20 Capital Budgeting: Methods of Investment Analysis

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Learning Objectives

1. Apply the concept of the time value of money to capital budgeting decisions.
2. Evaluate discounted cash flow (DCF) and non-DCF methods to calculate rate of return (ROR).
3. Analyze the impact of income taxes on discounted cash flows and capital budgeting decisions.
4. Apply the concept of relevance to DCF methods of capital budgeting.
5. Assess the complexities in capital budgeting within an interdependent set of value-chain business functions.
6. Apply the concept of defensive strategic investment to the capital budgeting process.

Capital Budgeting for Sustainable Business[1]

The Tennessee Valley Authority (TVA) is the United States' largest public power provider and is wholly owned by the U.S. government. Although owned by the federal government, TVA is not financed with tax dollars; rather, the utility's funding comes from the sale of power to its customers. Recently, TVA faced a difficult strategic decision: ensuring sufficient power generation while continuing to provide affordable power to a growing number of customers in its service area.

At the same time, TVA was replacing a significant part of its existing power generation capability. TVA previously announced plans to retire multiple coal power plants by 2018 to reach its goal of becoming a clean energy leader. Potential sources of new power generation included the construction of nuclear, natural gas, coal, wind, and solar plants. The power generation options had differing costs, expected cash flows, and useful lives. Moreover, TVA's construction decisions were constrained by a limited capital budget. TVA turned to net present value (NPV) and internal rate of return (IRR) calculations to guide its decision making.

After extensive calculations, TVA discovered that the NPVs and IRRs of natural gas, nuclear, and wind plants were positive. The NPVs of solar and coal plants were negative, and their IRRs were below TVA's cost of capital (calculated as the current yield to maturity on 30-year government debt plus an added 1% premium). In 2012, four renewable wind-power sources located in Kansas, Illinois, and Iowa began delivery to the TVA power grid and construction began on a new gas-fired combustion turbine/combined cycle generating power plant. Additionally, the Watts Bar Unit 2 nuclear power generator was scheduled to begin operation in 2015. Construction on the unit, which started in the mid-1980s, was resumed with updated technologies. TVA is also developing a smart grid deployment plan that will help customers better understand the costs and benefits of these new power sources.

[1] *Sources:* "TVA Releases Cost, Schedule Estimates for Watts Bar Nuclear Unit 2," Tennessee Valley Authority press release (Knoxville, TN, April 5, 2012); Bob Wood, Steven Isbell, and Cass Larson, "The Tennessee Valley Authority: The Cost of Power," *IMA Educational Case Journal,* Vol. 5, No. 4 (Montvale, NJ: Institute of Management Accountants, Inc., December 2012).

Capital Budgeting and Decision Making (5DM Approach)

▶ **LO 1**

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

Capital budgeting is the process of making long-run planning decisions for investments in projects. In much of accounting, income is calculated on a period-by-period basis. However, in choosing investments, managers often must make a selection from among a group of multiple projects, each of which may span several periods. Exhibit 20-1 illustrates these two different, yet intersecting, dimensions of cost analysis: (1) horizontally across, as the *project dimension*, which depicts the lifespan of the project, and (2) vertically upward, as the *accounting-period dimension*, which depicts the accounting period (in this case a year). Each project is represented as a horizontal rectangle starting and ending at different times and stretching over time spans longer than one year. The vertical rectangle for the 2012 accounting period, for example, represents the dimensions of income determination and routine annual planning and control that were ongoing that year.

Capital budgeting analyzes each project by considering all of the cash flows in the life of the investment, from the initial expenditures through the termination of the project. In this fashion, it is analogous to life-cycle budgeting and costing. For example, when Samsung considers a new line of smartphones, it begins by estimating all potential revenues from the new line as well as any costs that will be incurred along its life cycle. Only after examining the potential costs and benefits across all of the business functions in the value chain, from research and development (R&D) to customer service, across the entire lifespan of the new project, does Samsung decide whether the new model is a wise investment.

The 5DM model demonstrates how capital budgeting is both a decision-making and a control tool.

Step 1: Identify Projects

Identify potential capital investments that agree with the organization's strategy.

For example, when Samsung sought a strategy of product differentiation in the form of the *phablet*, the Samsung Galaxy II, it listed possible upgrades and changes from its present offering. Alternatively, a strategy of cost leadership could be promoted by projects that improve productivity and efficiency in its low cost model offerings.

Step 2: Obtain Information

Gather information from all parts of the value chain to evaluate alternative projects.

In this step, marketing is queried for potential revenue numbers, plant managers are asked about assembly times, and suppliers are consulted about prices and the availability of key components. Some projects may even be rejected at this stage. For example, suppose Samsung learns that the phablet simply cannot be built using existing production lines. It may opt to cancel the project altogether.

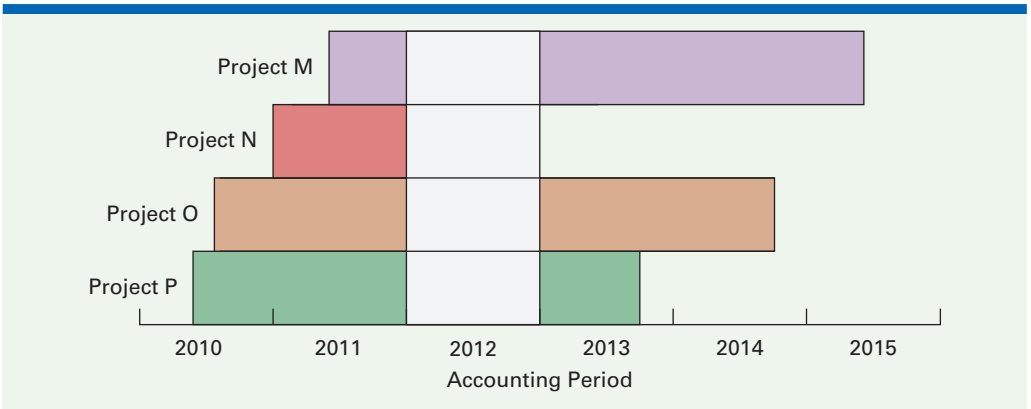

Exhibit 20-1 The Project and Time Dimensions of Capital Budgeting

Step 3: Make Predictions
Forecast all potential cash flows attributable to the alternative projects.

Capital investment projects generally involve substantial initial outlays, which are recouped over time through annual cash inflows and the disposal values at the termination of the project. As a result, they require the firm to make forecasts of cash flows several years into the future to estimate if the investment will be worth the cost.

Step 4: Make Decisions by Choosing Among Alternatives
Determine which investment yields the greatest benefit and the least cost to the organization.

Using the quantitative information obtained in step 3 (which is typically limited to financial information), managers use their judgment and intuition to factor in qualitative information and strategic considerations as well. For example, even if a proposed new line of low cost phones meets its financial targets on a standalone basis, Samsung might decide not to pursue it further if it feels that the new model will lessen the value of the firm's brand.

Step 5: Implement the Decision, Evaluate Performance, and Learn
Given the complexities of capital investment decisions and the long time horizons they span, this stage can be separated into two phases:

Phase 1: Obtain funding and make the investments selected in step 4.

Sources of funding include internally generated cash flow as well as equity and debt securities sold in capital markets. Managers must examine the most cost effective strategy to generate capital within the firm's capabilities and consistent with its overall strategy.

Phase 2: Track realized cash flows, compare against estimated numbers, and revise plans if necessary.

As the cash outflows and inflows begin to accumulate, managers can verify whether the predictions made in step 3 agree with the actual flows of cash from the project. When Microsoft initially released the new *Surface* tablet, its realized sales were substantially lower than the original demand estimates. Microsoft responded by adjusting supplies and raw materials and manufacturing fewer devices, reflective of demand.

To illustrate capital budgeting, consider Top-Spin tennis racquets. Top-Spin was one of the first major tennis-racquet producers to introduce graphite in its racquets. This allowed Top-Spin to produce some of the lightest and stiffest racquets in the market. However, new carbon-fibre impregnated racquets are even lighter and stiffer than their graphite counterparts. Top-Spin has always been an innovator in the tennis-racquet industry, and wants to stay that way, so in step 1, it identifies the carbon fibre racquet project. During information gathering (step 2), the company learns that it could feasibly begin using carbon-fibre in its racquets as early as 2016 if it replaces one of its graphite forming machines with a carbon-fibre weaving machine. After collecting additional data, Top-Spin begins to forecast future cash flows if it invests in the new machine (step 3). Top-Spin estimates that it can purchase a carbon-fibre weaving machine with a useful life of five years for a net after-tax initial investment of $379,100, which is calculated as follows:

Cost of new machine	$390,000
Investment in working capital	9,000
Cash flow from disposing of existing machine (after-tax)	(19,900)
Net initial investment for new machine	$379,100

New projects often necessitate additional investments in current assets such as inventories and receivables. In the case of Top-Spin, the purchase of the new machine is accompanied by an outlay of $9,000 for supplies and spare parts inventory. At the end of the project, the $9,000 in supplies and spare parts inventory is liquidated, resulting in a cash inflow. However, the machine itself is believed to have no terminal disposal value after five years.

Note

Working capital refers to the difference between current assets and current liabilities; and represents the capital used in the firm's day-to-day operations.

Managers estimate that by introducing carbon-fibre impregnated racquets, operating cash inflows (cash revenues minus cash operating costs) will increase by $100,000 (after tax) in the first four years and $91,000 in year 5. To simplify the analysis, suppose that all cash flows occur at the end of each year. Note that cash flow at the end of the fifth year also increases by $100,000: $91,000 in operating cash inflows and $9,000 in working capital.

Management next calculates the costs and benefits of the proposed project. This chapter discusses four capital budgeting methods to analyze financial information:

1. Net present value (NPV)
2. Internal rate of return (IRR)
3. Payback
4. Accrual accounting rate of return (AARR)

Both the net NPV and IRR methods use *discounted cash flows*, which we discuss in the following section.

A Note on Sources of Capital and Timing of Investments

Financing is most often the treasury function of an organization. Once the investment decision is made, then the financing must be acquired. Again this is an information-gathering process, and if financing is unavailable, this will change the investment decision. In reality, financing opportunities are often investigated simultaneously with the formal analyses of the costs and benefits of various investments. One reason is that interest expense is a cash cost of any investment financed by debt.

When a company such as Top-Spin finally makes a decision and moves forward with an investment, careful thought must be applied in choosing the source of capital to fund the project (step 5). These choices must be consistent with the company's overall strategy and within any constraints (e.g., an agreement with a debt-holder that it will take on no more debt). Long-term investments are appropriately financed by long-term capital to avoid the opportunity costs of spending too much cash immediately and jeopardizing the liquidity of the corporation. Good long-term debt contracts match the timing of cash outflows to pay obligations somewhat closely to the timing of predicted cash inflows. For example, an investment with a useful life of 25 years would be financed by a 25-year long-term debt contract. Sources of financing can also include internally generated cash flow from operations. However, this must be adequate to cover any working capital outlays in the first year of a long-term investment because long-term investments rarely generate cash inflow in their early years.

Discounted Cash Flows and the Time Value of Money

Discounted cash flow (DCF) methods measure all expected future cash inflows and outflows of a project discounted back to the present point in time. DCF focuses on *cash* inflows and outflows rather than on *operating income* as used in conventional accrual accounting. Cash is invested now with the expectation of receiving a greater amount of cash in the future. It is important to understand that accrual accounting estimates of value are reported on the statement of comprehensive income and statement of financial position according to generally accepted accounting principles (IFRS or ASPE). Cash flow will not equal either operating or net income for the current period. Companies

► LO 2

Evaluate discounted cash flow (DCF) and non-DCF methods to calculate rate of return (ROR).

without cash to fulfill their contractual obligations are either insolvent or bankrupt. Therefore, the management team must focus on predicted cash flow when creating a capital budget. The predicted timing and amount of cash inflow and outflow is especially important.

The key feature of DCF methods is the application of the **time value of money**. This method estimates how a dollar (or any other monetary unit) received today is worth more than a dollar received at any future time. The reason is that $1 received today can be invested at, for example, 10% per year so that it grows to $1.10 at the end of one year. The time value of money is the opportunity cost (the return of $0.10 forgone per year) from not having the money today. In this example, $1 received one year from now is worth $1 ÷ 1.10 = $0.9091 today. Similarly, $100 received one year from now will be weighted by 0.9091 to yield a DCF of $90.91, which is the value today of the $100 to be received next year.

The longer the time horizon (e.g., a project spanning 15 years as compared to a project spanning 5 years) results in a higher level of uncertainty. In practical terms, the risk increases the longer it takes to collect the long-term returns of a project, and the greater the potential that those returns may not be realized. In this way, DCF methods explicitly weigh cash flows by the time value of money. Note that DCF focuses exclusively on cash inflows and outflows rather than on operating income as determined by accrual accounting. The compound interest tables and formulas used in DCF analysis are in Appendix A.

The two DCF methods we describe are the NPV method and the IRR method. Both DCF methods use what is called the **required rate of return** (**RRR**), which is the minimum acceptable annual ROR on an investment. The RRR is internally set, usually by upper management, and typically reflects the return that an organization could expect to receive elsewhere for an investment of comparable risk. The RRR is also called the **discount rate**, **hurdle rate**, **cost of capital**, or **opportunity cost of capital**.

Suppose the CFO at Top-Spin has set the RRR for the firm's investments at 8% per year.

Net Present Value Method

The **net present value** (**NPV**) **method** calculates the expected financial gain or loss from a project by discounting all expected future cash inflows and outflows back to the present point in time using the RRR. Only projects with a positive NPV are acceptable because the return from these projects exceeds the cost of capital (the return available by investing the capital elsewhere). Managers prefer projects with higher NPVs to projects with lower NPVs, if all other things are equal.

To use the NPV method, apply the first three steps of the 5DM as follows:

Step 1: Identify the scope and form of the project, including an estimate of the *initial* cost of the investment. The focus should be on identifying projects that are consistent with the organization's strategy (e.g., cost leadership, market expansion, or product differentiation).

Step 2: Collect the relevant information on the project(s) including estimates from marketing on revenues and market impact and information from production departments on cash outflows, and investigate possible sources and costs of capital to invest in the project. You can include this information in your NPV model by sketching out the relevant cash inflows and outflows, and include the basic project information such as initial investment and useful life (see Exhibit 20-2).

The right side of Exhibit 20-2 shows how these cash flows are portrayed. Outflows appear in parentheses. Note that Exhibit 20-2 includes the outflow for the new machine at year 0, the time of the acquisition. The NPV method focuses only on cash flows in any form, which can include operations, purchase or sale of equipment, or investment or recovery of working capital. The discount factor is determined by choosing the correct compound interest table from Appendix A. In our example, we are looking for the present value of $1, and so we will refer to Table 2. If we use Table 2, we find the discount factors for

Exhibit 20-2 Forecast of Project Cash Flows

	A	B	C	D	E	F	G	H	I
1			Net initial investment	$379,100					
2	Project Information		Useful life	5 years					
3			Annual cash inflow	$100,000		Sketch the Cash Flows			
4			Required rate of return	8%					
5									
6		Present Value	Present Value of	Sketch of Relevant Cash Flows at End of Each Year					
7		of Cash Flow	$1 Discounted at 8%	0	1	2	3	4	5
8	**Approach 1: Discounting Each Year's Cash Flow Separately**[a]								
9	Net initial investment	$(379,100)	1.000	$(379,100)					
10		92,600	0.926		$100,000				
11		85,700	0.857			$100,000			
12	Annual cash inflow	79,400	0.794				$100,000		
13		73,500	0.735					$100,000	
14		68,100	0.681						$100,000
15	NPV if new machine purchased	$ 20,200							
16					Discount and Sum Cash Flows				
17	**Approach 2: Using Annuity Table**[b]								
18	Net initial investment	$(379,100)	1.000	$(379,100)					
19					$100,000	$100,000	$100,000	$100,000	$100,000
20									
21	Annual cash inflow	399,300	3.993						
22	NPV if new machine purchased	$ 20,200							
23									
24	*Note:* Parentheses denote relevant cash outflows throughout all exhibits in Chapter 20.								
25	[a] Present values from Table 2, Appendix A at the end of the book. For example, $0.857 = 1 \div (1.08)^2$.								
26	[b] Annuity present value from Table 4, Appendix A. The annuity value of 3.993 is the sum of the individual discount rates 0.926 + 0.857 + 0.794 + 0.735 + 0.681.								

periods 1–5 under the 8% column presents the five discount factors. We can discount each year's cash flow separately using Table 2 (Appendix A).

Step 3: The forecast of the project cash flows is determined through the application of the NPV method as depicted in Exhibit 20-2:

i. Calculate the outflow for the investment at the start of year 1 (also referred to as end of year 0). For Top-Spin, this is the acquisition of a new machine.

ii. Trace the unadjusted cash inflows and outflows over the life of the project.

iii. Discount the cash flows using the compound interest table from Appendix A (Table 2). In the Top-Spin example, we can discount each year's cash flow separately, and we find the discount factors for periods 1–5 under the 8% column. To obtain the present value amount, multiply each discount factor by the corresponding amount represented by the arrow on the right in Exhibit 20-2 ($379,100 × 1.000; $100,000 × 0.926; and so on to $100,000 × 0.681) and then sum these five amounts together. Subtracting the initial investment then reveals the NPV of the project as $20,200 (= $399,300 − $379,100).

Based on this calculation, we could conclude that the project is a good choice *financially*. However, other considerations must be examined in step 4 of the 5DM that are based on qualitative or non-financial information and manager's judgment.

An Alternative Route to the Solution

Because the investment in the new machine produces a series of equal cash flows ($100,000) at equal time intervals (once a year for five years), it constitutes an *annuity*. Because the cash flows are uniform, Appendix A, Table 4 (concerning the present value of an annuity) can be used to compute the value of the investment. Under this approach,

we find that the annuity factor for five periods under the 8% column is 3.993, which is the sum of the five discount factors used in the approach described above. We multiply the uniform annual cash inflow ($100,000) by this factor to obtain the present value of the inflows ($399,300). The annuity approach can only be used with uniform cash flows.

Assumptions about the timing and amount of cash flows are extremely important. If you use a programmable calculator or a popular spreadsheet program to calculate NPV, you may obtain a slightly different answer than if you use a compound interest table. The reason is that the compound interest table in Appendix A assumes the cash inflow all occurs at the *end* of each year, whereas many programs default to assume the inflow occurs at the beginning of each year. Most programs include an option to choose your assumption about the timing of cash inflows and the number of decimal places.

Internal Rate of Return Method

The **internal rate of return** (**IRR**) method calculates the discount rate at which the value of all expected cash inflows equals the present value of an investment's expected cash outflows. That is, the IRR is the discount rate that makes NPV = $0.

Exhibit 20-3 presents the cash flows and shows the calculation of NPV using a 10% annual discount rate for Top-Spin's carbon-fibre project. At a 10% discount rate, the NPV of the project is $0, therefore the IRR is 10% per year. IRR is sometimes called the **time-adjusted rate of return**.

Managers most often determine the discount rate that yields an NPV of $0 by using a financial calculator or computer program such as Microsoft Excel or Apple

Exhibit 20-3 Internal Rate of Return Method: Top-Spin's Carbon-Fibre Machine

	A	B	C	D	E	F	G	H	I
1			Net initial investment	$379,100					
2			Useful life	5 years					
3			Annual cash inflow	$100,000					
4			Annual discount rate	10%					
5									
6		Present Value	Present Value of	Sketch of Relevant Cash Flows at End of Each Year					
7		of Cash Flow	$1 Discounted at 10%	0	1	2	3	4	5
8	**Approach 1: Discounting Each Year's Cash Flow Separately**[b]								
9	Net initial investment	$(379,100)	1.000	$(379,100)					
10		90,900	0.909		$100,000				
11		82,600	0.826			$100,000			
12	Annual cash inflow	75,100	0.751				$100,000		
13		68,300	0.683					$100,000	
14		62,100	0.621						$100,000
15	NPV if new machine purchased[c]	$ 0							
16	(the zero difference proves that								
17	the internal rate of return is 10%)								
18									
19	**Approach 2: Using Annuity Table**								
20	Net initial investment	$(379,100)	1.000	$(379,100)					
21					$100,000	$100,000	$100,000	$100,000	$100,000
22									
23	Annual cash inflow	379,100	3.791[d]						
24	NPV if new machine purchased	$ 0							
25									
26	Note: Parentheses denote relevant cash outflows throughout all exhibits in Chapter 20.								
27	[a]The internal rate of return is computed by methods explained on pp. 758-759.								
28	[b]Present values from Table 2, Appendix A at the end of the book.								
29	[c]Sum is $(100) due to rounding. We round to $0.								
30	[d]Annuity present value from Table 4, Appendix A. The annuity table value of 3.791 is the sum of the individual discount rates								
31	0.909 + 0.826 + 0.751 + 0.683 + 0.621, subject to rounding.								

Numbers to provide the IRR. The following trial-and-error approach can also provide the answer.

Step 1: Use a discount rate and calculate the project's NPV.

Step 2: If the calculated NPV is less than zero, use a lower discount rate. (A *lower* discount rate will *increase* NPV. Remember that we are trying to find a discount rate for which NPV = $0.) If the NPV is greater than zero, use a higher discount rate to lower the NPV. Keep adjusting the discount rate until NPV = $0. In the Top-Spin example, a discount rate of 8% yields an NPV of +$20,200 (see Exhibit 20-2). A discount rate of 12% yields an NPV of −$18,600 (= 3.605, the present value annuity factor from Table 4, multiplied by $100,000, minus $379,100). Therefore, the discount rate that makes NPV = $0 must lie between 8% and 12%. We use 10% and get NPV = $0. Hence, the IRR is 10% per year.

The step-by-step computations of IRR are easier when the cash inflows are constant, as in our Top-Spin example.

An algebraic method can be adopted to solve for IRR. To do this, we must determine what factor F in Table 4 (in Appendix A) will satisfy the following equation:

$$\$379{,}100 = \$100{,}000F$$

$$\frac{\$379{,}100}{\$100{,}000} = F$$

$$3.791 = F$$

On the five-period line of Table 4, find the percentage column that is closest to 3.791. It is exactly 10%. If the factor (F) falls between the factors in two columns, straight-line interpolation is used to approximate IRR. Alternatively, a spreadsheet such as MS-Excel can be used to determine the IRR with a solver (pre-programmed) function.

A project is accepted only if the IRR equals or exceeds the RRR. In the Top-Spin example, the carbon-fibre machine has an IRR of 10%, which is greater than the required rate of 8%. On the basis of financial factors, Top-Spin should invest in the new machine. In general, the NPV and IRR decision rules result in consistent project acceptance or rejection decisions. If IRR exceeds the required return, then the project has a positive NPV (favouring acceptance). If IRR equals the required return, NPV = $0, so project acceptance and rejection yield the same value. If IRR is less than the required return, NPV is negative (favouring rejection). Obviously, managers prefer projects with higher IRRs to projects with lower IRRs, if all other things are equal. The IRR of 10% means the cash inflows from the project are adequate both to recover the net initial investment in the project and to earn a return of exactly 10% on the investment tied up in the project over its useful life.

Note

Interpolation is a simple method of estimating an unknown value that is assumed to be in a straight line (linear) relationship between the known points. It essentially means averaging the two known rates over the period to approximate the unknown value. (For an illustration of interpolation, see requirement 1 of the Problem for Self-Study at the end of this chapter.)

Comparison of Net Present Value and Internal Rate of Return Methods

The NPV method is generally regarded as the preferred method for project selection decisions. The NPV measure for a project captures the value (in today's dollars) of the surplus the project generates for the firm's shareholders, over and above the RRR.[2]

One advantage of the NPV method is that it expresses computations in dollars, not in percentages. Therefore, the sum of NPVs of individual projects will provide the NPV of a combination or portfolio of projects. In contrast, IRRs of individual projects cannot be added or averaged to represent the IRR of several projects.

[2] More detailed explanations of the preeminence of the NPV criterion can be found in corporate finance texts.

A second advantage is that the NPV of a project can always be computed and expressed as a unique number. Under the IRR method, it is possible that more than one IRR may exist for a given project. This is possible because there may be multiple discount rates that equate the NPV of a set of cash flows to zero. This is especially true in cases of non-uniform cash flows—when in one year the cash flows may be negative (outflows), and in another they may be positive (inflows). In such cases, it is difficult to know which of the IRR estimates should be compared to the firm's RRR.

A third advantage of the NPV method is that it can be used when the required return varies over the life of a project. Suppose Top-Spin's management sets an RRR of 9% per year in years 1 and 2 and 12% per year in years 3, 4, and 5. Total present value of the cash inflows can be calculated as $378,100 (computations not shown). It is not possible to use the IRR method in this case, because different RRRs in different years mean there is no single RRR that the IRR (a single figure) can be compared against to decide if the project should be accepted or rejected.

Finally, there are specific settings in which the IRR method is prone to indicating erroneous decisions (e.g., comparing mutually exclusive projects with unequal lives or unequal levels of initial investment). The IRR method implicitly assumes that project cash flows can be reinvested at the *project's* ROR. The NPV method, in contrast, accurately assumes that project cash flows can only be reinvested at the *company's* RRR. However, despite its limitations, surveys report widespread use of the IRR method.[3]

Sensitivity Analysis

To present the basics of the NPV and IRR methods, we have assumed that the expected values of cash flows will occur *for certain*. In reality, there is substantial uncertainty associated with the prediction of future cash flows. To examine how a result will change if the predicted financial outcomes are not achieved or if an underlying assumption changes, managers use *sensitivity analysis*, or a "what-if" technique. A common way to apply sensitivity analysis in capital budgeting decisions is to vary each of the inputs to the NPV calculation by a certain percentage (for example, increasing revenues by 10% or decreasing costs by 5%) and to assess the effect of the change on the project's NPV. Sensitivity analysis can take on other forms as well, such as considering broader changes in the political, social, or technological environments.

Suppose the manager at Top-Spin believes that forecasted cash flows are difficult to predict. She asks, "What are the minimum annual cash inflows that make the investment in a new carbon-fibre machine acceptable? That is, what inflows lead to an NPV of $0?"

For the data in Exhibit 20-2, let A = Annual cash flow and let NPV = $0. Net initial investment is $379,100, and the present value factor at the 8% required annual rate of return for a five-year annuity of $1 is 3.993. Then,

$$\begin{aligned} \text{NPV} &= \$0 \\ 3.993A - \$379{,}100 &= \$0 \\ 3.993A &= \$379{,}100 \\ A &= \$94{,}941 \end{aligned}$$

At the discount rate of 8% per year, the annual (after tax) cash inflows can decrease to $94,941 (a decline of $100,000 − $94,941 = $5,059) before the NPV falls to $0. If the manager believes she can attain annual cash inflows of at least $94,941, she can justify investing in the carbon-fibre machine on financial grounds.

Exhibit 20-4 shows that variations in the annual cash inflows or the RRR significantly affect the NPV of the carbon-fibre machine project. NPVs can also vary with different useful lives of a project. Sensitivity analysis helps managers to focus on variables that are sensitive, or have higher potential to change, and require careful attention.

[3] In a recent survey, John Graham and Campbell Harvey found that 75.7% of CFOs always or almost always used IRR for capital budgeting decisions, while a slightly smaller number, 74.9%, always or almost always used the NPV criterion.

	A	B	C	D	E	F
1	**Required**	**Annual Cash Flows**				
2	**Rate of Return**	**$ 80,000**	**$ 90,000**	**$100,000**	**$110,000**	**$120,000**
3	6%	$(42,140)	$ (20)	$ 42,100	$ 84,220	$126,340
4	8%	$(59,660)	$(19,730)	$ 20,200	$ 60,130	$100,060
5	10%	$(75,820)	$(37,910)	$ 0	$ 37,910	$ 75,820
6						
7	[a]All calculated amounts assume the project's useful life is five years.					

Exhibit 20-4 Net Present Value Under Different Assumptions of Cash Flows and Required Rates of Return

Income Tax and DCF in Capital Budgeting

▶ LO 3

Analyze the impact of income taxes on discounted cash flows and capital budgeting decisions.

Income taxes are mandatory cash disbursements and therefore are an important cash flow consideration. Income taxes almost always influence the amount and/or the timing of cash flows. Their basic role in capital budgeting is no different from that of any other cash disbursement. Income tax rates are progressive and depend on the amount of pretax income, with larger pretax income being taxed at higher rates. In capital budgeting, the relevant rate is the marginal income tax rate, that is, the tax rate paid on additional amounts of pretax income.

Suppose corporations pay income taxes of 15% on the first $50,000 of pretax income and 30% on pretax income over $50,000. The *marginal income tax rate* of a company with $75,000 of pretax income is 30%, because 30% of any *additional* income over $50,000 will be paid in taxes. In contrast, the company's *average income tax rate* is only 20%, (15% × $50,000 + 30% × $25,000 = $15,000 ÷ $75,000 of pretax income). When we assess tax effects of capital budgeting decisions, we will always use the *marginal* tax rate because that is the rate applied to the incremental cash flows generated by a proposed project.

The impact of income taxes on operating cash flows is straightforward. If a capital project results in a reduction in costs—for example, an annual cost saving of $60,000—then the company's taxable income will increase by $60,000, all other things being equal. If the company has a marginal tax rate of 40%, then the company's income taxes will increase by $24,000 (= $60,000 × 0.40). A net annual after-tax savings of $36,000 results (= $60,000 − $24,000). This means the after-tax savings can be calculated quickly as $60,000 × (1 − the tax rate) or $60,000 × 0.60 = $36,000. Similarly, if operating expenses increase by $250,000, then the taxable income will decrease by $250,000. If the company has a 40% marginal tax rate, then the tax saving will be $100,000 (= $250,000 × 0.40).

Tax Shields and the Effect on Investment Cash Flows

Organizations that pay income taxes use generally accepted accounting principles (e.g., IFRS or ASPE depending on the organization) to report their net income to the public. This permits managers to choose among depreciation methods in order to be able to present the most accurate data. The Canada Revenue Agency (CRA) does not permit this. Instead, tax laws require corporations to deduct capital cost allowance (CCA), not depreciation, when calculating their taxable income.

The Income Tax Act (ITA) assigns all depreciable capital purchases to a CCA class.[4] For example, a desk would qualify as a Class 8 asset, and is in a class that includes furniture, tools costing $500 or more each, appliances, refrigeration equipment, photocopiers, fax machines, and telephone equipment. It also includes data network infrastructure equipment and systems software acquired prior to March 23, 2004, outdoor advertising

[4] The income tax statutes for intangible assets such as patents, copyrights, goodwill, and trademarks differ, as does the terminology. The eligible capital expenditure is the acquisition cost of the intangible asset. The eligible capital property is 75% of the acquisition cost of the intangible asset. The full cost is not deductible because the asset is considered to provide indefinite benefit. Intangible assets, by definition, have an indefinite useful life, and the annual deduction is called the cumulative eligible capital amount (CECA), calculated at 7% on a declining balance basis.

Exhibit 20-5 Calculation of CCA Amounts for Years 1–4

	A	B	C	D
1		**CCA Rate**	20%	
2				
3				
4	Year	Purchase	CCA	UCC
5	0	$60,000		$60,000
6	1		$ 6,000	$54,000
7	2		$10,800	$43,200
8	3		$ 8,640	$34,560
9	4		$ 6,912	$27,648

signs, and other business equipment not specified as a different class. Companies may claim *up to* the amounts specified for an asset in any given class of tangible assets as detailed by CRA publications (but do not have to claim the full amount).[5] Companies may choose to carry unused CCA balances forward to future years when they have greater anticipated incomes (and thus, greater tax burdens).

Application in Capital Budgeting

The initial cost of the investment is the opening balance of what is called *undepreciated capital cost* (UCC). The CCA in any given year is deducted from the balance of the UCC, and thus the value of the investment has a declining balance for tax purposes. The CCA for a subsequent year is based on the CCA rate multiplied by the *new* UCC balance. Exhibit 20-5 shows the calculation of CCA amounts of a $60,000 Class 8 asset (CCA rate of 20%) over the first four years of the asset's life. When making these calculations, organizations must adhere to the **half-year rule**. The half-year rule assumes that all capital additions are purchased in the middle of the year, and thus only one-half of the stated CCA rate is allowed in the first year.

The starting UCC value of the asset is $60,000. The CCA dollar amount for year 1 is equal to the starting UCC multiplied by one-half the CCA rate, in this case 10% (= 20% × ½). The CCA rate for year 2 is determined by calculating the new UCC of $54,000—the previous year's UCC less the dollar value of the CCA (= $60,000 − $6,000). The new UCC is multiplied by the CCA rate for the asset (20%), which equals $10,800.

The CCA of each year is deducted in the calculation of a company's taxable income. Thus, the CCA is not a cash flow, but a tax savings, commonly called a *tax shield*. To determine the capital cost allowance for each year, the CCA must be multiplied by the company's marginal tax rate. If the marginal tax rate is 40% in the above example, the after-tax implications of the tax shield in year 1 would be $2,400 (= $6,000 × 40%). It is important to note that adjustments to the UCC are made based on *pre-tax* dollars.

In order to understand the impact of the tax shield in future years, it is necessary to discount the CCA in a similar fashion as any cash flow might be discounted. For instance, if the required return in the example above was 10%, the present value of the tax shield in year 2 would be ($10,800 × 40%) × 0.826 (the present value of $1 in two years at 10%) = $3,568.

Finally, the disposition of an asset at the end of its useful life must be considered in terms of the NPV of an investment, cash inflows (revenue from the disposal of the asset, called *salvage value*), and the loss of the tax shield now that the asset is no longer owned. The complete impact on the present value of an investment of the CCA tax shield can be calculated using the formula:

$$\text{PV tax shield on CCA} = \frac{CdT}{d+r} \times \frac{1+0.5r}{1+r} - \frac{SdT}{d+r} \times \frac{1}{(1+r)^n}$$

[5] For asset classes and capital allowances see: Canada Revenue Agency Classes of depreciable property: www.cra-rc.gc.ca/tx/bsnss/tpcs/slprtnr/rprtng/cptl/dprcbl-eng.html, accessed February 25, 2013.

where:

C = Cost of investment
d = CCA tax rate
T = Corporate tax rate
r = Discount rate
n = Number of periods in the project
S = Salvage value

To understand the implications of income tax and the tax shield generated by the CCA on capital budgeting and investment decisions, consider the following example.

Example Motor Corporation has purchased a CCA Class 8 asset (CCA rate of 20%) for $60,000, which is expected to generate savings in the amount of $25,000 per year. The useful life of the asset is four years and the asset will have a salvage value of $10,000 at the end of its life. The RRR is 10%, and the marginal tax rate for the company is 40%.

To calculate the present value of the investment in the above example, we rely on the present value of an annuity formula and the tax shield formula:

1. The NPV of Motor Corporation's investment is:

$$\text{NPV of investment} = \text{PV of the cash flow} + \text{PV of tax shield} - \text{Initial cost of investment} + \text{Salvage value}$$

2. The cash inflow, in this case, an annuity, is the after-tax savings, which can be calculated using Table 4 from Appendix A:

Annual savings × (1 − Tax rate) × PV of annuity (10%; 4 years)
= $25,000 × (1 − 0.4) × 3.170
= $25,000 × 0.6 × 3.170
= 47,550

3. The tax shield can be calculated using the above formula as:

$$\text{PV tax shield on CCA} = \frac{CdT}{d+r} \times \frac{1+0.5r}{1+r} - \frac{SdT}{d+r} \times \frac{1}{(1+r)^n}$$

PV tax shield on CCA

$$= \frac{(\$60{,}000)\,(20\%)\,(40\%)}{20\% + 10\%} \times \frac{1 + 0.5(10\%)}{1 + 10\%} - \frac{(\$10{,}000)\,(20\%)\,(40\%)}{20\% + 10\%} \times \frac{1}{(1 + 10\%)^4}$$

= $13,451

4. The salvage value can be calculated as the present value of income (Appendix A, Table 2).

Salvage value × PV of $1 (10%; 4 years)
= $10,000 × 0.683
= $6,830

5. Therefore, the NPV of the investment is:

NPV of investment = $47,550 + $13,451 − $60,000 + $6,830
= $7,831

This positive NPV would suggest the asset is a worthwhile investment. Because of rounding error, there will often be slight variations between the NPV as calculated through the formula method and through the timeline method. The error should not be treated as material to the calculation or the decision.

As an alternative to the formula method displayed above for calculating an asset's NPV inclusive of the CCA tax shield, a timeline model can be constructed as shown in Exhibit 20-6.

Exhibit 20-6 A Timeline Model

	A	B	C	D	E	F	G	H
1								
2		Initial Cost		$60,000				
3		Yearly Savings		$25,000				
4		Required Return		10%				
5		Tax Rate		40%				
6		CCA Rate		20%				
7		Salvage Value		$10,000				
8								
9								
10			**Present Value**	**Year**				
11				**0**	**1**	**2**	**3**	**4**
12	Initial Cost		−$60,000	−$60,000				
13								
14	Savings				$25,000	$25,000	$25,000	$25,000
15	After Tax Savings				$15,000	$15,000	$15,000	$15,000
16	Salvage							$10,000
17	Total Cash Flows				$15,000	$15,000	$15,000	$25,000
18								
19	PV of Cash Flows				$13,636	$12,397	$11,270	$17,075
20								
21	Sum of PV of Cash Flows		$54,378					
22	PV of Tax Shield		$13,451					
23								
24	NPV of Investment		$ 7,829					
25								

The columns on the right show the pre-tax savings generated by the new machine ($25,000 per year), and the after-tax impact of savings ($25,000 × (1 − 0.4) = $15,000). Note that year 4 has an additional cash flow in the form of revenue generated from the disposal of the asset (which also must be corrected for the time value of money). The present values of the yearly cash flows are then summed ($54,378) and added to the present value of the tax shield ($13,451). This results in an NPV for the investment of $7,829.

Relevant Information and DCF

► LO 4

Apply the concept of relevance to DCF methods of capital budgeting.

One of the biggest challenges in capital budgeting, particularly in DCF analysis, is determining which cash flows are relevant in making an investment selection. Relevant cash flows are the differences in expected future cash flows as a result of making the investment. A capital investment project typically has three categories of cash flows: (1) net initial investment in the project, which includes the acquisition of assets and any associated additions to working capital, minus the after-tax cash flow from the disposal of existing assets; (2) after-tax cash flow from operations (including income tax cash savings from annual depreciation deductions); and (3) after-tax cash flow from terminal disposal of an asset and recovery of working capital.

1. Net Initial Investment

Three components of net initial investment cash flows are (a) cash outflow to purchase the machine, (b) cash outflow for working capital, and (c) after-tax cash inflow from current disposal of the old machine.

1a. *Initial machine investment* — These outflows, made for purchasing plant and equipment, occur at the beginning of the project's life and include cash outflows for transporting and installing the equipment.

1b. *Initial working-capital investment.* Initial investments in plant and equipment are usually accompanied by additional investments in working capital. These additional investments take the form of current assets, such as accounts receivable and inventories, minus current liabilities, such as accounts payable. Working-capital investments are similar to plant and equipment investments in that they require cash. The magnitude of the investment generally increases as a function of the level of additional sales generated by the project. However, the exact relationship varies based on the nature of the project and the operating cycle of the industry.

1c. *After-tax cash flow from current disposal of old machine.* Any cash received from disposal of the old machine is a relevant cash inflow (in year 0). That's because it is an expected future cash flow that differs between the alternatives of investing and not investing in the new machine.

2. Cash Flow from Operations

This category includes the difference between successive years' cash flow from operations. Organizations make capital investments to generate future cash inflows.

2a. *Annual after-tax cash flow from recurring operations.* Cash inflows may result from savings in operating costs or from producing and selling additional goods. Annual cash flow from operations can be net outflows in some years. Cash outflows can include overhead or expenses related to the new investment.
Focus on cash flows from operations, NOT revenues and expenditures as reported in financial statements.

2b. *Income tax cash savings from annual CCA.* Deductions for CCA, in effect, partially offset the cost of acquiring new assets. The additional annual CCA deduction results in incremental income tax cash savings.

3. Terminal Disposal of Investment

The disposal of the new investment generally increases cash inflow when the project terminates. Errors in forecasting terminal disposal value are seldom critical for long-duration projects, because the present values of amounts to be received in the distant future are usually small. Two components of the terminal disposal value of an investment are (a) after-tax cash flow from terminal disposal of machines and (b) after-tax cash flow from recovery of working capital.

3a. *After-tax cash flow from terminal disposal of machines.* At the end of the useful life of the project, the machine's terminal disposal value may be $0 or an amount considerably less than the net initial investment. The relevant cash inflow is the difference in expected after-tax cash inflow from terminal disposal at the end of five years under the two alternatives of purchasing the new machine or keeping the old machine.

3b. *After-tax cash flow from terminal recovery of working-capital investment.* The initial investment in working capital is usually fully recouped when the project is terminated. At that time, inventories and accounts receivable necessary to support the project are no longer needed. If a company receives cash equal to the book value of its working capital, there is no gain or loss on working capital and, hence, no tax consequences.

Exhibit 20-7 presents the relevant cash inflows and outflows for Motor Corporation's decision to purchase the new machine as described earlier in the chapter. Assume that Motor Corporation has to make a $10,000 outlay of working capital at the beginning of the project, which it will fully recoup in the final year.

The columns on the right show the pre-tax savings generated by the new machine ($25,000 per year), and the after-tax impact of savings ($25,000 × (1 − 0.4) = $15,000). Note that year 4 has additional cash flows in the form of revenue generated from the disposal of the asset and the recapture of working capital (which also must be corrected for the time value of money). The present values of the yearly cash flows are then summed ($54,378) and added to the present value of the tax shield ($13,451). Thus, the present value of the cash inflows is $64,659. To arrive at the NPV of $4,659, we must subtract the cash outflows represented by the initial capital investment in the machine ($60,000) and the initial investment in working capital ($10,000).

Exhibit 20-7 Relevant Information in Motor Corporation's Decision to Invest

	A	B	C	D	E	F	G	H	I	J
1										
2			Initial Cost			$60,000				
3			Yearly Savings			$25,000				
4			Required Return			10%				
5			Tax Rate			40%				
6			CCA Rate			20%				
7			Salvage Value			$10,000				
8										
9										
10					**Present Value**			**Year**		
11						**0**	**1**	**2**	**3**	**4**
12	1a	Initial Cost			−$60,000	$60,000				
13	1b	Initial Working Capital Investment			−$10,000					
14		Savings					$25,000	$25,000	$25,000	$25,000
15	2a	After Tax Savings					$15,000	$15,000	$15,000	$15,000
16	3a	Salvage								$10,000
17	3b	Working Capital Recapture								$10,000
18		Total Cash Flows					$15,000	$15,000	$15,000	$35,000
19										
20		PV of Cash Flows					$13,636	$12,397	$11,270	$23,905
21										
22		Sum of PV of Cash Flows			$61,208					
23	2b	PV of Tax Shield			$13,451					
24										
25		NPV of Investment			$ 4,659					

Non-DCF Methods in Capital Budgeting

► LO 5

Assess the complexities in capital budgeting within an interdependent set of value-chain business functions.

DCF methods for capital budgeting focus on the application of the time value of money as a means of estimating risk and probable returns from investments. The primary advantage of these techniques is the ability to accommodate risk, inflation, and sensitivity in the decision model. However, both NPV and IRR can be cumbersome calculations, and alternatives to DCF methods do exist and are dramatically simpler. The two methods addressed here are the payback period and the AARR.

Payback Period

The **payback method** measures the time it will take to recoup the initial investment in a project in the form of net cash inflows. Like NPV and IRR, the payback method includes all sources of cash inflows (operations, disposal of equipment, or recovery of working capital). The payback method returns an answer in a number of periods (to recoup investment) rather than a dollar value of profitability or an ROR as in the case of NPV and IRR, respectively.

Payback Period and Uniform Cash Flows

Payback is simpler to calculate when a project has uniform cash flows, as opposed to non-uniform cash flows. In the Top-Spin example, the carbon-fibre machine costs

$379,100, has a five-year expected useful life, and generates $100,000 *uniform* cash flow each year. Calculation of the payback period is as follows:

$$\begin{aligned}\text{Payback} &= \frac{\text{Net initial investment}}{\text{Increase in cash flows}} \\ &= \frac{\$379{,}100}{\$100{,}000} \\ &= 3.8 \text{ years (rounded for simplicity)}\end{aligned}$$

The payback method highlights liquidity, which is often an important factor in capital budgeting decisions. Managers prefer projects with shorter paybacks (more liquid) to projects with longer paybacks, if all other things are equal. Projects with shorter payback periods give the organization more flexibility because funds for other projects become available sooner. Additionally, managers are less confident about cash flow predictions that stretch far into the future.

The major strength of the payback method is that it is easy to understand. Like the DCF methods described previously, the payback method is not affected by accrual accounting conventions like depreciation. Advocates of the payback method argue that it is a handy measure when (1) estimates of profitability are not crucial and preliminary screening of many proposals is necessary, and (2) the predicted cash flows in later years of the project are highly uncertain.

Unlike the NPV and IRR methods where management selects a ROR, under the payback method, management chooses a cutoff period for a project. Projects with a payback period that is less than the cutoff period are considered acceptable, and those with a payback period that is longer than the cutoff period are rejected. Japanese companies favour the payback method over other methods and use cutoff periods ranging from three to five years depending on the risks involved with the project. In general, modern risk management calls for using shorter cutoff periods for riskier projects.

Two major weaknesses of the payback method are (1) it neglects the time value of money and (2) it neglects to consider project cash flows after the net initial investment is recovered. Consider our discussion earlier about Top-Spin, and an alternative to the $379,100 machine mentioned. Assume that another machine, with a three-year useful life and zero terminal disposal price, requires only a $300,000 net initial investment and will also result in cash inflows of $100,000 per year. First, compare the two payback periods:

$$\text{Payback period for machine 1: } = \frac{\$379{,}100}{\$100{,}000} = 3.791 \text{ years}$$

$$\text{Payback period for machine 2: } = \frac{\$300{,}000}{\$100{,}000} = 3.000 \text{ years}$$

The payback criterion would favour buying the $300,000 machine, because it has a shorter payback. In fact, if the cutoff period is three years, then Top-Spin would not acquire machine 1 because it fails to meet the payback criterion. Consider next the NPV of the two investment options using Top-Spin's 8% RRR for the investment. At a discount rate of 8%, the NPV of machine 2 is −$42,300 (calculated as 2.577, the present value annuity factor for three years at 8% from Table 4, multiplied by $100,000 equals $257,700, minus the net initial investment of $300,000). Machine 1, as we know, has a positive NPV of $20,200 (from Exhibit 20-3). The NPV criterion suggests that Top-Spin should acquire machine 1. Machine 2, with a negative NPV, would fail to meet the NPV criterion. The payback method gives a different answer from the NPV method because the payback method (1) does not consider cash flows after the payback period and (2) does not discount cash flows.

An additional concern with the payback method is that choosing too short a cutoff period for project acceptance may promote the selection of only short-lived projects; the organization will tend to reject long-term, positive-NPV projects. This would prove particularly problematic in the pharmaceutical industry where drug development projects often run more than 15 years. Companies often use both the payback and DCF methods to select positive NPV projects with an acceptably short payback period.

Non-Uniform Cash Flows

When annual cash inflows are *not uniform,* the payback computation takes a cumulative form. The years' net cash inflows are accumulated until the amount of the net initial investment has been recovered. Assume that Venture Law Group is considering the purchase of videoconferencing equipment for $150,000. The equipment is expected to provide total cash savings of $380,000 over the next five years, due to reduced travel costs and more effective use of associates' time. The cash savings occur uniformly throughout each year, but non-uniformly across years. Payback occurs during the third year:

Year	Cash Savings	Cumulative Cash Savings	Net Initial Investment Yet to Be Recovered at the End of the Year
0	—	—	$150,000
1	$ 50,000	$ 50,000	100,000
2	60,000	110,000	40,000
3	80,000	190,000	—
4	90,000	280,000	—
5	100,000	380,000	—

Straight-line interpolation within the third year, which has cash savings of $80,000, reveals that the final $40,000 needed to recover the $150,000 investment (that is, $150,000 – $110,000 recovered by the end of year 2) will be achieved halfway through year 3 (in which $80,000 of cash savings occur):

$$\text{Payback} = 2 \text{ years} + \left(\frac{\$40{,}000}{\$80{,}000} \times 1 \text{ year}\right) = 2.5 \text{ years}$$

The videoconferencing example has a single cash outflow of $150,000 at year 0. Where a project has multiple cash outflows occurring at different points in time, these outflows are subtracted from revenue or savings inflows to derive a net cash outflow figure. The net cash flow is used to calculate the payback period. No adjustment is made for the time value of money when adding these cash outflows in computing the payback period.

Accrual Accounting Rate of Return

The **accrual accounting rate of return** (**AARR**) is an accounting measure of income divided by an accounting measure of investment. It is also called **accounting rate of return** or **return on investment** (**ROI**). Note that NPV, IRR, and payback are all based on cash flows, whereas AARR is based on accrual accounting. AARR is calculated as follows:

$$\text{AARR} = \frac{\text{Increase in after-tax income} - \text{Depreciation associated with the project}}{\text{Net initial investment}}$$

Consider the following example. A company expects to make a total investment of $300,000 in an asset, which has a zero terminal disposal price and terminates in five years. The asset will generate $90,000 in after-tax revenue.

The AARR is computed as follows. The numerator is equal to the after-tax income, less the depreciation of the asset. Using straight-line depreciation, the yearly depreciation is $60,000; thus, the numerator is $90,000 − $60,000 = $30,000. The net initial investment is $300,000. The AARR is equal to:

$$\text{AARR} = \frac{\$90{,}000 - \$60{,}000}{\$300{,}000}$$

$$= \frac{\$30{,}000}{\$300{,}000} = 10\%$$

In practice; there are variations on this formula. Some companies use "increase in expected average annual operating income" in the numerator and/or "average investment per year" in the denominator. The AARR method focuses on how investment decisions affect operating income numbers routinely reported by organizations. The AARR of 10% indicates the rate at which a dollar of investment generates operating income.

Strategic Factors in Capital Budgeting Decisions

▶ **LO 6**

Apply the concept of defensive strategic investment to the capital budgeting process.

A company's strategy is the source of its strategic capital budgeting decisions. Strategic investments may be undertaken offensively to grow market share and profitability, or defensively to avoid impairing a company's competitive advantage. The fourth step in the 5DM model as it relates to capital budgeting is the application of the manager's judgment in evaluating the financial information examined in the third step, and balancing that against qualitative and other quantitative information. Capital investment decisions that are strategic in nature require managers to study a broad range of factors that may be difficult to estimate.

The factors that companies consider for strategic investment decisions are far broader than costs alone (see Exhibit 20-8). For example, the reasons for introducing computer-integrated manufacturing (CIM) technology—faster response time, higher product quality, and greater flexibility in meeting changes in customer preferences—are often to increase revenues and contribution margins. Ignoring the revenue effects underestimates the financial benefits of CIM investments. However, the revenue benefits of technology investments of this sort are often difficult to quantify in financial terms that can be applied in an NPV model. Nevertheless, competitive and revenue advantages are important managerial considerations when introducing CIM.

Exhibit 20-8 presents examples of the broader set of factors that companies must examine. Predicting the full set of costs also presents problems. Three classes of costs are difficult to measure and are often underestimated:

1. Costs associated with a reduced competitive position in the industry. If other companies in the industry are investing in CIM, a company not investing in CIM will probably suffer a decline in market share because of its inferior quality and slower delivery performance. Several companies in the machine tool industry that continued to use a conventional manufacturing approach experienced rapid drops in market share after their competitors introduced CIM.
2. Costs of retraining the operating and maintenance personnel to handle the automated facilities.
3. Costs of developing and maintaining the software and maintenance programs to operate the automated manufacturing activities.

Customer Value and Capital Budgeting

To remain competitive, companies must keep their profitable customers and gain new ones. Consider Potato Supreme, which makes potato products for sale to retail outlets. It is currently analyzing two of its customers: Shine Stores and Always Open. Potato Supreme predicts the following cash flow from operations, net of income taxes (in thousands), from each customer account for the next five years:

	2015	2016	2017	2018	2019
Shine Stores	$1,450	$1,305	$1,175	$1,058	$ 950
Always Open	690	1,160	1,900	2,950	4,160

Exhibit 20-8 Factors Considered in Making Capital Budgeting Decisions for CIM Projects

Examples of Financial Outcomes	Examples of Nonfinancial and Qualitative Outcomes
Lower direct labour costs	Reduction in manufacturing cycle time
Lower hourly support labour costs	Increase in manufacturing flexibility
Less scrap and rework	Increase in business risk due to higher fixed cost structure
Lower inventory costs	Improved product delivery and service
Increase in software and related costs	Reduction in product development time
Higher costs of retraining personnel	Faster response to market changes
	Increased learning by workers about automation
	Improved competitive position in the industry

Which customer is more valuable to Potato Supreme?

Looking at only the first year, 2015, Shine Stores provides more than double the cash flow compared to Always Open ($1,450 versus $690). A different picture emerges, however, when looking over the entire five-year horizon. Using Potato Supreme's 10% RRR, the NPV of the Always Open customer is $7,610, compared to $4,591 for Shine Stores (computations not shown). These NPV amounts are calculated using the 10% NPV of $1,318 (= $1,450 × 0.909) for Shine Stores and $627 (= $690 × 0.909) for Always Open.

Note how NPV captures in its estimate of customer value the future growth of Always Open. Potato Supreme uses this information to allocate more resources and salespeople to service the Always Open account. Potato Supreme can also use NPV calculations to examine the effects of alternative ways of increasing customer loyalty and retention, such as introducing frequent-purchaser cards.

A comparison of year-to-year changes in customer NPV estimates highlights whether managers have been successful in maintaining long-run profitable relationships with their customers. Suppose the NPV of Potato Supreme's customer base declines 15% in one year. Management can then examine the reasons for the decline, such as aggressive pricing by competitors, and devise new product development and marketing strategies for the future.

Cellular telephone companies Rogers and Telus use NPV analyses to examine their strategy, which is focused on attempting to enroll customers for multiple years of service. The initial costs of marketing, providing a phone at a subsidized price, and other expenses

Concepts in Action

Capital Budgeting at Disney

*/Kyodo/Newscom

The Walt Disney Company, one of the world's leading entertainment producers with $42 billion in 2012 revenue, spends about $1 billion annually in capital investments on its theme park business. These funds are invested in new theme parks, rides and attractions, and other park construction and improvements.

Years ago, Disney developed a robust capital budgeting approval process. Project approval relied heavily on projected returns on capital investment as measured by net present value (NPV) and internal rate of return (IRR) calculations. This worked well for Disney's investments in its domestic theme park business, but the company experienced challenges when it considered building the DisneySea theme park near Tokyo, Japan.

While capital budgeting in the United States relies on discounted cash flow analysis, Japanese firms frequently use the average accounting return (AAR) method instead. AAR is analogous to an accrual accounting rate of return (AARR) measure based on average investment. However, it focuses on the first few years of a project (five years, in the case of DisneySea) and ignores terminal values.

Disney discovered that the difference in capital budgeting techniques between U.S. and Japanese firms reflected the difference in corporate governance in the two countries. The use of NPV and IRR in the United States underlined a focus on shareholder-value maximization. On the other hand, the preference for AAR in Japan reflected the importance of achieving complete consensus among all parties affected by the investment decision.

When the DisneySea project was evaluated, it was found to have a positive NPV but a negative AAR. To account for the differences in philosophies and capital budgeting techniques, managers at Disney introduced a third calculation method called average cash flow return (ACFR). This hybrid method measured the average cash flow over the first five years, with the asset assumed to be sold for book value at the end of that period at a fraction of the initial investment in the project. The resulting ratio was found to exceed the return on Japanese government bonds and hence to yield a positive return for DisneySea. As a result, the park was constructed next to Tokyo Disneyland and has since become a profitable addition to Disney's Japanese operations.

Sources: Mitsuru Misawa, "Tokyo Disneyland and the DisneySea Park: Corporate Governance and Differences in Capital Budgeting Concepts and Methods Between American and Japanese Companies," University of Hong Kong No. HKU568 (Hong Kong: University of Hong Kong Asia Case Research Center, 2006); The Walt Disney Company, *2012 Annual Report* (Burbank, CA: The Walt Disney Company, 2013).

are balanced against the estimated future service payments customers will make over the life of the contract. The objective is to prevent "customer churn," customers switching frequently from one company to another. The higher the probability of customer churn, the lower the NPV of the customer to the telecommunications company.

Investment in Research and Development

Companies such as Samsung, a global leader in designing, manufacturing, and marketing innovative wireless mobile devices like the Galaxy Tab and the Galaxy II, regard research and development (R&D) projects as important strategic investments. R&D payoffs are not only more uncertain than other investment projects, but also will often occur far into the future. Most companies engaged in these types of investment projects stage their R&D so they have the choice to increase or decrease their investment at different points in time based on its success. This option feature of R&D investments—called *real options*—is an important aspect of R&D investments and increases the NPV of these investments. That's because a company can limit its losses when things are going badly and take advantage of new opportunities when things are going well.

Capital Budgeting and Control: Evaluation and Application

▶ **LO 6**

Apply the concept of defensive strategic investment to the capital budgeting process.

The final step of capital budgeting begins with implementing the decision, or managing the project. This includes management control of the investment activity itself, as well as management control of the project as a whole. Capital budgeting projects, such as purchasing a carbon-fibre machine or videoconferencing equipment, are easier to implement than projects involving building shopping malls or manufacturing plants. The building projects are more complex, so monitoring and controlling the investment schedules and budgets are critical to successfully completing the investment activity.

Management Control: Performance Evaluation

Ideally managers should be evaluated on a project-by-project basis, which examines how well they achieve the amounts and timing of forecasted cash flows. In practice, however, managers are often evaluated based on aggregate information, especially when multiple projects are underway at any point in time. It is important then to ensure that the method of evaluation does not conflict with the use of the NPV method for making capital budgeting decisions.

For example, suppose that Top-Spin uses the AARR generated in each period to assess managerial performance. We know from the NPV method that the manager of the racquet production plant should purchase the carbon-fibre machine because it has a positive NPV. Despite that, the project may be rejected if the AARR on the net initial investment is lower than the minimum accounting rate of return the manager is required to achieve.

There is an inconsistency between using the NPV method as best for capital budgeting decisions and then using a different method to evaluate performance. This inconsistency means managers are tempted to make capital budgeting decisions on the basis of the method by which they are being evaluated, rather than the method best suited to the organization.

Other conflicts between decision making and performance evaluation persist even if a company uses similar measures for both purposes. If the AARR on the carbon-fibre machine exceeds the minimum required AARR but is below the current AARR of the production plant, the manager may still be tempted to reject purchase of the carbon-fibre machine because the lower AARR of the carbon-fibre machine will reduce the AARR of the entire plant and hurt the manager's reported performance. Or, consider an example where the cash inflows from the carbon-fibre machine occur mostly in the later years of the project. Then, even if the AARR on the project exceeds the current AARR of the plant (as well as the minimum required return), the manager may still reject the purchase since it will have a negative effect on the realized AARR for the first few years.

Management Control: The Investment Activity

Assumptions made by managers of a company drive the evaluation of alternative investments. A company may develop a simple DCF analysis using, for example, a 12% discount rate for all projects. As a company grows globally, risks of otherwise identical projects can vary widely and the issue of currency repatriation (reporting foreign revenue and cost in domestic currency) and political instability affect many countries. Expansion by a Canadian energy producer into Argentina or Somalia, for example, carries higher risk than expansion into the Gulf of Mexico.

Failing to adjust assumptions about the RRR to account for higher risk, such as regulatory and currency risk, produces a biased valuation of investment alternatives. Another factor that creates fundamental difficulties for applying analytic models of domestic investments to overseas expansion is the increasing complexity of international financing. Global expansion strategies require a capital budgeting process that evaluates each proposed investment as a distinct opportunity with unique risks. A single discount rate does not fit all alternatives.

An approach could begin by considering representatives from various countries and deriving a weighted average cost of capital (WACC) for each project. WACC is covered in introductory finance courses. Briefly, WACC calculations require measuring all of the constituent parts of financing for projects: the cost of debt, the target capital structure, the local-country tax rates, and an appropriate cost of equity.[6]

To capture the country-specific risks in foreign markets, one approach is to calculate a cost of debt and a cost of equity for each representative project using domestic data. The risk-free investment is assessed using the difference between the yield on local government bonds and the yield on corresponding domestic government Treasury bonds to both the cost of debt and the cost of equity. The difference, or sovereign spread, can approximate the incremental borrowing costs (and market risk) in the local country. This approach is a more sophisticated way to think about capital budgeting risk and its cost of capital around the world.

Management Control: The Post-Investment Audit

A post-investment audit compares the predictions of investment costs and outcomes made at the time a project was selected to the actual results. It provides management with feedback about the investment's performance. Suppose, for example, that actual outcomes (operating cash savings from the graphite machine in the Top-Spin example) are much lower than predicted outcomes. Management must then investigate whether this occurred because the original estimates were overly optimistic or because there were problems in implementing the project. Both types of problems are a concern.

Optimistic estimates are a concern because they may result in the acceptance of a project that would otherwise have been rejected. To discourage optimistic estimates, companies like DuPont maintain records comparing actual performance to the estimates made by individual managers when seeking approval for capital investments. DuPont believes that post-investment audits discourage managers from making unrealistic forecasts. Problems in implementing a project—such as weak project management, poor quality control, or inadequate marketing—are an obvious concern because the returns from the project will not meet expectations. Post-investment audits can point to areas requiring corrective action.

However, post-investment audits require thoughtfulness and care. They should be done only after project outcomes have stabilized because performing audits too early may yield misleading feedback. Obtaining actual results to compare against estimates is often not easy. For example, additional revenues from the new carbon-fibre technology may not be comparable to the estimated revenues because in any particular season, the rise or fall of a tennis star can greatly affect the popularity of the sport and the subsequent demand for racquets. Alternatively, increased traffic because of the carbon-fibre products

[6] Based on "Globalizing the Cost of Capital and Capital Budgeting at AES," Harvard Business School Case No. 9-204-109.

may boost other products' sales. A better evaluation might look at the average revenues across a couple of seasons.

The International Financial Reporting Standards (IFRS) require an annual post-investment review. Upon review, if the carrying value (acquisition cost less accumulated depreciation) materially misstates the long-term investment or liability values, then an impairment must be reported. The reported values must also be adjusted along with explanatory notes informing investors of the key changes in assumptions that explain the impairment. In subsequent years, if a reversal occurs with the impaired asset (and its fair market value exceeds the carrying value), then reporting must be adjusted to reflect the higher value. This change to financial accounting standards will lead to a new demand for the skills in applying management accounting methods long used in capital budgeting and forecasts to retrospective reporting of performance on the statement of financial position.

The 5DM Model: A Capital Budgeting Review

Step 1: Identify Projects *Identify potential capital investments that agree with the organization's strategy.*	When seeking out and identifying projects, it is important to focus on the organization's mission and vision. Seeking projects that are aligned with the strategy of the organization and will help achieve the mission are more likely to be successful.
Step 2: Obtain Information *Gather information from all parts of the value chain to evaluate alternative projects.*	The information gathered here can come from a variety of sources in the value chain, including R&D, production, and customer service. Information gathered here will be used in steps 3 and 4 to make effective capital budgeting decisions.
Step 3: Make Predictions *Forecast all potential cash flows attributable to the alternative projects.*	Capital investments require the firm to make forecasts of cash flows several years into the future. Factors that should be included are: initial cost of the investment, regular or irregular cash flows (in and out), the impact of income taxes, working capital flows, and other financial data from the organization and the economy. The tools we focus on in capital budgeting are: NPV, IRR, payback period, and AARR.
Step 4: Make Decisions by Choosing Among Alternatives *Determine which investment yields the greatest benefit and the least cost to the organization.*	Financial information is never enough to make the decision about a capital investment. It is necessary that managers use judgment in evaluating other forms of information that may impact the organization, such as societal and technological trends (i.e., social fashion or obsolescence); stakeholder requirements (i.e., investments that have non-monetary and subjective value); and other factors.
Stage 5: Implement the Decision, Evaluate Performance, and Learn *Given the complexities of capital investment decisions and the long time horizons they span, this stage can be separated into two phases:*	
Phase 1: Obtain funding and make the investments selected in step 4.	Sources of funding include internally generated cash flow as well as equity and debt securities sold in capital markets. Managers must examine the most cost effective strategy to generate capital within the firm's strategy and capabilities.

Phase 2: Track realized cash flows, compare against estimated numbers, and revise plans if necessary.

As the cash outflows and inflows begin to accumulate, managers can verify whether the predictions made in step 3 agree with the actual flows of cash from the project. Control and evaluation must be exercised judiciously to ensure that the project unfolds as intended.

Pulling it all Together—Problem for Self-Study

(Try to solve this problem before examining the solution that follows.)

Problem

Marist Sails is considering purchasing a new machine to sew sails for high performance racing yachts, to complement its existing product line of sails for cruising, or "day sailing" yachts. Assume that the expected annual cash inflows from new sails will be $130,000. A $379,100 net initial investment is required, and the machine has a five-year useful life and an 8% required rate of return. When calculating breakeven time, assume that the investment will occur immediately after management approves the project.

Compute the following:

Required ▶ ❶❷

1. Discounted cash flow
   a. Net present value
   b. Internal rate of return
   ❸ c. Net present value assuming a Class 8 asset (CCA of 20%), a tax rate of 40%, and a salvage value of $50,000.
2. ❷ Payback period
3. ❷ Accrual accounting rate of return on net initial investment
4. ❷ Calculate the payback period using discounted cash flows. Assume (for calculation purposes) that cash outflows and cash inflows occur at the end of each period.
5. ❹ To what five areas would you direct your attention when assessing relevant from irrelevant cash flows for two alternative long-term investments?
6. ❺ What prominent change in financial accounting standards has contributed to the importance of the interconnection of management accounting and financial reporting processes?
7. ❻ Aside from a growth strategy, for what other reason might managers undertake new investment?

Solution

1. a. $\text{NPV} = (\$130{,}000 \times 3.993) - \$379{,}100$
   $= \$519{,}090 - \$379{,}100 = \$139{,}990$

   b. There are several approaches to computing the IRR. One is to use a calculator with an IRR function; this gives an IRR of 21.16%. An alternative approach is to use Table 4 in Appendix A:

$$\$379{,}100 = \$130{,}000\, F$$

$$F = \frac{\$379{,}100}{\$130{,}000} = 2.916$$

On the five-period line of Table 4, the column closest to 2.916 is 22%. To obtain a more accurate number, straight-line interpolation can be used:

	Present Value	Factors
20%	2.991	2.991
IRR	—	2.916
22%	2.864	—
Difference	0.127	0.075

$$\text{IRR} = 20\% + \frac{0.075}{0.127}(2\%) = 21.18\% \text{ (difference due to rounding of PV factor to 3 decimals)}$$

c.

$$\begin{aligned}
\text{NPV} &= \text{Operational Cash Flows} = \$130{,}000 \times 3.993 = \$519{,}090 \\
&+ \text{Tax Shield} = \text{See below} = 94{,}580 \\
&+ \text{PV of Salvage} = \$50{,}000 \times 0.681 = 34{,}050 \\
&- \text{Initial Investment} = (389{,}100) \\
&+ \text{PV of WC recapture} = \$10{,}000 \times 0.681 = 6{,}810 \\
&= \$265{,}430
\end{aligned}$$

Tax Shield Calculation

$$\text{PV tax shield on CCA} = \frac{CdT}{d+r} \times \frac{1 + 0.5r}{1+r} - \frac{SdT}{d+r} \times \frac{1}{(1+r)^n}$$

PV tax shield on CCA

$$= \frac{(\$379{,}100)(20\%)(40\%)}{20\% + 8\%} \times \frac{1 + 0.5(8\%)}{1 + 8\%} - \frac{(\$50{,}000)(20\%)(40\%)}{20\% + 8\%} \times \frac{1}{(1 + 8\%)^5}$$

2. $$\text{Payback} = \frac{\text{Net initial investment}}{\text{Uniform increase in annual cash flows}}$$

$$= \$379{,}100 \div \$130{,}000 = 2.92 \text{ years}$$

3. $$\text{AARR} = \frac{\text{Increase in expected average annual operating income}}{\text{Net initial investment}}$$

$$\text{Increase in expected average annual operating savings} = [(\$130{,}000 \times 4) + \$120{,}000] \div 5 = \$128{,}000$$

$$\text{Average annual depreciation} = \$372{,}890 \div 5 = \$74{,}578$$

$$\text{Increase in expected average annual operating income} = \$128{,}000 - \$74{,}578 = \$53{,}422$$

$$\text{AARR} = \frac{\$53{,}422}{\$379{,}100} = 14.09\%$$

4. Payback using discounted cash flow computations is as follows:

Year	PV Discount Factor at 8% (1)	Investment Cash Outflows (2)	PV of Investment Cash Outflows* (3) = (1) × (2)	Cumulative PV of Investment Cash Outflows* (4)	Cash Inflows (5)	PV of Cash Inflows* (6) = (1) × (5)	Cumulative PV of Cash Inflows* (7)
0	1.000	$379,100	$379,100	$379,100			
1	0.926				$130,000	$120,380	$120,380
2	0.857				130,000	111,410	231,790
3	0.794				130,000	103,220	335,010
4	0.735				130,000	95,550	430,560
5	0.681				130,000	88,530	519,090

*At year 0.

$$\text{BET} = 3 \text{ years} + \frac{(\$379{,}100 - \$335{,}010)}{\$95{,}550}$$

$$= 3 \text{ years} + \frac{44.090}{95{,}550}$$

$$= 3.46 \text{ years}$$

5. The five areas where cash flows may differ are the cost of initial investment, including working capital requirements; liquidation values of any old investments; recurring cash flows; overhead costs, including depreciation (or CCA); and the terminal disposal price.
6. The convergence from national to international financial accounting and reporting standards now requires an annual post-investment audit. In addition, new standards for long-term liabilities require an annual review of their carrying value as well as an annual impairment test for long-term assets. The methods of capital budgeting are now recommended for use in valuation for financial reporting purposes.
7. Strategically, if competitors are undertaking specific types of long-term investments, failing to do so is highly likely to put a firm at a competitive disadvantage. An example is upgrading management information and control systems. A defensive strategy is to upgrade if all competitors are doing so. Thus, investments may be for growth or defence.

Summary Points

The following question-and-answer format summarizes the chapter's learning objectives. Each point presents a key question, and the guidelines are the answer to that question.

Learning Objectives	Guidelines
1. What does the term *time value of money* recognize?	The term recognizes that money received earlier is worth more because of the returns that can be generated sooner.
2. What are the disadvantages of DCF and non-DCF (payback and AARR) methods of capital budgeting?	The NPV method computes a result in dollars not percentages and can be used where the required rates of return vary over the life of the project. The payback method neglects any cash flow after the payback period and the time value of money. The AARR is an after-tax operating income divided by a measure of the investment. The AARR does not consider the time value of money. The payback and AARR methods are nondiscounted cash flow methods whereas the NPV and IRR are discounted cash flow methods.
3. Analyze the impact of income taxes on discounted cash flows and capital budgeting decisions.	Under the Income Tax Act (ITA) organizations can deduct a capital cost allowance (CCA), rather than depreciation, from income before taxes. This creates a tax savings, commonly called a *tax shield*. The amount of the tax shield is a material consideration in evaluating the cash inflows and outflows of an investment.
4. What does *relevance* mean in DCF analyses?	*Relevance* in this context means cash flow. No accruals, sunk cost, or cash flows unchanged by alternatives are relevant when these capital budgeting methods are applied. All cash flow is treated identically irrespective of its source from operations, financing, or disinvestment.

5. What conflicts can arise between using discounted cash flow methods for capital budgeting decisions and accrual accounting for performance evaluation? How can these conflicts be reduced?

Frequently, the decision made using a DCF method will not report good "operating income" results in the project's early years under accrual accounting. For this reason, managers are tempted not to use DCF methods even though the decisions based on them would be the best for the company over the long run. This conflict can be reduced by evaluating managers on a project-by-project basis, looking at their ability to achieve the amounts and timing of forecast cash flows.

6. What are the implications of a defensive long-term investment?

A defensive strategic or long-term investment is made for purposes of defending market share. The quantitative and non-quantitative factors are secondary to this purpose. One very great difficulty is properly identifying and assessing the long-term opportunity cost of lost market-share.

Appendix 20A

Capital Budgeting and Inflation

Examples discussed earlier do not include adjustments for inflation in the relevant revenues and costs. **Inflation** is the decline in the general purchasing power of the monetary unit, such as dollars. An inflation rate of 10% per year means that an item bought for $100 at the beginning of the year will cost $110 at the end of the year.

Why is it important to account for inflation in capital budgeting? Because declines in the general purchasing power of the monetary unit will inflate future cash flows above what they would have been in the absence of inflation. These inflated cash flows will cause the project to look better than it really is unless the analyst recognizes that the inflated cash flows are measured in dollars that have less purchasing power than the dollars that were initially invested. When analyzing inflation, distinguish real rate of return from nominal rate of return:

Real rate of return is the rate of return demanded to cover investment risk if there is no inflation. The real rate is made up of two elements: (a) a risk-free element (that's the pure rate of return on risk-free long-term government bonds when there is no expected inflation) and (b) a business-risk element (that's the risk premium demanded for bearing risk).
Nominal rate of return is the rate of return demanded to cover investment risk and the decline in general purchasing power of the monetary unit as a result of expected inflation. The nominal rate is made up of three elements: (a) a risk-free element when there is no expected inflation, (b) a business-risk element, and (c) an inflation element. Items (a) and (b) make up the real rate of return to cover investment risk. The inflation element is the premium above the real rate. The rates of return earned in the financial markets are nominal rates, because investors want to be compensated both for the investment risks they take and for the expected decline in the general purchasing power, as a result of inflation, of the money they get back.

Assume that the real rate of return for investments in high-risk cellular data-transmission equipment at Network Communications is 20% per year and that the expected inflation rate is 10% per year. Nominal rate of return is as follows:

$$\begin{aligned}\text{Nominal rate} &= (1 + \text{Real rate})(1 + \text{Inflation rate}) - 1\\ &= (1 + 0.20)(1 + 0.10) - 1\\ &= (1.20 \times 1.10) - 1 = 1.32 - 1 = 0.32, \text{ or } 32\%\end{aligned}$$

Nominal rate of return is related to the real rate of return and the inflation rate:

Real rate of return	0.20
Inflation rate	0.10
Combination (0.20 × 0.10)	0.02
Nominal rate of return	0.32

Note that the nominal rate, 0.32, is slightly higher than 0.30, the real rate (0.20) plus the inflation rate (0.10). That's because the nominal rate recognizes that inflation of 10% also decreases the purchasing power of the real rate of return of 20% earned during the year. The combination component represents the additional compensation investors seek for the decrease in the purchasing power of the real return earned during the year because of inflation.[7]

[7] The real rate of return can be expressed in terms of the nominal rate of return as follows:

$$\text{Real rate} = \frac{1 + \text{Nominal rate}}{1 + \text{Inflation rate}} - 1 = \frac{1 + 0.32}{1 + 0.10} - 1 = 0.20, \text{ or } 20\%$$

Net Present Value Method and Inflation

When incorporating inflation into the NPV method, the key is *internal consistency*. There are two internally consistent approaches:

1. *Nominal approach*—predicts cash inflows and outflows in nominal (or, stated) monetary units *and* uses a nominal rate as the required rate of return
2. *Real approach*—predicts cash inflows and outflows in real monetary units *and* uses a real rate as the required rate of return

We will limit our discussion to the simpler nominal approach. Consider an investment that is expected to generate sales of 100 units and a net cash inflow of $1,000 ($10 per unit) each year for two years *absent inflation*. Assume cash flows occur at the end of each year. If inflation of 10% is expected each year, net cash inflows from the sale of each unit would be $11 (= $10 × 1.10) in year 1 and $12.10 (= $11 × 1.10, or $10 × $(1.10)^2$) in year 2, resulting in net cash inflows of $1,100 in year 1 and $1,210 in year 2. The net cash inflows of $1,100 and $1,210 are nominal cash inflows because they include the effects of inflation. *Nominal cash flows are the cash flows that are recorded in the accounting system*. The cash inflows of $1,000 each year are real cash flows. The accounting system does not record these cash flows. The nominal approach is easier to understand and apply because it uses nominal cash flows from accounting systems and nominal rates of return from financial markets.

Assume that Network Communications can purchase equipment to make and sell a cellular data-transmission product at a net initial investment of $750,000. It is expected to have a four-year useful life and no terminal disposal value. An annual inflation rate of 10% is expected over this four-year period. Network Communications requires an after-tax nominal rate of return of 32%. The following table presents the predicted amounts of real (that's assuming no inflation) and nominal (that's after considering cumulative inflation) net cash inflows from the equipment over the next four years (excluding the $750,000 investment in the equipment and before any income tax payments):

Year (1)	Before-Tax Cash Inflows in Real Dollars (2)	Cumulative Inflation Rate Factor[a] (3)	Before-Tax Cash Inflows in Nominal Dollars (4) = (2) × (3)
1	$500,000	$(1.10)^1 = 1.1000$	$550,000
2	600,000	$(1.10)^2 = 1.2100$	726,000
3	600,000	$(1.10)^3 = 1.3310$	798,600
4	300,000	$(1.10)^4 = 1.4641$	439,230

[a]1.10 = 1.00 + 0.10 inflation rate.

We continue to make the simplifying assumption that cash flows occur at the end of each year. The income tax rate is 40%. For tax purposes, the cost of the equipment will be depreciated using the straight-line method.

Exhibit 20-9 shows the calculation of NPV using cash flows in nominal dollars and using a nominal discount rate. The calculations in Exhibit 20-9 include the net initial machine investment, annual after-tax cash flows from operations (excluding the depreciation effect), and income tax cash savings from annual depreciation deductions. The NPV is $202,513 and, based on financial considerations alone, Network Communications should purchase the equipment.

Appendix 20B

The Weighted Average Cost of Capital

A commonly used discount rate in capital budgeting analysis is the weighted average cost of capital (WACC). The WACC represents the cost of funds and is dependent on the capital structure of the organization. An important assumption is that the risk associated with any particular investment will be close to the average risk of the firm.

The optimal capital structure is most often defined as the proportion of debt and equity that maximizes the value of the organization. To determine the WACC the capital structure of the organization is examined and the cost of each individual source of financing is calculated and then weighted by its relative proportion in the total capital structure.

Exhibit 20-9 Net Present Value Method Using Nominal Approach to Inflation for Network Communications' New Equipment

	A	B	C	D	E	F	G	H	I	J	K	L
1						Present	Present Value					
2						Value of	Discount Factor[a] at	Sketch of Relevant Cash Flows at End of Each Year				
3						Cash Flow	32%	0	1	2	3	4
4	1.	Net initial investment										
5		Year	Investment Outflows									
6		0	$(750,000)			$(750,000)	← 1.000 ←	$(750,000)				
7	2a.	Annual after-tax cash flow from										
8		operations (excluding the depreciation effect)										
9			Annual		Annual							
10			Before-Tax	Income	After-Tax							
11			Cash Flow	Tax	Cash Flow							
12		Year	from Operations	Outflows	from Operations							
13		(1)	(2)	(3) = 0.40 x (2)	(4) = (2) - (3)							
14		1	$550,000	$220,000	$330,000	250,140	← 0.758 ←		$330,000			
15		2	726,000	290,400	435,600	250,034	← 0.574 ←			$435,600		
16		3	798,600	319,440	479,160	208,435	← 0.435 ←				$479,160	
17		4	439,230	175,692	263,538	86,704	← 0.329 ←					$263,538
18						795,313						
19	2b.	Income tax cash savings from annual										
20		depreciation deductions										
21		Year	Depreciation	Tax Cash Savings								
22		(1)	(2)	(3) = 0.40 x (2)								
23		1	$187,500[b]	$75,000		56,850	← 0.758 ←		$ 75,000			
24		2	187,500	75,000		43,050	← 0.574 ←			$ 75,000		
25		3	187,500	75,000		32,625	← 0.435 ←				$ 75,000	
26		4	187,500	75,000		24,675	← 0.329 ←					$ 75,000
27						157,200						
28	NPV if new equipment purchased					$ 202,513						
29												
30												
31	[a]The nominal discount rate of 32% is made up of the real rate of return of 20% and the inflation rate of 10% [(1 + 0.20) (1 + 1.10)] – 1 = 0.32.											
32	[b]$750,000 ÷ 4 = $187,500											

Determining Costs of Sources of Capital Structure

1. After-tax cost of debt = $k_d = k(1 - t)$

   where:

   k = interest rate
   t = corporate tax rate

2. The cost of preferred shares is derived from the present value of a perpetuity and is as follows

   Cost of preferred shares = $k_p = \frac{D}{P}$

   where:

   D = annual dividends paid per share
   P = the market value of one preferred share

3. Common shares can be valued using the dividend growth model (also called the Gordon Model) or the capital asset pricing model (CAPM). For our purposes the more commonly used approach will be adopted, namely the CAPM.

   $k_e = R_f + \beta(R_m - R_f)$

   where:

   R_f = the risk-free rate of the market
   β = a measure of the volatility of a particular investment relative to the market
   R_m = the risk of the organization

   $$\text{WACC} = \left(\frac{D}{C}\right)k_d + \left(\frac{P}{C}\right)k_p + \left(\frac{E}{C}\right)k_e$$

where:

D = market value of debt outstanding
P = market value of preferred stock outstanding
E = market value of common equity outstanding
C = the total amount of capital available to the firm

Example: Suppose an organization with a 40% tax rate has the following capital structure:

- $400,000 debt (yield to maturity is 10%)
- $200,000 preferred shares ($12 dividend and a market price of $96)
- $400,000 common equity (The company's β is 2 with a risk premium of 7.5%, where the risk-free rate is 5%.)

The WACC can be determined as follows:

$$\text{Cost of debt} = kb = k(1 - T) = 0.10 \times (1 - 0.4) = 6.0\%$$

$$\text{Cost of preferred} = kp = \frac{Dp}{Pp} = \frac{\$12}{\$96} = 12.5\%$$

$$\text{Cost of common shares} = k_e = R_f + \beta(R_m - R_f) = 5 + (2(7.5)) = 20\%$$

Weighted average cost of capital

$$= \left(\frac{40}{100} \times 6\%\right) + \left(\frac{20}{100} \times 12.5\%\right) + \left(\frac{40}{100} \times 20\%\right)$$

$$= 2.4\% + 2.5\% + 8\%$$

$$= 12.9\%$$

Terms to Learn

This chapter and the Glossary at the end of the book contain definitions of the following important terms:

accounting rate of return (**p. 768**)
accrual accounting rate of return (AARR) (**p. 768**)
capital budgeting (**p. 753**)
cost of capital (**p. 756**)
discount rate (**p. 756**)
discounted cash flow (DCF) (**p. 755**)
half-year rule (**p. 762**)
hurdle rate (**p. 756**)
inflation (**p. 777**)
internal rate of return (IRR) (**p. 758**)
net present value (NPV) (**p. 756**)
opportunity cost of capital (**p. 756**)
payback method (**p. 766**)
required rate of return (RRR) (**p. 756**)
return on investment (ROI) (**p. 768**)
time-adjusted rate of return (**p. 758**)
time value of money (**p. 756**)

Assignment Material

MyAccountingLab The questions, exercises, and problems marked in red can be found on MyAccountingLab. You can practice them as often as you want, and most feature step-by-step guided instructions to help you find the right answers. Exercises and Problems with an Excel icon in the margin have an accompanying Excel template on MyAccountingLab.

Short-Answer Questions

20-1 "Capital budgeting has the same focus as accrual accounting." Do you agree? Explain.
20-2 List and briefly describe each of the six parts in the capital budgeting decision process.
20-3 What is the essence of the discounted cash flow method?
20-4 "Only quantitative outcomes are relevant in capital budgeting analyses." Do you agree? Explain.
20-5 How can sensitivity analysis be incorporated in DCF analysis?
20-6 What is the payback method? What are its main strengths and weaknesses?
20-7 Describe the accrual accounting rate of return method. What are its main strengths and weaknesses?

20-8 "The trouble with discounted cash flow techniques is that they ignore depreciation costs." Do you agree? Explain.

20-9 "Let's be more practical. DCF is not the gospel. Managers should not become so enchanted with DCF that strategic considerations are overlooked." Do you agree? Explain.

20-10 "The net present value method is the preferred method for capital budgeting decisions. Therefore, managers will always use it." Do you agree? Explain.

20-11 "All overhead costs are relevant in NPV analysis." Do you agree? Explain.

20-12 List and briefly describe the five major categories of cash flows included in capital investment projects.

20-13 "Managers' control of job projects generally focuses on four critical success factors." Identify those factors.

20-14 Bill Watts, president of Western Publications, accepts a capital-budgeting project advocated by Division X. This is the division in which the president spent his first 10 years with the company. On the same day, the president rejects a capital-budgeting project proposal from Division Y. The manager of Division Y is incensed. She believes that the Division Y project has an internal rate of return at least 10 percentage points above that of the Division X project. She comments, "What is the point of all our detailed DCF analysis? If Watts is panting over a project, he can arrange to have the proponents of that project massage the numbers so that it looks like a winner." What advice would you give the manager of Division Y?

Exercises

20-15 **Terminology**. A number of terms are listed below:

accounting rate of return
adjusted rate of return
discount rate
hurdle rate
investment decision
net present value (NPV)
opportunity cost of capital
rate of return (ROR)
return on investment (ROI)
accrual accounting rate of return (AARR)
capital budgeting
discounted cash flow (DCF)
internal rate of return (IRR)
investments
payback method
required rate of return (RRR)
time-adjusted rate of return

Required

Select the terms from the above list to complete the following sentences.

The goal of _____ _____ is to provide capacity in a planned and orderly manner that will match the predicted demand growth of the company and achieve a targeted _____ ____ __ _____ on these investments. The determination of the ROR links closely to the operating income or profit on sales. That is why _____ affect the statement of financial position, the statement of comprehensive income, and the statement of cash flows. Capital budgeting requires a careful analysis of the amount and timing of cash outflows and cash inflows. There are four methods from which a management team can choose: ___ _____ __, _____ ____ __ _____, _____, _____ _____ ____ __ _____ (or _____ __ _____). The first two methods require the calculation of discounted cash flow. The NPV method requires that the management team determine what its _____ ____ ____(___) must be (also called the discount rate, hurdle rate, or opportunity cost of capital). This discount rate is the return the team could expect from investing in a different project of similar risk. In contrast the IRR (sometimes called the _____ ____ __ _____) is fully determined by cash inflow and outflow. It is the rate at which the discounted net cash flow is zero. The _____ is based on nominal, not discounted, cash flow. It is simply the total investment divided by cash inflow to determine the time it takes to recover the cost of the investment. The ____ is calculated by dividing the increase in an accrual, expected average operating income, by the cost of the initial investment.

20-16 **Exercises in compound interest, no income taxes.** To be sure that you understand how to use the tables in Appendix A at the end of this book, solve the following exercises. Ignore income tax considerations. The correct answers, rounded to the nearest dollar, appear on pages 792–793. ◀ LO 1, 2

Required

1. You have just won $5,000. How much money will you accumulate at the end of ten years if you invest it at 6% compounded annually? At 14%?
2. Ten years from now, the unpaid principal of the mortgage on your house will be $89,550. How much do you need to invest today at 6% interest compounded annually to accumulate the $89,550 in 10 years?

3. If the unpaid mortgage on your house in 10 years will be $89,550, how much money do you need to invest at the end of each year at 6% to accumulate exactly this amount at the end of the tenth year?
4. You plan to save $5,000 of your earnings at the end of each year for the next 10 years. How much money will you accumulate at the end of the tenth year if you invest your savings compounded at 12% per year?
5. You have just turned 65 and an endowment insurance policy has paid you a lump sum of $200,000. If you invest the sum at 6%, how much money can you withdraw from your account in equal amounts at the end of each year so that at the end of 10 years (age 75) there will be nothing left?
6. You have estimated that for the first 10 years after you retire you will need a cash inflow of $50,000 at the end of each year. How much money do you need to invest at 6% at your retirement age to obtain this annual cash inflow? At 20%?
7. The following table shows two schedules of prospective operating cash inflows, each of which requires the same net initial investment of $10,000 now:

	Annual Cash Inflows	
Year	**Plan A**	**Plan B**
1	$ 1,000	$ 5,000
2	2,000	4,000
3	3,000	3,000
4	4,000	2,000
5	5,000	1,000
Total	$15,000	$15,000

The required rate of return is 6% compounded annually. All cash inflows occur at the end of each year. In terms of net present value, which plan is more desirable? Show your computations.

LO 1, 2 ▶
1. a. Discount factor for 12% over 5 years, 3.605

20-17 Capital budgeting methods, no income taxes. Lethbridge Company runs hardware stores in Alberta. Lethbridge's management estimates that if it invests $160,000 in a new computer system, it can save $60,000 in annual cash operating costs. The system has an expected useful life of five years and no terminal disposal value. The required rate of return is 12%. Ignore income tax issues in your answers. Assume all cash flows occur at year-end except for initial investment amounts.

Required

1. Calculate the following for the new computer system:
   a. Net present value.
   b. Payback period.
   c. Internal rate of return.
   d. Accrual accounting rate of return based on the net initial investment (assume straight-line depreciation).
2. What other factors should Lethbridge Company consider in deciding whether to purchase the new computer system?

LO 1, 2 ▶
2. Discount factor, 2 small machines, 3.5460

20-18 New assets: comparison of approaches in capital budgeting. Panayiotis, the owner and manager of Micos Ltd., is evaluating the acquisition of new equipment needed to attend a new line of business. He has two alternatives: either buy two small machines or one large and more automatic machine:

	Buy 2 Small Machines	Buy 1 Large Machine
Net initial investment to acquire the asset	$120,000 per machine	$250,000
Useful life of the acquired asset	4 years both machines	5 years
Recurring cash inflow per year	$ 80,000	$ 80,000
Recurring cash outflow per year	$ 5,000 per machine	$ 15,000
Required rate of return	5%	5%

Required

1. Determine the payback period in years.
2. Determine the net present value of each project.
3. Do you estimate that the IRR of the project is higher or lower than 5%?
4. If both projects were independent, would you accept them?

20-19 New equipment purchase. Norberto Garcia, general manager of the Argentinean subsidiary of Innovation Inc., is considering the purchase of new industrial equipment to improve efficiency at its Cordoba plant. The equipment has an estimated useful life of five years. The estimated cash flows for the equipment are shown in the table that follows, with no anticipated change in working capital. Innovation has a 12% required rate of return. Assume depreciation is calculated on a straight-line basis. Assume all cash flows occur at year-end except for initial investment amounts.

◀ LO 4
1. a. NPV = $32,656

Initial investment	$80,000
Annual cash flow from operations (excluding the depreciation effect)	31,250
Cash flow from terminal disposal of equipment	0

Required

1. Calculate (a) net present value, (b) payback period, and (c) internal rate of return.
2. Compare and contrast the capital budgeting methods in requirement 1.
3. The controller of Innovation Inc. received Garcia's estimates but adjusted them to capture the added risk of doing the project in Argentina. Recalculate item 1 with a required rate of return of 20% and explain if the project will be approved by Innovation Inc. for its Argentinean subsidiary.

20-20 Capital budgeting with uneven cash flows, no income taxes. Southern Cola is considering the purchase of a special-purpose bottling machine for $23,000. It is expected to have a useful life of four years with no terminal disposal value. The plant manager estimates the following savings in cash operating costs:

◀ LO 1, 2
1. Present value of savings of cash operating costs, $21,170

Year	Amount
1	$10,000
2	8,000
3	6,000
4	5,000
Total	$29,000

Southern Cola uses a required rate of return of 16% in its capital budgeting decisions. Ignore income taxes in your analysis. Assume all cash flows occur at year-end except for initial investment amounts.

Required

Calculate the following for the special-purpose bottling machine:

1. Net present value.
2. Payback period.
3. Internal rate of return.
4. Accrual accounting rate of return based on net initial investment. (Assume straight-line depreciation. Use the average annual savings in cash operating costs when computing the numerator of the accrual accounting rate of return.)

20-21 Comparison of projects, no income taxes. (CMA, adapted) New Bio Corporation is a rapidly growing biotech company that has a required rate of return of 12%. It plans to build a new facility in Mississauga, Ontario. The building will take two years to complete. The building contractor offered New Bio a choice of three payment plans, as follows:

◀ LO 1
1. Plan 1 NPV, ($3,901,725)

- **Plan I** Payment of $375,000 at the time of signing the contract and $4,425,000 upon completion of the building. The end of the second year is the completion date.
- **Plan II** Payment of $1,500,000 at the time of signing the contract and $1,500,000 at the end of each of the two succeeding years.
- **Plan III** Payment of $150,000 at the time of signing the contract and $1,500,000 at the end of each of the three succeeding years.

Required

1. Using the net present value method, calculate the comparative cost of each of the three payment plans being considered by New Bio.
2. Which payment plan should New Bio choose? Explain.
3. Discuss the financial factors, other than the cost of the plan and the nonfinancial factors that should be considered in selecting an appropriate payment plan.

LO 2 ▶
1.b. Project A has a Payback period of 3 years.

20-22 Payback and NPV methods, no income taxes. (CMA, adapted) Andrews Construction is analyzing its capital expenditure proposals for the purchase of equipment in the coming year. The capital budget is limited to $6,000,000 for the year. Lori Bart, staff analyst at Andrews, is preparing an analysis of the three projects under consideration by Corey Andrews, the company's owner.

	A	B	C	D
1		**Project A**	**Project B**	**Project C**
2	**Projected cash outflow**			
3	Net initial investment	$3,000,000	$1,500,000	$4,000,000
4				
5	**Projected cash inflows**			
6	Year 1	$1,000,000	$ 400,000	$2,000,000
7	Year 2	1,000,000	900,000	2,000,000
8	Year 3	1,000,000	800,000	200,000
9	Year 4	1,000,000		100,000
10				
11	Required rate of return	10%	10%	10%

Required

1. Because the company's cash is limited, Andrews thinks the payback method should be used to choose between the capital budgeting projects.
   a. What are the benefits and limitations of using the payback method to choose between projects?
   b. Calculate the payback period for each of the three projects. Ignore income taxes. Using the payback method, which projects should Andrews choose?
2. Bart thinks that projects should be selected based on their NPVs. Assume all cash flows occur at the end of the year except for initial investment amounts. Calculate the NPV for each project. Ignore income taxes.
3. Which projects, if any, would you recommend funding? Briefly explain why.

LO 3 ▶
1. Present Value: $14,142

20-23 New equipment purchase. Presentation Graphics prepares slides and other aids for individuals making presentations. It estimates it can save $42,000 a year in cash operating costs for the next five years if it buys a special-purpose colour-slide workstation at a cost of $90,000. The workstation qualifies for a capital cost allowance rate of 25%, declining balance, and will have a zero terminal disposal price at the end of year 5. Presentation Graphics has a 12% after-tax required rate of return. Its income tax rate is 40% each year for the next five years.

Required

Compute (a) net present value, (b) payback period, and (c) internal rate of return.

LO 3 ▶
1. Present value of terminal disposal of machine, 13,163

20-24 DCF, accrual accounting rate of return, working capital, evaluation of performance, no income taxes. Century Lab plans to purchase a new centrifuge machine for its Manitoba facility. The machine costs $137,500 and is expected to have a useful life of eight years, with a terminal disposal value of $37,500. Savings in cash operating costs are expected to be $31,250 per year. However, additional working capital is needed to keep the machine running efficiently. The working capital must continually be replaced, so an investment of $10,000 needs to be maintained at all times, but this investment is fully recoverable (will be "cashed in") at the end of the useful life. Century Lab's required rate of return is 14%. Ignore income taxes in your analysis. Assume all cash flows occur at year-end except for initial investment amounts.

Required

1. Calculate net present value.
2. Calculate internal rate of return.
3. Calculate accrual accounting rate of return based on net initial investment. Assume straight-line depreciation.
4. You have the authority to make the purchase decision. Why might you be reluctant to base your decision on the DCF methods?

LO 2 ▶
1. a. Discount factor, 3.6048

20-25 Net present value, internal rate of return, sensitivity analysis. Muskoka Landscaping Ltd. is planning to buy equipment costing $25,000 to improve its services. The equipment is expected to save $8,000 in cash operating costs per year. Its estimated useful life is five years, and it will have zero terminal disposal price. The required rate of return is 12%.

Required

1. Compute (a) the net present value and (b) the internal rate of return.
2. What is the minimum annual cash savings that will make the equipment desirable on a net present value basis?
3. When might a manager calculate the minimum annual cash savings described in requirement 2 rather than use the $8,000 savings in cash operating costs per year to calculate the net present value or internal rate of return?

20-26 DCF, accrual accounting rate of return, working capital, evaluation of performance, no income taxes. Homer Inc. plans to purchase a new rendering machine for its animation facility. The machine costs $102,500 and is expected to have a useful life of eight years, with a terminal disposal value of $22,500. Savings in cash operating costs are expected to be $22,250 per year. However, additional working capital is needed to maintain the operations of the rendering machine. The working capital must continually be replaced, so an investment of $10,000 needs to be maintained at all times, but this investment is fully recoverable (will be "cashed in") at the end of the useful life. Century Lab's required rate of return is 12%. Ignore income taxes in your analysis. Assume all cash flows occur at year-end except for initial investment amounts. Century Lab uses straight-line depreciation for its machines.

◀ LO 3
1. Present Value $6,200

Required

1. Calculate net present value.
2. Calculate internal rate of return.
3. Calculate accrual accounting rate of return based on net initial investment.
4. Calculate accrual accounting rate of return based on average investment.
5. You have the authority to make the purchase decision. Why might you be reluctant to base your decision on the DCF methods?

20-27 DCF, accrual accounting rate of return, working capital, evaluation of performance. Edilcan Inc. has been offered an automated special-purpose welder (robot) for $60,000. The machine is expected to have a useful life of eight years with a terminal disposal price of $12,000. Savings in cash operating costs are expected to be $15,000 per year. However, additional working capital is needed to keep the welder running efficiently and without stoppages. Working capital includes mainly argon gas, wires, and tips. These items must continually be replaced, so an investment of $5,000 must be maintained in them at all times, but this investment is fully recoverable (will be "cashed in") at the end of the useful life. Edilcan's required rate of return is 14%.

◀ LO 3
1. a. Present value of annuity of savings in cash operating costs, $69,583

Required

1. **a.** Compute the net present value.
   b. Compute the internal rate of return.
2. Compute the accrual accounting rate of return based on the net initial investment. Assume straight-line depreciation.
3. You have the authority to make the purchase decision. Why might you be reluctant to base your decision on the DCF model?

20-28 Capital budgeting methods, no income taxes. Windsor Hospital is a non-tax paying not for profit entity. It estimates that it can save $28,000 a year in cash operating costs for the next 10 years if it buys a special-purpose eye-testing machine at a cost of $110,000. No terminal disposal value is expected. Windsor Hospital's required rate of return is 14%. Assume all cash flows occur at year-end except for initial investment amounts.

◀ LO 3
1. payback Period is 3.93 years

Required

1. Compute (a) the net present value, (b) the payback period, (c) the internal rate of return, and (d) the accrual accounting rate of return.
2. What other factors should Windsor Hospital consider in its decision?

20-29 Equipment replacement, net present value, relevant costs, payback. Edgeley Inc., a logistics operator located in Concord, Ontario, is considering replacing one of its tractor trailers (informally known as a 53' truck). The truck was purchased for $64,800 two years ago, has a current book value of $45,600, and a remaining useful life of four years. Its current disposal price is $31,200; in four years its terminal disposal price is expected to be $7,200. The annual cash operating costs of the truck are expected to be $42,000 for each of the next three years and $48,000 in year 4.

Edgeley is considering the purchase of a new 53' truck for $67,200. Annual cash operating costs for the new truck are expected to be $30,000. The new truck has a useful life of four years and a terminal disposal price of $9,600.

◀ LO 2
1. NPV, keep old truck, $126,833

Edgeley Inc. depreciates all its trucks using straight-line depreciation calculated on the difference between the initial cost and the terminal disposal price divided by the estimated useful life. Edgeley uses a rate of return of 12% in its capital budgeting decisions.

Required

1. Using a net present value criterion, should Edgeley Inc. purchase the new truck?
2. Compute the payback period for Edgeley Inc. if it purchases the new 53' truck.

LO 5 ▶
1. Operating income, high-volume customer, year 1, $657

20-30 NPV and customer profitability. Microdot Inc. sells and distributes computer networking equipment; its overall margin on sales is 10%. Microdot has customers of two kinds: low and high volume. Low-volume customers on average generate sales for $5,000 per year and the average tenure is four years. High-volume customers on average generate sales for $18,000. Their average tenure is seven years but they require an initial investment of $8,000 (comprised mostly of legal fees paid to lawyers to review the long-term contract and upgrades in the software to allow customers to place purchase orders online). Assume a 12% required rate of return.

Required

1. Calculate operating income per customer in each year.
2. Microdot estimates the value of each kind of customer by calculating the customer's projected NPV over the total expected time of the contract. Use the operating incomes calculated above to compute the value of each kind of customer.
3. Indicate which type of customer is more profitable for Microdot Inc.

LO 5 ▶
1. Present value of recurring cash operating savings, $5,390

20-31 Inflation and not-for-profit institution, no tax aspects. KopiPro is considering the purchase of a photocopying machine for $5,500 on December 31, 2016. It has a useful life of five years and a zero residual disposal price. Depreciation will be applied on a straight-line basis. The cash operating savings are expected to be $1,350 annually, measured in December 31, 2016, dollars. The discount factor is 18.8%, which includes the effects of anticipated inflation of 10%. KopiPro pays no taxes due to being a non-profit organization. The present values of $1 discounted at 18.8% received at the end of 1, 2, 3, 4, and 5 periods are 0.842, 0.709, 0.596, 0.502, and 0.423.

Required

1. A KopiPro official computed the net present value of the project using an 18.8% discount rate without adjusting the cash operating savings for inflation. What net present value figure did he compute? Is this approach correct? If not, how would you redo the analysis?
2. (a) What is the real rate of return required by KopiPro for investing in the photocopying machine? (b) Calculate the net present value using the real rate of return approach to incorporating inflation.
3. Compare your analyses in requirements 1 and 2. Present generalizations that seem applicable about the analysis of inflation in capital budgeting.

LO 1 ▶
1. a. Total present value of recurring cash flows from drill bits, $156,974

20-32 Income taxes and inflation. StrengthCo is considering an investment of $254,200 in special tools, with a life expectancy of four years and a residual price of $24,000. The tools would be purchased on December 31, 2016, and would enable StrengthCo to manufacture drill bits to very high tolerances without incurring any incremental costs, and to earn additional cash flows of $2.40 per unit in 2017, $2.54 in 2018, $2.70 in 2019, and $2.86 in 2020. StrengthCo expects to sell 37,500 units each year for the next four years. StrengthCo is subject to a 40% tax rate. The after-tax required rate of return determined by the plant manager, James Marco, is 18%. The tools qualify for a capital cost allowance rate of 35%, declining balance.

Required

1. Compute the net present value of the project.
2. Marco feels that inflation will persist for the next four years at the rate of 6% per year. However, the 18% minimum desired rate of return already includes a return required to cover the effects of anticipated inflation. Repeat requirement 1 to take inflationary effects into consideration.
3. Could you have taken inflation into account in a way different from what you did in requirement 2? Broadly describe how without actually performing any calculations.

LO 5 ▶
1. a. Total present value of recurring after-tax operating savings, $65,599

20-33 New equipment purchase, income taxes. Anna's Bakery plans to purchase a new oven with an estimated useful life of four years. The estimated pretax cash flows for the oven are as shown in the table that follows, with no anticipated change in working capital. Anna's Bakery has a 12% after-tax required rate of return and a 40% income tax rate. Assume depreciation is calculated on a straight-line basis for accounting purposes using the initial oven investment and estimated terminal disposal value of the oven. Assume all cash flows occur at year-end except for initial investment amounts. Equipment is subject to 20% CCA rate declining balance for income tax purposes.

	Relevant Cash Flows at End of Each Year				
	0	1	2	3	4
Initial machine investment	$(88,000)				
Annual cash flow from operations (excluding the depreciation effect)		$36,000	$36,000	$36,000	$36,000
Cash flow from terminal disposal of motor					0

Required

1. Calculate (a) net present value, (b) payback period, and (c) internal rate of return.
2. Compare and contrast the capital budgeting methods in requirement 1.

Problems

20-34 NPV. (CMA, adapted) Fox Valley Healthcare Inc. is a not-for-profit organization that operates eight nursing homes and 10 assisted-living facilities. The company has grown considerably over the last three years and expects to continue to expand in the years ahead, particularly in the area of assisted-living facilities for seniors.

◀ LO 1
1. Plan I NPV, $(3,213,600)

Jim Ruffalo, president of Fox Valley, has developed a plan to add a new building for top management and the administrative staff. He has selected a building contractor, Vukacek Construction Co., and has reached agreement on the building and its construction. Vukacek is ready to start as soon as the contract is signed and will complete the work in two years.

The building contractor has offered Fox Valley a choice of three payment plans:

- **Plan I:** Payment of $240,000 on the signing of the contract and $3,600,000 at the time of completion.
- **Plan II:** Payment of $1,200,000 on the signing of the contract and $1,200,000 at the end of each of the two succeeding years. The end of the second year is the completion date.
- **Plan III:** Payment of $120,000 on the signing of the contract and $1,200,000 at the end of each of the three succeeding years.

Ruffalo is not sure which payment plan he should accept. He has asked the treasurer, Lisa Monroe, for her assessment and advice. Fox Valley will finance the construction with a long-term loan and has a borrowing rate of 10%.

Required

1. Using the net present value method, calculate the comparative cost of each of the three payment plans being considered by Fox Valley Healthcare Inc.
2. Which payment plan should the treasurer recommend? Explain.
3. Discuss the financial factors, other than the cost of the plan, and nonfinancial factors that should be considered in selecting an appropriate payment plan.

20-35 DCF, sensitivity analysis, no income taxes. (CMA, adapted) LVT is an international manufacturer of fragrances for women. Management at LVT is considering expanding the product line to men's fragrances. From the best estimates of the marketing and production managers, annual sales (all for cash) for this new line are 1,000,000 units at $25 per unit; cash variable cost is $10 per unit; cash fixed cost is $5,000,000 per year. The investment project requires $30,000,000 of cash outflow and has a project life of five years.

◀ LO 1, 2
1. Cash inflow from operations, $10,000,000

At the end of the five-year useful life, there will be no terminal disposal value. Assume all cash flows occur at year-end except for initial investment amounts.

Men's fragrance is a new market for Landom, and management is concerned about the reliability of the estimates. The controller has proposed applying sensitivity analysis to selected factors. Ignore income taxes in your computations. Landom's required rate of return on this project is 14%.

Required

1. Calculate the net present value of this investment proposal.
2. Calculate the effect on the net present value of the following two changes in assumptions. (Treat each item independently of the other.)
   a. 5% reduction in the selling price.
   b. 5% increase in the variable cost per unit.
3. Discuss how management would use the data developed in requirements 1 and 2 in its consideration of the proposed capital investment.

LO 1, 2 ▶
1. Present value of net cash inflows, $51,520

20-36 NPV, IRR, and sensitivity analysis. Fluffy Cupcake Company is considering expanding by buying a new (additional) machine that costs $42,000, has zero terminal disposal value, and has a 10-year useful life. It expects the annual increase in cash revenues from the expansion to be $23,000 per year. It expects additional annual cash costs to be $16,000 per year. Its cost of capital is 6%. Ignore taxes.

Required

1. Calculate the net present value and internal rate of return for this investment.
2. Assume the finance manager of Fluffy Cupcake Company is not sure about the cash revenues and costs. The revenues could be anywhere from 10% higher to 10% lower than predicted. Assume cash costs are still $16,000 per year. What are NPV and IRR at the high and low points for revenue?
3. The finance manager thinks that costs will vary with revenues, and if the revenues are 10% higher, the costs will be 7% higher. If the revenues are 10% lower, the costs will be 10% lower. Recalculate the NPV and IRR at the high and low revenue points with this new cost information.
4. The finance manager has decided that the company should earn 2% more than the cost of capital on any project. Recalculate the original NPV in requirement 1 using the new discount rate.

LO 3 ▶
1. Present value if Part No. 789 is purchased, $(7,916)

20-37 Relevance and DCF. The Strubel Company currently makes as many units of Part No. 789 as it needs. David Lin, general manager of the Strubel Company, has received a bid from the Gabriella Company for making Part No. 789. Current plans call for Gabriella to supply 1,000 units of Part No. 789 per year at $60 a unit. Gabriella can begin supplying on January 1, 2016, and continue for five years, after which time Strubel will not need the part. Gabriella can accommodate any change in Strubel's demand for the part and will supply it for $60 a unit, regardless of quantity.

Jacqueline Tyson, the controller of the Strubel Company, reports the following costs for manufacturing 1,000 units of Part No. 789:

Direct materials	$26,400
Direct manufacturing labour	13,200
Variable manufacturing overhead	8,400
Depreciation on machine	12,000
Product and process engineering	4,800
Rent	2,400
Allocation of general plant overhead costs	6,000
Total costs	$73,200

The following additional information is available:

a. Part No. 789 is made on a machine used exclusively for the manufacture of Part No. 789. The machine was acquired on January 1, 2015, at a cost of $72,000. The machine has a useful life of six years and zero terminal disposal price. Depreciation is calculated on the straight-line method.
b. The machine could be sold today for $18,000.
c. Product and process engineering costs are incurred to ensure that the manufacturing process for Part No. 789 works smoothly. Although these costs are fixed in the short run, with respect to units of Part No. 789 produced, they can be saved in the long run if this part is no longer produced. If Part No. 789 is outsourced, product and process engineering costs of $4,800 will be incurred for 2016 but not thereafter.
d. Rent costs of $2,400 are allocated to products on the basis of the floor space used for manufacturing the product. If Part No. 789 is discontinued, the space currently used to manufacture it would become available. The company could then use the space for storage purposes and save $1,200 currently paid for outside storage.
e. General plant overhead costs are allocated to each department on the basis of direct manufacturing labour dollars. These costs will not change in total. But no general plant overhead will be allocated to Part No. 789 if the part is outsourced.

Assume that Strubel requires a 12% rate of return for this project.

Required

1. Should David Lin outsource Part No. 789? Prepare a quantitative analysis.
2. Describe any sensitivity analysis that seems advisable, but you need not perform any sensitivity calculations.
3. What other factors should Lin consider in making a decision?
4. Lin is particularly concerned about his bonus for 2016. The bonus is based on Strubel's accounting income. What decision will Lin make if he wants to maximize his bonus in 2016?

20-38 NPV and customer profitability, no taxes. Christen Granite sells granite counter tops to the construction industry. Christen Granite has three customers: Homebuilders, a small construction company that builds private luxury homes; Kitchen Constructors, a company that designs and builds kitchens for hospitals and hotels; and Subdivision Erectors, a construction company that builds large subdivisions in major metro suburbs. Following are Christen Granite's revenue and cost data by customer for the year ended December 31, 2016:

◀ LO 5
1. 2017 Homebuilders cash flow from operations, $16,764

	Homebuilders	Kitchen Constructors	Subdivision Erectors
Revenues	$54,000	$390,000	$1,032,000
Cost of goods sold	26,400	216,000	660,000
Operating costs	12,000	90,000	282,000

Operating costs include order processing, sales visits, delivery, and special delivery costs. Christen estimates that revenue and costs will increase as follows on an annual basis:

	Homebuilders	Kitchen Constructors	Subdivision Erectors
Revenues	5%	15%	8%
Cost of goods sold	4%	4%	4%
Operating costs	4%	4%	4%

Required

1. Calculate operating income per customer for 2016 and for each year of the 2017–2021 period.
2. Christen estimates the value of each customer by calculating the customer's projected NPV over the next five years (2017–2021). Use the operating incomes calculated above to compute the value of all three customers. Christen uses a 10% discount rate.
3. Recently, Kitchen Constructors (KC), Christen's most valuable customer, has been threatening to leave. Lawson Tops, Christen's fiercest competitor, has offered KC a greater discount. KC demands a 20% discount from Christen if the latter wants to keep KC's business. At the same time, Christen reevaluates the KC account and anticipates annual revenue increases of only 5% thereafter. Should Christen grant KC the 20% discount? What is the five-year value of KC after incorporating the 20% discount? What other factors should Christen consider before making a final decision?
4. What are the possible adverse effects of caving in to KC's pressure?

20-39 Payback, even and uneven cash flows. You have the opportunity to expand your business by purchasing new equipment for $189,000. You expect to incur fixed costs of $96,000 per year to use this new equipment, and you expect to incur variable costs in the amount of approximately 10% of annual revenues.

◀ LO 1, 2
1. Net annual cash inflow, $30,000

Required

1. Calculate the payback period for this investment assuming you will generate $140,000 in cash revenues every year.
2. Assume you expect the following revenue stream for this investment:

Year 1: $ 90,000	Year 4: $155,000	Year 7: $140,000
Year 2: 115,000	Year 5: 170,000	Year 8: 125,000
Year 3: 130,000	Year 6: 180,000	Year 9: 80,000

Based on this estimated revenue stream, what is the payback period for this investment?

20-40 NPV and AARR, goal-congruence issues. Nate Stately, a manager of the Plate division for the Great Slate Manufacturing Company, has the opportunity to expand the division by investing in additional machinery costing $320,000. He would depreciate the equipment using the straight-line method, and expects it to have no residual value. It has a useful life of six years. The firm mandates a required rate of return of 16% on investments. Nate estimates annual net cash inflows for this investment of $100,000 and an investment in working capital of $5,000.

◀ LO 1, 2, 4
1. Present value of initial investments, ($325,000)

Required

1. Calculate the net present value of this investment.
2. Calculate the accrual accounting rate of return for this investment.

3. Should Nate accept the project? Will Nate accept the project if his bonus depends on achieving an accrual accounting rate of return of 16%? How can this conflict be resolved?

LO 3, 4 ▶
1. Annual cash flow from operations with new equipment, $760,000

20-41 Recognizing cash flows for capital investment projects, NPV. Met-All Manufacturing manufactures over 20,000 different products made from metal, including building materials, tools, and furniture parts. The manager of the Furniture Parts division has proposed that his division expand into bicycle parts as well. The Furniture Parts division currently generates cash revenues of $4,700,000 and incurs cash costs of $3,600,000, with an investment in assets of $12,090,000. One-quarter of the cash costs are direct labour.

The manager estimates that the expansion of the business will require an investment in working capital of $45,000. Because the company already has a facility, there would be no additional rent or purchase costs for a building, but the project would generate an additional $390,000 in annual cash overhead. Moreover, the manager expects annual materials cash costs for bicycle parts to be $1,700,000, and labour for the bicycle parts to be about the same as the labour cash costs for furniture parts.

The Controller of Met-All, working with various managers, estimates that the expansion would require the purchase of equipment with a $5,000,000 cost and an expected disposal value of $400,000 at the end of its 10-year useful life. Depreciation would occur on a straight-line basis.

The CFO of Met-All determines the firm's cost of capital as 12%. The CFO's salary is $460,000 per year. Adding another division will not change that. The CEO asks for a report on expected revenue for the project, and is told by the marketing department that it might be able to achieve cash revenue of $3,750,000 annually from bicycle parts. Met-All Manufacturing has a tax rate of 30%.

Required

1. Separate the cash flows into four groups: (1) net initial investment cash flows, (2) cash flows from operations, (3) cash flows from terminal disposal of investment, and (4) cash flows not relevant to the capital budgeting problem.
2. Calculate the NPV of the expansion project and comment on your analysis.

LO 3, 4 ▶
2. Annual cash flow from operations, $9,320

20-42 Recognizing cash flows for capital investment projects. Ludmilla Quagg owns a fitness centre and is thinking of replacing the old Fit-O-Matic machine with a brand new Flab-Buster 3000. The old Fit-O-Matic has a historical cost of $50,000 and accumulated depreciation of $46,000, but has a trade-in value of $5,000. It currently costs $1,200 per month in utilities and another $10,000 a year in maintenance to run the Fit-O-Matic. Ludmilla feels that the Fit-O-Matic can be used for another 10 years, after which it would have no salvage value.

The Flab-Buster 3000 would reduce the utilities costs by 30% and cut the maintenance cost in half. The Flab-Buster 3000 costs $98,000, has a 10-year life, and an expected disposal value of $10,000 at the end of its useful life. Ludmilla charges customers $10 per hour to use the fitness centre. Replacing the fitness machine will not affect the price of service or the number of customers she can serve.

Ludmilla also looked at replacing the Fit-O-Matic with a Walk-N-Pull Series 3, which costs $78,000. However, she prefers the Flab-Buster 3000.

Required

1. Ludmilla wants to evaluate the Flab-Buster 3000 project using capital budgeting techniques, but does not know how to begin. To help her, read through the problem and separate the cash flows into four groups: (1) net initial investment cash flows, (2) cash flow savings from operations, (3) cash flows from terminal disposal of investment, and (4) cash flows not relevant to the capital budgeting problem.
2. Assuming a required rate of return of 8%, and straight-line depreciation over remaining useful life of machines, should Ludmilla buy the Flab-Buster 3000?

LO 5 ▶
1. Present value, years 1–9 cash inflows, increase capacity project, $2,131,200

20-43 Defensive and offensive strategies in capital budgeting. (CMA, adapted) The management of Kleinburg Industrial Bakery is analyzing two competing investment projects and they must decide which one can be done immediately and which one can be postponed for at least a year. The details of each proposed investment are shown on the next page.

The bakery has a 12% required rate of return to evaluate all investments that directly impact operations and amortizes the investment in plant and equipment using straight-line depreciation over 10 years on the difference between the initial investment and terminal disposal price.

Required

1. Calculate the net present value of each proposal.
2. Which project should the bakery choose on the basis of the NPV calculations?
3. Mention which strategic factors must be considered by the managers when ranking the projects.

	Project: Increase Capacity to Serve New Markets	Project: Upgrade Customer Service
Proposed by	Production manager	Sales and marketing manager
Rationale	Assets are operating at full capacity and we are unable to attend to all the demand, therefore we need to expand our facilities to produce more kilograms.	The fleet of trucks and vans need to be upgraded with tracking devices and remote connections to flex the planning of routes. The new software will allow the company to be paperless and respond faster to customers' requests.
Investment	$600,000	$345,000
Working capital	$ 50,000	$150,000
Terminal disposal value	$60,000	None
Expected useful life	10 years	5 years
Expected increase in operating income	$400,000	$80,000
Expected savings in administrative costs	None	$40,000

Collaborative Learning Cases

20-44 Net present value, internal rate of return, sensitivity analysis. Francesca Freed wants a Burg-N-Fry franchise. The buy-in is $500,000. Burg-N-Fry headquarters tells Francesca that typical annual operating costs are $160,000 (cash) and that she can bring in "as much as" $260,000 in cash revenues per year. Burg-N-Fry headquarters also wants her to pay 10% of her revenues to them per year. Francesca wants to earn at least 8% on the investment, because she has to borrow the $500,000 at a cost of 6%. Use a 12-year window, and ignore taxes.

◀ LO 1, 2, 3, 4, 5
1. Annual net cash inflows, periods 1–12, $74,000

Required

1. Find the NPV and IRR of this investment, given the information that Burg-N-Fry has given Francesca.
2. Francesca is nervous about the "as much as" statement from Burg-N-Fry, and worries that the cash revenues will be lower than $260,000. Repeat requirement 1 using revenues of $240,000 and $220,000.
3. Francesca thinks she should try to negotiate a lower payment to the Burg-N-Fry headquarters, and also thinks that if revenues are lower than $260,000, her costs might also be lower by about $10,000. Repeat requirement 2 using $150,000 as annual cash operating cost and a payment to Burg-N-Fry of only 6% of sales revenues.
4. Discuss how the sensitivity analysis will affect Francesca's decision to buy the franchise. Why don't you have to recalculate the internal rate of return if you change the desired (discount) interest rate?

20-45 Relevant costs, capital budgeting, strategic decision. (M. Porporato, adapted) Wilcox is a family-owned company that has been making microwaves for almost 20 years. The company's production line includes 10 models, ranging from a basic model to a deluxe stainless steel model. Most of its sales are through independently owned retailers in medium-sized towns in central Canada, giving the microwaves an image of high quality and price. However, industry sales have been stagnant and those of Wilcox have been falling in the past two years due to the Asian brands. Currently Wilcox sells 75,000 units per year at an average price of $120 each with variable unit costs of $60 (of which materials is $30). As a result Wilcox is operating its plant at about 75% of a one-shift capacity, although in its "golden years" in the early 1990s it was operating at 75% of a two-shift capacity.

◀ LO 1, 2, 3, 4, 5
1. Top Line unit contribution margin, $20

In the spring of 2016, Oh Mart, a chain of large supermarkets, approached Wilcox's CEO and asked about the possibility of producing microwaves for them. The microwaves will be sold under the Oh Mart house brand, called Top Line. They are offering a five-year contract that could be automatically extended on a year-to-year basis, unless one party gives the other at least three months' notice that it does not wish to extend the contract. The deal is for 24,000 units per year with a unit price of $90 each. Oh Mart does not want title on a microwave to pass from Wilcox to Oh Mart until the microwave is shipped to a specific Oh Mart store. Additionally Oh Mart wants the Top Line microwaves to be somewhat different in appearance from Wilcox's other microwaves. These requirements would increase Wilcox's purchasing, inventorying, and production costs.

In order to be able to give an answer to Oh Mart, knowing that they had no room to negotiate, Wilcox managers gathered the following information:

1. First-year costs of producing Top Line microwaves:

Materials (includes items specific to Oh Mart models)	$40
Labour (same as with regular microwaves)	20
Overhead at 100% of labour (50% is variable; the 100% rate is based on a volume of 100,000 units per year)	20
Total unit cost	$80

2. Related added inventories (the cost of financing them is estimated to be close to 15% per year):

Materials:	two-month supply (a total of 4,000 units)
Work in process:	1,000 units, half completed (but all materials for them issued)
Finished goods:	500 units (awaiting next carload lot shipment to an Oh Mart central warehouse in Concord, Ontario)

3. Impact on Wilcox's regular sales. Wilcox's sales over the next two years are expected to be about 75,000 units a year if it forgoes the Oh Mart deal, based on the CEO's estimates after launching a new "top of the line" microwave. If Wilcox accepts the deal, it would lose about 5,000 units of the regular sales volume a year, since its retail distribution is quite strong in Oh Mart market regions. These estimates do not include the possibility that a few of Wilcox's current dealers might drop its line if they find out that Wilcox is making microwaves for Oh Mart with a lower selling price.

Instructions

Form groups of three students to complete the following requirements.

Requirements

1. Determine if the proposal by Oh Mart will increase Wilcox's net income in the next year.
2. Calculate the total value of the contract (suppose there is no renewal after the fifth year).
3. On the basis of the net present value criterion, should Wilcox accept the offer?
4. Estimate the strategic consequences of accepting the proposal (consider the current situation of the industry, Wilcox positioning, image, distribution, and production issues).

Answers to Exercises in Compound Interest (Exercise 20-16)

The general approach to these exercises centres on a key question: Which of the four basic tables in Appendix A should be used? No computations should be made until this basic question has been answered with confidence.

1. **From Table 1.** The $5,000 is the present value P of your winnings. Their future value S in 10 years will be:

$$S = P(1 + r)^n$$

The conversion factor, $(1 + r)^n$, is on line 10 of Table 1.

$$\text{Substituting at 6\%: } S = 5{,}000(1.791) = \$8{,}955$$
$$\text{Substituting at 14\%: } S = 5{,}000(3.707) = \$18{,}535$$

2. **From Table 2.** The $89,550 is a future value. You want the present value of that amount. $P = S \div (1 + r)^n$. The conversion factor, $1 \div (1 + r)^n$, is on line 10 of Table 2. Substituting,

$$P = \$89{,}550(0.558) = \$49{,}969$$

3. **From Table 3.** The $89,550 is a future value. You are seeking the uniform amount (annuity) to set aside annually. Note that $1 invested each year for 10 years at 6% has a future value of $13.181 after 10 years, from line 10 of Table 3.

$$S_n = \text{Annual deposit } (F)$$
$$\$89{,}550 = \text{Annual deposit } (13.181)$$
$$\text{Annual deposit} = \frac{\$89{,}550}{13.181} = \$6{,}794$$

4. **From Table 3.** You need to find the future value of an annuity of $5,000 per year. Note that $1 invested each year for 10 years at 12% has a future value of $17.549 after 10 years.

$$S_n = \$5{,}000\ F, \text{ where } F \text{ is the conversion factor}$$
$$S_n = \$5{,}000(17.549) = \$87{,}745$$

5. From Table 4. When you reach age 65, you will get $200,000, a present value at that time. You need to find the annuity that will exactly exhaust the invested principal in 10 years. To pay yourself $1 each year for 10 years when the interest rate is 6% requires you to have $7.360 today, from line 10 of Table 4.

$$P_n = \text{Annual withdrawal } (F)$$
$$\$200{,}000 = \text{Annual withdrawal } (7.360)$$
$$\text{Annual withdrawal} = \frac{\$200{,}000}{7.360} = \$27{,}174$$

6. From Table 4. You need to find the present value of an annuity for 10 years.

$$\text{At 6\%: } P_n = \text{Annual withdrawal } (F)$$
$$P_n = \$50{,}000\ (7.360)$$
$$P_n = \$368{,}000$$

$$\text{At 20\%: } P_n = \$50{,}000\ (4.192)$$
$$P_n = \$209{,}600, \text{ a much lower figure}$$

7. Plan B is preferable. The NPV of plan B exceeds that of plan A by $980 ($3,126 − $2,146): Even though plans A and B have the same total cash inflows over the five years, plan B is preferred because it has greater cash inflows occurring earlier.

		Plan A		Plan B	
Year	**PV Factor at 6%**	**Cash Inflows**	**PV of Cash Inflows**	**Cash Inflows**	**PV of Cash Inflows**
0	1.000	$(10,000)	$(10,000)	$(10,000)	$(10,000)
1	0.943	1,000	943	5,000	4,715
2	0.890	2,000	1,780	4,000	3,560
3	0.840	3,000	2,520	3,000	2,520
4	0.792	4,000	3,168	2,000	1,584
5	0.747	5,000	3,735	1,000	747
			$ 2,146		$ 3,126