FIN 2704/2704X

Week 8 Slides

LEADING FROM ASIA

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Introduction to Capital Budgeting

Learning objectives

Understand what **Capital Budgeting** is

Example: Capital Budgeting Decision

"Jurong Aromatics Corporation announced US$2 billion investment on Jurong Island" EnergyAsia, October 22, 2007

- Newly-established Jurong Aromatics Corporation Pte Ltd (JAC) said it will start building a US$2 billion petrochemical plant on Singapore's Jurong Island next year.
- When completed in 2011, the complex will produce around 1.5 million tonnes of aromatics, comprising 800,000 tonnes of paraxylene, 200,000 tonnes of orthoxylene, 450,000 tonnes of benzene, and 2.5 million tonnes of oil products. The plant would provide raw materials to textile and plastics manufacturers.

➡ *What type of analysis did Jurong Aromatics management follow in order to reach this decision to build the plant? Capital budgeting lecture introduces this*

Example: Capital Budgeting Decision

"ExxonMobil completes acquisition of Jurong Aromatics Corporation's Jurong Island Plant" August 28, 2017

- ExxonMobil has completed its acquisition of Jurong Aromatics Corporation's Jurong Island plant, one of the largest aromatic facilities in the world. The deal, for an undisclosed sum, was first announced in May this year.
- The facility has an ethylene production capacity of 1.9 million tonnes each year. It will boost ExxonMobil's Singapore aromatics production to over 3.5 million tonnes each year, including 1.8 million tonnes of paraxylene, and add 65,000 barrels a day of transportation fuels capacity.

- *ExxonMobil's acquisition was also a reflection of its capital budgeting activities.*

Example: Capital Budgeting Decision

"Campana to build $20m data centre corridor in Southeast Asia"
DataCenter News, October 4, 2018

- Singapore-based Campana Group are welcoming a US$20 million investment following a series B funding round from Japan's Mitsui & Co. with global law firm Herbert Smith Freehills acting to advise the transaction.
- According to Herbert Smith Freehills, this investment into Campana will go towards the construction of the largest high-speed data center corridor connecting Singapore and Myanmar, with prebuilt connections for Thailand.
- "This is typical of the increasing investment we're seeing in data and tech infrastructure in Asia, and in Southeast Asia in particular," says Herbert Smith Freehills Asia head of TMT Mark Robinson.
- "The new network will utilize submarine cables and land connections to meet the demand from Myanmar's rapid growth in online activity"

➡ *As per the Jurong Aromatics example, this reflects a thoroughly considered capital budgeting decision.*

Capital Budgeting

- Recall that ***current expenditures*** are short-term in nature and are completely expensed in the year incurred.
- ***Capital expenditures*** are expenditures on fixed assets that will be used for production over a period of years. As such, in accounting terms these expenditures are capitalized and then depreciated over a period of years.
- ***Capital budgeting*** refers to the process of deciding how to allocate the firm's scarce capital resources (land, labor, and capital) to its various investment alternatives. It considers whether a project is worth undertaking (i.e., worth its capital expenditures).
- The ***over-riding rule*** of capital budgeting is to accept all projects for which the *cost is less than, or equal to, the benefit:*
  - Accept if: Cost ≤ Benefit
  - Reject if: Cost > Benefit

Summary

- Capital budgeting refers to the process of deciding how to allocate the firm's scarce capital resources to its various investment alternatives
  - Accept if: Cost ≤ Benefit
  - Reject if: Cost > Benefit

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Net Present Value (NPV)

Learning objectives

Be able to compute the **net present value (NPV)** and understand why it is the best decision criterion

What Are Good Decision Criteria?

Since value must take into account what **amount** of cash flow is received, **when** it is received and the **likelihood** associated with receiving those cash flows, we need to ask ourselves the following questions when evaluating decision criteria:

1. Does the decision rule adjust for the ***time value of money***?

2. Does the decision rule ***adjust for risk***?

3. Does the decision rule provide information on whether we are ***creating value*** for the firm?

Capital Budgeting Example A:

You are looking at a new project and you have estimated the following cash flows:

- Year 0: $CF_0 = -165{,}000$
- Year 1: $CF_1 = 63{,}120$; NI = 13,620
- Year 2: $CF_2 = 70{,}800$; NI = 3,300
- Year 3: $CF_3 = 91{,}080$; NI = 29,100
- Average Book Value = 72,000

Your required return for assets of this risk is 12%.

The NPV Decision Making Recipe

1. Estimate the expected future cash flows:
   - Amount and timing (Use a time-line)
2. Estimate the *required return* for projects of this risk level
   - May have to use CAPM
3. Find the present value of the cash flows and subtract the initial investment.

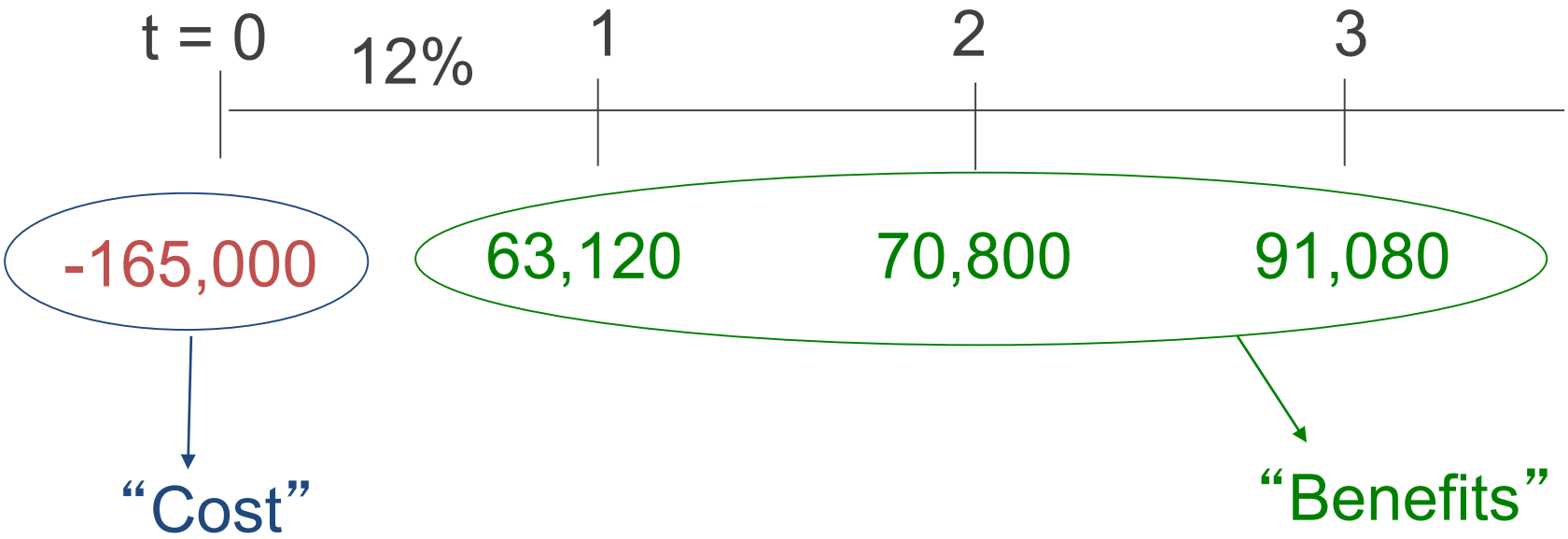
$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t} - CF_0$$

NPV Rule*: Accept the project If NPV > 0*

Net Present Value

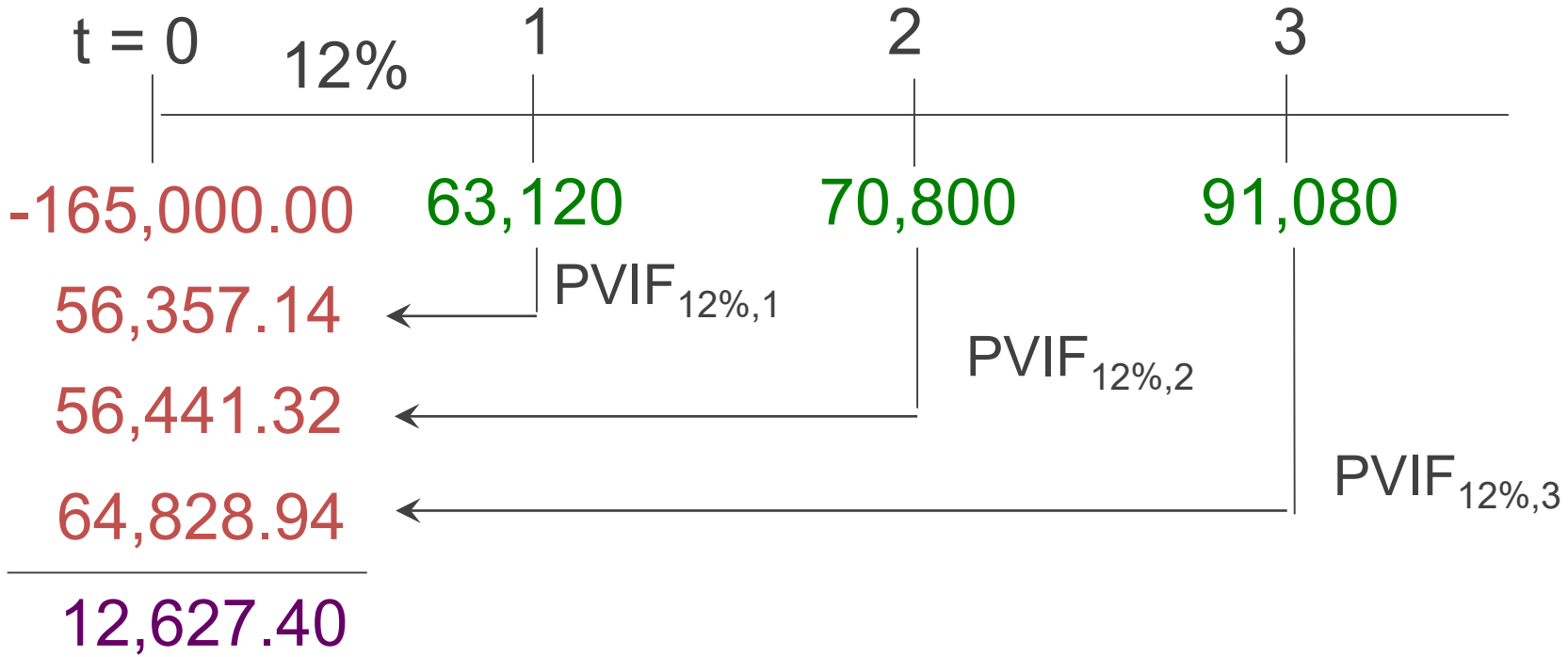
- The difference between the ***intrinsic value*** of a project and its ***cost*** is the ***NPV.***
- *How much value is created from undertaking an investment*?
  - If PV(Cash Inflows) > PV(Cash Outflows), this means that taking on the project will ↑ the value of the firm
  - Thus a ***positive NPV*** 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 owners' wealth***, NPV is a direct measure of how well this project will meet our goal.

Timeline for Example A



Computing NPV for Example A

- Draw a time-line and using the formulas:



❖NPV = 63,120/(1.12) + 70,800/$(1.12)^2$ + 91,080/$(1.12)^3$ – 165,000 = 12,627.40

- *Do we accept or reject the project?* **Accept**

Using TI BA II Plus Calculator:

- Press <CF> & Use <↓> and <↑> to enter the following values:

  CF_0: 165000 **<+/-> <ENTER>** → CF_0 = -165,000

  <↓> **C01:** 63120 **<ENTER>** → CF_1 = 63,120

  <↓> **F01:** **1** → Freq. of receiving 63,120 is 1.

  <↓> **C02:** 70800 **<ENTER>** → CF_2 = 70,800

  <↓> **F02:** **1** → Freq. of receiving 70,800 is 1.

  <↓> **C03:** 91080 **<ENTER>** → CF_3 = 91,080

  <↓> **F03:** **1** → Freq. of receiving 91,080 is 1.

- Press <NPV> to display the current discount rate (I)

  12 <ENTER> → I = 12 : Enter discount rate 12%

  <↓> **NPV:** **0** → to reach the NPV function.

  <CPT> NPV: **12,627.41** → NPV = **12,627.41**

Evaluating NPV as a Capital Budgeting Decision Criteria

- 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 criteria?

Summary

To calculate NPV:

- Find the present value of the cash flows and subtract the initial investment
- NPV Rule: Accept the project If NPV > 0

Payback & Discounted Payback

Learning objectives

Be able to compute **payback** and **discounted payback** and understand their shortcomings

Payback Period

Payback period is the # of years to recover initial costs

- How long does it take to get the initial cost back in a nominal sense?
- The Payback Decision Recipe
  1. Estimate the cash flows
  2. Add the future cash flows to the initial cost until the initial investment has been recovered

Payback Period Decision Rule*: Accept if the payback period is less than some preset limit (determined arbitrarily)*

Capital Budgeting Example A:

You are looking at a new project and you have estimated the following cash flows:

- Year 0: $CF_0 = -165{,}000$
- Year 1: $CF_1 = 63{,}120$; NI = 13,620
- Year 2: $CF_2 = 70{,}800$; NI = 3,300
- Year 3: $CF_3 = 91{,}080$; NI = 29,100
- Average Book Value = 72,000

Your required return for assets of this risk is 12%.

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Computing Payback For Example A

- 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*
  - To be more exact, $2 \; and \; \frac{31080}{91080} = 2.34$ years
- *Do we accept or reject the project?* **Reject**

Evaluating Payback as a Decision Criteria

- 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 criteria?

Payback

Advantages

- Quick and easy to calculate
- Easy to understand
- Adjusts for uncertainty of later cash flows
- Biased towards 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 payback on a discounted basis
- Compare to a specified required period

Discounted Payback Rule: ***Accept the project if it pays back on a discounted basis within the specified time (again arbitrarily selected)***

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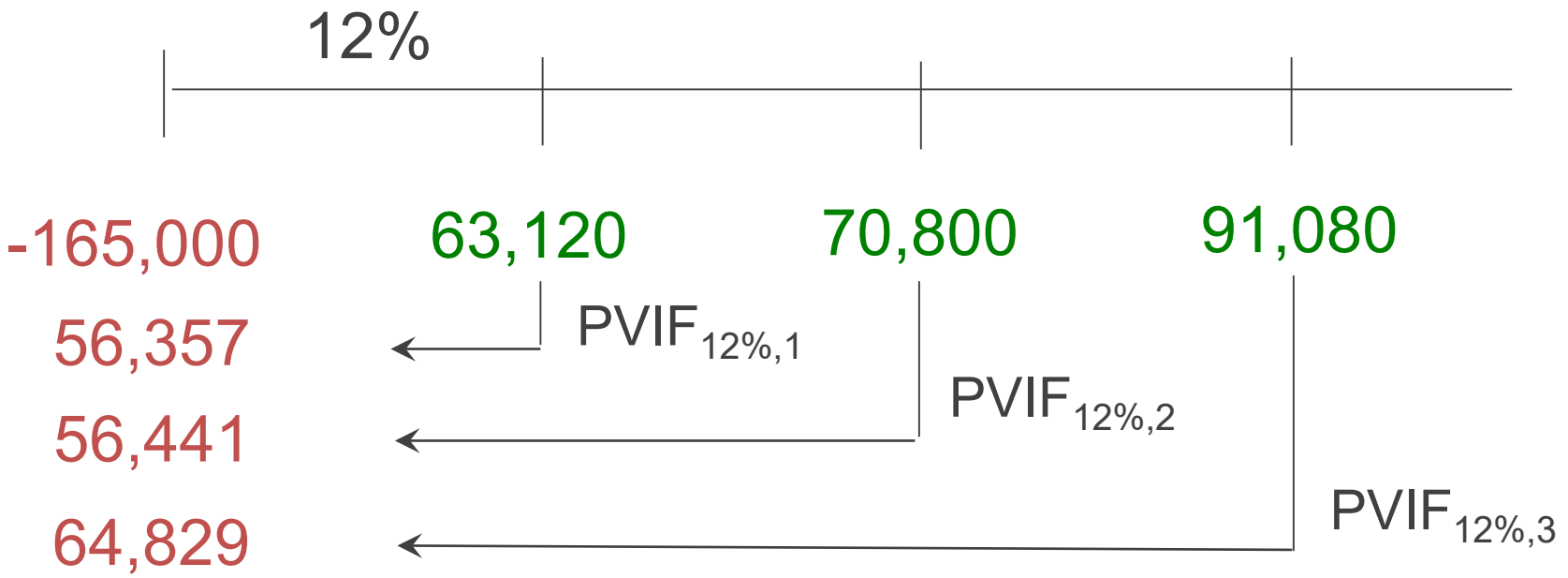
Computing Discounted Payback: Example A

Assume we will accept the project if it pays back on a discounted basis in 2 years.

1. Compute the PV for each cash flow:



Computing Discounted Payback: Example A

2. Determine the payback period using discounted cash flows

- Year 1: -165,000 + 56,357 = -108,643
- Year 2: -108,643 + 56,441 = -52,202
- Year 3: - 52,202 + 64,829 = 12,627 project pays back in year 3

$$\Rightarrow 2\frac{52,202}{64,829} = 2.81 \text{ years}$$

- *Do we accept or reject the project?* **Reject**

Evaluating Discounted Payback Decision Criteria

- 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 criteria?

Discounted Payback

Advantages

- Includes time value of money
- Easy to understand
- Does not accept negative estimated NPV investments
- 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

Payback Period Example – Serious Deficiencies

Cash Flows	A	B
Initial Outlay	-$10,000	-$10,000
1	$5,000	$5,000
2	$4,000	$5,000
3	$4,000	0
4	$4,000	0
5	$4,000	0

If the desired payback period is 2 years, which project do you invest in?

Summary

Payback period is the # of years to recover initial costs

- How long does it take to get the initial cost back in a nominal sense?
- Payback Period Decision Rule: Accept if the payback period is less than some preset limit (determined arbitrarily)
- Use discounted payback period to take into account time value of money

Average Accounting Return (AAR)

Learning objectives

Be able to compute average accounting return and understand its shortcomings

Average Accounting Return

- There are many different definitions for average accounting return
- The one used in your textbook 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***

Average Accounting Return Decision Rule:

Accept the project if the AAR is greater than a preset rate (determined arbitrarily)

Capital Budgeting Example A:

You are looking at a new project and you have estimated the following cash flows:

- Year 0: $CF_0 = -165{,}000$
- Year 1: $CF_1 = 63{,}120$; NI = 13,620
- Year 2: $CF_2 = 70{,}800$; NI = 3,300
- Year 3: $CF_3 = 91{,}080$; NI = 29,100
- Average Book Value = 72,000

Your required return for assets of this risk is 12%.

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 = 0.213 = 21.3%

- ***Do we accept or reject the project?*** **Reject**

Evaluating AAR as a Decision Criteria Test

- 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?

Average Accounting Return

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 intrinsic/market values

Summary

Average Accounting Return (AAR)

- Average net income / average book value
- Accept the project if the AAR is greater than a preset rate (determined arbitrarily)
- Based on accounting net income and book values, not cash flows and intrinsic/market values

Internal Rate of Return (IRR)

Learning objectives

Be able to compute the **internal rate of return (IRR) & Modified IRR** and understand the strengths and weaknesses

Internal Rate of Return

- Definition: IRR is the return that makes the NPV = 0
- 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

General IRR Rule: ***Accept the project if the IRR is greater than the required return***

Capital Budgeting Example A:

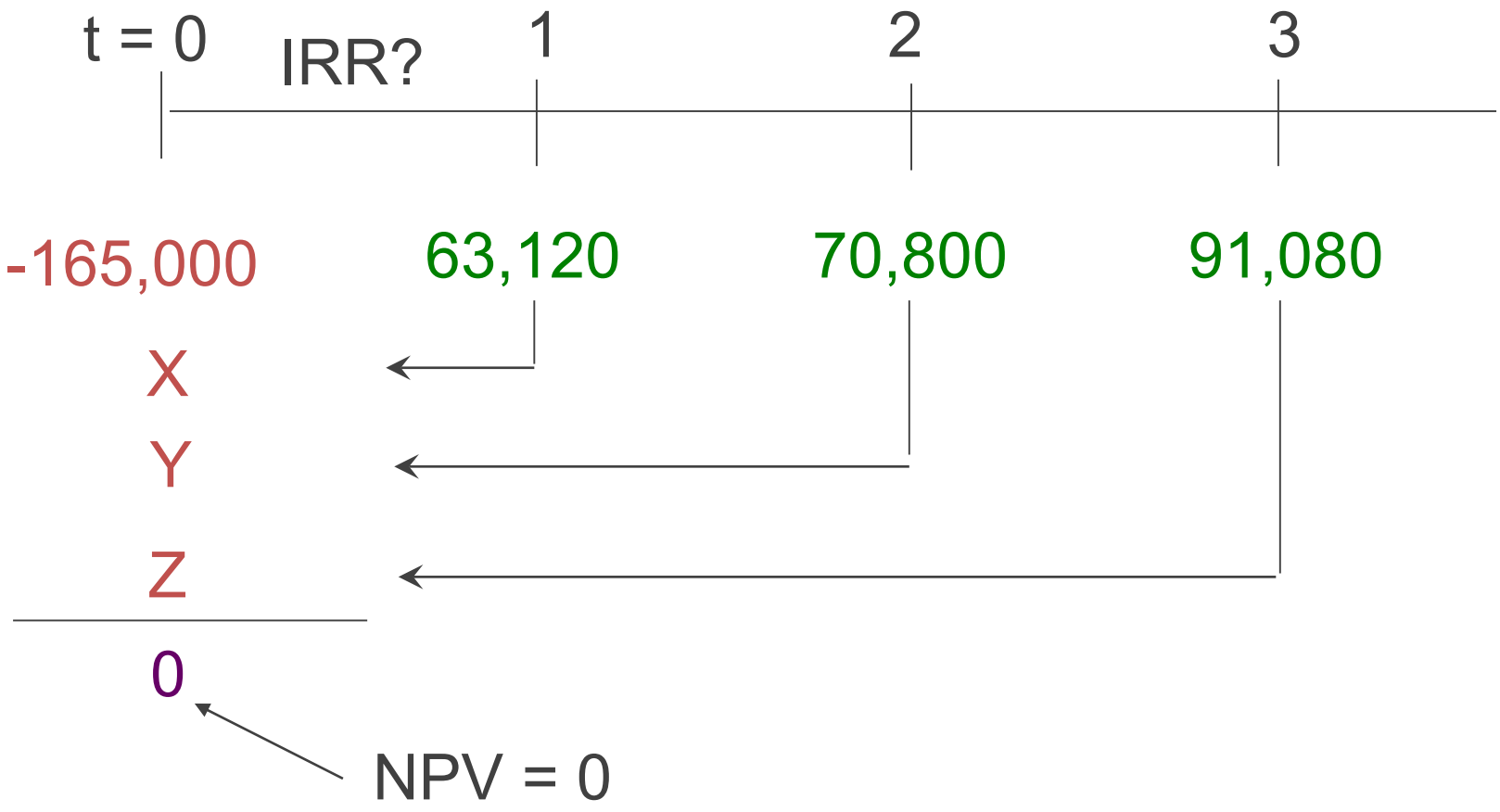
You are looking at a new project and you have estimated the following cash flows:

- Year 0: $CF_0 = -165{,}000$
- Year 1: $CF_1 = 63{,}120$; NI = 13,620
- Year 2: $CF_2 = 70{,}800$; NI = 3,300
- Year 3: $CF_3 = 91{,}080$; NI = 29,100
- Average Book Value = 72,000

Your required return for assets of this risk is 12%.

Computing IRR for Example A

Solve for *unknown discount rate*:



The Internal Rate of Return (IRR)

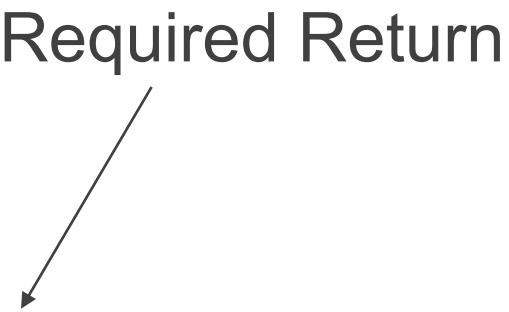
The IRR is the discount rate that makes the NPV equal to zero:

$$NPV = -165{,}000 + \frac{\$63{,}120}{(1+IRR)} + \frac{\$70{,}800}{(1+IRR)^2} + \frac{\$91{,}080}{(1+IRR)^3}$$

$$NPV = 0$$

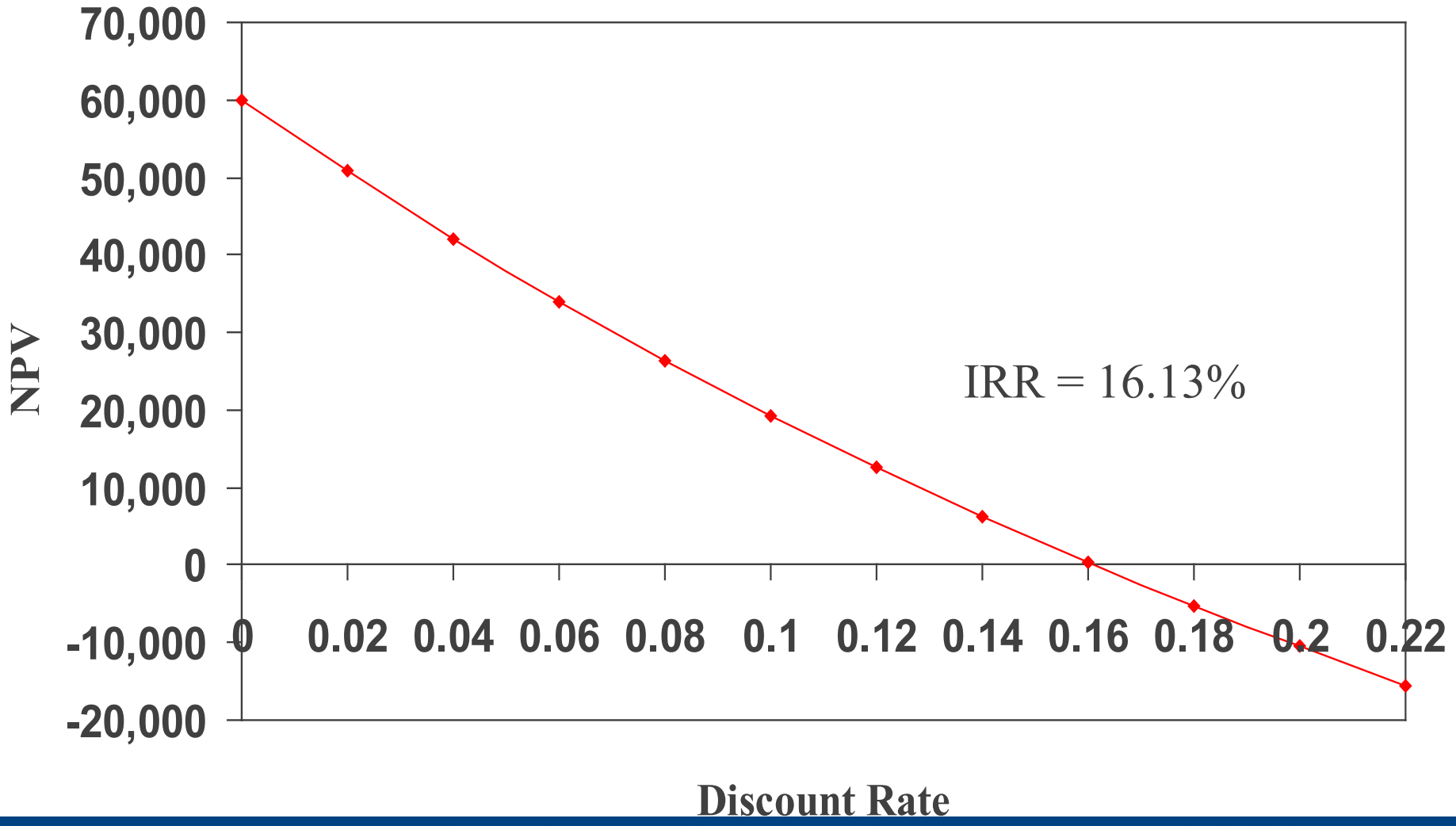
Using the TI BA II Plus Financial Calculator

- 165,000 <+/-> <CFj>
- 63,120 <CFj>
- 70,800 <CFj>
- 91,080 <CFj>
- Do not press <NPV>!!!
- Press <IRR> <CPT> $\Rightarrow$ 16.13 > 12%



- *Do we accept or reject the project?* **Accept**
- If you do not have a financial calculator, then this becomes a trial and error process

NPV Profile for Example A



Evaluating IRR as a Decision Criteria

- 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

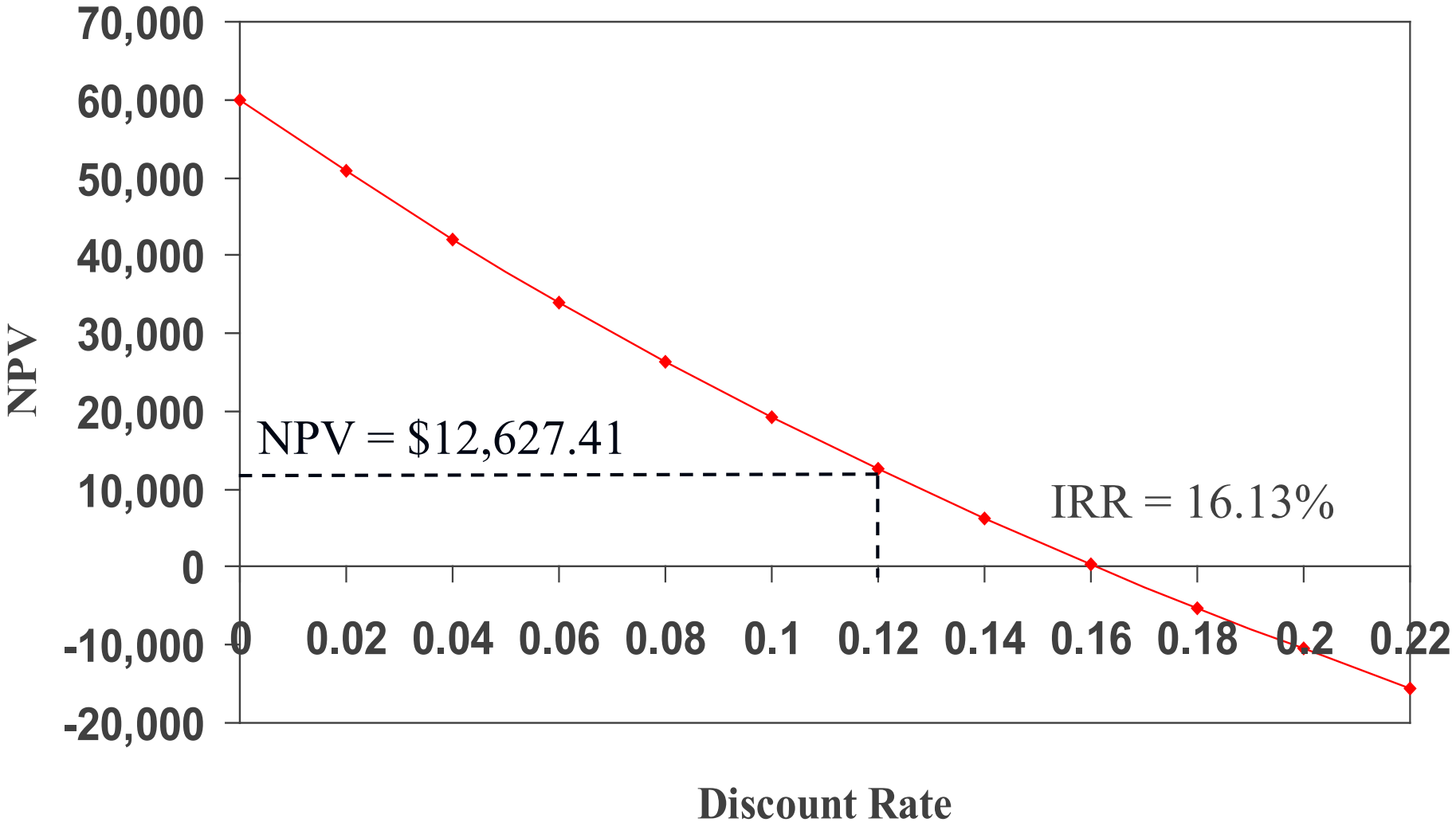
Example A: Summary of Capital Budgeting Decisions

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.

NPV Profile for Example A



NPV vs. IRR

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

The Difference Between Independent And Mutually Exclusive Projects:

Projects are:

1. **Independent**, if the cash flows of one are unaffected by the acceptance of the other.

2. **Mutually exclusive**, if the cash flows of one can be adversely impacted by the acceptance of the other (usually due to limitation of available funds)

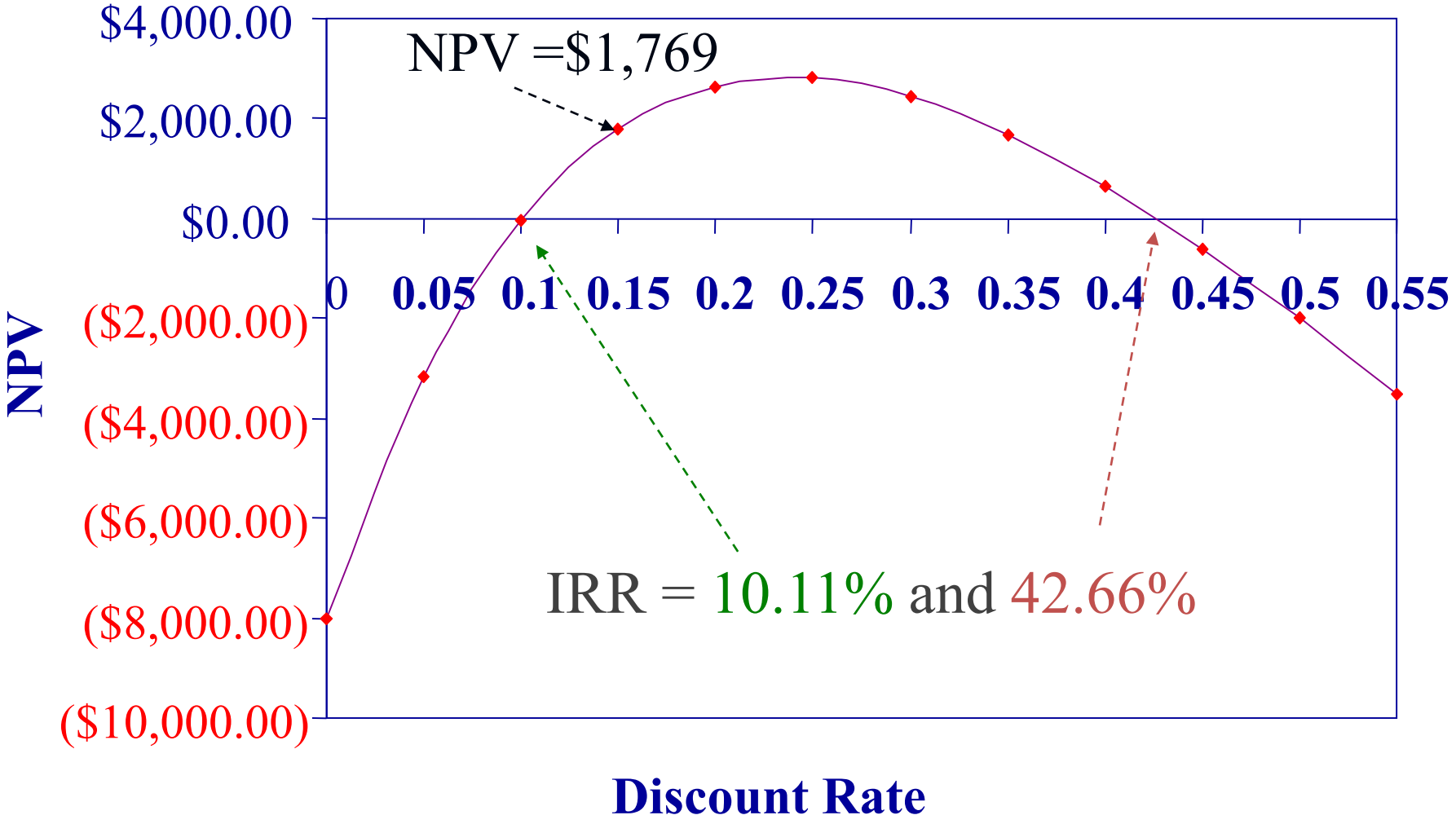
IRR and Non-Conventional Cash Flows

- When a project's cash flows change sign more than once, there can be 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 (Decommissioning costs)
- The required return is 15%.
- Should we accept or reject the project?

NPV Profile


$4,000.00
$2,000.00
$0.00
($2,000.00)
($4,000.00)
($6,000.00)
($8,000.00)
($10,000.00)
NPV
NPV =$1,769
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0.55
IRR = 10.11% and 42.66%
Discount Rate

Summary of Decision Rules

- The NPV is positive at a required return of 15%, so you should ***Accept***
- If you use the financial calculator, some models (e.g. yours!) would give 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 next year 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

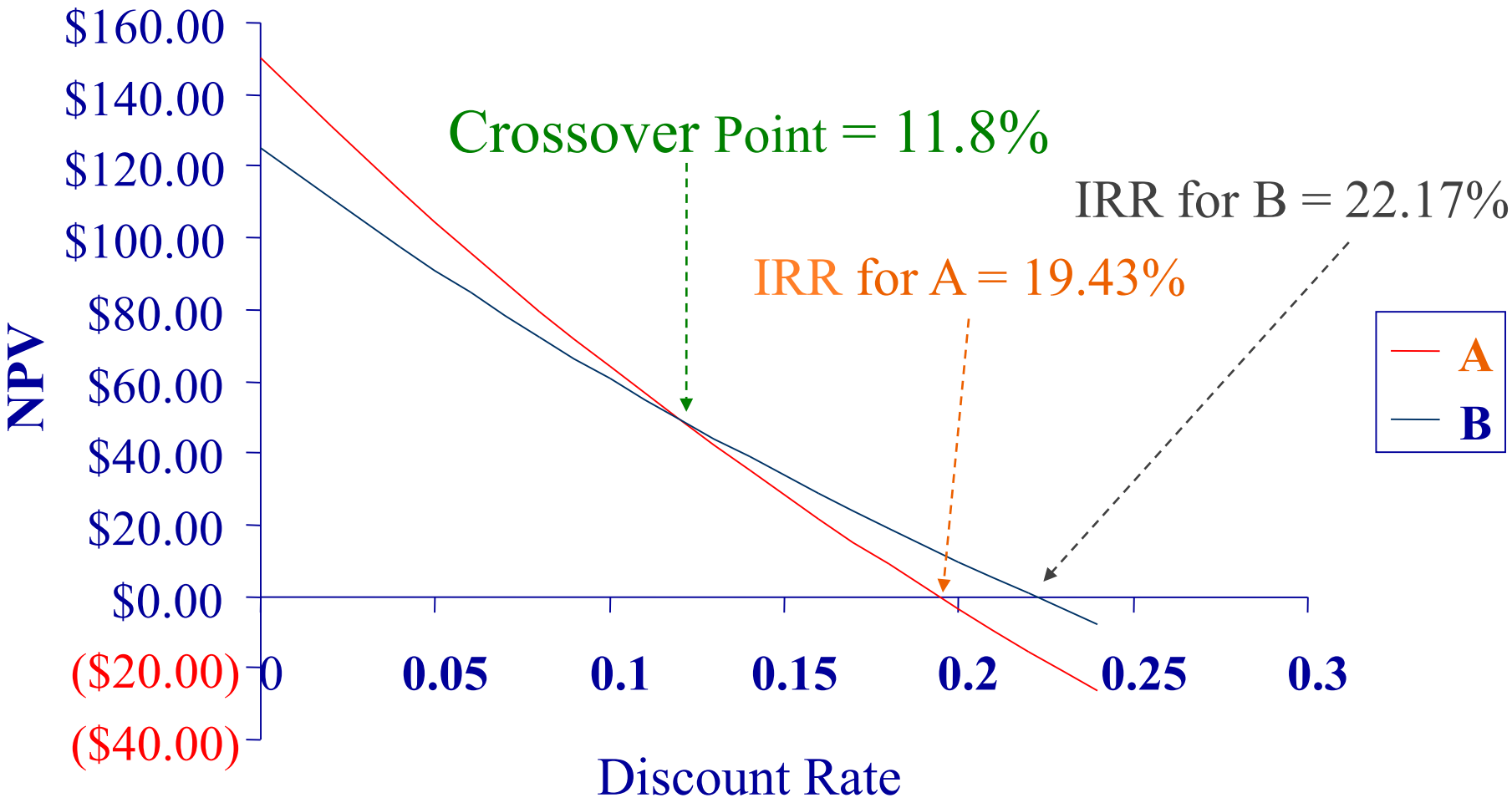
Example With Mutually Exclusive Projects

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



Reasons Why NPV Profiles Cross

- ***Size (scale) differences***: at discount rate = 0, the NPV of smaller project B is less than (hence below the) larger project A (on the y-axis).
- ***Timing differences:*** the project with faster payback provides more CF in early years for reinvestment. It is less sensitive to changes in discount rate. If r is high, early CF is especially good, $NPV_B > NPV_A$.

Reinvestment Rate Assumptions

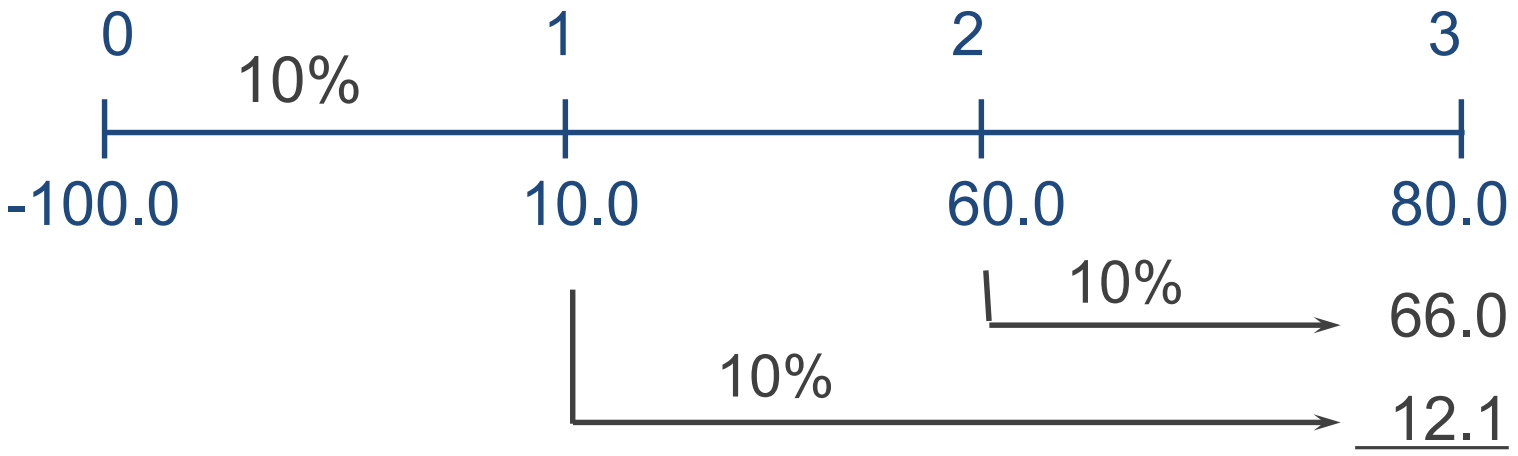
- NPV method assumes CFs are reinvested at company's ***weighted average cost of capital*** (WACC), i.e. the opportunity cost of capital.
- IRR method assumes CFs are reinvested at the IRR.
- Assuming CFs are reinvested at the opportunity cost of capital is more realistic, so NPV method is the best. **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.

Since Managers Tend to Prefer The IRR To The NPV Method, Is There A *Better* IRR Measure?

- Yes, **Modified IRR (MIRR).** There are a number of different MIRR methods. Your text reviews (i) the discounting approach, (ii) the reinvestment approach and (iii) the combination approach.
- We will focus on the **combination approach**
  - Under this method, the MIRR is the discount rate that causes the PV of a project's terminal value (TV) to equal the PV of its costs
  - TV is found by *compounding* positive project inflows at WACC* to the date of maturity
  - PV of costs is found by discounting negative project cash flows to time zero using WACC
- MIRR assumes cash flows are reinvested at the WACC.

****Recall that WACC is a firm's overall interest rate, referred to as Weighed Average Cost of Capital***

Calculating MIRR



MIRR = 16.5%

-100.0

158.1

PV *outflows*

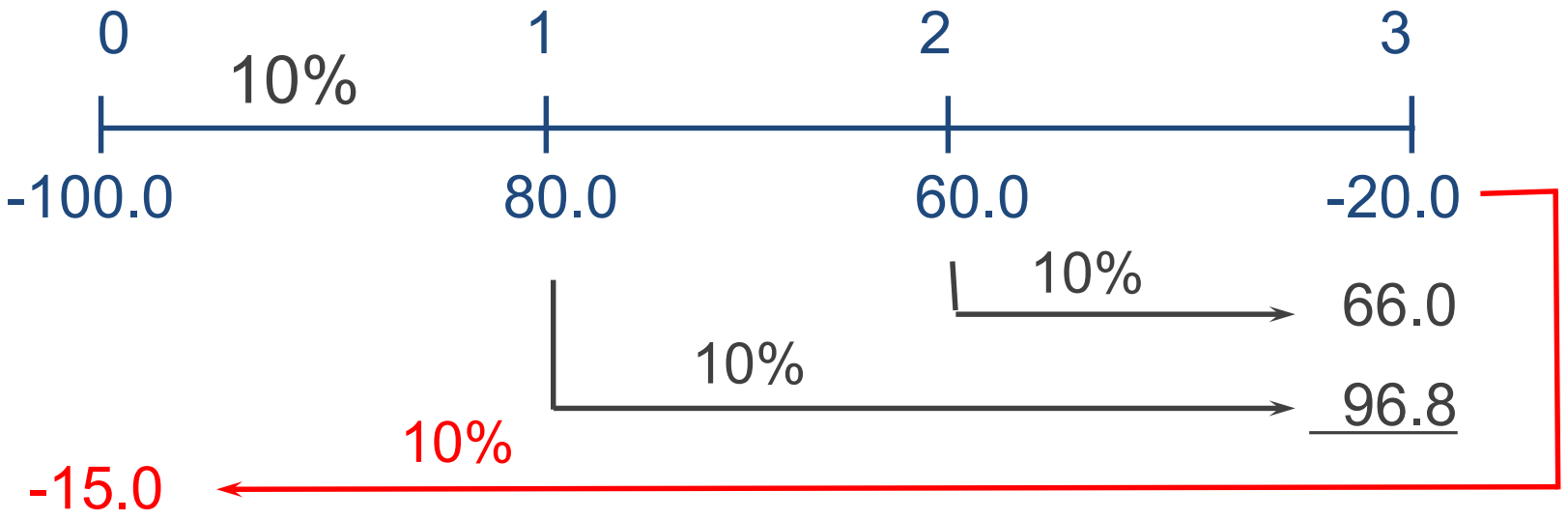
$100 = $158.1 / (1 + MIRR)^3

TV *inflows*

MIRR = 16.5%

N = 3;
FV = 158.1
PV = -100
Cpt I/Y

Calculating MIRR



MIRR = 12.28%

-115.0 ← 162.8

PV ***outflows***

$115 = $162.8 / (1 + MIRR)^3

TV ***inflows***

MIRR = 12.28%

N = 3;
FV = 162.8
PV = -115
Cpt I/Y

Why Use MIRR vs. IRR?

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

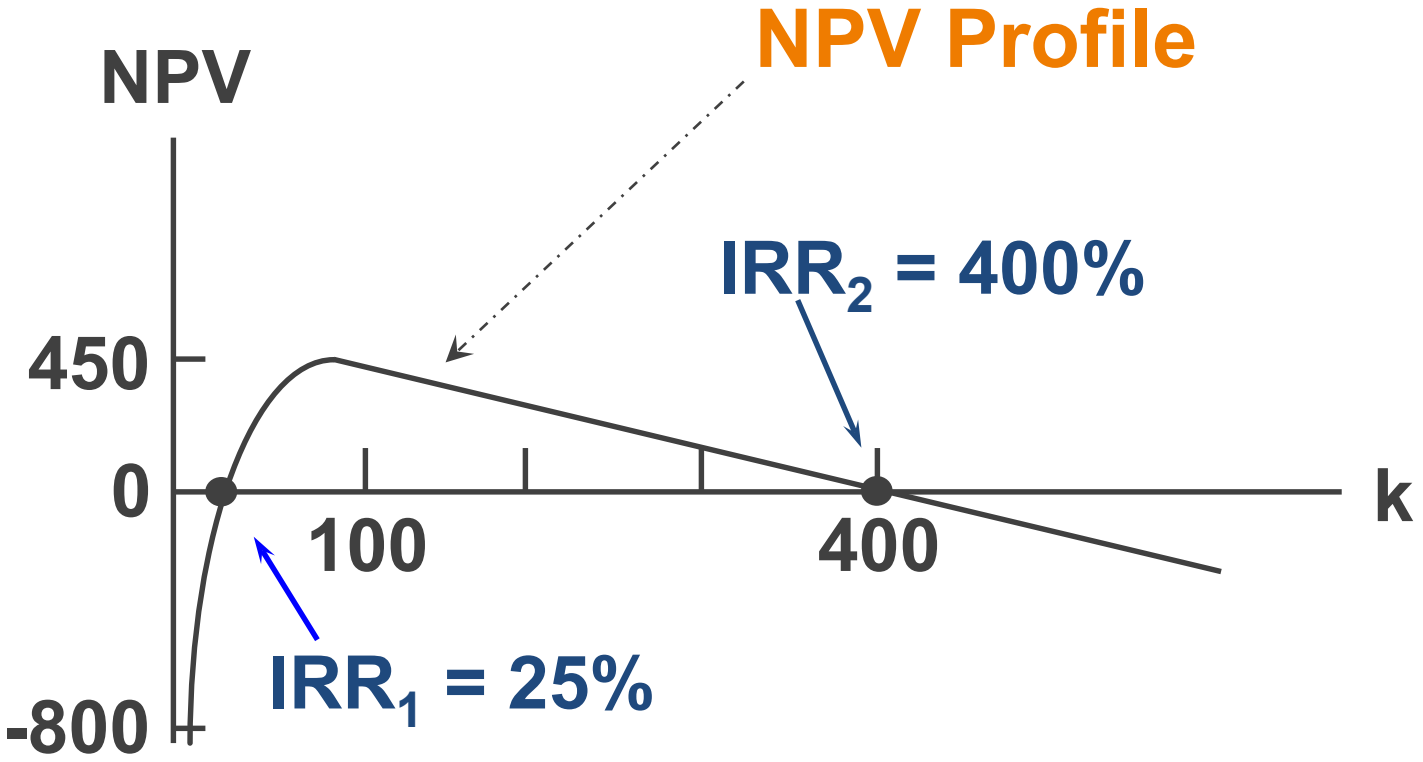
Another IRR Example

Project P has the following cash flows:

Find Project P's NPV and IRR.

- NPV = -$386.78
- IRR = ?

Multiple IRRs



Why Are There Multiple IRRs?

- At very low discount rates, the PV of CF_2 is large & negative, so NPV < 0.
- At very high discount rates, the PV of both CF_1 and CF_2 are low, so CF_0 dominates and again NPV < 0.
- In between, the discount rate hits CF_2 harder than CF_1, so NPV > 0.
- Result: 2 IRRs.

When to use the MIRR instead of the IRR? Accept Project P?

- When there are non-normal CFs and more than one IRR, use MIRR
  - PV of outflows @ 10% = $\frac{-\$5{,}000}{(1.1)^2}$ + (-$800) = -$4,932.2314.
  - TV of inflows @ 10% = $5,000*(1.1) = $5,500.
  - MIRR = 5.6%. (N=2; PV=-$4,932.2314; FV=$5,500; cpt I/Y)
- Do not accept Project P
  - ❖ NPV = -$386.78 < 0.
  - ❖ MIRR = 5.6% < 10%.

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 use NPV
- IRR is unreliable in the following situations
  - Non-conventional cash flows
  - Mutually exclusive projects
- Use MIRR if you really want to use IRR

Summary

- Internal Rate of Return (IRR)
  - The return that makes the NPV = 0
  - Accept the project if the IRR is greater than the required return
- NPV and IRR will generally give us the same decision, except for:
  1. Mutually exclusive projects
  2. Non-conventional cash flows
- Modified IRR (MIRR): the discount rate that causes the PV of a project's terminal value (TV) to equal the PV of its costs

Profitability Index & Review of Capital Budgeting

Learning objectives

Be able to compute **profitability index** and understand its shortcomings

Be able to make a capital budgeting decision based on some decision criteria

Profitability Index

- Measures the benefit per unit cost, based on the time value of money
- Also know as a "benefit – cost" ratio

$$PI = \frac{Total\ PV\ of\ future\ CF's}{Initial\ Cost}$$

← "benefits"

← "costs"

Profitability Index Decision Rule: ***Accept if PI > 1***

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 where we have limited capital (1 period capital rationing)
  - Select alternative with highest PI

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

Project 1	Project 2
CF0 = -$30m	CF0 = -$50m
NPV = $6m	NPV = $8m
PI = 1.2	PI = 1.16

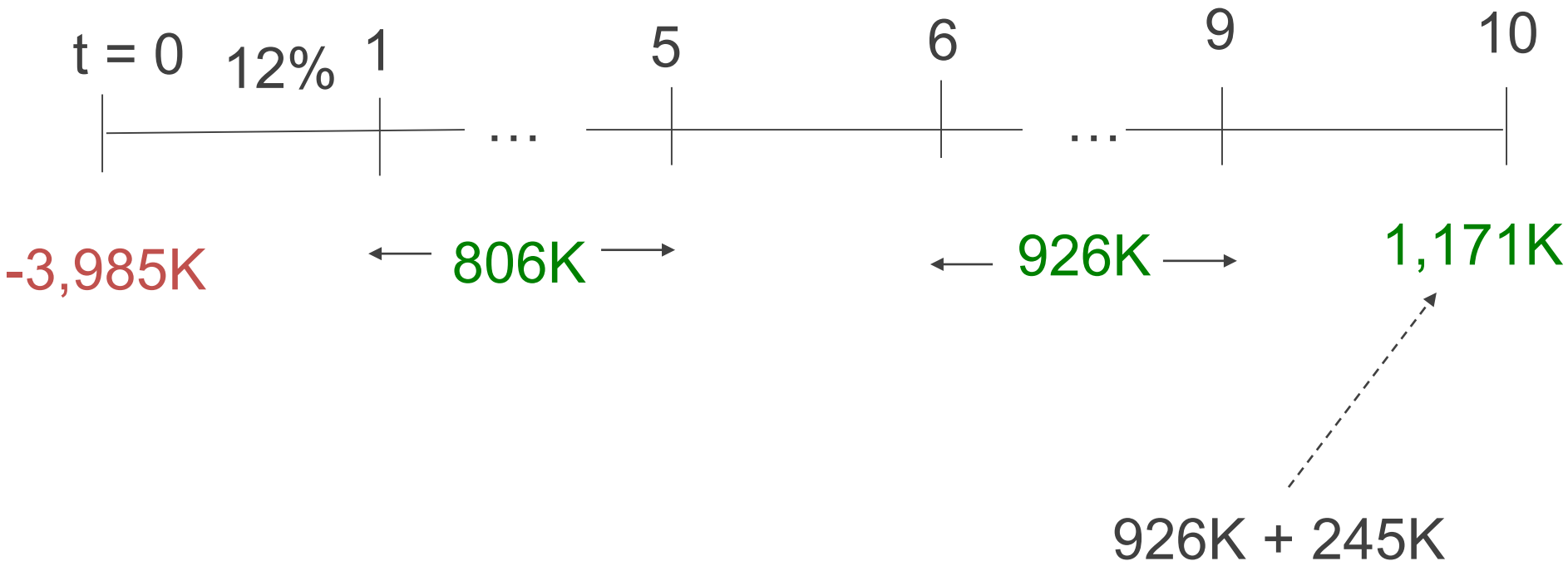
Quick Review

- What decision rule should be the primary decision method?
- When is the IRR rule unreliable?
- Consider the following Perma Filter example. The required return is 12% and required payback is 5 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?

Example: Perma-Filter Co.
Summary of Cash Flows

	Cash Flow
Initial Investment	-$3,985,000
OCF in years 1 to 5	$806,000
OCF in years 6 to 10	$926,000
Net Salvage Value	$245,000

Timeline for Perma-Filter Project



Payback Period

	Cash Flows	Accumulated
Initial Outlay	-$3,985,000	-$3,985,000
1	806,000	-3,179,000
2	806,000	-2,373,000
3	806,000	-1,567,000
4	806,000	-761,000
5	806,000	$45,000

$$\text{Payback Period} = 4 \frac{761{,}000}{806{,}000} = 4.94 \text{ years}$$

Discounted Payback Period

	Discounted CF_j	Accumulated
Initial Outlay	($3,985,000)	-$3,985,000
1	719,643	-3,265,357
2	642,538	-2,622,819
3	573,695	-2,049,124
4	512,228	-1,536,896
5	457,346	-1,079,550
6	469,140	-610,410
7	418,875	-191,535
8	373,996	182,461

$$\text{Discounted Payback Period} = 7\frac{191{,}535}{373{,}996} = 7.51\ years$$

Using TI BA II Plus Calculator

- Press <CF> & Use <↓> and <↑> to enter the following values:

  CF_0: 3985000 <+/-> **<ENTER>** → CF_0 = - 3985000

  <↓> **C01:** 806000 **<ENTER>**

  <↓> **F01:** 5 **<ENTER>** → 806,000 is received from t = 1 to 5.

  <↓> **C02:** 926000 **<ENTER>**

  <↓> **F02:** **4 <ENTER>** → 926,000 is received from t = 6 to 9.

  <↓> **C03:** 1171000 **<ENTER>** → CF_{10} = 1171000 (=926000+245000)

- Press **<NPV>** to display the current discount rate (I)

  12 <ENTER> → I = 12 : Enter discount rate 12%

  <↓> **NPV:** 0 → to reach the NPV function.

  <CPT> NPV: 893,416.82 → NPV = **893,416.82**

- Press <**IRR> & <CPT> IRR:** 16.97 → IRR = **16.97%**

Comprehensive Problem 1

- An investment project has the following cash flows: CF_0 = -1,000,000; CF_1 to CF_8 = 200,000 annually.
- 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?

Comprehensive Problem 1

- NPV = -$6,472; reject the project since it would lower the value of the firm.
- IRR = 11.81%, so reject the project since it would tie up investable funds in a project that will provide insufficient return.
- The NPV and IRR decision rules will provide the same decision for all independent projects with conventional/normal cash flow patterns.
  - If a project adds value to the firm (i.e., has a positive NPV), then it must be expected to provide a return (IRR) above that which is required (WACC). Both of those justifications are good for shareholders.

Comprehensive Problem 2

- 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?

Comprehensive Problem 2

- Payback period = 4 years
- The project does not pay back on a discounted basis.
- NPV = -2,758.72
- IRR = 7.93% < 9%
- We should reject the project.