficient generators that will produce more electricity and have lower operating costs. The salvage value of the old generators is higher than their removal cost.
- *Proposal B* calls for raising the level of the dam to retain more water for generating power and increasing the force of water flowing through the dam. This will significantly increase the amount of electricity generated by the plant. Operating costs will not be affected.

**Required**

Presented are a number of cost and revenue items. Indicate in the appropriate columns whether each item is relevant or irrelevant to proposals A and B.

	Proposal A	Proposal B
1. Cost of new furniture for the city manager's office	_____	_____
2. Cost of old generators	_____	_____
3. Cost of new generators	_____	_____
4. Operating cost of old generators	_____	_____
5. Operating cost of new generators	_____	_____
6. The police chief's salary	_____	_____
7. Depreciation on old generators	_____	_____
8. Salvage value of old generators	_____	_____
9. Removal cost of old generators	_____	_____
10. Cost of raising dam	_____	_____
11. Maintenance costs of water plant	_____	_____
12. Revenues from sale of electricity	_____	_____

M17-14. Classifying Relevant and Irrelevant Items**LO1**

The law firm of Hannan, Taylor, and Masteller has been asked to represent a local client. All legal proceedings will be held out of town in Boston.

Required

The law firm's accountant has asked you to help determine the incremental cost of accepting this client. Classify each of the following items on the basis of their relationship to this engagement. Items may have multiple classifications.



	Relevant costs		Irrelevant costs	
	Opportunity	Outlay	Outlay	Sunk
1. The case will require three attorneys to stay four nights in a Boston hotel. The predicted hotel bill is \$2,400.				
2. Hannan, Taylor, and Masteller's professional staff is paid \$2,000 per day for out-of-town assignments.				
3. Last year, depreciation on Hannan, Taylor, and Masteller's office was \$25,000.				
4. Round-trip transportation to Boston is expected to cost \$250 per person.				
5. The firm has recently accepted an engagement that will require partners to spend two weeks in Chicago. The predicted out-of-pocket costs of this trip are \$8,500.				
6. The firm has a maintenance contract on its computer equipment that will cost \$2,200 next year.				
7. If the firm accepts the client and sends attorneys to Boston, it will have to decline a conflicting engagement in Miami that would have provided a net cash inflow of \$15,000.				
8. The firm's variable overhead is \$80 per client hour.				
9. The firm pays \$250 per year for Mr. Masteller's subscription to a law journal.				
10. Last year the firm paid \$3,500 to increase the insulation in its building.				

LO1, 2 M17-15. Relevant Costs for Equipment Replacement Decision

Dr. Heller paid \$50,000 for X-ray equipment four years ago. The equipment was expected to have a useful life of 10 years from the date of acquisition with annual operating costs of \$32,000. Technological advances have made the machine purchased four years ago obsolete with a zero salvage value. An improved X-ray device incorporating the new technology is available at an initial cost of \$55,000 and annual operating costs of \$21,000. The new machine is expected to last only six years before it, too, is obsolete. Asked to analyze the financial aspects of replacing the obsolete but still functional machine, Dr. Heller's accountant prepared the following analysis. After looking over these numbers, the company's manager rejected the proposal.

Six-year savings $[(\$32,000 - \$21,000) \times 6]$	\$ 66,000
Cost of new machine	(55,000)
Undepreciated cost of old machine	(30,000)
Advantage (disadvantage) of replacement	<u><u>\$ (19,000)</u></u>

Required

Perform an analysis of relevant costs to determine whether the manager made the correct decision.

LO1, 2, 4 M17-16. Special Order

Soni LTD produces wall mounts for flat panel television sets. The forecasted income statement for 2017 is as follows:

SONI, LTD Budgeted Income Statement For the Year 2017		
Sales (\$44 per unit)	\$ 4,400,000	
Cost of good sold (\$36 per unit)	(3,600,000)	
Gross profit	800,000	
Selling expenses (\$3 per unit)	(300,000)	
Net income	<u><u>\$ 500,000</u></u>	



Additional Information

(1) Of the production costs and selling expenses, \$800,000 and \$100,000, respectively, are fixed. (2) Soni LTD received a special order from a hospital supply company offering to buy 12,500 wall mounts for \$30. If it accepts the order, there will be no additional selling expenses, and there is currently sufficient excess capacity to fill the order. The company's sales manager argues for rejecting the order because "we are not in the business of paying \$36 to make a product to sell for \$30."

Required

Do you think the company should accept the special order? Should the decision be based only on the profitability of the sale, or are there other issues that Soni should consider? Explain.

M17-17. Sell or Process Further**LO1, 2, 6**

Bear Lake Boat Company manufactures sailboat hulls at a cost of \$5,200 per unit. The hulls are sold to boatyards for \$6,000. The company is evaluating the desirability of adding masts, sails, and rigging to the hulls prior to sale at an additional cost of \$1,500. The completed sailboats could then be sold for \$7,000 each.

Required

Determine whether the company should sell sailboat hulls or process them further into complete sailboats. Assume sales volume will not be affected.

**Exercises****E17-18. Special Order****LO1, 2, 4**

Great Oaks Farm grows organic vegetables and sells them to local restaurants after processing. The farm's leading product is Salad-in-a-Bag, which is a mixture of organic green salad ingredients prepared and ready to serve. The company sells a large bag to restaurants for \$25. It calculates the variable cost per bag at \$19 (including \$1 for local delivery), and the average total cost per bag is \$22. Because the vegetables are perishable and Great Oaks Farm is experiencing a large crop, the farm has extra capacity. A representative of a restaurant association in another city has offered to buy fresh salad stock from the company to augment its regular supply during an upcoming international festival. The restaurant association wants to buy 2,500 bags during the next month for \$21 per bag. Delivery to restaurants in the other city will cost the company \$0.75 per bag. It can meet most of the order with excess capacity but would sacrifice 400 bags of regular sales to fill this special order. Please assist Great Oaks Farm's management by answering the following questions.

Required

- a. Using differential analysis, what is the impact on profits of accepting this special order?
- b. What nonquantitative issues should management consider before making a final decision?
- c. How would the analysis change if the special order were for 2,500 bags per month for the next five years?

E17-19. Special Order**LO1, 2, 4**

Nature's Garden, a new restaurant situated on a busy highway in Pomona, California, specializes in a chef's salad selling for \$7. Daily fixed costs are \$1,200, and variable costs are \$4 per meal. With a capacity of 800 meals per day, the restaurant serves an average of 750 meals each day.

Required

- a. Determine the current average cost per meal.
- b. A busload of 30 Girl Scouts stops on its way home from the San Bernardino National Forest. The leader offers to bring them in if the scouts can all be served a meal for a total of \$150. The owner refuses, saying he would lose \$0.60 per meal if he accepted this offer. How do you think the owner arrived at the \$0.60 figure? Comment on the owner's reasoning.
- c. A local businessman on a break overhears the conversation with the leader and offers the owner a one-year contract to feed 300 of the businessman's employees one meal each day at a special price of \$4.50 per meal. Should the restaurant owner accept this offer? Why or why not?

**E17-20. Special Order: High-Low Cost Estimation****LO1, 2, 4**

ABS Inc. produces air bag systems that it sells to North American automobile manufacturers. Although the company has a capacity of 150,000 units per year, it is currently producing at an annual rate of 90,000 units. ABS Inc. has received an order from a Japanese manufacturer to purchase 30,000 units at \$8.75 each. Budgeted costs for 90,000 and 120,000 units are as follows:



	90,000 Units	120,000 Units
Manufacturing costs		
Direct materials.....	\$ 225,000	\$ 300,000
Direct labor.....	157,500	210,000
Factory overhead	<u>607,500</u>	<u>630,000</u>
Total	990,000	1,140,000
Selling and administrative	<u>382,500</u>	<u>390,000</u>
Total	<u>\$1,372,500</u>	<u>\$1,530,000</u>
Costs per unit		
Manufacturing.....	\$ 11.00	\$ 9.50
Selling and administrative	<u>4.25</u>	<u>3.25</u>
Total	<u>\$15.25</u>	<u>\$12.75</u>

Sales to North American manufacturers are priced at \$20 per unit, but the sales manager believes the company should aggressively seek the Japanese business even if it results in a loss of \$4.00 per unit. She believes obtaining this order would open up several new markets for the company's product. The general manager commented that the company cannot tighten its belt to absorb the \$120,000 loss ($\$4.00 \times 30,000$) it would incur if the order is accepted.

Required

- Determine the financial implications of accepting the order. (*Hint:* Use the high-low method to determine variable costs per unit.)
- How would your analysis differ if the company were operating at capacity? Determine the advantage or disadvantage of accepting the order under full-capacity circumstances.

LO1, 2, 5

Hewlett-Packard
(HPQ)
Sanmina Corp.
(SANM)



E17-21. Outsourcing (Make-or-Buy) Decision

Assume a division of **Hewlett-Packard** currently makes 10,000 circuit boards per year used in producing diagnostic electronic instruments at a cost of \$36 per board, consisting of variable costs per unit of \$24 and fixed costs per unit of \$12. Further assume **Sanmina Corporation** offers to sell Hewlett-Packard the 10,000 circuit boards for \$36 each. If Hewlett-Packard accepts this offer, the facilities currently used to make the boards could be rented to one of Hewlett-Packard's suppliers for \$30,000 per year. In addition, \$5 per unit of the fixed overhead applied to the circuit boards would be totally eliminated.

Required

Should HP outsource this component from Sanmina Corporation? Support your answer with relevant cost calculations.

LO1, 2, 5

E17-22. Outsourcing (Make-or-Buy) Decision

Mountain Air Limited manufactures a line of room air purifiers. Management is currently evaluating the possible production of an air purifier for automobiles. Based on an annual volume of 10,000 units, the predicted cost per unit of an auto air purifier follows.

Direct materials.....	\$ 9.00
Direct labor.....	1.40
Factory overhead	<u>10.00</u>
Total	<u>\$20.40</u>

These cost predictions include \$80,000 in fixed factory overhead averaged over 10,000 units.

The completed air purifier units include a battery-operated electric motor, which Mountain Air assembles with parts purchased from an outside vendor for \$2.00 per motor. Mini Motor Company has offered to supply an assembled battery-operated motor at a cost of \$5.50 per unit, with a minimum annual order of 5,000 units. If Mountain Air accepts this offer, it will be able to reduce the variable labor and variable overhead costs of the auto air purifier by 50 percent.

Required

- Determine whether Mountain Air should continue to make the electric motor or outsource it from Mini Motor Company. (*Hint:* analyze the relevant costs of making the "motors," not the entire air purifier.)

- b. If it could otherwise rent the motor-assembly space for \$25,000 per year, should it make or outsource this component?
- c. What additional factors should it consider in deciding whether to make or outsource the electric motors?

E17-23. Make or Buy

Priya Rahavy, M.D., is a general practitioner whose offices are located in the Lake Forest Professional Building. In the past, Dr. Rahavy has operated her practice with a nurse, a receptionist/secretary, and a part-time bookkeeper. Dr. Rahavy, like many small-town physicians, has billed her patients and their insurance companies from her own office. The part-time bookkeeper, who works 15 hours per week, is employed exclusively for this purpose.

LO1, 2, 5



North Avenue Physician's Service Center has offered to take over all of Dr. Rahavy's billings and collections for an annual fee of \$24,000. If Dr. Rahavy accepts this offer, she will no longer need the bookkeeper. The bookkeeper's wages and fringe benefits amount to \$20 per hour, and the bookkeeper works 50 weeks per year. With all the billings and collections done elsewhere, Dr. Rahavy will have three additional hours available per week to see patients. She sees an average of four patients per hour at an average fee of \$30 per visit. Dr. Rahavy's practice is expanding, and new patients often have to wait several weeks for an appointment. She has resisted expanding her office hours or working more than 50 weeks per year. Finally, if Dr. Rahavy signs on with the center, she will no longer need to rent a records storage facility for \$200 per month.

Required

Conduct a relevant cost analysis to determine if it is profitable to outsource the bookkeeping.

E17-24. Sell or Process Further

Port Allen Chemical Company processes raw material D into joint products E and F. Raw material D costs \$12 per liter. It costs \$100 to convert 100 liters of D into 60 liters of E and 40 liters of F. Product F can be sold immediately for \$12 per liter or processed further into Product G at an additional cost of \$10 per liter. Product G can then be sold for \$26 per liter.

LO1, 2, 6



Required

Determine whether Product F should be sold or processed further into Product G.

E17-25. Limited Resources

Assume **Fender** produces only three guitars: the Stratocaster, Dreadnought and Telecaster. A limitation of 720 labor hours per week prevents Fender from meeting the sales demand for these products. Product information is as follows:

	Stratocaster	Dreadnought	Telecaster
Unit selling price.....	\$960	\$600	\$1,260
Unit variable costs	(600)	(300)	(1,080)
Unit contribution margin.....	\$360	\$300	\$180
Labor hours per unit	36	24	36

Required

- a. Determine the weekly contribution from each product when total labor hours are allocated to the product with the highest
 1. Unit selling price.
 2. Unit contribution margin.
 3. Contribution per labor hour.*(Hint: Each situation is independent of the others.)*
- b. What generalization can be made regarding the allocation of limited resources to achieve short-run profit maximization?
- c. Determine the opportunity cost the company will incur if management requires the weekly production of 20 Telecasters.
- d. Give reasons why a company may not allocate resources in the most economical way in some situations.

LO7
Fender Musical Instruments Corp.



- b. If it could otherwise rent the motor-assembly space for \$25,000 per year, should it make or outsource this component?
- c. What additional factors should it consider in deciding whether to make or outsource the electric motors?

E17-23. Make or Buy

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LO1, 2, 5



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Required

Conduct a relevant cost analysis to determine if it is profitable to outsource the bookkeeping.

E17-24. Sell or Process Further

Port Allen Chemical Company processes raw material D into joint products E and F. Raw material D costs \$12 per liter. It costs \$100 to convert 100 liters of D into 60 liters of E and 40 liters of F. Product F can be sold immediately for \$12 per liter or processed further into Product G at an additional cost of \$10 per liter. Product G can then be sold for \$26 per liter.

LO1, 2, 6



Required

Determine whether Product F should be sold or processed further into Product G.

E17-25. Limited Resources

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Unit contribution margin.....	\$360	\$300	\$180
Labor hours per unit	36	24	36

Required

- a. Determine the weekly contribution from each product when total labor hours are allocated to the product with the highest
 1. Unit selling price.
 2. Unit contribution margin.
 3. Contribution per labor hour.*(Hint: Each situation is independent of the others.)*
- b. What generalization can be made regarding the allocation of limited resources to achieve short-run profit maximization?
- c. Determine the opportunity cost the company will incur if management requires the weekly production of 20 Telecasters.
- d. Give reasons why a company may not allocate resources in the most economical way in some situations.

LO7
Fender Musical Instruments Corp.



LO7 E17-26. Limited Resources

Maria Pajet, a regional sales representative for UniTec Systems Inc. has been working about 80 hours per week calling on a total of 123 regular customers each month. Because of family and health considerations, she has decided to reduce her hours to a maximum of 160 per month. Unfortunately, this cutback will require Maria to turn away some of her regular customers or, at least, serve them less frequently than once a month. Maria has developed the following information to assist her in determining how to best allocate time:

	Customer Classification		
	Large Business	Small Business	Individual
Number of customers	8	35	80
Average monthly sales per customer	\$2,500	\$1,500	\$600
Commission percentage.....	5%	8%	10%
Hours per customer per monthly visit	5.0	3.0	2.5

Required

- Develop a monthly plan that indicates the number of customers Maria should call on in each classification to maximize her monthly sales commissions.
- Determine the monthly commissions Maria will earn if she implements this plan.
- Give one or two reasons why Maria might decide not to follow the conclusions of the above analysis entirely.

Problems

LO1, 2, 3 P17-27. Multiple Changes in Profit Plans

In an attempt to improve profit performance, Anderson Company's management is considering a number of alternative actions. An October 2017 contribution income statement for Anderson Company follows.

ANDERSON COMPANY Contribution Income Statement For Month of October 2017		
Sales (10,000 units × \$40)		\$400,000
Less variable costs		
Direct materials (10,000 units × \$5)	\$50,000	
Direct labor (10,000 units × \$14)	140,000	
Variable factory overhead (10,000 units × \$6).....	60,000	
Selling and administrative (10,000 units × \$5)	50,000	(300,000)
Contribution margin (10,000 units × \$10)		100,000
Less fixed costs		
Factory overhead	50,000	
Selling and administrative	60,000	(110,000)
Net income (loss)		<u><u>\$ (10,000)</u></u>

Required

Determine the effect of each of the following independent situations on monthly profit.

- Purchasing automated assembly equipment, which should reduce direct labor costs by \$5 per unit and increase variable overhead costs by \$2 per unit and fixed factory overhead by \$22,000 per month.
- Reducing the selling price by \$5 per unit. This should increase the monthly sales by 5,000 units. At this higher volume, additional equipment and salaried personnel would be required. This will increase fixed factory overhead by \$2,800 per month and fixed selling and administrative costs by \$2,500 per month.

- c. Buying rather than manufacturing a component of Anderson's final product. This will increase direct materials costs by \$12 per unit. However, direct labor will decline \$4 per unit, variable factory overhead will decline \$1 per unit, and fixed factory overhead will decline \$15,000 per month.
- d. Increasing the unit selling price by \$4 per unit. This action should result in a 1,000-unit decrease in monthly sales.
- e. Combining alternatives (a) and (d).

P17-28. Multiple Changes in Profit Plans: Multiple Products

LO1, 2, 3

Information on Guadalupe Ltd.'s three products follows:

	A	B	C
Unit sales per month	□ 900	1,400	900
Selling price per unit	\$10.00	\$15.00	\$8.00
Variable costs per unit.....	<u>(10.40)</u>	<u>(12.00)</u>	<u>(4.00)</u>
Unit contribution margin.....	<u>\$ (0.40)</u>	<u>\$ □ 3.00</u>	<u>\$ 4.00</u>

Required

Determine the effect each of the following situations would have on monthly profits. Each situation should be evaluated independently of all others.

- a. Product A is discontinued.
- b. Product A is discontinued, and the subsequent loss of customers causes sales of Product B to decline by 100 units.
- c. The selling price of A is increased to \$11.00 with a sales decrease of 150 units.
- d. The price of Product B is increased to \$16.00 with a resulting sales decrease of 200 units. However, some of these customers shift to Product A; sales of Product A increase by 140 units.
- e. Product A is discontinued, and the plant in which A was produced is used to produce D, a new product. Product D has a unit contribution margin of \$0.60. Monthly sales of Product D are predicted to be 600 units.
- f. The selling price of Product C is increased to \$9.0, and the selling price of Product B is decreased to \$14.00. Sales of C decline by 200 units, while sales of B increase by 300 units.

P17-29. Relevant Costs and Differential Analysis

LO1, 2

Cornerstone Bank paid \$120,000 for a check-sorting machine in January 2013. The machine had an estimated life of 10 years and annual operating costs of \$110,000, excluding depreciation. Although management is pleased with the machine, recent technological advances have made it obsolete. Consequently, as of January 2017, the machine has a book value of \$72,000, a remaining operating life of 6 years, and a salvage value of \$0.

The manager of operations is evaluating a proposal to acquire a new optical scanning and sorting machine. The new machine would cost \$168,000 and reduce annual operating costs to \$70,000, excluding depreciation. Because of expected technological improvements, the manager believes the new machine will have an economic life of 6 years and no salvage value at the end of that life. Prior to signing the papers authorizing the acquisition of the new machine, the president of the bank prepared the following analysis:

Six-year savings $[(\$110,000 - \$70,000) \times 6 \text{ years}]$	\$240,000
Cost of new machine.....	(168,000)
Loss on disposal of old machine	<u>(72,000)</u>
Advantage (disadvantage) of replacement.....	<u>\$ □□□ □□0</u>

After looking at these numbers, the manager rejected the proposal and commented that he was "tired of looking at marginal projects. This bank is in business to make a profit, not to break even. If you want to break even, go work for the government."

Required

- a. Evaluate the president's analysis.
- b. Prepare a differential analysis of six-year totals for the old and the new machines.
- c. Speculate on some limitations of the model or other issues that might be a factor in making a final decision.

LO1, 2, 4 P17-30. Special Order

Cruise Company produces a variety of electric scooters. Management follows a pricing policy of manufacturing cost plus 60 percent. In response to a request from Pulse Cycles, LLC, the following price has been developed for an order of 300 scooters (the smallest scooter Cruise produces):

Manufacturing costs	
Direct materials.....	\$24,000
Direct labor.....	30,000
Factory overhead.....	36,000
Total	90,000
Markup (60%)	54,000
Selling price	<u><u>\$144,000</u></u>

Pulse Cycles rejected this price and offered to purchase the 300 scooters at a price of \$120,000. The following additional information is available:

- Cruise has sufficient excess capacity to produce the scooters.
- Factory overhead is applied on the basis of direct labor dollars.
- Budgeted factory overhead is \$800,000 for the current year. Of this amount, \$200,000 is fixed. Of the \$36,000 of factory overhead assigned to the Pulse Cycles order, only \$27,000 is driven by the special order; \$9,000 is a fixed cost.
- Selling and administrative expenses are budgeted as follows:

Fixed.....	\$180,000 per year
Variable	\$40 per unit manufactured and sold

Required

- a. The president of Cruise wants to know if he should allow Pulse Cycles to have the scooters for \$120,000. Determine the effect on profits of accepting Pulse Cycles' offer.
- b. Briefly explain why certain costs should be omitted from the analysis in requirement (a).
- c. Assume Cruise is operating at capacity and could sell the 300 scooters at its regular markup.
 1. Determine the opportunity cost of accepting Pulse Cycles' offer.
 2. Determine the effect on profits of accepting Pulse Cycles' offer.
- d. What other factors should Cruise consider before deciding to accept the special order?

LO1, 2, 4 P17-31. Special Order

Every Halloween, Peterson's Ice Cream Shop offers a trick-or-treat package of 25 coupons for \$8. The coupons are redeemable by children 12 years or under, for a single-scoop cone, with a limit of one coupon per child per visit. Coupon sales average 500 books per year. The printing costs are \$100. A single-scoop cone of Peterson's ice cream normally sells for \$1.20. The variable costs of a single-scoop cone are \$0.80.

Required

- a. Determine the loss if all coupons are redeemed without any other effect on sales.
- b. Assume all coupons will not be redeemed. With regular sales unaffected, determine the coupon redemption rate at which Peterson's will break even on the offer.
- c. Assuming regular sales are not affected and one additional single-scoop cone is sold at the regular price each time a coupon is redeemed, determine the coupon redemption rate at which Peterson's will break even on the offer.
- d. Determine the profit or loss incurred on the offer if the coupon redemption rate is 60 percent and:
 1. One-fourth of the redeemed coupons have no effect on sales.
 2. One-fourth of the redeemed coupons result in additional sales of two single-scoop cones.
 3. One-fourth of the redeemed coupons result in additional sales of three single-scoop cones.
 4. One-fourth of the redeemed coupons come out of regular sales of single-scoop cones.

P17-32. Applications of Differential Analysis**LO1, 2, 3, 4, 5**

Nantucket Optics Company manufactures high-end sunglasses that it sells to mail-order distributors for \$60. Manufacturing and other costs follow:

Variable Costs per Unit		Fixed Costs per Month	
Direct materials.....	\$13	Factory overhead	\$20,000
Direct labor.....	12	Selling and administrative	10,000
Factory overhead	2	Total	<u><u>\$30,000</u></u>
Distribution.....	<u>3</u>		
Total	<u><u>\$30</u></u>		

The variable distribution costs are for transportation to mail-order distributors. The current monthly production and sales volume is 5,000 units. Monthly capacity is 6,000 units.

Required

Determine the effect of each of the following independent situations on monthly profits.

- A \$2.00 increase in the unit selling price should result in a 1,200-unit decrease in monthly sales.
- A 10% decrease in the unit selling price should result in a 2,000-unit increase in monthly sales. However, because of capacity constraints, the last 1,000 units would be produced during overtime with the direct labor costs increasing by 60 percent.
- A British distributor has proposed to place a special, one-time order for 1,000 units at a reduced price of \$55 per unit. The distributor would pay all transportation costs. There would be additional fixed selling and administrative costs of \$1,000.
- A Swiss distributor has proposed to place a special, one-time order for 2,500 units at a special price of \$55 per unit. The distributor would pay all transportation costs. There would be additional fixed selling and administrative costs of \$1,500. Assume overtime production is not possible.
- Nantucket Optics provides a designer case for each pair of sunglasses that it manufactures. A Chinese manufacturer has offered a one-year contract to supply the cases at a cost of \$4 per unit. If Nantucket Optics accepts the offer, it will be able to reduce variable manufacturing costs by 10%, reduce fixed costs by \$1,500, and rent out some freed-up space for \$2,000 per month.
- The glasses also come with four different color inserts that allow the user to change the appearance of the glasses to match her or his clothing. Making the glasses in only one color without the color inserts would reduce the cost by \$5, and Nantucket Optics believes the selling price would have to decrease to \$55.

P17-33. Applications of Differential Analysis**LO1, 2, 3, 4, 5**

Adventure Expeditions offers guided back-country hiking/camping trips in British Columbia. Adventure provides a guide and all necessary food and equipment at a fee of \$50 per person per day. Adventure currently provides an average of 600 guide-days per month in June, July, August, and September. Based on available equipment and staff, maximum capacity is 800 guide-days per month. Monthly variable and fixed operating costs (valued in Canadian dollars) are as follows:

Variable Costs per Guide-Day		Fixed Costs per Month	
Food	\$25	Equipment rental.....	\$25,000
Guide salary	25	Administration	5,000
Supplies.....	2	Advertising	2,000
Insurance.....	<u>8</u>	Total	<u><u>\$12,000</u></u>
Total	<u><u>\$40</u></u>		

Required

Determine the effect of each of the following situations on monthly profits. Each situation is to be evaluated independently of all others.

- a. A \$12 increase in the daily fee should result in a 150-unit decrease in monthly sales.
- b. A \$7 decrease in the daily fee should result in a 300-unit increase in monthly sales. However, because of capacity constraints, the last 100 guide-days would be provided by subcontracting to another firm at a cost of \$46 per guide-day.
- c. A French tour agency has proposed to place a special, one-time order for 75 guide-days at a reduced fee of \$45 per guide-day. The agency would pay all insurance costs. There would be additional fixed administrative costs of \$200.
- d. An Italian tour agency has proposed to place a special, one-time order for 300 guide-days next month at a special fee of \$40 per guide-day. The agency would pay all insurance costs. There would be additional fixed administrative costs of \$200. Assume additional capacity beyond 800 guide-days is not available.
- e. An Alberta outdoor supply company has offered to supply all necessary food and camping equipment at \$7.50 per guide-day. This eliminates the current food costs and reduces the monthly equipment rental costs to \$1,800.
- f. Clients currently must carry a backpack and assist in camp activities such as cooking. Adventure is considering the addition of mules to carry all food and equipment and the hiring of college students to perform camp activities such as cooking. This will increase variable costs by \$12 per guide-day and fixed costs by \$1,000 per month. However, 600 full-service guide-days per month could now be sold at \$75 each.

LO1, 2 P17-34. Continue or Discontinue

Westview Eye Clinic primarily performs three medical procedures: cataract removal, corneal implants, and laser keratotomy. At the end of the first quarter of this year, Dr. Rajan, president of Westview, expressed grave concern about the cataract sector because it had reported a loss of \$100,000. He rationalized that “since the cataract market is losing \$100,000, and the overall practice is making \$330,000, if we eliminate the cataract market, our total profits will increase to \$430,000.”

Required

- a. Is the president’s analysis correct?
- b. Will total profits increase if the cataract section is dropped?
- c. Is it possible total profits will decline?

Management Applications

LO1, 2, 3 MA17-35. Assessing the Impact of an Incentive Plan²

Overview

Ladbrecks is a major department store with fifty retail outlets. The company’s stores compete with outlets run by companies such as Nordstrom, Macys, Bloomingdales, and Saks Fifth Avenue. During the early nineties the company decided that providing excellent customer service was the key ingredient for success in the retail industry. Therefore, during the mid 1990s the company implemented an incentive plan for its sales associates in twenty of its stores. Your job is to assess the financial impact of the plan and to provide a recommendation to management to continue or discontinue the plan based on your findings.

Incentives in Retail

The past decade has evidenced a concerted effort by many firms to empower and motivate employees to improve performance. A recent *New York Times* article reported that more and more firms are offering bonus plans to hourly workers. An Ernst and Young survey of the retail industry indicates that virtually all department stores currently offer incentive programs such as straight commissions, base salary plus commission, and quota bonus programs. Although these programs can add to payroll costs, the survey respondents indicated that they believe these plans have contributed to major improvements in customer service.

² Written to illustrate the use of relevant costs and revenues for decision making. This example is based on an actual company’s experience with implementing an incentive plan. The company name and the financial numbers and key ratios have been altered.

Company's Background

Ladbrecks was founded by members of the Ladbreck family in the 1880s. The first store opened under the name Ladbreck Dry Goods. Growth was fueled through acquisitions as the industry consolidated during the 1960s. Over this hundred-year period, sales associates were paid a fixed hourly wage. Raises were based on seniority. Sales associates were expected to be neat and courteous to customers. The advent of specialty stores and the stated intention of an upscale west coast retailer to begin opening stores in the Midwest concerned Ladbreck's management. Building on its history of excellence in customer service, the company initiated its performance-based incentive plan to support its stated firm-wide strategy of "customer emphasis" with "employee empowerment." Management expected it to result in further enhancement of customer service and, consequently, in an increase in sales generated at its stores.

Incentive Plan

The plan was implemented in stores sequentially as company managers intended to examine and evaluate the plan's impact on sales and profitability. Initially, the firm selected one store from a group of similar stores in the same general area to begin the implementation. By the end of 1994, ten stores had implemented the plan. In 1995, ten more stores implemented the plan, bringing the total to 20 out of a total of 50.

The performance-based incentive plan is best described as a bonus program. At the time of the plan's implementation, sales associates received little in the form of annual merit increases, and promotions were rare. The bonus payment became the only significant reward for high performance. Each week sales associates are paid a base hourly rate times hours worked. In addition, under the plan sales associates could increase their compensation by receiving a bonus at the end of each quarter. The contract provides sales-force personnel with a cash bonus only if the actual quarterly sales generated by the employee exceed a quarterly sales goal. Individualized pre-specified sales goals were established for each employee based only on the individual's base hourly rate, hours worked and a multiplier (multiplier = 1/bonus rate). The bonus is computed as a fixed percentage of the excess sales (actual sales minus a pre-specified sales goal) by the employee in a quarter (see Exhibit 1).

$$\begin{aligned}\text{Employee's Bonus} &= 0.08 \times \frac{(\text{Employee's actual sales for quarter} - \text{Employee's targeted sales for quarter})}{\text{Employee's targeted sales for quarter}} \\ \text{Where employee's} &= \text{Employee's hourly wage} \times \text{Hours worked in quarter} \times 12.5 \\ \text{targeted sales for quarter} &\end{aligned}$$

Senior managers regarded the incentive plan as a major change for the firm and its sales force. Management expected that the new incentive scheme would motivate many changes in employee behavior that would enhance customer service. Sales associates were now expected to build a client base to generate repeat sales. Actions consistent with this approach include developing and updating customer address lists (including details of their needs and preferences), writing thank you notes and contacting customers about upcoming sales and new merchandise that matched their preferences.

Consultant's Task

Management decided to call you in to provide an independent assessment. While the company thought that sales had increased with the plan's implementation, the human resource department did not know exactly how to quantify the plan's impact on sales and expenses. It suspected that employee salaries, cost of goods sold, and inventory carrying costs, as well as sales, may have changed due to the plan's implementation. You, therefore, requested information on these financial variables.

Sales Analysis: Because each of the twenty stores implemented the plan at different dates, and store sales fluctuated greatly with the seasons and the economy, you could not simply plot store sales. Instead, for each of the twenty stores, you picked another Ladbreck store as a control and computed for 48 months the following series of monthly sales:³

$$\text{Percent Change in Sales} = \frac{[(\text{Plan Store Sales in Month t} \div \text{Plan Store Sales in Month t-24}) - (\text{Control Store Sales in Month t} \div \text{Control Store Sales in Month t-24})] \times 100}{}$$

The plan's implementation was denoted as month 25, so you had 24 months prior to the plan and 24 months after the plan. Averages were then taken for the twenty stores. If the control procedure worked then you expected that the first 24 months of the series would fluctuate around zero. The actual results

³ For instance, assume sales for plan store were \$2,200 this January and \$2,000 two Januaries ago. Also assume that sales in the control store were \$4,400 this January and \$4,000 two Januaries ago. Percent change = $2,200/2,000 - 4,400/4,000 = 0$.

are reported in Figure 1 page 17-36. Month 25 is denoted as the rollout month, the month the incentive plan began.

Expense Analysis: You then plotted wage expense/sales, cost of goods sold/sales, and inventory turnover for the twenty stores for the 24 months preceding the plan and the first 24 months after plan implementation. After pulling out seasonal effects these monthly series are presented in Figures 2, 3 and 4. If the plan has no impact on these expenses then you would expect no dramatic change in the series around month 25.

Figure 2 plots (wage expense in month t/sales in month t)

Figure 3 plots (cost of goods sold in month t/sales in month t)

Figure 4 plots “annual” turnover computed as $(12 \times \text{cost of goods sold in month t}/\text{inventory at beginning of month t})$

For example, if monthly cost of sales is \$100 and the annual inventory turnover ratio is 4, it suggests a monthly turnover of 0.333 with the firm holding an average inventory of \$300 throughout the year. (Note that a monthly inventory turnover of .333 implies an annual turnover of 4 (from 12×0.333).

Financial Report for Store: A typical annual income statement for a pre-plan Ladbreck store before fixed charges, taxes and incidentals looks as follows.

	Total	Percent
Sales.....	10,000,000	100
Cost of goods sold	6,300,000	63
Gross profit.....	3,700,000	37
Employee salaries.....	800,000	8
Profit before fixed charges.....	2,900,000	29

A store also has substantial charges for rent, management salaries, insurance, etc. but they are fixed with respect to the incentive plan.

Required

- a. Suppose the goal of the firm is to now provide superior customer service by having the sales consultant identify and sell to the specific needs of the customer. What does this goal suggest about a change in managerial accounting and control systems?
- b. Provide an estimate of the impact of the incentive plan on sales.
- c. Did the sales impact occur all at once, or did it occur gradually?
- d. What is the impact of the incentive plan on wage expense as a percent of sales?
- e. What is the impact of the incentive plan on cost of good sold as a percent of sales?
- f. What is the impact of incentive plan on inventory turnover (turnover = cost of goods sold ÷ inventory)? [If sales go up then stores are selling more goods; therefore, more goods need to be on the floor or those goods on floor need to turn over faster.]
- g. What is the additional dollar amount of inventory that must be held?
- h. Using the information on sales and expenses for a typical store, provide an analysis of the additional store profit contributed by the plan. Assume that it costs 12% a year to carry the added inventory.
- i. Look at Exhibit 1, which provides a partial listing of employee pay for one small department within a store. Which “type” of employee is receiving the bonus?
- j. Should the company keep the plan? Explain your estimate of the financial impact of the plan and also incorporate any nonfinancial information you feel is relevant in justifying your decision.

Exhibit 1 ■ Wages by subset of employees in Ladbreck's fashion department

Name	Years of Service	Hourly Wage Rate	Hours Worked in Quarter	Regular Pay	Actual Sales for Quarter	Bonus	Total Pay Quarter
BOB MARLEY	2	4.00	400	1,600	25,000	400	2,000
JIMI HENDRIX	16	7.50	440	3,300	41,000	0	3,300
MILLIE SMALL	24	9.99	440	4,396	40,000	0	4,396
AL GREEN	11	6.00	400	2,400	36,000	480	2,880
BOB DYLAN	4	5.00	400	2,000	30,000	400	2,400
JANIS JOPLIN	10	6.00	400	2,400	30,000	0	2,400
WILSON PICKETT	16	7.50	440	3,300	50,000	700	4,000
BRUCE SPRINGSTEEN	23	9.99	440	4,396	30,000	0	4,396
MICHIGAN & SMILEY	13	7.00	400	2,800	38,000	240	3,040
RICHIE FURAY	22	9.90	400	3,960	30,000	0	3,960
JOHN LENNON	5	5.00	400	2,000	34,000	720	2,720
JULIO IGLESIAS	4	5.00	480	2,400	46,000	1,280	3,680
TOMMY PETTY	11	6.00	400	2,400	36,000	480	2,880
JOAN BAEZ	21	9.90	400	3,960	40,000	0	3,960
BB KING	8	6.00	400	2,400	38,000	640	3,040
GLADYS KNIGHT	14	8.00	480	3,840	46,000	0	3,840
NEIL YOUNG	15	8.00	480	3,840	36,000	0	3,840
BO DIDDLEY	4	5.00	400	2,000	30,000	400	2,400

Figure 1
Percentage Change in Sales

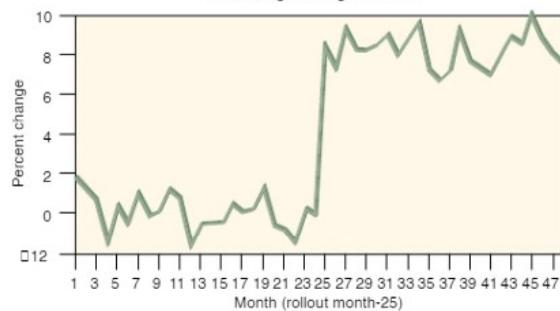


Figure 3
Cost of Goods Sold as a Percent of Sales

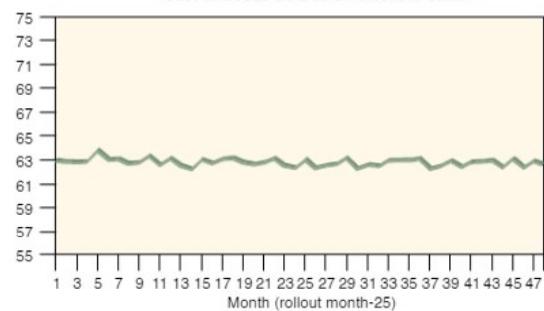


Figure 2
Wage Expense as a Percent of Sales

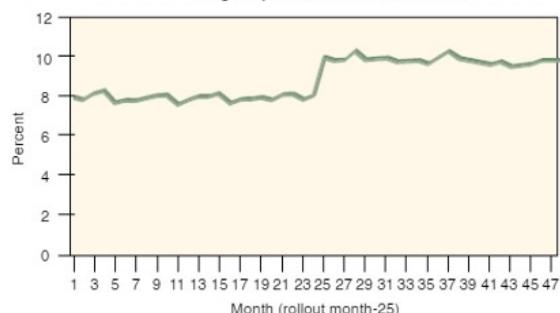
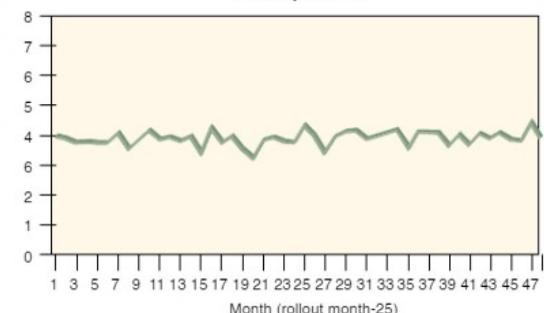


Figure 4
Inventory Turnover



Solutions to Review Problems

Review 17-1—Solution

Relevant costs	Irrelevant costs
Cost of machine	Building lease cost
Residual value of machine	Vice president's salary
Operating cost of machine	
Direct labor savings	
Cost of manager	
Opportunity cost of renting released space	

Review 17-2—Solution

a.	Purchase Machine	Use Labor	Difference (in total cost of purchasing machine)
Cost of new machine.....	\$1,000,000		\$1,000,000
Residual value of machine.....	(100,000)		(100,000)
Operating cost of machine (\$10,000 × 60 months).....	600,000		600,000
Cost of direct laborers (5,000 clubs × \$5 × 60 months)....		\$1,500,000	(1,500,000)
Cost of one manager (\$6,000 × 60 months).....		360,000	(360,000)
Rental value of freed up space (\$3,500 × 60 months).....		210,000	(210,000)
Total costs.....	<u><u>\$1,500,000</u></u>	<u><u>\$2,070,000</u></u>	<u><u>\$570,000</u></u>
Advantage of purchasing machine			<u><u>\$570,000</u></u>

- b. Even though the new machine would save estimated costs of \$570,000 over the next five years, there are several qualitative questions that should be answered, including the following:
- Will the new machine provide the same quality product as the current workers?
 - How important is it to have a cost structure that includes variable labor costs versus more fixed machine costs? If a business decline should occur, variable costs are often easier to eliminate than fixed costs.
 - What is the expected effect on worker morale and community image of eliminating a significant number of jobs in the plant?
 - How important is it for the sales staff to be able to promote the product as primarily handmade, versus machine made?

Review 17-3—Solution

Unit selling price.....	\$4.80
Unit variable costs	(2.50)
Unit contribution margin.....	<u><u>\$2.30</u></u>

a.	Profit decrease from reduced sales given no changes in prices or costs (1,800 units × \$2.30)	\$ (4,140)
	Profit increase from increase in selling price [(15,000 units – 1,800 units) × \$1.50].....	<u><u>19,800</u></u>
	Increase in monthly profit.....	<u><u>\$15,660</u></u>

b.	Profit increase from increased sales given no changes in prices or costs (6,000 units \times \$2.30)	\$13,800
	Profit decrease from reduced selling price of all units [(15,000 units + 6,000 units) \times \$1.80]	(37,800)
	Profit decrease from increased direct labor costs for the last 1,000 units [1,000 units \times (\$0.20 \times 0.50)]	(100)
	Decrease in monthly profit.....	<u><u>\$24,100)</u></u>

Review 17-4—Solution

a.	Increase in revenues (4,000 units \times \$4.00).....	\$16,000
	Increase in costs	
	Direct materials (4,000 units \times \$2.00).....	\$8,000
	Direct labor (4,000 units \times \$0.20).....	800
	Factory overhead (4,000 units \times \$0.25).....	1,000
	Selling and administrative.....	<u>500</u>
	Increase in profits.....	<u><u>\$5,700)</u></u>

b.	Increase in revenues (8,000 units \times \$4.00).....	\$32,000
	Increase in costs	
	Direct materials (8,000 units \times \$2.00).....	\$16,000
	Direct labor (8,000 units \times \$0.20).....	1,600
	Factory overhead (8,000 units \times \$0.25).....	2,000
	Selling and administrative.....	500
	Opportunity cost of lost regular sales [(15,000 units + 8,000 units – 20,000 unit capacity) \times \$2.30].....	<u>6,900</u>
	Increase in profits.....	<u><u>\$5,000)</u></u>

Review 17-5—Solution

	Cost to Make	Cost to Buy	Difference (income effect of buying)
Cost to buy (15,000 units \times \$1.00)		\$15,000	\$15,000
Cost to make			
Direct materials (15,000 units \times \$2.00 \times 0.40).....	\$12,000		12,000
Direct labor (15,000 units \times \$0.20 \times 0.40).....	1,200		1,200
Factory overhead (15,000 units \times \$0.25 \times 0.40).....	1,500		1,500
Opportunity cost.....	<u>1,000</u>		<u>1,000</u>
Totals	<u>\$15,700</u>	<u>\$15,000</u>	<u>\$700</u>
Advantage of buying		<u>700</u>	

Review 17-6—Solution

Increase in revenues		
Package individually (15,000 units \times \$5.05).....	\$75,750	
Sell in bulk (15,000 units \times \$4.80).....	<u>(72,000)</u>	\$3,750
Additional packaging costs (15,000 units \times \$0.10)		<u>(1,500)</u>
Advantage of individual packaging.....		<u>\$2,250</u>

Review 17-7—Solution

Intuition suggests that the extra capacity should be devoted either to produce the Instrument Knob, which has the highest sales price, or the Pointer Knob, which has the highest per-unit contribution margin and net income. However, an analysis of the contribution margin of each product per unit of constraining factor reveals that the Star Knob should receive the extra capacity.

Note that fixed costs are allocated among products on the basis of machine hours—the constraining resource in our example. Furthermore, the unit allocations of fixed costs indicate that the Pointer Knob requires three times as many machine hours as the Instrument Knob and six times as many as the Star Knob. The contribution per unit of machine capacity for each product is as follows:

	Pointer Knob	Instrument Knob	Star Knob
Contribution margin per case	\$12	\$6	\$4
Divided by units machine capacity required	<u>6</u>	<u>2</u>	<u>1</u>
Contribution margin per unit of machine capacity (the constraining resource).....	\$2	\$3	\$4

Use of the remaining capacity generates a greater contribution margin if devoted to the Star Knob.

