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10

Capital Budgeting

Long-range Planning

In your personal life, you make many short-run decisions, such as where to go on vacation this year, and many long-run decisions, such as whether to buy a home. The quality of these decisions determines, to a large extent, the success of your life. Businesses also face short-run and long-run decisions.

In previous chapters, you studied how accountants help management make short-run decisions, such as what prices to charge for their products this year. Accountants also play an important role in advising management on long-range decisions that will benefit the company for many years, such as investing in new buildings and equipment. Long-run decisions have a great impact on the long-run success of a company. Incorrect long-run decisions can threaten the survival of a company.

Whereas short-run decisions involve items such as selling prices, costs, volume, and profits in the current year, long-run decisions involve investments in capital assets, such as buildings and equipment, affecting the current year and many future years. Planning for these investments is referred to as *capital budgeting.*

This chapter introduces the general concepts behind capital budgeting. Then, it discusses and illustrates four methods for selecting the best alternatives among capital projects. Two of these methods involve the use of present value concepts. Finally, the chapter stresses the importance of the postaudit review of capital project decisions.

Learning Objectives

After studying this chapter, you should be able to:

1. Define capital budgeting and explain the effects of making poor capital-budgeting decisions.
2. Determine the net cash inflows, after taxes, for both an asset addition and an asset replacement.
3. Evaluate projects using the payback period.
4. Evaluate projects using the unadjusted rate of return.
5. Evaluate projects using the net present value.
6. Evaluate projects using the profitability index.

(*continued*)

Objectives

7. Evaluate projects using the time-adjusted rate of return.
8. Determine, for project evaluation, the effect of an investment in working capital.

Capital Budgeting Defined

Capital budgeting is the process of considering alternative capital projects and selecting those alternatives that provide the most profitable return on available funds, within the framework of company goals and objectives. A **capital project** is any available alternative to purchase, build, lease, or renovate buildings, equipment, or other long-range major items of property. The alternative selected usually involves large sums of money and brings about a large increase in fixed costs for a number of years in the future. Once a company builds a plant or undertakes some other capital expenditure, its future plans are less flexible.

Poor capital-budgeting decisions can be costly because of the large sums of money and relatively long periods involved. If a poor capital budgeting decision is implemented, the company can lose all or part of the funds originally invested in the project and not realize the expected benefits. In addition, other actions taken within the company regarding the project, such as finding suppliers of raw materials, are wasted if the capital-budgeting decision must be revoked. Poor capital-budgeting decisions may also harm the company's competitive position because the company does not have the most efficient productive assets needed to compete in world markets.

Investment of funds in a poor alternative can create other poblems as well. Workers hired for the project might be laid off if the project fails, creating morale and unemployment problems. Many of the fixed costs still remain even if a plant is closed or not producing. For instance, advertising efforts would be wasted, and stock prices could be affected by the decline in income.

Objective 1
Define capital budgeting and explain the effects of making poor capital-budgeting decisions.

On the other hand, failure to invest enough funds in a good project also can be costly. Ford's Mustang is an excellent example of this problem. At the time of the original capital-budgeting decision, if Ford had correctly estimated the Mustang's popularity, the company would have expended more funds on the project. Because of an undercommitment of funds, Ford found itself short on production capacity, which caused lost and postponed sales of the automobile.

Finally, the amount of funds available for investment is limited. Thus, once a company makes a capital investment decision, alternative investment opportunities are normally lost. The benefits or returns lost by rejecting the best alternative investment are the **opportunity cost** of a given project.

For all these reasons, companies must be very careful in their analysis of capital projects. Capital expenditures do not occur as often as ordinary expenditures such as payroll or inventory purchases but involve substantial sums of money that are then committed for a long period. Therefore, the means by which companies evaluate capital expenditure decisions should be much more formal and detailed than would be necessary for ordinary purchase decisions.

Project Selection: A General View

Making capital-budgeting decisions involves analyzing cash inflows and outflows. This section shows you how to calculate the benefits and costs used in capital-budgeting decisions. Because money has a time value, these benefits and costs are adjusted for time under the last two methods covered in the chapter.

Time Value of Money

Money received today is worth more than the same amount of money received at a future date, such as a year from now. This principle is known as the *time value of money.* Money has time value because of investment opportunities, not because of inflation. For example, $100 today is worth more than $100 to be received one year from today because the $100 received today, once invested, grows to some amount

greater than $100 in one year. Future value and present value concepts are extremely important in assessing the desirability of long-term investments (capital budgeting).

Net Cash Inflow

The **net cash inflow** (as used in capital budgeting) is the net cash benefit expected from a project in a period. The net cash inflow is the difference between the periodic cash inflows and the periodic cash outflows for a proposed project.

Objective 2
Determine the net cash inflows, after taxes, for both an asset addition and an asset replacement.

Asset Acquisition Assume, for example, that a company is considering the purchase of new equipment for $120,000. The equipment is expected (1) to have a useful life of 15 years and no salvage value, and (2) to produce cash inflows (revenue) of $75,000 per year and cash outflows (costs) of $50,000 per year. Ignoring depreciation and taxes, the annual net cash inflow is computed as follows:

Cash inflows	$75,000
Cash outflows	50,000
Net cash inflow	$25,000

Depreciation and Taxes The computation of the net cash inflow usually includes the effects of depreciation and taxes. Although depreciation does not involve a cash outflow, it is deductible in arriving at federal taxable income. Thus, depreciation reduces the amount of cash outflow for federal income taxes. This reduction is a tax savings made possible by a depreciation tax shield. A **tax shield** is the total amount by which taxable income is reduced due to the deductibility of an item. For example, if depreciation is $8,000, the tax shield is $8,000. To simplify the illustration, we assume the use of the straight-line depreciation for tax purposes throughout the chapter. Straight-line depreciation can be elected for tax purposes, even under the new tax law.

The tax shield results in a tax savings. The amount of the tax savings can be found by multiplying the tax rate by the amount of the depreciation tax shield. The formula is:

Reinforcing Problem
E10–1 Determine estimated income and net cash inflow for an asset addition.

$$\text{Tax rate} \times \text{Depreciation tax shield} = \text{Tax savings}$$

Using the data in the previous example and assuming straight-line depreciation of $8,000 per year and a 40% tax rate, the amount of the tax savings is $3,200 (40% × $8,000 depreciation tax shield). Now, considering taxes and depreciation, we compute the annual net cash inflow from the $120,000 of equipment as follows:

	Change in Net Income	Change in Cash Flow
Cash inflows	$75,000	$75,000
Cash outflows	50,000	50,000
Net cash inflow before taxes	$25,000	$25,000
Depreciation	8,000	
Income before income taxes	$17,000	
Deduct: Income tax at 40%	6,800	6,800
Net income after taxes	$10,200	
Net cash inflow (after taxes)		$18,200

If there were no depreciation tax shield, federal income tax expense would have been $10,000, or ($25,000 × 40%), and the net after-tax cash inflow from the investment would have been $15,000, found by ($25,000 – $10,000), or [$25,000 × (1 – 40%)].

The depreciation tax shield, however, reduces federal income tax expense by $3,200, or ($8,000 × 40%), and increases the investment's after-tax net cash inflow by the same amount. Therefore, the following formula also can be used to determine the after-tax net cash inflow from an investment:

$$\text{Net cash inflow after taxes} = \underbrace{\left[\text{Net cash inflow before taxes} \times \left(1 - \text{Tax rate}\right)\right]}_{\text{Net cash inflow after taxes (ignoring depreciation)}} + \underbrace{\left[\text{Depreciation expense} \times \text{Tax rate}\right]}_{\text{Tax savings attributable to depreciation tax shield}}$$

$$= [\$25{,}000 \times (1 - .4)] + [\$8{,}000 \times .4] = \$18{,}200$$

Asset Replacement Sometimes a company must decide whether or not it should replace existing plant assets. Such replacement decisions often occur when faster and more efficient machinery and equipment appear on the market.

The computation of the net cash inflow is more complex for a replacement decision than for an acquisition decision because cash inflows and outflows for two items (the asset being replaced and the new asset) must be considered. To illustrate, assume that a company operates two machines purchased four years ago at a cost of $18,000 each. The estimated useful life of each machine is 12 years (with no salvage value). Each machine will produce 40,000 units of product per year. The annual cash operating expenses (labor, repairs, etc.) for the two machines together total $14,000. After the old machines have been used for four years, a new machine becomes available. The new machine can be acquired for $28,000 and has an estimated useful life of eight years (with no salvage value). The new machine produces 60,000 units annually and entails annual cash operating expenses of $10,000. The $4,000 reduction in operating expenses ($14,000 – $10,000) is a $4,000 increase in net cash inflow (savings) before taxes.

The firm pays $28,000 in the first year to acquire the new machine. In addition to this initial outlay, the annual net cash inflow from replacement is computed as follows:

Reinforcing Problem
E10–2 Determine additional cash inflow for an asset replacement.

$$\text{Net cash inflow after taxes} = \left[\begin{array}{c}\text{Annual net cash inflows (savings) before taxes}\end{array} \times \left(1 - \text{Tax rate}\right)\right] + \left[\begin{array}{c}\text{Additional annual depreciation expense}\end{array} \times \text{Tax rate}\right]$$

Using these data, the following display shows how you can use this formula to find the net cash flow after taxes:

Annual cash operating expenses:		
Old machines		$14,000
New machine		10,000
Annual net cash inflow (savings) before taxes		$ 4,000
1 – Tax rate		× 60%
Annual net cash inflow (savings)* after taxes ignoring depreciation (1)		$ 2,400
Annual depreciation expense:		
Old machines	$ 3,000	
New machine	3,500	
Additional annual depreciation expense	$ 500	
Tax rate	× 40%	
Tax savings from additional depreciation (2)		200
Net cash inflow after taxes (1) + (2)		$ 2,600

*Cash savings are considered to be cash inflows.

In formula format, the calculation is:

$$\text{Net cash inflow after taxes} = [\$4{,}000 \times (1 - .4)] + [\$500 \times .4] = \$2{,}600$$

Notice that these figures concentrated only on the differences in costs for each of the two alternatives. Two other items also are relevant to the decision. First, the purchase of the new machine creates a $28,000 cash outflow immediately after acquisition. Second, the two old machines can probably be sold, and the selling price or salvage value of the old machines creates a cash inflow in the period of disposal. Also, the previous example used straight-line depreciation. If the modified Accelerated Cost Recovery System (modified ACRS) had been used, the tax shield would have been larger in the early years and smaller in the later years of the asset's life.

Out-of-Pocket and Sunk Costs A distinction between out-of-pocket costs and sunk costs needs to be made for capital budgeting decisions. An **out-of-pocket cost** is a cost requiring a future outlay of resources, usually cash. Out-of-pocket costs can be avoided or changed in amount. Future labor and repair costs are examples of out-of-pocket costs.

Sunk costs are costs already incurred. Nothing can be done about sunk costs at the present time; they cannot be avoided or changed in amount. The price paid for a machine becomes a sunk cost the minute the purchase has been made (before that moment it was an out-of-pocket cost). The amount of that past outlay cannot be changed, regardless of whether the machine is scrapped or used. Thus, depreciation is a sunk cost because it represents a past cash outlay. Depletion and amortization of assets, such as ore deposits and patents, are also sunk costs.

A sunk cost is a past cost, while an out-of-pocket cost is a future cost. Only the out-of-pocket costs (the future cash outlays) are relevant to capital budgeting decisions. Sunk costs are not relevant, except for any effect they have on the cash outflow for taxes.

Initial Cost and Salvage Value Any cash outflows necessary to acquire an asset and place it in a position and condition for its intended use are part of the **initial cost of the asset**. If an investment has a salvage value, that value is a cash inflow in the year of the asset's disposal.

The Cost of Capital The cost of capital is important in project selection. Certainly, any acceptable proposal should offer a return that exceeds the cost of the funds used to finance it. **Cost of capital**, usually expressed as a rate, is the cost of all sources of capital (debt and equity) employed by a company. For convenience, most current liabilities, such as accounts payable and federal income taxes payable, are treated as being without cost. Every other item on the right (equity) side of the balance sheet has a cost. The subject of determining the cost of capital is a controversial topic in the literature of accounting and finance and is not discussed here. We give the assumed rates for the cost of capital in this book. Next, we describe several techniques for deciding whether to invest in capital projects.

Project Selection: Payback Period

Objective 3
Evaluate projects using the payback period.

The **payback period** is the time it takes for the cumulative sum of the annual net cash inflows from a project to equal the initial net cash outlay. In effect, the payback period answers the question: How long will it take the capital project to recover, or pay back, the initial investment? If the net cash inflows each year are a constant amount, the formula for the payback period is:

$$\text{Payback period} = \frac{\text{Initial cash outlay}}{\text{Annual net cash inflow (or benefit)}}$$

For the two assets discussed in the previous section, you can compute the payback period as follows. The purchase of the $120,000 equipment creates an annual net cash inflow after taxes of $18,200, so the payback period is 6.6 years, computed as follows:

$$\text{Payback period} = \frac{\$120{,}000}{\$18{,}200} = 6.6 \text{ years}$$

The payback period for the replacement machine with a $28,000 cash outflow in the first year and an annual net cash inflow of $2,600, is 10.8 years, computed as follows:

$$\text{Payback period} = \frac{\$28{,}000}{\$2{,}600} = 10.8 \text{ years}$$

Remember that the payback period indicates how long it will take the machine to pay for itself. The replacement machine being considered has a payback period of 10.8 years but a useful life of only 8 years. Therefore, because the investment cannot pay for itself within its useful life, the company should not purchase a new machine to replace the two old machines.

In each of the previous examples, the projected net cash inflow per year was uniform. When the annual returns are uneven, companies use a cumulative calculation to determine the payback period, as shown in the following situation.

Neil Company is considering a capital investment project that costs $40,000 and is expected to last 10 years. The projected annual net cash inflows are:

Year	Investment	Annual Net Cash Inflow	Cumulative Net Cash Inflows
0	$40,000	—	—
1	—	$8,000	$8,000
2	—	6,000	14,000
3	—	7,000	21,000
4	—	5,000	26,000
5	—	8,000	34,000
6	—	6,000	**40,000**
7	—	3,000	43,000
8	—	2,000	45,000
10	—	1,000	49,000

The payback period in this example is six years—the time it takes to recover the $40,000 original investment.

When using payback period analysis to evaluate investment proposals, management may choose one of these rules to decide on project selection:

Reinforcing Problems
E10–3 Compute payback period for a new machine.
E10–6 Rank projects using the payback method

1. Select the investments with the shortest payback periods.
2. Select only those investments that have a payback period of less than a specified number of years.

Both decision rules focus on the rapid return of invested capital. If capital can be recovered rapidly, a firm can invest it in other projects, thereby generating more cash inflows or profits.

Some managers use payback period analysis in capital budgeting decisions due to its simplicity. However, this type of analysis has two important limitations:

1. Payback period analysis ignores the time period beyond the payback period. For example, assume Allen Company is considering two alternative investments; each

requires an initial outlay of $30,000. Proposal Y returns $6,000 per year for five years, while proposal Z returns $5,000 per year for eight years. The payback period for Y is five years ($30,000/$6,000) and for Z is six years ($30,000/$5,000). But, if the goal is to maximize income, proposal Z should be selected rather than proposal Y, even though Z has a longer payback period. This is because Z returns a total of $40,000, while Y simply recovers the initial $30,000 outlay.

2. Payback analysis also ignores the time value of money. For example, assume the following net cash inflows are expected in the first three years from two capital projects:

	Net Cash Inflows	
	Project A	Project B
First year	$15,000	$ 9,000
Second year	12,000	12,000
Third year	9,000	15,000
Total	$36,000	$36,000

Assume that both projects have the same net cash inflow each year beyond the third year. If the cost of each project is $36,000, each has a payback period of three years. But common sense indicates that the projects are not equal because money has time value and can be reinvested to increase income. Because larger amounts of cash are received earlier under Project A, it is the preferable project.

Project Selection: Unadjusted Rate of Return

Objective 4
Evaluate projects using the unadjusted rate of return.

Another method of evaluating investment projects that you are likely to encounter in practice is the **unadjusted rate of return** method. To compute the unadjusted rate of return, divide the average annual income after taxes by the average amount of investment in the project. The *average investment* is the (Beginning balance + Ending balance)/2. If the ending balance is zero (as we assume), the average investment equals the original cash investment divided by 2. The formula for the unadjusted rate of return is:

$$\text{Unadjusted rate of return} = \frac{\text{Average annual income after taxes}}{\text{Average amount of investment}}$$

Notice that this calculation uses annual income rather than net cash inflow.[1]

To illustrate the use of the unadjusted rate of return, assume Thomas Company is considering two capital project proposals, each having a useful life of three years. The company does not have enough funds to undertake both projects. Information relating to the projects follows:

Proposal	Initial Cost	Salvage Value	Average Annual Before-Tax Net Cash Inflow	Average Annual Depreciation
1	$76,000	$4,000	$45,000	$24,000
2	95,000	5,000	55,000	30,000

[1]Some formulas use the initial investment in the denominator instead of the average investment. We prefer the average investment because it approximates the use of assets throughout the year not just at the beginning of the year.

Assuming a 40% tax rate, Thomas Company can determine the unadjusted rate of return for each project as follows:

Reinforcing Problem
E10–4 Compute unadjusted rate of return for a new machine.

		Proposal 1	Proposal 2
Average investment: (original outlay + salvage value) ÷ 2	(1)	$40,000	$50,000
Annual net cash inflow (before income taxes)		$45,000	$55,000
Annual depreciation		24,000	30,000
Annual income (before income taxes)		$21,000	$25,000
Deduct: Income taxes at 40%		8,400	10,000
Average annual net income from investment	(2)	$12,600	$15,000
Rate of return (2) ÷ (1)		31.5%	30%

From these calculations, if Thomas Company makes an investment decision solely on the basis of the unadjusted rate of return, it would select Proposal 1 since it has a higher rate.

Also, the company could compute the unadjusted rate of return with the following formula:

$$\text{Rate of return} = \frac{\left(\begin{array}{c}\text{Average annual}\\ \text{before-tax net cash inflow}\end{array} - \begin{array}{c}\text{Average annual}\\ \text{depreciation}\end{array}\right) \times \left(1 - \begin{array}{c}\text{Tax}\\ \text{rate}\end{array}\right)}{\text{Average investment}}$$

For Proposal 1, the computation is as follows:

$$\text{Rate of return} = \frac{(\$45{,}000 - \$24{,}000) \times (1 - 0.4)}{[(\$76{,}000 + \$4{,}000)/2]} = \frac{(\$21{,}000) \times (0.6)}{\$40{,}000} = \frac{\$12{,}600}{\$40{,}000} = 31.5\%$$

For Proposal 2, the computation is as follows:

$$\text{Rate of return} = \frac{(\$55{,}000 - \$30{,}000) \times (1 - 0.4)}{[(\$95{,}000 + \$5{,}000)/2]} = \frac{(\$25{,}000) \times (0.6)}{\$50{,}000} = \frac{\$15{,}000}{\$50{,}000} = 30\%$$

Sometimes companies receive information on the average annual after-tax net cash inflow. Average annual after-tax net cash inflow is equal to annual before-tax cash inflow minus taxes. Given this information, the firms could deduct the depreciation to arrive at average net income. For instance, for Proposal 2, Thomas Company would compute average net income as follows:

After-tax net cash inflow ($55,000 – $10,000)	$45,000
Less: Depreciation	30,000
Average net income	$15,000

The unadjusted rate of return, like payback period analysis, has several limitations:

1. The length of time over which the return is earned is not considered.
2. The rate allows a sunk cost, depreciation, to enter into the calculation. Since depreciation can be calculated in so many different ways, the rate of return can be manipulated by simply changing the method of depreciation used for the project.

3. The timing of cash flows is not considered. Thus, the time value of money is ignored.

Unlike the two project selection methods just illustrated, the remaining two methods—net present value and time-adjusted rate of return—take into account the time value of money in the analysis. In both of these methods, we assume that all net cash inflows occur at the end of the year. Often used in capital budgeting analysis, this assumption makes the calculation of present values less complicated than if we assume the cash flows occurred at some other time.

Project Selection: Net Present Value Method

Objective 5
Evaluate projects using the net present value.

In this section, you learn to calculate the net present value of capital projects. Then you learn how to use the profitability index to evaluate projects costing different amounts. The profitability index is a refinement of the net present value method.

The **net present value** method uses the company's required minimum rate of return as a discount rate and discounts all expected after-tax cash inflows and outflows from the proposed investment back to their present values. The net present value of the proposed investment is the difference between the present value of the annual net cash inflows and the present value of the required cash outflows.

In many projects, the only cash outflow is the initial investment, and since it occurs immediately, the initial investment does not need to be discounted. Therefore, in such projects, a company may compute the net present value of the proposed project as the present value of the annual net cash inflows minus the initial investment. Other types of projects require that additional investments, such as a major repair, be made at later dates in the life of the project. In those cases, the company must discount the cash outflows to their present value before comparing them to the present value of the net cash inflows.

A major issue in acknowledging the time value of money in the net present value method is determining an appropriate discount rate to use in computing the present value of cash flows. Management requires some minimum rate of return on its investments. This rate should be the company's cost of capital, but that rate is difficult to determine. Therefore, under the net present value method, management often selects a target rate that it believes to be at or above the company's cost of capital, and then uses that rate as a basis for present value calculations.

To illustrate the net present value method, assume Morris Company is considering a capital investment project that will cost $25,000. Morris expects net cash inflows after taxes for the next four years to be $8,000, $7,500, $8,000, and $7,500, respectively. Management requires a minimum rate of return of 14% and wants to know if the project is acceptable. The following analysis uses the tables in the Appendix at the end of this text:

	Annual Net Cash Inflow (after taxes)	Present Value of $1 at 14% (from Table A.3)	Total Present Value
First year	$8,000	0.87719	$ 7,018
Second year	7,500	0.76947	5,771
Third year	8,000	0.67497	5,400
Fourth year	7,500	0.59208	4,441
Present value of net cash inflows			$22,630
Cost of investment			25,000
Net present value			$(2,370)

Because the present value of the net cash inflows, $22,630, is less than the initial outlay of $25,000, the project is not acceptable. The net present value for the project is equal to the present value of its net cash inflows less the present value of its cost (the investment amount), which in this instance is –$2,370, calculated as ($22,630 – $25,000).

When a company uses the net present value method to screen alternative projects, it considers the project with the higher net present value to be more desirable. In general, a proposed capital investment is acceptable if it has a positive net present value. In the previous example, if the expected net cash inflows from the investment had been $10,000 per year for four years, the present value of the benefits would have been (from Table A.4 in the Appendix):

Reinforcing Problem
E10–7 Determine the acceptability of a project using net present value.

$$\$10{,}000 \times 2.9137 = \$29{,}137$$

This calculation yields a net present value of $4,137, or $29,137 – $25,000. Since the net present value is positive, the investment proposal is acceptable. However, a competing project may have an even higher net present value.

When comparing investment projects costing different amounts, the net present value method does not provide a valid means by which to rank the projects in order of desirability assuming limited financial resources. A profitability index provides this additional information to management.

Profitability Index

Objective 6
Evaluate projects using the profitability index.

A **profitability index** is the ratio of the present value of the expected net cash inflows (after taxes) divided by the initial cash outlay (or present value of cash outlays if future outlays are required). The profitability index formula is:

$$\text{Profitability index} = \frac{\text{Present value of net cash inflows}}{\text{Initial cash outlay (or present value of cash outlays if future outlays are required)}}$$

Management should consider only those proposals having a profitability index greater than or equal to 1.00. Proposals with a profitability index of less than 1.00 cannot yield the minimum rate of return because the present value of the projected cash inflows is less than the initial cost.

To illustrate use of the profitability index, assume that a company is considering two alternative capital outlay proposals that have the following initial costs and expected net cash inflows after taxes:

	Proposal X	Proposal Y
Initial outlay	$7,000	$9,500
Expected net cash inflow (after taxes):		
Year 1	$5,000	$9,000
Year 2	4,000	6,000
Year 3	6,000	3,000

Management's minimum desired rate of return is 20%.

The net present values and profitability indexes can be computed as follows, using Table A.3 in the Appendix at the end of this book:

	Present Value	
	Proposal X	Proposal Y
Year 1 (net cash inflow in year 1 × 0.83333)	$ 4,167	$ 7,500
Year 2 (net cash inflow in year 2 × 0.69444)	2,778	4,167
Year 3 (net cash inflow in year 3 × 0.57870)	3,472	1,736
Present value of net cash inflows	$10,417	$13,403
Initial outlay	7,000	9,500
Net present value	$ 3,417	$ 3,903

	Proposal X	Proposal Y
Profitability index	$\frac{\$10,417}{\$7,000} = 1.49$	$\frac{\$13,403}{\$9,500} = 1.41$

Reinforcing Problem
E10–5 Compute the profitability index for two projects and rank projects.

When the net present values are compared, Proposal Y appears to be more favorable than Proposal X because its net present value is higher. However, the profitability indexes indicate Proposal X is the more desirable investment because it has the higher profitability index. The higher the profitability index, the more profitable the project per dollar of investment. Proposal X earns a higher rate of return on a smaller investment than Proposal Y.

Another technique for evaluating capital projects that accounts for the time value of money is the time-adjusted rate of return method. The next section discusses this method.

An Accounting Perspective

Business Insight Like U.S. managers, Japanese managers incorporate the cost of capital into their capital investment decisions. However, Japanese managers tend to rely more on consensus decision making, less on the numbers. Discount rates in Japan are generally lower than in the United States. Typical U.S. discount rates range from 10% to 25% depending on the riskiness of the project and the rate of inflation. In Japan, the discount rates tend to be around 10%, even lower in some cases.

Project Selection: The Time-Adjusted Rate of Return (or Internal Rate of Return)

Objective 7
Evaluate projects using the time-adjusted rate of return.

The **time-adjusted rate of return**, also called the *internal rate of return,* equates the present value of expected after-tax net cash inflows from an investment with the cost of the investment. It does this by finding the rate at which the net present value of the project is zero. If the time-adjusted rate of return equals or exceeds the cost of capital or target rate of return, a firm should consider the investment further. If the proposal's time-adjusted rate of return is less than the minimum rate, the firm should reject the proposal. Ignoring other considerations, the higher the time-adjusted rate of return, the more desirable the project.

Calculators and computer software with time-adjusted rate of return functions are readily available. Present value tables also can approximate the time-adjusted rate of return. To illustrate, assume Young Company is considering a $90,000 investment expected to last 25 years with no salvage value. The investment yields a $15,000 annual after-tax net cash inflow. This $15,000 is referred to as an **annuity**, which is a series of equal cash inflows.

The first step in computing the rate of return is to determine the payback period. In this case, the payback period is six years ($90,000 ÷ $15,000). The second step is to examine Table A.4 in the Appendix (present value of an annuity) to find the present value factor that is nearest in amount to the payback period of 6. Since the investment

A Broader Perspective

Caterpillar, Inc.

Caterpillar, Inc., invested $1.5 billion in a worldwide factory modernization program. Caterpillar's management realized it must continually monitor the performance of this modernization if the project was to realize its potential.

At Caterpillar, the projects are grouped into "bundles" of related projects. For example, all of the new assets used for a new product would be bundled together. "Each bundle is monitored every six months at Caterpillar, although a few key characteristics of some bundles are monitored monthly" [p. 32]. Characteristics used in monitoring performance include the amount of money projected versus the amount actually spent on the projects, the number of people expected to be used on the projects versus the number actually used, and the estimated reduction in product cost versus the reduction in product cost actually achieved.

Many firms believe their evaluation of project performance leaves much to be desired. Caterpillar's idea of "bundling" similar projects should be helpful to other firms making significant changes in their production processes and product lines.

Source: Based on the article by James A. Hendricks, Robert C. Bastian, and Thomas L. Sexton, "Bundle Monitoring of Strategic Projects," *Management Accounting,* February 1992, pp. 31–35.

is expected to yield returns for 25 years, look at that row in the table. In that row, the factor nearest to 6 is 5.92745, which appears under the 16.5% interest column. The third step is to multiply the annual return of $15,000 by the 5.92745 factor; the result is $88,912, which is just below the $90,000 cost of the project. Thus, the actual rate of return is slightly less than 16.5%. The rate of return is less than 16.5% but more than 16% because as interest rates increase, present values decrease because less investment is needed to generate the same income.

The preceding example involves uniform net cash inflows from year to year. But what happens when net cash inflows are not uniform? In such instances, a trial and error procedure is necessary if present value tables are used. For example, assume that Young Company is considering a $200,000 project that will last four years and yield the following returns:

Year	Net Cash Inflow (after taxes)
1	$ 20,000
2	40,000
3	80,000
4	150,000
Total	$ 290,000

The average annual cash inflow is $290,000 ÷ 4 = $72,500. Based on this average net cash inflow, the payback period is $200,000 ÷ $72,500 = 2.76 years. Looking in the four-year row of Table A.4 in the Appendix, we find that the factor 2.77048 is nearest to the payback period of 2.76. In this case, however, cash flows are not uniform. The largest returns occur in the later years of the asset's life. Since the early returns have the largest present value, the rate of return is likely to be less than the 16.5% rate that corresponds to the present value factor 2.77048. If the returns had been greater during the earlier years of the asset's life, the correct rate of return would have been higher than 16.5%. To find the specific discount rate that yields a present value closest to the initial outlay of $200,000, we try out several interest rates less than 16%. The rate of return is found by trial and error. The following computation reveals the rate to be slightly higher than 12%:

Reinforcing Problems
E10–8 Compute time-adjusted rate of return.
E10–9 Rank projects using the payback period, net present value, and time-adjusted rate of return.

Year	Return	Present Value Factor at 12%	Present Value of Net Cash Inflows
1	$ 20,000	0.89286	$ 17,857
2	40,000	0.79719	31,888
3	80,000	0.71178	56,942
4	150,000	0.63553	95,330
			$202,017

Since the cost of capital is not a precise percentage, some financial theorists argue that the time-adjusted rate of return method is preferable to the net present value method. Under the time-adjusted rate of return method, the cost of capital is used only as a cutoff point in deciding which projects are acceptable and should be given more consideration.

No matter which time value of money concept is considered better, these methods are both theoretically superior to the payback period and the unadjusted rate of return methods. However, the time value of money methods are more difficult to compute unless you use a business calculator or a microcomputer spreadsheet program. In reality, no single method should be used by itself to make capital-budgeting decisions. Managers should consider all aspects of the investment, including such nonquantitative factors as employee morale (layoff of workers due to higher efficiency of a new machine) and company flexibility (versatility of production of one machine over another). The company commits itself to its investment in a capital project for a long time and should use the best selection techniques and judgment available.

Too often, in capital project selection decisions, investments in working capital are ignored. The next section shows how to incorporate this factor into the analysis.

An Accounting Perspective

Use of Technology People use computer spreadsheets extensively in evaluating capital projects. Decisions about investing in capital projects require a lot of thinking about the future. Because no one can predict the future with certainty, people often make numerous estimates of future cash flows—some optimistic, some pessimistic, and some simply best guesses. Computer spreadsheets make the preparation of numerous forecasts feasible, and even fun.

Investments in Working Capital

Objective 8
Determine, for project evaluation, the effect of an investment in working capital.

An investment in a capital asset usually must be supported by an investment in working capital, such as accounts receivable and inventory. For example, companies often invest in a capital project expecting to increase sales. Increased sales usually bring about an increase in accounts receivable from customers and an increase in inventory to support the higher sales level. The increases in current assets—accounts receivable and inventory—are investments in working capital that usually are recovered in full at the end of a capital project's life. Such working capital investments should be considered in capital-budgeting decisions.

To illustrate, assume that a company is considering a capital project involving a $50,000 investment in machinery and a $40,000 investment in working capital. The machine, which will produce a new product, has an estimated useful life of eight years and no salvage value. The annual cash inflows (before taxes) are estimated at $25,000, with annual cash outflows (before taxes) of $5,000. The annual net cash inflow from the project is computed as follows (assuming straight-line depreciation and a 40% tax rate):

Cash inflows	$25,000
Cash outflows	5,000
Net cash inflow before taxes	$20,000
1 – Tax rate	× 60%
Net cash inflow after taxes (ignoring depreciation) (1)	$12,000
Depreciation tax shield ($50,000 ÷ 8 years)	$ 6,250
Income tax rate	× 40%
Depreciation tax savings (2)	$ 2,500
Annual net cash inflow, years 1–8 (1) + (2)	$14,500

The annual net cash inflow from the machine is $14,500 each year for eight years. However, the working capital investment must be considered. The investment of $40,000 in working capital at the start of the project is an additional outlay that must be made when the project is started. The $40,000 would be tied up every year until the project is finished, or in this case, until the end of the life of the machine. At that point, the working capital would be released, and the $40,000 could be used for other investments. Therefore, the $40,000 is a cash outlay at the start of the project and a cash inflow at the end of the project.

The net present value of the project is computed as follows (assuming a 14% minimum desired rate of return):

Net cash inflow, years 1–8 ($14,500 × 4.63886)	$67,263
Recovery of investment in working capital ($40,000 × 0.35056)	14,022
Present value of net cash inflows	$81,285
Initial cash outlay ($50,000 + $40,000)	90,000
Net present value	$(8,715)

The discount factor for the cash inflows, 4.63886, comes from Table A.4 in the Appendix at the end of the book, because the cash inflows in this example are a series of equal payments—an annuity. The recovery of the investment in working capital is assumed to represent a single lump sum received at the end of the project's life. As such, it is discounted using a factor (0.35056) that comes from Table A.3 in the Appendix.

The investment is not acceptable because it has a negative net present value. If the working capital investment had been ignored, the proposal would have had a rather large positive net present value of $17,263 ($67,263 – $50,000). Thus, it should be obvious that investments in working capital must be considered if correct capital-budgeting decisions are to be made.

The next topic discussed in the chapter is the postaudit. This important step improves the chances that future capital project selection decisions are based on realistic projections of benefits and costs.

The Postaudit

The last step in the capital-budgeting process is a postaudit review that should be performed by a person not involved in the capital-budgeting decision-making process. Such a person can provide an impartial judgment on the project's worthiness. This step should be performed early in the project's life, but enough time should have passed for any operational bugs to have been worked out. Actual operating costs and revenues should be determined and compared with those estimated when the project was originally reviewed and accepted. The postaudit review performs these functions:

1. Lets management know if the projections were accurate and if the particular project is performing as expected regarding cash inflows and outflows.
2. May identify additional factors for management to consider in upcoming capital-budgeting decisions, such as cash outflows that were forgotten in a particular project.
3. Provides a review of the capital-budgeting process to determine how effectively and efficiently it is working. The postaudit provides information that allows management to compare the actual results of decisions with the expectations it had during the planning and selection phases of the capital-budgeting process.

Investing in High Technology Projects

Many companies have found it hard to justify high technology investments. A U.S. auto manufacturer, for example, found it difficult to justify investing in a new computer-based flexible manufacturing system because its cost savings occurred so far in the future. When discounted, the present value of these savings did not justify the initial outlay. The president of the company was convinced, however, that the new system had benefits not quantified in the cash flow estimates, so he approved the investment even though it had a negative net present value.

Companies have difficulty in justifying an investment in high technology projects for several reasons. First, often several years pass before companies see the cash inflows from the investment. Even if the cash inflows are high, their net present value is low if they come several years in the future.

Second, management has difficulty identifying and measuring all of the benefits of new technology. When personal computers replaced typewriters, for example, people learned many new ways of creating and storing documents by using the computer. These benefits occurred because people used computers and experimented with them. These benefits would have been difficult to predict, much less measure, back when companies were trying to justify investment in personal computers. Managers believe that sometimes they just have to have faith that the investment is a good one, even though they cannot justify it on quantifiable economic grounds.

Capital Budgeting in Not-for-Profit Organizations

The concepts discussed in this chapter also apply to not-for-profit organizations, such as universities, school districts, cities, and not-for-profit hospitals. Since these organizations are not subject to as many taxes as profit-making organizations, the cash flows related to taxes are usually zero or near zero.

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Understanding the Learning Objectives

Objective 1
Define capital budgeting and explain the effects of making poor capital-budgeting decisions.

- Capital budgeting is the process of considering alternative capital projects and selecting those alternatives that provide the most profitable return on available funds, within the framework of company goals and objectives.
- Poor capital budgeting decisions can cause a company to lose all or part of the funds originally invested in a project and can harm the company's competitive position in world markets.

Objective 2
Determine the net cash inflows, after taxes, for both an asset addition and an asset replacement.

- Asset addition:

$$\text{Net cash inflow after taxes} = \left[\text{Net cash inflow before taxes} \times \left(1 - \text{Tax rate}\right)\right] + \left[\text{Depreciation expense} \times \text{Tax rate}\right]$$

- Asset replacement:

$$\text{Net cash inflow after taxes} = \left[\begin{array}{c}\text{Annual net cash inflows (savings) before taxes}\end{array} \times \left(1 - \text{Tax rate}\right)\right] + \left[\begin{array}{c}\text{Additional annual depreciation expense}\end{array} \times \text{Tax rate}\right]$$

Objective 3
Evaluate projects using the payback period.

- $\text{Payback period} = \dfrac{\text{Initial cash outlay}}{\text{Annual net cash inflows (or benefits)}}$

Objective 4
Evaluate projects using the unadjusted rate of return.

- $\text{Unadjusted rate of return} = \dfrac{\text{Average annual income after taxes}}{\text{Average amount of investment}}$

Objective 5
Evaluate projects using the net present value.

- All expected after-tax cash inflows and outflows from the proposed investment are discounted to their present values using the company's required minimum rate of return as a discount rate. The net present value of the proposed investment is the difference between the present value of the annual net cash inflows and the present value of the required cash outflows.

Objective 6
Evaluate projects using the profitability index.

- $\text{Profitability index} = \dfrac{\text{Present value of net cash inflows}}{\text{Initial cash outlay (or present value of cash outlays if future outlays are required)}}$

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- The time-adjusted rate of return equates the present value of expected after-tax net cash inflows from an investment with the cost of the investment by finding the rate at which the net present value of the project is zero. If the time-adjusted rate of return equals or exceeds the cost of capital or the target rate of return, the project should be considered. If the rate is less than the minimum rate, the project should be rejected.

Objective 7
Evaluate projects using the time-adjusted rate of return.

- The investment in working capital causes the net present value to be lower than it would be if the working capital investment is ignored. Therefore, the required return of a project must be higher to account for the investment in working capital.

Objective 8
Determine, for project evaluation, the effect of an investment in working capital.

Demonstration Problem

Barkley Company is considering three different investments; the following data relate to these investments:

Investment	Initial Cash Outlay	Expected Before-Tax Net Cash Inflow per Year	Expected After-Tax Net Cash Inflow per Year	Expected Life of Proposals* (years)
A	$50,000	$13,333	$10,000	10
B	60,000	12,000	8,800	15
C	75,000	15,000	10,500	20

*No estimated salvage value. Use straight-line depreciation.

The income tax rate is 40%. The salvage value of each investment is zero. Management requires a minimum return on investments of 14%.

Required

Rank these proposals using the following selection techniques:

a. Payback period.
b. Unadjusted rate of return.
c. Profitability index.
d. Time-adjusted rate of return.

Solution to Demonstration Problem

a. Payback period:

Proposal	(a) Investment	(b) Annual After-Tax Cash Inflow	(a) ÷ (b) Payback Period (years)
A	$50,000	$10,000	5.00
B	60,000	8,800	6.82
C	75,000	10,500	7.14

b. Unadjusted rate of return:

Proposal	*(a)* Average Investment	*(b)* Average Annual Before-Tax Net Cash Inflow	*(c)* Average Depreciation	*(d) = [(b − c) × (1 − .4)]* Average Annual Income	*(d) ÷ (a)* Rate of Return
A	$25,000	$13,333	$5,000	$5,000	20%
B	30,000	12,000	4,000	4,800	16%
C	37,500	15,000	3,750	6,750	18%

The proposals in order of desirability are A, C, and B.

c. Profitability index:

Proposal	*(a)* Annual After-Tax Net Cash Inflow	*(b)* Present Value Factor at 14%	*(c) = (a) × (b)* Present Value of Annual Net Cash Inflow	*(d)* Initial Cash Outlay	*(c) ÷ (d)* Profitability Index
A	$10,000*	5.21612	$52,161	$50,000	1.04
B	8,800	6.14217	54,051	60,000	0.90
C	10,500	6.62313	69,543	75,000	0.93

*This amount was given. However, the amount can also be calculated as follows:

Expected before-tax net cash inflow	$13,333
Less depreciation	5,000
Taxable income	$ 8,333
1 – Tax rate	× 60%
After-tax annual income	$ 5,000
Add back depreciation	5,000
Annual after-tax net cash inflow	$10,000

The proposals in order of desirability are A, C, and B. (But neither B nor C should be considered acceptable since each has a profitability index of less than one.)

d. Time-adjusted rate of return:

Proposal	Rate	How Found
A	15% (slightly above)	($50,000/$10,000) = Factor of 5 in 10 period row
B	12% (slightly below)	($60,000/$8,800) = Factor of 6.82 in 15 period row
C	13% (slightly below)	($75,000/$10,500) = Factor of 7.14 in 20 period row

The proposals in order of desirability are A, C, and B. (But neither B nor C earns the minimum rate of return.)

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*** A 0.25% interest rate reduction is available for borrowers who elect to have monthly principal and interest payments transferred electronically from a savings or checking account. The interest rate reduction will begin when automatic principal and interest payments start, and will remain in effect as long as automatic payments continue without interruption. This reduced interest rate will return to contract rate if automatic payments are cancelled, rejected or returned for any reason. Upon request, borrowers are also entitled to an additional 0.25% interest rate reduction if (1) the first 36 payments of principal and interest are paid on time, and (2) at any time prior to the 36th on time payment, the borrower who receives the monthly bill elects to have monthly principal and interest payments transferred electronically from a savings or checking account, and continues to make such automatic payments through the 36th payment. This reduced interest rate will not be returned to contract rate if, after receiving the benefit, the borrower discontinues automatic electronic payment. The lender and servicer reserve the right to modify or discontinue borrower benefit programs (other than the co-signer release benefit) at any time without notice.

New Terms*

Annuity A series of equal cash inflows. 299
Capital budgeting The process of considering alternative capital projects and selecting those alternatives that provide the most profitable return on available funds, within the framework of company goals and objectives. 290
Capital project Any available alternative to purchase, build, lease, or renovate equipment, buildings, property, or other long-term assets. 290
Cost of capital The cost of all sources of capital (debt and equity) employed by a company. 293
Initial cost of an asset Any cash outflows necessary to acquire an asset and place it in a position and condition for its intended use. 293
Net cash inflow The periodic cash inflows from a project less the periodic cash outflows related to the project. 291
Net present value A project selection technique that discounts all expected after-tax cash inflows and outflows from the proposed investment to their present values using the company's minimum rate of return as a discount rate. If the amount obtained by this process exceeds or equals the investment amount, the proposal is considered acceptable for further consideration. 297
Opportunity cost The benefits or returns lost by rejecting the best alternative investment. 290
Out-of-pocket cost A cost requiring a future outlay of resources, usually cash. 293
Payback period The period of time it takes for the cumulative sum of the annual net cash inflows from a project to equal the initial net cash outlay. 293
Profitability index The ratio of the present value of the expected net cash inflows (after taxes) divided by the initial cash outlay (or present value of cash outlays if future outlays are required). 298
Sunk costs Costs that have already been incurred. Nothing can be done about sunk costs at the present time; they cannot be avoided or changed in amount. 293
Tax shield The total amount by which taxable income is reduced due to the deductability of an item. 291
Time-adjusted rate of return A project selection technique that finds a rate of return that will equate the present value of future expected net cash inflows (after taxes) from an investment with the cost of the investment; also called *internal rate of return.* 299
Unadjusted rate of return The rate of return computed by dividing average annual income after taxes from a project by the average amount of the investment. 295

**Some terms listed in earlier chapters are repeated here for your convenience.*

Self-Test

True-False

Indicate whether each of the following is true or false.

1. Depreciation does not involve a cash outflow; it is deductible in arriving at federal taxable income.
2. The price a company is going to pay for a machine is an out-of-pocket cost.
3. Sunk costs and out-of-pocket costs are relevant to capital-budgeting decisions.
4. A formula for unadjusted rate of return is as follows:

$$\text{Unadjusted rate of return} = \frac{\text{Average annual income after taxes}}{\text{Average amount of investment}}$$

5. When investment projects costing different amounts are being compared, the net present value does not provide a valid means by which to rank projects in order of contribution to income or desirability assuming limited financial resources.

Multiple-Choice

Choose the best answer for each of the following questions.

1. Which of the following is incorrect regarding the payback period method?

a. The payback period ignores the time period beyond the payback period.

b. When using payback analysis for investment decisions, one rule is to select the shortest payback period investment.

c . The formula for the payback period is:

$$\text{Payback period} = \frac{\text{Initial cash outlay}}{\text{Annual amount of investment}}$$

d. Payback analysis ignores the time value of money.

2. When using time value of money concepts, all aspects of the investment should be considered including which of the following?

a. Employee morale.

b. No single time value of money method should be used by itself to make capital budgeting decisions.

c. Company flexibility.

d. All of the above.

3. Which of the following correctly describe(s) the limitations when using the unadjusted rate of return.

a. Timing of cash flows is not considered.

b. It allows a sunk cost, depreciation, to enter into the calculation.

c. The length of time over which the return will be earned is not considered.

d. All of the above.

4. Which of the following statements is (are) true regarding the profitability index?

a. Only proposals with profitability indexes greater than 1.00 should be considered.

b. Only proposals with profitability indexes less than 1.00 should be considered.

c. The profitability index is the ratio of the initial cash outlay divided by the present value of cash benefits (before taxes).

d. **b** and **c**.

5. Which of the following statements is (are) true regarding net present value?

a. When determining an appropriate discount rate, management uses net cash outflow.

b. With projects that require an investment at a later date, management must discount the cash outflow to its present value before it is compared to the present value of cash inflows.

c. When using the net present value to screen alternative projects, as long as the project's net present value is equal to the investment the project is desirable.

d. **b** and **c**.

6. Which of the following statements is (are) true regarding the time-adjusted rate of return?

a. The first step in computing the rate of return is determining the payback period.

b. The annual after-tax net cash inflow also is called an annuity.

c. The cost of capital is used only as a cutoff point in deciding which projects should be considered further.

d. All of the above.

Now turn to page 317 to check your answers.

Questions

1. How do capital expenditures differ from ordinary expenditures?
2. What effects can capital-budgeting decisions have on a company?
3. What effect does depreciation have on cash flow?
4. Give an example of an out-of-pocket cost and a sunk cost by describing a situation in which both are encountered.
5. A machine is being considered for purchase. The salesperson attempting to sell the machine says that it will pay for itself in five years. What is meant by this statement?
6. Discuss the limitations of the payback period method.
7. What is the profitability index, and of what value is it?
8. What is the time-adjusted rate of return on a capital investment?
9. What role does the cost of capital play in the time-adjusted rate of return method and in the net present value method?
10. What is the purpose of a postaudit? When should a postaudit be performed?
11. A friend who knows nothing about the concepts in this chapter is considering purchasing a house for rental to students. In just a few words, what would you tell your friend to think about in making this decision?

Exercises

Exercise 10–1
Determine estimated income and net cash inflow for an asset addition (L.O. 2)

Diane Manufacturing Company is considering investing $600,000 in new equipment with an estimated useful life of 10 years and no salvage value. The equipment is expected to produce $240,000 in cash inflows and $160,000 in cash outflows annually. The company uses straight-line depreciation, and has a 40% tax rate. Determine the annual estimated net income and net cash inflow.

Exercise 10–2
Determine additional cash inflow for an asset replacement (L.O. 2)

Zen Manufacturing Company is considering replacing a four-year-old machine with a new, advanced model. The old machine was purchased for $60,000, has an estimated useful life of 10 years with no salvage value, and has annual maintenance costs of $15,000. The new machine would cost $45,000, but annual maintenance costs would be only $6,000. The new machine would have an estimated useful life of 10 years with no salvage value. Using straight-line depreciation and an assumed 40% tax rate, compute the additional annual cash inflow if the old machine is replaced.

Exercise 10–3
Compute payback period for a new machine (L.O. 3)

Given the following annual costs, compute the payback period for the new machine if its initial cost is $420,000.

	Old Machine	New Machine
Depreciation	$ 18,000	$ 42,000
Labor	72,000	63,000
Repairs	21,000	4,500
Other costs	12,000	3,600
	$123,000	$113,100

Exercise 10–4
Compute unadjusted rate of return for a new machine (L.O. 4)

Jefferson Company is considering investing $33,000 in a new machine. The machine is expected to last five years and to have a salvage value of $8,000. Annual before-tax net cash inflow from the machine is expected to be $7,000. Calculate the unadjusted rate of return. The income tax rate is 40%.

Exercise 10–5
Compute the profitability index for two projects and rank projects (L.O. 6)

Compute the profitability index for each of the following two proposals assuming the desired minimum rate of return is 20%. Based on the profitability indexes, which proposal is better?

	Proposal 1	Proposal 2
Initial cash outlay	$16,000	$10,300
Net cash inflow (after taxes):		
First year	10,000	6,000
Second year	9,000	6,000
Third year	6,000	4,000
Fourth year	–0–	2,500

Exercise 10–6
Rank projects using the payback period (L.O. 3)

Ross Company is considering three alternative investment proposals. Using the following information, rank the proposals in order of desirability using the payback period method.

	Proposal		
	A	B	C
Initial outlay	$360,000	$ 360,000	$360,000
Net cash inflow (after taxes):			
First year	$ –0–	$ 90,000	$ 90,000
Second year	180,000	270,000	180,000
Third year	180,000	90,000	270,000
Fourth year	90,000	180,000	450,000
	$450,000	$ 630,000	$990,000

Exercise 10–7
Determine acceptability of a project using net present value (L.O. 5)

Simone Company is considering the purchase of a new machine costing $50,000. It is expected to save $9,000 cash per year for 10 years, has an estimated useful life of 10 years, and no salvage value. Management will not make any investment unless at least an 18% rate of return can be earned. Using the net present value method, determine if the proposal is acceptable. Assume all tax effects are included in these numbers.

Exercise 10–8
Compute time-adjusted rate of return (L.O. 7)

Refer to the data in Exercise 10–7. Calculate the time-adjusted rate of return.

Exercise 10–9
Rank projects using the payback period, net present value, and time-adjusted rate of return (L.O. 3, 5, 7)

Rank the following investments for Renate Company in order of their desirability using the (*a*) payback period method, (*b*) net present value method, and (*c*) time-adjusted rate of return method. Management requires a minimum rate of return of 14%.

Investment	Initial Cash Outlay	Expected After-Tax Net Cash Inflow per Year	Expected Life of Proposal (years)
A	$120,000	$15,000	8
B	150,000	26,000	20
C	240,000	48,000	10

Problems

Problem 10–1
Determine net cash inflow and payback period for an asset addition (L.O. 2, 3)

Hamlet Company is considering the purchase of a new machine that would cost $300,000 and would have an estimated useful life of 10 years with no salvage value. The new machine is expected to have annual before-tax cash inflows of $100,000 and annual before-tax cash outflows of $40,000. The company will depreciate the machine using straight-line depreciation, and the assumed tax rate is 40%.

Required

a. Determine the net after-tax cash inflow for the new machine.

b. Determine the payback period for the new machine.

Problem 10–2
Determine additional cash inflow for an asset replacement (L.O. 2)

Graham Company currently uses four machines to produce 400,000 units annually. The machines were bought three years ago for $50,000 each and have an expected useful life of 10 years with no salvage value. These machines cost a total of $30,000 per year to repair and maintain.

The company is considering replacing the four machines with one technologically superior machine capable of producing 400,000 units annually by itself. The machine would cost $140,000 and have an estimated useful life of seven years with no salvage value. Annual repair and maintenance costs are estimated at $14,000.

Required

Assuming straight-line depreciation and a 40% tax rate, determine the annual additional after-tax net cash inflow if the new machine is acquired.

Problem 10–3
Evaluate asset replacement using payback and net present value (L.O. 3, 5)

Macro Company owns five machines that it uses in its manufacturing operations. Each of the machines was purchased four years ago at a cost of $120,000. Each machine has an estimated life of 10 years with no expected salvage value. A new machine has become available. One new machine has the same productive capacity as the five old machines combined; it can produce 800,000 units each year. The new machine will cost $648,000, is estimated to last six years, and will have a salvage value of $72,000. A trade-in allowance of $24,000 is available for each of the old machines. These are the operating costs per unit:

	Five Old Machines	New Machine
Repairs	$ 0.6796	$ 0.0856
Depreciation	0.1500	0.2400
Power	0.1890	0.1036
Other operating costs	0.1620	0.0496
Operating costs per unit	$ 1.1806	$ 0.4788

Required

Ignore federal income taxes. Use the payback period method for (**a**) and (**b**).

a. Do you recommend replacing the old machines? Support your answer with computations. Disregard all factors except those reflected in the data just given.

b. If the old machines were already fully depreciated, would your answer be different? Why?

c. Using the net present value method with a discount rate of 20%, present a schedule showing whether or not the new machine should be acquired.

Problem 10–4
Calculate time-adjusted rate of return for new equipment; determine effect of altering useful life and net cash inflows (L.O. 7)

Span Fruit Company has used a particular canning machine for several years. The machine has a zero salvage value. The company is considering buying a technologically improved machine at a cost of $232,000. The new machine will save $50,000 per year after taxes in cash operating costs. If the company decides not to buy the new machine, it can use the old machine for an indefinite time by incurring heavy repair costs. The new machine would have an estimated useful life of eight years.

Required

a. Compute the time-adjusted rate of return for the new machine.

b. Management thinks the estimated useful life of the new machine may be more or less than eight years. Compute the time-adjusted rate of return for the new machine if its useful life is (1) 5 years and (2) 12 years, instead of 8 years.

c. Suppose the new machine's useful life is eight years, but the annual after-tax cost savings are only $45,000. Compute the time-adjusted rate of return.

d. Assume the annual after-tax cost savings from the new machine will be $35,000 and its useful life will be 10 years. Compute the time-adjusted rate of return.

Problem 10–5
Rank proposals using the payback period, unadjusted rate of return, profitability index, and time-adjusted rate of return (L.O. 3, 4, 6, 7)

Merryll, Inc., is considering three different investments involving depreciable assets with no salvage value. The following data relate to these investments:

Investment	Initial Cash Outlay	Expected Before-Tax Net Cash Inflow per Year	Expected After-Tax Net Cash Inflow per Year	Life of Proposal (years)
1	$140,000	$37,333	$28,000	10
2	240,000	72,000	48,000	20
3	360,000	89,333	68,000	10

The income tax rate is 40%. Management requires a minimum return on investment of 12%.

Required

Rank these proposals using the following selection techniques:

a. Payback period.
b. Unadjusted rate of return.
c. Profitability index.
d. Time-adjusted rate of return.

Problem 10–6
Make capital-budgeting decision using net present value (L.O. 5)

Slow to Change Company has decided to computerize its accounting system. The company has two alternatives—it can lease a computer under a three-year contract or purchase a computer outright.

If the computer is leased, the lease payment will be $5,000 each year. The first lease payment will be due on the day the lease contract is signed. The other two payments will be due at the end of the first and second years. The lessor will provide all repairs and maintenance.

If the company purchases the computer outright, it will incur the following costs:

Acquisition cost	$10,500
Repairs and maintenance:	
First year	300
Second year	250
Third year	350

The computer is expected to have only a three-year useful life because of obsolescence and technological advancements. The computer will have no salvage value and be depreciated on a double-declining-balance basis. Slow to Change Company's cost of capital is 16%.

Required

a. Calculate the net present value of out-of-pocket costs for the lease alternative.
b. Calculate the net present value of out-of-pocket costs for the purchase alternative.
c. Do you recommend that the company purchase or lease the machine?

Problem 10–7
Make capital-budgeting decision using the net present value (L.O. 5)

Van Gogh Sports Company is trying to decide whether to add tennis equipment to its existing line of football, baseball, and basketball equipment. Market research studies and cost analyses have provided the following information:

1. Van Gogh will need additional machinery and equipment to manufacture the tennis equipment. The machines and equipment will cost $450,000, have an estimated 10-year useful life, and have a $10,000 salvage value.
2. Sales of tennis equipment for the next 10 years have been projected as follows:

Years	Sales in Dollars
1	$ 75,000
2	112,500
3	168,750
4	187,500
5	206,250
6–10 (each year)	225,000

3. Variable costs are 60% of selling price, and fixed costs (including straight-line depreciation) will total $88,500 per year.
4. The company must advertise its new product line to gain rapid entry into the market. Its advertising campaign costs will be:

Years	Annual Advertising Cost
1–3	$75,000
4–10	37,500

5. The company requires a 14% minimum rate of return on investments.

Required

Using the net present value method, decide whether or not Van Gogh Sports Company should add the tennis equipment to its line of products. (Ignore federal income taxes.) Round to the nearest dollar.

Problem 10–8
Evaluate investment proposal using net present value (L.O. 5)

Jordan Company is considering purchasing new equipment costing $2,400,000. Jordan estimates that the useful life of the equipment will be five years and that it will have a salvage value of $600,000. The company uses straight-line depreciation. The new equipment is expected to have a net cash inflow (before taxes) of $258,000 annually. Assume that the tax rate is 40% and that management requires a minimum return of 14%.

Required

Using the net present value method, determine whether the equipment is an acceptable investment.

Problem 10–9
Make capital-budgeting decision using net present value (L.O. 5)

Penny Company has an opportunity to sell some equipment for $40,000. Such a sale will result in a tax-deductible loss of $4,000. If the equipment is not sold, it is expected to produce net cash inflows after taxes of $8,000 for the next 10 years. After 10 years, the equipment can be sold for its book value of $4,000. Assume a 40% federal income tax rate.

Required

Management currently has other opportunities that will yield 18%. Using the net present value method, show whether the company should sell the equipment. Prepare a schedule to support your conclusion.

Alternate Problems

Problem 10–1A
Determine increase of cash inflow for machine replacement (L.O. 2)

Mark's Manufacturing Company is currently using three machines that it bought seven years ago to manufacture its product. Each machine produces 10,000 units annually. Each machine originally cost $25,500 and has an estimated useful life of 17 years with no salvage value.

The new assistant manager of Mark's Manufacturing Company suggests that the company replace the three old machines with two technically superior machines for $22,500 each. Each new machine would produce 15,000 units annually and would have an estimated useful life of 10 years with no salvage value.

The new assistant manager points out that the cost of maintaining the new machines would be much lower. Each old machine costs $2,500 per year to maintain; each new machine would cost only $1,500 a year to maintain.

Required

Compute the increase in after-tax annual net cash inflow that would result from replacing the old machines; use straight-line depreciation and an assumed tax rate of 40%.

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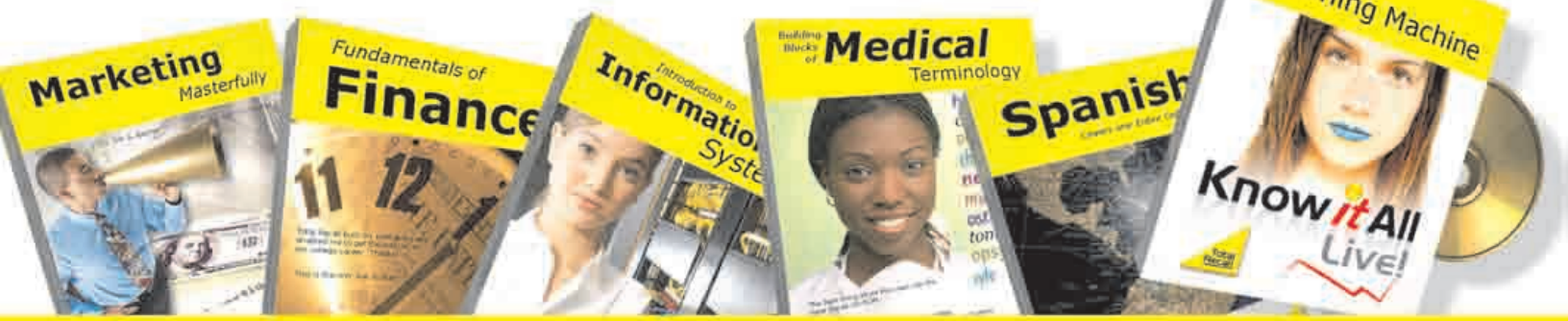

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Problem 10–2A
Determine desirability of asset replacement using payback; develop schedule to aid in project evaluation (L.O. 3, 5)

Fed Extra Company is considering replacing 10 of its delivery vans that originally cost $30,000 each; depreciation of $18,750 has already been taken on each van. The vans were originally estimated to have useful lives of eight years and no salvage value. Each van travels an average of 150,000 miles per year. The 10 new vans, if purchased, will cost $36,000 each. Each van will be driven 150,000 miles per year and will have no salvage value at the end of its three-year estimated useful life. A trade-in allowance of $3,000 is available for each of the old vans. Following is a comparison of costs of operation per mile:

	Old Vans	New Vans
Fuel, lubricants, etc.	$0.152	$0.119
Tires	0.067	0.067
Repairs	0.110	0.087
Depreciation	0.025	0.080
Other operating costs	0.051	0.043
Operating costs per mile	$0.405	$0.396

Required

Use the payback period method for (**a**) and (**b**).

a. Do you recommend replacing the old vans? Support your answer with computations and disregard all factors not related to the preceding data.

b. If the old vans were already fully depreciated, would your answer be different? Why?

c. Assume that all cost flows for operating costs fall at the end of each year and that 18% is an appropriate rate for discounting purposes. Using the net present value method, present a schedule showing whether or not the new vans should be acquired.

Problem 10–3A
Compute time-adjusted rate of return for asset replacement and effect of altering useful life and cash flows in calculations (L.O. 7)

Mesa Company has been using an old-fashioned computer for many years. The computer has no salvage value. The company is considering buying a computer system at a cost of $35,000. The new computer system will save $7,000 per year after taxes in cash (including tax effects of depreciation). If the company decides not to buy the new computer system, it can use the old one for an indefinite time. The new computer system will have an estimated useful life of 10 years.

Required

a. Compute the time-adjusted rate of return for the new computer system.

b. The company is uncertain about the new computer system's 10-year useful life. Compute the time-adjusted rate of return for the new computer system if its useful life is (1) 6 years and (2) 15 years, instead of 10 years.

c. Suppose the computer system has a useful life of 10 years, but the annual after-tax cost savings are only $4,500. Compute the time-adjusted rate of return.

d. Assume the annual after-tax cost savings will be $7,500 and the useful life will be eight years. Compute the time-adjusted rate of return.

Problem 10–4A
Evaluate asset replacement using net present value (L.O. 5)

Ott's Fresh Produce Company has always purchased its trucks outright and sold them after three years. The company is ready to sell its present fleet of trucks and is trying to decide whether it should continue to purchase trucks or whether it should lease trucks. If the trucks are purchased, the company will incur the following costs:

	Costs per Fleet
Acquisition cost	$312,000
Repairs:	
First year	3,600
Second year	6,600
Third year	9,000
Other annual costs	9,600

At the end of three years, the trucks could be sold for a total of $96,000. Another fleet of trucks would then be purchased. The costs just listed, including the same acquisition cost, also would be incurred with respect to the second fleet of trucks. The second fleet also could be sold for $96,000 at the end of three years.

If the company leases the trucks, the lease contract will run for six years. One fleet of trucks will be provided immediately, and a second fleet of trucks will be provided at the end of three years. The company will pay $126,000 per year under the lease contract. The first lease payment will be due on the day the lease contract is signed. The lessor bears the cost of all repairs.

Using the net present value method, determine if the comapny should buy or lease the trucks. Assume the company's cost of capital is 18%. (Ignore federal income taxes.)

Required

Beyond the Numbers—Critical Thinking

Business Decision Case 10–1
Compute net present value of several proposals; rank proposals in order of acceptability (L.O. 5)

Lloyd's Company wishes to invest $750,000 in capital projects that have a minimum expected rate of return of 14%. The company is evaluating five proposals. Acceptance of one proposal does not preclude acceptance of any of the other proposals. The company's criterion is to select proposals that meet its 14% minimum required rate of return. The relevant information related to the five proposals is as follows:

Investment	Initial Cash Outlay	Expected After-Tax Net Cash Inflow per Year	Expected Life of Proposal (years)
A	$150,000	$45,000	5
B	300,000	60,000	8
C	375,000	82,500	10
D	450,000	78,000	12
E	150,000	31,500	10

a. Compute the net present value of each of the five proposals.

b. Which projects should be undertaken? Why? Rank them in order of desirability.

Required

Business Decision Case 10–2
Evaluate computation of a project's net present value; determine acceptability of project (L.O. 5)

Slick Company is considering a capital project involving a $225,000 investment in machinery and a $45,000 investment in working capital. The machine has an expected useful life of 10 years and no salvage value. The annual cash inflows (before taxes) are estimated at $90,000 with annual cash outflows (before taxes) of $30,000. The company uses straight-line depreciation. Assume the federal income tax rate is 40%.

The company's new accountant computed the net present value of the project using a minimum required rate of return of 16% (the company's cost of capital). The accountant's computations follow:

Cash inflows	$ 90,000
Cash outflows	30,000
Net cash inflow	$ 60,000
Present value factor at 16%	× 4.833
Present value of net cash inflow	$289,980
Initial cash outlay	225,000
Net present value	$ 64,980

a. Are the accountant's computations correct? If not, compute the correct net present value.

b. Is this capital project acceptable to the company? Why or why not?

Required

An Accounting Perspective—Writing Experience 10–3
Compare Japanese and U.S. measures of cost of capital

Refer to "An Accounting Perspective" on page 299. Write a brief paper explaining why managers in Japan might use lower measures of the cost of capital than U.S. managers.

Ethics Case—Writing Experience 10–4

Rebecca Peters just learned that First Bank's investment review committee rejected her pet project, a new computerized method of storing data that would enable customers to have instant access to their bank records. Peters' software consulting firm specializes in working with financial institutions. This project for First Bank was her first as project manager.

Following up, Peters learned that First Bank's investment review committee liked the idea but were not convinced that the new software's financial benefits would justify the cost of the software. When she told a colleague about the rejection at First Bank, the colleague said, "Why don't you tell the committee this software will increase the bank's profits? After we installed the software in the bank in Indianapolis, their profits increased substantially. We even have data from that bank that you could present."

Peters thought about the suggestion. She knew First Bank would be pleased with the software if they installed it, and she wanted to make the sale. She also knew that the situation in Indianapolis was different; profits there had increased primarily because of other software that had reduced the bank's operating costs.

Required

What should Rebecca Peters do? Write her a letter telling what you would do.

Group Assignment 10–5
Discuss a new business idea

For summer employment, a friend is considering investing in a coffee stand on a busy street near office buildings. Being unfamiliar with the concepts in this chapter, your friend doesn't know how to make the decision. In teams of four, help your friend get started by providing a framework and questions that your friend should answer. (For example, how much will the investment be? How much are the estimated cash flows from sales?) Prepare a memorandum from the group to your instructor; list your questions and suggestions for your friend. In the heading, include the date, to whom it is written, from whom, and the subject matter.

Group Project 10–6
Writing assignment

You have the option of choosing between two projects with equal total cash flows over five years but different annual cash flows. In groups of two or three students, determine which project should be selected for investment. Write a memorandum to your instructor addressing this issue. Be sure to provide examples to reinforce your answer. The heading of the memorandum should contain the date, to whom it is written, from whom, and the subject matter.

Group Project 10–7
Writing assignment

A manager comments to her superior, "There is no need to perform a postaudit. The project was justified based on our initial projections and we were given the green light to proceed. It's been a year since we started the project, a postaudit would be a waste of time." In groups of two or three students, respond to this comment. Do you agree? Do you disagree? If this manager is right, why bother with a postaudit? Write a memorandum to your instructor addressing these questions. The heading of the memorandum should contain the date, to whom it is written, from whom, and the subject matter.

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Using the Internet—A View of the Real World

Internet Project 10–8
Find and report on an article located on the Internet

Using any Internet search engine enter "budgeting" (be sure to include the quotation marks). Select an article that directly discusses budgeting in an organization or industry and print a copy of the article. You are encouraged (but not required) to find an article that answers some of the following questions: What is the purpose of budgeting? How are budgets developed? How is budgeting used to motivate employees? How might budgeting create ethical dilemmas?

Write a memorandum to your instructor summarizing the key points of the article. The heading of the memorandum should contain the date, to whom it is written, from whom, and the subject matter. Be sure to include a copy of the article used for this assignment.

Internet Project 10–9
Find and report on an article located on the Internet

Using any Internet search engine select one of the new terms at the end of the chapter and perform a key word search. Be sure to include quotation marks (for example: "Payback period"). Select an article that directly discusses the new term used, and print a copy of the article. Write a memorandum to your instructor summarizing the key points of the article. The heading of the memorandum should contain the date, to whom it is written, from whom, and the subject matter. Be sure to include a copy of the article used for this assignment.

Answers to Self-Test

True-False

1. **True.** Depreciation does not involve a cash outflow; it is deductible in arriving at federal taxable income.
2. **True.** The price paid for a machine becomes a sunk cost the minute the purchase has been made.
3. **False.** Only the out-of-pocket costs (the future cash outlays) are relevant to capital-budgeting decisions.
4. **True.**

$$\text{Unadjusted rate of return} = \frac{\text{Average annual income after taxes}}{\text{Average amount of investment}}$$

5. **True.** The profitability index should be used to rank these projects.

Multiple-Choice

1. **c.** The correct formula is:

$$\text{Payback period} = \frac{\text{Initial cash outlay}}{\text{Annual net cash inflow (or benefit)}}$$

2. **d.** All of the above choices are correct answers.
3. **d.** All of the above choices are correct answers.
4. **a.** A profitability index is the ratio of the present value of the expected net cash inflows (after taxes) divided by the initial cash outlay (or present value of cash outlays if future outlays are required).
5. **b.** With projects that require an investment at a later date, management must discount the cash outflow to its present value before it is compared to the present value of cash inflows.
6. **d.** All of the choices are correct answers.