

## 5: How Is Capital Budgeting Used to Make Decisions?

### Chapter 5 How Is Capital Budgeting Used to Make Decisions?

Julie Jackson is the president and owner of Jackson's Quality Copies, a store that makes photocopies for its customers and that has several copy machines. Julie has the following discussion with Mike Haley, the company's accountant:

*Julie:*

*Mike, I think it's time to buy a new copy machine. Our volume of copies has increased dramatically over the last year, and we need a copier that does a better job of handling the big jobs.*

*Mike:*

*Do you have any idea how much the new machine will cost?*

*Julie:*

*We can purchase a new copier for \$50,000, maintenance costs will total \$1,000 a year, and the copier is expected to last 7 years. Since the new machine is quicker and will require less attention by our employees, we should save about \$11,000 a year in labor costs.*

*Mike:*

*Will it have any salvage value at the end of seven years?*

*Julie:*

*Yes. The salvage value should be about \$5,000.*

*Mike:*

*How soon do you want to do this?*

*Julie:*

*As soon as possible. From what I can tell, this is a winning proposition. The cash inflows of \$82,000 that we will get from the labor cost savings and the salvage value exceed the cash outflows of \$57,000 that we expect to spend on the machine and annual maintenance costs. What do you think?*

*Mike:*

*Let me take a look at the numbers before we jump into this. We have to consider more than just total cash inflows and outflows. I'll get back to you by the end of the week.*

*Julie:*

*Okay, thanks for your help!*

Jackson's Quality Copies is facing a decision common to many organizations: whether to invest in equipment that will last for many years or to continue with existing equipment. This type of decision differs from the decisions covered in the previous chapter because long-term investment decisions affect organizations for several years. We will return to Julie's plan to purchase a new copier after we provide background information on long-term investment decisions.

#### 5.1 Capital Budgeting and Decision Making

##### Learning Objective

1. Apply the concept of the time value of money to capital budgeting decisions.

*Question: What is the difference between management decisions made in Chapter 4 "How Are Relevant Revenues and Costs Used to Make Decisions?" and management decisions made in this chapter?*

*Answer: The types of decisions covered in this chapter and Chapter 4 "How Are Relevant Revenues and Costs Used to Make Decisions?" are similar in that they require an analysis of differential revenues and costs. However, Chapter 4 "How Are Relevant*

Revenues and Costs Used to Make Decisions?” involves short-run operating decisions (e.g., special orders from customers), while this chapter focuses on long-run capacity decisions (e.g., purchasing long-lived assets to increase capacity for many years).

Organizations make a variety of long-run investment decisions. The **San Francisco Symphony** invests in stage risers for its orchestra members. **McDonald's** invests in new restaurants. **Honda Motor Co.** invests in new manufacturing facilities. **Bank of America** invests in new branches. These examples have one common feature: all of these companies are investing in assets that will affect the organization for several years.

*Question: The process of analyzing and deciding which long-term investments to make is called a **capital budgeting decision**, also known as a capital expenditure decision. Capital budgeting decisions involve using company funds (capital) to invest in long-term assets. How does the evaluation of these types of capital budgeting decisions differ from short-term operating decisions discussed in Chapter 4 “How Are Relevant Revenues and Costs Used to Make Decisions?”?*

*Answer:* When looking at capital budgeting decisions that affect future years, we must consider the time value of money. The time value of money concept is the premise that a dollar received today is worth more than a dollar received in the future. To clarify this point, suppose a friend owes you \$100. Would you prefer to receive \$100 today or 3 years from today? The money is worth more to you if you receive it today because you can invest the \$100 for 3 years.

For capital budgeting decisions, the issue is how to value future cash flows in today's dollars. The term **cash flow** refers to the amount of cash received or paid at a specific point in time. The term **present value** describes the value of future cash flows (both in and out) in today's dollars.

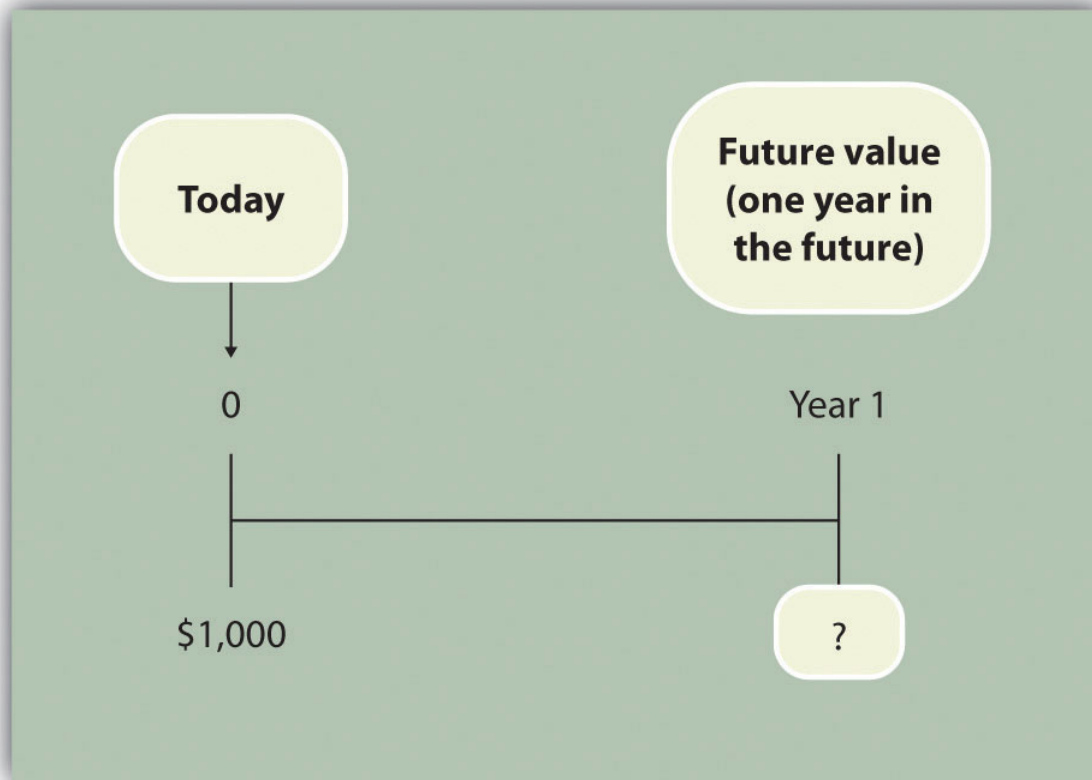
When managers evaluate investments in long-term assets, they want to know how much cash would be spent on the investment and how much cash would be received as a result of the investment. The investment proposal is likely rejected if cash inflows do not exceed cash outflows. (Think about a personal investment. If you would receive only \$700 in the future from an investment of \$1,000 today, you undoubtedly would not make the investment because you would lose \$300!) If cash inflows are expected to exceed cash outflows, managers must consider *when* the cash inflows and outflows occur before taking on the investment. (Again, consider an investment of \$1,000 today. If you expect to receive \$1,050 in 20 years rather than at the end of 1 year, you would probably think twice before investing because it would take 20 years to make \$50!)

*Question: We use two methods to evaluate long-term investments, both of which consider the time value of money. What are these two methods?*

*Answer:* The first is called the *net present value (NPV) method*, and the second is called the *internal rate of return method*. Before presenting these two methods, let's discuss the time value of money (present value) concepts.

## The Present Value Formula

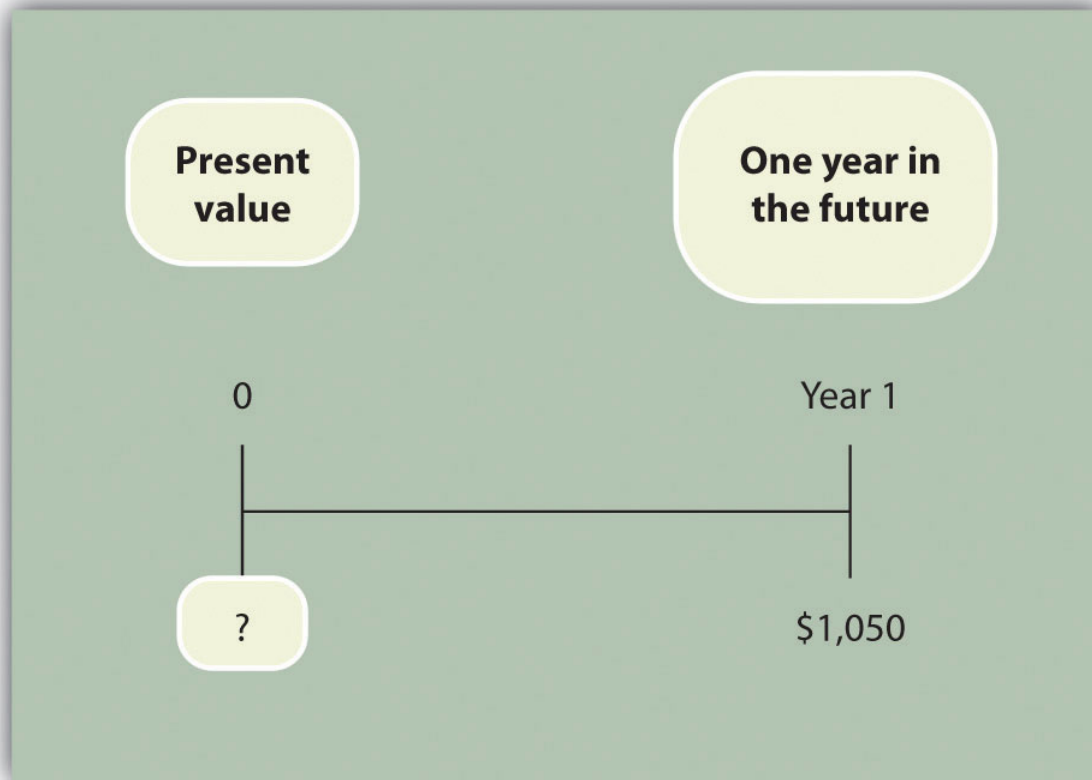
*Question: Suppose you invest \$1,000 for 1 year at an interest rate of 5 percent per year, as shown in the following timeline. How much will you have at the end of 1 year (or what is the **future value** of the investment)?*



Answer: You will have \$1,050:

$$\$1,050 = \$1,000 \times (1 + .05)$$

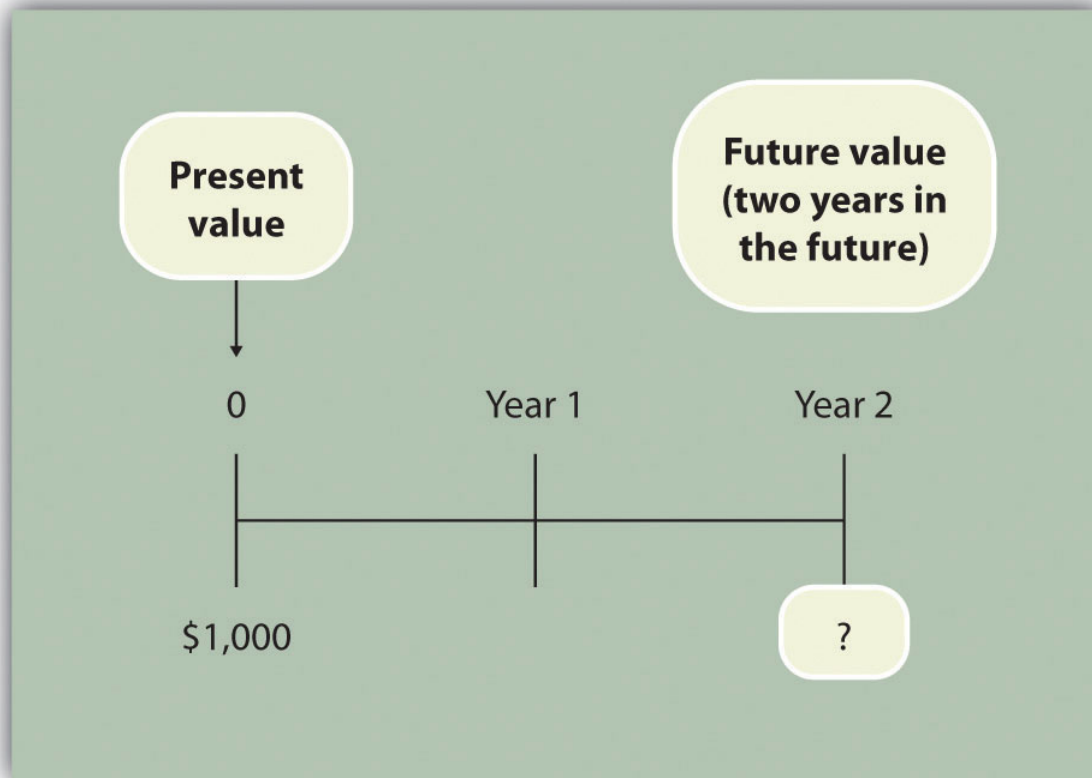
*Question: Let's change course and find the present value of the same future cash flow. If you receive \$1,050 in 1 year, how much is that worth in today's dollars assuming an annual interest rate of 5 percent?*



Answer: The present value is \$1,000, calculated as follows:

$$\$1,000 = \$1,050 / (1 + .05)$$

Question: Let's go back to finding a future value. Assume you invest \$1,000 today at an annual rate of 5 percent for 2 years. How much will you have at the end of 2 years?



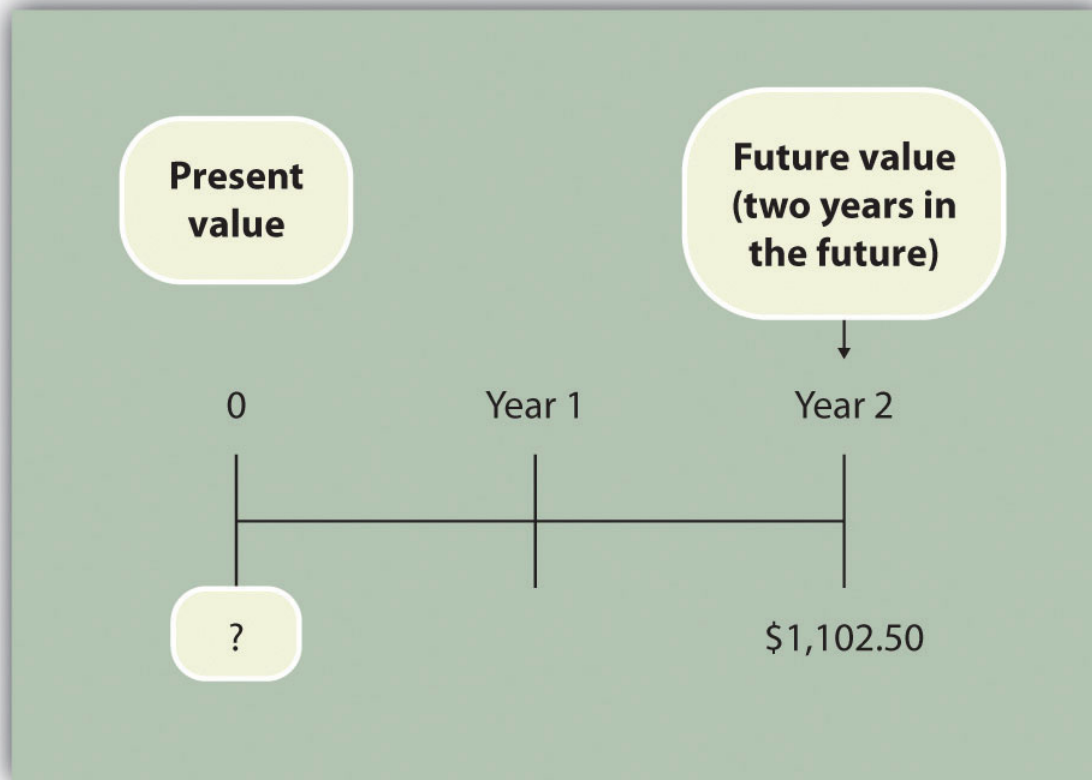
Answer: At the end of 1 year, you will have \$1,050 ( $= \$1,000 \times [1 + .05]$ ). At the end of the second year, you will have \$1,102.50, which is  $\$1,050 \times (1 + .05)$ . The equation is

$$\$1,102.50 = \$1,000 \times (1 + .05) \times (1 + .05)$$

or

$$\$1,102.50 = \$1,000 \times (1 + .05)^2$$

*Question: Again, let's change course and find the present value of the same future cash flow. If you receive \$1,102.50 in 2 years, how much is that worth in today's dollars assuming an annual interest rate of 5 percent?*



Answer: The present value is \$1,000, calculated as follows:

$$\$1,000 = \$1,102.50 / (1 + .05)^2$$

These examples show that one equation can be used to find the *present value* of a future cash flow. The equation is

#### Key Equation

$$P = F_n / (1 + r)^n$$

where

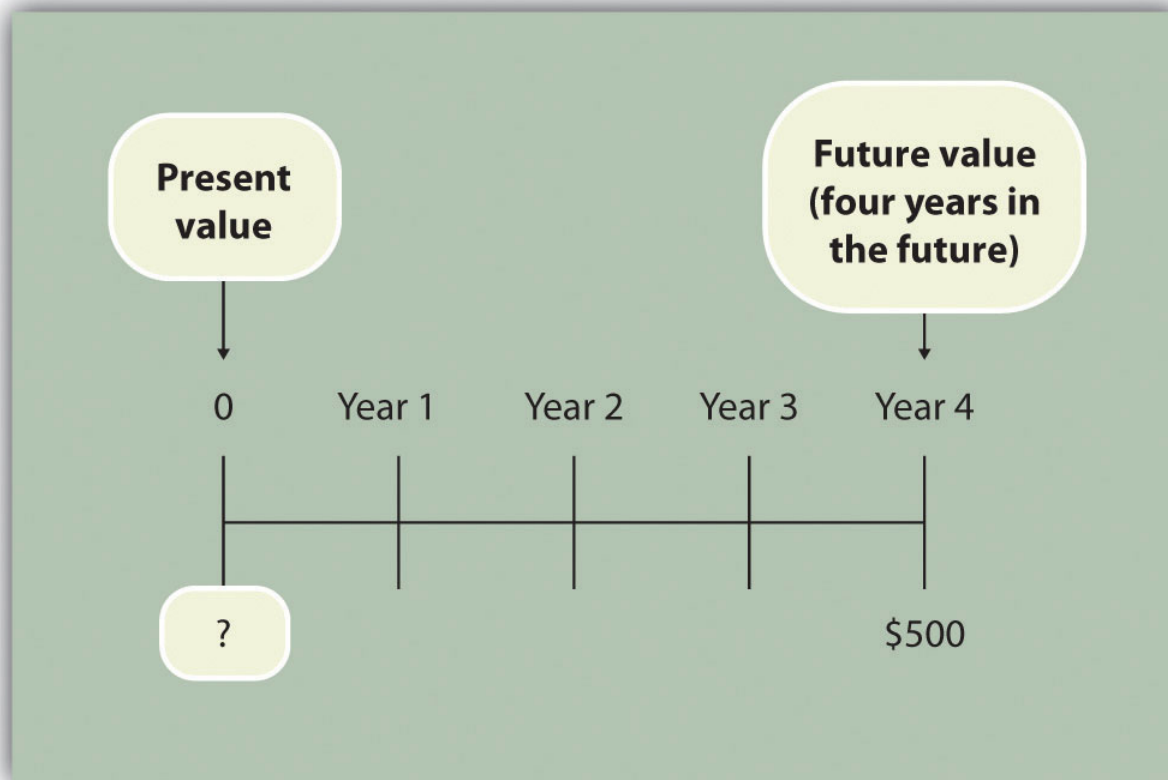
P = Present value of an amount

$F_n$  = Amount received  $n$  years in the future

$r$  = Annual interest rate

$n$  = Number of years

*Question: Let's use this formula to solve for the following: Assume \$500 will be received 4 years from today, and the annual interest rate is 10 percent. What is the present value of this cash flow?*



Answer: The present value is \$341.51, calculated as follows:

$$P = F_n / (1+r)^n = \$500 / (1+.10)^4 = \$500 / 1.4641 = \$341.51$$

## Present Value Tables

*Question: Although most managers use spreadsheets, such as Excel, to perform present value calculations (discussed later in this chapter), you can also use the present value tables in the appendix to this chapter, labeled Figure 5.9 “Present Value of \$1 Received at the End of ” and Figure 5.10 “Present Value of a \$1 Annuity Received at the End of Each Period for “, for these calculations. Figure 5.9 “Present Value of \$1 ” simply provides the present value of \$1 (i.e.,  $F = \$1$ ) given the number of years ( $n$ ) and the interest rate ( $r$ ). How are these tables used to calculate present value amounts?*

Answer: Let’s look at an example to see how these tables work. Assume \$1 will be received 4 years from today ( $n = 4$ ), and the interest rate is 10 percent ( $r = 10$  percent). What is the present value of this cash flow? Look at Figure 5.9 “Present Value of \$1 Received at the End of ” in the appendix. Find the column labeled *10 percent* and the row labeled *4*. The present value is \$0.6830, or \$0.68 rounded. The table amount given is often called a *factor*. The factor in this example is 0.6830 (note that the formula to find this factor is shown at the top of Figure 5.9 “Present Value of \$1 Received at the End of “).

Now assume all the same facts, except that \$500 rather than \$1 will be received in 4 years. To find the present value, simply multiply the factor found in Figure 5.9 “Present Value of \$1 Received at the End of ” by \$500, as follows:

$$\text{Present value} = \text{Amount received in the future} \times \text{Present value factor} = \$500 \times 0.6830 = \$341.50$$

Notice that this present value is the same as the one we calculated using the formula  $P = F_n \div (1 + r)^n$ , with the exception of a small difference due to rounding the factor in Figure 5.9 “Present Value of \$1 Received at the End of “. Next, we use present value concepts to evaluate projects with the NPV method.

## Key Takeaways

- Present value calculations tell us the value of future cash flows in today’s dollars. The present value of a cash flow can be calculated by using the formula  $P = F_n \div (1 + r)^n$ . It can also be calculated by using the tables in the appendix of this chapter.

Simply find the factor in Figure 5.9 “Present Value of \$1 Received at the End of ” given the number of years ( $n$ ) and annual interest rate ( $r$ ). Then multiply the factor by the future cash flow, as follows:

Present value = Amount received in the future  $\times$  Present value factor

### Check Yourself

For each of the following independent scenarios, calculate the present value of the cash flow described. Round to the nearest dollar.

1. You will receive \$5,000, 5 years from today, and the interest rate is 8 percent.
2. You will receive \$80,000, 9 years from today, and the interest rate is 10 percent.
3. You will receive \$400,000, 20 years from today, and the interest rate is 20 percent.
4. You will receive \$250,000, 10 years from today, and the interest rate is 15 percent.

### Solution

Two approaches can be used to find the present value of a cash flow. The first requires using the formula  $P = F_n \div (1 + r)^n$ . The second requires using Figure 5.9 “Present Value of \$1 Received at the End of ” in the appendix to find the present value factor and inserting it in the following formula:

Present value = Amount received in the future  $\times$  Present value factor (from Figure 5.9 “Present Value of \$1 Received at the End of ”)

We show both approaches in the following solutions.

1. Using the formula  $P = F_n \div (1 + r)^n$ , we get

$$\$3,403 = \$5,000 \div (1 + .08)^5$$

Using Figure 5.9 “Present Value of \$1 Received at the End of ”, we get

$$\text{Present value} = \text{Future value} \times \text{Present value factor} \quad \$3,403 = \$5,000 \times 0.6806$$

2. Using the formula  $P = F_n \div (1 + r)^n$ , we get

$$\$33,928 = \$80,000 \div (1 + .10)^9$$

Using Figure 5.9 “Present Value of \$1 Received at the End of ”, we get

$$\text{Present value} = \text{Future value} \times \text{Present value factor} \quad \$33,928 = \$80,000 \times 0.4241$$

3. The small difference between the two approaches is due to rounding the factor in Figure 5.9 “Present Value of \$1 Received at the End of ”.

Using the formula  $P = F_n \div (1 + r)^n$ , we get

$$10,434 = \$400,000 \div (1 + .20)^{20}$$

Using Figure 5.9 “Present Value of \$1 Received at the End of ”, we get

$$\text{Present value} = \text{Future value} \times \text{Present value factor} \quad \$10,440 = \$400,000 \times 0.0261$$

4. The small difference between the two approaches is due to rounding the factor Figure 5.9 “Present Value of \$1 Received at the End of ”.

Using the formula  $P = F_n \div (1 + r)^n$ , we get

$$\$61,796 = \$250,000 \div (1 + .15)^{10}$$

Using Figure 5.9 “Present Value of \$1 Received at the End of ”, we get

$$\text{Present value} = \text{Future value} \times \text{Present value factor} \quad \$61,800 = \$250,000 \times 0.2472$$

## 5.2 Net Present Value



## Learning Objective

1. Evaluate investments using the net present value (NPV) approach.

*Question: Now that we have the tools to calculate the present value of future cash flows, we can use this information to make decisions about long-term investment opportunities. How does this information help companies to evaluate long-term investments?*

Answer: The **net present value (NPV)** is a method of evaluating investments adds the present value of all cash inflows and subtracts the present value of all cash outflows. The term *discounted cash flows* is also used to describe the NPV method. In the previous section, we described how to find the present value of a cash flow. The term *net* in *net present value* means to combine the present value of all cash flows related to an investment (both positive and negative).

Recall the problem facing Jackson's Quality Copies at the beginning of the chapter. The company's president and owner, Julie Jackson, would like to purchase a new copy machine. Julie feels the investment is worthwhile because the cash inflows over the copier's life total \$82,000, and the cash outflows total \$57,000, resulting in net cash inflows of \$25,000 (= \$82,000 – \$57,000). However, this approach ignores the timing of the cash flows. We know from the previous section that the further into the future the cash flows occur, the lower the value in today's dollars.

*Question: How do managers adjust for the timing differences related to future cash flows?*

Answer: Most managers use the NPV approach. This approach requires three steps to evaluate an investment:

**Step 1. Identify the amount and timing of the cash flows required over the life of the investment.**

**Step 2. Establish an appropriate interest rate to be used for evaluating the investment, typically called the **required rate of return**.** (This rate is also called the *discount rate* or *hurdle rate*.)

**Step 3. Calculate and evaluate the NPV of the investment.**

Let's use Jackson's Quality Copies as an example to see how this process works.

**Step 1. Identify the amount and timing of the cash flows required over the life of the investment.**

*Question: What are the cash flows associated with the copy machine that Jackson's Quality Copies would like to buy?*

Answer: Jackson's Quality Copies will pay \$50,000 for the new copier, which is expected to last 7 years. Annual maintenance costs will total \$1,000 a year, labor cost savings will total \$11,000 a year, and the company will sell the copier for \$5,000 at the end of 7 years. Figure 5.1 "Cash Flows for Copy Machine Investment by Jackson's Quality Copies" summarizes the cash flows related to this investment. Amounts in parentheses are cash outflows. All other amounts are cash inflows.

Figure 5.1 Cash Flows for Copy Machine Investment by Jackson's Quality Copies

Timeline	Today 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Purchase price	\$(50,000)							
Maintenance cost		\$ (1,000)	\$ (1,000)	\$ (1,000)	\$ (1,000)	\$ (1,000)	\$ (1,000)	\$ (1,000)
Labor savings		11,000	11,000	11,000	11,000	11,000	11,000	11,000
Salvage value								5,000
Total cash in (out)	<u>\$(50,000)</u>	<u>\$ 10,000</u>	<u>\$ 10,000</u>	<u>\$ 10,000</u>	<u>\$ 10,000</u>	<u>\$ 10,000</u>	<u>\$ 10,000</u>	<u>\$ 15,000</u>

**Step 2. Establish an appropriate interest rate to be used for evaluating the investment.**

*Question: How do managers establish the interest rate to be used for evaluating an investment?*

Answer: Although managers often estimate the interest rate, this estimate is typically based on the organization's *cost of capital*. The **cost of capital** is the weighted average costs associated with debt and equity used to fund long-term investments. The cost of debt is simply the interest rate associated with the debt (e.g., interest for bank loans or bonds issued). The cost of equity is more

difficult to determine and represents the return required by owners of the organization. The weighted average of these two sources of capital represents the cost of capital (finance textbooks address the complexities of this calculation in more detail).

The general rule is the higher the risk of the investment, the higher the required rate of return (assume *required rate of return* is synonymous with *interest rate* for the purpose of calculating the NPV). A firm evaluating a long-term investment with risk similar to the firm's average risk will typically use the cost of capital. However, if a long-term investment carries higher than average risk for the firm, the firm will use a required rate of return higher than the cost of capital.

The accountant at Jackson's Quality Copies, Mike Haley, has established the cost of capital for the firm at 10 percent. Since the proposed purchase of a copy machine is of average risk to the company, Mike will use 10 percent as the required rate of return.

### Step 3. Calculate and evaluate the NPV of the investment.

*Question: How do managers calculate the NPV of an investment?*

Answer: Figure 5.2 "NPV Calculation for Copy Machine Investment by Jackson's Quality Copies" shows the NPV calculation for Jackson's Quality Copies. Examine this table carefully. The cash flows come from Figure 5.1 "Cash Flows for Copy Machine Investment by Jackson's Quality Copies". The present value factors come from Figure 5.9 "Present Value of \$1 Received at the End of " in the appendix ( $r = 10$  percent;  $n = \text{year}$ ). The bottom row, labeled *present value* is calculated by multiplying the total cash in (out)  $\times$  present value factor, and it represents total cash flows for each time period in today's dollars. The bottom right of Figure 5.2 "NPV Calculation for Copy Machine Investment by Jackson's Quality Copies" shows the NPV for the investment, which is the sum of the bottom row labeled *present value*.

Figure 5.2 NPV Calculation for Copy Machine Investment by Jackson's Quality Copies

Timeline (n) $\longrightarrow$	Today 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	
Purchase price	\$(50,000)								
Maintenance cost		\$ (1,000)	\$ (1,000)	\$ (1,000)	\$ (1,000)	\$ (1,000)	\$ (1,000)	\$ (1,000)	
Labor savings		11,000	11,000	11,000	11,000	11,000	11,000	11,000	
Salvage value								5,000	
Total cash in (out)	\$(50,000)	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 15,000	
PV factor ( $r = 10\%$ )	$\times 1.0000$	$\times 0.9091$	$\times 0.8264$	$\times 0.7513$	$\times 0.6830$	$\times 0.6209$	$\times 0.5645$	$\times 0.5132$	
Present value	<u>\$(50,000) +</u>	<u>\$ 9,091 +</u>	<u>\$ 8,264 +</u>	<u>\$ 7,513 +</u>	<u>\$ 6,830 +</u>	<u>\$ 6,209 +</u>	<u>\$ 5,645 +</u>	<u>\$ 7,698 =</u>	<u>\$ 1,250</u>

The NPV is \$1,250. Because NPV is  $> 0$ , accept the investment. (The investment provides a return greater than 10 percent.)

### The NPV Rule

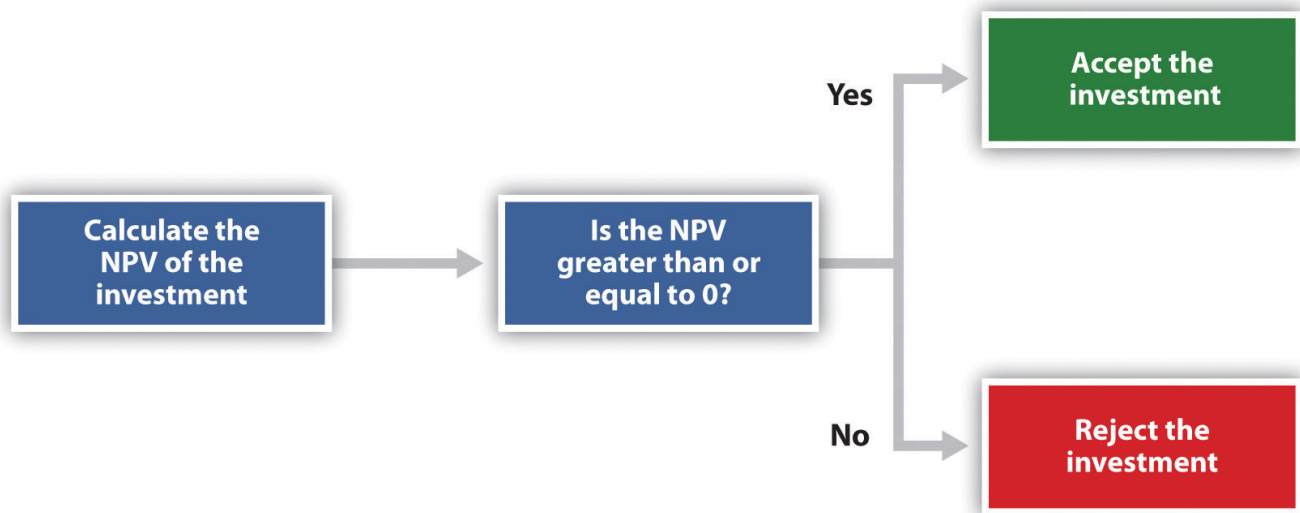
*Question: Once the NPV is calculated, how do managers use this information to evaluate a long-term investment?*

Answer: Managers apply the following rule to decide whether to proceed with the investment:

NPV Rule: *If the NPV is greater than or equal to zero, accept the investment; otherwise, reject the investment.*

As summarized in Figure 5.3 "The NPV Rule", if the NPV is greater than zero, the rate of return from the investment is higher than the required rate of return. If the NPV is zero, the rate of return from the investment equals the required rate of return. If the NPV is less than zero, the rate of return from the investment is less than the required rate of return. Since the NPV is greater than zero for Jackson's Quality Copies, the investment is generating a return greater than the company's required rate of return of 10 percent.

Figure 5.3 The NPV Rule



Note that the present value calculations in Figure 5.3 “The NPV Rule” assume that the cash flows for years 1 through 7 occur at the end of each year. In reality, these cash flows occur throughout each year. The impact of this assumption on the NPV calculation is typically negligible.

#### Business in Action 5.1

##### Cost of Capital by Industry

Cost of capital can be estimated for a single company or for entire industries. **New York University’s Stern School of Business** maintains cost of capital figures by industry. Almost 7,000 firms were included in accumulating this information. The following list shows industries with the highest cost of capital of the industries tracked by NYU. Notice that high-risk industries have relatively high costs of capital.

Transportation (Railroads)	11.17%
Computers/Peripherals	9.90%
Shipbuilding & Marine	9.37%
Software (Internet)	9.29%
Tobacco	8.83%
Precious Metals	8.73%
Drugs (Biotechnology)	8.60%
Drugs (Pharmaceutical)	8.51%
Software (Entertainment)	8.40%
Education	8.30%
Electrical Equipment	8.27%
Engineering/Construction	8.03%
Semiconductor	7.99%
Semiconductor Equip	7.94%
Entertainment	7.83%

Steel	7.82%
Paper/Forest Products	7.80%

Source: [http://people.stern.nyu.edu/adamodar/New\\_Home\\_Page/datafile/wacc.htm](http://people.stern.nyu.edu/adamodar/New_Home_Page/datafile/wacc.htm)

## Annuity Tables

*Question: Notice in Figure 5.1 “Cash Flows for Copy Machine Investment by Jackson’s Quality Copies” that the rows labeled maintenance cost and labor savings have identical cash flows from one year to the next. Identical cash flows that occur in regular intervals, such as these at Jackson’s Quality Copies, are called an **annuity**. How can we use annuities in an alternate format to calculate the NPV?*

*Answer: In Figure 5.4 “Alternative NPV Calculation for Jackson’s Quality Copies”, we demonstrate an alternative approach to calculating the NPV.*

Figure 5.4 Alternative NPV Calculation for Jackson’s Quality Copies

Item Description	(A) Cash Flow In (Out)	(B) Present Value Factor ( $r = 10\%$ )	(A) $\times$ (B) Present Value
Purchase price (today)	\$ (50,000)	1.000*	\$ (50,000)
Annual maintenance costs (years 1–7)	(1,000)	4.8684**	(4,868)
Annual labor savings (years 1–7)	11,000	4.8684**	53,552
Salvage value (end of year 7)	5,000	0.5132*	2,566
Net present value			<u>\$ 1,250</u>

\*Because this is not an annuity, use Figure 5.9 “Present Value of \$1 Received at the End of ” in the appendix.

\*\*Because this is an annuity, use Figure 5.10 “Present Value of a \$1 Annuity Received at the End of Each Period for ” in the appendix. The number of years ( $n$ ) equals seven since identical cash flows occur each year for seven years.

Note: the NPV of \$1,250 is the same as the NPV in Figure 5.2 “NPV Calculation for Copy Machine Investment by Jackson’s Quality Copies”.

The *purchase price* and *salvage value* rows in Figure 5.4 “Alternative NPV Calculation for Jackson’s Quality Copies” represent one-time cash flows, and thus we use Figure 5.9 “Present Value of \$1 Received at the End of ” in the appendix to find the present value factor for these items (these are *not* annuities). The *annual maintenance costs* and *annual labor savings* rows represent cash flows that occur each year for seven years (these are annuities). We use Figure 5.10 “Present Value of a \$1 Annuity Received at the End of Each Period for ” in the appendix to find the present value factor for these items (note that the number of years,  $n$ , equals seven since the cash flows occur each year for seven years). Simply multiply the cash flow shown in column (A) by the present value factor shown in column (B) to find the present value for each line item. Then sum the present value column to find the NPV. This alternative approach results in the same NPV shown in Figure 5.2 “NPV Calculation for Copy Machine Investment by Jackson’s Quality Copies”.

## Business in Action 5.2

### Winning the Lottery

Like many other states, California pays out lottery winnings in installments over several years. For example, a \$1,000,000 lottery winner in California will receive \$50,000 each year for 20 years.

Does this mean that the State of California must have \$1,000,000 on the day the winner claims the prize? No. In fact, California has approximately \$550,000 in cash to pay \$1,000,000 over 20 years. This \$550,000 in cash represents the present value of a \$50,000 annuity lasting 20 years, and the state invests it so that it can provide \$1,000,000 to the winner over 20 years.

Source: California State Lottery, “California State Lottery Home Page,” <http://www.calottery.com>.

### Key Takeaways

- Present value calculations tell us the value of cash flows in today’s dollars. The NPV method adds the present value of all cash inflows and subtracts the present value of all cash outflows related to a long-term investment. If the NPV is greater than or equal to zero, accept the investment; otherwise, reject the investment.

### Check Yourself

The management of Chip Manufacturing, Inc., would like to purchase a specialized production machine for \$700,000. The machine is expected to have a life of 4 years, and a salvage value of \$100,000. Annual maintenance costs will total \$30,000. Annual labor and material savings are predicted to be \$250,000. The company’s required rate of return is 15 percent.

1. Ignoring the time value of money, calculate the net cash inflow or outflow resulting from this investment opportunity.
2. Find the NPV of this investment using the format presented in Figure 5.2 “NPV Calculation for Copy Machine Investment by Jackson’s Quality Copies”.
3. Find the NPV of this investment using the format presented in Figure 5.4 “Alternative NPV Calculation for Jackson’s Quality Copies”.
4. Should Chip Manufacturing, Inc., purchase the specialized production machine? Explain.

### Solution

1. The net cash inflow, ignoring the time value of money, is \$280,000, calculated as follows:

Timeline (n) →	Today 0	Year 1	Year 2	Year 3	Year 4	
Purchase price	\$(700,000)					
Maintenance costs		\$ (30,000)	\$ (30,000)	\$ (30,000)	\$ (30,000)	
Labor and material savings		250,000	250,000	250,000	250,000	
Salvage value					100,000	
Total cash in (out)	<u>\$(700,000) +</u>	<u>\$220,000 +</u>	<u>\$220,000 +</u>	<u>\$220,000 +</u>	<u>\$320,000 =</u>	<u>\$ 280,000</u>

2. The NPV is \$(14,720), calculated as follows:

Timeline (n) →	Today 0	Year 1	Year 2	Year 3	Year 4	
Purchase price	\$(700,000)					
Maintenance costs		\$ (30,000)	\$ (30,000)	\$ (30,000)	\$ (30,000)	
Labor and material savings		250,000	250,000	250,000	250,000	
Salvage value					100,000	
Total cash in (out)	<u>\$(700,000)</u>	<u>\$ 220,000</u>	<u>\$ 220,000</u>	<u>\$ 220,000</u>	<u>\$ 320,000</u>	
PV factor (r = 15%)	<u>× 1.0000</u>	<u>× 0.8696</u>	<u>× 0.7561</u>	<u>× 0.6575</u>	<u>× 0.5718</u>	
Present value	<u>\$(700,000) +</u>	<u>\$ 191,312 +</u>	<u>\$ 166,342 +</u>	<u>\$ 144,650 +</u>	<u>\$ 182,976 =</u>	<u>\$ (14,720)</u>

3. The alternative format used for calculating the NPV is shown as follows. Note that the NPV here is identical to the NPV calculated previously in part 2.



<u>Item Description</u>	<u>(A) Cash Flow In (Out)</u>	<u>(B) Present Value Factor (<math>r = 15\%</math>)</u>	<u>(A) × (B) Present Value</u>
Purchase price (today)	\$ (700,000)	1.000*	\$ (700,000)
Annual maintenance costs (years 1–4)	(30,000)	2.8550**	(85,650)
Annual labor and material savings (years 1–4)	250,000	2.8550**	713,750
Salvage value (end of year 4)	100,000	0.5718*	57,180
Net present value			<u>\$ (14,720)</u>

\*Because this is not an annuity, use Figure 5.9 “Present Value of \$1 Received at the End of ” in the appendix.

\*\*Because this is an annuity, use Figure 5.10 “Present Value of a \$1 Annuity Received at the End of Each Period for ” in the appendix. The number of years ( $n$ ) equals four since identical cash flows occur each year for four years.

- Because the NPV is less than 0, the return generated by this investment is less than the company’s required rate of return of 15 percent. Thus Chip Manufacturing, Inc., should *not* purchase the specialized production machine.

### 5.3 The Internal Rate of Return

#### Learning Objectives

- Evaluate investments using the internal rate of return (IRR) approach.

*Question: Using the internal rate of return (IRR) to evaluate investments is similar to using the net present value (NPV) in that both methods consider the time value of money. However, the IRR provides additional information that helps companies evaluate long-term investments. What is the IRR, and how does it help managers make decisions related to long-term investments?*

Answer: The **internal rate of return (IRR)** is the rate required ( $r$ ) to get an NPV of zero for a series of cash flows. The IRR represents the time-adjusted rate of return for the investment being considered. The *IRR decision rule* states that if the IRR is greater than or equal to the company’s required rate of return (recall that this is often called the *hurdle rate*), the investment is accepted; otherwise, the investment is rejected.

Most managers use a spreadsheet, such as Excel, to calculate the IRR for an investment (we discuss this later in the chapter). However, we can also use trial and error to approximate the IRR. *The goal is simply to find the rate that generates an NPV of zero.* Let’s go back to the Jackson’s Quality Copies example. Figure 5.4 “Alternative NPV Calculation for Jackson’s Quality Copies” provides the projected cash flows for a new copy machine and the NPV calculation using a rate of 10 percent. Recall that the NPV was \$1,250, indicating the investment generates a return greater than the company’s required rate of return of 10 percent.

Although it is useful to know that the investment’s return is greater than the company’s required rate of return, managers often want to know the exact return generated by the investment. (It is often not enough to state that the exact return is something higher than 10 percent!) Managers also like to rank investment opportunities by the return each investment is expected to generate. Our goal now is to determine the exact return—that is, to determine the IRR. We know from Figure 5.4 “Alternative NPV Calculation for Jackson’s Quality Copies” that the copy machine investment generates a return greater than 10 percent. Figure 5.5 “Finding the IRR for Jackson’s Quality Copies” summarizes this calculation with the 2 columns under the 10 percent heading.

The far right side of Figure 5.5 “Finding the IRR for Jackson’s Quality Copies” shows that the NPV is \$(2,100) if the rate is increased to 12 percent (recall our goal is to find the rate that yields an NPV of 0). Thus the IRR is between 10 and 12 percent. Next, we try 11 percent. As shown in the middle of Figure 5.5 “Finding the IRR for Jackson’s Quality Copies”, 11 percent provides an NPV of \$(469). Thus the IRR is between 10 and 11 percent; it is closer to 11 percent because \$(469) is closer to 0 than \$1,250. (Note that as the rate *increases*, the NPV *decreases*, and as the rate *decreases*, the NPV *increases*.)

Figure 5.5 Finding the IRR for Jackson's Quality Copies

Item Description	Cash Flow In (Out)	10%		11%		12%	
		Factor at 10%	Present Value	Factor at 11%	Present Value	Factor at 12%	Present Value
Purchase price (today)	\$(50,000)	1.000*	\$(50,000)	1.000*	\$(50,000)	1.000*	\$(50,000)
Maintenance cost (years 1–7)	(1,000)	4.8684**	(4,868)	4.7122**	(4,712)	4.5638**	(4,564)
Labor savings (years 1–7)	11,000	4.8684**	53,552	4.7122**	51,834	4.5638**	50,202
Salvage value (end of year 7)	5,000	0.5132*	2,566	0.4817*	2,409	0.4523*	2,262
Net present value			<u>\$ 1,250</u>		<u>\$ (469)</u>		<u>\$ (2,100)</u>

\*Because this is not an annuity, use Figure 5.9 “Present Value of \$1 Received at the End of ” in the appendix.

\*\*Because this is an annuity, use Figure 5.10 “Present Value of a \$1 Annuity Received at the End of Each Period for ” in the appendix. The number of years ( $n$ ) equals seven since identical cash flows occur each year for seven years.

Note: the NPV of \$(469) is closest to 0. Thus the IRR is close to 11 percent.

This trial and error approach allows us to approximate the IRR. As stated earlier, if the IRR is greater than or equal to the company's required rate of return, the investment is accepted; otherwise, the investment is rejected. For Jackson's Quality Copies, the IRR of approximately 11 percent is greater than the company's required rate of return of 10 percent. Thus the investment should be accepted.

### Computer Application

#### Using Excel to Calculate NPV and IRR

Let's use the Jackson's Quality Copies example presented at the beginning of the chapter to illustrate how Excel can be used to calculate the NPV and IRR. Two steps are required to calculate the NPV and IRR using Excel. All cell references are to the following spreadsheet shown.

	A	B	C	D	E	F	G	H	I	J
1		Today	Year	Year	Year	Year	Year	Year	Year	
2	Timeline →	0	1	2	3	4	5	6	7	
3	Purchase price	(\$50,000)								
4	Maintenance cost		(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	
5	Labor savings		\$11,000	\$11,000	\$11,000	\$11,000	\$11,000	\$11,000	\$11,000	
6	Salvage value									\$5,000
7	Total cash in (out)	(\$50,000)	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$15,000	
8										
9										
10	Required rate of return	0.10								
11										
12										
13										
14										
15										
16	Function used to calculate <b>net present value</b> in cell H16 is	=NPV(B10,C7:I7)+B7				<b>Answer:</b>		<b>\$1,250</b>		
17										
18										
19										
20										
21										
22										
23										
24										
25										
26										
27										
28	Function used to calculate <b>internal rate of return</b> in cell H28 is	=IRR(B7:I7,0.12)				<b>Answer:</b>		<b>10.72%</b>		
29										
30										
31										
32										
33										
34										
35										
36										

### Step 1. Enter the data in the spreadsheet.

Rows 1 through 7 in the spreadsheet show the cash flows associated with the proposal to purchase a new copy machine at Jackson's Quality Copies (first presented in Figure 5.1 "Cash Flows for Copy Machine Investment by Jackson's Quality Copies").

### Step 2. Input the functions to calculate NPV and IRR.

We selected cell H16 to calculate the NPV, so this is where the NPV function is input. Cell E16 shows the function in detail with dialogue boxes provided for clarification. Notice that the resulting NPV of \$1,250 shown in cell H16 is the same as the NPV calculated in Figure 5.2 "NPV Calculation for Copy Machine Investment by Jackson's Quality Copies" and Figure 5.4 "Alternative NPV Calculation for Jackson's Quality Copies".

We selected cell H28 to calculate the IRR, so this is where the IRR function is input. Cell E28 shows the function in detail. Notice that the resulting IRR of 10.72 percent shown in cell H28 is very close to our approximation of slightly less than 11 percent shown in Figure 5.5 "Finding the IRR for Jackson's Quality Copies".

As an alternative to entering a function directly into the spreadsheet, the NPV function under the *Formulas* menu in Excel can be used. Simply select the cell in the spreadsheet where you would like the answer to appear (H16 in this case), and go to the *Formulas* menu. Click on the *fx* symbol or *Insert Function* on the formula bar. Search for the function by typing in NPV, select NPV where it appears in the box, then select OK. When asked for the *Rate*, enter the cell where the rate appears (B10). Then under *Value 1* enter the cells containing the series of cash flows, starting with year 1 (shown as C7:I7, which means C7 through I7). Select OK. Now go back and add the cash flow at time 0 (B7) to the end of the NPV function. The resulting formula will look like the formula shown in E16, and the answer will appear in the cell where the function is entered (H16).



The IRR function can be inserted into a cell using the same process presented previously. Select the cell in the spreadsheet where you would like the answer to appear (H28), and go to the *Formulas* menu. Click on the *fx* symbol or *Insert Function* on the formula bar. Search for the function by typing in *IRR*, select *IRR* where it appears in the box below, then select *OK*. When asked for *Values*, enter the cells containing the series of cash flows, starting with time 0 (shown as B7:I7, which means B7 through I7 *the amount in the first referenced cell must be negative or excel will give you an error*). When asked for a *Guess*, enter your best guess as to what the IRR might be (this provides the system with a starting point), then select *OK*. The resulting formula will look like the formula shown in E28, and the answer will appear in the cell where the function is entered (H28).

### Key Takeaways

- The IRR is the rate required ( $r$ ) to get an NPV of zero for a series of cash flows and represents the time-adjusted rate of return for an investment. If the IRR is greater than or equal to the company's required rate of return (often called the hurdle rate), the investment is accepted; otherwise, the investment is rejected. Excel can be used to easily calculate the NPV and IRR.

## 5.4 Other Factors Affecting NPV and IRR Analysis

### Learning Objectives

1. Understand the impact of cash flows, qualitative factors, and ethical issues on long-term investment decisions.

*Question: We have described the net present value (NPV) and internal rate of return (IRR) approaches to evaluating long-term investments. With both of these approaches, there are several important issues that must be considered. What are these important issues?*

*Answer:* These issues include focusing on cash flows, factoring in inflation, assessing qualitative factors, and ethical considerations. All are described next.

### Focusing on Cash Flows

*Question: Which basis of accounting is used to calculate the NPV and IRR for long-term investments, cash or accrual?*

*Answer:* Both methods of evaluating long-term investments, NPV and IRR, focus on the amount of cash flows and when the cash flows occur. Note that the timing of revenues and costs in financial accounting using the accrual basis is often not the same as when the cash inflows and outflows occur. A sale can be recorded in one period, and the cash be collected in a future period. Costs can occur in one period, and the cash be paid in a future period. For the purpose of making NPV and IRR calculations, managers typically use the time period when the cash flow occurs.

When a company invests in a long-term asset, such as a production building, the cash outflow for the asset is included in the NPV and IRR analyses. The depreciation taken on the asset in future periods is not a cash flow and is *not* included in the NPV and IRR calculations. However, there is a cash benefit related to depreciation (often called a *depreciation tax shield*) since income taxes paid are reduced as a result of recording depreciation expense.

### Factoring in Inflation

*Question: Is inflation included in cash flow projections when calculating the NPV and IRR?*

*Answer:* Most managers make cash flow projections that include an adjustment for inflation. When this is done, a rate must be used that also factors in inflation over the life of the investment. As discussed earlier in the chapter, the required rate of return used for NPV calculations is based on the firm's cost of capital, which is the weighted average cost of debt and equity. Since the cost of debt and equity already includes the effect of inflation, no inflation adjustment is necessary when establishing the required rate of return.

The important point here is that *cash flow projections must include adjustments for inflation to match the required rate of return, which already factors in inflation*. If cash flows are not adjusted for inflation, managers are likely underestimating future cash flows and therefore underestimating the NPV of the investment opportunity. This is particularly pronounced for economies that have relatively high rates of inflation.

For the purposes of this chapter, assume all cash flows and required rates of return are adjusted for inflation.

## Be Aware of Qualitative Factors

*Question: So far, this chapter has focused on using cash flow projections and the time value of money to evaluate long-term investments. Using these quantitative factors to make decisions allows managers to support decisions with measurable data. For example, the investment opportunity at Jackson's Quality Copies presented at the beginning of the chapter was accepted because the NPV of \$1,250 was greater than 0, and the IRR of 11 percent was greater than the company's required rate of return of 10 percent. Why do most companies also consider nonfinancial factors, often called qualitative factors, when making a long-term investment decision?*

Answer: Although using quantitative factors for decision making is important, qualitative factors may outweigh the quantitative factors in making a decision. For example, a large manufacturer of medical devices recently invested several million dollars in a small start-up medical device firm. When asked about the NPV analysis, the manager responsible for the investment indicated, "My staff did a quick and dirty NPV analysis, which indicated we should not invest in the company. However, the technology they were using for their device was of such strategic importance to us, we could not pass up the investment." This is an example of *qualitative* factors (strategic importance to the company) outweighing *quantitative* factors (negative NPV).

Similar situations often arise when companies must invest in long-term assets even though NPV and IRR analyses indicate otherwise. Here are a few examples:

- Investing in new production facilities may be essential to maintaining a reputation as the industry leader in innovation, even though the quantitative analysis (NPV and IRR) points to rejecting the investment. (It is difficult to quantify the benefits of being the "industry leader in innovation.")
- Investing in pollution control devices for an oil refinery may provide social benefits even though the quantitative analysis (NPV and IRR) points to rejecting the investment. (Although a reduction in fines and legal costs may be quantifiable and included in the analyses, it is difficult to quantify the social benefits.)
- Investing in a new product line of entry-level automobiles may increase foot traffic at the showroom, resulting in increased sales of other products, even though the quantitative analysis (NPV and IRR) points to rejecting the investment. (It is difficult to quantify the impact of the new product line on sales of existing product lines.)

Clearly, managers must look at the financial information and analysis when considering whether to invest in long-term assets. However, the analysis does not stop with financial information. Managers and decision makers must also consider qualitative factors.

## Business in Action 5.3 – Nike's financial statements and management explanation

### Nike Cash Flow statement

## Ethical Issues

*Question: Our discussion of NPV and IRR methods implies that managers can easily make capital budgeting decisions once NPV and IRR analyses are completed and qualitative factors have been considered. However, managers sometimes make decisions that are not in the best interest of the company. Why might managers make decisions that are not in the best interest of the company?*

Answer: Several examples are provided next.

## Short-Term Incentives Affect Long-Term Decisions

Managers are often evaluated and compensated based on annual financial results. The financial results are typically measured using financial accounting data prepared on an accrual basis.

Suppose you are a manager considering an investment opportunity to start a new product line that has a positive NPV. Because the NPV is positive, you should accept the investment proposal. However, revenues and related cash inflows are not significant until after the second year. In the first two years, revenues are low and depreciation charges are high, resulting in significantly lower overall company net income than if the project were rejected. Assuming you are evaluated and compensated based on annual net income, you may be inclined to reject the new product line regardless of the NPV analysis.

Many companies are aware of this conflict between the manager's incentive to improve short-term results and the company's goal to improve long-term results. To mitigate this conflict, some companies offer managers part ownership in the company (e.g., through stock options), creating an incentive to increase the value of the company over the long run.

## Modifying Cash Flow Estimates to Get Approval

Managers often have a vested interest in getting proposals approved regardless of NPV and IRR results. For example, assume a manager spent several years developing a plan to construct a new production facility. Because of the significant work involved, and the projected benefits of building a new facility, the manager wants to see the proposal approved. However, the NPV analysis indicates the production facility proposal does not meet the company's minimum required rate of return. As a result, the manager decides to inflate projected cash inflows to get a positive NPV, and the project is approved.

Clearly, a conflict exists between the company's desire to accept projects that meet or exceed the required rate of return and the manager's desire to get approval for a "pet" project regardless of its profitability. Again, having part ownership in a company provides an incentive for managers to reject proposals that will not increase the value of the company.

Another way to mitigate this conflict is to conduct a [postaudit](#), which compares the original capital budget with the actual results. Managers who provide misleading capital budget analyses are identified through this process. Postaudits provide an incentive for managers to provide accurate estimates.

### Key Takeaways

- Although accountants are responsible for providing relevant and objective financial information to help managers make decisions, several important factors play a significant role in the decision-making process as described here:
  - NPV and IRR analyses use cash flows to evaluate long-term investments rather than the accrual basis of accounting.
  - Cash flow projections must include adjustments for inflation to match the required rate of return, which already factor in inflation.
  - Using quantitative factors to make decisions allows managers to support decisions with measurable data. However, nonfinancial factors (often called qualitative factors) must be considered as well.
  - Circumstances sometimes exist that cause managers to make decisions that are not in the best interest of the company. For example, managers may be evaluated on short-term financial results even though it is in the best interest of the company to invest in projects that are profitable in the long term. Thus projects that reduce short-term profitability in lieu of significant long-term profits may be rejected.

## 5.6 Additional Complexities of Estimating Cash Flows

### Learning Objective

1. Evaluate investments with multiple investment and working capital cash flows.

*Question: The examples in this chapter are intended to help you learn the basics of evaluating investments using the net present value (NPV), and internal rate of return (IRR). However, there are two additional items related to estimating cash flows that must be considered: investment cash outflows and working capital. How do these two items impact long-term investment decisions?*

*Answer: These items impact the analysis of long-term investments as described next.*

### Investment Cash Outflows

The examples thus far have assumed that cash outflows for the investment occur only at the beginning of the investment. However, some investments require cash outflows at varying points throughout the life of the project. For example, suppose the **Walmart** plans to open a new store, which requires a \$10,000,000 investment at the beginning of the project for construction of the building. However, the building will be expanded at the end of year 4, at a cost of \$2,000,000, to meet an expected increase in demand. The \$2,000,000 cash outflow must be included in the cash flows of the project for year 4 when calculating the NPV and IRR.

### Working Capital

[Working capital](#) is defined as current assets (cash, accounts receivable, inventory, and the like) minus current liabilities (accounts payable, wages payable, and accrued liabilities, for instance). Many long-term investments require working capital. For example,

**Walmart** will need cash in its registers when it opens the new store. Working capital is also required to fund inventory. Working capital necessary for long-term investments should be included as a cash outflow, typically at the beginning of the project.

Some long-term investments have an expected life, at the end of which working capital is returned to the company for investment elsewhere. When this happens, the working capital is included in the cash flow analysis as a cash *outflow* at the beginning of the project and a cash *inflow* at the end of the project.

### Key Takeaways

- Investment proposals often include investment cash outflows at varying points throughout the life of the project. These cash flows must be included when evaluating investment proposals using NPV, and IRR. Many investments include working capital cash flows required to fund items such as inventory and accounts receivable. Working capital is included as a cash outflow, typically at the beginning of the project, and is often returned back to the company as a cash inflow later in the project.

### Check yourself

The management of Environmental Engineering, Inc. (EEI), would like to open an office for 6 years in a high-growth area of Las Vegas. The initial investment required to purchase an office building is \$250,000, and EEI needs \$50,000 in working capital for the new office. Working capital will be returned to EEI at the end of 6 years. EEI expects to remodel the office at the end of 3 years at a cost of \$200,000. Annual *net* cash receipts from daily operations (cash receipts minus cash payments) are expected to be as follows:

Year 1	\$ 60,000
Year 2	\$ 80,000
Year 3	\$120,000
Year 4	\$150,000
Year 5	\$160,000
Year 6	\$110,000

Although the company's cost of capital is 8 percent, management set a required rate of return of 12 percent due to the high risk associated with this project.

- Find the NPV of this investment using the format presented in Figure 5.2 "NPV Calculation for Copy Machine Investment by Jackson's Quality Copies".
- Based on your answer to 1, should EEI open the new office? Explain.

### Solution

- The NPV is \$27,571, as shown in the following figure.

Timeline (n) →	Today 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	
Building cost	\$(250,000)							
Working capital	(50,000)							
Net cash receipts		\$ 60,000	\$ 80,000	\$120,000	\$150,000	\$160,000	\$110,000	
Remodel cost				(200,000)				
Return of working capital							50,000	
Total cash in (out)	\$(300,000)	\$ 60,000	\$ 80,000	\$(80,000)	\$150,000	\$160,000	\$160,000	
PV factor ( $r = 12\%$ )	$\times 1.0000$	$\times 0.8929$	$\times 0.7972$	$\times 0.7118$	$\times 0.6355$	$\times 0.5674$	$\times 0.5066$	
Present value	<u>\$(300,000) +</u>	<u>\$ 53,574 +</u>	<u>\$ 63,776 +</u>	<u>\$(56,944) +</u>	<u>\$ 95,325 +</u>	<u>\$ 90,784 +</u>	<u>\$ 81,056 =</u>	<u>\$ 27,571</u>

- The NPV is \$27,571. Because NPV is  $> 0$ , accept the investment. (The investment provides a return greater than 12 percent.)

## 5.8 Appendix: Present Value Tables

Figure 5.9 Present Value of \$1 Received at the End of  $n$  Periods

Periods	Rate per Period														
	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	18%	20%	25%	30%
0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1	0.9524	0.9434	0.9346	0.9259	0.9174	0.9091	0.9009	0.8929	0.8850	0.8772	0.8696	0.8475	0.8333	0.8000	0.7692
2	0.9070	0.8900	0.8734	0.8573	0.8417	0.8264	0.8116	0.7972	0.7831	0.7695	0.7561	0.7182	0.6944	0.6400	0.5917
3	0.8638	0.8396	0.8163	0.7938	0.7722	0.7513	0.7312	0.7118	0.6931	0.6750	0.6575	0.6086	0.5787	0.5120	0.4552
4	0.8227	0.7921	0.7629	0.7350	0.7084	0.6830	0.6587	0.6355	0.6133	0.5921	0.5718	0.5158	0.4823	0.4096	0.3501
5	0.7835	0.7473	0.7130	0.6806	0.6499	0.6209	0.5935	0.5674	0.5428	0.5194	0.4972	0.4371	0.4019	0.3277	0.2693
6	0.7462	0.7050	0.6663	0.6302	0.5963	0.5645	0.5346	0.5066	0.4803	0.4556	0.4323	0.3704	0.3349	0.2621	0.2072
7	0.7107	0.6651	0.6227	0.5835	0.5470	0.5132	0.4817	0.4523	0.4251	0.3996	0.3759	0.3139	0.2791	0.2097	0.1594
8	0.6768	0.6274	0.5820	0.5403	0.5019	0.4665	0.4339	0.4039	0.3762	0.3506	0.3269	0.2660	0.2326	0.1678	0.1226
9	0.6446	0.5919	0.5439	0.5002	0.4604	0.4241	0.3909	0.3606	0.3329	0.3075	0.2843	0.2255	0.1938	0.1342	0.0943
10	0.6139	0.5584	0.5083	0.4632	0.4224	0.3855	0.3522	0.3220	0.2946	0.2697	0.2472	0.1911	0.1615	0.1074	0.0725
11	0.5847	0.5268	0.4751	0.4289	0.3875	0.3505	0.3173	0.2875	0.2607	0.2366	0.2149	0.1619	0.1346	0.0859	0.0558
12	0.5568	0.4970	0.4440	0.3971	0.3555	0.3186	0.2858	0.2567	0.2307	0.2076	0.1869	0.1372	0.1122	0.0687	0.0429
13	0.5303	0.4688	0.4150	0.3677	0.3262	0.2897	0.2575	0.2292	0.2042	0.1821	0.1625	0.1163	0.0935	0.0550	0.0330
14	0.5051	0.4423	0.3878	0.3405	0.2992	0.2633	0.2320	0.2046	0.1807	0.1597	0.1413	0.0985	0.0779	0.0440	0.0254
15	0.4810	0.4173	0.3624	0.3152	0.2745	0.2394	0.2090	0.1827	0.1599	0.1401	0.1229	0.0835	0.0649	0.0352	0.0195
16	0.4581	0.3936	0.3387	0.2919	0.2519	0.2176	0.1883	0.1631	0.1415	0.1229	0.1069	0.0708	0.0541	0.0281	0.0150
17	0.4363	0.3714	0.3166	0.2703	0.2311	0.1978	0.1696	0.1456	0.1252	0.1078	0.0929	0.0600	0.0451	0.0225	0.0116
18	0.4155	0.3503	0.2959	0.2502	0.2120	0.1799	0.1528	0.1300	0.1108	0.0946	0.0808	0.0508	0.0376	0.0180	0.0089
19	0.3957	0.3305	0.2765	0.2317	0.1945	0.1635	0.1377	0.1161	0.0981	0.0829	0.0703	0.0431	0.0313	0.0144	0.0068
20	0.3769	0.3118	0.2584	0.2145	0.1784	0.1486	0.1240	0.1037	0.0868	0.0728	0.0611	0.0365	0.0261	0.0115	0.0053
21	0.3589	0.2942	0.2415	0.1987	0.1637	0.1351	0.1117	0.0926	0.0768	0.0638	0.0531	0.0309	0.0217	0.0092	0.0040
22	0.3418	0.2775	0.2257	0.1839	0.1502	0.1228	0.1007	0.0826	0.0680	0.0560	0.0462	0.0262	0.0181	0.0074	0.0031
23	0.3256	0.2618	0.2109	0.1703	0.1378	0.1117	0.0907	0.0738	0.0601	0.0491	0.0402	0.0222	0.0151	0.0059	0.0024
24	0.3101	0.2470	0.1971	0.1577	0.1264	0.1015	0.0817	0.0659	0.0532	0.0431	0.0349	0.0188	0.0126	0.0047	0.0018
25	0.2953	0.2330	0.1842	0.1460	0.1160	0.0923	0.0736	0.0588	0.0471	0.0378	0.0304	0.0160	0.0105	0.0038	0.0014
26	0.2812	0.2198	0.1722	0.1352	0.1064	0.0839	0.0663	0.0525	0.0417	0.0331	0.0264	0.0135	0.0087	0.0030	0.0011
27	0.2678	0.2074	0.1609	0.1252	0.0976	0.0763	0.0597	0.0469	0.0369	0.0291	0.0230	0.0115	0.0073	0.0024	0.0008
28	0.2551	0.1956	0.1504	0.1159	0.0895	0.0693	0.0538	0.0419	0.0326	0.0255	0.0200	0.0097	0.0061	0.0019	0.0006
29	0.2429	0.1846	0.1406	0.1073	0.0822	0.0630	0.0485	0.0374	0.0289	0.0224	0.0174	0.0082	0.0051	0.0015	0.0005
30	0.2314	0.1741	0.1314	0.0994	0.0754	0.0573	0.0437	0.0334	0.0256	0.0196	0.0151	0.0070	0.0042	0.0012	0.0004

Note: Factor= $1/(1+r)^n$

Figure 5.10 Present Value of a \$1 Annuity Received at the End of Each Period for  $n$  Periods



Periods	Rate per Period														
	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	18%	20%	25%	30%
1	0.9524	0.9434	0.9346	0.9259	0.9174	0.9091	0.9009	0.8929	0.8850	0.8772	0.8696	0.84746	0.8333	0.8000	0.7692
2	1.8594	1.8334	1.8080	1.7833	1.7591	1.7355	1.7125	1.6901	1.6681	1.6467	1.6257	1.56564	1.5278	1.4400	1.3609
3	2.7232	2.6730	2.6243	2.5771	2.5313	2.4869	2.4437	2.4018	2.3612	2.3216	2.2832	2.17427	2.1065	1.9520	1.8161
4	3.5460	3.4651	3.3872	3.3121	3.2397	3.1699	3.1024	3.0373	2.9745	2.9137	2.8550	2.69006	2.5887	2.3616	2.1662
5	4.3295	4.2124	4.1002	3.9927	3.8897	3.7908	3.6959	3.6048	3.5172	3.4331	3.3522	3.12717	2.9906	2.6893	2.4356
6	5.0757	4.9173	4.7665	4.6229	4.4859	4.3553	4.2305	4.1114	3.9975	3.8887	3.7845	3.4976	3.3255	2.9514	2.6427
7	5.7864	5.5824	5.3893	5.2064	5.0330	4.8684	4.7122	4.5638	4.4226	4.2883	4.1604	3.8115	3.6046	3.1611	2.8021
8	6.4632	6.2098	5.9713	5.7466	5.5348	5.3349	5.1461	4.9676	4.7988	4.6389	4.4873	4.0776	3.8372	3.3289	2.9247
9	7.1078	6.8017	6.5152	6.2469	5.9952	5.7590	5.5370	5.3282	5.1317	4.9464	4.7716	4.3030	4.0310	3.4631	3.0190
10	7.7217	7.3601	7.0236	6.7101	6.4177	6.1446	5.8892	5.6502	5.4262	5.2161	5.0188	4.4941	4.1925	3.5705	3.0915
11	8.3064	7.8869	7.4987	7.1390	6.8052	6.4951	6.2065	5.9377	5.6869	5.4527	5.2337	4.6560	4.3271	3.6564	3.1473
12	8.8633	8.3838	7.9427	7.5361	7.1607	6.8137	6.4924	6.1944	5.9176	5.6603	5.4206	4.7932	4.4392	3.7251	3.1903
13	9.3936	8.8527	8.3577	7.9038	7.4869	7.1034	6.7499	6.4235	6.1218	5.8424	5.5831	4.9095	4.5327	3.7801	3.2233
14	9.8986	9.2950	8.7455	8.2442	7.7862	7.3667	6.9819	6.6282	6.3025	6.0021	5.7245	5.0081	4.6106	3.8241	3.2487
15	10.3797	9.7122	9.1079	8.5595	8.0607	7.6061	7.1909	6.8109	6.4624	6.1422	5.8474	5.0916	4.6755	3.8593	3.2682
16	10.8378	10.1059	9.4466	8.8514	8.3126	7.8237	7.3792	6.9740	6.6039	6.2651	5.9542	5.1624	4.7296	3.8874	3.2832
17	11.2741	10.4773	9.7632	9.1216	8.5436	8.0216	7.5488	7.1196	6.7291	6.3729	6.0472	5.2223	4.7746	3.9099	3.2948
18	11.6896	10.8276	10.0591	9.3719	8.7556	8.2014	7.7016	7.2497	6.8399	6.4674	6.1280	5.2732	4.8122	3.9279	3.3037
19	12.0853	11.1581	10.3356	9.6036	8.9501	8.3649	7.8393	7.3658	6.9380	6.5504	6.1982	5.3162	4.8435	3.9424	3.3105
20	12.4622	11.4699	10.5940	9.8181	9.1285	8.5136	7.9633	7.4694	7.0248	6.6231	6.2593	5.3527	4.8696	3.9539	3.3158
21	12.8212	11.7641	10.8355	10.0168	9.2922	8.6487	8.0751	7.5620	7.1016	6.6870	6.3125	5.3837	4.8913	3.9631	3.3198
22	13.1630	12.0416	11.0612	10.2007	9.4424	8.7715	8.1757	7.6446	7.1695	6.7429	6.3587	5.4099	4.9094	3.9705	3.3230
23	13.4886	12.3034	11.2722	10.3711	9.5802	8.8832	8.2664	7.7184	7.2297	6.7921	6.3988	5.4321	4.9245	3.9764	3.3254
24	13.7986	12.5504	11.4693	10.5288	9.7066	8.9847	8.3481	7.7843	7.2829	6.8351	6.4338	5.4509	4.9371	3.9811	3.3272
25	14.0939	12.7834	11.6536	10.6748	9.8226	9.0770	8.4217	7.8431	7.3300	6.8729	6.4641	5.4669	4.9476	3.9849	3.3286
26	14.3752	13.0032	11.8258	10.8100	9.9290	9.1609	8.4881	7.8957	7.3717	6.9061	6.4906	5.4804	4.9563	3.9879	3.3297
27	14.6430	13.2105	11.9867	10.9352	10.0266	9.2372	8.5478	7.9426	7.4086	6.9352	6.5135	5.4919	4.9636	3.9903	3.3305
28	14.8981	13.4062	12.1371	11.0511	10.1161	9.3066	8.6016	7.9844	7.4412	6.9607	6.5335	5.5016	4.9697	3.9923	3.3312
29	15.1411	13.5907	12.2777	11.1584	10.1983	9.3696	8.6501	8.0218	7.4701	6.9830	6.5509	5.5098	4.9747	3.9938	3.3317
30	15.3725	13.7648	12.4090	11.2578	10.2737	9.4269	8.6938	8.0552	7.4957	7.0027	6.5660	5.5168	4.9789	3.9950	3.3321

Note: Factor= $1-(1+r)^{-nr}$

## End-of-Chapter Exercises

### Questions

1. What is the difference between capital budgeting decisions covered in this chapter and management decisions covered in Chapter 4 “How Are Relevant Revenues and Costs Used to Make Decisions?”?
2. What concept must be considered when looking at cash flows over several years for a long-term investment? Explain.
3. What is meant by the term *present value*?
4. What is the formula used to calculate the present value of a future cash flow? Describe each component.
5. Describe the three steps required to evaluate investments using the net present value method.
6. How do most firms establish the required rate of return used to calculate the net present value?
7. What is meant by the term *internal rate of return*? Explain the IRR decision rule?
8. For the purpose of calculating net present value and internal rate of return, do companies use the accrual basis of accounting? Explain.

9. Why might a firm choose to accept a long-term investment even if the net present value is below zero?
10. What might cause a manager to reject a long-term investment even though the net present value is positive?
11. Describe the two steps required to calculate net present value and internal rate of return when using Excel.
12. What does the term *working capital* refer to, and how does working capital affect the evaluation of long-term investments?

### Brief Exercises

**13. Investment Decision at Jackson's Quality Copies.** Refer to the dialogue at Jackson's Quality Copies presented at the beginning of the chapter. What is Julie Jackson proposing? What information did Mike, the accountant, get from Julie to evaluate the proposal?

**14. Present Value Calculations.** For each of the following independent scenarios, use Figure 5.9 "Present Value of \$1 Received at the End of " in the appendix to calculate the present value of the cash flow described.

1. \$10,000 will be received 4 years from today. The rate is 10 percent.
2. \$10,000 will be received 4 years from today. The rate is 20 percent.
3. \$50,000 will be received 15 years from today. The rate is 12 percent.
4. \$50,000 will be received 15 years from today. The rate is 6 percent.

**15. Present Value Calculations (Annuities).** For each of the following independent scenarios, use Figure 5.10 "Present Value of a \$1 Annuity Received at the End of Each Period for " in the appendix to calculate the present value of the cash flow described. Round to the nearest dollar.

1. \$1,000 will be received at the end of each year for 6 years. The rate is 12 percent.
2. \$1,000 will be received at the end of each year for 6 years. The rate is 15 percent.
3. \$10,000 will be received at the end of each year for 6 years. The rate is 7 percent.
4. \$250,000 will be received at the end of each year for 4 years. The rate is 10 percent.

**16. Net Present Value Calculations.** Freefall, Inc., has two independent investment opportunities, each requiring an initial investment of \$65,000. The company's required rate of return is 8 percent. The cash inflows for each investment are provided as follows.

	Investment Y	Investment Z
Year 1	\$ 35,000	\$ 5,000
Year 2	25,000	15,000
Year 3	15,000	25,000
Year 4	5,000	35,000
Total inflows	<u>\$ 80,000</u>	<u>\$ 80,000</u>

*Required:*

1. Without resorting to calculations, which investment will have the highest net present value? Explain.

Calculate the net present value for each investment (remember to include the initial investment cash outflow in your calculation). Should the company invest in either investment? Round to the nearest dollar.

**17. Internal Rate of Return Calculation.** An investment costing \$50,000 today will result in cash savings of \$5,000 per year for 15 years. Use trial and error to approximate the internal rate of return for this investment proposal.

**18. Evaluating Qualitative Factors.** Chem, Inc., produces chemical products. The company recently decided to invest in expensive pollution control devices even though the negative net present value pointed toward rejecting this investment. What qualitative factor likely led the company to make the investment in spite of the negative net present value?

**19. Ethical Issues in Making a Capital Budgeting Decision.** Assume the manager of a store earns an annual bonus based on meeting a certain level of net income, which has been achieved consistently over the past five years. The company is currently considering the addition of a second store, which is expected to become profitable after two years. The manager is responsible for making the final decision whether the second store should be opened and would receive an annual bonus only if a certain level of net income were achieved for both stores combined.

Why might the manager refuse to invest in the new store even though the investment is projected to achieve a return greater than the company's required rate of return?

**20. Net Present Value Calculation Using Excel.** An investment costing \$200,000 today will result in cash savings of \$85,000 per year for 3 years. The company's required rate of return is 11 percent. Use Excel to calculate the net present value of this investment in a format similar to the one in the *Computer Application* box in the chapter.

**21. Net Present Value Analysis with Multiple Investments.** A project requiring an investment of \$20,000 today and \$10,000 one year from today, will result in cash savings of \$4,000 per year for 15 years. Find the net present value of this investment using a rate of 10 percent. Round to the nearest dollar.

Exercises:

**22. Net Present Value Analysis.** Architect Services, Inc., would like to purchase a blueprint machine for \$50,000. The machine is expected to have a life of 4 years, and a salvage value of \$10,000. Annual maintenance costs will total \$14,000. Annual savings are predicted to be \$30,000. The company's required rate of return is 11 percent.

*Required:*

1. Ignoring the time value of money, calculate the net cash inflow or outflow resulting from this investment opportunity.
2. Find the net present value of this investment using the format presented in Figure 5.2 "NPV Calculation for Copy Machine Investment by Jackson's Quality Copies". Should the company purchase the blueprint machine? Explain.

**23. Internal Rate of Return Analysis.** Architect Services, Inc., would like to purchase a blueprint machine for \$50,000. The machine is expected to have a life of 4 years, and a salvage value of \$10,000. Annual maintenance costs will total \$14,000. Annual savings are predicted to be \$30,000. The company's required rate of return is 11 percent (this is the same data as the previous exercise).

*Required:*

1. Use trial and error to approximate the internal rate of return for this investment proposal. Round to the nearest dollar.
2. Should the company purchase the blueprint machine? Explain.

**24. Net Present Value Analysis with Multiple Investments, Alternative Format.** Conway Construction Corporation would like to purchase a fleet of trucks at a cost of \$260,000. Additional equipment needed to maintain the fleet of trucks will be purchased at the end of year 2 for \$40,000. The trucks are expected to have a life of 8 years, and a salvage value of \$20,000. Annual costs for maintenance, insurance, and other cash expenses will total \$42,000. Annual net cash receipts resulting from this purchase are predicted to be \$135,000. The company's required rate of return is 14 percent.

*Required:*

1. Find the net present value of this investment using the format presented in Figure 5.4 "Alternative NPV Calculation for Jackson's Quality Copies".
2. Should the company purchase the new fleet of trucks? Explain.

**25. Calculating NPV and IRR Using Excel.** Wood Products Company would like to purchase a computerized wood lathe for \$100,000. The machine is expected to have a life of 5 years, and a salvage value of \$5,000. Annual maintenance costs will total \$20,000. Annual net cash receipts resulting from this machine are predicted to be \$45,000. The company's required rate of return is 15 percent.

*Required:*

1. Use Excel to calculate the net present value and internal rate of return in a format similar to the *Computer Application* spreadsheet shown in the chapter.
2. Should the company purchase the wood lathe? Explain.



## Problems

**26. Evaluating Alternative Investments.** Washington Brewery has two independent investment opportunities to purchase brewing equipment so the company can meet growing customer demand. The first option (equipment A) requires an initial investment of \$230,000 for equipment with an expected life of 5 years and a salvage value of \$20,000. The second option (equipment B) requires an initial investment of \$120,000 for equipment with an expected life of 4 years and a salvage value of \$15,000. The company's required rate of return is 10 percent. Additional cash flow information for each investment is provided as follows.

	Year 1	Year 2	Year 3	Year 4	Year 5
<b>Equipment A</b>					
Utility savings	\$ 12,000	\$ 14,000	\$ 15,000	\$ 16,000	\$ 17,000
Additional revenue	45,000	48,000	50,000	55,000	60,000
Maintenance costs	(5,000)	(8,000)	(10,000)	(13,000)	(16,000)
<b>Equipment B</b>					
Utility savings	\$ 8,000	\$ 9,000	\$ 10,000	\$ 10,000	–
Additional revenue	35,000	36,000	38,000	42,000	–
Maintenance costs	(6,000)	(8,000)	(9,000)	(11,000)	–

*Required:*

1. Calculate the net present value for each investment using the format presented in Figure 5.2 “NPV Calculation for Copy Machine Investment by Jackson’s Quality Copies”. (Remember to include the initial investment cash outflow and salvage value in your calculation.) Round to the nearest dollar
2. Which, if any, investment is preferable? Explain.

**27. Calculating NPV and IRR Using Excel.** Sherwin Moore Paint Company would like to further automate its production process by purchasing production equipment for \$660,000. The equipment is expected to have a useful life of 8 years, and will be sold at the end of 8 years for \$40,000. The equipment requires significant maintenance work at an annual cost of \$75,000. Labor and material cost savings, shown in the table, are also expected to be significant.

Year 1	\$160,000
Year 2	\$190,000
Year 3	\$200,000
Year 4	\$240,000
Year 5	\$280,000
Year 6	\$220,000
Year 7	\$180,000
Year 8	\$155,000

The company's required rate of return is 11 percent.

*Required:*

1. Use Excel to calculate the net present value and internal rate of return in a format similar to the *Computer Application* spreadsheet shown in the chapter.
2. Should the company purchase the production equipment? Explain.

**28. Calculating NPV and IRR Using Excel.** Oil Production, Inc., would like to drill oil from land the company already owns. The equipment is expected to cost \$4,000,000, has a useful life of 5 years, and will be sold at the end of 5 years for \$400,000. Annual costs for maintenance and other cash expenses will total \$550,000. Annual net cash receipts resulting from the sale of oil are predicted to be \$1,900,000. Working capital of \$270,000 is required at the beginning of the project and will be returned at the end of 5 years. The equipment will require refurbishing at the end of year 3 at a cost of \$300,000. Although the company's cost of capital is 15 percent, management established a required rate of return of 20 percent due to the high risk associated with this project.

*Required:*

1. Use Excel to calculate the net present value and internal rate of return in a format similar to the *Computer Application* spreadsheet shown in the chapter.
2. Should the company accept the proposal? Explain.

**29. Net Present Value and Internal Rate of Return; Ethical Issues.** Tower CD Stores would like to open a retail store in Houston. The initial investment to purchase the building is \$420,000, and an additional \$50,000 in working capital is required. Since this store will be operating for many years, the working capital will not be returned in the near future. Tower expects to remodel the store at the end of 3 years at a cost of \$100,000. Annual net cash receipts from daily operations (cash receipts minus cash payments) are expected to be as follows.

Year 1	\$ 80,000
Year 2	\$115,000
Year 3	\$118,000
Year 4	\$140,000
Year 5	\$155,000
Year 6	\$167,000
Year 7	\$175,000

The company's required rate of return is 13 percent. Assume management decided to limit the analysis to 7 years.

*Required:*

1. Find the net present value of this investment using the format presented in Figure 5.2 "NPV Calculation for Copy Machine Investment by Jackson's Quality Copies". Round to the nearest dollar.
2. Use Excel to calculate the internal rate of return for this investment proposal.
3. Based on your answer to requirements 1 and 2, should Tower open the new store? Explain.
4. Assume the manager of the company wanted to live in Houston and intentionally inflated the projected annual cash receipts so that the proposal would be accepted. The proposal would otherwise have been rejected. Explain how the company's use of a postaudit would help to prevent this type of unethical behavior.

One Step Further: Skill-Building Cases

**30. Internet Project: Capital Expenditures at Intel.** Go to Intel's Web site (<http://www.intel.com>) and review the *Consolidated Statements of Cash Flows* portion of the company's financial statements. Find the *Additions to property, plant and equipment* line item in the *Investing Activities* section of the statement, and answer the following questions. Be sure to submit a printed copy of the consolidated statements of cash flows with your answers.

1. How much cash did **Intel** spend on additions to property, plant, and equipment in the most current year? How does this amount compare with amounts spent in the previous two years?

2. Describe two capital budgeting decision techniques that were likely used by **Intel** to make long-term investment decisions.

**31. Group Activity: Qualitative Factors.** Each of the following scenarios is being considered at three separate companies.

1. A large regional energy company uses coal to produce electricity that is sold to local power companies. Although government regulations will not require a cleaner process for at least five years, the company is considering spending millions of dollars on equipment that will reduce pollutants from its production process. However, the net present value analysis indicates this proposal should be rejected.
2. A producer of mountain bikes known for its expensive, high-quality bikes would like to introduce a less expensive entry-level line of mountain bikes. However, the projected internal rate of return for this proposal is lower than the company's minimum required rate of return.
3. A maker of computer chips with a reputation of staying on the cutting edge of technology would like to invest in a new production facility. However, the net present value analysis indicates this proposal should be rejected.

*Required:*

Your instructor will divide the class into groups of two to four students, and assign one of the three independent scenarios listed previously to each group. Each group must perform the requirements listed here:

1. Identify at least two qualitative factors that may lead to accepting the proposal.
2. Discuss each option, based on the findings of your group, with the class.

#### Comprehensive Cases

**32. Ethical Issues in Capital Budgeting.** Loomis Nursery grows a variety of plants for wholesale distribution. The company would like to expand its operations and is considering a move to one of two locations. The first location, Wyatville, is one hour from the ocean and therefore attractive for employees who like to travel on weekends. The second location, Kenton, is not as close to the ocean, and much further from desirable vacation destinations.

The company's controller, Lisa Lennox, created a net present value analysis for each location. The Kenton location had a positive net present value, and the Wyatville location had a negative net present value. Upon providing this information to the chief financial officer of the company, Max Madden, Lisa was asked to "review the numbers carefully and make sure all the benefits of moving to Wyatville were included in the analysis." Lisa knew that Max preferred vacationing near the ocean and had a strong desire to move operations to Wyatville. However, she was unable to find any errors in her analysis and could not identify any additional benefits.

Lisa approached Max with this information. Max responded, "There is no way Kenton should have a higher net present value than Wyatville. Redo your analysis to show that Wyatville has the highest net present value, and have it on my desk by the end of the week."

*Required:*

1. Is Max Madden's request ethical? Explain.
2. How should Lisa handle this situation? (It may be helpful to review the presentation of ethics in Chapter 1 "What Is Managerial Accounting?".)

**33. Ethical Issues in Capital Budgeting.** Toyonda Motor Company produces a variety of products including motorcycles, all-terrain vehicles, marine engines, automobiles, light trucks, and heavy-duty trucks. Each division manager at Toyonda Motor Company is paid a base salary and is given an annual cash bonus if the division achieves profits of at least 10 percent of the value of assets invested in the division (this is called *return on investment*).

Peggy Parkins, manager of the Light Truck Division, is considering investing in new production equipment. The net present value of the proposal is positive, and Peggy is convinced the new equipment will provide a competitive edge in future years. However, because of the significant up-front cost and related depreciation, short-term profits will be negatively affected by this investment. In fact, the new equipment will reduce return on investment below the 10 percent threshold for at least 3 years, which will prevent Peggy from receiving her annual bonuses for at least 3 years. However, profits are expected to increase significantly after the three-year period. Peggy is planning to retire in two years and therefore would prefer to reject the proposal to invest in new production equipment.

*Required:*

1. Describe the ethical conflict facing Peggy Parkins.
2. What type of employee compensation system might prevent this type of conflict?

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