

Lecture 3

名词解释.

Net Present Value

净现值

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9 Sep 2025

Should I approve the Project?

Suppose you are the CFO of a company. You are offered an investment that promises to pay \$10,000 in one year. The investment costs \$9,600 now. Your interest rate is 5%. Should you buy?

- Naïve answer: Yes. Because $10,000 > 9,600$.
- Wrong! Because of the time value of money, cash flows happened at different points of time are not directly comparable!

Net Present Value (NPV)

Suppose you are the CFO of a company. You are offered an investment that promises to pay \$10,000 in one year is offered for sale for \$9,600. Your interest rate is 5%. Should you buy?

- Right answer:

$$\begin{aligned} \text{NPV} &= -9600 + 10,000/1.05 \\ &= -9600 + 9523.81 \\ &= -\$76.19 \end{aligned}$$

- Reject the project since the present value of the cash inflow is smaller than the cost. We can instead invest the \$9,600 elsewhere at 5%.

NPV Formula



- The formula for *NPV* of an investment can be written as:

$$\text{NPV} = -C_0 + \frac{C_1}{1+r} + \frac{C_2}{(1+r)^2} + \dots + \frac{C_T}{(1+r)^T} = -C_0 + \sum_{i=1}^T \frac{C_i}{(1+r)^i}$$

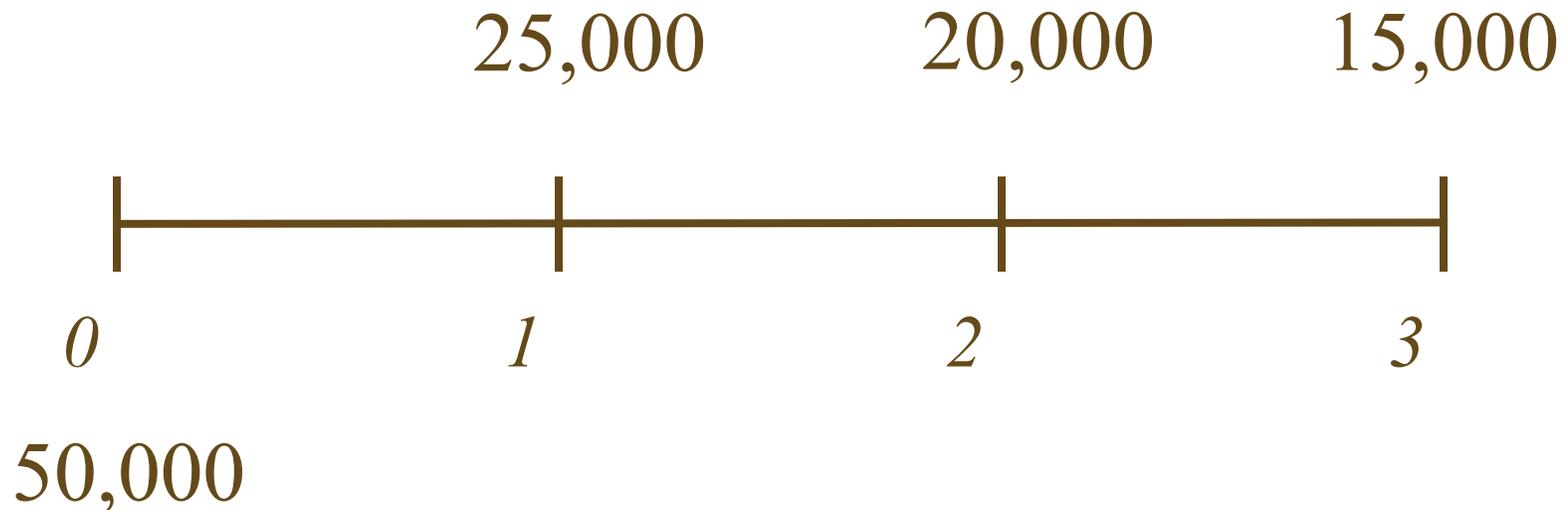
C_T is the cash flow at time T

- NPV Rule:
 - Accept the project when $\text{NPV} > 0$
 - Reject the project when $\text{NPV} < 0$

NPV: Example



NPV Finance.com has an opportunity to invest in a new high-speed computer that costs \$50,000. The computer will generate cash flows (from cost savings) of \$25,000 one year from now, \$20,000 two years from now, and \$15,000 three years from now. The computer will be worthless after three years, and no additional cash flows will occur. Finance.com has determined that the appropriate discount rate is 7 percent for this investment. Should Finance.com make this investment in a new high-speed computer? What is the net present value of the investment?



Hand calculation

	Cash Flows	Present Value Factor
Year 0	-\$50,000	$1 = 1$
1	\$25,000	$\frac{1}{1.07} = .9346$
2	\$20,000	$\left(\frac{1}{1.07}\right)^2 = .8734$
3	\$15,000	$\left(\frac{1}{1.07}\right)^3 = .8163$

Year 0	$-\$50,000 \times 1$	=	$-\$50,000$
1	$\$25,000 \times .9346$	=	$\$23,364.49$
2	$\$20,000 \times .8734$	=	$\$17,468.77$
3	$\$15,000 \times .8163$	=	$\$12,244.47$
		Total:	$\$ 3,077.73$

NPV Using Spreadsheet

<i>t</i>	<i>Cash flow</i>
0	\$ (50,000)
1	25,000
2	20,000
3	15,000

Return: 7%

NPV: \$3,077.73

- NPV function actually calculates present values, not net present values.
- Do not include CF0 in the NPV function, but add it outside.

NPV function “ $=NPV(\text{rate}, CF1, CF2, \dots) + CF0$ ”

NPV Using Web Financial Calculator

秉文在线金融计算器: <http://www.ibluelink.com/calc/>

秉文金融计算器 Financial Calculator

货币时间价值

利率换算

房贷摊销

现金流

日期换算

债券计算器

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关于秉文

现金流

IRR与NPV计算

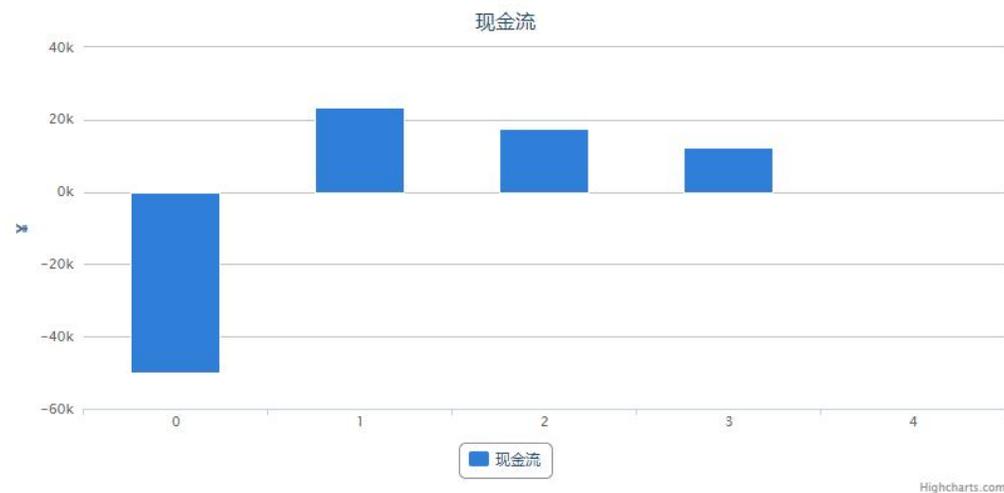
贴现率 %

猜测值

	CFj	Nj	操作
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4	<input type="text" value="0"/>	<input type="text" value="1"/>	<input type="button" value="删除"/>
			<input type="button" value="添加"/>

内部回报率(IRR) %

净现值(NPV)



NPV Estimation

- Net Present Value (NPV) = Initial Investment + Total PV of future CF
- Key steps in estimating NPV:
 1. Estimate future cash flows: how much? and when?
 2. Estimate discount rate: project risk? 贴现率.
 3. Estimate initial costs
- Minimum Acceptance Criteria: Accept if $NPV > 0$
- Ranking Criteria: Choose the highest NPV

Why NPV method works?



- Remember the goal of financial management is to maximize the shareholder's value.
- A firm can be viewed as the sum of many projects. Some are successful ones while some are not.
- Accepting positive NPV projects benefits the stockholders. The value of the firm rises by the NPV of the project
- The NPV is very sensitive to the discount rate. It is the required rate for the investment, or the expected rate with the same risk in the capital market.

Internal Rate of Return (IRR)

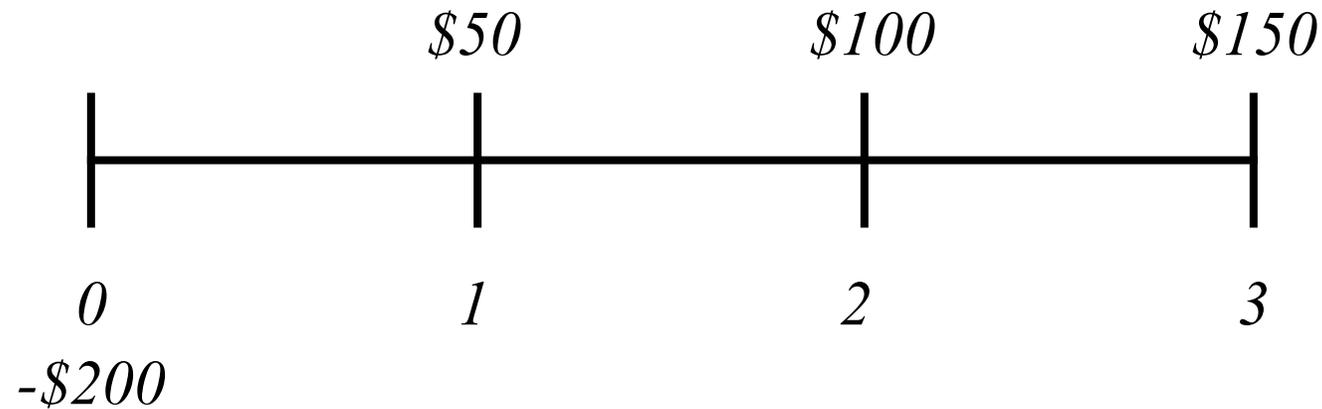
内部收益率



- IRR: the discount rate that sets NPV to zero
- Minimum Acceptance Criteria: Accept if the IRR exceeds the required return
- Ranking Criteria: Select alternative with the highest IRR
- Reinvestment assumption: All future cash flows are assumed to be reinvested at the IRR

IRR: Example

Consider the following project:



$$NPV = 0 = -200 + \frac{\$50}{(1 + IRR)} + \frac{\$100}{(1 + IRR)^2} + \frac{\$150}{(1 + IRR)^3}$$

The internal rate of return for this project is 19.44%

IRR using Web Financial Calculator

秉文金融计算器 Financial Calculator

货币时间价值

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贴现率 %

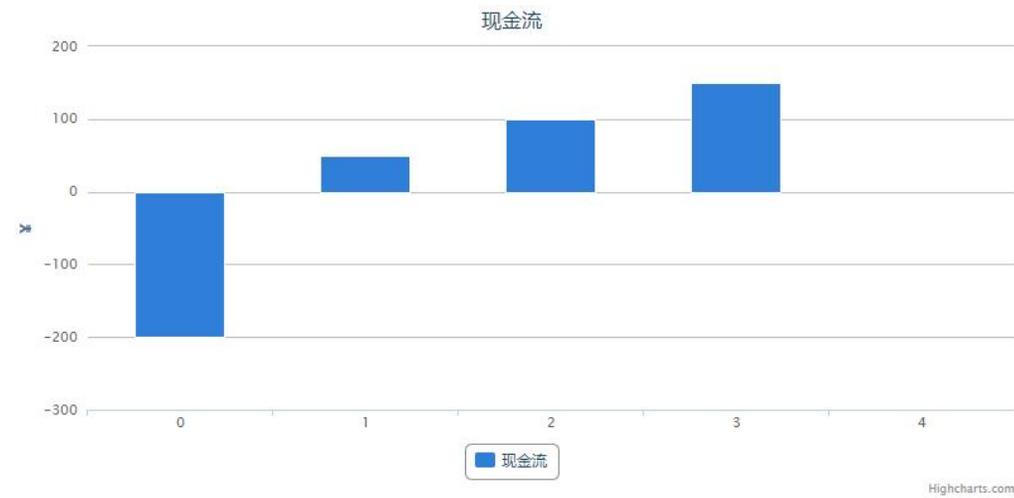
猜测值

	CFj	Nj	操作
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3	<input type="text" value="150"/>	<input type="text" value="1"/>	<input type="button" value="删除"/>
4	<input type="text" value="0"/>	<input type="text" value="1"/>	<input type="button" value="删除"/>
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内部回报率(IRR) %

净现值(NPV)

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IRR Application

Plan A: Borrow 100 at 3%, you pay 109 three years later (一次性还本付息)

Plan B: Borrow 100 at 3%, you pay 3 at each year end, and pay 100 three years later (每年付息到期还本) .

Plan C: Borrow 100, you pay 16, 32, 60 in the following three years.

Question:

- 3%: Simple or compound interest?
- Which plan should you choose?

$$16 + 32 + 60$$

$$108$$

Problems with IRR

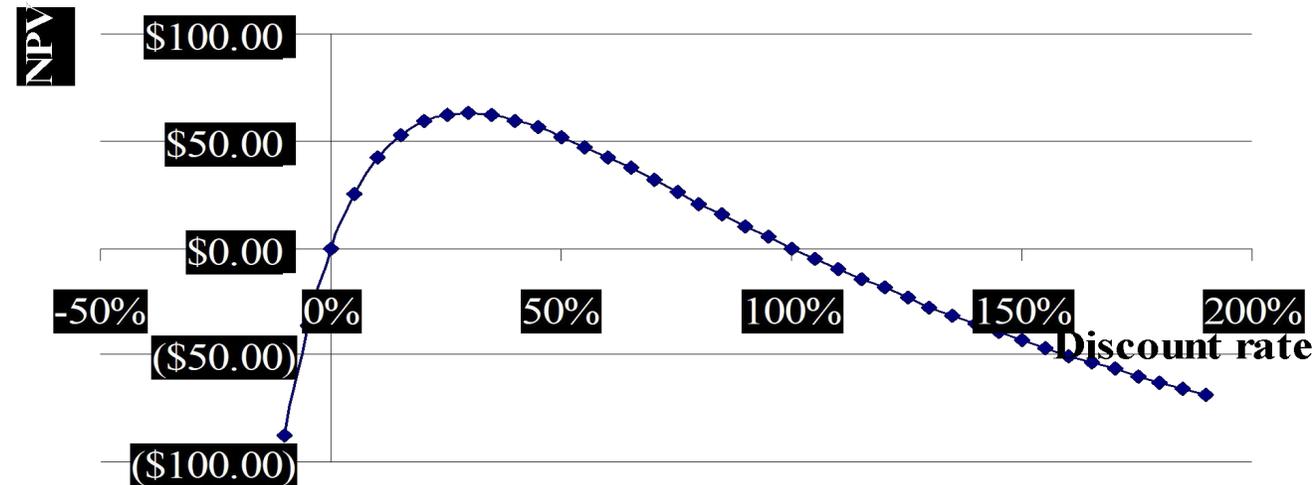
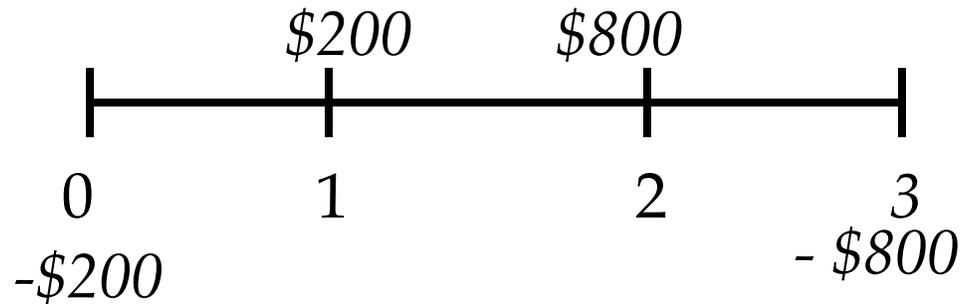


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- Multiple IRRs
 - Are we Borrowing or lending
 - The scale problem
 - The timing problem
- } Only for mutually exclusive projects

Multiple IRR Problem

There are two IRRs (0% and 100%) for this project:



- Which one should we use?
- When the cash flow changes signs, multiple IRRs problem can happen.

Investing or Financing Problem

- Consider two projects: Project A (-100, 130), Project B (100, -130)
- Both of the IRR of the two projects are 30%.
- However, for financing, the IRR rule is reversed.
- That is, accept the project when $IRR < \text{Required return}$, and reject it when $IRR > \text{Required return}$.

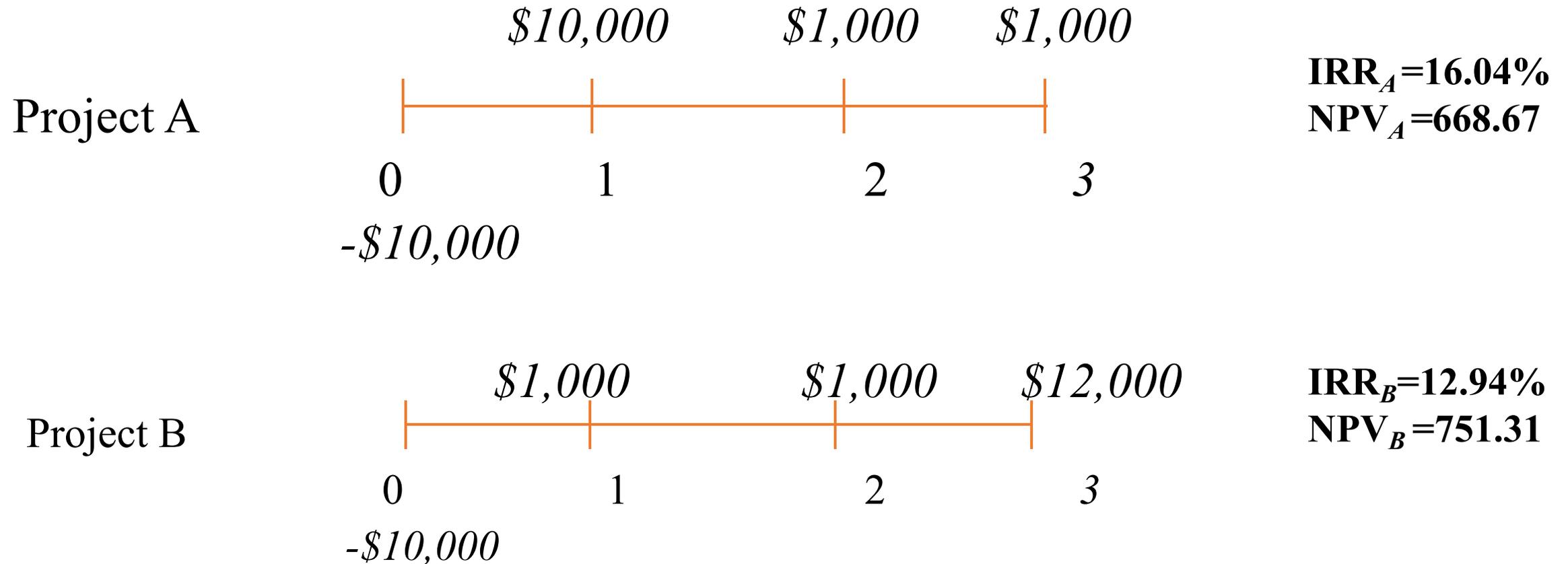
The Scale Problem

- Mutually Exclusive Projects: only one of several potential projects can be chosen.
- Independent Projects: accepting or rejecting one project does not affect the decision of the other projects.
- The IRR method may conflict with the NPV method in evaluating mutually exclusive projects. Remember always use the NPV rule.

	Cash Flow at Date 0	Cash Flow at Date 1	NPV @25%	IRR
Small budget	-\$10 million	\$40 million	\$22 million	300%
Large budget	-25 million	65 million	27 million	160

The Timing Problem

Assume 10% discount rate, which project should choose?



IRR Summary

- Disadvantages:
 - Does not distinguish between investing and borrowing
 - IRR may not exist, or there may be multiple IRRs
 - Problems with mutually exclusive investments

- Advantages:
 - Easy to understand and communicate

NPV vs. IRR



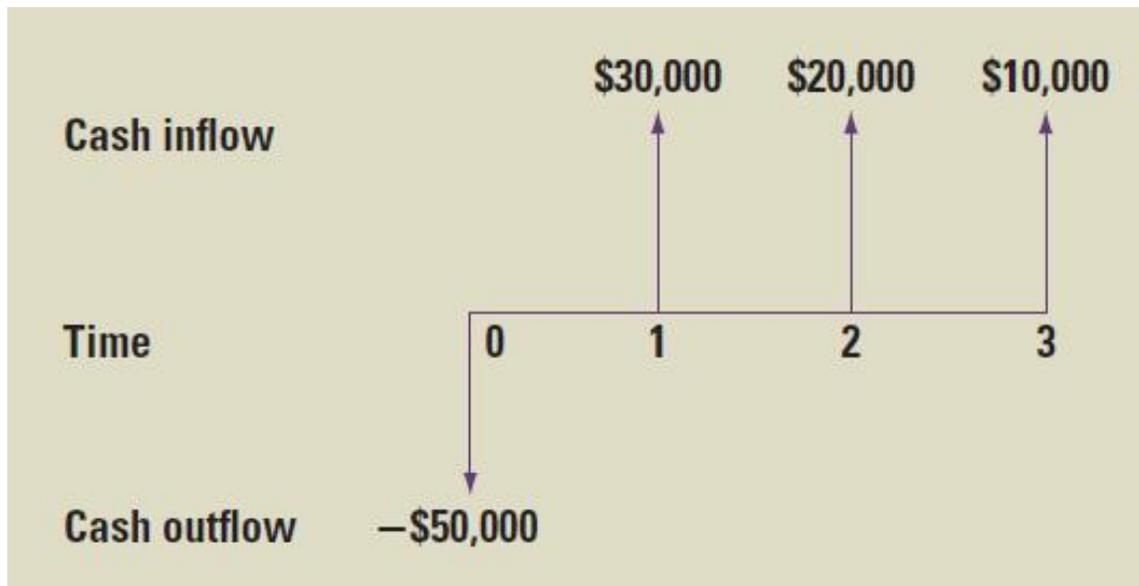
- NPV and IRR will generally give the same decision.
- Exceptions:
 - Non-conventional cash flows – cash flow signs change more than once.
 - Mutually exclusive projects
 - Initial investments are substantially different.
 - Timing of cash flows is substantially different.
- When they give different conclusions, use the NPV one.

Payback Period Rule

回收期法



- How long does it take the project to “pay back” its initial investment?
- Payback Period = number of years to recover initial costs
- Minimum Acceptance Criteria: Set by management



Payback Period = 2 year

Payback Period Rule

- Disadvantages:
 - Ignores the time value of money
 - Ignores cash flows after the payback period
 - Biased against long-term projects
 - Requires an arbitrary acceptance criteria
 - A project accepted based on the payback criteria may not have a positive NPV

- Advantages:
 - Easy to understand
 - Biased toward liquidity

Profitability Index (PI)



- $PI = \text{Total PV of future cash flows} / \text{Initial investment}$
- Minimum Acceptance Criteria: Accept if $PI > 1$
- Ranking Criteria: Select alternative with highest PI
- The PI method can be used in capital rationing

Capital Rationing

Suppose you have only \$20, which project should you choose?

Project	Cash Flows (\$000,000)			PV @ 12% of Cash Flows Subsequent to Initial Investment (\$000,000)	Profitability Index	NPV @12% (\$000,000)
	C_0	C_1	C_2			
1	-\$20	\$70	\$10	\$70.5	3.53	\$50.5
2	-10	15	40	45.3	4.53	35.3
3	-\$10	-\$5	\$60	\$43.4	4.34	\$33.4

- Trial and error, and choose the combination with the highest-NPV.
- Or judge by PI, choose project 2 and 3. The NPV rule does not work when capital is limited.

Profitability Index (PI)

- Disadvantages:

- Since it is a ratio, there may be problems with mutually exclusive investments (the scale problem)

- Advantages:

- May be useful when available investment funds are limited
- Easy to understand and communicate
- Correct decision when evaluating independent projects

Which Method Is More Popular?

- Some firms may use payback, while others choose an alternative approach.
- The most frequently used technique for large corporations is either IRR or NPV.
- When IRR and NPV generate opposite conclusion, choose the NPV method.

Capital Budgeting: Example

Compute the IRR, NPV, PI, and payback period for the following two projects. Assume the required return is 10%.

Year	Project A	Project B
0	-\$200	-\$150
1	\$200	\$50
2	\$800	\$100
3	-\$800	\$150

0 or 10%

Capital Budgeting: Example

	Project A	Project B
CF_0	-\$200.00	-\$150.00
PV_0 of CF_{1-3}	\$241.92	\$240.80
NPV =	\$41.92	\$90.80
IRR =	0%, 100%	36.19%
PI =	1.2096	1.6053

Capital Budgeting: Example

Payback Period:

Time	<i>Project A</i>		<i>Project B</i>	
	CF	Cum. CF	CF	Cum.CF
0	-200	-200		-150
1	200	0	50	-100
2	800	800		100
3	-800	0	150	150

Payback period for project B = 2 years.

Payback period for project A = 1 or 3 years?

Summary

- Net present value
 - Difference between present value and cost
 - Accept 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
 - IRR is unreliable with non-conventional cash flows or mutually exclusive projects

Summary



- 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

- Payback period
 - Length of time until initial investment is recovered
 - Take the project if it pays back in some specified period
 - Does not account for time value of money, and there is an arbitrary cutoff period