Part III
Capital Budgeting

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Key Concepts and Skills

- Be able to compute payback and discounted payback and understand their shortcomings
- Understand accounting rates of return and their shortcomings
- Be able to compute internal rates of return (standard and modified) and understand their strengths and weaknesses
- Be able to compute the net present value and understand why it is the best decision criterion
- Be able to compute the profitability index and understand its relation to net present value

Chapter Outline

- Net Present Value
- The Payback Rule
- The Discounted Payback
- The Internal Rate of Return
- The Profitability Index
- The Practice of Capital Budgeting

Good Decision Criteria

- We need to ask ourselves the following questions when evaluating capital budgeting decision rules:
  - Does the decision rule adjust for the time value of money?
  - Does the decision rule adjust for risk?
  - Does the decision rule provide information on whether we are creating value for the firm?

Net Present Value

- The difference between the market value of a project and its cost
- How much value is created from undertaking an investment?
  - The first step is to estimate the expected future cash flows.
  - The second step is to estimate the required return for projects of this risk level.
  - The third step is to find the present value of the cash flows and subtract the initial investment.

Project Example Information

- You are reviewing a new project and have estimated the following cash flows:
  - Year 0: CF = -165,000
  - Year 1: CF = 63,120; NI = 13,620
  - Year 2: CF = 70,800; NI = 3,300
  - Year 3: CF = 91,080; NI = 29,100
  - Average Book Value = 72,000
- Your required return for assets of this risk level is 12%.

NPV – Decision Rule

- ***If the NPV is positive, accept the project***
- A positive NPV means that the project is expected to add value to the firm and will therefore increase the wealth of the owners.
- Since our goal is to increase owner wealth, NPV is a direct measure of how well this project will meet our goal.

Computing NPV for the Project

- Using the formulas:
  - NPV = -165,000 + 63,120/(1.12) + 70,800/$(1.12)^2$ + 91,080/$(1.12)^3$ = 12,627.41
- Using the calculator:
  - CF_0 = -165,000; C01 = 63,120; F01 = 1; C02 = 70,800; F02 = 1; C03 = 91,080; F03 = 1; NPV; I = 12; CPT NPV = 12,627.41
- ***Do we accept or reject the project?***

Practice Question

Anderson Systems is considering a project that has the following cash flow and WACC data. What is the project's NPV? Note that if a project's expected NPV is negative, it should be rejected.

WACC: 9.00%

Year	0	1	2	3
Cash flows	-$1,000	$500	$500	$500

NPV = $265.65

Practice Question

Cornell Enterprises is considering a project that has the following cash flow and WACC data. What is the project's NPV?

WACC: 10.00%

Decision Criteria Test - NPV

- Does the NPV rule account for the time value of money?
- Does the NPV rule account for the risk of the cash flows?
- Does the NPV rule provide an indication about the increase in value?
- Should we consider the NPV rule for our primary decision rule?

Calculating NPVs with a Spreadsheet

- Spreadsheets are an excellent way to compute NPVs, especially when you have to compute the cash flows as well.
- Using the NPV function
  - The first component is the required return entered as a decimal
  - The second component is the range of cash flows *beginning with year 1*
  - Subtract the initial investment after computing the NPV

NPV sensitivity

- Last month, Lloyd's Systems analyzed the project whose cash flows are shown below. However, before the decision to accept or reject the project took place, the Federal Reserve changed interest rates and therefore the firm's WACC. The Fed's action did not affect the forecasted cash flows. By how much did the change in the WACC affect the project's forecasted NPV?
- Old WACC: 10.00%
- New WACC: 11.25%

Payback Period

- How long does it take to get the initial cost back in a nominal sense?
- Computation
  - Estimate the cash flows
  - Subtract the future cash flows from the initial cost until the initial investment has been recovered
- Decision Rule – ***Accept if the payback period is less than some preset limit***

Computing Payback

- Assume we will accept the project if it pays back within two years.
  - Year 1: 165,000 – 63,120 = 101,880 still to recover
  - Year 2: 101,880 – 70,800 = 31,080 still to recover
  - Year 3: 31,080 – 91,080 = -60,000 *project pays back in year 3*
- ***Do we accept or reject the project?***

Practice Question

- Stern Associates is considering a project that has the following cash flow data. What is the project's payback?
-

Year	0	1	2	3	4	5
Cash flows	-$1,100		$300	$310	$320	$330	$340

Practice Question

- . Mansi Inc. is considering a project that has the following cash flow data. What is the project's payback?
-

Year	0	1	2	3
Cash flows	-$750	$300	$325	$350

Year	0	1	2	3
Cash flows	-$750	$300	$325	$350

Decision Criteria Test - Payback

- Does the payback rule account for the time value of money?
- Does the payback rule account for the risk of the cash flows?
- Does the payback rule provide an indication about the increase in value?
- Should we consider the payback rule for our primary decision rule?

Advantages and Disadvantages of Payback

- Advantages
  - Easy to understand
  - Adjusts for uncertainty of later cash flows
  - Biased toward liquidity
- Disadvantages
  - Ignores the time value of money
  - Requires an arbitrary cutoff point
  - Ignores cash flows beyond the cutoff date
  - Biased against long-term projects, such as research and development, and new projects

Discounted Payback Period

- Compute the present value of each cash flow and then determine how long it takes to pay back on a discounted basis
- Compare to a specified required period
- Decision Rule: ***Accept the project if it pays back on a discounted basis within the specified time***

Computing Discounted Payback

- Assume we will accept the project if it pays back on a discounted basis in 2 years.
- Compute the PV for each cash flow and determine the payback period using discounted cash flows
  - Year 1: $165,000 – 63,120/1.12^1 = 108,643$
  - Year 2: $108,643 – 70,800/1.12^2 = 52,202$
  - Year 3: $52,202 – 91,080/1.12^3 = -12,627$ project pays back in year 3
- ***Do we accept or reject the project?***

Practice Question

- Fernando Designs is considering a project that has the following cash flow and WACC data. What is the project's discounted payback?
- WACC: 10.00%
- Year 0 1 2 3
- Cash flows -$900 $500 $500 $500
-

Decision Criteria Test – Discounted Payback

- Does the discounted payback rule account for the time value of money?
- Does the discounted payback rule account for the risk of the cash flows?
- Does the discounted payback rule provide an indication about the increase in value?
- Should we consider the discounted payback rule for our primary decision rule?

Advantages and Disadvantages of Discounted Payback

- Advantages
  - Includes time value of money
  - Easy to understand
  - Does not accept negative estimated NPV investments when all future cash flows are positive
  - Biased towards liquidity
- Disadvantages
  - May reject positive NPV investments
  - Requires an arbitrary cutoff point
  - Ignores cash flows beyond the cutoff point
  - Biased against long-term projects, such as R&D and new products

Internal Rate of Return

- This is the most important alternative to NPV
- It is often used in practice and is intuitively appealing
- It is based entirely on the estimated cash flows and is independent of interest rates found elsewhere

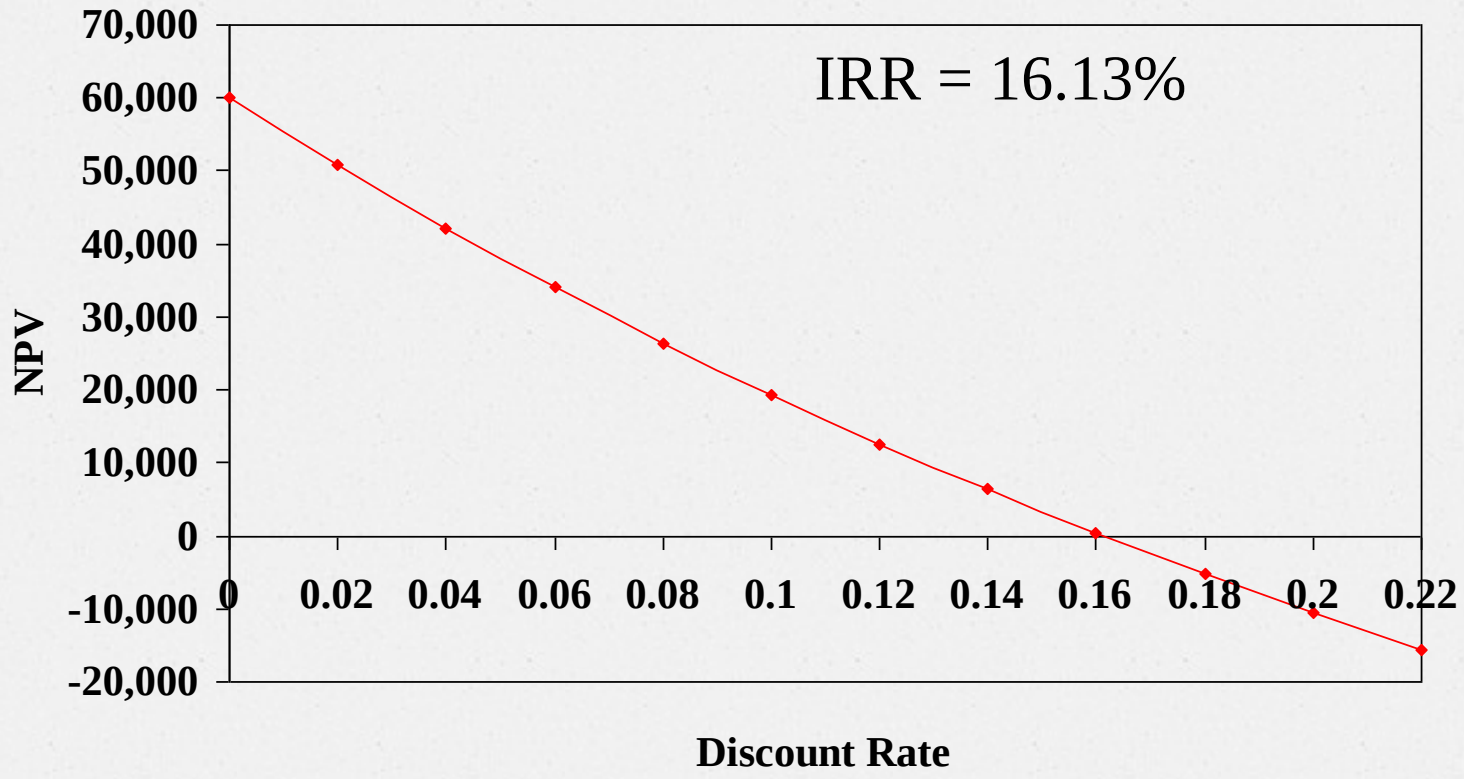
IRR – Definition and Decision Rule

- Definition: IRR is the return that makes the NPV = 0
- Decision Rule: ***Accept the project if the IRR is greater than the required return.***

Computing IRR

- If you do not have a financial calculator, then this becomes a trial and error process
- Calculator
  - Enter the cash flows as you did with NPV
  - Press IRR and then CPT
  - IRR = 16.13% > 12% required return
- ***Do we accept or reject the project?***

NPV Profile for the Project



Practice Question

Data Computer Systems is considering a project that has the following cash flow data. What is the project's IRR? Note that a project's IRR can be less than the WACC (and even negative), in which case it will be rejected.

Year	0	1	2	3
Cash flows	-$1,100	$450	$470	$490

Decision Criteria Test - IRR

- Does the IRR rule account for the time value of money?
- Does the IRR rule account for the risk of the cash flows?
- Does the IRR rule provide an indication about the increase in value?
- Should we consider the IRR rule for our primary decision criteria?

Advantages of IRR

- Knowing a return is intuitively appealing
- It is a simple way to communicate the value of a project to someone who doesn't know all the estimation details
- If the IRR is high enough, you may not need to estimate a required return, which is often a difficult task

Calculating IRRs With A Spreadsheet

- You start with the cash flows the same as you did for the NPV
- You use the IRR function
  - You first enter your range of cash flows, beginning with the initial cash flow
  - You can enter a guess, but it is not necessary
  - The default format is a whole percent – you will normally want to increase the decimal places to at least two

Summary of Decisions for the Project

Summary	
Net Present Value	***Accept***
Payback Period	***Reject***
Discounted Payback Period	***Reject***
Average Accounting Return	***Reject***
Internal Rate of Return	***Accept***

NPV vs. IRR

- NPV and IRR will generally give us the same decision
- Exceptions:
  - Nonconventional cash flows – cash flow signs change more than once
  - Mutually exclusive projects
    - Initial investments are substantially different (issue of scale)
    - Timing of cash flows is substantially different

IRR and Nonconventional Cash Flows

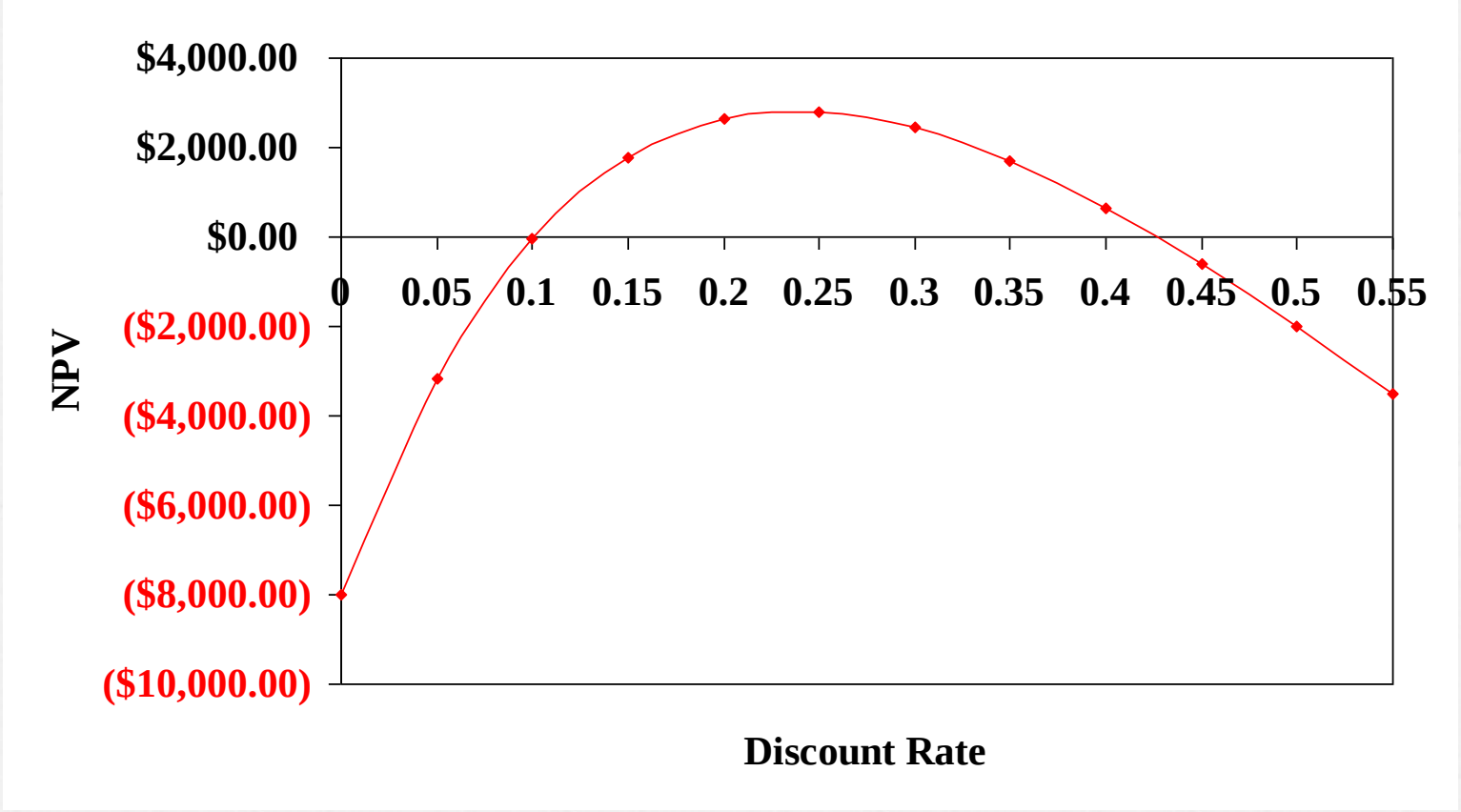
- When the cash flows change sign more than once, there is more than one IRR
- When you solve for IRR you are solving for the root of an equation, and when you cross the x-axis more than once, there will be more than one return that solves the equation
- If you have more than one IRR, which one do you use to make your decision?

Another Example: Nonconventional Cash Flows

- Suppose an investment will cost $90,000 initially and will generate the following cash flows:
  - Year 1: 132,000
  - Year 2: 100,000
  - Year 3: -150,000
- The required return is 15%.
  - Should we accept or reject the project?

NPV Profile

IRR = 10.11% and 42.66%



Summary of Decision Rules

- The NPV is positive at a required return of 15%, so you should ***Accept***
- If you use the financial calculator, you would get an IRR of 10.11% which would tell you to ***Reject***
- You need to recognize that there are non-conventional cash flows and look at the NPV profile

IRR and Mutually Exclusive Projects

- Mutually exclusive projects
  - If you choose one, you can't choose the other
  - Example: You can choose to attend graduate school at either Harvard or Stanford, but not both
- Intuitively, you would use the following decision rules:
  - NPV – choose the project with the higher NPV
  - IRR – choose the project with the higher IRR

Example With Mutually Exclusive Projects

Period	Project A	Project B
0	-500	-400
1	325	325
2	325	200
IRR	19.43%	22.17%
NPV	64.05	60.74

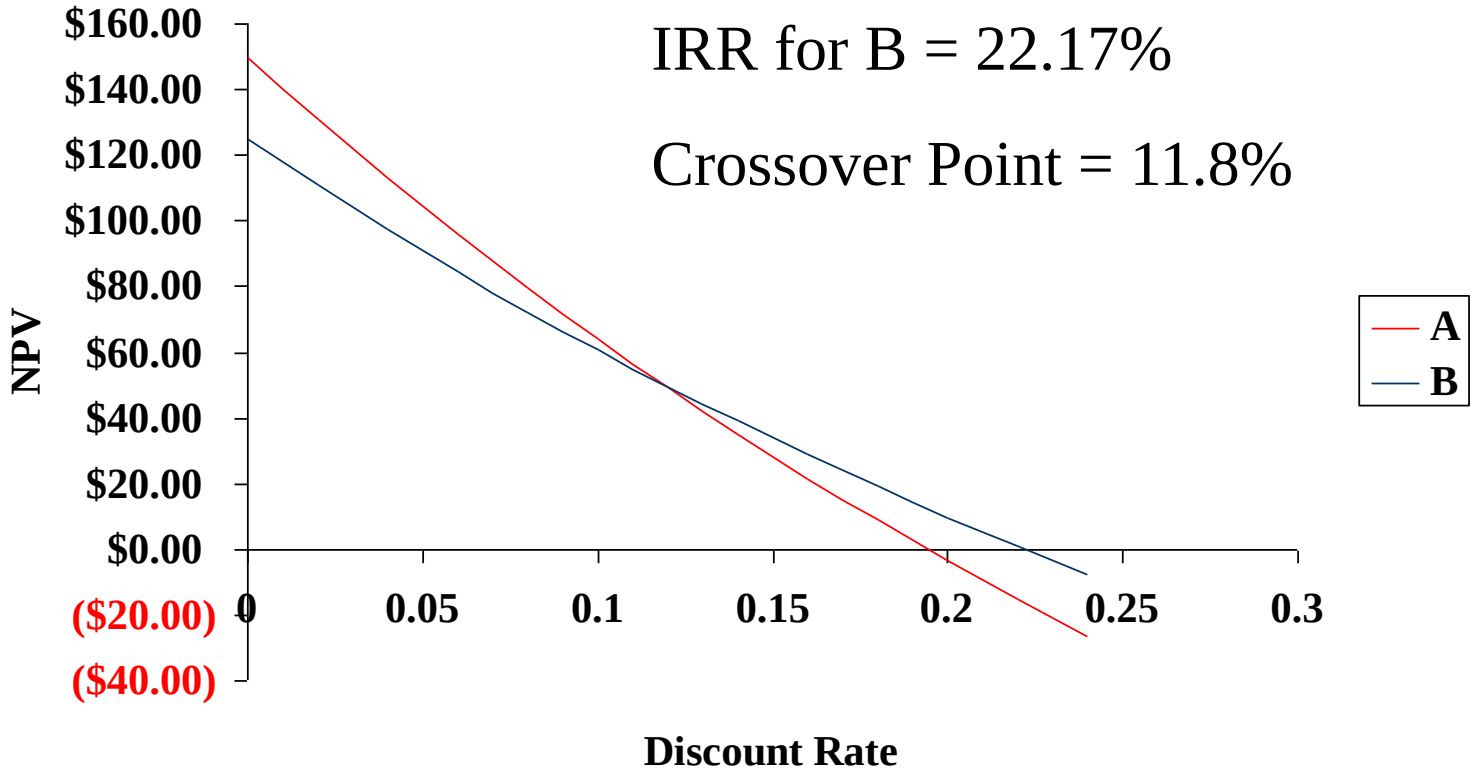
- The required return for both projects is 10%.
- Which project should you accept and why?

NPV Profiles

IRR for A = 19.43%

IRR for B = 22.17%

Crossover Point = 11.8%



Conflicts Between NPV and IRR

- NPV directly measures the increase in value to the firm
- Whenever there is a conflict between NPV and another decision rule, you should ***always*** use NPV
- IRR is unreliable in the following situations
  - Nonconventional cash flows
  - Mutually exclusive projects

Modified IRR

- Calculate the net present value of all cash outflows using the **borrowing rate**.
- Calculate the net future value of all cash inflows using the investing rate.
- Find the rate of return that equates these values.
- Benefits: single answer and specific rates for borrowing and reinvestment

- Ehrmann Data Systems is considering a project that has the following cash flow and WACC data. What is the project's MIRR? Note that a project's MIRR can be less than the WACC (and even negative), in which case it will be rejected.

- WACC: 10.00%

Year	0	1	2	3
Cash flows	-$1,000	$450	$450	$450

- WACC: 10.00%
- Year 0 1 2 3
- Cash flows -$1,000 $450 $450 $450
- Compounded values, FVs
  $544.5 $495.0 $450.0

- TV = Sum of compounded inflows: $1,489.50

- MIRR = 14.20% Found as discount rate that equates PV of TV to cost, discounted back 3 years @ WACC
- MIRR = 14.20% Alternative calculation, using Excel's MIRR function

Profitability Index

- Measures the benefit per unit cost, based on the time value of money
- A profitability index of 1.1 implies that for every $1 of investment, we create an additional $0.10 in value
- This measure can be very useful in situations in which we have limited capital

Advantages and Disadvantages of Profitability Index

- Advantages
  - Closely related to NPV, generally leading to identical decisions
  - Easy to understand and communicate
  - May be useful when available investment funds are limited
- Disadvantages
  - May lead to incorrect decisions in comparisons of mutually exclusive investments

Capital Budgeting In Practice

- We should consider several investment criteria when making decisions
- NPV and IRR are the most commonly used primary investment criteria
- Payback is a commonly used secondary investment criteria

Summary – DCF Criteria

- Net present value
  - Difference between market value and cost
  - Take the project if the NPV is positive
  - Has no serious problems
  - Preferred decision criterion
- Internal rate of return
  - Discount rate that makes NPV = 0
  - Take the project if the IRR is greater than the required return
  - Same decision as NPV with conventional cash flows
  - IRR is unreliable with nonconventional cash flows or mutually exclusive projects
- Profitability Index
  - Benefit-cost ratio
  - Take investment if PI > 1
  - Cannot be used to rank mutually exclusive projects
  - May be used to rank projects in the presence of capital rationing

Summary – Payback Criteria

- Payback period
  - Length of time until initial investment is recovered
  - Take the project if it pays back within some specified period
  - Doesn’t account for time value of money, and there is an arbitrary cutoff period
- Discounted payback period
  - Length of time until initial investment is recovered on a discounted basis
  - Take the project if it pays back in some specified period
  - There is an arbitrary cutoff period

Quick Quiz

- Consider an investment that costs $100,000 and has a cash inflow of $25,000 every year for 5 years. The required return is 9%, and required payback is 4 years.
  - What is the payback period?
  - What is the discounted payback period?
  - What is the NPV?
  - What is the IRR?
  - Should we accept the project?
- What decision rule should be the primary decision method?
- When is the IRR rule unreliable?

Ethics Issues

- An ABC poll in the spring of 2004 found that one-third of students age 12 – 17 admitted to cheating and the percentage increased as the students got older and felt more grade pressure. If a book entitled "How to Cheat: A User's Guide" would generate a positive NPV, would it be proper for a publishing company to offer the new book?
- Should a firm exceed the minimum legal limits of government imposed environmental regulations and be responsible for the environment, even if this responsibility leads to a wealth reduction for the firm? Is environmental damage merely a cost of doing business?
- Should municipalities offer monetary incentives to induce firms to relocate to their areas?

Comprehensive Problem

- An investment project has the following cash flows: CF0 = -1,000,000; C01 – C08 = 200,000 each
- If the required rate of return is 12%, what decision should be made using NPV?
- How would the IRR decision rule be used for this project, and what decision would be reached?
- How are the above two decisions related?