# CHAPTER

**15**

**CAPITAL BUDGETING**

**Learning Objectives**

After reading and studying Chapter 15, you should be able to answer the following questions:

1. Why do most capital budgeting methods focus on cash flows?
2. How is payback period computed, and what does it measure?
3. How are the net present value and profitability index of a project computed, and what do they measure?
4. How is the internal rate of return on a project computed, and what does that rate measure?
5. How do taxation and depreciation affect cash flows?
6. What are the underlying assumptions and limitations of each capital project evaluation method?
7. How do managers rank investment projects?
8. How is risk considered in capital budgeting analyses?
9. How and why should management conduct a postinvestment audit of a capital project?
10. (*Appendix 1*) How are present values calculated?
11. *(Appendix 2)* What are the advantages and disadvantages of the accounting rate of return method?

**Terminology**

**Accounting rate of return** **(ARR):** the rate of earnings obtained on the average capital investment over a project’s life; computed as average annual profits divided by average investment; not based on cash flow

**Annuity:** a series of equal cash flows (either positive or negative) over time

**Annuity due:** a series of equal cash flows received or paid at the beginning of a period

**Capital assets:** long-term assets used to generate future revenues or cost savings or to provide distribution, service, or production capacity

**Capital budgeting:** the evaluation and ranking of alternative future investments in order to allocate limited resources effectively and efficiently

**Cash flow:** receipts or disbursements of cash; in capital budgeting, cash flows that arise from the purchase, operation, and disposition of capital assets

**Compound interest:** a method of determining interest in which interest that was earned in prior periods is added to the original investment so that, in each successive period, interest is earned on both principal and interest

**Compounding period:** the time between each interest computation

**Cost of capital** **(COC):** the weighted average cost of the various sources of funds (debt and equity) that compose a firm’s financial structure

**Discount rate:** the rate of return used to discount future cash flows to their present value amounts; it should equal or exceed an organization’s weighted average cost of capital

**Discounting:** the process of reducing future cash flows to present value amounts by removing the portion of the future values representing interest

**Financing decision:** a judgment regarding the method of raising capital to fund an investment

**Future value** **(FV):** the amount to which one or more sums of money invested at a specified interest rate will grow over a specified number of time periods

**Hurdle rate:** the rate of return specified as the lowest acceptable return on investment; it should generally be at least equal to the cost of capital; the hurdle rate is commonly the discount rate used in computing net present value amounts

**Independent projects:** investment projects that have no specific bearing on one another

**Internal rate of return** **(IRR):** the discount rate that causes the present value of the net cash inflows to equal the present value of the net cash outflows

**Investment decision:** a judgment about which assets to acquire to accomplish an entity’s mission

**Judgmental method (of risk adjustment):** method in which decision makers use logic and reasoning to decide whether a project provides an acceptable rate of return in relation to its risk

**Mutually exclusive projects:** projects that fulfill the same function; one project will be chosen from such a group, excluding all others from further consideration because they would provide unneeded or redundant capability

**Mutually inclusive projects:** a set of proposed capital projects that are all related; if the primary project is chosen, all related projects are also selected

**Net present value** **(NPV):** the difference between the present values of all cash inflows and outflows for an investment project

**Net present value method:** a process that uses the discounted cash flows of a project to determine whether the rate of return on that project is equal to, higher than, or lower than the desired rate of return

**Ordinary annuity:** a series of equal cash flows received or paid at the end of a period

**Payback period:** measures the time required for a project’s cash inflows to equal the original investment

**Postinvestment audit:** the process of gathering information on the actual results of a capital project and comparing them to the expected results

**Preference decision:** a decision where projects are ranked according to their impact on the achievement of company objectives

**Present value** **(PV):** the amount that one or more future cash flows is worth currently, given a specified rate of interest

**Profitability index** **(PI):** a ratio that compares the total present value of an investment’s net cash inflows to the net investment

**Reinvestment assumption:** an assumption made about the rates of return that will be earned by intermediate cash flows from a capital project; NPV and PI assume reinvestment at the discount rate while IRR assumes reinvestment at the IRR

**Return of capital:** the recovery of a project’s original investment (or principal)

**Return on capital:** income equal to the rate of return multiplied by the investment amount

**Risk:** uncertainty reflecting the possibility of differences between the expected and actual future returns from an investment

**Risk-adjusted discount rate method:** a formal method of adjusting for risk in which the decision maker increases the rate used for discounting the future cash inflows and decreases the rate used for discounting future cash outflows to compensate for increased risk

**Screening decision:** determines whether a capital project is desirable based on some previously established minimum criterion or criteria

**Sensitivity analysis:** a process of determining the amount of change that must occur in a variable before a different decision would be made

**Simple interest:** a method of determining interest in which interest is earned on only the original investment (or principal) amount

**Tax benefit (of depreciation):** the amount of depreciation deductible for tax purposes multiplied by the tax rate; the reduction in taxes caused by the deductibility of depreciation

**Tax shield (of depreciation):** the amount of depreciation deductible for tax purposes; the amount of revenue shielded from taxes because of the depreciation deduction

**Time line:** a representation of the amounts and timing of all cash inflows and outflows used in analyzing a capital investment proposal

**Time value of money:** a term used to describe the fact that a dollar received today has more value than a dollar that will be received one year from today since the dollar received today can be invested to generate a return during the year.

**Lecture Outline**

**LO.1: Why do most capital budgeting methods focus on cash flows?**

1. Introduction
   1. Choosing the assets in which an organization will invest is one of the most important business decisions for managers.
   2. **Capital assets** consist of assets that are used to generate future revenues or cost savings or to provide distribution, service, or production capacity.
   3. This chapter discusses techniques used to evaluate the potential financial costs and benefits of capital projects.
2. Capital Asset Acquisition
   1. **Capital budgeting** involves evaluating and ranking alternative future investments to allocate limited resources effectively and efficiently.
      1. The process includes planning for and preparing the capital budget as well as reviewing past investments to assess the success of past decisions and to enhance decisions in the future.
      2. Planned annual expenditures for capital projects for the near term (less than 5 years) and summary information for the long term (6 to 10 years) are shown in the capital budget, which is a key instrument in implementing organizational strategies.
   2. Capital budgeting involves comparing and evaluating alternative projects.
      1. Managers and accountants apply various criteria to evaluate the feasibility of alternative projects.
      2. Although financial criteria are used to assess virtually all projects, firms now also use nonfinancial criteria to assess critically activities that have benefits that are difficult to quantify monetarily.
   3. Text **Exhibit 15.1 (p. 601)** provides quantitative and qualitative criteria used by the forest products industry to evaluate capital projects.
      1. By evaluating potential projects using a portfolio of criteria, managers can be confident that they have considered all project costs and contributions.
      2. Additionally, using multiple criteria allows for a balanced evaluation of short-and long-term benefits, as well as the effects of capital spending on all significant company stakeholders.
3. Use of Cash Flows in Capital Budgeting
   1. Any investment made by an organization is expected to earn some type of return in the form of interest, cash dividends, or operating income.
   2. Converting accrual-based income to cash flow information puts all investment returns on an equivalent basis.
   3. **Cash flows** are the receipts or disbursements of cash; when related to capital budgeting, cash flows arise from the purchase, operation, and disposition of a capital asset.
   4. In evaluating capital projects, a distinction is made between operating cash flows and financing cash flows.
      1. Interest expense is a cash outflow associated with debt financing and is not part of the project selection process.
      2. Project funding is a financing, not an investment decision.
         1. A **financing decision** is a judgment regarding the method of raising capital to fund an investment.
         2. An **investment decision** is a judgment about which assets to acquire to accomplish an entity’s mission.
         3. Management must justify an asset’s acquisition and use prior to justifying the method of financing that asset.
         4. Including financing receipts and disbursements with other project cash flows confuses the evaluation of a project’s profitability because financing costs relate to all projects of an entity rather than to a specific project.
   5. Cash flows from a capital project are received and paid at different times during a project’s life.
      1. Some cash flows occur at the beginning of a period, other cash flows occur during the period, and still others occur at the end.
      2. Analysts assume that cash flows always occur at either the beginning or the end of the time period during which they actually occur in order to simplify capital budgeting analysis.
4. Cash Flows Illustrated
   1. Text **Exhibit 15.2 (p. 603)** presents the expected costs and cost savings of a proposed capital project for the company discussed in the chapter.
   2. Time lines
      1. A **time line** is a device that visually illustrates the points in time when cash flows are expected to be received or paid, making it a helpful tool for analyzing the cash flows of a capital investment proposal.
      2. Cash inflows are shown as positive amounts on a time line, cash outflows are shown as negative amounts, and today equals *t* = 0.

**LO.2: How is payback period computed, and what does it measure?**

* 1. Payback period
     1. The **payback period** is the time required for a project’s cash inflows to equal the original investment.
     2. The longer it takes to recover the initial investment, the greater is the project’s risk because cash flows in the more distant future are more uncertain than relatively current cash flows.
     3. The faster capital is returned from an investment, the more rapidly it can be invested in other projects.
     4. Payback period for a project having unequal cash inflows is determined by accumulating cash flows until the original investment is recovered.
     5. An **annuity** is a series of equal cash flows (either positive or negative) over time.
        1. When the cash flows represent an annuity, the payback period is determined as follows:

Payback Period = Investment ÷ Annuity

* + 1. Company management typically sets a maximum acceptable payback period as one of the evaluation techniques for capital projects.
    2. The payback period method ignores three important things: inflows that occur after the payback period has been reached; the company’s desired rate of return; and the time value of money.

1. Discounting Future Cash Flows
   1. General
      1. A time value is associated with money because interest is paid or received on money.
         1. For example, $1 received today has more value than $1 to be received one year from today because money received today can be invested to generate a return that will cause it to accumulate to more than $1 over time; this effect is referred to as the **time value of money.**
         2. **Discounting** is the process of reducing future cash flows to their present value amounts by removing the portion of the future values representing interest.
      2. The “imputed” interest amount is based on two considerations: the length of time until the cash flow is received or paid and the rate of interest assumed.
      3. **Present value** **(PV)** is the common base of current dollars that results when all future values associated with a project are discounted.
      4. Capital project evaluations require estimates of the amounts and timing of future cash inflows and outflows.
      5. Managers must estimate the rate of return on capital investments required by the company; this rate is called the discount rate.
         1. The **discount rate** is the rate of return used to determine the imputed interest portion of future cash receipts and expenditures; it should equal or exceed an organization’s weighted average cost of capital.
         2. The **cost of capital** **(COC)** is the weighted average cost of the various sources of funds (debt and stock) that comprise a firm’s financial structure.
      6. Managers must distinguish between cash flows that represent a *return of capital* and those representing a *return on capital.*
         1. A **return of capital** is the recovery of the original investment or the return of principal.
         2. A **return on capital** represents income and equals the discount rate multiplied by the investment amount.
      7. To determine whether a project meets a company’s desired rate of return, one of several discounted cash flow methods can be used. These are the net present value method, the profitability index, and the internal rate of return method.

**LO.3: How are the net present value and profitability index of a project computed, and what do they measure?**

* 1. Net present value method
     1. The **net present value** **method** is a process that uses the discounted cash flows of a project to determine whether the rate of return on that project is equal to, higher than, or lower than the desired rate of return.
     2. A project’s **net present value** **(NPV)** is the difference between the total present value of all cash outflows and the total present value of all cash outflows for an investment project.
     3. Net present value data and calculations are provided in text **Exhibit 15.3 (p. 605)**.
     4. The net present value represents the net cash benefit (or, if negative, the net cash cost) of acquiring and using the proposed asset.
        1. If the NPV is zero, the project’s actual rate of return is equal to the required rate of return.
        2. If the NPV is positive, the actual rate is more than the required rate of return.
        3. If the NPV is negative, the actual rate is less than the required rate of return.
     5. Text **Exhibit 15.4 (p. 606)** provides net present values at alternative discount rates and indicates that the NPV is not a single, unique amount, but is a function of two factors:
        1. Changing the discount rate while holding the amounts and timing of cash flows constant affects the NPV. Increasing the discount rate causes NPV to decrease; decreasing the discount rate causes NPV to increase.
        2. Changes in estimated amounts and/or timing of cash inflows and outflows affect a project’s net present value.
     6. When amounts and timing of cash flows change in conjunction with one another, the effects of the changes can be determined only by calculation.
     7. The net present value method provides information on how the actual rate compares to the desired rate, allowing managers to eliminate from consideration any projects on which the rates of return are less than the desired rate and, therefore, not acceptable.
        1. This method can also be used to select the best project when choosing among investments that can perform the same task or achieve the same objective.
        2. This method should *not* be used to compare independent projects requiring different levels of initial investment as such a comparison favors projects having higher net present values over those with lower net present values without regard to the capital invested in the project.
  2. Profitability Index
     1. The **profitability index** **(PI)** is a ratio that compares the present value of net cash flows to the project’s net investment and is calculated as:

PI = Total Present Value of Net Cash Flows ÷ Net Investment

* + 1. The total present value (PV) of net cash flows equals the PV of future cash inflows minus the PV of future cash outflows.
    2. The PV of net cash inflows represents an output measure of the project’s worth, whereas the net investment represents an input measure of the project’s cost.
       1. By relating these two measures, the profitability index gauges the efficiency of the firm’s use of capital.
       2. The higher the index, the more efficient is the capital investment.
       3. If the PI = 1.0, the project’s actual rate of return is equal to the required rate of return.
       4. If the PI exceeds 1.0, the project’s actual rate is more than the required rate of return.
       5. If the PI is less than 1.0, the project’s actual rate is less than the required rate of return.
    3. Thus, like NPV, the PI does not indicate the project’s expected rate of return.

**LO.4: How is the internal rate of return on a project computed, and what does that rate measure?**

* 1. The internal rate of return
     1. The **internal rate of return (IRR)** is the discount rate that causes the present value of the net cash inflows to equal the present value of the net cash outflows and is the project’s expected rate of return; if the IRR is used to determine the NPV of a project, the NPV is zero. The following formula can be used to determine NPV:

NPV = –Investment + PV of cash inflows – PV of cash outflows other than the investment

NPV = –Investment + Cash inflows (PV factor) – Cash outflows (PV factor)

* + 1. The IRR is most easily calculated for projects having equal annual net cash flows. When an annuity exists, the IRR formula can be restated as follows:

NPV = –Net investment + PV of annuity amount

NPV = –Net investment + (Cash flow annuity amount × PV factor)

* + 1. The investment and annual cash flow amounts are known from the expected data and NPV is known to be zero at the IRR; the IRR and its PV factor are unknown. To determine the IRR, substitute known amounts into the formula, rearrange terms, and solve for the unknown PV factor:

NPV = –Net investment + (Annuity × PV factor)

0 = –Net investment + (Annuity × PV factor)

Net investment = (Annuity × PV factor)

Net investment ÷ Annuity = PV factor

* + 1. The solution yields a PV factor for the number of annuity periods corresponding to the project’s life at an interest rate equal to the IRR.
    2. Finding this factor in the PV of an annuity table and reading the interest rate at the top of the column in which the factor is found provides the IRR.
    3. Refer to text **Exhibit 15.5 (p. 609)** for a plot of the NPVs that result from discounting the example project’s cash flows at various rates of return.
    4. Manually finding the IRR of a project that has unequal annual cash flows is more complex and requires an iterative trial-and-error process whereby different discount rates are tried until NPV = 0.
    5. A company’s **hurdle rate** is the rate of return specified as the lowest acceptable rate on an investment; it should be at least equal to the cost of capital.
    6. The higher the IRR, the more financially attractive the investment proposal.
       1. In choosing among alternative investments, however, managers cannot look solely at the internal rates of return on projects because the rates do not reflect the dollars involved as an investor would normally rather have a 20 percent return on $1,000 than a 100 percent return on $5!
    7. Using the IRR method has three drawbacks:
       1. When uneven cash flows exist, the iterative process is inconvenient and time consuming;
       2. Unless PV tables that provide factors for fractional interest rates are available, finding the precise IRR on a project is difficult; and
       3. Some projects can have several rates of return that will make the NPV of the cash flows equal zero. (This phenomenon usually occurs when there are net cash inflows in some years and net cash outflows in other years of the investment project’s life other than at time 0).
    8. In performing discounted cash flow analyses, accrual-based accounting information must be converted to cash flow data.
       1. One accrual that deserves special attention is depreciation.
       2. Although depreciation is not a cash flow, it has cash flow implications because of its effect on income tax payments.

**LO.5: How do taxation and depreciation affect cash flows?**

1. Effect of Depreciation on After-Tax Cash Flows
   1. Depreciation provides a **tax shield** which is the amount of depreciation deductible for tax purposes.
   2. This tax shield provides a **tax benefit** equal to the amount of depreciation deductible for tax purposes multiplied by the tax rate.
   3. Alternative depreciation methods and asset depreciable lives for tax purposes can dramatically affect projected after-tax cash flows, NPV, PI, and IRR.
      1. The depreciation for purposes of calculating income taxes rather than the amount used for financial accounting purposes is relevant in discounted cash flow analysis.
      2. Unpredictable changes may also occur in the tax rate structure.
      3. See text **Exhibit 15.6 (p. 612)** for the different after-tax cash flows and net present values that result if the same project is subjected to either a 25 percent (situation B) or 40 percent (situation C) tax rate.
      4. Based on the net present value criterion, a decrease in the tax rate makes the equipment a more acceptable investment; an increase has the opposite effect.
   4. Managers are best able to make informed decisions concerning capital investments if they understand how depreciation and taxes affect the various capital budgeting techniques.

**LO.6: What are the underlying assumptions and limitations of each capital project evaluation method?**

1. Assumptions and Limitations of Methods
   1. Text **Exhibit 15.7 (p. 613)** summarizes the assumptions and limitations of the various capital budgeting models.
   2. Managers should understand the basic similarities and differences of the various methods and use several techniques to evaluate a project.
   3. All of the methods have two similar limitations:
      1. None of the methods provides a mechanism to include management preferences in regard to the timing of cash flows except to the extent that payback indicates the promptness of the investment recovery; and
      2. All of the methods use single, deterministic measures of cash flow amounts rather than probabilities.
   4. The first limitation can be compensated for by subjectively favoring projects whose cash flow profiles better suit management’s preferences, assuming other project factors are equal; the second limitation can be overcome by using probability estimates of cash flows.
2. Investment Decision
   1. Management must identify the best asset(s) for the firm to acquire to fulfill the company’s goals and objectives. Making such an identification requires answering the following four questions.
      1. Is the activity worthy of an investment?
         1. A company acquires assets when they have value in relation to specific activities in which the company is engaged.
         2. An activity’s worth is measured by cost-benefit analysis, and for most capital budgeting decisions, costs and benefits can be measured in monetary terms.
         3. Difficulty in quantification is no reason to exclude benefits from capital budgeting analyses since surrogate quantifiable measures can be obtained for hard-to-quantify benefits.
         4. Monetary benefits of the capital project may be known in advance not to exceed the costs, but the project is essential for other reasons.
      2. Which assets can be used for the activity?
         1. The determination of available and suitable assets to conduct the intended activity is closely connected to the evaluation of the activity’s worth.
         2. Management must have an idea of how much the needed assets will cost to determine if the activity should be pursued and therefore should gather the specific monetary and nonmonetary information provided in text **Exhibit 15.8 (p. 615)**.
         3. Information used in a capital project analysis may employ surrogate, indirect measures, and management must have both quantitative and qualitative information on each asset to answer the next question.
      3. Of the available assets for each activity, which is the best investment?
         1. Management should select the best asset from the possible candidates and exclude all others from consideration, using all available information.
         2. If a company has a standing committee to discuss, evaluate, and approve capital projects, the committee should recognize that two types of capital decisions need to be made—screening and preference decisions.
            * A **screening decision** is the first decision made in evaluating capital projects that determines whether a project is desirable based on some previously established minimum criterion or criteria.
            * A **preference decision** is the second decision made in capital project evaluation in which projects are ranked according to their impact on the achievement of company objectives.
         3. Deciding which asset is the best investment requires the use of one or more of the evaluation techniques discussed previously. Some techniques are used to screen (e.g., payback), while others are used to rank (e.g., PI) the projects.
      4. Of the “best investments” for all worthwhile activities, in which ones should the company invest?
         1. **Mutually exclusive projects** are composed of a set of proposed capital projects that fulfill the same function; one project will be chosen from such a group, causing all others to be excluded from further consideration because they would provide unneeded or redundant capability.
         2. **Independent projects** are investment projects that have no specific bearing on one another.
         3. **Mutually inclusive projects** are composed of a set of capital projects that are all related and that must all be chosen if the primary project is chosen.
         4. Text **Exhibit 15.9 (p. 616)** illustrates a typical investment decision process in which a firm is determining the best way to provide transportation for its sales force.
         5. To ensure that capital funds are invested in the best projects available, managers must carefully evaluate all projects and decide which of them represents the most effective and efficient use of resources.
            * The evaluation process should consider activity priorities, cash flows, and project risk.
            * Projects should then be ranked in order of acceptability.

**LO.7: How do managers rank investment projects?**

1. Ranking Multiple Capital Projects
   1. All time-value-of-money evaluation techniques will typically indicate the same decision alternative.
   2. Often managers must choose among multiple, mutually exclusive projects.
      1. Multiple project evaluation decisions require that a ranking be made, generally using net present value, profitability index, and/or internal rate of return techniques.
      2. Managers can use results from the evaluation techniques to rank projects in descending order of acceptability.
      3. Although based on the same figures, the NPV and PI methods do not always provide the same rank order because the former is a dollar measure and the latter is a percentage.
      4. When the IRR is used, rankings of multiple projects are based on expected rates of return. Rankings provided by the IRR method are not always in the same order as those given by the NPV or PI methods.
      5. Conflicting results arise because of differing underlying **reinvestment assumptions** among the three methods.
         1. The reinvestment assumption focuses on how the cash flows released during a project’s life are assumed to be reinvested until the end of that project’s life.
         2. The NPV and PI techniques assume that released cash flows are reinvested at the discount rate, which is typically the cost of capital rate.
         3. The IRR method assumes that released cash flows are reinvested at the expected internal rate of return, which is higher than the COC for projects with positive NPVs. In such a case, the IRR method could provide a misleading indication of project success because additional projects that have such a high return might not be found.

**LO.8: How is risk considered in capital budgeting analyses?**

1. Compensating for Risk in Capital Project Evaluation
   1. **Risk** is uncertainty; it reflects the possibility of differences between the expected and actual future returns from an investment.
      1. Managers considering a capital investment should understand and compensate for the degree of risk involved in that investment.
      2. A manager may use the following three approaches to compensate for risk: the judgmental method, the risk-adjusted discount rate method, or sensitivity analysis.
   2. Judgmental Method
      1. The **judgmental method** of risk adjustment is an informal method of adjusting for risk that allows the decision makers to use logic and reasoning to decide whether a project provides an acceptable rate of return in relation to its risk.
   3. Risk-Adjusted Discount Rate Method
      1. The **risk-adjusted discount rate method** is a formal method of adjusting for risk in which the decision maker increases (decreases) the rate used for discounting the future cash inflows (outflows) to compensate for increased risk.
      2. Text **Exhibit 15.10 (p. 618)** provides estimates of the development cost, annual cash savings, and NPV amounts for a capital project using different discount rates to compensate for risk.
   4. Sensitivity Analysis
      1. General
         1. **Sensitivity analysis** is a process of determining the amount of change that must occur in a variable before a different decision would be made.
         2. Sensitivity analysis considers the possibility of “what if” a variable is different than originally expected.
      2. Range of the Discount Rate
         1. A capital project that provides a rate of return equal to or greater than the hurdle or discount rate is considered to be an acceptable investment.
         2. Because the discount and hurdle rates should be set minimally at the organization’s cost of capital, an increase in the cost of capital should cause an increase in the discount rate—and a corresponding decrease in the NPV of the project’s cash flows.
         3. Sensitivity analysis allows a company to ascertain what increases may occur in the estimated cost of capital and still have an acceptable project; as long as the project’s IRR is equal to or greater than the cost of capital, the project will be acceptable.
      3. Range of the Cash Flows
         1. An investment’s projected cash flows are also sensitive to changes in estimation.
         2. Company management wants to know how small the net cash inflows can be for the project to still remain desirable, and such a determination requires that the present value of the cash flows be greater than the cost of the investment.
      4. Range of the Life of the Asset
         1. Asset life is related to many factors, some are controllable while others are not.
         2. An error in the asset’s estimated life will change the number of periods from which cash flows can be expected, and such changes could affect the accept/reject decision for a project.
   5. Sensitivity analysis does not reduce the uncertainty surrounding the estimate of each variable, but it does provide management with a sense of tolerance for estimation errors by providing ranges with upper and lower limits for selected variables.

**LO.9: How and why should management conduct a postinvestment audit of a capital project?**

1. Postinvestment Audit
   1. A **postinvestment audit** is the process of gathering information on the actual results of a capital project and comparing them to the expected results.
   2. The postinvestment audit process provides a feedback or control feature both to the persons who submitted and those who approved the original project information.
   3. A postinvestment audit becomes more crucial as the size of the capital expenditure increases.
   4. The performance of a postinvestment audit is difficult since the actual information may not be in the same form as were the original estimates, and some project benefits may be difficult to quantify. In the text **Exhibits 15.11 and 15.12** provide examples of a postinvestment audit of a capital project.
   5. Postinvestment audits provide managers with information that can help them make better capital investment decisions in the future.

**LO.10: (*Appendix 1*) How are present values calculated?**

1. Time Value of Money
   1. **Future value** **(FV)** refers to the amount to which a sum of money invested at a specified interest rate will grow over a specified number of time periods.
   2. *Present value* (PV) is the amount that future cash flows are worth currently, given a specified rate of interest.
   3. Future and present values depend on three things: amount of the cash flow, rate of interest, and timing of the cash flow.
   4. The *discount rate* is the rate of return used in present value calculations; a present value is a future value discounted back the same number of periods at the same rate of interest.
   5. **Simple interest** is a method of determining interest in which interest is earned only on the original investment or principal amount.
   6. **Compound interest** is a method of determining interest in which interest that was earned in prior periods is added to the original investment so that, in each successive period, interest is earned on both principal and interest.
   7. The **compounding period** is the time between each interest computation.
2. Present Value of a Single Cash Flow
   1. A present value is simply a future value discounted back to the present using some applicable rate of interest.
   2. Present values are computed as follows:

PV = FV ÷ (1 + *i*)n

where PV = present value of a future amount

FV = future value of a current investment

*i* = interest rate per compounding period

n = number of compounding periods

1. Present Value of an Annuity
   1. An *annuity* is a cash flow (either positive or negative) that is repeated over consecutive periods.
      1. An **ordinary annuity** is a series of equal cash flows, each being received or paid at the end of a period.
      2. An **annuity due** is a series of equal cash flows, each being received or paid at the beginning of a period.
   2. Situations often exist in which an annuity is “nested” or surrounded by unequal flows.
   3. The appendix illustrates how to compute the present value of an annuity.

**LO.11: *(Appendix 2)* What are the advantages and disadvantages of the accounting rate of return method?**

1. Accounting Rate of Return
   1. The **accounting rate of return** **(ARR)** measures the rate of earnings obtained on the average capital investment over a project’s life; the formula to calculate the ARR is as follows:

ARR = Average Annual Profits from Project ÷ Average Investment in Project

* + 1. Project investment includes original cost and project support costs, such as those needed for working capital items.
    2. Investment cost, salvage value, and working capital released at the end of the project’s life are summed and divided by two to obtain the average investment.
    3. A project’s calculated ARR is compared with a pre-established ARR hurdle rate set by management which may be higher than the discount rate since the method does not include the time value of money.

**Multiple Choice Questions**

1. (LO.1) Which of the following is *not* a quantitative capital project evaluation method illustrated in the text?
   1. Discounted payback period
   2. Profitability index
   3. Market share
   4. All of the above are quantitative capital project evaluation methods.
2. (LO.2) The payback period for an investment project is defined as the
   1. number of years required for cumulative project profits to equal the initial investment.
   2. number of years required for cumulative project cash flows to equal the average investment.
   3. number of years required for cumulative project cash flows to equal the initial investment.
   4. period of time sufficient to earn a return equal to the cost of capital.

**The next three questions are based on the following information:**

A Company is reviewing an investment proposal whose initial cost will be $105,000 and whose returns are presented in the following schedule:

Annual

Net After-Tax Annual

Year Book Value Cash Flows   Net Income

1 $70,000 $50,000 $15,000

2 42,000 45,000 17,000

3 21,000 40,000 19,000

4 7,000 35,000 21,000

5 -0- 30,000 23,000

All cash flows are assumed to take place at the end of the year. The salvage value of the investment at the end of each year is equal to its net book value and there will be no salvage value at the end of the investment’s life. The company uses an 8% after-tax target rate of return for new investment proposals. The present value interest factors for an 8% rate of return are provided below:

Present Value of PV of an Annuity of

$1 Received at $1 Received at

Year the End of Period the end of Each Period

1 .93 .93

2 .86 1.79

3 .79 2.58

4 .74 3.32

5 .68 4.00

1. (LO.2) The traditional payback period for the investment proposal is
   1. 0.875 years.
   2. 1.933 years.
   3. 2.250 years.
   4. over 5 years.
2. (LO.3) The net present value of the investment proposal is
   1. ($30,240).
   2. $58,100.
   3. $163,100.
   4. $200,000.
3. (LO.3) What is the investment’s profitability index?
   1. 1.90
   2. 1.55
   3. 1.00
   4. 0.90
4. (LO.3) Select the *incorrect* capital budgeting decision rule from the following.
   1. Under the NPV model, accept a project whose NPV is zero.
   2. Under the PI model, accept all projects whose PI is 1.0 or lower.
   3. Under the NPV model, accept a project whose NPV is positive.
   4. No general decision rule is available for the payback model.
5. (LO.4) Select the *incorrect* statement concerning the internal rate of return (IRR) method of evaluating capital projects.
   1. The IRR is the discount rate that causes the net present value to be zero.
   2. The IRR is most easily computed for projects having equal annual net cash inflows.
   3. Any project with a positive IRR should be accepted.
   4. Manually finding the IRR of a project that has unequal annual cash flows requires an iterative trial-and-error process.
6. (LO.5) Which of the following equations correctly computes the tax benefit of depreciation?
   1. Depreciation tax deduction x the tax rate
   2. Depreciation tax deduction x (1 – the tax rate)
   3. Depreciation tax deduction x (1 + the tax rate)
   4. Depreciation tax deduction
7. (LO.6) All of the following are limitations of the payback method of evaluating capital projects *except*:
   1. cash flows and project life are treated as deterministic without explicit consideration of probabilities.
   2. the time value of money is ignored.
   3. the cash flow pattern preferences are not explicitly recognized.
   4. project returns are measured in terms of earnings.
8. (LO.7) The rankings of mutually exclusive investments determined using the internal rate of return (IRR) method and the net present value (NPV) method may be different when
   1. the lives of the multiple projects are equal and the size of the required investments are equal.
   2. the required rate of return equals the IRR of each project.
   3. the required rate of return is higher than the IRR of each project.
   4. multiple projects have unequal lives and the size of the investment for each project is different.
9. (LO.8) A formal method of considering capital project risk requires making adjustments to the discount or hurdle rate. Under the risk-adjusted discount rate method, the decision maker
   1. increases the rate used for discounting future cash inflows.
   2. decreases the rate used for discounting future cash inflows.
   3. does not adjust the discount rate for future cash inflows.
   4. only adjusts the discount rate for future cash outflows.
10. (LO.9) Select the *incorrect* statement concerning postinvestment audits.
    1. In a postinvestment audit of a capital project, information on actual project results is gathered and compared to expected results.
    2. A postinvestment audit becomes more crucial as the size of the capital expenditure increases.
    3. A postinvestment audit eliminates the likelihood that project sponsors will provide overly optimistic forecasts of future revenues or cost savings.
    4. Postinvestment audit comparisons should be made using the same techniques used originally to determine project acceptance.
11. (LO.10 Appendix 1) Select the *incorrect* statement concerning the time value of money.
    1. Future values depend on three factors: amount of cash flow, rate of interest, and timing.
    2. From an investor’s perspective, simple interest is preferable to compound interest.
    3. An ordinary annuity in one in which the cash flows occur at the end of the period.
    4. The time between interest computations is referred to as the compounding period.
12. (LO.11 Appendix 2) All of the following capital budgeting models measure project returns using cash flows *except* the
    1. accounting rate of return model.
    2. internal rate of return model.
    3. net present value model.
    4. payback model.
13. (LO.11 Appendix 2) G Company is reviewing an investment proposal that will cost $100,000 and that is expected to have the following returns:

Annual

Net After-Tax Annual

Year Cash Flows   Net Income

1 $40,000 $50,000

2 40,000 40,000

3 40,000 30,000

4 40,000 20,000

All cash flows are assumed to take place at the end of the year. Zero salvage value is expected at the end of the investment’s life. The company uses a 8% target rate of return for new investment proposals. What is this project’s accounting rate of return using the initial value of the investment?

* 1. 35%
  2. 40%
  3. 70%
  4. 80%

**Multiple Choice Solutions**

1. c
2. c
3. c (CMA Adapted)

Investment

Recovered

Through

Year Cash Flows Unrecovered Years

0 $105,000

1 $50,000 55,000 1.00

2 45,000 10,000 1.00

3 10,000 -0- 0.25 ($10,000 ÷ $40,000)

**2.25 years**

1. b (CMA Adapted)

Present

Annual Value Present

Net After-Tax of $1 Value of

Year Cash Flows   Factor Cash Flows

1 $50,000 .93 $ 46,500

2 45,000 .86 38,700

3 40,000 .79 31,600

4 35,000 .74 25,900

5 30,000 .68 20,400

$ 163,100 Total Present Value

(105,000) Investment

**$ 58,100** Net Present Value

1. b (CMA Adapted)

$163,100 / $105,000 = **1.55**

1. b
2. c
3. a
4. d
5. d (CMA Adapted)
6. a
7. c
8. b
9. a
10. a

(($50,000 + $40,000 + $30,000 + $20,000) / 4) / $100,000 = **35%**