



Finance for Cultural Organisations

Lecture 7. Net Present Value and Other Investment Criteria



Lecture 6: Net Present Value and Other Investment Criteria

- Be able to compute payback and discounted payback and understand their shortcomings
- Understand accounting rates of return and their shortcomings
- Be able to compute the internal rate of return and understand its strengths and weaknesses
- Be able to compute the net present value and understand why it is the best decision criterion

Reading

- RWJ Ch9, HBP Ch8.

Chapter Outline

- Net Present Value
- The Payback Rule
- The Discounted Payback
- The Average Accounting Return
- 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?

Project Example Information

- You are looking at a new project and you 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 is 12%.

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.

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:
 - $NPV = 63,120/(1.12) + 70,800/(1.12)^2 + 91,080/(1.12)^3 - 165,000 = 12,627.42$
- 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?***

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

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 for the Project

- 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?***

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 for the Project

- 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?***

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

Average Accounting Return

- There are many different definitions for average accounting return
- The one used in the book is:
 - Average net income / average book value
 - Note that the average book value depends on how the asset is depreciated.
- Need to have a target cutoff rate
- Decision Rule: ***Accept the project if the AAR is greater than a preset rate.***

Computing AAR for the Project

- Assume we require an average accounting return of 25%
- Average Net Income:
 - $(13,620 + 3,300 + 29,100) / 3 = 15,340$
- $AAR = 15,340 / 72,000 = .213 = 21.3\%$
- ***Do we accept or reject the project?***

Decision Criteria Test - AAR

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



Advantages and Disadvantages of AAR

- Advantages

- Easy to calculate
- Needed information will usually be available

- Disadvantages

- Not a true rate of return; time value of money is ignored
- Uses an arbitrary benchmark cutoff rate
- Based on accounting net income and book values, not cash flows and market values

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

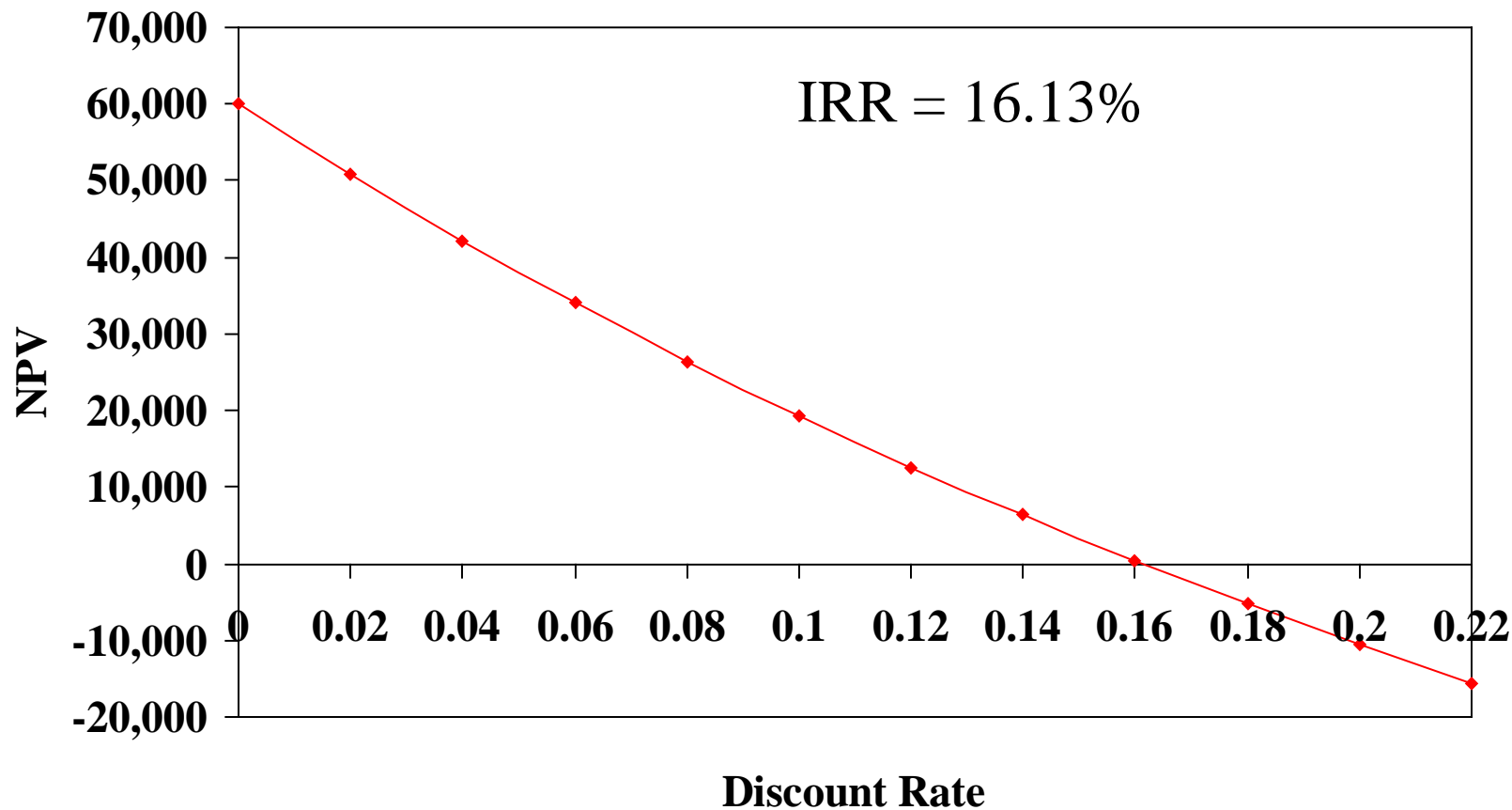
- Definition: IRR is the return that makes the $NPV = 0$
- Decision Rule: ***Accept the project if the IRR is greater than the required return***

Computing IRR for the Project

- 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



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



Summary of Decisions for the Project

Summary	
Net Present Value	<i>Accept</i>
Payback Period	<i>Reject</i>
Discounted Payback Period	<i>Reject</i>
Average Accounting Return	<i>Reject</i>
Internal Rate of Return	<i>Accept</i>



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



NPV vs. IRR

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

IRR and Non-conventional Cash Flows

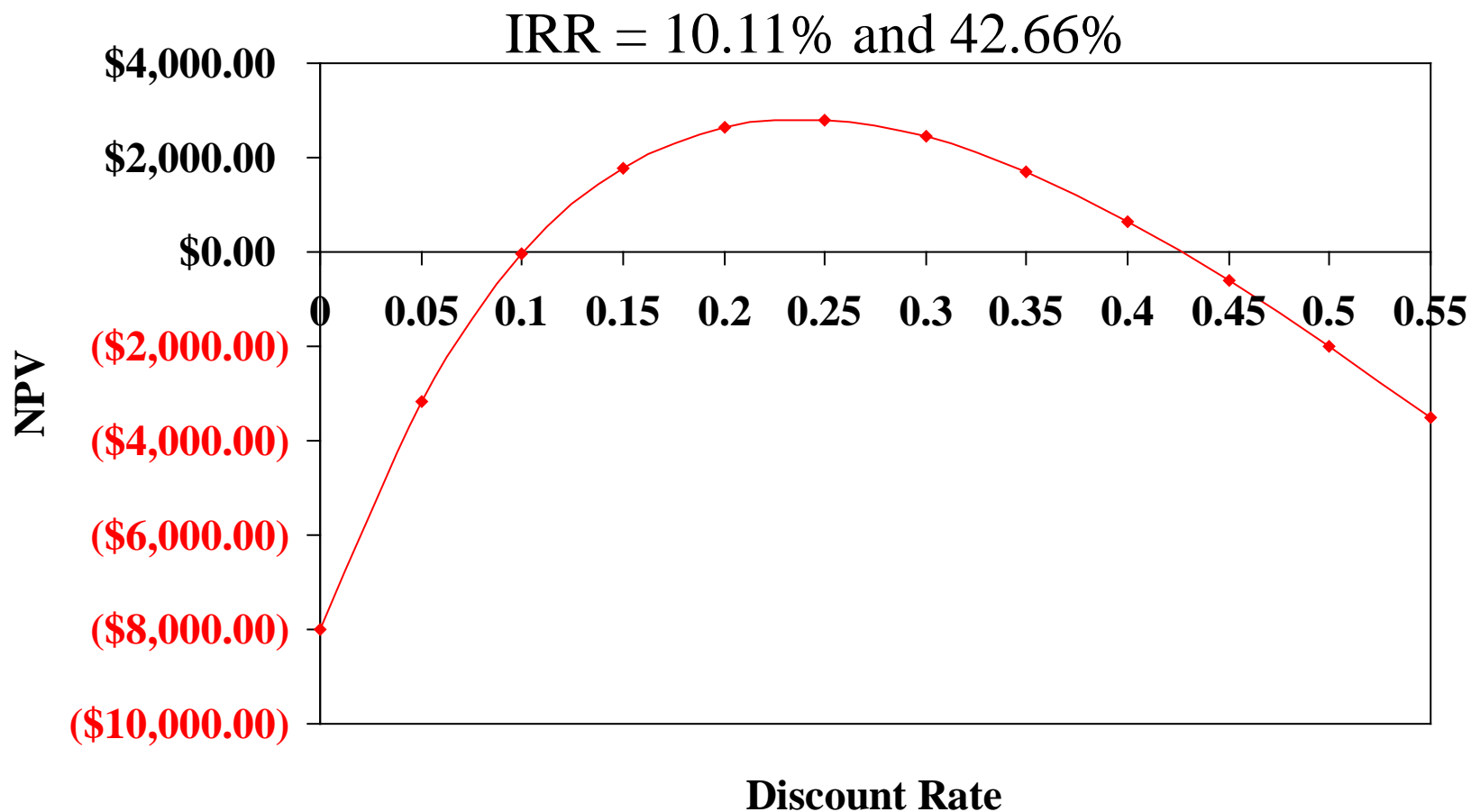
- When the cash flows change sign more than once, there is more than one IRR
- When you solve for IRR you are solving for the root of an equation and when you cross the x-axis more than once, there will be more than one return that solves the equation
- If you have more than one IRR, which one do you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

Another Example – Non-conventional 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



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

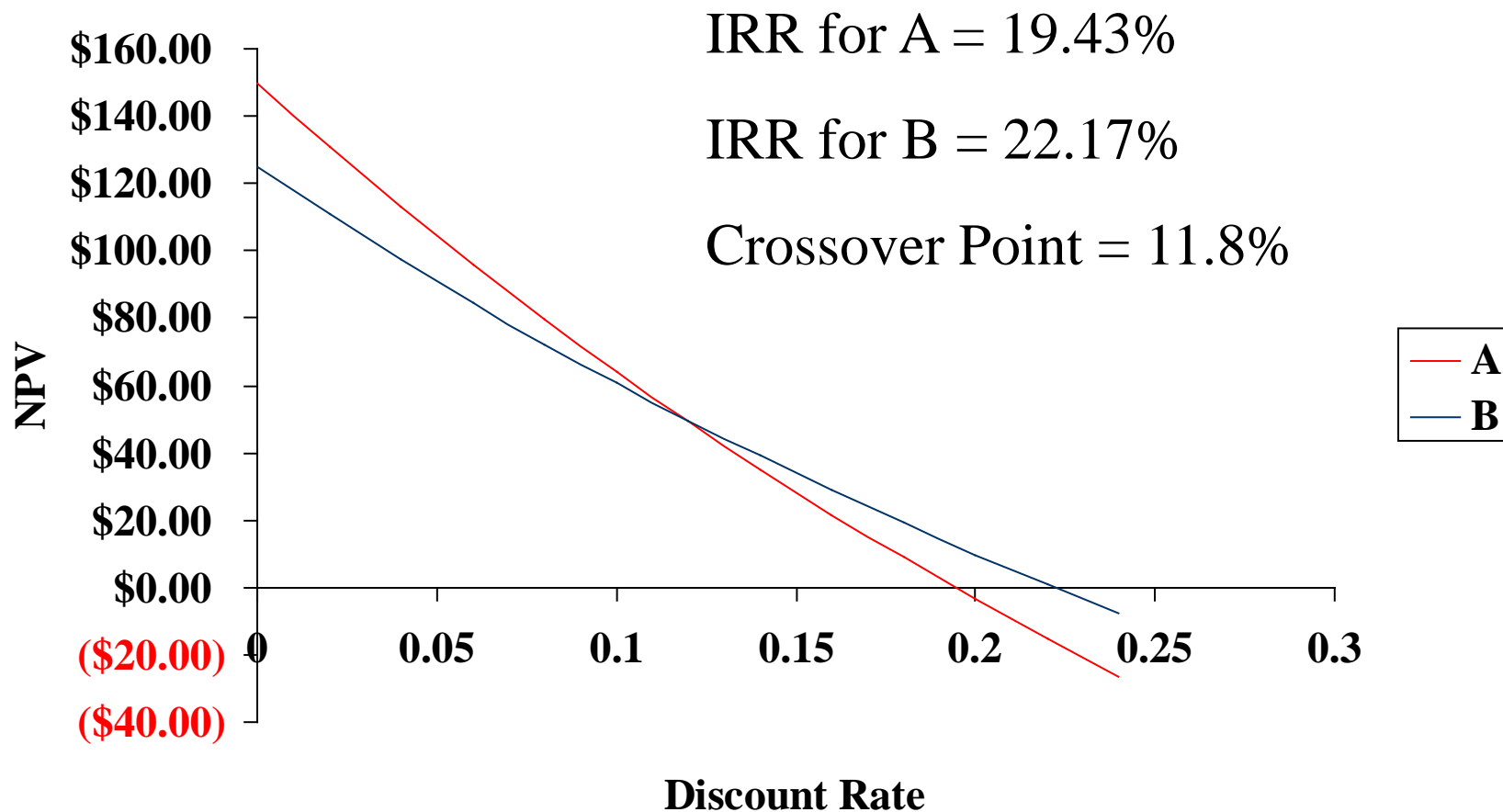
Period	Project A	Project B
0	-500	-400
1	325	325
2	325	200
IRR	19.43%	22.17%
NPV	64.05	60.74

The required return for both projects is 10%.

Which project should you accept and why?



NPV Profiles





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
 - Non-conventional cash flows
 - Mutually exclusive projects

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 – Discounted Cash Flow 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 non-conventional 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

Summary – Accounting Criterion

- Average Accounting Return
 - Measure of accounting profit relative to book value
 - Similar to return on assets measure
 - Take the investment if the AAR exceeds some specified return level
 - Serious problems and should not be used

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?