Chapter 11

Investment Decision Criteria
Chapter 11 Contents

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  1. An Overview of Capital Budgeting
  2. Net Present Value
  3. Other Investment Criteria
  4. A Glance at Actual Capital Budgeting Practices
Learning Objectives

1. Understand how to identify the sources and types of profitable investment opportunities.

2. Evaluate investment opportunities using net present value and describe why net present value provides the best measure for evaluating investments.

3. Use the profitability index, internal rate of return, and payback criteria to evaluate investment opportunities.

4. Understand current business practice with respect to the use of capital budgeting criteria.
Principles Used in This Chapter

• Principle 3: Cash Flows Are the Source of Value.
  – We value an investment opportunities by evaluating its expected cash flows.

• Principle 1: Money Has a Time Value.
  – While evaluating investment opportunities, we discount all cash flows back to the present.

• Principle 2: There is a Risk-Reward Tradeoff.
  – While evaluating investment opportunities, we factor risk into the analysis by increasing the discount rate while calculating the present value of cash flows.

• Principle 4: Market Prices Reflect Information.
  – The risk adjusted discount rate used to calculate the present values of project’s cash flows depends upon the market prices that reflect information.
Three Lessons from Disney

• Background
  – Disney’s decision to invest $17.5 million to build Disneyland park in California is an example of capital budgeting decision.
  – Subsequently, Disney opened theme parks in Orlando, Tokyo, Paris and most recently invested $3.5 billion to build a theme park in Hong Kong.
    • Today parks and resorts account for over 30% of Disney’s Revenue.

• Disney Lessons
  1. Capital budgeting decisions are critical to a firm’s success.
  2. Very large investments are frequently the result of many smaller investment decisions that define a business strategy.
  3. Successful investment choices lead to the development of managerial expertise and capabilities that influence the firm’s choice of future investments.
The Typical Capital Budgeting Process

- **Phase I:** The firm’s management identifies promising investment opportunities.
- **Phase II:** The value creating potential of various opportunities are thoroughly evaluated.
  - So the goal is to identify promising opportunities and select those that will create the most value for the firm’s common stockholders.

What Are the Sources of Good Investment Projects?

- It is not easy to find profitable investment opportunities in competitive markets.
- Good investments are most likely to be found in markets that are less competitive where barriers to new entrants are sufficiently high to keep out would-be competitors.
Types of Capital Investment Projects

1) **Revenue enhancing Investments** (for example, entering a new market)

2) **Cost-reduction investments** (for example, installing a more efficient equipment)

3) **Mandatory investments** that are a result of government mandate (for example, installing mandatory safety features in a car)
Which of the following factors is least important to capital budgeting decisions?

1. The time value of money
2. The risk-return tradeoff
3. Net income based on accrual accounting principles
4. Cash flows directly resulting from the decision
Finance Tools to Assess Capital Investment Projects

• Before an investment is made, the firm will like to evaluate whether it will create value.

• To determine the desirability of investment proposals, we can use several analytical tools such as:
  – Net Present Value (NPV),
  – Equivalent Annual Cost (EAC),
  – the Profitability Index (PI),
  – the Internal Rate of Return (IRR),
  – the Modified Internal Rate of Return (MIRR),
  – the payback period,
  – and discounted payback period.
Net Present Value

- The **net present value (NPV)** is the difference between the present value of cash inflows and the cash outflows. NPV estimates the amount of wealth that the project creates.

- **Decision Criteria**: Investment projects should be accepted if the NPV of the project is positive and should be rejected if the NPV is negative.
Rationale for the NPV Method

NPV = PV of inflows – Cost
     = Net gain in wealth

• If projects are independent, accept if the project NPV > 0.

• If projects are mutually exclusive, accept projects with the highest positive NPV, those that add the most value.

• In this example, accept S if mutually exclusive (NPV_S > NPV_L), and accept both if independent.
Calculating an Investment’s NPV - Logic

- The NPV of an investment proposal can be defined as follows:

\[
\text{Net Present Value or NPV} = \frac{\text{Cash Flow for Year 0 (} CF_0 \text{)}}{1 + \text{Discount Rate (} k \text{)}}^1 + \frac{\text{Cash Flow for Year 1 (} CF_1 \text{)}}{1 + \text{Discount Rate (} k \text{)}}^2 + \ldots + \frac{\text{Cash Flow for Year } n (} CF_n \text{)}}{1 + \text{Discount Rate (} k \text{)}}^n
\]

Cost of making the investment = Initial cash flow, this is typically a cash outflow taking on a negative value.

Present value of the investment’s cash inflows = Present value of the project’s future cash inflows.
**Figure 11.1**

A Quick Reference Guide to Net Present Value

Net present value (NPV) measures the value added to shareholder wealth from an investment project. NPV can be thought of as a manifestation of the old adage that the way to make money is to “buy low and sell high,” where \( CF_0 \) represents the cost of “buying” and the present value of the investment’s future cash flows is the price at which the project’s future cash flows should “sell.” Consequently, buying at \( CF_0 \) and selling at a price equal to the present value of the project’s future cash flows makes sense only where we buy low or \( CF_0 \) is less than the present value of the cash inflows, i.e., the NPV is positive.

\[
NPV = CF_0 + \frac{CF_1}{(1 + k)^1} + \frac{CF_2}{(1 + k)^2} + \cdots + \frac{CF_n}{(1 + k)^n}
\]  

(11–1)

**Important Definitions and Concepts:**

- **NPV** is equal to the difference in the present value of the investment’s future cash flows and the cost of making the investment (the initial cash outlay, \( CF_0 \)).
- \( CF_0 \) is the initial cash flow, which is typically a cash outflow that is represented by a negative number.
- \( CF_1 \) through \( CF_n \) represent the expected cash flows for periods 1 through \( n \). Note that the expected cash flows can be either positive (inflows) or negative (outflows).
- \( k \) is the required rate of return or discount rate used to calculate the present value of the project’s expected future cash flows. Projects with riskier cash flows should have higher discount rates than projects with less risky cash flows. We discuss the determination of \( k \) in Chapter 14.
- \( n \) is the number of periods of cash flows for the project being evaluated.
Independent Versus Mutually Exclusive Investment Projects

• An **independent investment project** is one that stands alone and can be undertaken without influencing the acceptance or rejection of any other project.

• A **mutually exclusive project** prevents another project from being accepted.

• **Evaluating an Independent Investment Opportunity**
  – It will require two steps:
    1. Calculate NPV;
    2. Accept the project if NPV is positive and reject if it is negative.
Example 11-1 Calculating the NPV for Project Long

Project Long requires:

• An initial investment of $100,000
  – Is expected to generate a cash flow of $70,000 in year one, $30,000 per
    year in years two and three, $25,000 in year four, and $10,000 in year 5.

• The discount rate (k) appropriate for calculating the NPV of
  project Long is 17 percent.

• Is Project Long a good investment opportunity?
**Checkpoint 11.1**

**STEP 1: Picture the problem**

Project Long requires an initial investment of $100,000 and is expected to produce the following cash flows over the next 5 years:

\[ k = 17\% \]

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Cash Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>–$100,000</td>
</tr>
<tr>
<td>1</td>
<td>$70,000</td>
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<tr>
<td>2</td>
<td>$30,000</td>
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<tr>
<td>3</td>
<td>$30,000</td>
</tr>
<tr>
<td>4</td>
<td>$25,000</td>
</tr>
<tr>
<td>5</td>
<td>$10,000</td>
</tr>
</tbody>
</table>

**STEP 2: Decide on a solution strategy**

Our strategy for analyzing whether this is a good investment opportunity involves first calculating the present value of the cash inflows and then comparing them to the amount of money invested, the initial cash outflow, to see if the difference or NPV is positive. The NPV for Project Long is equal to the present value of the project’s expected cash flows for years 1 through 5 minus the initial cash outlay \((CF_0)\). We can use Equation 11–1 to solve this problem. Thus, the first step in the solution is to calculate the present value of the future cash flows by discounting the cash flows using \( k = 17\% \). Then, from this quantity we subtract the initial cash outlay of $100,000.

We can calculate this present value using the mathematics of discounted cash flow, a financial calculator, or a spreadsheet. We demonstrate all three methods below:
Solution Logic

**STEP 3: Solve**

Using the Mathematical Formulas.

Using Equation 11–1,

\[
NPV = -\$100,000 + \frac{\$70,000}{(1 + .17)^1} + \frac{\$30,000}{(1 + .17)^2} + \frac{\$30,000}{(1 + .17)^3} + \frac{\$25,000}{(1 + .17)^4} + \frac{\$10,000}{(1 + .17)^5}
\]

Solving the equation we get,

\[
NPV = -\$100,000 + \$59,829 + \$21,915 + \$18,731 + \$13,341 + \$4,561
= -\$100,000 + \$118,378
NPV = \$18,378
\]

Using a Financial Calculator.

Before using the CF button, make sure you clear your calculator by inputting CF; 2nd; CE/C.

<table>
<thead>
<tr>
<th>Data and Key Input</th>
<th>Display</th>
</tr>
</thead>
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<td>↓ ; 2; ENTER</td>
<td>F02 = 2.00</td>
</tr>
<tr>
<td>↓ ; 25,000; ENTER</td>
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</tr>
<tr>
<td>↓ ; 1; ENTER</td>
<td>F03 = 1.00</td>
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<tr>
<td>↓ ; 10,000; ENTER</td>
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<tr>
<td>NPV; 17; ENTER</td>
<td>I = 17</td>
</tr>
<tr>
<td>↓ ; CPT</td>
<td>NPV = 18,378</td>
</tr>
</tbody>
</table>
Checkpoint 11.1

**STEP 4: Analyze**

Project Long requires an initial investment of $100,000 and provides future cash flows that have a present value of $118,378. Consequently, the project cash flows are $18,378 more than the required investment. Since the project's future cash flows are worth more than the initial cash outlay required to make the investment, the project is an acceptable project.
Example 11-2

- Saber Electronics provides specialty manufacturing services to defense contractors located in the Seattle, WA area.
  - The initial outlay is $3 million
  - Management estimates that the firm might generate cash flows for years one through five equal to $500,000; $750,000; $1,500,000; $2,000,000; and $2,000,000.
  - Saber uses a 20% discount rate for this type of project.
  - Is this a good investment opportunity?
Step 1: Picture the Problem

$\text{k=20\%}$

Years

Cash flows (in $ millions)

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>-$3M</td>
<td>+$0.5M</td>
<td>+$0.75M</td>
<td>+$1.5M</td>
<td>$2M</td>
<td>$2M</td>
<td></td>
</tr>
</tbody>
</table>

Net Present Value =?
Step 2: Decide on a Solution Strategy

- We need to analyze if this is a good investment opportunity. We can do that by computing the Net Present Value (NPV), which requires computing the present value of all cash flows.

- We can compute the NPV by using a mathematical formula, a financial calculator or a spreadsheet.
Step 3: Solve

- Using Mathematical Formula

\[
\text{Net Present Value or } NPV = \text{Cash Flow for Year 0} (CF_0) + \frac{\text{Cash Flow for Year 1} (CF_1)}{(1 + \text{Discount Rate} (k))^1} + \frac{\text{Cash Flow for Year 2} (CF_2)}{(1 + \text{Discount Rate} (k))^2} + \cdots + \frac{\text{Cash Flow for Year } n (CF_n)}{(1 + \text{Discount Rate} (k))^n}
\]

Cost of making the investment = Initial cash flow, this is typically a cash outflow taking on a negative value.

Present value of the investment’s cash inflows = Present value of the project’s future cash inflows.
Step 3: Solve (cont.)

- NPV = -$3m + $.5m/(1.2) + $.75m/(1.2)^2 + $1.5m/(1.2)^3 + $2m/(1.2)^4 + $2m/(1.2)^5

- NPV = -$3,000,000 + $416,666.67 + $520,833.30 + $868,055.60 + $964,506 + $803,755.10

- NPV = $573,817

PV of Cash in = 416.666.67 + ... + 803,755.10
= $3,573,817

Minus Initial Investment of $3,000,000

Equals NPV = $573,817 which means you earn more than 20% return.
Step 4: Analyze

- The project requires an initial investment of $3,000,000 and generates futures cash flows that have a present value of $3,573,817.
- Consequently, the project cash flows are $573,817 more than the required investment.
- Since the NPV is positive, the project is an acceptable project.
- A positive NPV indicates the project earns more than the discount rate (cost of capital) of 20%.
ABC Service can purchase a new assembler for $15,052 that will provide an annual net cash flow of $6,000 per year for five years. Calculate the NPV of the assembler if the required rate of return is 12%. (Round your answer to the nearest $1.)

1. $1,056
2. $4,568
3. $7,621
4. $6,577
Evaluating Mutually Exclusive Investment Opportunities

• There are times when a firm must choose the best project or set of projects from the set of positive NPV investment opportunities.
• These are considered mutually exclusive opportunities as the firm cannot undertake all positive NPV projects.
• Following are two situations where firm is faced with mutually exclusive projects:
  1. **Substitutes** – Where firm is trying to pick between alternatives that perform the same function.
  2. **Firm Constraints** – Firm may face constraints such as limited managerial time or financial capital that may limit its ability to invest in all the positive NPV opportunities.
**Method: Choosing Between Mutually Exclusive Investments**

1. If mutually exclusive investments have equal lives, calculate the NPVs and choose the one with the higher NPV.

2. If mutually exclusive investments do not have equal lives, you must calculate the Equivalent Annual Cost (EAC), the cost per year.

3. Select the one that has a lower EAC.
Choosing Between Mutually Exclusive Investments (cont.)

- Computation of EAC requires two steps:
  1. Compute NPV
  2. Compute EAC as per equation 11-2

\[
\text{Equivalent Annual Cost (EAC)} = \frac{\text{PV of Costs}}{(1 + k)^1 + (1 + k)^2 + \cdots + (1 + k)^n} = \frac{\text{PV of Costs}}{\text{Annuity Present Value Interest factor}}
\]
Example 11.2: Calculating the Equivalent Annual Cost (EAC)

Suppose your bottling plant is in need of a new bottle capper. You are considering two different capping machines that will perform equally well, but have different expected lives.

• The more expensive one costs $30,000 to buy, requires the payment of $3,000 per year for maintenance and operation expenses, and will last for 5 years.

• The cheaper model costs only $22,000, requires operating and maintenance costs of $4,000 per year, and lasts for only 3 years.

• Regardless of which machine you select, you intend to replace it at the end of its life with an identical machine with identical costs and operating performance characteristics.

• Because there is not a market for used cappers, there will be no salvage value associated with either machine.

• Assume that the discount rate on both of these machines is 8 percent.
Checkpoint 11.2

**STEP 1: Picture the problem**

You are considering two alternative pieces of equipment, one with a 5-year life and one with a 3-year life:

**Project Long (5-year Life):**

\[ k = 8\% \]

- **Time Period**
  - 0
  - 1
  - 2
  - 3
  - 4
  - 5
  - **Years**

- **Cash Flow**
  - $-30,000
  - $-3,000
  - $-3,000
  - $-3,000
  - $-3,000
  - $-3,000

**Project Short (3-year Life):**

\[ k = 8\% \]

- **Time Period**
  - 0
  - 1
  - 2
  - 3
  - **Years**

- **Cash Flow**
  - $-22,000
  - $-4,000
  - $-4,000
  - $-4,000

**STEP 2: Decide on a solution strategy**

The question we need to answer is which capping machine offers the lowest cost per year of operation. We can use a calculator to determine the equivalent annual cost (EAC) for each piece of equipment, which will tell us the cost per year for each alternative, and then choose the one with the lowest cost.
Checkpoint 11.2

STEP 3: Solve

Using the Mathematical Formulas.

The present value of the costs of the five-year project can be calculated using a slightly modified (solving for PV of Costs instead of NPV) version of Equation (11-1) as follows:

\[
PV \text{ of Costs} = C_0 + \frac{C_1}{(1 + k)^1} + \frac{C_2}{(1 + k)^2} + \frac{C_3}{(1 + k)^3} + \frac{C_4}{(1 + k)^4} + \frac{C_5}{(1 + k)^5}
\]

\[
= -\$30,000 + \frac{-\$3,000}{(1 + .08)^1} + \frac{-\$3,000}{(1 + .08)^2} + \frac{-\$3,000}{(1 + .08)^3} + \frac{-\$3,000}{(1 + .08)^4} + \frac{-\$3,000}{(1 + .08)^5}
\]

\[
= -\$41,978
\]

Similarly, for the three-year project we calculate the present value of the costs as follows:

\[
PV \text{ of Costs} = C_0 + \frac{C_1}{(1 + k)^1} + \frac{C_2}{(1 + k)^2} + \frac{C_3}{(1 + k)^3}
\]

\[
= -\$22,000 + \frac{-\$4,000}{(1 + .08)^1} + \frac{-\$4,000}{(1 + .08)^2} + \frac{-\$4,000}{(1 + .08)^3}
\]

\[
= -\$32,308
\]

Now that we have the present value of the costs we can compute the EAC for each, which is the annual cash flow that is equivalent to the present value of the costs. For the five-year project, the EAC is:

\[
EAC = \frac{PV \text{ of Costs}}{\text{Annuity Present Value Interest Factor 8\% 5 years}}
\]

\[
EAC_{\text{long project}} = \frac{-\$41,978}{3.9927} = -\$10,514
\]

The three-year project’s EAC can be computed in the same way, i.e.,

\[
EAC = \frac{PV \text{ of Costs}}{\text{Annuity Present Value Interest Factor 8\% 3 years}}
\]

\[
EAC_{\text{short project}} = \frac{-\$32,308}{2.5771} = -\$12,537
\]

Step 3 cont.
## Checkpoint 11.2

### Using a Financial Calculator.
First, after clearing your calculator, we calculate the present value of the costs for one life cycle of each project.

#### Project Long:

<table>
<thead>
<tr>
<th>Data and Key Input</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>CF; −30,000; ENTER</td>
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<td>C01 = −3,000.00</td>
</tr>
<tr>
<td>↓; 5; ENTER</td>
<td>F01 = 5.00</td>
</tr>
<tr>
<td>NPV; 8; ENTER</td>
<td>I − 8</td>
</tr>
<tr>
<td>↓ CPT</td>
<td>NPV = −41,978</td>
</tr>
</tbody>
</table>

#### Project Short:

<table>
<thead>
<tr>
<th>Data and Key Input</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>CF; −22,000; ENTER</td>
<td>CF0 = −22,000.00</td>
</tr>
<tr>
<td>↓; −4,000; ENTER</td>
<td>C01 = −2,000.00</td>
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<tr>
<td>↓; 3; ENTER</td>
<td>F01 = 3.00</td>
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<tr>
<td>NPV; 8; ENTER</td>
<td>I = 8</td>
</tr>
<tr>
<td>↓ CPT</td>
<td>NPV = −32,308</td>
</tr>
</tbody>
</table>

*Step 3 cont.*
Note that the present value of the costs of both pieces of equipment are negative since we are calculating the present value of the costs. Second, we calculate the value of the annuity payments over the project’s life that would produce the same present value of the costs that you just calculated.

**Project Long:**

<table>
<thead>
<tr>
<th>Enter</th>
<th>5</th>
<th>8.0</th>
<th>-41,978</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>I/Y</td>
<td>PV</td>
<td>PMT</td>
</tr>
</tbody>
</table>

**Solve for**

\[ EAC_{\text{long project}} = -10,514 \]

**Project Short:**

<table>
<thead>
<tr>
<th>Enter</th>
<th>3</th>
<th>8.0</th>
<th>-32,308</th>
<th>0</th>
</tr>
</thead>
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<tr>
<td></td>
<td>N</td>
<td>I/Y</td>
<td>PV</td>
<td>PMT</td>
</tr>
</tbody>
</table>

**Solve for**

\[ EAC_{\text{short project}} = -12,537 \]
STEP 4: Analyze

We can see that the EAC associated with the longer life project, \(-\$10,514\), is less than the EAC for the shorter life project, \(-\$12,537\), thus we should accept the longer project. In effect, it is the least expensive alternative even though it costs the most to purchase originally. The reason this works out is that by spending the extra money required to buy the longer lived machine we do not have to repeat the purchase for 5 years; whereas the shorter life machine, although cheaper to purchase, must be replaced every 3 years. This is not always the case, however, as it depends on the cost of acquiring the longer life machine and the annual operating costs.

The EAC decision criteria is generally applied to mutually exclusive projects where the only difference is in length of life and costs. Thus, with the EAC we ignore cash inflows, since they are identical. However, if the mutually exclusive projects produce different cash inflows, we can still use this technique, but rather than calculate the present value of the costs (which would have a negative value), we would calculate the project’s NPV (which would have a positive value) and select the project with the highest EAC.
Practice the EAC Method

- What is EAC for a machine that costs $50,000
- requires payment of $6,000 per year for maintenance and operation expense,
- and lasts for 6 years?
- Assume that the discount rate is 9% and there will be no salvage value associated with the machine.
- In addition, you intend to replace this machine at the end of its life with an identical machine with identical costs.
Step 1: Picture the Problem

k = 9%
Years
Cash flows (in $, thousands)

EAC = ?
Step 2: Solve Using Mathematical Formula

It requires 2 steps:

- Computation of NPV
  
  • Here the cash inflows are equal so we can use the annuity equation to determine the PV of cash inflows.

\[
NPV = -$50,000 + PV \text{ of } $6,000 \text{ each year} \\
= -$50,000 + -$6,000 (PV \text{ of Annuity Factor}) \\
= -$50,000 + -$6,000 \{[1-(1/(1.09)^6)] ÷ (.06)} \\
= -$50,000 + -$6,000 \{4.4859\} = -$76,915
\]

Computation of EAC

• EAC = NPV ÷ Annuity Factor
  
  \[
  = -$76,915 ÷ 4.4859 \\
  = -$17,145.95
  \]

Simpler approach would be PV = -76,915; I/Y = 9%, N=6, FV=0
Now solve for PMT = ??
11.3 Other Investment Criteria
Profitability Index

- The **profitability index (PI)** is a cost-benefit ratio equal to the present value of an investment’s future cash flows divided by its initial cost:

\[
\text{Profitability Index (PI)} = \frac{\sum_{t=1}^{n} \left( \frac{\text{Cash Flow for Year } t \ (CF_t)}{\left(1 + \text{Discount Rate } (k) \right)^t} \right)}{\text{Initial Cash Outlay (CF}_0\text{)}}
\]

- **Decision Criteria:**
  - If PI is greater than one, it indicates that the investment should be accepted. The NPV will be positive.
  - If PI is less than one, the project should be rejected. If PI is less than one, the NPV will be negative.
Checkpoint 11.3

Example: Calculating the Profitability Index
Project Long is expected to provide five years of cash inflows and to require an initial investment of $100,000. The discount rate that is appropriate for calculating the PI of Project Long is 17 percent. Is Project Long a good investment opportunity?
**Checkpoint 11.3**

**STEP 3: Solve**

In Checkpoint 11.1 we demonstrated how to calculate the present value of Project Long’s future cash flows using the time value of money formulas, a financial calculator, and a spreadsheet. Thus, we only summarize the results of these calculations below:

\[ k = 17\% \]

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Year</th>
<th>Cash Flow</th>
</tr>
</thead>
<tbody>
<tr>
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<td>$(100,000)</td>
</tr>
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<td>$70,000</td>
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</tbody>
</table>

The present value of the expected cash flows for years 1 through 5 is $118,378.

\[
\begin{align*}
\text{Present value of future cash flows} &= \$118,378 \\
\text{Less: Initial cash outlay} &= \$(100,000) \\
\text{Equals: Net present value} &= \$18,378 \\
\text{Profitability index} &= \$118,378/100,000 = 1.18378
\end{align*}
\]
Checkpoint 11.3: Check Yourself

• PNG Pharmaceuticals is considering an investment in a new automated materials handling system that is expected to reduce its drug manufacturing costs by eliminating much of the waste currently involved in its specialty drug division.

• The new system will require an initial investment of $50,000 and is expected to provide cash savings over the next six-year period as shown on next slide.
Step 3: Solve (cont.)

- **Step 1**: Computing PV of Cash Inflows

<table>
<thead>
<tr>
<th>Year</th>
<th>Expected Cash flow</th>
<th>Present Value at 10% discount rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$15,000</td>
<td>$13,636.36</td>
</tr>
<tr>
<td>2</td>
<td>$8,000</td>
<td>$6,611.57</td>
</tr>
<tr>
<td>3</td>
<td>$10,000</td>
<td>$7,513.14</td>
</tr>
<tr>
<td>4</td>
<td>$12,000</td>
<td>$8,196.16</td>
</tr>
<tr>
<td>5</td>
<td>$14,000</td>
<td>$8,692.90</td>
</tr>
<tr>
<td>6</td>
<td>$16,000</td>
<td>$9,031.58</td>
</tr>
<tr>
<td><strong>NPV of Expected Cash flows, Years 1-6</strong></td>
<td></td>
<td><strong>$53,681.72</strong></td>
</tr>
</tbody>
</table>
Step 3: Solve (cont.)

- **Step 2:** Compute the PI

- \( \text{PI} = \frac{\text{PV of expected CF}_{1-6}}{\text{Initial Outlay}} \)

  \[
  = \frac{\$53,681.72}{\$50,000}
  = 1.073
  \]
Internal Rate of Return

• The **internal rate of return** (IRR) of an investment is analogous to the yield to maturity (YTM) of a bond defined in Chapter 9.

\[
NPV = CF_0 + \frac{CF_1}{(1 + IRR)^1} + \frac{CF_2}{(1 + IRR)^2} + \frac{CF_3}{(1 + IRR)^3} + \cdots + \frac{CF_n}{(1 + IRR)^n} = 0
\]

• **Decision Criteria**: Accept the project if the IRR is greater than the discount rate used to calculate the net present value of the project, and reject it otherwise.
Example: Calculating the IRR for Project Long

Calculating the IRR is “difficult” with odd cash flows

Project Long is expected to provide five years of cash inflows and to require an initial investment of $100,000. The required rate of return or discount rate that is appropriate for valuing the cash flows of Project Long is 17 percent. What is Project Long’s IRR, and is it a good investment opportunity?
**STEP 3: Solve**

Before we demonstrate the two solution methods, let’s first take a look at the solution which we will find to be 27.68%. Discounting the project cash flows for years 1 through 5 back to the present using the IRR, which is 27.68%, we see that the resulting NPV is 0.

\[ k = 27.68\% \]

<table>
<thead>
<tr>
<th>Time Period</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash Flow</td>
<td>$(100,000)</td>
<td>$70,000</td>
<td>$30,000</td>
<td>$30,000</td>
<td>$25,000</td>
<td>$10,000</td>
</tr>
</tbody>
</table>

The present value of the expected cash flows for years 1 through 5 is $100,000 when discounted using 27.68%.

\[
\begin{align*}
\text{Present value of cash flows for years 1 – 5} &= 54,826 \\
&= 18,404 \\
&= 14,414 \\
&= 9,408 \\
&= 2,948 \\
\text{Less: Initial cash outlay} &= (100,000) \\
\text{Net present value} &= 0
\end{align*}
\]

*Step 3 cont.*
Checkpoint 11.4

Using the Mathematical Formulas.
To solve for the IRR by hand, we follow a trial and error approach. Using this method, we must calculate NPV using many different discount rates until we find the discount rate that produces a zero NPV. For example, if we were to calculate the NPV for discount rates starting with 0% and increasing in increments of 4% up to 68%, we would get the following set of results (note that we have cheated here and used an Excel spreadsheet to reduce the tedium of making all these NPV calculations).

<table>
<thead>
<tr>
<th>Discount Rates</th>
<th>Computed NPVs</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>$65,000</td>
</tr>
<tr>
<td>4%</td>
<td>$51,304</td>
</tr>
<tr>
<td>8%</td>
<td>$39,532</td>
</tr>
<tr>
<td>12%</td>
<td>$29,331</td>
</tr>
<tr>
<td>16%</td>
<td>$20,428</td>
</tr>
<tr>
<td>20%</td>
<td>$12,603</td>
</tr>
<tr>
<td>24%</td>
<td>$5,683</td>
</tr>
<tr>
<td>28%</td>
<td>$(473)</td>
</tr>
<tr>
<td>32%</td>
<td>$(5,978)</td>
</tr>
<tr>
<td>36%</td>
<td>$(10,926)</td>
</tr>
<tr>
<td>40%</td>
<td>$(15,394)</td>
</tr>
<tr>
<td>44%</td>
<td>$(19,445)</td>
</tr>
<tr>
<td>48%</td>
<td>$(23,133)</td>
</tr>
<tr>
<td>52%</td>
<td>$(26,504)</td>
</tr>
<tr>
<td>56%</td>
<td>$(29,595)</td>
</tr>
<tr>
<td>60%</td>
<td>$(32,439)</td>
</tr>
<tr>
<td>64%</td>
<td>$(35,063)</td>
</tr>
<tr>
<td>68%</td>
<td>$(37,492)</td>
</tr>
</tbody>
</table>

NPV profile for project long

Note: Since the NPV = 0 for a discount rate between 24% and 28%, the IRR is between 24% and 28%.

Notice that the computed NPV approaches a value of zero where we use a discount rate between 24 and 28%. This graph of NPVs and different discount rates is called the NPV Profile of the project (we will have more to say about this profile later). We can calculate the IRR directly using either a financial calculator or spreadsheet as we now demonstrate.
Checkpoint 11.4

Using a Financial Calculator.

<table>
<thead>
<tr>
<th>Data and Key Input</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>CF: -100,000; ENTER</td>
<td>CF0 = -100,000.00</td>
</tr>
<tr>
<td>↓; 70,000; ENTER</td>
<td>C01 = 70,000.00</td>
</tr>
<tr>
<td>↓; 1; ENTER</td>
<td>F01 = 1.00</td>
</tr>
<tr>
<td>↓; 30,000; ENTER</td>
<td>C02 = 30,000.00</td>
</tr>
<tr>
<td>↓; 2; ENTER</td>
<td>F02 = 2.00</td>
</tr>
<tr>
<td>↓; 25,000; ENTER</td>
<td>C03 = 25,000.00</td>
</tr>
<tr>
<td>↓; 1; ENTER</td>
<td>F03 = 1.00</td>
</tr>
<tr>
<td>↓; 10,000; ENTER</td>
<td>C04 = 10,000.00</td>
</tr>
<tr>
<td>↓; 1; ENTER</td>
<td>F04 = 1.00</td>
</tr>
<tr>
<td>IRR; CPT</td>
<td>IRR = 27.68%</td>
</tr>
</tbody>
</table>

Using an Excel Spreadsheet.

Cell B10 contains the Excel formula for the IRR calculation, which appears as follows: 
`=IRR(B3:B8)`. The only inputs to the IRR function in Excel are the project cash flows.²

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Annual</td>
</tr>
<tr>
<td>2</td>
<td>Year</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>IRR</td>
</tr>
</tbody>
</table>

What appears in the spreadsheet then is the IRR of 27.68%.
caprock knowledge is a small consulting firm in west texas. they are considering the purchase of a new copying center for the office that can copy, fax, and scan documents. the new machine costs $10,000 to purchase and is expected to provide annual cash flow savings of $3,000 for the next four years. compute the IRR of the investment.

- FV = 0; PV = -10,000; n = 4; PMT = 3,000
- compute I/Y = 7.71% = IRR

- if the firm’s hurdle rate is 12% do you accept or reject?
Complications with IRR: Multiple Rates of Return

• Although any project can have only one NPV, a single project can, under certain circumstances, have more than one IRR.

• Checkpoint 11.5 illustrates a case of multiple IRRs.
Checkpoint 11.5

The Problem of Multiple IRRs for Projects

Descartes’ Rule of Signs tells us that there can be as many IRRs for an investment project as there are changes in the sign of the cash flows over its n-year life. To illustrate the problem, consider a project that has three cash flows: a $235,000 outlay in year 0, a $540,500 inflow in year 1, and a $310,200 outflow at the end of year 2. Calculate the IRR for the investment.
### Checkpoint 11.5

#### STEP 1: Picture the problem

\[ k = ? \]

<table>
<thead>
<tr>
<th>Time Period</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash Flow</td>
<td>–$235,000</td>
<td>$540,500</td>
<td>–$310,200</td>
<td></td>
</tr>
</tbody>
</table>

#### STEP 2: Decide on a solution strategy

To solve the problem, we determine the discount rate that make the NPV = 0 by constructing a NPV profile for the project. In this instance we use discount rates in increments of 2% ranging from 0% to 30%.
Checkpoin 11.5

**STEP 3: Solve**

We calculate the discount rate that make the NPV = 0 for of the investment using discount rates ranging from 0% to 30%. For example, the NPV for a 10% discount rate is calculated using Equation (11–1) as follows:

\[
NPV = CF_0 + \frac{CF_1}{(1 + k)^1} + \frac{CF_2}{(1 + k)^2}
\]

\[
= -\$235,000 + \frac{\$540,500}{(1 + .10)^1} + \frac{\$310,200}{(1 + .10)^2} = 0
\]
Checkpoint 11.5

**STEP 4: Analyze**

There are two IRRs for this project: 10% and 20%. This results from the fact that there are two sign changes in the project cash flows. Thus, if the risk-appropriate discount rate for the project is between 10% and 20% the project creates value and should be undertaken, otherwise it should be rejected.
Reinvestment Rate Assumptions

• NPV method assumes CFs are reinvested at the WACC.
• IRR method assumes CFs are reinvested at IRR.
• Assuming CFs are reinvested at the opportunity cost of capital is more realistic, so NPV method is the best. NPV method should be used to choose between mutually exclusive projects.
• Perhaps a hybrid of the IRR that assumes cost of capital reinvestment is needed.
**NPV Profiles**: Using the IRR with Mutually Exclusive Investments

- **Problem that is faced**: When comparing two mutually exclusive projects, IRR and NPV may not lead to the same conclusion.
- For example, we may be selecting between 2 projects and both IRR and NPV values may suggest that the projects are financially feasible.
- However, the ranking of two projects may not be the same using NPV and IRR.
Figure 11.2 cont.

Ranking Mutually Exclusive Investments: NPV vs. IRR

Apex Engineering is considering the purchase of an automated accounting system and is trying to decide between the AA+ and BBR systems. Both systems have the same cost but because of functionality differences, the patterns of cash flows are quite different. Apex uses a 15% required rate of return or discount rate to evaluate its investments.

(Panel A) Expected Cash Flows

<table>
<thead>
<tr>
<th>Year</th>
<th>AA+</th>
<th>BBR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$(500,000)</td>
<td>$(500,000)</td>
</tr>
<tr>
<td>1</td>
<td>100,000</td>
<td>400,000</td>
</tr>
<tr>
<td>2</td>
<td>200,000</td>
<td>300,000</td>
</tr>
<tr>
<td>3</td>
<td>300,000</td>
<td>200,000</td>
</tr>
<tr>
<td>4</td>
<td>400,000</td>
<td>200,000</td>
</tr>
<tr>
<td>5</td>
<td>500,000</td>
<td>100,000</td>
</tr>
</tbody>
</table>

NPV  | $412,730     | $370,241     |

IRR  | 38%           | 52%           |

- Both alternatives have positive NPVs and IRRs that exceed Apex’s 15% required rate of return.
- However, the projects are ranked differently using NPV or IRR: AA+ has the higher NPV while BBR has a higher IRR.
- The ranking difference is due to the effect of discounting and the difference in the patterns of the cash flows for the two projects.
- AA+ cash flows increase over time while BBR’s decrease.
- Higher discount rates have a disproportionate effect on present values as we see in Panel B.
(Panel B) NPV Profiles

<table>
<thead>
<tr>
<th>Discount Rate</th>
<th>AA+</th>
<th>BBR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>$1,000,000</td>
<td>$700,000</td>
</tr>
<tr>
<td>5%</td>
<td>$756,639</td>
<td>$568,722</td>
</tr>
<tr>
<td>10%</td>
<td>$565,259</td>
<td>$460,528</td>
</tr>
<tr>
<td>15%</td>
<td>$412,730</td>
<td>$370,241</td>
</tr>
<tr>
<td>20%</td>
<td>$289,673</td>
<td>$294,046</td>
</tr>
<tr>
<td>25%</td>
<td>$189,280</td>
<td>$229,088</td>
</tr>
<tr>
<td>30%</td>
<td>$106,532</td>
<td>$173,199</td>
</tr>
<tr>
<td>35%</td>
<td>$37,680</td>
<td>$124,709</td>
</tr>
<tr>
<td>40%</td>
<td>$(20,111)</td>
<td>$82,317</td>
</tr>
<tr>
<td>45%</td>
<td>$(69,011)</td>
<td>$44,998</td>
</tr>
<tr>
<td>50%</td>
<td>$(110,700)</td>
<td>$11,934</td>
</tr>
<tr>
<td>55%</td>
<td>$(146,489)</td>
<td>$(17,531)</td>
</tr>
<tr>
<td>60%</td>
<td>$(177,414)</td>
<td>$(43,930)</td>
</tr>
<tr>
<td>65%</td>
<td>$(204,298)</td>
<td>$(67,701)</td>
</tr>
</tbody>
</table>

**Figure 11.2 cont.**
Modified Internal Rate of Return

- Modified Internal Rate of Return (MIRR) deals with the problem of multiple IRRs.

- This is done by rearranging the cash flows so that there is only one change of sign of the cash flows over the life of the project.
Since managers prefer the IRR to the NPV method, is there a better IRR measure?

- Yes, MIRR is the discount rate that causes the PV of a project’s terminal value (TV) to equal the PV of costs. TV is found by compounding inflows at WACC.
- MIRR assumes cash flows are reinvested at the WACC.
Calculating MIRR

\[ \text{PV outflows} = \frac{\text{TV inflows}}{(1 + \text{MIRR}_L)^3} \]

\[ \text{MIRR}_L = 16.5\% \]
Why use MIRR versus IRR?

- MIRR assumes reinvestment at the opportunity cost $= WACC$. MIRR also avoids the multiple IRR problem.
- Managers like rate of return comparisons, and MIRR is better for this than IRR.
Payback Period

• The Payback period for an investment opportunity is the number of years needed to recover initial cash outlay required to make the investment.

• Decision Criteria: Accept the project if the payback period is less than a pre-specified number of years.
## Calculating Payback

**Project L’s Payback Calculation**

<table>
<thead>
<tr>
<th>Time</th>
<th>CF&lt;sub&gt;t&lt;/sub&gt;</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-100</td>
<td>-100</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
<td>-90</td>
</tr>
<tr>
<td>2</td>
<td>60</td>
<td>-30</td>
</tr>
<tr>
<td>3</td>
<td>80</td>
<td>50</td>
</tr>
</tbody>
</table>

Payback<sub>L</sub> = 2 + 30/80 = 2.375 years

Payback<sub>S</sub> = 1.600 years
Limitations of Payback Period

1. It ignores the time value of money
2. The payback period ignores cash flows that are generated by the project beyond the end of the payback period.
3. There is no clear-cut way to define the cutoff criterion for the payback period that is tied to the value creation potential of the investment.
Table 11.1  Limitations of the Payback Period Criterion

Limitations of the Payback Period as an investment criteria include:

- **a)** Does not account for the time value of money.
- **b)** Does not consider cash flows beyond the payback period.
- **c)** Utilizes an arbitrary cutoff criterion.

<table>
<thead>
<tr>
<th></th>
<th>Project Long</th>
<th>Project Short</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cash Flows</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Annual</td>
<td>Cumulative</td>
</tr>
<tr>
<td>Initial cash outlay</td>
<td>$(100,000)</td>
<td>$(100,000)</td>
</tr>
<tr>
<td>Year 1</td>
<td>70,000</td>
<td>(30,000)</td>
</tr>
<tr>
<td><strong>Year 2</strong></td>
<td><strong>30,000</strong></td>
<td>0</td>
</tr>
<tr>
<td>Year 3</td>
<td>30,000</td>
<td>30,000</td>
</tr>
<tr>
<td>Year 4</td>
<td>25,000</td>
<td>55,000</td>
</tr>
<tr>
<td>Year 5</td>
<td>10,000</td>
<td>65,000</td>
</tr>
</tbody>
</table>

Payback equals 2 years for both projects since it takes 2 years to recover the cost of the initial outlay from the cash inflows. However, Project Long looks a lot better since it continues to provide cash inflows after the payback year!
Discounted Payback Period

- **Discounted payback period** is similar to payback period except it uses discounted cash flows to calculate the discounted period. The discount rate is the same as the one used for calculating the NPV.

- **Decision Criteria**: Accept the project if its discounted payback period is less than the pre-specified number of years.
Table 11.2  Discounted Payback Period Example (Discount Rate = 17%)  

The standard Payback Period does not account for the time value of money, so the Discounted Payback Period discounts investment cash flows back to the present before cumulating them to calculate payback.

### Project Long

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial cash outlay</td>
<td>$(100,000)</td>
<td>$(100,000)</td>
<td>$(100,000)</td>
<td>$(100,000)</td>
</tr>
<tr>
<td>Year 1</td>
<td>70,000</td>
<td>(30,000)</td>
<td>59,829</td>
<td>(40,171)</td>
</tr>
<tr>
<td>Year 2</td>
<td><strong>30,000</strong></td>
<td>0</td>
<td><strong>21,915</strong></td>
<td><strong>(18,256)</strong></td>
</tr>
<tr>
<td>Year 3</td>
<td>30,000</td>
<td>30,000</td>
<td>18,731</td>
<td>476</td>
</tr>
<tr>
<td>Year 4</td>
<td>25,000</td>
<td>55,000</td>
<td>13,341</td>
<td>13,817</td>
</tr>
<tr>
<td>Year 5</td>
<td>10,000</td>
<td>65,000</td>
<td>4,561</td>
<td>18,378</td>
</tr>
</tbody>
</table>

### Project Short

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial cash outlay</td>
<td>$(100,000)</td>
<td>$(100,000)</td>
<td>$(100,000)</td>
<td>$(100,000)</td>
</tr>
<tr>
<td>Year 1</td>
<td>50,000</td>
<td>(50,000)</td>
<td>42,735</td>
<td>(57,265)</td>
</tr>
<tr>
<td>Year 2</td>
<td><strong>50,000</strong></td>
<td>0</td>
<td><strong>36,526</strong></td>
<td><strong>(20,739)</strong></td>
</tr>
<tr>
<td>Year 3</td>
<td></td>
<td></td>
<td></td>
<td>(20,739)</td>
</tr>
<tr>
<td>Year 4</td>
<td></td>
<td></td>
<td></td>
<td>(20,739)</td>
</tr>
<tr>
<td>Year 5</td>
<td></td>
<td></td>
<td></td>
<td>(20,739)</td>
</tr>
</tbody>
</table>

Discounted Payback equals 2.97 years for Project Long! Three years of discounted cash flows sum to a positive $476 and since we need to sum to 0 we do not need a full 3 years of discounted cash flows (we need $18,256/$18,731 = .97 of year three’s cash inflow).

Discounted Payback is never achieved for Project Short! The discounted cash flows never cumulate to equal zero.
Attractiveness of Payback Methods

1. Payback and discounted payback are more intuitive and relatively easier to understand compared to NPV or IRR.

2. Payback period can be seen as a crude indicator of risk as payback favors initial year cash flows, which, in general, are less risky than more distant cash flows.

3. Discounted payback is used as a supplemental analytical tool in cases where obsolescence is a risk and the emphasis is on getting the money back before the market disappears or the product becomes obsolete.

4. Payback method is useful when capital is being rationed and managers would like to know how long a project will tie up capital.
### Table 11.3  Basic Capital-Budgeting Techniques

These are the primary capital-budgeting techniques or criteria that are used in industry practice. Of these techniques, net present value or NPV offers the best single indicator of the investment alternative’s potential contribution to the value of the firm.

<table>
<thead>
<tr>
<th>Investment Criterion</th>
<th>Definition</th>
<th>Decision Rule</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Present Value (NPV)</td>
<td>Present value of expected cash inflows minus the present value of cash outflows.</td>
<td>Accept investments that have a positive NPV.</td>
<td>Theoretically correct in that it measures directly the increase in value that the project is expected to produce. Measures the increase in shareholder wealth expected from undertaking the project being analyzed.</td>
<td>Somewhat complicated to compute (requires an understanding of the time value of money). Not familiar to managers without formal business education.</td>
</tr>
<tr>
<td>Profitability Index (PI)</td>
<td>Present value of expected future cash flows divided by the initial cash investment.</td>
<td>When the PI is greater than one, the NPV will be positive, so the project should be accepted. When PI is less than one, which indicates a bad investment, NPV will be negative and the project should be rejected.</td>
<td>Theoretically correct in that it measures directly the increase in value that the project is expected to produce. Useful when rank ordering positive NPV projects where capital is being rationed.</td>
<td>Not as familiar to managers as NPV and does not add any additional information.</td>
</tr>
<tr>
<td>Internal Rate of Return (IRR)</td>
<td>The discount rate that makes NPV equal to zero.</td>
<td>Accept the project if the IRR is greater than the required rate of return or discount rate used to calculate the net present value of the project, and reject it otherwise.</td>
<td>Provides a rate of return metric, which many managers prefer.</td>
<td>Cannot always be estimated. Sometimes provides multiple rates of return for projects with multiple changes in the sign of their cash flows over time. Can provide conflicting indications to NPV for mutually exclusive projects.</td>
</tr>
<tr>
<td>Modified Internal Rate of Return (MIRR)</td>
<td>The discount rate that makes the NPV of the modified cash flow stream equal to zero.</td>
<td>Accept the project if the MIRR is greater than the required rate of return or discount rate used to calculate the net present value of the project, and reject it otherwise.</td>
<td>Always produces a single rate of return estimate.</td>
<td>The rate of return produced by the MIRR is not unique to the project since it is influenced by the discount rate used to discount the negative cash flows.</td>
</tr>
<tr>
<td>Payback</td>
<td>Time until the initial cash outlay has been recovered.</td>
<td>If the project payback is less than the maximum the firm will accept, the project is acceptable.</td>
<td>Easy to understand and calculate. An indication of risk (how long it takes to recover the investment),</td>
<td>Ignores time value of money. Ignores cash flows beyond the payback period. No rational way to determine the cutoff value for payback.</td>
</tr>
<tr>
<td>Discounted Payback</td>
<td>The number of years required to recover the initial investment out of project discounted future cash flows.</td>
<td>If the discounted project payback is less than the maximum the firm will accept, the project is acceptable.</td>
<td>Same as payback. Plus, by discounting the cash flows, this measure takes into account the time value of money.</td>
<td>Same as the last two items above. Also, since cash inflows must be discounted, discounted payback is more complicated to compute than payback.</td>
</tr>
</tbody>
</table>
11.4 A Glance at Actual Capital Budgeting Practices
A Glance at Actual Capital Budgeting Practices

• Figure 11-3 shows the results of a survey of CFOs of large US firms, showing the popularity of the payback, discounted payback, NPV, PI, and IRR methods for evaluating capital investment opportunities.

• The results show that NPV and IRR methods are the most popular although many firms use Payback method too.
Figure 11.3
Survey of the Popularity of Capital-Budgeting Methods
These survey results are based on the survey responses of 392 chief financial officers of large U.S. firms. CFOs were asked if they used any of the following standard techniques. Specifically, they were asked how frequently they used different capital-budgeting techniques on a scale of 0 to 4 (with 0 meaning “never,” 1 “almost never,” 2 “sometimes,” 3 “almost always,” and 4 “always”). The results below are the percentage of the CFOs who said they always or almost always used a particular method.

![Bar chart showing the popularity of capital-budgeting methods]

Source: John Graham and Campbell Harvey, “How do CFOs make capital budgeting and capital structure decisions?” *Journal of Applied Corporate Finance, Volume 15, Number 1* (Spring 2002), 8–23.