Lecture 6

Capital Budgeting

Instructor: Prof. Chen (Alison) Yao
CUHK Business School

Role of Financial Manager

- What long-term investments should the firm take on? (capital budgeting decision)
- Where will we get the long-term financing to pay for the investment? (capital structure decision)
- How will we manage the everyday financial activities of the firm? (working capital management decision)

Capital Budgeting

What type of analysis need to be carried out in order to make the decision?

Good Decision Criteria

We need to ask ourselves the following questions when evaluating decision criteria:

- 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?

Lecture Outline

- This lecture presents and compares different procedures used in practice to decide which project are worth undertaking
  - Net present value (NPV)
  - Payback Rule
  - Internal Rate of Return (IRR)
    - NPV vs IRR

Net Present Value

- **NPV**: the difference between the market value of a project and its cost

- 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.

Estimate Net Present Value

- 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.

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

- **NPV Decision Rule**: accept the project if *NPV* is positive.

Net Present Value Example

Suppose we are asked to decide whether a new consumer product should be launched. Based on projected sales and costs, we expect that the cash flows over the five-year life of the project will be $2,000 in the first two years, $4,000 in the next two, and $5,000 in the last year. It will cost about $10,000 be begin production. We use a 10 percent discount rate to evaluate new products. What should we do here?

Solution

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

$$= \frac{\$2{,}000}{1.1} + \frac{\$2{,}000}{1.1^2} + \frac{\$4{,}000}{1.1^3} + \frac{\$4{,}000}{1.1^4} + \frac{\$5{,}000}{1.1^5} - \$10{,}000$$

$$= \$2{,}313$$

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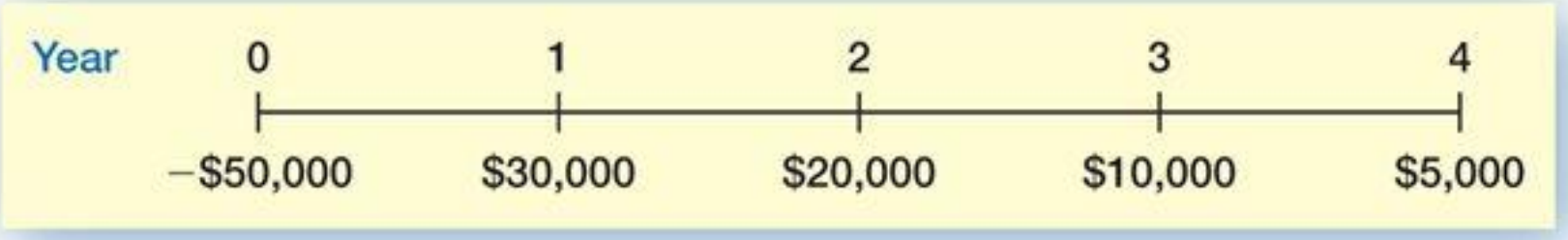
Payback Period

Payback Period: the amount of time required for an investment to generate cash flows sufficient to recover its initial cost.

- How long does it take to get the initial cost back in a *nominal* sense?
- E.g., the initial investment is $50,000. This investment 'pays for itself' in exactly two years.



Payback Period

- Computation
  - Estimate the cash flows
  - Subtract the future cash flows from the initial cost until the initial investment has been recovered

- **Payback Period Decision Rule:** accept the project if the payback period is less than some preset limit

Payback Period Example

- You are reviewing a new project and have estimated the following cash flows:
  - Year 0: CF = -165,000
  - Year 1: CF = 63,120
  - Year 2: CF = 70,800
  - Year 3: CF = 91,080
- 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*

- Payback period = 2 + 31,080/91,080= 2.34 years

The “preset limit” in this example is two-year. Should we accept or reject the project?

Advantages and Disadvantages

- Advantages
  - Easy to understand
  - Biased towards short-term projects
- 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

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Internal Rate of Return

- **Internal rate of return (IRR):** the rate at which the net present value of all the cash flows from a project equal zero

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

$$\sum_{i=1}^{t} \frac{CF_i}{(1+IRR)^i} - CF_0 = 0$$

- 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 Decision Rule:** accept the project if IRR is greater than the required return

Internal Rate of Return Example

An investment costs $100 and has a cash flow of $60 per year for two years. What is its Internal Rate of Return?

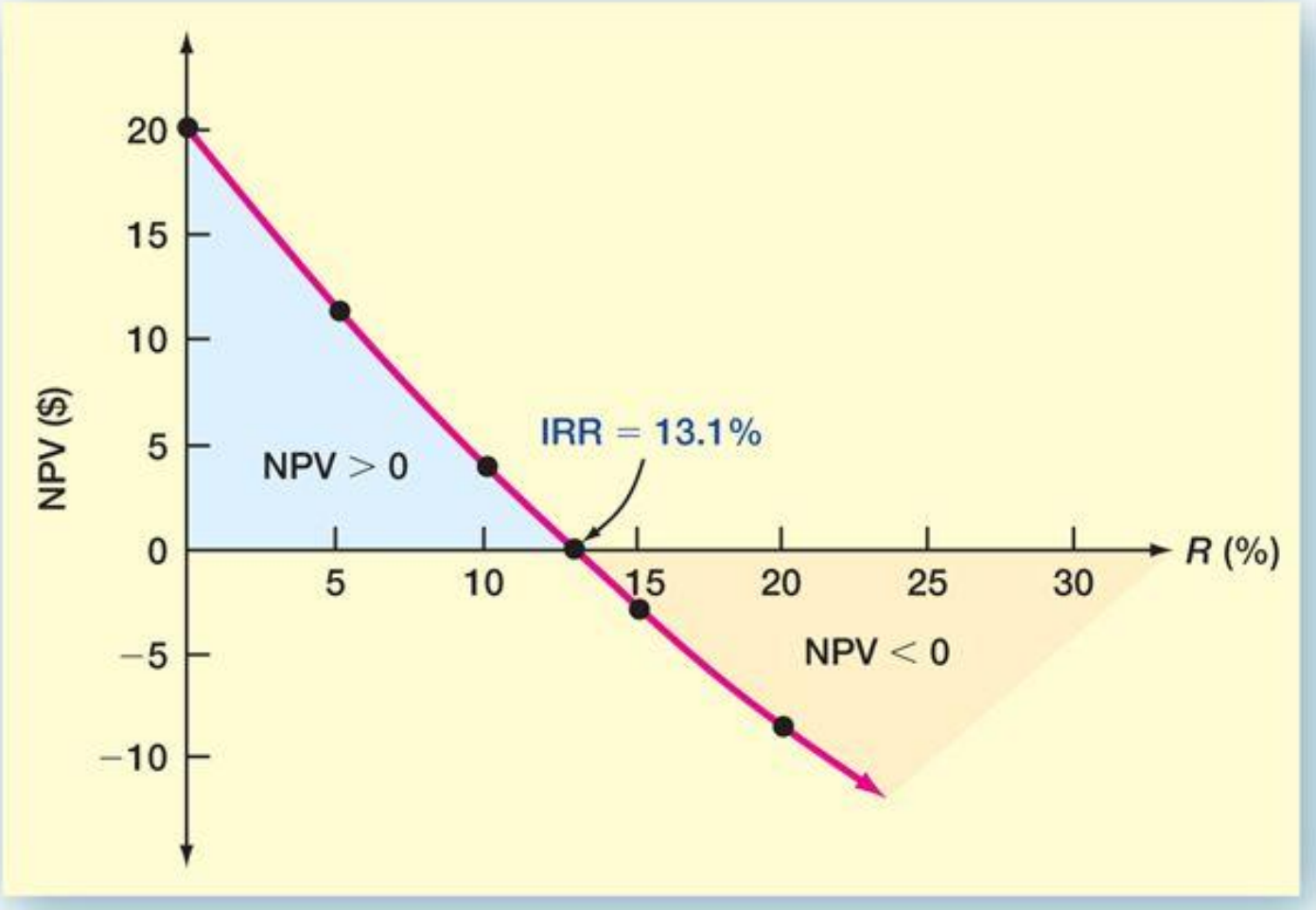
$$NPV = 0 = \sum_{i=1}^{t} \frac{CF_i}{(1+IRR)^i} - CF_0$$

$$NPV = 0 = \frac{\$60}{(1+IRR)} + \frac{\$60}{(1+IRR)^2} - 100$$

Trial and error:

Discount Rate	NPV
0%	$20
5%	11.56
10%	4.13
15%	-2.46
20%	-8.33

Internal Rate of Return Example



Advantages of IRR

- Knowing a return is intuitively appealing
- It is a simple way to communicate the value of a project to someone who does not 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

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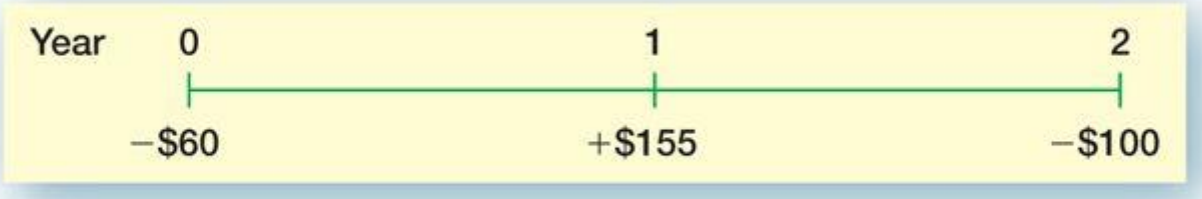
NPV vs. IRR

- NPV and IRR will generally give the same decision
- Exceptions:
  - Nonconventional cash flows – cash flow signs change more than once
    - There might be more than one IRR.
  - Mutually exclusive projects
    - Taking one project means giving up the other

Non-conventional Cash Flows Example

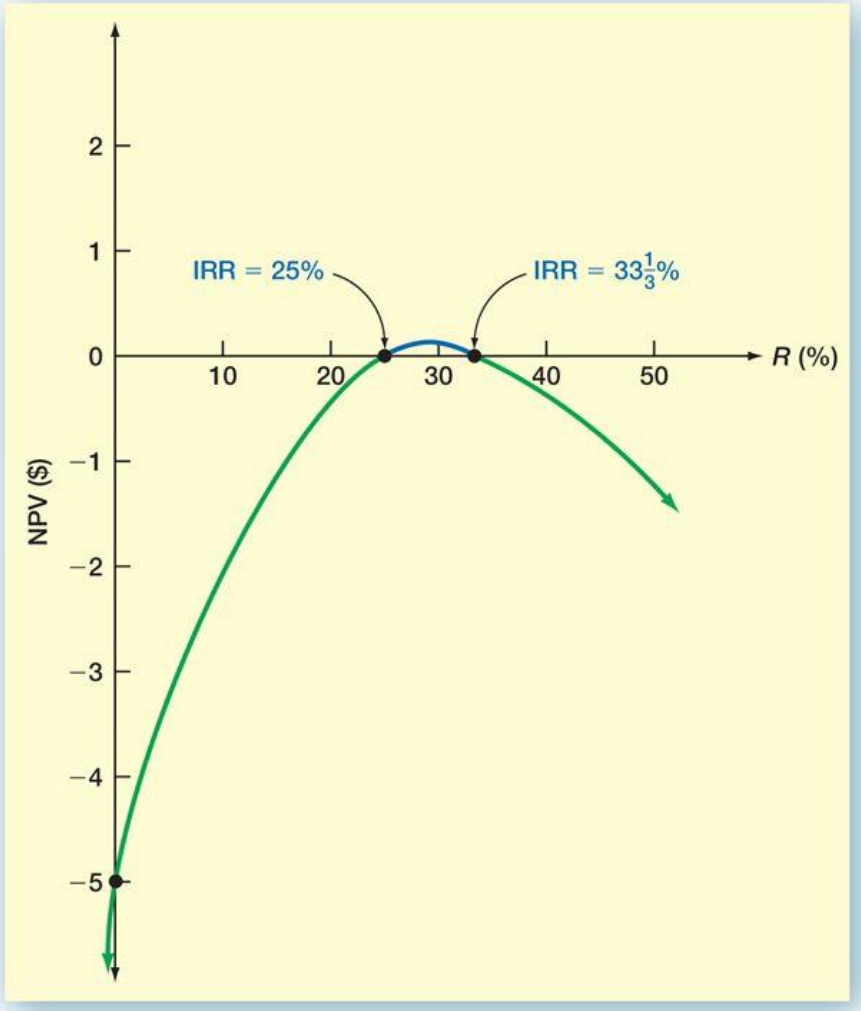
Suppose we have a mining project that requires a $60 investment. Our cash flow in the first year will be $155. In the second year, the mine will be depleted, but we will have to spend $100 to restore the terrain.



$$\frac{\$155}{(1+IRR)}+\frac{-\$100}{(1+IRR)^2}-60=0$$

$$IRR=25\%\ IRR=33.3\%$$

Non-conventional Cash Flows Example



Discount Rate	NPV
0%	-$5.00
10%	-1.74
20%	-0.28
30%	0.06
40%	-0.31

- Suppose our required return is 10%. Should we take this investment?
- However, the NPV is negative if required return is 10%

Mutually Exclusive Projects

- Mutually exclusive projects
  - If you choose one, you cannot choose the other
    - Example: You can choose to attend graduate school at either Harvard or Stanford, but not both
  - Scales are substantially different
  - Timing of cash flows is substantially different

Mutually Exclusive Projects Example

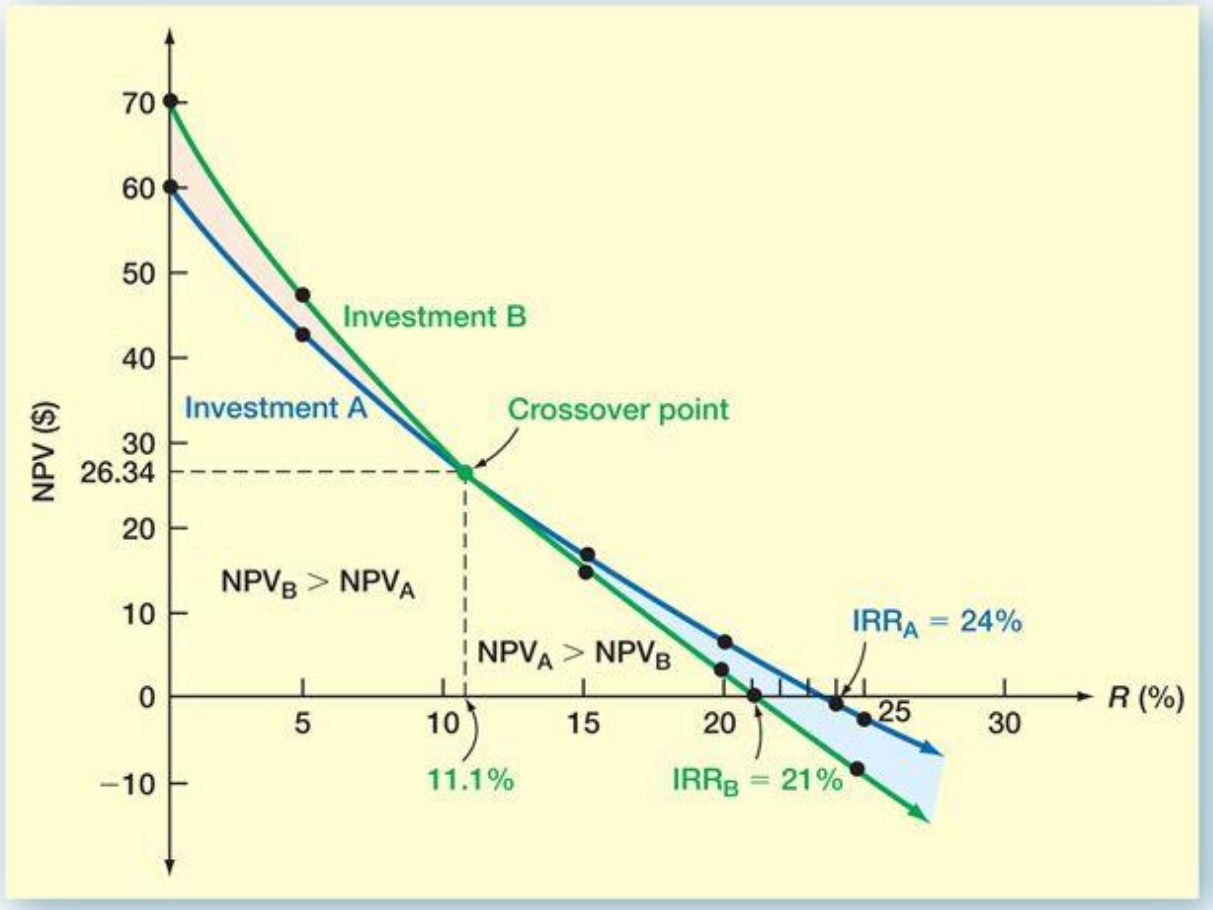
Consider the following cash flows from two mutually exclusive investments.

Year	Investment A	Investment B
0	-$100	-$100
1	50	20
2	40	40
3	40	50
4	30	60
IRR	**24%**	**21%**

Required Rate of Return	NPV (A)	NPV (B)
0%	$60.00	$70.00
5%	43.13	47.88
10%	29.06	29.79
15%	17.18	14.82
20%	7.06	2.31

- Should we choose the project with higher IRR or the project with higher NPV?

Mutually Exclusive Projects Example



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

Calculating the Crossover Rate

Crossover rate: the discount that makes the NPV of the two project equal

Example: we have the following two mutually exclusive projects:

Year	Investment A	Investment B	Difference
0	-$400	-$500	-$100
1	250	320	70
2	280	340	60

What is the crossover rate for the two projects?

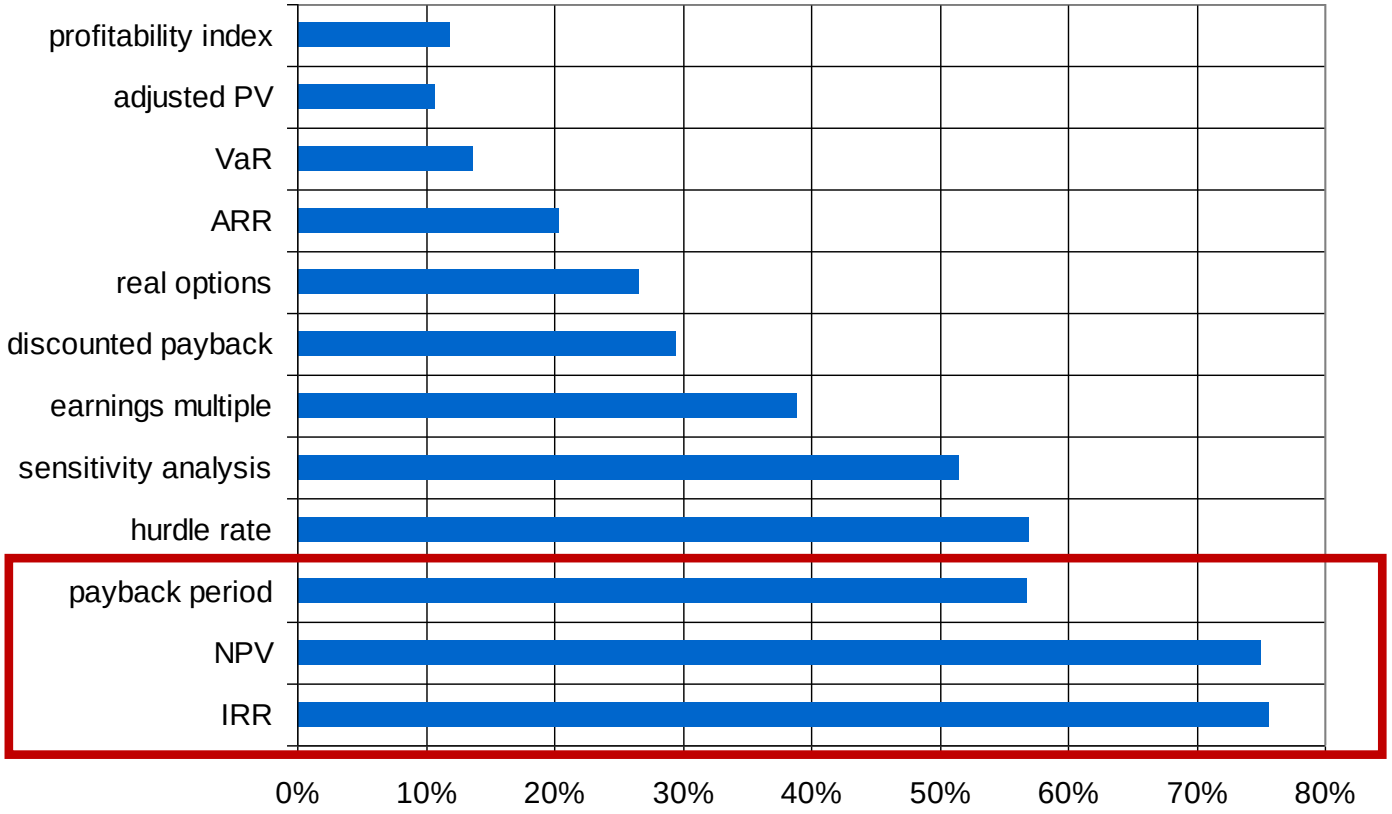
$$-\$100 + \frac{\$70}{(1+\mathrm{r})} + \frac{\$60}{(1+r)^2} = 0$$

$$r = 20\%$$

If the required return is 20%, $NPV_A = NPV_B$, and we are indifferent between the two investments

What Rule Do Managers Use?

Survey Evidence:



Source: Graham, J.R. & C.R. Harvey, JFE (2001)

Summary

- This lectures presents and compares a number of different procedures used in practice.
  - Net Present Value (NPV)
  - Internal Rate of Return (IRR)
  - Payback Period