Chapter 14

Capital Budgeting Decisions

Capital Investments: A Key to Profitable Growth

BUSINESS FOCUS

Cintas Corporation, headquartered in Cincinnati, Ohio, has experienced 37 years of uninterrupted growth in sales and profits. The company provides highly specialized services to businesses of all types throughout North America, but the backbone of its success is providing corporate identity uniforms to more than five million North American workers. Cintas has 350 uniform rental facilities, 15 manufacturing plants, and seven distribution centers across North America. While these numbers are certain to grow in the future, the challenge for Cintas is choosing among competing capital expansion opportunities.

At Cintas, each capital investment proposal must be accompanied by a financial analysis that estimates the cash inflows and outflows associated with the project. The job of Paul Carmichael, the Controller of Cintas' Rental Division, is to challenge the validity of the assumptions underlying the financial estimates. Is the cost to build the new facility underestimated? Are future revenue growth rates overly optimistic? Is it necessary to build a new facility, or could an existing facility be refurbished or expanded? Asking these types of constructive questions helps Cintas channel its limited investment funds to the growth opportunities that will create the most long-term value for shareholders. ■

Source: Author's conversation with Paul Carmichael, Controller, Rental Division, Cintas Corporation.

Learning Objectives

After studying Chapter 14, you should be able to:

LO1 Evaluate the acceptability of an investment project using the net present value method.

LO2 Evaluate the acceptability of an investment project using the internal rate of return method.

LO3 Evaluate an investment project that has uncertain cash flows.

LO4 Rank investment projects in order of preference.

LO5 Determine the payback period for an investment.

LO6 Compute the simple rate of return for an investment.

LO7 (Appendix 14A) Understand present value concepts and the use of present value tables.

LO8 (Appendix 14C) Include income taxes in a capital budgeting analysis.

Managers are often involved in making decisions that involve an investment today in the hope of realizing future profits. For example, Tri-Con Global Restaurants, Inc. makes an investment when it opens a new Pizza Hut restaurant. L. L. Bean makes an investment when it installs a new computer to handle customer billing. DaimlerChrysler makes an investment when it redesigns a product such as the Jeep Eagle. Merck & Co. invests in medical research. Amazon.com makes an investment when it redesigns its website. All of these investments require committing funds today with the expectation of earning a return on those funds in the future in the form of additional cash inflows or reduced cash outflows.

The term **capital budgeting** is used to describe how managers plan significant investments in projects that have long-term implications such as the purchase of new equipment or the introduction of new products. Most companies have many more potential projects than can actually be funded. Hence, managers must carefully select those projects that promise the greatest future return. How well managers make these capital budgeting decisions is a critical factor in the long-run profitability of the company.

Capital Budgeting—Planning Investments

Typical Capital Budgeting Decisions

Any decision that involves an outlay now in order to obtain a future return is a capital budgeting decision. Typical capital budgeting decisions include:

1. Cost reduction decisions. Should new equipment be purchased to reduce costs?
2. Expansion decisions. Should a new plant, warehouse, or other facility be acquired to increase capacity and sales?
3. Equipment selection decisions. Which of several available machines should be purchased?
4. Lease or buy decisions. Should new equipment be leased or purchased?
5. Equipment replacement decisions. Should old equipment be replaced now or later?

Capital budgeting decisions fall into two broad categories—*screening decisions* and *preference decisions*. **Screening decisions** relate to whether a proposed project is acceptable—whether it passes a preset hurdle. For example, a company may have a policy of accepting projects only if they promise a return of 20% on the investment. The required rate of return is the minimum rate of return a project must yield to be acceptable. **Preference decisions,** by contrast, relate to selecting from among several acceptable alternatives. To illustrate, a company may be considering several different machines to replace an existing machine on the assembly line. The choice of which machine to purchase is a preference decision. In this chapter, we first discuss screening decisions and then move on to preference decisions toward the end of the chapter.

The Time Value of Money

As stated earlier, capital investments usually earn returns that extend over fairly long periods of time. Therefore, it is important to recognize *the time value of money* when evaluating investment proposals. A dollar today is worth more than a dollar a year from now if for no other reason than that you could put a dollar in a bank today and have more than a dollar a year from now. Therefore, projects that promise earlier returns are preferable to those that promise later returns.

Capital budgeting techniques that recognize the time value of money involve *discounting cash flows*. We will spend most of this chapter showing how to use discounted cash flow

methods in making capital budgeting decisions. If you are not already familiar with discounting and the use of present value tables, you should read Appendix 14A: The Concept of Present Value at the end of this chapter before proceeding any further.

IN BUSINESS

CHOOSING A CAT

Sometimes a long-term decision does not have to involve present value calculations or any other sophisticated analytical technique. White Grizzly Adventures of Meadow Creek, British Columbia, needs two snowcats for its powder skiing operations—one for shuttling guests to the top of the mountain and one to be held in reserve in case of mechanical problems with the first. Bombardier of Canada sells new snowcats for $250,000 and used, reconditioned snowcats for $150,000. In either case, the snowcats are good for about 5,000 hours of operation before they need to be reconditioned. From White Grizzly's perspective, the choice is clear. Since both new and reconditioned snowcats last about 5,000 hours, but the reconditioned snowcats cost $100,000 less, the reconditioned snowcats are the obvious choice. They may not have all of the latest bells and whistles, but they get the job done at a price a small company can afford.

Bombardier snowcats do not have passenger cabs as standard equipment. To save money, White Grizzly builds its own custom-designed passenger cab for about $15,000, using recycled Ford Escort seats and industrial-strength aluminum for the frame and siding. If purchased at retail, a passenger cab would cost about twice as much and would not be as well-suited for snowcat skiing.

Source: Brad & Carole Karafil, owners and operators of White Grizzly Adventures, www.whitegrizzly.com.

Discounted Cash Flows—The Net Present Value Method

LEARNING OBJECTIVE 1
Evaluate the acceptability of an investment project using the net present value method.

Two approaches to making capital budgeting decisions use discounted cash flows. One is the *net present value method,* and the other is the *internal rate of return method.* The net present value method is discussed in this section; the internal rate of return method is discussed in the following section.

The Net Present Value Method Illustrated

Under the net present value method, the present value of a project's cash inflows is compared to the present value of the project's cash outflows. The difference between the present value of these cash flows, called the **net present value,** determines whether or not the project is an acceptable investment. To illustrate, consider the following data:

Example A: Harper Company is contemplating the purchase of a machine capable of performing certain operations that are now performed manually. The machine will cost $50,000, and it will last for five years. At the end of the five-year period, the machine will have a zero scrap value. Use of the machine will reduce labor costs by $18,000 per year. Harper Company requires a minimum pretax return of 20% on all investment projects.[1]

Should the machine be purchased? Harper Company must determine whether a cash investment now of $50,000 can be justified if it will result in an $18,000 reduction in cost in each of the next five years. It may appear that the answer is obvious since the total cost savings is $90,000 ($18,000 per year × 5 years). However, the company can earn a 20% return by investing its money elsewhere. It is not enough that the cost reductions cover just the original cost of the machine; they must also yield a return of at least 20% or the company would be better off investing the money elsewhere.

[1] For simplicity, we ignore inflation and taxes. The impact of income taxes on capital budgeting decisions is discussed in Appendix 14C.

EXHIBIT 14–1
Net Present Value Analysis of a Proposed Project

14–1

Initial cost	$50,000
Life of the project	5 years
Annual cost savings	$18,000
Salvage value	$0
Required rate of return	20%

Item	Year(s)	Amount of Cash Flow	20% Factor	Present Value of Cash Flows
Annual cost savings	1–5	$ 18,000	2.991*	$53,838
Initial investment	Now	$(50,000)	1.000	(50,000)
Net present value				$ 3,838

*From Exhibit 14B–2 in Appendix 14B at the end of this chapter.

To determine whether the investment is desirable, the stream of annual $18,000 cost savings should be discounted to its present value and then compared to the cost of the new machine. Harper Company's minimum required return of 20% should be used as the *discount rate* in the discounting process. Exhibit 14–1 illustrates the computation of the net present value of this proposed project. The annual cost savings of $18,000 is multiplied by 2.991, the present value factor of a five-year annuity at the discount rate of 20%, to obtain $53,838.[2] This is the present value of the annual cost savings. The present value of the initial investment is computed by multiplying the investment amount of $50,000 by 1.000, the present value factor for any cash flow that occurs immediately.

According to the analysis, Harper Company should purchase the new machine. The present value of the cost savings is $53,838, whereas the present value of the required investment (cost of the machine) is only $50,000. Deducting the present value of the required investment from the present value of the cost savings yields the *net present value* of $3,838. Whenever the net present value is zero or greater, as in our example, an investment project is acceptable. Whenever the net present value is negative (the present value of the cash outflows exceeds the present value of the cash inflows), an investment project is not acceptable. In sum:

If the Net Present Value Is . . .	Then the Project Is . . .
Positive	Acceptable, since it promises a return greater than the required rate of return.
Zero	Acceptable, since it promises a return equal to the required rate of return.
Negative	Not acceptable, since it promises a return less than the required rate of return.

There is another way to interpret the net present value. Harper Company could spend up to $53,838 for the new machine and still obtain the minimum required 20% rate of return. The net present value of $3,838, therefore, shows the amount of "cushion" or "margin of error." One way to look at this is that the company could underestimate the cost of the new machine by up to $3,838, or overestimate the net present value of the future cash savings by up to $3,838, and the project would still be financially attractive.

[2] Unless otherwise stated, for the sake of simplicity we will assume in this chapter that all cash flows other than the initial investment occur at the ends of years.

Emphasis on Cash Flows

Accounting net income is based on accruals that ignore when cash flows occur. However, in capital budgeting, the timing of cash flows is critical. The present value of a cash flow depends on when it occurs. For that reason, cash flow rather than accounting net income is the focus in capital budgeting.[3] Examples of cash outflows and cash inflows that are often relevant to capital investment decisions are described below.

Typical Cash Outflows Most projects have at least three types of cash outflows. First, they often require an immediate cash outflow in the form of an initial investment in equipment, other assets, and installation costs. Any salvage value realized from the sale of old equipment can be recognized as a reduction in the initial investment or as a cash inflow. Second, some projects require a company to expand its working capital. **Working capital** is current assets (e.g., cash, accounts receivable, and inventory) less current liabilities. When a company takes on a new project, the balances in the current asset accounts often increase. For example, opening a new Nordstrom's department store requires additional cash in sales registers and more inventory. These additional working capital needs are treated as part of the initial investment in a project. Third, many projects require periodic outlays for repairs and maintenance and additional operating costs.

Typical Cash Inflows Most projects also have at least three types of cash inflows. First, a project will normally increase revenues or reduce costs. Either way, the amount involved should be treated as a cash inflow for capital budgeting purposes. Notice that from a cash flow standpoint, a reduction in costs is equivalent to an increase in revenues. Second, cash inflows are also frequently realized from selling equipment for its salvage value when a project ends, although the company may actually have to pay to dispose of some low-value or hazardous items. Third, any working capital that was tied up in the project can be released for use elsewhere at the end of the project and should be treated as a cash inflow at that time. Working capital is released, for example, when a company sells off its inventory or collects its accounts receivable.

IN BUSINESS

BEST BUY'S BIG GAMBLE

Best Buy is overhauling hundreds of its stores in an effort to tailor merchandise offerings and employee skills to meet the needs of each store's target customers. The cost to revamp one department of one store can easily exceed $600,000 for lighting and fixtures plus additional costs for employee training. While these initial cash outflows are readily quantifiable, the future cash inflows that they will generate are highly uncertain.

The first few dozen stores overhauled by Best Buy recorded sales growth that was three times greater than non-renovated stores. Best Buy reacted to these initial results by hastily renovating 154 more stores over the next three months. Shortly after completing these expensive renovations, the company had the misfortune of informing Wall Street that the newly revamped stores' growth rates were only slightly higher than non-renovated stores. This disappointing news apparently caused the market value of Best Buy's common stock to plummet by almost $3 billion in one day. Clearly, Wall Street analysts had serious concerns about the future cash flow generating ability of this capital investment project. Despite the "bump in the road," Best Buy remains committed to its course of action; however, the company has decided to slow down the pace of its implementation.

Source: Matthew Boyle, "Best Buy's Giant Gamble," *Fortune*, April, 3, 2006, pp. 69–75.

[3] Under certain conditions, capital budgeting decisions can be correctly made by discounting appropriately defined accounting net income. However, this approach requires advanced techniques that are beyond the scope of this book.

In summary, the following types of cash flows are common in business investment projects:

Cash outflows:
- Initial investment (including installation costs).
- Increased working capital needs.
- Repairs and maintenance.
- Incremental operating costs.

Cash inflows:
- Incremental revenues.
- Reduction in costs.
- Salvage value.
- Release of working capital.

Recovery of the Original Investment

The net present value method automatically provides for return of the original investment. Whenever the net present value of a project is positive, the project will recover the original cost of the investment plus sufficient excess cash inflows to compensate for tying up funds in the project. To demonstrate this point, consider the following situation:

Example B: Carver Hospital is considering the purchase of an attachment for its X-ray machine that will cost $3,170. The attachment will be usable for four years, after which time it will have no salvage value. It will increase net cash inflows by $1,000 per year in the X-ray department. The hospital's board of directors requires a rate of return of at least 10% on such investments in equipment.

A net present value analysis of the desirability of purchasing the X-ray attachment is presented in Exhibit 14–2. Notice that the attachment promises exactly a 10% return on the original investment, since the net present value is zero at a 10% discount rate.

Each annual $1,000 cash inflow arising from use of the attachment is made up of two parts. One part represents a recovery of a portion *of* the original $3,170 paid for the attachment, and the other part represents a return *on* this investment. The breakdown of each year's $1,000 cash inflow between recovery *of* investment and return *on* investment is shown in Exhibit 14–3.

The first year's $1,000 cash inflow consists of a return *on* investment of $317 (a 10% return *on* the $3,170 original investment), plus a $683 return *of* that investment. Since the amount of the unrecovered investment decreases each year, the dollar amount of the return on investment also decreases each year. By the end of the fourth year, all $3,170 of the original investment has been recovered.

EXHIBIT 14–2
Carver Hospital—Net Present Value Analysis of X-Ray Attachment

Initial cost	$3,170
Life of the project	4 years
Annual net cash inflow	$1,000
Salvage value	$0
Required rate of return	10%

Item	Year(s)	Amount of Cash Flow	10% Factor	Present Value of Cash Flows
Annual net cash inflow	1–4	$ 1,000	3.170*	$3,170
Initial investment	Now	$(3,170)	1.000	(3,170)
Net present value				$ 0

*From Exhibit 14B–2 in Appendix 14B.

EXHIBIT 14–3
Carver Hospital—Breakdown of Annual Cash Inflows

Year	(1) Investment Outstanding during the Year	(2) Cash Inflow	(3) Return on Investment (1) × 10%	(4) Recovery of Investment during the Year (2) − (3)	(5) Unrecovered Investment at the End of the Year (1) − (4)
1	$3,170	$1,000	$317	$ 683	$2,487
2	$2,487	$1,000	$249	751	$1,736
3	$1,736	$1,000	$173	827	$909
4	$909	$1,000	$91	909	$0
Total investment recovered				$3,170	

Simplifying Assumptions

Two simplifying assumptions are usually made in net present value analysis.

The first assumption is that all cash flows other than the initial investment occur at the end of periods. This is somewhat unrealistic in that cash flows typically occur *throughout* a period rather than just at its end. The purpose of this assumption is to simplify computations.

The second assumption is that all cash flows generated by an investment project are immediately reinvested at a rate of return equal to the discount rate. Unless these conditions are met, the net present value computed for the project will not be accurate. We used a discount rate of 10% for Carver Hospital in Exhibit 14–2. Unless the cash flows in each period are immediately reinvested at a 10% return, the net present value computed for the X-ray attachment will be misstated.

Choosing a Discount Rate

A positive net present value indicates that the project's return exceeds the discount rate. A negative net present value indicates that the project's return is less than the discount rate. Therefore, if the company's minimum required rate of return is used as the discount rate, a project with a positive net present value has a return that exceeds the minimum required rate of return and is acceptable. Contrarily, a project with a negative net present value has a return that is less than the minimum required rate of return and is unacceptable.

What is a company's minimum required rate of return? The company's *cost of capital* is usually regarded as the minimum required rate of return. The **cost of capital** is the average rate of return the company must pay to its long-term creditors and its shareholders for the use of their funds. If a project's rate of return is less than the cost of capital, the company does not earn enough to compensate its creditors and shareholders. Therefore, any project with a rate of return less than the cost of capital should be rejected.

The cost of capital serves as a *screening device.* When the cost of capital is used as the discount rate in net present value analysis, any project with a negative net present value does not cover the company's cost of capital and should be discarded as unacceptable.

An Extended Example of the Net Present Value Method

Example C provides an extended example of how the net present value method is used to analyze a proposed project. This example helps tie together and reinforce many of the ideas discussed thus far.

Example C: Under a special licensing arrangement, Swinyard Company has an opportunity to market a new product for a five-year period. The product would be purchased from the manufacturer, with Swinyard Company responsible for promotion and distribution costs. The licensing arrangement could be renewed at the end of the five-year period. After careful study, Swinyard Company estimated the following costs and revenues for the new product:

Cost of equipment needed	$60,000
Working capital needed	$100,000
Overhaul of the equipment in four years	$5,000
Salvage value of the equipment in five years	$10,000
Annual revenues and costs:	
Sales revenues	$200,000
Cost of goods sold	$125,000
Out-of-pocket operating costs (for salaries, advertising, and other direct costs)	$35,000

At the end of the five-year period, if Swinyard decides not to renew the licensing arrangement the working capital would be released for investment elsewhere. Swinyard Company uses a 14% discount rate. Would you recommend that the new product be introduced?

This example involves a variety of cash inflows and cash outflows. The solution is given in Exhibit 14–4.

Notice how the working capital is handled in this exhibit. It is counted as a cash outflow at the beginning of the project and as a cash inflow when it is released at the end of the project. Also notice how the sales revenues, cost of goods sold, and out-of-pocket costs are handled. **Out-of-pocket costs** are actual cash outlays for salaries, advertising, and other operating expenses.

Since the net present value of the proposal is positive, the new product is acceptable.

EXHIBIT 14–4

The Net Present Value Method—An Extended Example

Sales revenues	$200,000
Less cost of goods sold	125,000
Less out-of-pocket costs for salaries, advertising, etc.	35,000
Annual net cash inflows	$ 40,000

Item	Year(s)	Amount of Cash Flow	14% Factor	Present Value of Cash Flows
Purchase of equipment	Now	$(60,000)	1.000	$ (60,000)
Working capital needed	Now	$(100,000)	1.000	(100,000)
Overhaul of equipment	4	$(5,000)	0.592*	(2,960)
Annual net cash inflows from sales of the product line	1–5	$40,000	3.433†	137,320
Salvage value of the equipment	5	$10,000	0.519*	5,190
Working capital released	5	$100,000	0.519*	51,900
Net present value				$ 31,450

*From Exhibit 14B–1 in Appendix 14B.
†From Exhibit 14B–2 in Appendix 14B.

Discounted Cash Flows—The Internal Rate of Return Method

LEARNING OBJECTIVE 2
Evaluate the acceptability of an investment project using the internal rate of return method.

The **internal rate of return** is the rate of return promised by an investment project over its useful life. It is sometimes referred to simply as the *yield* on a project. The internal rate of return is computed by finding the discount rate that equates the present value of a project's cash outflows with the present value of its cash inflows. In other words, the internal rate of return is the discount rate that results in a net present value of zero.

The Internal Rate of Return Method Illustrated

To illustrate the internal rate of return method, consider the following data:

Example D: Glendale School District is considering the purchase of a large tractor-pulled lawn mower. At present, the lawn is mowed using a small hand-pushed gas mower. The large, tractor-pulled mower will cost $16,950 and will have a useful life of 10 years. It will have a negligible scrap value, which can be ignored. The tractor-pulled mower would do the job faster than the old mower, resulting in labor savings of $3,000 per year.

To compute the internal rate of return promised by the new mower, we must find the discount rate that will cause the net present value of the project to be zero. How do we do this? The simplest and most direct approach *when the net cash inflow is the same every year* is to divide the investment in the project by the expected net annual cash inflow. This computation will yield a factor from which the internal rate of return can be determined. The formula is as follows:

$$\text{Factor of the internal rate of return} = \frac{\text{Investment required}}{\text{Net annual cash inflow}} \qquad (1)$$

The factor derived from formula (1) is then located in the present value tables to see what rate of return it represents. Using formula (1) and the data for the Glendale School District's proposed project, we get:

$$\frac{\text{Investment required}}{\text{Net annual cash inflow}} = \frac{\$16{,}950}{\$3{,}000} = 5.650$$

Thus, the discount factor that will equate a series of $3,000 cash inflows with a present investment of $16,950 is 5.650. Now we need to find this factor in Exhibit 14B–2 in Appendix 14B to see what rate of return it represents. We should use the 10-period line in Exhibit 14B–2 because the cash flows for the project continue for 10 years. If we scan along the 10-period line, we find that a factor of 5.650 represents a 12% rate of return. Therefore, the internal rate of return promised by the mower project is 12%. We can verify this by computing the project's net present value using a 12% discount rate. This computation is shown in Exhibit 14–5.

Notice from Exhibit 14–5 that using a 12% discount rate equates the present value of the annual cash inflows with the present value of the investment required for the project, leaving a zero net present value. The 12% rate therefore represents the internal rate of return promised by the project.

EXHIBIT 14–5
Evaluation of the Mower Purchase Using a 12% Discount Rate

Initial cost	$16,950
Life of the project	10 years
Annual cost savings	$3,000
Salvage value	$0

Item	Year(s)	Amount of Cash Flow	12% Factor	Present Value of Cash Flows
Annual cost savings	1–10	$3,000	5.650*	$16,950
Initial investment	Now	$(16,950)	1.000	(16,950)
Net present value				$ 0

*From Exhibit 14B–2 in Appendix 14B.

Salvage Value and Other Cash Flows

The technique just demonstrated works if a project's cash flows are identical every year. But what if they are not? For example, what if a project will have some salvage value at the end of its life in addition to the annual cash inflows? Under these circumstances, a trial-and-error process may be used to find the rate of return that will equate the cash inflows with the cash outflows. The trial-and-error process can be carried out by hand; however, computer software programs such as spreadsheets can perform the necessary computations in seconds. In short, erratic or uneven cash flows should not prevent an analyst from determining a project's internal rate of return.

Using the Internal Rate of Return

To evaluate a project, the internal rate of return is compared to the company's minimum required rate of return, which is usually the company's cost of capital. If the internal rate of return is equal to or greater than the required rate of return, then the project is considered to be acceptable. If the internal rate of return is less than the required rate of return, then the project is rejected.

In the case of the Glendale School District example, let us assume that the district has set a minimum required rate of return of 15% on all projects. Since the large mower's internal rate of return is only 12%, the project does not clear the 15% hurdle and should be rejected.

The Cost of Capital as a Screening Tool

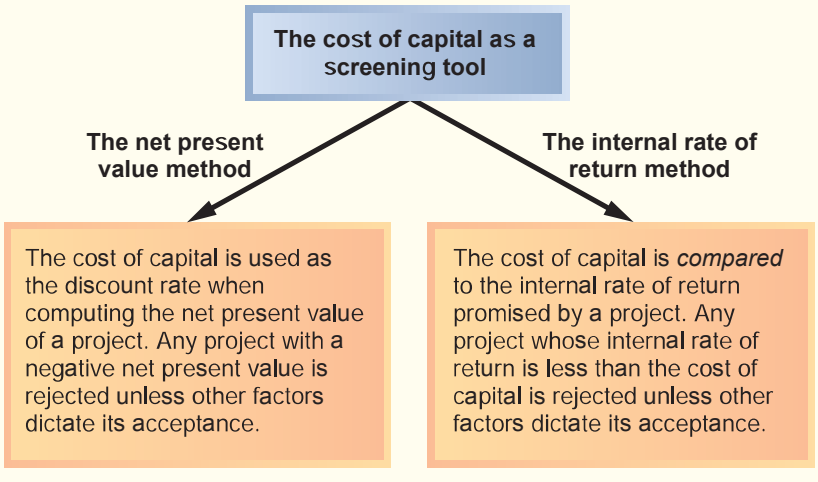
As we have seen in preceding examples, the cost of capital often operates as a *screening* device, helping screen out undesirable investment projects. This screening is accomplished in different ways, depending on whether the company is using the internal rate of return method or the net present value method.

When the internal rate of return method is used, the cost of capital is used as the *hurdle rate* that a project must clear for acceptance. If the internal rate of return of a project is not great enough to clear the cost of capital hurdle, then the project is ordinarily rejected. We saw the application of this idea in the Glendale School District example, where the hurdle rate was set at 15%.

When the net present value method is used, the cost of capital is the *discount rate* used to compute the net present value of a proposed project. Any project yielding a negative net present value is rejected unless other factors are significant enough to warrant its acceptance.

The use of the cost of capital as a screening tool is summarized in Exhibit 14–6.

EXHIBIT 14–6
Capital Budgeting Screening Decisions



Comparison of the Net Present Value and Internal Rate of Return Methods

The net present value method has several important advantages over the internal rate of return method.

First, the net present value method is often simpler to use than the internal rate of return method. As mentioned earlier, the internal rate of return method may require hunting for the discount rate that results in a net present value of zero. This can be a very laborious trial-and-error process, although it can be automated using a computer.

Second, the internal rate of return method makes a questionable assumption. Both methods assume that cash flows generated by a project during its useful life are immediately reinvested elsewhere. However, the two methods make different assumptions concerning the rate of return that is earned on those cash flows. The net present value method assumes the rate of return is the discount rate, whereas the internal rate of return method assumes the rate of return is the internal rate of return on the project. Specifically, if the internal rate of return of the project is high, this assumption may not be realistic. It is generally more realistic to assume that cash inflows can be reinvested at a rate of return equal to the discount rate—particularly if the discount rate is the company's cost of capital or an opportunity rate of return. For example, if the discount rate is the company's cost of capital, this rate of return can be actually realized by paying off the company's creditors and buying back the company's stock with cash flows from the project. In short, when the net present value method and the internal rate of return method do not agree concerning the attractiveness of a project, it is best to go with the net present value method. Of the two methods, it makes the more realistic assumption about the rate of return that can be earned on cash flows from the project.

Expanding the Net Present Value Method

So far all of our examples have involved an evaluation of a single investment project. In the following section we expand the discussion of the net present value method to include evaluation of two alternative projects. In addition, we integrate relevant cost concepts into the discounted cash flow analysis. We use two approaches to compare competing investment projects—the *total-cost approach* and the *incremental-cost approach*. Each approach is illustrated in the next few pages.

The Total-Cost Approach

The total-cost approach is the most flexible method for comparing competing projects. To illustrate the mechanics of the approach, consider the following data:

Example E: Harper Ferry Company operates a high-speed passenger ferry service across the Mississippi River. One of its ferryboats is in poor condition. This ferry can be renovated at an immediate cost of $200,000. Further repairs and an overhaul of the motor will be needed five years from now at a cost of $80,000. In all, the ferry will be usable for 10 years if this work is done. At the end of 10 years, the ferry will have to be scrapped at a salvage value of $60,000. The scrap value of the ferry right now is $70,000. It will cost $300,000 each year to operate the ferry, and revenues will total $400,000 annually.

As an alternative, Harper Ferry Company can purchase a new ferryboat at a cost of $360,000. The new ferry will have a life of 10 years, but it will require some repairs costing $30,000 at the end of 5 years. At the end of 10 years, the ferry will have a scrap value of $60,000. It will cost $210,000 each year to operate the ferry, and revenues will total $400,000 annually.

Harper Ferry Company requires a return of at least 14% before taxes on all investment projects.

Should the company purchase the new ferry or renovate the old ferry? Exhibit 14–7 (page 636) shows the solution using the total-cost approach.

Two points should be noted from the exhibit. First, *all* cash inflows and *all* cash outflows are included in the solution under each alternative. No effort has been made to isolate those cash flows that are relevant to the decision and those that are not relevant. The inclusion of all cash flows associated with each alternative gives the approach its name—the *total-cost* approach.

EXHIBIT 14–7
The Total-Cost Approach to Project Selection

	New Ferry	Old Ferry
Annual revenues	$400,000	$400,000
Annual cash operating costs	210,000	300,000
Net annual cash inflows	$190,000	$100,000

Item	Year(s)	Amount of Cash Flows	14% Factor*	Present Value of Cash Flows
Buy the new ferry:				
Initial investment	Now	$(360,000)	1.000	$(360,000)
Salvage value of the old ferry	Now	$70,000	1.000	70,000
Repairs in five years	5	$(30,000)	0.519	(15,570)
Net annual cash inflows	1–10	$190,000	5.216	991,040
Salvage value of the new ferry	10	$60,000	0.270	16,200
Net present value				701,670
Keep the old ferry:				
Renovation	Now	$(200,000)	1.000	(200,000)
Repairs in five years	5	$(80,000)	0.519	(41,520)
Net annual cash inflows	1–10	$100,000	5.216	521,600
Salvage value of the old ferry	10	$60,000	0.270	16,200
Net present value				296,280
Net present value in favor of buying the new ferry				$ 405,390

*All present value factors are from Exhibits 14B–1 and 14B–2 in Appendix 14B.

Second, notice that a net present value is computed for each alternative. This is a distinct advantage of the total-cost approach because an unlimited number of alternatives can be compared side by side to determine the best option. For example, another alternative for Harper Ferry Company would be to get out of the ferry business entirely. If management desired, the net present value of this alternative could be computed to compare with the alternatives shown in Exhibit 14–7. Still other alternatives might be open to the company. In the case at hand, given only two alternatives, the data indicate that the most profitable choice is to purchase the new ferry.[4]

IN BUSINESS

DOES IT REALLY NEED TO BE NEW?

Tom Copeland, the director of Corporate Finance Practice at the consulting firm Monitor Group, observes: "If they could afford it, most people would like to drive a new car. Managers are no different . . . [I]n my experience, . . . [managers] routinely spend millions of dollars on new machines years earlier than they need to. In most cases, the overall cost (including the cost of breakdowns) is 30% to 40% lower if a company continues servicing an existing machine for five more years instead of buying a new one. In order to fight impulsive acquisitions of new machinery, companies should require unit managers to run the numbers on all alternative investment options open to them—including maintaining the existing assets or buying used ones."

Source: Tom Copeland, "Cutting Costs Without Drawing Blood," *Harvard Business Review*, September–October 2000, pp. 3–7.

[4] The alternative with the highest net present value is not always the best choice, although it is the best choice in this case. For further discussion, see the section Preference Decisions—The Ranking of Investment Projects.

EXHIBIT 14–8
The Incremental-Cost Approach to Project Selection

Item	Year(s)	Amount of Cash Flows	14% Factor*	Present Value of Cash Flows
Incremental investment to buy the new ferry	Now	$(160,000)	1.000	$(160,000)
Salvage value of the old ferry now	Now	$70,000	1.000	70,000
Difference in repairs in five years	5	$50,000	0.519	25,950
Increase in net annual cash inflows	1–10	$90,000	5.216	469,440
Difference in salvage value in 10 years	10	$0	0.270	0
Net present value in favor of buying the new ferry				$ 405,390

*All present value factors are from Exhibits 14B–1 and 14B–2 in Appendix 14B.

The Incremental-Cost Approach

When only two alternatives are being considered, the incremental-cost approach offers a simpler and more direct route to a decision. In the incremental-cost approach, only those costs and revenues that *differ* between the two alternatives are included in the analysis. To illustrate, refer again to the data in Example E relating to Harper Ferry Company. The solution using only differential costs is presented in Exhibit 14–8.[5]

Two things should be noted from the data in this exhibit. First, the net present value in favor of buying the new ferry of $405,390 shown in Exhibit 14–8 agrees with the net present value shown under the total-cost approach in Exhibit 14–7. The two approaches are just different roads to the same destination.

Second, the costs used in Exhibit 14–8 are just the differences between the costs shown for the two alternatives in the prior exhibit. For example, the $160,000 incremental investment required to purchase the new ferry in Exhibit 14–8 is the difference between the $360,000 cost of the new ferry and the $200,000 cost required to renovate the old ferry from Exhibit 14–7. The other figures in Exhibit 14–8 have been computed in the same way.

Least-Cost Decisions

Some decisions do not involve any revenues. For example, a company may be trying to decide whether to buy or lease an executive jet. The choice would be made on the basis of which alternative—buying or leasing—would be least costly. In situations such as these, where no revenues are involved, the most desirable alternative is the one with the *least total cost* from a present value perspective. Hence, these are known as least-cost decisions. To illustrate a least-cost decision, consider the following data:

Example F: Val-Tek Company is considering replacing an old threading machine with a new threading machine that would substantially reduce annual operating costs. Selected data relating to the old and new machines are presented below:

	Old Machine	New Machine
Purchase cost when new	$200,000	$250,000
Salvage value now	$30,000	—
Annual cash operating costs	$150,000	$90,000
Overhaul needed immediately	$40,000	—
Salvage value in six years	$0	$50,000
Remaining life	6 years	6 years

Val-Tek Company uses a 10% discount rate.

[5] Technically, the incremental-cost approach is misnamed, since it focuses on differential costs (that is, on both cost increases and decreases) rather than just on incremental costs. As used here, the term *incremental costs* should be interpreted broadly to include both cost increases and cost decreases.

EXHIBIT 14–9
The Total-Cost Approach (Least-Cost Decision)

Item	Year(s)	Amount of Cash Flows	10% Factor*	Present Value of Cash Flows
Buy the new machine:				
Initial investment	Now	$(250,000)	1.000	$(250,000)†
Salvage value of the old machine	Now	$30,000	1.000	30,000†
Annual cash operating costs	1–6	$(90,000)	4.355	(391,950)
Salvage value of the new machine	6	$50,000	0.564	28,200
Present value of net cash outflows				(583,750)
Keep the old machine:				
Overhaul needed now	Now	$(40,000)	1.000	$ (40,000)
Annual cash operating costs	1–6	$(150,000)	4.355	(653,250)
Present value of net cash outflows				(693,250)
Net present value in favor of buying the new machine				$ 109,500

*All factors are from Exhibits 14B–1 and 14B–2 in Appendix 14B.
†These two items could be netted into a single $220,000 incremental-cost figure ($250,000 − $30,000 = $220,000).

Exhibit 14–9 analyzes the alternatives using the total-cost approach. Because this is a least-cost decision, the present values are negative for both alternatives. However, the present value of the alternative of buying the new machine is $109,500 higher than the other alternative. Therefore, buying the new machine is the less costly alternative.

Exhibit 14–10 presents an analysis of the same alternatives using the incremental-cost approach. Once again, the total-cost and incremental-cost approaches arrive at the same answer.

IN BUSINESS

TRADING IN THAT OLD CAR?

Consumer Reports magazine provides the following data concerning the alternatives of keeping a four-year-old Ford Taurus for three years or buying a similar new car to replace it. The illustration assumes the car would be purchased and used in suburban Chicago.

	Keep the Old Taurus	Buy a New Taurus
Annual maintenance	$1,180	$650
Annual insurance	$370	$830
Annual license	$15	$100
Trade-in value in three years	$605	$7,763
Purchase price, including sales tax		$17,150

Consumer Reports is ordinarily extremely careful in its analysis, but in this instance it has omitted one financial item that differs substantially between the alternatives. What is it? To check your answer, go to the textbook website at www.mhhe.com/garrison12e. After accessing the site, click on the link to the Internet Exercises and then the link to this chapter.

Source: "When to Give Up on Your Clunker," *Consumer Reports*, August 2000, pp. 12–16.

EXHIBIT 14–10
The Incremental-Cost Approach (Least-Cost Decision)

Item	Year(s)	Amount of Cash Flows	10% Factor*	Present Value of Cash Flows
Incremental investment required to purchase the new machine	Now	$(210,000)	1.000	$(210,000)†
Salvage value of the old machine	Now	$30,000	1.000	30,000†
Savings in annual cash operating costs	1–6	$60,000	4.355	261,300
Difference in salvage value in six years	6	$50,000	0.564	28,200
Net present value in favor of buying the new machine				$ 109,500

*All factors are from Exhibits 14B–1 and 14B–2 in Appendix 14B.
†These two items could be netted into a single $180,000 incremental-cost figure ($210,000 − $30,000 = $180,000).

Uncertain Cash Flows

LEARNING OBJECTIVE 3
Evaluate an investment project that has uncertain cash flows.

Thus far, we have assumed that all future cash flows are known with certainty. However, future cash flows are often uncertain or difficult to estimate. A number of techniques are available for handling this complication. Some of these techniques are quite technical—involving computer simulations or advanced mathematical skills—and are beyond the scope of this book. However, we can provide some very useful information to managers without getting too technical.

An Example

As an example of difficult-to-estimate future cash flows, consider the case of investments in automated equipment. The up-front costs of automated equipment and the tangible benefits, such as reductions in operating costs and waste, tend to be relatively easy to estimate. However, the intangible benefits, such as greater reliability, greater speed, and higher quality, are more difficult to quantify in terms of future cash flows. These intangible benefits certainly impact future cash flows—particularly in terms of increased sales and perhaps higher selling prices—but the cash flow effects are difficult to estimate. What can be done?

A fairly simple procedure can be followed when the intangible benefits are likely to be significant. Suppose, for example, that a company with a 12% discount rate is considering purchasing automated equipment that would have a 10-year useful life. Also suppose that a discounted cash flow analysis of just the tangible costs and benefits shows a negative net present value of $226,000. Clearly, if the intangible benefits are large enough, they could turn this negative net present value into a positive net present value. In this case, the amount of additional cash flow per year from the intangible benefits that would be needed to make the project financially attractive can be computed as follows:

Net present value excluding the intangible benefits (negative)	$(226,000)
Present value factor for an annuity at 12% for 10 periods (from Exhibit 14B–2 in Appendix 14B)	5.650

$$\frac{\text{Negative net present value to be offset, } \$226{,}000}{\text{Present value factor, } 5.650} = \$40{,}000$$

Thus, if the intangible benefits of the automated equipment are worth at least $40,000 a year to the company, then the automated equipment should be purchased. If, in the judgment of

management, these intangible benefits are not worth $40,000 a year, then the automated equipment should not be purchased.

This technique can be used in other situations in which future cash flows are difficult to estimate. For example, this technique can be used when the salvage value is difficult to estimate. To illustrate, suppose that all of the cash flows from an investment in a supertanker have been estimated—other than its salvage value in 20 years. Using a discount rate of 12%, management has determined that the net present value of all of these cash flows is a negative $1.04 million. This negative net present value would be offset by the salvage value of the supertanker. How large would the salvage value have to be to make this investment attractive?

Net present value excluding salvage value (negative)	$(1,040,000)
Present value factor at 12% for 20 periods (from Exhibit 14B–1 in Appendix 14B)	0.104

$$\frac{\text{Negative net present value to be offset, } \$1{,}040{,}000}{\text{Present value factor, } 0.104} = \$10{,}000{,}000$$

Thus, if the salvage value of the tanker in 20 years is at least $10 million, its net present value would be positive and the investment would be made. However, if management believes the salvage value is unlikely to be as large as $10 million, the investment should not be made.

Real Options

The analysis in this chapter has assumed that an investment cannot be postponed and that, once started, nothing can be done to alter the course of the project. In reality, investments can often be postponed. Postponement is a particularly attractive option when the net present value of a project is modest using current estimates of future cash flows and the future cash flows involve a great deal of uncertainty that may be resolved over time. Similarly, once an investment is made, management can often exploit changes in the business environment and take actions that enhance future cash flows. For example, buying a supertanker provides management with a number of options, some of which may become more attractive as time unfolds. Instead of operating the supertanker itself, the company may decide to lease it to another operator if the rental rates become high enough. Or, if a supertanker shortage develops, management may decide to sell the supertanker and take a gain. In the case of an investment in automated equipment, management may initially buy only the basic model without costly add-ons, but keep the option open to add more capacity and capability later. The ability to delay the start of a project, to expand it if conditions are favorable, to cut losses if they are unfavorable, and to otherwise modify plans as business conditions change adds value to many investments. These advantages can be quantified using what is called *real options* analysis, but the techniques are beyond the scope of this book.

IN BUSINESS

THINKING AHEAD

With an eye on environmental concerns, the board of directors of Royal Dutch/Shell, the Anglo-Dutch energy company, has decided that all big projects must explicitly take into account the likely future costs of abating carbon emissions. Calculations must assume a cost of $5 per ton of carbon dioxide emission in 2005 through 2009, rising to $20 per ton from 2010 onward. A Shell manager explains: "We know that $5 and $20 are surely the wrong price, but everyone else who assumes a carbon price of zero in the future will be more wrong. This is not altruism. We see it as giving us a competitive edge."

Source: "Big Business Bows to Global Warming," *The Economist*, December 2, 2000, p. 81.

Preference Decisions—The Ranking of Investment Projects

LEARNING OBJECTIVE 4
Rank investment projects in order of preference.

Recall that when considering investment opportunities, managers must make two types of decisions—screening decisions and preference decisions. Screening decisions, which come first, pertain to whether or not a proposed investment is acceptable. Preference decisions come *after* screening decisions and attempt to answer the following question: "How do the remaining investment proposals, all of which have been screened and provide an acceptable rate of return, rank in terms of preference? That is, which one(s) would be *best* for the company to accept?"

Sometimes preference decisions are called rationing decisions, or ranking decisions. Limited investment funds must be rationed among many competing alternatives. Hence, the alternatives must be ranked. Either the internal rate of return method or the net present value method can be used in making preference decisions. However, as discussed earlier, if the two methods are in conflict, it is best to use the net present value method, which is more reliable.

Internal Rate of Return Method

When using the internal rate of return method to rank competing investment projects, the preference rule is: *The higher the internal rate of return, the more desirable the project.* An investment project with an internal rate of return of 18% is usually considered preferable to another project that promises a return of only 15%. Internal rate of return is widely used to rank projects.

Net Present Value Method

The net present value of one project cannot be directly compared to the net present value of another project unless the initial investments are equal. For example, assume that a company is considering two competing investments, as shown below:

	Investment	
	A	B
Investment required	$(10,000)	$(5,000)
Present value of cash inflows	11,000	6,000
Net present value	$ 1,000	$ 1,000

Although each project has a net present value of $1,000, the projects are not equally desirable if the funds available for investment are limited. The project requiring an investment of only $5,000 is much more desirable than the project requiring an investment of $10,000. This fact can be highlighted by dividing the net present value of the project by the investment required. The result, shown below in equation form, is called the **project profitability index.**

$$\text{Project profitability index} = \frac{\text{Net present value of the project}}{\text{Investment required}} \quad (2)$$

The project profitability indexes for the two investments above would be computed as follows:

	Investment	
	A	B
Net present value (a)	$1,000	$1,000
Investment required (b)	$10,000	$5,000
Project profitability index, (a) ÷ (b)	0.10	0.20

When using the project profitability index to rank competing investments projects, the preference rule is: *The higher the project profitability index, the more desirable the project.*[6] Applying this rule to the two investments above, investment B should be chosen over investment A.

The project profitability index is an application of the techniques for utilizing constrained resources discussed in Chapter 13. In this case, the constrained resource is the limited funds available for investment, and the project profitability index is similar to the contribution margin per unit of the constrained resource.

A few details should be clarified with respect to the computation of the project profitability index. The "Investment required" refers to any cash outflows that occur at the beginning of the project, reduced by any salvage value recovered from the sale of old equipment. The "Investment required" also includes any investment in working capital that the project may need.

Other Approaches to Capital Budgeting Decisions

The net present value and internal rate of return methods are widely used as decision-making tools. However, some managers also use the payback method and simple rate of return method to make capital budgeting decisions. Each of these methods will be discussed in turn.

The Payback Method

LEARNING OBJECTIVE 5
Determine the payback period for an investment.

The payback method focuses on the *payback period.* The **payback period** is the length of time that it takes for a project to recover its initial cost from the cash receipts that it generates. This period is sometimes referred to as "the time that it takes for an investment to pay for itself." The basic premise of the payback method is that the more quickly the cost of an investment can be recovered, the more desirable is the investment.

The payback period is expressed in years. *When the net annual cash inflow is the same every year,* the following formula can be used to compute the payback period:

$$\text{Payback period} = \frac{\text{Investment required}}{\text{Net annual cash inflow}} \quad (3)$$

To illustrate the payback method, consider the following data:

14–2

Example G: York Company needs a new milling machine. The company is considering two machines: machine A and machine B. Machine A costs $15,000, has a useful life of ten years, and will reduce operating costs by $5,000 per year. Machine B costs only $12,000, will also reduce operating costs by $5,000 per year, but has a useful life of only five years.

Required:
Which machine should be purchased according to the payback method?

$$\text{Machine A payback period} = \frac{\$15{,}000}{\$5{,}000} = 3.0 \text{ years}$$

$$\text{Machine B payback period} = \frac{\$12{,}000}{\$5{,}000} = 2.4 \text{ years}$$

According to the payback calculations, York Company should purchase machine B because it has a shorter payback period than machine A.

[6] Because of the "lumpiness" of projects, the project profitability index ranking may not be perfect. Nevertheless, it is a good starting point. For further details, see the Profitability Analysis Appendix at the end of the book.

IN BUSINESS

ENTREPRENEURIAL INGENUITY AT ITS BEST

Jonathan Pratt owns two Ümani Cafés in Westchester County, New York. He used to pay $200 a month to dispose of the vegetable oil that is used to fry foods in his restaurants. Plus, he bought $700 of gas every month to operate his company's pick-up truck. Then Pratt got an idea. He purchased a diesel-powered Ford F250 on eBay for $11,000 and paid $1,500 to haul the truck from Arizona to New York. Next, he installed an $850 conversion kit on his new truck to enable it to run on vegetable oil. Since he no longer has to pay to dispose of vegetable oil or buy gasoline, Pratt figures that his investment will pay for itself in about 15 months ($13,350 ÷ $900 = 14.83 months). Furthermore, he now has the best smelling car in town—it smells like french fries when he drives down the road.

Source: Jean Chatzky, "Out of the Frying Pan, Into the Ford," *Money*, October, 2004, p. 28.

Evaluation of the Payback Method

The payback method is not a true measure of the profitability of an investment. Rather, it simply tells a manager how many years are required to recover the original investment. Unfortunately, a shorter payback period does not always mean that one investment is more desirable than another.

To illustrate, refer back to Example G above. Machine B has a shorter payback period than machine A, but it has a useful life of only 5 years rather than 10 years for machine A. Machine B would have to be purchased twice—once immediately and then again after the fifth year—to provide the same service as just one machine A. Under these circumstances, machine A would probably be a better investment than machine B, even though machine B has a shorter payback period. Unfortunately, the payback method ignores all cash flows that occur after the payback period.

A further criticism of the payback method is that it does not consider the time value of money. A cash inflow to be received several years in the future is weighed the same as a cash inflow received right now. To illustrate, assume that for an investment of $8,000 you can purchase either of the two following streams of cash inflows:

Year	0	1	2	3	4	5	6	7	8
Stream 1					$8,000	$2,000	$2,000	$2,000	$2,000
Stream 2		$2,000	$2,000	$2,000	$2,000	$8,000			

Which stream of cash inflows would you prefer to receive in return for your $8,000 investment? Each stream has a payback period of 4.0 years. Therefore, if payback alone is used to make the decision, the streams would be considered equally desirable. However, from a time value of money perspective, stream 2 is much more desirable than stream 1.

On the other hand, under certain conditions the payback method can be very useful. For one thing, it can help identify which investment proposals are in the "ballpark." That is, it can be used as a screening tool to help answer the question, "Should I consider this proposal further?" If a proposal doesn't provide a payback within some specified period, then there may

be no need to consider it further. In addition, the payback period is often of great importance to new companies that are "cash poor." When a company is cash poor, a project with a short payback period but a low rate of return might be preferred over another project with a high rate of return but a long payback period. The reason is that the company may simply need a faster return of its cash investment. And finally, the payback method is sometimes used in industries where products become obsolete very rapidly—such as consumer electronics. Since products may last only a year or two, the payback period on investments must be very short.

IN BUSINESS

CONSERVATION IS NOT SELF-DENIAL

Amory Lovins, the director of the Rocky Mountain Institute in Snowmass, Colorado, is a passionate advocate of energy efficiency as a means of conserving natural resources and reducing pollution. Rather than cutting energy consumption by adopting more austere lifestyles, Lovins believes that energy consumption can be radically cut by using energy more efficiently. This approach has the virtues of combining energy conservation with cash savings and better living standards. He claims that America's annual electric bill of $220 billion could be cut in half by making investments with a payback period of one year or less. To illustrate his point, Lovins designed the institute's headquarters to require no furnace or air conditioning. During the cold winters, daytime solar heat enters the building through a built-in greenhouse, is soaked up by massive stone walls and foundations, and is then released at night. The institute is hardly a chilling, austere structure. Its passive heating system supports a small stand of tropical fruit trees, a mini fish farm, an indoor waterfall, and a hot tub. Lovins claims that the building's efficient design added only $6,000 to its construction costs and the payback period on this investment was only 10 months.

Source: David Stipp, "Can This Man Solve America's Energy Crisis?" *Fortune*, May 13, 2002, pp. 100–110.

An Extended Example of Payback

As shown by formula (3) given earlier, the payback period is computed by dividing the investment in a project by the net annual cash inflows that the project will generate. If new equipment is replacing old equipment, then any salvage value to be received when disposing of the old equipment should be deducted from the cost of the new equipment, and only the *incremental* investment should be used in the payback computation. In addition, any depreciation deducted in arriving at the project's net operating income must be added back to obtain the project's expected net annual cash inflow. To illustrate, consider the following data:

Example H: Goodtime Fun Centers, Inc., operates amusement parks. Some of the vending machines in one of its parks provide very little revenue, so the company is considering removing the machines and installing equipment to dispense soft ice cream. The equipment would cost $80,000 and have an eight-year useful life with no salvage value. Incremental annual revenues and costs associated with the sale of ice cream would be as follows:

Sales	$150,000
Variable expenses	90,000
Contribution margin	60,000
Fixed expenses:	
Salaries	27,000
Maintenance	3,000
Depreciation	10,000
Total fixed expenses	40,000
Net operating income	$ 20,000

The vending machines can be sold for a $5,000 scrap value. The company will not purchase equipment unless it has a payback period of three years or less. Does the ice cream dispenser pass this hurdle?

EXHIBIT 14–11
Computation of the Payback Period

Step 1: *Compute the net annual cash inflow.* Since the net annual cash inflow is not given, it must be computed before the payback period can be determined:

Net operating income (given above)	$20,000
Add: Noncash deduction for depreciation	10,000
Net annual cash inflow	$30,000

Step 2: *Compute the payback period.* Using the net annual cash inflow figure from above, the payback period can be determined as follows:

Cost of the new equipment	$80,000
Less salvage value of old equipment	5,000
Investment required	$75,000

$$\text{Payback period} = \frac{\text{Investment required}}{\text{Net annual cash inflow}}$$

$$= \frac{\$75,000}{\$30,000} = 2.5 \text{ years}$$

Exhibit 14–11 computes the payback period for the ice cream dispenser. Several things should be noted. First, depreciation is added back to net operating income to obtain the net annual cash inflow from the new equipment. Depreciation is not a cash outlay; thus, it must be added back to adjust net operating income to a cash basis. Second, the payback computation deducts the salvage value of the old machines from the cost of the new equipment so that only the incremental investment is used in computing the payback period.

Since the proposed equipment has a payback period of less than three years, the company's payback requirement has been met.

IN BUSINESS

COUNTING THE ENVIRONMENTAL COSTS

Companies often grossly underestimate how much they are spending on environmental costs. Many of these costs are buried in broad cost categories such as manufacturing overhead. Kestrel Management Services, LLC, a management consulting firm specializing in environmental matters, found that one chemical facility was spending five times as much on environmental expenses as its cost system reported. At another site, a small manufacturer with $840,000 in pretax profits thought that its annual safety and environmental compliance expenses were about $50,000 but, after digging into the accounts, found that the total was closer to $300,000. Alerted to this high cost, management of the company invested about $125,000 in environmental improvements, anticipating a three- to six-month payback period. By taking steps such as more efficient dust collection, the company improved its product quality, reduced scrap rates, decreased its consumption of city water for cooling, and reduced the expense of discharging wastewater into the city's sewer system. Further analysis revealed that spending $50,000 to improve energy efficiency would reduce annual energy costs by about $45,000. Few of these costs were visible in the company's traditional cost accounting system.

Source: Thomas P. Kunes, "A Green and *Lean* Workplace?" *Strategic Finance*, February 2001, pp. 71–73, 83.

Payback and Uneven Cash Flows

When the cash flows associated with an investment project change from year to year, the simple payback formula that we outlined earlier cannot be used. Consider the following data:

Year	Investment	Cash Inflow
1	$4,000	$1,000
2		$0
3		$2,000
4	$2,000	$1,000
5		$500
6		$3,000
7		$2,000

What is the payback period on this investment? The answer is 5.5 years, but to obtain this figure it is necessary to track the unrecovered investment year by year. The steps involved in this process are shown in Exhibit 14–12. By the middle of the sixth year, sufficient cash inflows will have been realized to recover the entire investment of $6,000 ($4,000 + $2,000).

EXHIBIT 14–12
Payback and Uneven Cash Flows

Year	Investment	Cash Inflow	Unrecovered Investment*
1	$4,000	$1,000	$3,000
2		$0	$3,000
3		$2,000	$1,000
4	$2,000	$1,000	$2,000
5		$500	$1,500
6		$3,000	$0
7		$2,000	$0

*Year X unrecovered investment = Year X-1 unrecovered investment + Year X investment − Year X cash inflow

The Simple Rate of Return Method

LEARNING OBJECTIVE 6
Compute the simple rate of return for an investment.

The **simple rate of return** method is another capital budgeting technique that does not involve discounting cash flows. The simple rate of return is also known as the accounting rate of return or the unadjusted rate of return.

Unlike the other capital budgeting methods that we have discussed, the simple rate of return method focuses on accounting net operating income rather than cash flows. To obtain the simple rate of return, the annual incremental net operating income generated by a project is divided by the initial investment in the project as shown below.

$$\text{Simple rate of return} = \frac{\text{Annual incremental net operating income}}{\text{Initial investment}} \quad (4)$$

Two additional points should be made. First, depreciation charges that result from making the investment should be deducted when determining the annual incremental net operating income. Second, the initial investment should be reduced by any salvage value realized from the sale of old equipment.

Example I: Brigham Tea, Inc., is a processor of low-acid tea. The company is contemplating purchasing equipment for an additional processing line. The additional processing line would increase revenues by $90,000 per year. Incremental cash operating expenses would be $40,000 per year. The equipment would cost $180,000 and have a nine-year life with no salvage value.

To apply the formula for the simple rate of return, we must first determine the annual incremental net operating income from the project:

Annual incremental revenues		$90,000
Annual incremental cash operating expenses	$40,000	
Annual depreciation ($180,000 − $0)/9	20,000	
Annual incremental expenses		60,000
Annual incremental net operating income		$30,000

Given that the annual incremental net operating income from the project is $30,000 and the initial investment is $180,000, the simple rate of return is 16.7% as shown below:

$$\text{Simple rate of return} = \frac{\text{Annual incremental net operating income}}{\text{Initial investment}}$$

$$= \frac{\$30{,}000}{\$180{,}000}$$

$$= 16.7\%$$

Example J: Midwest Farms, Inc., hires people on a part-time basis to sort eggs. The cost of this hand-sorting process is $30,000 per year. The company is investigating an egg-sorting machine that would cost $90,000 and have a 15-year useful life. The machine would have negligible salvage value, and it would cost $10,000 per year to operate and maintain. The egg-sorting equipment currently being used could be sold now for a scrap value of $2,500.

This project is slightly different from the preceding project because it involves cost reductions with no additional revenues. Nevertheless, the annual incremental net operating income can be computed by treating the annual cost savings as if it were incremental revenues as follows:

Annual incremental cost savings		$30,000
Annual incremental cash operating expenses	$10,000	
Annual depreciation ($90,000 − $0)/15	6,000	
Annual incremental expenses		16,000
Annual incremental net operating income		$14,000

Thus, even though the new equipment would not generate any additional revenues, it would reduce costs by $14,000 a year. This would have the effect of increasing net operating income by $14,000 a year.

Finally, the salvage value of the old equipment offsets the initial cost of the new equipment as follows:

Cost of the new equipment	$90,000
Less salvage value of the old equipment	2,500
Initial investment	$87,500

Given the annual incremental net operating income of $14,000 and the initial investment of $87,500, the simple rate of return is 16.0% computed as follows:

$$\text{Simple rate of return} = \frac{\text{Annual incremental net operating income}}{\text{Initial investment}}$$

$$= \frac{\$14{,}000}{\$87{,}500}$$

$$= 16.0\%$$

IN BUSINESS

AN AMAZING RETURN

Ipswitch, Inc., a software developer and seller, has moved much of its business to the Web. Potential customers can download free trial copies of the company's software at www.ipswitch.com. After the trial period, a customer must return to the Web site to purchase and download a permanent copy of the software. The initial investment in setting up a Web site was modest—roughly $190,000. The cost of keeping the Web site up and running and updated with the latest product information is about $1.3 million a year—mainly in the form of salaries and benefits for eight employees. The company estimates that additional revenues brought in by the Web amount to about $13 million per year and that the company saves about $585,000 per year in direct mail advertising costs by using the Web for much of its advertising instead. Assuming that the cost of sales is almost zero for downloaded software, the accounting rate of return on the initial investment in the Web site is 6,466% ([$13,000,000 − $1,300,000 + $585,000] ÷ $190,000)!

Source: Karen N. Kroll, "Many Happy Returns," *Inc.* magazine, November 30, 2001, pp. 150–152.

Criticisms of the Simple Rate of Return

The simple rate of return method ignores the time value of money. It considers a dollar received 10 years from now to be as valuable as a dollar received today. Thus, the simple rate of return method can be misleading if the alternatives have different cash flow patterns. Additionally, many projects do not have constant incremental revenues and expenses over their useful lives. As a result, the simple rate of return will fluctuate from year to year, with the possibility that a project may appear to be desirable in some years and undesirable in others. In contrast, the net present value method provides a single number that summarizes all of the cash flows over the entire useful life of the project.

Postaudit of Investment Projects

After an investment project has been approved and implemented, a *postaudit* should be conducted. A **postaudit** involves checking whether or not expected results are actually realized. This is a key part of the capital budgeting process because it helps keep managers honest in their investment proposals. Any tendency to inflate the benefits or downplay the costs in a proposal should become evident after a few postaudits have been conducted. The postaudit also provides an opportunity to reinforce and possibly expand successful projects and to cut losses on floundering projects.

The same capital budgeting method should be used in the postaudit as was used in the original approval process. That is, if a project was approved on the basis of a net present value analysis, then the same procedure should be used in performing the postaudit. However, the data used in the postaudit analysis should be *actual observed data* rather than estimated data. This gives management an opportunity to make a side-by-side comparison to see how well the project has succeeded. It also helps assure that estimated data received on future proposals will be carefully prepared, since the persons submitting the data knows that their estimates will be compared to actual results in the postaudit process. Actual results that are far out of line with original estimates should be carefully reviewed.

IN BUSINESS

CAPITAL BUDGETING IN PRACTICE

A survey of Fortune 1000 companies—the largest companies in the United States—asked CFOs how often various capital budgeting methods are used in their companies. Some of the results of that survey are displayed below:

	Frequency of Use				
Capital Budgeting Tool	Always	Often	Sometimes	Rarely	Never
Net present value	50%	35%	11%	3%	1%
Internal rate of return	45%	32%	15%	6%	2%
Payback	19%	33%	22%	17%	9%
Accounting rate of return	5%	9%	19%	16%	50%

Many companies use more than one method—for example, they may use both the net present value and the internal rate of return methods to evaluate capital budgeting projects. Note that the two discounted cash flow methods—net present value and internal rate of return—are by far the most commonly used in practice.

A similar survey of companies in the United Kingdom yielded the following results:

	Frequency of Use			
Capital Budgeting Tool	Always	Mostly	Often	Rarely
Net present value	43%	20%	14%	7%
Internal rate of return	48%	20%	10%	5%
Payback	30%	16%	17%	14%
Accounting rate of return	26%	15%	18%	7%

Note that while the results were quite similar for the U.S. and U.K. companies, the U.K. companies were more likely to use the payback and accounting rate of return methods than the U.S. companies.

Sources: Patricia A. Ryan and Glenn P. Ryan, "Capital Budgeting Practices of the Fortune 1000: How Have Things Changed?" *Journal of Business and Management*, Fall 2002, pp. 355–364; and Glen C. Arnold and Panos D. Hatzopoulus, "The Theory-Practice Gap in Capital Budgeting: Evidence from the United Kingdom," *Journal of Business Finance & Accounting* 27(5) & 27(6), June/July 2000, pp. 603–626.

Summary

Investment decisions should take into account the time value of money because a dollar today is more valuable than a dollar received in the future. The net present value and internal rate of return methods both reflect this fact. In the net present value method, future cash flows are discounted to their present value. The difference between the present value of the cash inflows and the present value of the cash outflows is called a project's net present value. If the net present value of a project is negative, the project is rejected. The discount rate in the net present value method is usually based on a minimum required rate of return such as a company's cost of capital.

The internal rate of return is the rate of return that equates the present value of the cash inflows and the present value of the cash outflows, resulting in a zero net present value. If the internal rate of return is less than a company's minimum required rate of return, the project is rejected.

After rejecting projects whose net present values are negative or whose internal rates of return are less than the minimum required rate of return, more projects may remain than can be supported with available funds. The remaining projects can be ranked using either the project profitability index or

internal rate of return. The project profitability index is computed by dividing the net present value of the project by the required initial investment.

Some companies prefer to use either the payback method or the simple rate of return to evaluate investment proposals. The payback period is the number of periods that are required to fully recover the initial investment in a project. The simple rate of return is determined by dividing a project's accounting net operating income by the initial investment in the project.

Review Problem 1: Basic Present Value Computations

Each of the following situations is independent. Work out your own solution to each situation, and then check it against the solution provided.

1. John plans to retire in 12 years. Upon retiring, he would like to take an extended vacation, which he expects will cost at least $40,000. What lump-sum amount must he invest now to have $40,000 at the end of 12 years if the rate of return is:
   a. Eight percent?
   b. Twelve percent?
2. The Morgans would like to send their daughter to a music camp at the end of each of the next five years. The camp costs $1,000 a year. What lump-sum amount would have to be invested now to have $1,000 at the end of each year if the rate of return is:
   a. Eight percent?
   b. Twelve percent?
3. You have just received an inheritance from a relative. You can either receive a $200,000 lump-sum amount at the end of 10 years or receive $14,000 at the end of each year for the next 10 years. If your discount rate is 12%, which alternative would you prefer?

Solution to Review Problem 1

1. *a.* The amount that must be invested now would be the present value of the $40,000, using a discount rate of 8%. From Table 14B–1 in Appendix 14B, the factor for a discount rate of 8% for 12 periods is 0.397. Multiplying this discount factor by the $40,000 needed in 12 years will give the amount of the present investment required: $40,000 × 0.397 = $15,880.
   b. We will proceed as we did in (*a*) above, but this time we will use a discount rate of 12%. From Table 14B–1 in Appendix 14B, the factor for a discount rate of 12% for 12 periods is 0.257. Multiplying this discount factor by the $40,000 needed in 12 years will give the amount of the present investment required: $40,000 × 0.257 = $10,280.
   Notice that as the discount rate (desired rate of return) increases, the present value decreases.
2. This part differs from (1) above in that we are now dealing with an annuity rather than with a single future sum. The amount that must be invested now is the present value of the $1,000 needed at the end of each year for five years. Since we are dealing with an annuity, or a series of annual cash flows, we must refer to Exhibit 14B–2 in Appendix 14B for the appropriate discount factor.
   a. From Exhibit 14B–2 in Appendix 14B, the discount factor for 8% for five periods is 3.993. Therefore, the amount that must be invested now to have $1,000 available at the end of each year for five years is $1,000 × 3.993 = $3,993.
   b. From Exhibit 14B–2 in Appendix 14B, the discount factor for 12% for five periods is 3.605. Therefore, the amount that must be invested now to have $1,000 available at the end of each year for five years is $1,000 × 3.605 = $3,605.
   Again, notice that as the discount rate increases, the present value decreases. When the rate of return increases, less must be invested today to yield a given amount in the future.
3. For this part we will need to refer to both Exhibits 14B–1 and 14B–2 in Appendix 14B. From Exhibit 14B–1, we will need to find the discount factor for 12% for 10 periods, then apply it to the $200,000 lump sum to be received in 10 years. From Exhibit 14B–2, we will need to find the discount factor for 12% for 10 periods, then apply it to the series of $14,000 payments to be received over the 10-year period. Whichever alternative has the higher present value is the one that should be selected.

$$\$200{,}000 \times 0.322 = \$64{,}400$$

$$\$14{,}000 \times 5.650 = \$79{,}100$$

Thus, you should prefer to receive the $14,000 per year for 10 years rather than the $200,000 lump sum. This means that you could invest the $14,000 received at the end of each year at 12% and have *more* than $200,000 at the end of 10 years.

Review Problem 2: Comparison of Capital Budgeting Methods

Lamar Company is considering a project that would have an eight-year life and require a $2,400,000 investment in equipment. At the end of eight years, the project would terminate and the equipment would have no salvage value. The project would provide net operating income each year as follows:

Sales		$3,000,000
Variable expenses		1,800,000
Contribution margin		1,200,000
Fixed expenses:		
Advertising, salaries, and other fixed out-of-pocket costs	$700,000	
Depreciation	300,000	
Total fixed expenses		1,000,000
Net operating income		$ 200,000

The company's discount rate is 12%.

Required:

1. Compute the net annual cash inflow from the project.
2. Compute the project's net present value. Is the project acceptable?
3. Find the project's internal rate of return to the nearest whole percent.
4. Compute the project's payback period.
5. Compute the project's simple rate of return.

Solution to Review Problem 2

1. The net annual cash inflow can be computed by deducting the cash expenses from sales:

Sales	$3,000,000
Variable expenses	1,800,000
Contribution margin	1,200,000
Advertising, salaries, and other fixed out-of-pocket costs	700,000
Net annual cash inflow	$ 500,000

Or the net annual cash inflow can be computed by adding depreciation back to net operating income:

Net operating income	$200,000
Add: Noncash deduction for depreciation	300,000
Net annual cash inflow	$500,000

2. The net present value is computed as follows:

Item	Year(s)	Amount of Cash Flows	12% Factor	Present Value of Cash Flows
Cost of new equipment	Now	$(2,400,000)	1.000	$(2,400,000)
Net annual cash inflow	1–8	$500,000	4.968	2,484,000
Net present value				$ 84,000

Yes, the project is acceptable because it has a positive net present value.

3. The formula for computing the factor of the internal rate of return is:

$$\text{Factor of the internal rate of return} = \frac{\text{Investment required}}{\text{Net annual cash inflow}}$$

$$= \frac{\$2,400,000}{\$500,000} = 4.800$$

Looking in Exhibit 14B–2 in Appendix 14B at the end of the chapter and scanning along the 8-period line, we find that a factor of 4.800 represents a rate of return of about 13%.

4. The formula for the payback period is:

$$\text{Payback period} = \frac{\text{Investment required}}{\text{Net annual cash flow}}$$

$$= \frac{\$2,400,000}{\$500,000}$$

$$= 4.8 \text{ years}$$

5. The formula for the simple rate of return is:

$$\text{Simple rate of return} = \frac{\text{Annual incremental net operating income}}{\text{Initial investment}}$$

$$= \frac{\$200,000}{\$2,400,000}$$

$$= 8.3\%$$

Glossary

Capital budgeting The process of planning significant investments in projects that have long-term implications such as the purchase of new equipment or the introduction of a new product. (p. 626)

Cost of capital The average rate of return a company must pay to its long-term creditors and shareholders for the use of their funds. (p. 631)

Internal rate of return The discount rate at which the net present value of an investment project is zero; the rate of return promised by a project over its useful life. (p. 633)

Net present value The difference between the present value of an investment project's cash inflows and the present value of its cash outflows. (p. 627)

Out-of-pocket costs Actual cash outlays for salaries, advertising, repairs, and similar costs. (p. 632)

Payback period The length of time that it takes for a project to fully recover its initial cost out of the cash receipts that it generates. (p. 642)

Postaudit The follow-up after a project has been approved and implemented to determine whether expected results were actually realized. (p. 648)

Preference decision A decision in which the alternatives must be ranked. (p. 626)

Project profitability index The ratio of the net present value of a project's cash flows to the investment required. (p. 641)
Screening decision A decision as to whether a proposed investment project is acceptable. (p. 626)
Simple rate of return The rate of return computed by dividing a project's annual incremental accounting net operating income by the initial investment required. (p. 646)
Working capital Current assets less current liabilities. (p. 629)

Appendix 14A: The Concept of Present Value

LEARNING OBJECTIVE 7
Understand present value concepts and the use of present value tables.

A dollar received today is more valuable than a dollar received a year from now for the simple reason that if you have a dollar today, you can put it in the bank and have more than a dollar a year from now. Since dollars today are worth more than dollars in the future, cash flows that are received at different times must be weighted differently.

The Mathematics of Interest

If a bank pays 5% interest, then a deposit of $100 today will be worth $105 one year from now. This can be expressed as follows:

$$F_1 = P(1 + r) \quad (1)$$

where F_1 = the balance at the end of one period, P = the amount invested now, and r = the rate of interest per period.

In the case where $100 is deposited in a savings account that earns 5% interest, P = $100 and $r = 0.05$. Under these conditions, F_1 = $105.

The $100 present outlay is called the **present value** of the $105 amount to be received in one year. It is also known as the *discounted value* of the future $105 receipt. The $100 represents the value in present terms of $105 to be received a year from now when the interest rate is 5%.

Compound Interest

What if the $105 is left in the bank for a second year? In that case, by the end of the second year the original $100 deposit will have grown to $110.25:

Original deposit	$100.00
Interest for the first year:	
$100 × 0.05	5.00
Balance at the end of the first year	105.00
Interest for the second year:	
$105 × 0.05	5.25
Balance at the end of the second year	$110.25

Notice that the interest for the second year is $5.25, as compared to only $5.00 for the first year. This difference arises because interest is being paid on interest during the second year. That is, the $5.00 interest earned during the first year has been left in the account and has been added to the original $100 deposit when computing interest for the second year. This is known as **compound interest.** In this case, the compounding is annual. Interest can be compounded on a semiannual, quarterly, monthly, or even more frequent basis. The more frequently compounding is done, the more rapidly the balance will grow.

We can determine the balance in an account after n periods of compounding using the following equation:

$$F_n = P(1 + r)^n \quad (2)$$

where n = the number of periods of compounding.

If $n = 2$ years and the interest rate is 5% per year, then the balance in two years will be computed as follows:

$$F_2 = \$100(1 + 0.05)^2$$

$$F_2 = \$110.25$$

Present Value and Future Value Exhibit 14A–1 shows the relationship between present value and future value. As shown in the exhibit, if $100 is deposited in a bank at 5% interest compounded annually, it will grow to $127.63 by the end of five years.

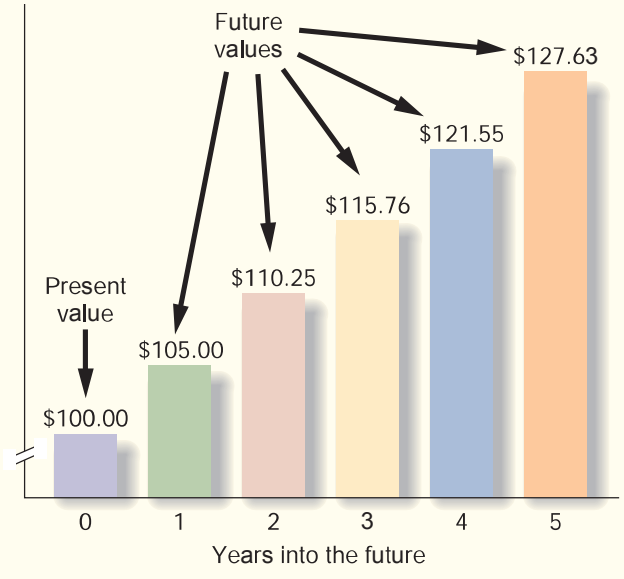
Computation of Present Value

An investment can be viewed in two ways—either in terms of its future value or in terms of its present value. We have seen from our computations above that if we know the present value of a sum (such as our $100 deposit), the future value in n years can be computed by using equation (2). But what if the situation is reversed and we know the *future* value of some amount but we do not know its present value?

For example, assume that you are to receive $200 two years from now. You know that the future value of this sum is $200 because this is the amount that you will be receiving in two years. But what is the sum's present value—what is it worth *right now?* The present value of any sum to be received in the future can be computed by turning equation (2) around and solving for P:

$$P = \frac{F_n}{(1 + r)^n} \quad (3)$$

EXHIBIT 14A–1
The Relationship between Present Value and Future Value



In our example, F_n = $200 (the amount to be received in the future), r = 0.05 (the annual rate of interest), and n = 2 (the number of years in the future that the amount will be received).

$$P = \frac{\$200}{(1 + 0.05)^2}$$

$$P = \frac{\$200}{1.1025}$$

$$P = \$181.40$$

As shown by the computation above, the present value of a $200 amount to be received two years from now is $181.40 if the interest rate is 5%. In effect, $181.40 received *right now* is equivalent to $200 received two years from now.

The process of finding the present value of a future cash flow, which we have just completed, is called **discounting.** We have *discounted* the $200 to its present value of $181.40. The 5% interest that we have used to find this present value is called the **discount rate.** Discounting future sums to their present value is a common practice in business, particularly in capital budgeting decisions.

If you have a power key (y^x) on your calculator, the above calculations are fairly easy. However, some of the present value formulas we will be using are more complex. Fortunately, tables are available in which many of the calculations have already been done. For example, Exhibit 14B–1 in Appendix 14B shows the discounted present value of $1 to be received at various periods in the future at various interest rates. The table indicates that the present value of $1 to be received two periods from now at 5% is 0.907. Since in our example we want to know the present value of $200 rather than just $1, we need to multiply the factor in the table by $200:

$$\$200 \times 0.907 = \$181.40$$

This answer is the same as we obtained earlier using the formula in equation (3).

Present Value of a Series of Cash Flows

Although some investments involve a single sum to be received (or paid) at a single point in the future, other investments involve a *series* of cash flows. A series of identical cash flows is known as an **annuity.** To provide an example, assume that a company has just purchased some government bonds. The bonds will yield interest of $15,000 each year and will be held for five years. What is the present value of the stream of interest receipts from the bonds? As shown in Exhibit 14A–2, if the discount rate is 12%, the present value of this stream is $54,075. The discount factors used in this exhibit were taken from Exhibit 14B–1 in Appendix 14B.

Exhibit 14A–2 illustrates two important points. First, the present value of the $15,000 interest declines the further it is into the future. The present value of $15,000 received a year from now is $13,395, as compared to only $8,505 if received five years from now. This point simply underscores the time value of money.

EXHIBIT 14A–2
Present Value of a Series of Cash Receipts

Year	Factor at 12% (Exhibit 14B–1)	Interest Received	Present Value
1	0.893	$15,000	$13,395
2	0.797	$15,000	11,955
3	0.712	$15,000	10,680
4	0.636	$15,000	9,540
5	0.567	$15,000	8,505
			$54,075

The second point is that the computations used in Exhibit 14A–2 involved unnecessary work. The same present value of $54,075 could have been obtained more easily by referring to Exhibit 14B–2 in Appendix 14B. Exhibit 14B–2 contains the present value of $1 to be received each year over a *series* of years at various interest rates. Exhibit 14B–2 has been derived by simply adding together the factors from Exhibit 14B–1, as follows:

Year	Exhibit 14B–1 Factors at 12%
1	0.893
2	0.797
3	0.712
4	0.636
5	0.567
	3.605

The sum of the five factors above is 3.605. Notice from Exhibit 14B–2 that the factor for $1 to be received each year for five years at 12% is also 3.605. If we use this factor and multiply it by the $15,000 annual cash inflow, then we get the same $54,075 present value that we obtained earlier in Exhibit 14A–2.

$$\$15{,}000 \times 3.605 = \$54{,}075$$

Therefore, when computing the present value of a series of equal cash flows that begins at the end of period 1, Exhibit 14B–2 should be used.

To summarize, the present value tables in Appendix 14B should be used as follows:

Exhibit 14B–1: This table should be used to find the present value of a single cash flow (such as a single payment or receipt) occurring in the future.

Exhibit 14B–2: This table should be used to find the present value of a series of identical cash flows beginning at the end of the current period and continuing into the future.

The use of both of these tables is illustrated in various exhibits in the main body of the chapter. *When a present value factor appears in an exhibit, you should take the time to trace it back into either Exhibit 14B–1 or Exhibit 14B–2 to get acquainted with the tables and how they work.* (Review Problem 1 at the end of the chapter is designed for those who would like some practice in present value analysis before attempting the homework exercises and problems.)

Glossary (Appendix 14A)

Annuity A series of identical cash flows. (p. 655)
Compound interest The process of paying interest on interest in an investment. (p. 653)
Discount rate The rate of return that is used to find the present value of a future cash flow. (p. 655)
Discounting The process of finding the present value of a future cash flow. (p. 655)
Present value The value now of an amount that will be received in some future period. (p. 653)

Appendix 14B: Present Value Tables

EXHIBIT 14B–1

Present Value of \$1; $\frac{1}{(1 + r)^n}$

Periods	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%	21%	22%	23%	24%	25%
1	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901	0.893	0.885	0.877	0.870	0.862	0.855	0.847	0.840	0.833	0.826	0.820	0.813	0.806	0.800
2	0.925	0.907	0.890	0.873	0.857	0.842	0.826	0.812	0.797	0.783	0.769	0.756	0.743	0.731	0.718	0.706	0.694	0.683	0.672	0.661	0.650	0.640
3	0.889	0.864	0.840	0.816	0.794	0.772	0.751	0.731	0.712	0.693	0.675	0.658	0.641	0.624	0.609	0.593	0.579	0.564	0.551	0.537	0.524	0.512
4	0.855	0.823	0.792	0.763	0.735	0.708	0.683	0.659	0.636	0.613	0.592	0.572	0.552	0.534	0.516	0.499	0.482	0.467	0.451	0.437	0.423	0.410
5	0.822	0.784	0.747	0.713	0.681	0.650	0.621	0.593	0.567	0.543	0.519	0.497	0.476	0.456	0.437	0.419	0.402	0.386	0.370	0.355	0.341	0.328
6	0.790	0.746	0.705	0.666	0.630	0.596	0.564	0.535	0.507	0.480	0.456	0.432	0.410	0.390	0.370	0.352	0.335	0.319	0.303	0.289	0.275	0.262
7	0.760	0.711	0.665	0.623	0.583	0.547	0.513	0.482	0.452	0.425	0.400	0.376	0.354	0.333	0.314	0.296	0.279	0.263	0.249	0.235	0.222	0.210
8	0.731	0.677	0.627	0.582	0.540	0.502	0.467	0.434	0.404	0.376	0.351	0.327	0.305	0.285	0.266	0.249	0.233	0.218	0.204	0.191	0.179	0.168
9	0.703	0.645	0.592	0.544	0.500	0.460	0.424	0.391	0.361	0.333	0.308	0.284	0.263	0.243	0.225	0.209	0.194	0.180	0.167	0.155	0.144	0.134
10	0.676	0.614	0.558	0.508	0.463	0.422	0.386	0.352	0.322	0.295	0.270	0.247	0.227	0.208	0.191	0.176	0.162	0.149	0.137	0.126	0.116	0.107
11	0.650	0.585	0.527	0.475	0.429	0.388	0.350	0.317	0.287	0.261	0.237	0.215	0.195	0.178	0.162	0.148	0.135	0.123	0.112	0.103	0.094	0.086
12	0.625	0.557	0.497	0.444	0.397	0.356	0.319	0.286	0.257	0.231	0.208	0.187	0.168	0.152	0.137	0.124	0.112	0.102	0.092	0.083	0.076	0.069
13	0.601	0.530	0.469	0.415	0.368	0.326	0.290	0.258	0.229	0.204	0.182	0.163	0.145	0.130	0.116	0.104	0.093	0.084	0.075	0.068	0.061	0.055
14	0.577	0.505	0.442	0.388	0.340	0.299	0.263	0.232	0.205	0.181	0.160	0.141	0.125	0.111	0.099	0.088	0.078	0.069	0.062	0.055	0.049	0.044
15	0.555	0.481	0.417	0.362	0.315	0.275	0.239	0.209	0.183	0.160	0.140	0.123	0.108	0.095	0.084	0.074	0.065	0.057	0.051	0.045	0.040	0.035
16	0.534	0.458	0.394	0.339	0.292	0.252	0.218	0.188	0.163	0.141	0.123	0.107	0.093	0.081	0.071	0.062	0.054	0.047	0.042	0.036	0.032	0.028
17	0.513	0.436	0.371	0.317	0.270	0.231	0.198	0.170	0.146	0.125	0.108	0.093	0.080	0.069	0.060	0.052	0.045	0.039	0.034	0.030	0.026	0.023
18	0.494	0.416	0.350	0.296	0.250	0.212	0.180	0.153	0.130	0.111	0.095	0.081	0.069	0.059	0.051	0.044	0.038	0.032	0.028	0.024	0.021	0.018
19	0.475	0.396	0.331	0.277	0.232	0.194	0.164	0.138	0.116	0.098	0.083	0.070	0.060	0.051	0.043	0.037	0.031	0.027	0.023	0.020	0.017	0.014
20	0.456	0.377	0.312	0.258	0.215	0.178	0.149	0.124	0.104	0.087	0.073	0.061	0.051	0.043	0.037	0.031	0.026	0.022	0.019	0.016	0.014	0.012
21	0.439	0.359	0.294	0.242	0.199	0.164	0.135	0.112	0.093	0.077	0.064	0.053	0.044	0.037	0.031	0.026	0.022	0.018	0.015	0.013	0.011	0.009
22	0.422	0.342	0.278	0.226	0.184	0.150	0.123	0.101	0.083	0.068	0.056	0.046	0.038	0.032	0.026	0.022	0.018	0.015	0.013	0.011	0.009	0.007
23	0.406	0.326	0.262	0.211	0.170	0.138	0.112	0.091	0.074	0.060	0.049	0.040	0.033	0.027	0.022	0.018	0.015	0.012	0.010	0.009	0.007	0.006
24	0.390	0.310	0.247	0.197	0.158	0.126	0.102	0.082	0.066	0.053	0.043	0.035	0.028	0.023	0.019	0.015	0.013	0.010	0.008	0.007	0.006	0.005
25	0.375	0.295	0.233	0.184	0.146	0.116	0.092	0.074	0.059	0.047	0.038	0.030	0.024	0.020	0.016	0.013	0.010	0.009	0.007	0.006	0.005	0.004
26	0.361	0.281	0.220	0.172	0.135	0.106	0.084	0.066	0.053	0.042	0.033	0.026	0.021	0.017	0.014	0.011	0.009	0.007	0.006	0.005	0.004	0.003
27	0.347	0.268	0.207	0.161	0.125	0.098	0.076	0.060	0.047	0.037	0.029	0.023	0.018	0.014	0.011	0.009	0.007	0.006	0.005	0.004	0.003	0.002
28	0.333	0.255	0.196	0.150	0.116	0.090	0.069	0.054	0.042	0.033	0.026	0.020	0.016	0.012	0.010	0.008	0.006	0.005	0.004	0.003	0.002	0.002
29	0.321	0.243	0.185	0.141	0.107	0.082	0.063	0.048	0.037	0.029	0.022	0.017	0.014	0.011	0.008	0.006	0.005	0.004	0.003	0.002	0.002	0.002
30	0.308	0.231	0.174	0.131	0.099	0.075	0.057	0.044	0.033	0.026	0.020	0.015	0.012	0.009	0.007	0.005	0.004	0.003	0.003	0.002	0.002	0.001
40	0.208	0.142	0.097	0.067	0.046	0.032	0.022	0.015	0.011	0.008	0.005	0.004	0.003	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000

EXHIBIT 14B–2

Present Value of an Annuity of $1 in Arrears; $\frac{1}{r}\left[1 - \frac{1}{(1+r)^n}\right]$

Periods	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%	21%	22%	23%	24%	25%
1	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901	0.893	0.885	0.877	0.870	0.862	0.855	0.847	0.840	0.833	0.826	0.820	0.813	0.806	0.800
2	1.886	1.859	1.833	1.808	1.783	1.759	1.736	1.713	1.690	1.668	1.647	1.626	1.605	1.585	1.566	1.547	1.528	1.509	1.492	1.474	1.457	1.440
3	2.775	2.723	2.673	2.624	2.577	2.531	2.487	2.444	2.402	2.361	2.322	2.283	2.246	2.210	2.174	2.140	2.106	2.074	2.042	2.011	1.981	1.952
4	3.630	3.546	3.465	3.387	3.312	3.240	3.170	3.102	3.037	2.974	2.914	2.855	2.798	2.743	2.690	2.639	2.589	2.540	2.494	2.448	2.404	2.362
5	4.452	4.329	4.212	4.100	3.993	3.890	3.791	3.696	3.605	3.517	3.433	3.352	3.274	3.199	3.127	3.058	2.991	2.926	2.864	2.803	2.745	2.689
6	5.242	5.076	4.917	4.767	4.623	4.486	4.355	4.231	4.111	3.998	3.889	3.784	3.685	3.589	3.498	3.410	3.326	3.245	3.167	3.092	3.020	2.951
7	6.002	5.786	5.582	5.389	5.206	5.033	4.868	4.712	4.564	4.423	4.288	4.160	4.039	3.922	3.812	3.706	3.605	3.508	3.416	3.327	3.242	3.161
8	6.733	6.463	6.210	5.971	5.747	5.535	5.335	5.146	4.968	4.799	4.639	4.487	4.344	4.207	4.078	3.954	3.837	3.726	3.619	3.518	3.421	3.329
9	7.435	7.108	6.802	6.515	6.247	5.995	5.759	5.537	5.328	5.132	4.946	4.772	4.607	4.451	4.303	4.163	4.031	3.905	3.786	3.673	3.566	3.463
10	8.111	7.722	7.360	7.024	6.710	6.418	6.145	5.889	5.650	5.426	5.216	5.019	4.833	4.659	4.494	4.339	4.192	4.054	3.923	3.799	3.682	3.571
11	8.760	8.306	7.887	7.499	7.139	6.805	6.495	6.207	5.938	5.687	5.453	5.234	5.029	4.836	4.656	4.486	4.327	4.177	4.035	3.902	3.776	3.656
12	9.385	8.863	8.384	7.943	7.536	7.161	6.814	6.492	6.194	5.918	5.660	5.421	5.197	4.988	4.793	4.611	4.439	4.278	4.127	3.985	3.851	3.725
13	9.986	9.394	8.853	8.358	7.904	7.487	7.103	6.750	6.424	6.122	5.842	5.583	5.342	5.118	4.910	4.715	4.533	4.362	4.203	4.053	3.912	3.780
14	10.563	9.899	9.295	8.745	8.244	7.786	7.367	6.982	6.628	6.302	6.002	5.724	5.468	5.229	5.008	4.802	4.611	4.432	4.265	4.108	3.962	3.824
15	11.118	10.380	9.712	9.108	8.559	8.061	7.606	7.191	6.811	6.462	6.142	5.847	5.575	5.324	5.092	4.876	4.675	4.489	4.315	4.153	4.001	3.859
16	11.652	10.838	10.106	9.447	8.851	8.313	7.824	7.379	6.974	6.604	6.265	5.954	5.668	5.405	5.162	4.938	4.730	4.536	4.357	4.189	4.033	3.887
17	12.166	11.274	10.477	9.763	9.122	8.544	8.022	7.549	7.120	6.729	6.373	6.047	5.749	5.475	5.222	4.990	4.775	4.576	4.391	4.219	4.059	3.910
18	12.659	11.690	10.828	10.059	9.372	8.756	8.201	7.702	7.250	6.840	6.467	6.128	5.818	5.534	5.273	5.033	4.812	4.608	4.419	4.243	4.080	3.928
19	13.134	12.085	11.158	10.336	9.604	8.950	8.365	7.839	7.366	6.938	6.550	6.198	5.877	5.584	5.316	5.070	4.843	4.635	4.442	4.263	4.097	3.942
20	13.590	12.462	11.470	10.594	9.818	9.129	8.514	7.963	7.469	7.025	6.623	6.259	5.929	5.628	5.353	5.101	4.870	4.657	4.460	4.279	4.110	3.954
21	14.029	12.821	11.764	10.836	10.017	9.292	8.649	8.075	7.562	7.102	6.687	6.312	5.973	5.665	5.384	5.127	4.891	4.675	4.476	4.292	4.121	3.963
22	14.451	13.163	12.042	11.061	10.201	9.442	8.772	8.176	7.645	7.170	6.743	6.359	6.011	5.696	5.410	5.149	4.909	4.690	4.488	4.302	4.130	3.970
23	14.857	13.489	12.303	11.272	10.371	9.580	8.883	8.266	7.718	7.230	6.792	6.399	6.044	5.723	5.432	5.167	4.925	4.703	4.499	4.311	4.137	3.976
24	15.247	13.799	12.550	11.469	10.529	9.707	8.985	8.348	7.784	7.283	6.835	6.434	6.073	5.746	5.451	5.182	4.937	4.713	4.507	4.318	4.143	3.981
25	15.622	14.094	12.783	11.654	10.675	9.823	9.077	8.422	7.843	7.330	6.873	6.464	6.097	5.766	5.467	5.195	4.948	4.721	4.514	4.323	4.147	3.985
26	15.983	14.375	13.003	11.826	10.810	9.929	9.161	8.488	7.896	7.372	6.906	6.491	6.118	5.783	5.480	5.206	4.956	4.728	4.520	4.328	4.151	3.988
27	16.330	14.643	13.211	11.987	10.935	10.027	9.237	8.548	7.943	7.409	6.935	6.514	6.136	5.798	5.492	5.215	4.964	4.734	4.524	4.332	4.154	3.990
28	16.663	14.898	13.406	12.137	11.051	10.116	9.307	8.602	7.984	7.441	6.961	6.534	6.152	5.810	5.502	5.223	4.970	4.739	4.528	4.335	4.157	3.992
29	16.984	15.141	13.591	12.278	11.158	10.198	9.370	8.650	8.022	7.470	6.983	6.551	6.166	5.820	5.510	5.229	4.975	4.743	4.531	4.337	4.159	3.994
30	17.292	15.372	13.765	12.409	11.258	10.274	9.427	8.694	8.055	7.496	7.003	6.566	6.177	5.829	5.517	5.235	4.979	4.746	4.534	4.339	4.160	3.995
40	19.793	17.159	15.046	13.332	11.925	10.757	9.779	8.951	8.244	7.634	7.105	6.642	6.233	5.871	5.548	5.258	4.997	4.760	4.544	4.347	4.166	3.999

Appendix 14C: Income Taxes in Capital Budgeting Decisions

LEARNING OBJECTIVE 8
Include income taxes in a capital budgeting analysis.

We ignored income taxes in this chapter for two reasons. First, many organizations do not pay income taxes. Not-for-profit organizations, such as hospitals and charitable foundations, and governmental agencies are exempt from income taxes. Second, capital budgeting is complex and is best absorbed in small doses. Now that we have a solid foundation in the concepts of present value and discounting, we can explore the effects of income taxes on capital budgeting decisions.

The U.S. income tax code is enormously complex. We only scratch the surface here. To keep the subject within reasonable bounds, we have made many simplifying assumptions about the tax code. Among the most important of these assumptions are: (1) taxable income equals net income as computed for financial reports; and (2) the tax rate is a flat percentage of taxable income. The actual tax code is far more complex than this; indeed, experts acknowledge that no one person knows or can know it all. However, the simplifications that we make throughout this appendix allow us to cover the most important implications of income taxes for capital budgeting without getting bogged down in details.

The Concept of After-Tax Cost

Businesses, like individuals, must pay income taxes. In the case of businesses, the amount of income tax that must be paid is determined by the company's net taxable income. Tax deductible expenses (tax deductions) decrease the company's net taxable income and hence reduce the taxes the company must pay. For this reason, expenses are often stated on an *after-tax* basis. For example, if a company pays rent of $10 million a year but this expense results in a reduction in income taxes of $3 million, the after-tax cost of the rent is $7 million. An expenditure net of its tax effect is known as **after-tax cost.**

To illustrate, assume that a company with a tax rate of 30% is contemplating a training program that costs $60,000. What impact will this have on the company's taxes? To keep matters simple, let's suppose the training program has no immediate effect on sales. How much does the company actually pay for the training program after taking into account the impact of this expense on taxes? The answer is $42,000 as shown in Exhibit 14C–1 (page 660). While the training program costs $60,000 before taxes, it would reduce the company's taxes by $18,000, so its *after-tax* cost would be only $42,000.

The after-tax cost of any tax-deductible cash expense can be determined using the following formula:[1]

$$\begin{pmatrix}\text{After-tax cost}\\ \text{(net cash outflow)}\end{pmatrix} = (1 - \text{Tax rate}) \times \text{Tax-deductible cash expense} \qquad (1)$$

We can verify the accuracy of this formula by applying it to the $60,000 training program expenditure:

$$(1 - 0.30) \times \$60{,}000 = \$42{,}000 \text{ after-tax cost of the training program}$$

This formula is very useful because it provides the actual amount of cash a company must pay after considering tax effects. It is this actual, after-tax, cash outflow that should be used in capital budgeting decisions.

Similar reasoning applies to revenues and other *taxable* cash inflows. Since these cash receipts are taxable, the company must pay out a portion of them in taxes. The **after-tax benefit,** or net cash inflow, realized from a particular cash receipt can be obtained by applying a simple variation of the cash expenditure formula used above:

$$\begin{pmatrix}\text{After-tax benefit}\\ \text{(net cash inflow)}\end{pmatrix} = (1 - \text{Tax rate}) \times \text{Taxable cash receipt} \qquad (2)$$

[1] This formula assumes that a company is operating at a profit; if it is operating at a loss, the tax situation can be very complex. For simplicity, we assume in all examples, exercises, and problems that the company is operating at a profit.

EXHIBIT 14C–1
The Computation of After-Tax Cost

	Without Training Program		With Training Program
Sales	$850,000		$850,000
Less tax deductible expenses:			
Salaries, insurance, and other	700,000		700,000
New training program			60,000
Total expenses	700,000		760,000
Taxable income	$150,000		$ 90,000
Income taxes (30%)	$ 45,000		$ 27,000
Cost of new training program		$60,000	
Less: Reduction in income taxes ($45,000 − $27,000)		18,000	
After-tax cost of the new training program		$42,000	

We emphasize the term *taxable cash receipts* because not all cash inflows are taxable. For example, the release of working capital at the end of an investment project would not be a taxable cash inflow. It is not counted as income for either financial accounting or income tax reporting purposes since it is simply a recovery of the initial investment.

Depreciation Tax Shield

Depreciation is not a cash flow. For this reason, depreciation was ignored in Chapter 14 in all discounted cash flow computations. However, depreciation does affect the taxes that must be paid and therefore has an indirect effect on a company's cash flows.

To illustrate the effect of depreciation deductions on tax payments, consider a company with annual cash sales of $500,000 and cash operating expenses of $310,000. In addition, the company has a depreciable asset on which the depreciation deduction is $90,000 per year. The tax rate is 30%. As shown in Exhibit 14C–2, the depreciation deduction reduces the company's taxes by $27,000. In effect, the depreciation deduction of $90,000 *shields* $90,000 in revenues from taxation and thereby *reduces* the amount of taxes that the company must pay. Because depreciation deductions shield revenues from taxation, they are generally referred to as a **depreciation tax shield.**[2] The reduction in tax payments made possible by the depreciation tax shield is equal to the amount of the depreciation deduction, multiplied by the tax rate as follows:

$$\text{Tax savings from the depreciation tax shield} = \text{Tax rate} \times \text{Depreciation deduction} \quad (3)$$

We can verify this formula by applying it to the $90,000 depreciation deduction in our example:

$$0.30 \times \$90{,}000 = \$27{,}000 \text{ reduction in tax payments}$$

In this appendix, when we estimate after-tax cash flows for capital budgeting decisions, we will include the tax savings provided by the depreciation tax shield.

To keep matters simple, we will assume in all of our examples and problem materials that depreciation reported for tax purposes is straight-line depreciation, with no deduction for salvage value. In other words, we will assume that the entire original cost of the asset is written

[2] The term *depreciation tax shield* may convey the impression that there is something underhanded about depreciation deductions—that companies are getting some sort of a special tax break. However, to use the depreciation deduction, a company must have already acquired a depreciable asset—which typically requires a cash outflow. Essentially, the tax code requires companies to delay recognizing the cash outflow as an expense until depreciation charges are recorded.

EXHIBIT 14C–2
The Impact of Depreciation Deductions on Tax Payments

	Without Depreciation Deduction	With Depreciation Deduction
Sales	$500,000	$500,000
Cash operating expenses	310,000	310,000
Cash flow from operations	190,000	190,000
Depreciation expense	—	90,000
Taxable income	$190,000	$100,000
Income taxes (30%)	$ 57,000	$ 30,000
	$27,000 lower taxes with the depreciation deduction	
Cash flow comparison:		
Cash flow from operations (above)	$190,000	$190,000
Income taxes (above)	57,000	30,000
Net cash flow	$133,000	$160,000
	$27,000 greater cash flow with the depreciation deduction	

off evenly over its useful life. Since the net book value of the asset at the end of its useful life will be zero under this depreciation method, we will assume that any proceeds received on disposal of the asset at the end of its useful life will be taxed as ordinary income.

In actuality, the rules for depreciation are more complex than this and most companies take advantage of accelerated depreciation methods allowed under the tax code. These accelerated methods usually result in a reduction in current taxes and an offsetting increase in future taxes. This shifting of part of the tax burden from the current year to future years is advantageous from a present value point of view because a dollar today is worth more than a dollar in the future. A summary of the concepts we have introduced so far is given in Exhibit 14C–3.

Example of Income Taxes and Capital Budgeting

Armed with an understanding of after-tax cost, after-tax revenue, and the depreciation tax shield, we are now prepared to examine a comprehensive example of income taxes and capital budgeting.

EXHIBIT 14C–3
Tax Adjustments Required in a Capital Budgeting Analysis

Item	Treatment
Tax-deductible cash expense*	Multiply by (1 − Tax rate) to get after-tax cost.
Taxable cash receipt*	Multiply by (1 − Tax rate) to get after-tax cash inflow.
Depreciation deduction	Multiply by the tax rate to get the tax savings from the depreciation tax shield.

*Cash expenses can be deducted from the cash receipts and the difference multiplied by (1 − Tax rate). See the example at the top of Exhibit 14C–4.

Holland Company owns the mineral rights to land that has a deposit of ore. The company is uncertain if it should purchase equipment and open a mine on the property. After careful study, the company assembled the following data.

Cost of equipment needed	$300,000
Working capital needed	$75,000
Estimated annual cash receipts from sales of ore	$250,000
Estimated annual cash expenses for salaries, insurance, utilities, and other cash expenses of mining the ore	$170,000
Cost of road repairs needed in 6 years	$40,000
Salvage value of the equipment in 10 years	$100,000

The ore in the mine would be exhausted after 10 years of mining activity, at which time the mine would be closed. The equipment would then be sold for its salvage value. Holland Company uses the straight-line method, assuming no salvage value, to compute depreciation deductions for tax purposes. The company's after-tax cost of capital is 12% and its tax rate is 30%.

Should Holland Company purchase the equipment and open a mine on the property? The solution to the problem is given in Exhibit 14C–4. We suggest that you go through this solution item by item and note the following points:

Cost of new equipment. The initial investment of $300,000 in the new equipment is included in full with no reductions for taxes. This represents an *investment,* not an expense, so no tax adjustment is made. (Only revenues and expenses are adjusted for the effects of taxes.) However, this investment does affect taxes through the depreciation deductions that are considered below.

Working capital. Observe that the working capital needed for the project is included in full with no reductions for taxes. Like the cost of new equipment, working capital is an investment and not an expense so no tax adjustment is made. Also observe that no tax adjustment is made when the working capital is released at the end of the project's life. The release of working capital is not a taxable cash flow because it is a return of investment funds back to the company.

EXHIBIT 14C–4
Example of Income Taxes and Capital Budgeting

	Per Year
Cash receipts from sales of ore	$250,000
Less payments for salaries, insurance, utilities, and other cash expenses	170,000
Net cash receipts	$ 80,000

Items and Computations	Year(s)	(1) Amount	(2) Tax Effect*	After-Tax Cash Flows (1) × (2)	12% Factor	Present Value of Cash Flows
Cost of new equipment	Now	$(300,000)	—	$(300,000)	1.000	$(300,000)
Working capital needed	Now	$(75,000)	—	$(75,000)	1.000	(75,000)
Net annual cash receipts (above)	1–10	$80,000	1 − 0.30	$56,000	5.650	316,400
Road repairs	6	$(40,000)	1 − 0.30	$(28,000)	0.507	(14,196)
Annual depreciation deductions	1–10	$30,000	0.30	$9,000	5.650	50,850
Salvage value of equipment	10	$100,000	1 − 0.30	$70,000	0.322	22,540
Release of working capital	10	$75,000	—	$75,000	0.322	24,150
Net present value						$ 24,744

*Taxable cash receipts and tax-deductible cash expenses are multiplied by (1 − Tax rate) to determine the after-tax cash flow. Depreciation deductions are multiplied by the tax rate itself to determine the after-tax cash flow (i.e., tax savings from the depreciation tax shield).

Net annual cash receipts. The net annual cash receipts from sales of ore are adjusted for the effects of income taxes, as discussed earlier in the chapter. Note at the top of Exhibit 14C–4 that the annual cash expenses are deducted from the annual cash receipts to obtain the net cash receipts. This simplifies computations.

Road repairs. Since the road repairs occur just once (in the sixth year), they are treated separately from other expenses. Road repairs would be a tax-deductible cash expense, and therefore they are adjusted for the effects of income taxes, as discussed earlier in the chapter.

Depreciation deductions. The tax savings provided by depreciation deductions is essentially an annuity that is included in the present value computations in the same way as other cash flows.

Salvage value of equipment. Since the company does not consider salvage value when computing depreciation deductions, book value will be zero at the end of the life of an asset. Thus, any salvage value received is taxable as income to the company. The after-tax benefit is determined by multiplying the salvage value by (1 − Tax rate).

Since the net present value of the proposed mining project is positive, the equipment should be purchased and the mine opened. Study Exhibit 14C–4 thoroughly. *Exhibit 14C–4 is the key exhibit!*

Summary (Appendix 14C)

Unless a company is a tax-exempt organization, such as a not-for-profit school or a governmental unit, income taxes should be considered in making capital budgeting decisions. Tax-deductible cash expenditures and taxable cash receipts are placed on an after-tax basis by multiplying them by (1 − Tax rate). Only the after-tax amount should be used in determining the desirability of an investment proposal.

Although depreciation is not a cash outflow, it is a valid deduction for tax purposes and as such affects income tax payments. The depreciation tax shield—computed by multiplying the depreciation deduction by the tax rate itself—also results in savings in income taxes.

Glossary (Appendix 14C)

After-tax benefit The amount of net cash inflow realized from a taxable cash receipt after income tax effects have been considered. The amount is determined by multiplying the taxable cash receipt by (1 − Tax rate). (p. 659)

After-tax cost The amount of net cash outflow resulting from a tax-deductible cash expense after income tax effects have been considered. The amount is determined by multiplying the tax-deductible cash expense by (1 − Tax rate). (p. 659)

Depreciation tax shield A reduction in tax that results from depreciation deductions. The reduction in tax is computed by multiplying the depreciation deduction by the tax rate. (p. 660)

Questions

14-1 What is the difference between capital budgeting screening decisions and capital budgeting preference decisions?

14-2 What is meant by the term *time value of money?*

14-3 What is meant by the term *discounting?*

14-4 Why isn't accounting net income used in the net present value and internal rate of return methods of making capital budgeting decisions?

14-5 Why are discounted cash flow methods of making capital budgeting decisions superior to other methods?

14-6 What is net present value? Can it ever be negative? Explain.
14-7 Identify two simplifying assumptions associated with discounted cash flow methods of making capital budgeting decisions.
14-8 If a company has to pay interest of 14% on long-term debt, then its cost of capital is 14%. Do you agree? Explain.
14-9 What is meant by an investment project's internal rate of return? How is the internal rate of return computed?
14-10 Explain how the cost of capital serves as a screening tool when dealing with (*a*) the net present value method and (*b*) the internal rate of return method.
14-11 As the discount rate increases, the present value of a given future cash flow also increases. Do you agree? Explain.
14-12 Refer to Exhibit 14–4. Is the return on this investment proposal exactly 14%, more than 14%, or less than 14%? Explain.
14-13 How is the project profitability index computed, and what does it measure?
14-14 What is meant by the term *payback period?* How is the payback period determined? How can the payback method be useful?
14-15 What is the major criticism of the payback and simple rate of return methods of making capital budgeting decisions?
14-16 (Appendix 14C) What is meant by after-tax cost and how is the concept used in capital budgeting decisions?
14-17 (Appendix 14C) What is a depreciation tax shield and how does it affect capital budgeting decisions?
14-18 (Appendix 14C) Ludlow Company is considering the introduction of a new product line. Would an increase in the income tax rate tend to make the new investment more or less attractive? Explain.
14-19 (Appendix 14C) Assume that an old piece of equipment is sold at a loss. From a capital budgeting point of view, what two cash inflows will be associated with the sale?
14-20 (Appendix 14C) Assume that a new piece of equipment costs $40,000 and that the tax rate is 30%. Should the new piece of equipment be included in the capital budgeting analysis as a cash outflow of $40,000, or as a cash outflow of $28,000 [$40,000 × (1 − 0.30)]? Explain.

Exercises

EXERCISE 14-1 Net Present Value Method [LO1]
The management of Opry Company, a wholesale distributor of suntan products, is considering the purchase of a $25,000 machine that would reduce operating costs in its warehouse by $4,000 per year. At the end of the machine's 10-year useful life, it will have no scrap value. The company's required rate of return is 12%.

Required:
(Ignore income taxes.)
1. Determine the net present value of the investment in the machine.
2. What is the difference between the total, undiscounted cash inflows and cash outflows over the entire life of the machine?

EXERCISE 14-2 Internal Rate of Return [LO2]
Pisa Pizza Parlor is investigating the purchase of a new $45,000 delivery truck that would contain specially designed warming racks. The new truck would have a six-year useful life. It would save $5,400 per year over the present method of delivering pizzas. In addition, it would result in the sale of 1,800 more pizzas each year. The company realizes a contribution margin of $2 per pizza.

Required:
(Ignore income taxes.)
1. What would be the total annual cash inflows associated with the new truck for capital budgeting purposes?
2. Find the internal rate of return promised by the new truck to the nearest whole percent.
3. In addition to the data above, assume that due to the unique warming racks, the truck will have a $13,000 salvage value at the end of six years. Under these conditions, compute the internal rate of return to the nearest whole percent. (Hint: You may find it helpful to use the net present value approach; find the discount rate that will cause the net present value to be closest to zero. Use the format shown in Exhibit 14–4.)

EXERCISE 14-3 Uncertain Future Cash Flows [LO3]

Union Bay Plastics is investigating the purchase of automated equipment that would save $100,000 each year in direct labor and inventory carrying costs. This equipment costs $750,000 and is expected to have a 10-year useful life with no salvage value. The company requires a minimum 15% rate of return on all equipment purchases. This equipment would provide intangible benefits such as greater flexibility and higher-quality output that are difficult to estimate and yet are quite significant.

Required:

(Ignore income taxes.)

What dollar value per year would the intangible benefits have to be worth in order to make the equipment an acceptable investment?

EXERCISE 14-4 Preference Ranking [LO4]

Information on four investment proposals is given below:

	Investment Proposal			
	A	B	C	D
Investment required	$(85,000)	$(200,000)	$(90,000)	$(170,000)
Present value of cash inflows	119,000	250,000	135,000	221,000
Net present value	$ 34,000	$ 50,000	$ 45,000	$ 51,000
Life of the project	5 years	7 years	6 years	6 years

Required:

1. Compute the project profitability index for each investment proposal.
2. Rank the proposals in terms of preference.

EXERCISE 14-5 Payback Method [LO5]

The management of Weimar Inc., a civil engineering design company, is considering an investment in a high-quality blueprint printer with the following cash flows:

Year	Investment	Cash Inflow
1	$38,000	$2,000
2	$6,000	$4,000
3		$8,000
4		$9,000
5		$12,000
6		$10,000
7		$8,000
8		$6,000
9		$5,000
10		$5,000

Required:

1. Determine the payback period of the investment.
2. Would the payback period be affected if the cash inflow in the last year were several times larger?

EXERCISE 14-6 Simple Rate of Return Method [LO6]

The management of Wallingford MicroBrew is considering the purchase of an automated bottling machine for $80,000. The machine would replace an old piece of equipment that costs $33,000 per year to operate. The new machine would cost $10,000 per year to operate. The old machine currently in use could be sold now for a scrap value of $5,000. The new machine would have a useful life of 10 years with no salvage value.

Required:

Compute the simple rate of return on the new automated bottling machine.


EXERCISE 14-7 (Appendix 14A) Basic Present Value Concepts [LO7]

Each of the following parts is independent. (Ignore income taxes.)

1. Largo Freightlines plans to build a new garage in three years to have more space for repairing its trucks. The garage will cost $400,000. What lump-sum amount should the company invest now to have the $400,000 available at the end of the three-year period? Assume that the company can invest money at:
   a. Eight percent.
   b. Twelve percent.
2. Martell Products, Inc., can purchase a new copier that will save $5,000 per year in copying costs. The copier will last for six years and have no salvage value. What is the maximum purchase price that Martell Products would be willing to pay for the copier if the company's required rate of return is:
   a. Ten percent?
   b. Sixteen percent?
3. Sally has just won the million-dollar Big Slam jackpot at a gambling casino. The casino will pay her $50,000 per year for 20 years as the payoff. If Sally can invest money at a 10% rate of return, what is the present value of her winnings? Did she really win a million dollars? Explain.

EXERCISE 14-8 (Appendix 14C) After-Tax Costs [LO8]

Solve each of the following parts independently:

a. Stoffer Company has hired a management consulting firm to review and make recommendations concerning Stoffer's organizational structure. The consulting firm's fee will be $100,000. What will be the after-tax cost of the consulting firm's fee if Stoffer's tax rate is 30%?
b. The Green Hills Riding Club has redirected its advertising toward a different sector of the market. As a result of this change in advertising, the club's annual revenues have increased by $40,000. If the club's tax rate is 30%, what is the after-tax benefit from the increased revenues?
c. The Golden Eagles Basketball Team has just installed an electronic scoreboard in its playing arena at a cost of $210,000. For tax purposes, the entire original cost of the electronic scoreboard will be depreciated over seven years, using the straight-line method. Determine the yearly tax savings from the depreciation tax shield. Assume that the income tax rate is 30%.

EXERCISE 14-9 Comparison of Projects Using Net Present Value [LO1]

Sharp Company has $15,000 to invest. The company is trying to decide between two alternative uses of the funds as follows:

	Invest in Project A	Invest in Project B
Investment required	$15,000	$15,000
Annual cash inflows	$4,000	$0
Single cash inflow at the end of 10 years		$60,000
Life of the project	10 years	10 years

Sharp Company uses a 16% discount rate.

Required:

(Ignore income taxes.) Which investment would you recommend that the company accept? Show all computations using net present value. Prepare separate computations for each investment.

EXERCISE 14-10 Basic Net Present Value Analysis [LO1]

On January 2, Fred Critchfield paid $18,000 for 900 shares of the common stock of Acme Company. Mr. Critchfield received an $0.80 per share dividend on the stock at the end of each year for four years. At the end of four years, he sold the stock for $22,500. Mr. Critchfield has a goal of earning a minimum return of 12% on all of his investments.

Required:

(Ignore income taxes.) Did Mr. Critchfield earn a 12% return on the stock? Use the net present value method and the general format shown in Exhibit 14–4. Round all computations to the nearest whole dollar.


EXERCISE 14-11 Internal Rate of Return and Net Present Value [LO1, LO2]

Scalia's Cleaning Service is investigating the purchase of an ultrasound machine for cleaning window blinds. The machine would cost $136,700, including invoice cost, freight, and training of employees to operate it. Scalia's has estimated that the new machine would increase the company's cash flows, net of expenses, by $25,000 per year. The machine would have a 14-year useful life with no expected salvage value.

Required:

(Ignore income taxes.)

1. Compute the machine's internal rate of return to the nearest whole percent.
2. Compute the machine's net present value. Use a discount rate of 16% and the format shown in Exhibit 14–5. Why do you have a zero net present value?
3. Suppose that the new machine would increase the company's annual cash flows, net of expenses, by only $20,000 per year. Under these conditions, compute the internal rate of return to the nearest whole percent.

EXERCISE 14-12 Uncertain Future Life [LO3]

Worldwide Travel Service has made an investment in certain equipment that cost the company $307,100. The equipment is expected to generate cash inflows of $50,000 each year.

Required:

How many years will the equipment have to be used in order to provide the company with a 14% return on its investment?

EXERCISE 14-13 Basic Payback Period and Simple Rate of Return Computations [LO5, LO6]

Martin Company is considering the purchase of a new piece of equipment. Relevant information concerning the equipment follows:

Purchase cost	$180,000
Annual cost savings that will be provided by the equipment	$37,500
Life of the equipment	12 years

Required:

(Ignore income taxes.)

1. Compute the payback period for the equipment. If the company rejects all proposals with a payback period of more than four years, would the equipment be purchased?
2. Compute the simple rate of return on the equipment. Use straight-line depreciation based on the equipment's useful life. Would the equipment be purchased if the company's required rate of return is 14%?

EXERCISE 14-14 (Appendix 14A) Basic Present Value Concepts [LO7]

Consider each of the following situations independently. (Ignore income taxes.)

1. Annual cash inflows from two competing investment opportunities are given below. Each investment opportunity will require the same initial investment. Compute the present value of the cash inflows for each investment using a 20% discount rate.

	Investment	
Year	X	Y
1	$ 1,000	$ 4,000
2	2,000	3,000
3	3,000	2,000
4	4,000	1,000
	$10,000	$10,000

2. At the end of three years, when you graduate from college, your father has promised to give you a used car that will cost $12,000. What lump sum must he invest now to have the $12,000 at the end of three years if he can invest money at:
   a. Six percent?
   b. Ten percent?
3. Mark has just won the grand prize on the "Hoot 'n' Holler " quiz show. He has a choice between (*a*) receiving $500,000 immediately and (*b*) receiving $60,000 per year for eight years plus a lump sum of $200,000 at the end of the eight-year period. If Mark can get a return of 10% on his investments, which option would you recommend that he accept? (Use present value analysis, and show all computations.)
4. You have just learned that you are a beneficiary in the will of your late Aunt Susan. The executrix of her estate has given you three options as to how you may receive your inheritance:
   a. You may receive $50,000 immediately.
   b. You may receive $75,000 at the end of six years.
   c. You may receive $12,000 at the end of each year for six years (a total of $72,000).
   If you can invest money at a 12% return, which option would you prefer?

EXERCISE 14-15 (Appendix 14C) After-Tax Cash Flows in Net Present Value Analysis [LO8]

Kramer Corporation is considering two investment projects, each of which would require $50,000. Cost and cash flow data concerning the two projects are given below:

	Project A	Project B
Investment in high-speed photocopier	$50,000	
Investment in working capital		$50,000
Net annual cash inflows	$9,000	$9,000
Life of the project	8 years	8 years

The high-speed photocopier would have a salvage value of $5,000 in eight years. For tax purposes, the company computes depreciation deductions assuming zero salvage value and uses straight-line depreciation. The photocopier would be depreciated over eight years. At the end of eight years, the investment in working capital would be released for use elsewhere. The company requires an after-tax return of 10% on all investments. The tax rate is 30%.

Required:

Compute the net present value of each investment project. (Round to the nearest whole dollar.)

EXERCISE 14-16 Working With Net Present Value [LO1]

Mountain View Hospital has purchased new lab equipment for $134,650. The equipment is expected to last for three years and to provide cash inflows as follows:

Year 1	$45,000
Year 2	$60,000
Year 3	?

Required:

Assuming that the equipment will yield exactly a 16% rate of return, what is the expected cash inflow for Year 3?

EXERCISE 14-17 Basic Net Present Value and Internal Rate of Return Analysis [LO1, LO2]

(Ignore income taxes.) Consider each case below independently.

1. Minden Company's required rate of return is 15%. The company can purchase a new machine at a cost of $40,350. The new machine would generate cash inflows of $15,000 per year and have a four-year life with no salvage value. Compute the machine's net present value. (Use the format shown in Exhibit 14–1.) Is the machine an acceptable investment? Explain.
2. Leven Products, Inc., is investigating the purchase of a new grinding machine that has a projected life of 15 years. It is estimated that the machine will save $20,000 per year in cash operating costs. What is the machine's internal rate of return if it costs $111,500 new?

3. Sunset Press has just purchased a new trimming machine that cost $14,125. The machine is expected to save $2,500 per year in cash operating costs and to have a 10-year life. Compute the machine's internal rate of return. If the company's required rate of return is 16%, did it make a wise investment? Explain.

EXERCISE 14-18 Net Present Value Analysis of Two Alternatives [LO1]

Wriston Company has $300,000 to invest. The company is trying to decide between two alternative uses of the funds. The alternatives are as follows:

	A	B
Cost of equipment required	$300,000	$0
Working capital investment required	$0	$300,000
Annual cash inflows	$80,000	$60,000
Salvage value of equipment in seven years	$20,000	$0
Life of the project	7 years	7 years

The working capital needed for project B will be released for investment elsewhere at the end of seven years. Wriston Company uses a 20% discount rate.

Required:

(Ignore income taxes.) Which investment alternative (if either) would you recommend that the company accept? Show all computations using the net present value format. Prepare separate computations for each project.

EXERCISE 14-19 Payback Period and Simple Rate of Return [LO5, LO6]

The Heritage Amusement Park would like to construct a new ride called the Sonic Boom, which the park management feels would be very popular. The ride would cost $450,000 to construct, and it would have a 10% salvage value at the end of its 15-year useful life. The company estimates that the following annual costs and revenues would be associated with the ride:

Ticket revenues		$250,000
Less operating expenses:		
Maintenance	$40,000	
Salaries	90,000	
Depreciation	27,000	
Insurance	30,000	
Total operating expenses		187,000
Net operating income		$ 63,000

Required:

(Ignore income taxes.)

1. Assume that the Heritage Amusement Park will not construct a new ride unless the ride provides a payback period of six years or less. Does the Sonic Boom ride satisfy this requirement?
2. Compute the simple rate of return promised by the new ride. If Heritage Amusement Park requires a simple rate of return of at least 12%, does the Sonic Boom ride meet this criterion?

EXERCISE 14-20 (Appendix 14C) Net Present Value Analysis Including Income Taxes [LO8]

Press Publishing Company hires students from the local university to collate pages on various printing jobs. This collating is all done by hand, at a cost of $60,000 per year. A collating machine has just come onto the market that could be used in place of the student help. The machine would cost $140,000 and have a 10-year useful life. It would require an operator at an annual cost of $18,000 and have annual maintenance costs of $7,000. New roller pads would be needed on the machine in five years at a total cost of $20,000. The salvage value of the machine in 10 years would be $40,000.

For tax purposes, the company computes depreciation deductions assuming zero salvage value and uses straight-line depreciation. The collating machine would be depreciated over 10 years. Management requires a 14% after-tax return on all equipment purchases. The company's tax rate is 30%.

Required:

1. Determine the before-tax net annual cost savings that the new collating machine will provide.
2. Using the data from (1) above and other data from the exercise, compute the collating machine's net present value. (Round all dollar amounts to the nearest whole dollar.) Would you recommend that the machine be purchased?

Problems

PROBLEM 14-21 Net Present Value Analysis; Uncertain Cash Flows [LO1, LO3]

Tiger Computers, Inc., of Singapore is considering the purchase of an automated etching machine for use in the production of its circuit boards. The machine would cost $900,000. (All currency amounts are in Singapore dollars.) An additional $650,000 would be required for installation costs and for software. Management believes that the automated machine would provide substantial annual reductions in costs, as shown below:

	Annual Reduction in Costs
Labor costs	$240,000
Material costs	$96,000

The new machine would require considerable maintenance work to keep it in proper adjustment. The company's engineers estimate that maintenance costs would increase by $4,250 per month if the machine were purchased. In addition, the machine would require a $90,000 overhaul at the end of the sixth year.

The new etching machine would be usable for 10 years, after which it would be sold for its scrap value of $210,000. It would replace an old etching machine that can be sold now for its scrap value of $70,000. Tiger Computers, Inc., requires a return of at least 18% on investments of this type.

Required:

(Ignore income taxes.)

1. Compute the net annual cost savings promised by the new etching machine.
2. Using the data from (1) above and other data from the problem, compute the new machine's net present value. (Use the incremental-cost approach.) Would you recommend that the machine be purchased? Explain.
3. Assume that management can identify several intangible benefits associated with the new machine, including greater flexibility in shifting from one type of circuit board to another, improved quality of output, and faster delivery as a result of reduced throughput time. What dollar value per year would management have to attach to these intangible benefits in order to make the new etching machine an acceptable investment?

PROBLEM 14-22 Basic Net Present Value Analysis [LO1]

Renfree Mines, Inc., owns the mining rights to a large tract of land in a mountainous area. The tract contains a mineral deposit that the company believes might be commercially attractive to mine and sell. An engineering and cost analysis has been made, and it is expected that the following cash flows would be associated with opening and operating a mine in the area:

Cost of equipment required	$850,000
Net annual cash receipts	$230,000*
Working capital required	$100,000
Cost of road repairs in three years	$60,000
Salvage value of equipment in five years	$200,000

*Receipts from sales of ore, less out-of-pocket costs for salaries, utilities, insurance, and so forth.

It is estimated that the mineral deposit would be exhausted after five years of mining. At that point, the working capital would be released for reinvestment elsewhere. The company's required rate of return is 14%.

Required:

(Ignore income taxes.) Determine the net present value of the proposed mining project. Should the project be accepted? Explain.

PROBLEM 14-23 Simple Rate of Return; Payback [LO5, LO6]

Lugano's Pizza Parlor is considering the purchase of a large oven and related equipment for mixing and baking "crazy bread." The oven and equipment would cost $120,000 delivered and installed. It would be usable for about 15 years, after which it would have a 10% scrap value. The following additional information is available:

a. Mr. Lugano estimates that purchase of the oven and equipment would allow the pizza parlor to bake and sell 72,000 loaves of crazy bread each year. The bread sells for $1.25 per loaf.
b. The cost of the ingredients in a loaf of bread is 40% of the selling price. Mr. Lugano estimates that other costs each year associated with the bread would be the following: salaries, $18,000; utilities, $9,000; and insurance, $3,000.
c. The pizza parlor uses straight-line depreciation on all assets, deducting salvage value from original cost.

Required:

(Ignore income taxes.)

1. Prepare a contribution format income statement showing the net operating income each year from production and sale of the crazy bread.
2. Compute the simple rate of return for the new oven and equipment. If a simple rate of return above 12% is acceptable to Mr. Lugano, will he purchase the oven and equipment?
3. Compute the payback period on the oven and equipment. If Mr. Lugano purchases any equipment with less than a six-year payback, will he purchase this equipment?

PROBLEM 14-24 (Appendix 14C) Basic Net Present Value Analysis Including Income Taxes [LO8]

Rapid Parcel Service has been offered an eight-year contract to deliver mail and small parcels between army installations. To accept the contract, the company would have to purchase several new delivery trucks at a total cost of $450,000. Other data relating to the contract follow:

Net annual cash receipts (before taxes) from the contract	$108,000
Cost of overhauling the motors in the trucks in five years	$45,000
Salvage value of the trucks at termination of the contract	$20,000

If the contract were accepted, several old, fully depreciated trucks would be sold at a total price of $30,000. These funds would be used to help purchase the new trucks. For tax purposes, the company computes depreciation deductions assuming zero salvage value and uses straight-line depreciation. The trucks would be depreciated over eight years. The company requires a 12% after-tax return on all equipment purchases. The tax rate is 30%.

Required:

Compute the net present value of this investment opportunity. Round all dollar amounts to the nearest whole dollar. Would you recommend that the contract be accepted?

PROBLEM 14-25 Basic Net Present Value Analysis [LO1]

eXcel

Doughboy Bakery would like to buy a new machine for putting icing and other toppings on pastries. These are now put on by hand. The machine that the bakery is considering costs $90,000 new. It would last the bakery for eight years but would require a $7,500 overhaul at the end of the fifth year. After eight years, the machine could be sold for $6,000.

The bakery estimates that it will cost $14,000 per year to operate the new machine. The present manual method of putting toppings on the pastries costs $35,000 per year. In addition to reducing operating costs, the new machine will allow the bakery to increase its production of pastries by 5,000 packages per year. The bakery realizes a contribution margin of $0.60 per package. The bakery requires a 16% return on all investments in equipment.

Required:
(Ignore income taxes.)
1. What are the net annual cash inflows that will be provided by the new machine?
2. Compute the new machine's net present value. Use the incremental cost approach, and round all dollar amounts to the nearest whole dollar.

PROBLEM 14-26 Preference Ranking of Investment Projects [LO4]
Austin Company is investigating five different investment opportunities. Information on the four projects under study is given below:

	Project Number			
	1	2	3	4
Investment required	$(480,000)	$(360,000)	$(270,000)	$(450,000)
Present value of cash inflows at a 10% discount rate	567,270	433,400	336,140	522,970
Net present value	$ 87,270	$ 73,400	$ 66,140	$ 72,970
Life of the project	6 years	12 years	6 years	3 years
Internal rate of return	16%	14%	18%	19%

Since the company's required rate of return is 10%, a 10% discount rate has been used in the present value computations above. Limited funds are available for investment, so the company can't accept all of the available projects.

Required:
1. Compute the project profitability index for each investment project.
2. Rank the four projects according to preference, in terms of:
   a. Net present value
   b. Project profitability index
   c. Internal rate of return
3. Which ranking do you prefer? Why?

eXcel

PROBLEM 14-27 Net Present Value Analysis [LO1]
Frank White will retire in six years. He wants to open some type of small business operation that can be managed in the free time he has available from his regular occupation, but that can be closed easily when he retires. He is considering several investment alternatives, one of which is to open a laundromat. After careful study, Mr. White has determined the following:

a. Washers, dryers, and other equipment needed to open the laundromat would cost $194,000. In addition, $6,000 in working capital would be required to purchase an inventory of soap, bleaches, and related items and to provide change for change machines. (The soap, bleaches, and related items would be sold to customers at cost.) After six years, the working capital would be released for investment elsewhere.
b. The laundromat would charge $1.50 per use for the washers and $0.75 per use for the dryers. Mr. White expects the laundromat to gross $1,800 each week from the washers and $1,125 each week from the dryers.
c. The only variable costs in the laundromat would be 7½ cents per use for water and electricity for the washers and 9 cents per use for gas and electricity for the dryers.
d. Fixed costs would be $3,000 per month for rent, $1,500 per month for cleaning, and $1,875 per month for maintenance, insurance, and other items.
e. The equipment would have a 10% disposal value in six years.

Mr. White will not open the laundromat unless it provides at least a 12% return.

Required:
(Ignore income taxes.)
1. Assuming that the laundromat would be open 52 weeks a year, compute the expected net annual cash receipts from its operation (gross cash receipts less cash disbursements). (Do not include the cost of the equipment, the working capital, or the salvage values in these computations.)

2. Would you advise Mr. White to open the laundromat? Show computations using the net present value method of investment analysis. Round all dollar amounts to the nearest whole dollar.

PROBLEM 14-28 Simple Rate of Return; Payback; Internal Rate of Return [LO2, LO5, LO6]


Chateau Beaune is a family-owned winery located in the Burgundy region of France, which is headed by Gerard Despinoy. The harvesting season in early fall is the busiest part of the year for the winery, and many part-time workers are hired to help pick and process grapes. Mr. Despinoy is investigating the purchase of a harvesting machine that would significantly reduce the amount of labor required in the picking process. The harvesting machine is built to straddle grapevines, which are laid out in low-lying rows. Two workers are carried on the machine just above ground level, one on each side of the vine. As the machine slowly crawls through the vineyard, the workers cut bunches of grapes from the vines, which then fall into a hopper. The machine separates the grapes from the stems and other woody debris. The debris are then pulverized and spread behind the machine as a rich ground mulch. Mr. Despinoy has gathered the following information relating to the decision of whether to purchase the machine:

a. The winery would save €190,000 per year in labor costs with the new harvesting machine. In addition, the company would no longer have to purchase and spread ground mulch—at an annual savings of €10,000. (The French currency is the euro, which is denoted by the symbol €.)
b. The harvesting machine would cost €480,000. It would have an estimated 12-year useful life and zero salvage value. The winery uses straight-line depreciation.
c. Annual out-of-pocket costs associated with the harvesting machine would be insurance, €1,000; fuel, €9,000; and a maintenance contract, €12,000. In addition, two operators would be hired and trained for the machine, and they would be paid a total of €70,000 per year, including all benefits.
d. Mr. Despinoy feels that the investment in the harvesting machine should earn at least a 16% rate of return.

Required:

(Ignore income taxes.)

1. Determine the annual net savings in cash operating costs that would be realized if the harvesting machine were purchased.
2. Compute the simple rate of return expected from the harvesting machine.
3. Compute the payback period on the harvesting machine. Mr. Despinoy will not purchase equipment unless it has a payback period of five years or less. Under this criterion, should the harvesting machine be purchased?
4. Compute (to the nearest whole percent) the internal rate of return promised by the harvesting machine. Based on this computation, does it appear that the simple rate of return is an accurate guide in investment decisions?

PROBLEM 14-29 Net Present Value; Uncertain Future Cash Flows; Postaudit [LO1, LO3]

"If we can get that new robot to combine with our other automated equipment, we'll have a complete flexible manufacturing system (FMS) in place in our Northridge plant," said Hal Swain, production manager for Diller Products.

"Let's just hope that reduced labor and inventory costs can justify its acquisition," replied Linda Wycoff, the controller. "Otherwise, we'll never get it. You know how the president feels about equipment paying for itself out of reduced costs."

Selected data relating to the robot are provided below:

Cost of the robot	$1,600,000
Software and installation	$700,000
Annual savings in labor costs	?
Annual savings in inventory carrying costs	$190,000
Monthly increase in power and maintenance costs	$2,500
Salvage value in 12 years	$90,000
Useful life	12 years

Engineering studies suggest that use of the robot will result in a savings of 20,000 direct labor-hours each year. The labor rate is $16 per hour. Also, the smoother work flow made possible by the FMS will allow the company to reduce the amount of inventory on hand by $300,000. The released funds will be available for use elsewhere in the company. This inventory reduction will take place in the first year of operation. The company's required rate of return is 20%.

Required:

(Ignore income taxes.)

1. Determine the net *annual* cost savings if the robot is purchased. (Do not include the $300,000 inventory reduction or the salvage value in this computation.)
2. Compute the net present value of the proposed investment in the robot. Based on these data, would you recommend that the robot be purchased? Explain.
3. Assume that the robot is purchased. At the end of the first year, Linda Wycoff has found that some items didn't work out as planned. Due to unforeseen problems, software and installation costs were $125,000 more than estimated, and direct labor has been reduced by only 17,500 hours per year, rather than by 20,000 hours. Assuming that all other cost data were accurate, does it appear that the company made a wise investment? Show computations, using the net present value format as in (2) above. (Hint: It might be helpful to place yourself back at the beginning of the first year, with the new data.)
4. Upon seeing your analysis in (3) above, the president stated, "That robot is the worst investment we've ever made. And here we'll be stuck with it for years."
   a. Explain to the president what benefits other than cost savings might accrue from using the new robot and FMS.
   b. Compute for the president the dollar amount of cash inflow that would be needed each year from the benefits in (*a*) above in order for the equipment to yield a 20% rate of return.


PROBLEM 14-30 Internal Rate of Return; Sensitivity Analysis [LO2]

Dr. Heidi Black is the managing partner of the Crestwood Dental Clinic. Dr. Black is trying to determine whether or not the clinic should move patient files and other items out of a spare room in the clinic and use the room for dental work. She has determined that it would require an investment of $142,950 for equipment and related costs of getting the room ready for use. Based on receipts being generated from other rooms in the clinic, Dr. Black estimates that the new room would generate a net cash inflow of $37,500 per year. The equipment purchased for the room would have a seven-year estimated useful life.

Required:

(Ignore income taxes.)

1. Compute the internal rate of return on the equipment for the new room to the nearest whole percent. Verify your answer by computing the net present value of the equipment using the internal rate of return you have computed as the discount rate.
2. Assume that Dr. Black will not purchase the new equipment unless it promises a return of at least 14%. Compute the amount of annual cash inflow that would provide this return on the $142,950 investment.
3. Although seven years is the average life for dental equipment, Dr. Black knows that due to changing technology this life can vary substantially. Compute the internal rate of return to the nearest whole percent if the life of the equipment were (*a*) five years and (*b*) nine years, rather than seven years. Is there any information provided by these computations that you would be particularly anxious to show Dr. Black?
4. Dr. Black is unsure about the estimated $37,500 annual cash inflow from the room. She thinks that the actual cash inflow could be as much as 20% greater or less than this figure.
   a. Assume that the actual cash inflow each year is 20% greater than estimated. Recompute the internal rate of return to the nearest whole percent.
   b. Assume that the actual cash inflow each year is 20% less than estimated. Recompute the internal rate of return to the nearest whole percent.
5. Refer to the original data. Assume that the equipment is purchased and that the room is opened for dental use. However, due to an increasing number of dentists in the area, the clinic is able to generate only $30,000 per year in net cash receipts from the new room. At the end of five years, the clinic closes the room and sells the equipment to a newly licensed dentist for a cash price of $61,375. Compute the internal rate of return to the nearest whole percent that the clinic earned on its investment over the five-year period. Round all dollar amounts to the nearest whole dollar. (Hint: A useful way to proceed is to find the discount rate that will cause the net present value of the investment to be equal to, or near, zero).

PROBLEM 14-31 Net Present Value Analysis of a Lease or Buy Decision [LO1]


Blinko Products wants an airplane for use by its corporate staff. The airplane that the company wishes to acquire, a Zephyr II, can be either purchased or leased from the manufacturer. The company has made the following evaluation of the two alternatives:

Purchase alternative. If the Zephyr II is purchased, then the costs incurred by the company would be as follows:

Purchase cost of the plane	$850,000
Annual cost of servicing, licenses, and taxes	$9,000
Repairs:	
First three years, per year	$3,000
Fourth year	$5,000
Fifth year	$10,000

The plane would be sold after five years. Based on current resale values, the company would be able to sell it for about one-half of its original cost at the end of the five-year period.

Lease alternative. If the Zephyr II is leased, then the company would have to make an immediate deposit of $50,000 to cover any damage during use. The lease would run for five years, at the end of which time the deposit would be refunded. The lease would require an annual rental payment of $200,000 (the first payment is due at the end of Year 1). As part of this lease cost, the manufacturer would provide all servicing and repairs, license the plane, and pay all taxes. At the end of the five-year period, the plane would revert to the manufacturer, as owner.

Blinko Products' required rate of return is 18%.

Required:

(Ignore income taxes.)

1. Use the total-cost approach to determine the present value of the cash flows associated with each alternative.
2. Which alternative would you recommend that the company accept? Why?

PROBLEM 14-32 Simple Rate of Return; Payback [LO5, LO6]

Nagoya Amusements Corporation places electronic games and other amusement devices in supermarkets and similar outlets throughout Japan. Nagoya Amusements is investigating the purchase of a new electronic game called Mystic Invaders. The manufacturer will sell 20 games to Nagoya Amusements for a total price of ¥180,000. (The Japanese currency is yen, which is denoted by the symbol ¥.) Nagoya Amusements has determined the following additional information about the game:

a. The game would have a five-year useful life and a negligible salvage value. The company uses straight-line depreciation.
b. The game would replace other games that are unpopular and generating little revenue. These other games would be sold for a total of ¥30,000.
c. Nagoya Amusements estimates that Mystic Invaders would generate annual incremental revenues of ¥200,000 (total for all 20 games). Annual incremental out-of-pocket costs would be (in total): maintenance, ¥50,000; and insurance, ¥10,000. In addition, Nagoya Amusements would have to pay a commission of 40% of total revenues to the supermarkets and other outlets in which the games were placed.

Required:

(Ignore income taxes.)

1. Prepare a contribution format income statement showing the net operating income each year from Mystic Invaders.
2. Compute the simple rate of return on Mystic Invaders. Will the game be purchased if Nagoya Amusements accepts any project with a simple rate of return greater than 14%?
3. Compute the payback period on Mystic Invaders. If the company accepts any investment with a payback period of less than three years, will the game be purchased?


PROBLEM 14-33 Preference Ranking of Investment Projects [LO4]

Yancey Company has limited funds available for investment and must ration the funds among four competing projects. Selected information on the four projects follows:

Project	Investment Required	Net Present Value	Life of the Project (years)	Internal Rate of Return
A	$800,000	$221,615	7	18%
B	$675,000	$210,000	12	16%
C	$500,000	$175,175	7	20%
D	$700,000	$152,544	3	22%

The net present values above have been computed using a 10% discount rate. The company wants your assistance in determining which project to accept first, which to accept second, and so forth. The company's investment funds are limited.

Required:

1. Compute the project profitability index for each project.
2. In order of preference, rank the four projects in terms of:
   a. Net present value.
   b. Project profitability index.
   c. Internal rate of return.
3. Which ranking do you prefer? Why?

PROBLEM 14-34 Net Present Value Analysis of a New Product [LO1]

Atwood Company has an opportunity to produce and sell a revolutionary new smoke detector for homes. To determine whether this would be a profitable venture, the company has gathered the following data on probable costs and market potential:

a. New equipment would have to be acquired to produce the smoke detector. The equipment would cost $100,000 and be usable for 12 years. After 12 years, it would have a salvage value equal to 10% of the original cost.
b. Production and sales of the smoke detector would require a working capital investment of $40,000 to finance accounts receivable, inventories, and day-to-day cash needs. This working capital would be released for use elsewhere after 12 years.
c. An extensive marketing study projects sales in units over the next 12 years as follows:

Year	Sales in Units
1	4,000
2	7,000
3	10,000
4–12	12,000

d. The smoke detectors would sell for $45 each; variable costs for production, administration, and sales would be $25 per unit.
e. To gain entry into the market, the company would have to advertise heavily in the early years of sales. The advertising program follows:

Year	Amount of Advertising
1–2	$70,000
3	$50,000
4–12	$40,000

f. Other fixed costs for salaries, insurance, maintenance, and straight-line depreciation on equipment would total $127,500 per year. (Depreciation is based on cost less salvage value.)
g. The company's required rate of return is 20%.

Required:

(Ignore income taxes.)

1. Compute the net cash inflow (cash receipts less yearly cash operating expenses) anticipated from sale of the smoke detectors for each year over the next 12 years.
2. Using the data computed in (1) above and other data provided in the problem, determine the net present value of the proposed investment. Would you recommend that Atwood Company accept the smoke detector as a new product?

PROBLEM: 14-35 (Appendix 14C) A Comparison of Investment Alternatives Including Income Taxes [LO8]

Ms. Keri Lee, an expert in retrofitting buildings to meet seismic safety standards, has just received a $200,000 after-tax bonus for the successful completion of a project on time and under budget. Business has been so good that she is planning to retire in 12 years, spending her time relaxing in the sun, skiing, and doing charitable work. Ms. Lee is considering two alternatives for investing her bonus.

Alternative 1. Municipal bonds can be purchased that mature in 12 years and that bear interest at 8%. This interest would be tax-free and paid semiannually. (In discounting a cash flow that occurs semiannually, the procedure is to halve the discount rate and double the number of periods. Use the same procedure for discounting the principal returned when the bonds reach maturity.)

Alternative 2. A small discount perfume shop is available for sale at a nearby factory outlet center. The business can be purchased from its current owner for $200,000. The following information relates to this alternative:

a. Of the purchase price, $80,000 would be for fixtures and other depreciable items. The remainder would be for the company's working capital (inventory, accounts receivable, and cash). The fixtures and other depreciable items would have a remaining useful life of at least 12 years but would be depreciated for tax reporting purposes over eight years using the following allowances published by the Internal Revenue Service:

Year	Percentage of Original Cost Depreciated
1	14.3%
2	24.5
3	17.5
4	12.5
5	8.9
6	8.9
7	8.9
8	4.5
	100.0%

Salvage value is not deducted when computing depreciation for tax purposes. At any rate, at the end of 12 years, these depreciable items would have a negligible salvage value; however, the working capital would be released for reinvestment elsewhere.

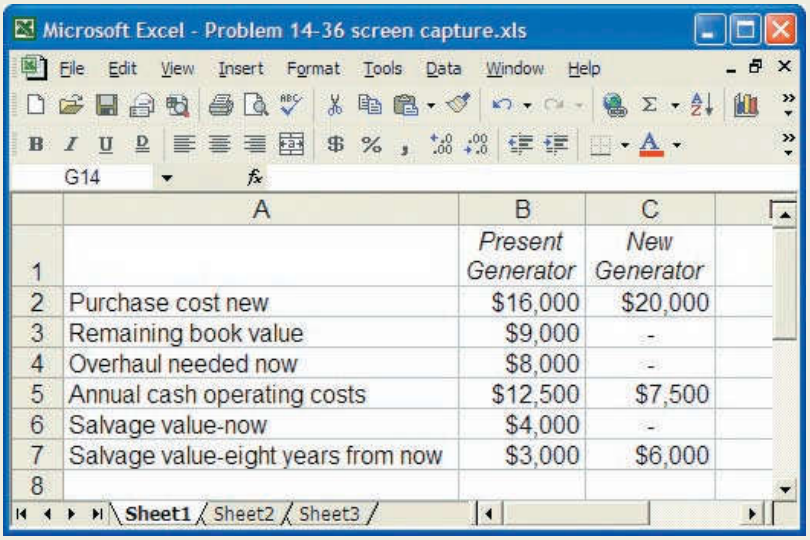
b. Store records indicate that sales have averaged $400,000 per year, and out-of-pocket costs have averaged $370,000 per year (*not* including income taxes). These out-of-pocket costs include rent on the building, cost of goods sold, utilities, and wages and salaries for the sales staff and the store manager. Ms. Lee plans to entrust the day-to-day operations of the store to the manager.
c. Ms. Lee's tax rate is 40%.

Required:

Advise Ms. Lee as to which alternative should be selected. Use the total-cost approach to discounted cash flow in your analysis and a discount rate of 8%. (Round all dollar amounts to the nearest whole dollar.)

PROBLEM: 14-36 Net Present Value; Total and Incremental Approaches [LO1]

Eastbay Hospital has an auxiliary generator that is used when power failures occur. The generator is worn out and must be either overhauled or replaced with a new generator. The hospital has assembled the following information:



	A	B	C
1		*Present Generator*	*New Generator*
2	Purchase cost new	$16,000	$20,000
3	Remaining book value	$9,000	-
4	Overhaul needed now	$8,000	-
5	Annual cash operating costs	$12,500	$7,500
6	Salvage value-now	$4,000	-
7	Salvage value-eight years from now	$3,000	$6,000
8			

Sheet1 Sheet2 Sheet3

If the company keeps and overhauls its present generator, then the generator will be usable for eight more years. If a new generator is purchased, it will be used for eight years, after which it will be replaced. The new generator would be diesel-powered, resulting in a substantial reduction in annual operating costs, as shown above.

The hospital computes depreciation on a straight-line basis. All equipment purchases are evaluated using a 16% discount rate.

Required:

(Ignore income taxes.)

1. Should Eastbay Hospital keep the old generator or purchase the new one? Use the total-cost approach to net present value in making your decision.
2. Redo (1) above, this time using the incremental-cost approach.

PROBLEM: 14-37 (Appendix 14C) Net Present Value Analysis Including Income Taxes [LO8]

The Crescent Drilling Company owns the drilling rights to several tracts of land on which natural gas has been found. The amount of gas on some of the tracts is somewhat marginal, and the company is unsure whether it would be profitable to extract and sell the gas that these tracts contain. One such tract is tract 410, on which the following information has been gathered:

Investment in equipment needed for extraction work	$600,000
Working capital investment needed	$85,000
Annual cash receipts from sale of gas, net of related cash operating expenses (before taxes)	$110,000
Cost of restoring land at completion of extraction work	$70,000

The natural gas in tract 410 would be exhausted after 10 years of extraction work. The equipment would have a useful life of 15 years, but it could be sold for only 15% of its original cost when extraction was completed. For tax purposes, the company would depreciate the equipment over 10 years using straight-line depreciation and assuming zero salvage value. The tax rate is 30%, and the company's after-tax discount rate is 10%. The working capital would be released for use elsewhere at the completion of the project.

Required:

1. Compute the net present value of tract 410. Round all dollar amounts to the nearest whole dollar.
2. Would you recommend that the investment project be undertaken?

Cases


CASE 14-38 Ethics and the Manager; Postaudit

After five years with a national CPA firm with mostly large manufacturing clients, Amy Kimbell joined Hi-Quality Productions Inc. (Hi-Q) as manager of Manufacturing Accounting. Amy has both CPA and CMA credentials.

Hi-Q is a publicly held company producing automotive components. One operation in the Alpha Division requires a highly automated process. Hi-Q's top management and board of directors had outsourced this particular high-tech operation to another company to avoid making a large investment in technology they viewed as constantly changing.

Each operating division of Hi-Q has a budget committee. Two years ago, the Alpha Division budget committee presented to the board its proposal to bring the high-tech operation in house. This would require a capital investment of approximately $4 million but would lead to more than enough cost savings to justify this expenditure. The board approved the proposal, and the investment was made. Later the same year, Amy Kimbell was promoted to assistant corporate controller. In this position, she sits on the budget committee of all divisions.

A little more than a year after the high-tech process was put into operation, the board requested a postaudit review of the actual cost savings. When the board requests such a review, the data are supplied by the management of the affected division and are reviewed by the division's budget committee. When the data were sent to the budget committee for review, Amy Kimbell noted that several of the projections in the original proposal were very aggressive. These included a very high salvage value for the equipment as well as a very long useful life over which cost savings were projected to occur. If more realistic projections had been used, Amy doubted that the board would have agreed to make the investment.

Also in the postaudit review, Amy noted that substantial amounts of incremental service department operating costs directly caused by the new investment were not being attributed to the high-tech operation. Instead, these costs were being allocated as general overhead to all departments. In addition, she noted that the estimated rate for spoiled and defective work contained in the proposal was being used in the review rather than the actual rate, which was considerably higher.

When Amy Kimbell brought these points to the attention of the division's budget committee, she was told that as a new member of the committee she would not be held responsible for decisions, such as the investment in the high-tech operation, that were made prior to her arrival. Accordingly, she should let the seasoned members of the committee handle this particular review. When Amy continued to express her concerns, she was firmly informed that it had been the unanimous decision of the committee to approve the original proposal because it was thought to be in the best long-run interest of the company. And given this consensus, it was felt that certain "adjustments and exceptions" to the postaudit review were justified to ensure the overall long-run well-being of the company.

Required:

1. What should Amy do? (Refer to the IMA's Statement of Ethical Professional Practice for guidance.)
2. Do you have any suggestions for revising the way in which postaudits are conducted at Hi-Q?

(Adapted from Roland L. Madison and Curtis C. Verschoor, "New Position Brings Ethical Dilemma," *Strategic Finance,* December 2000, pp. 22, 24. Used with permission from the IMA, Montvale, NJ, USA, www.imanet.org.)


CASE 14-39 Net Present Value Analysis of a Lease or Buy Decision [LO1]

Wyndham Stores operates a regional chain of upscale department stores. The company is going to open another store soon in a prosperous and growing suburban area. In discussing how the company can acquire the desired building and other facilities needed to open the new store, Harry Wilson, the company's marketing vice president, stated, "I know most of our competitors are starting to lease facilities, rather than buy, but I just can't see the economics of it. Our development people tell me that we can buy the building site, put a building on it, and get all the store fixtures we need for $14 million. They also say that property taxes, insurance, maintenance, and repairs would run $200,000 a year. When you figure that we plan to keep a site for 20 years, that's a total cost of $18 million. But then when you realize that the building and property will be worth at least $5 million in 20 years, that's a net cost to us of only $13 million. Leasing costs a lot more than that."

"I'm not so sure," replied Erin Reilley, the company's executive vice president. "Guardian Insurance Company is willing to purchase the building site, construct a building and install fixtures to our specifications, and then lease the facility to us for 20 years for an annual lease payment of only $1 million."

"That's just my point," said Harry. "At $1 million a year, it would cost us $20 million over the 20 years instead of just $13 million. And what would we have left at the end? Nothing! The building would belong to the insurance company! I'll bet they would even want the first lease payment in advance."

"That's right," replied Erin. "We would have to make the first payment immediately and then one payment at the beginning of each of the following 19 years. However, you're overlooking a few things. For one thing, we would have to tie up a lot of our funds for 20 years under the purchase alternative. We would have to put $6 million down immediately if we buy the property, and then we would have to pay the other $8 million off over four years at $2 million a year."

"But that cost is nothing compared to $20 million for leasing," said Harry. "Also, if we lease, I understand we would have to put up a $400,000 security deposit that we wouldn't get back until the end. And besides that, we would still have to pay all the repair and maintenance costs just like we owned the property. No wonder those insurance companies are so rich if they can swing deals like this."

"Well, I'll admit that I don't have all the figures sorted out yet," replied Erin. "But I do have the operating cost breakdown for the building, which includes $90,000 annually for property taxes, $60,000 for insurance, and $50,000 for repairs and maintenance. If we lease, Guardian will handle its own insurance costs and will pay the property taxes, but we'll have to pay for the repairs and maintenance. I need to put all this together and see if leasing makes any sense with our 12% before-tax required rate of return. The president wants a presentation and recommendation in the executive committee meeting tomorrow."

Required:

(Ignore income taxes.)

1. Using the net present value approach, determine whether Wyndham Stores should lease or buy the new store. Assume that you will be making your presentation before the company's executive committee.
2. How will you reply in the meeting if Harry Wilson brings up the issue of the building's future sales value?

CASE 14-40 Comparison of Alternatives Using Net Present Value Analysis [LO1]

Woolrich Company's market research division has projected a substantial increase in demand over the next several years for one of the company's products. To meet this demand, the company will need to produce units as follows:

Year	Production in Units
1	20,000
2	30,000
3	40,000
4–10.	45,000

At present, the company is using a single model 2600 machine to manufacture this product. To increase its productive capacity, the company is considering two alternatives:

Alternative 1. The company could purchase another model 2600 machine that would operate along with the one it now owns. The following information is available on this alternative:

a. The model 2600 machine now in use was purchased for $165,000 four years ago. Its present book value is $99,000, and its present market value is $90,000.
b. A new model 2600 machine costs $180,000 now. The old model 2600 machine will have to be replaced in six years at a cost of $200,000. The replacement machine will have a market value of about $100,000 when it is four years old.
c. The variable cost required to produce one unit of product using the model 2600 machine is given under the "general information" below.
d. Repairs and maintenance costs each year on a single model 2600 machine total $3,000.

Alternative 2. The company could purchase a model 5200 machine and use the old model 2600 machine as standby equipment. The model 5200 machine is a high-speed unit with double the capacity of the model 2600 machine. The following information is available on this alternative:

a. The cost of a new model 5200 machine is $250,000.
b. The variable cost required to produce one unit of product using the model 5200 machine is given under the "general information" below.

c. The model 5200 machine is more costly to maintain than the model 2600 machine. Repairs and maintenance on a model 5200 machine and on a model 2600 machine used as standby would total $4,600 per year.

The following general information is available on the two alternatives:

a. Both the model 2600 machine and the model 5200 machine have a 10-year life from the time they are first used in production. The scrap value of both machines is negligible and can be ignored. Straight-line depreciation is used by the company.
b. The two machine models are not equally efficient. Comparative variable costs per unit of product are as follows:

	Model 2600	Model 5200
Direct materials per unit	$0.36	$0.40
Direct labor per unit	0.50	0.22
Supplies and lubricants per unit	0.04	0.08
Total variable cost per unit	$0.90	$0.70

c. No other factory costs would change as a result of the decision between the two machines.
d. Woolrich Company uses an 18% discount rate.

Required:

(Ignore income taxes.)

1. Which alternative should the company choose? Use the net present value approach. (Round to the nearest whole dollar.)
2. Suppose that the cost of direct materials increases by 50%. Would this make the model 5200 machine more or less desirable? Explain. No computations are needed.
3. Suppose that the cost of direct labor increases by 25%. Would this make the model 5200 machine more or less desirable? Explain. No computations are needed.