FN201: Lecture Note 5
Investment Criteria and Decision

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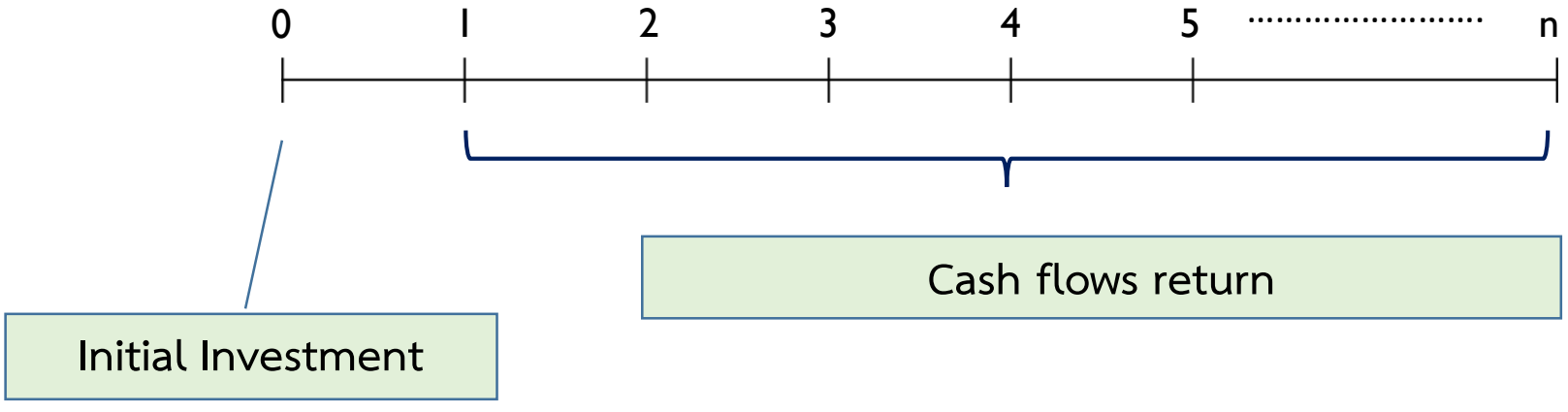
Project Decision

1. Replacement needed to continue profitable operations
2. Replacement to reduce costs
3. Expansion of existing products or markets
4. Expansion into new products or markets
5. Contraction decisions
6. Safety and/or environmental projects
7. Mergers
8. Others (i.e. catch-all items)

Overview

Investment time line



Decision Tools

1. Net Present Value (NPV)
2. Internal Rate of Return (IRR)
   - Modified Internal Rate of Return (MIRR)
3. Profitability Index (PI)
4. Payback period (PP)
   - Regular PP
   - Discounted PP

1 Net Present Value (NPV)

= PV value of a project's cash inflows minus PV of its costs (cash outflows)

$$NPV = CF_0 + \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \ldots + \frac{CF_N}{(1+r)^N}$$

$$= \sum_{t=0}^{N} \frac{CF_t}{(1+r)^t}$$

1 Net Present Value (NPV)

Example: Find Net Present Value of these projects when cost of capital = 12%

Year	Expected Net Cash Flows	
	Project X	Project Y
0	-10,000	-10,000
1	6,500	3,500
2	3,000	3,500
3	3,000	3,500
4	1,000	3,500

NPV **X = $966.01** **Y= $630.72**

1 Net Present Value (NPV)

Decision criteria:

1. Independent projects

   = cash flows of each project are not affected by the other

   NPV exceeds zero

2. Mutually exclusive projects

   = two different ways to accomplish the same result

   Highest NPV project

2 Internal Rate of Return (IRR)

= the discount rate that forces the PV of cash inflows to equal the PV of cash outflows

$$NPV = CF_0 + \frac{CF_1}{(1+IRR)^1} + \frac{CF_2}{(1+IRR)^2} + \ldots + \frac{CF_N}{(1+IRR)^N}$$

$$= \sum_{t=0}^{N} \frac{CF_t}{(1+IRR)^t} = 0$$

Key Assumption

= Project cash flows can be reinvested at the same rate or at the IRR itself

2 Internal Rate of Return (IRR)

Trial and Error / Excel / Calculator

Example: Find the Internal Rate of Return (IRR) of these projects

Year	Expected Net Cash Flows	
	Project X	Project Y
0	-10,000	-10,000
1	6,500	3,500
2	3,000	3,500
3	3,000	3,500
4	1,000	3,500

IRR **X = 18.03%** **Y= 14.96%**

2 Internal Rate of Return (IRR)

Decision criteria:

1. Independent projects

IRR exceeds cost of capital

2. Mutually exclusive projects

Highest IRR project

2 Internal Rate of Return (IRR)

The assumption of reinvestment of project cash flows does not generally hold!

= IRR overstates the true expected rate of return of the accepted project

Modified Internal Rate of Return (MIRR)

$$\sum_{t=0}^{N} \frac{COF_t}{(1+r)^t} = \frac{\sum_{t=0}^{N} CIF_t (1+r)^{N-t}}{(1+MIRR)^N}$$

$$PV\ Costs = \frac{Terminal\ Value\ (\mathrm{TV})}{(1+MIRR)^N}$$

2 Internal Rate of Return (IRR)

Example: Find the Modified Internal Rate of Return (MIRR) of these projects when reinvestment rate = cost of capital at 12%

Year	Expected Net Cash Flows	
	Project X	Project Y
0	-10,000	-10,000
1	6,500	3,500
2	3,000	3,500
3	3,000	3,500
4	1,000	3,500
MIRR	**X = 14.61%**	**Y = 13.73%**
IRR	**X = 18.03%**	**Y = 14.96%**

2 Internal Rate of Return (IRR)

Decision criteria:

1. Independent projects

NPV, IRR, and MIRR reach the same conclusion.

MIRR exceeds cost of capital

2. Mutually exclusive projects

Highest MIRR project

NPV, IRR, and MIRR may result in conflicts!

Net Present Value vs. Internal Rate of Return Decision for mutually exclusive projects

NPV vs. IRR

A) when cost of capital = 12%

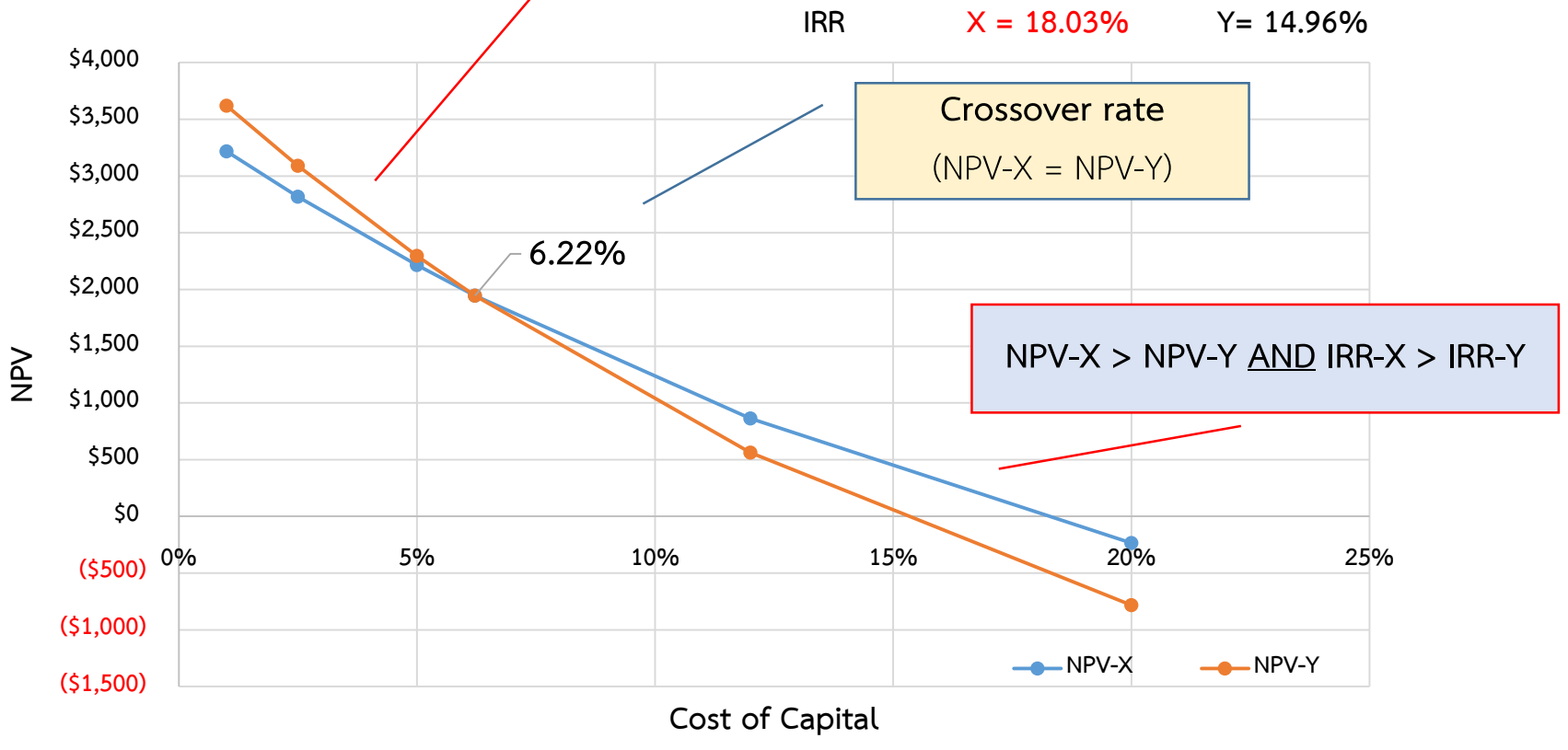
NPV	X = $966.01	Y = $630.72
IRR	X = 18.03%	Y = 14.96%
MIRR	X = 14.61%	Y = 13.73%

B) what if cost of capital = 5%

NPV	X = $2,325.78	Y = $2,410.83
IRR	X = 18.03%	Y = 14.96%
MIRR	X = 14.61%	Y = 13.73%

NPV vs. IRR

Net Present Value Profiles



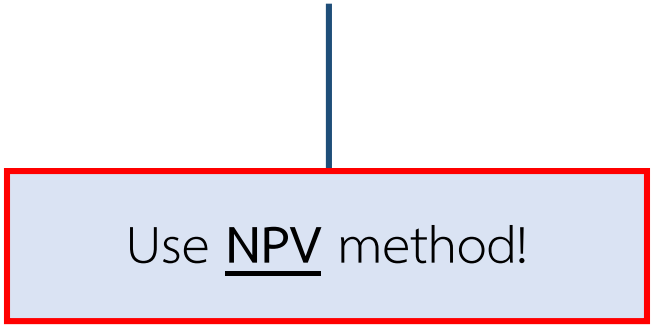
NPV vs. IRR

Conflicts arise because:

1. Timing differences of project cash flows

2. Project size (initial investment) differences

Which one is better?



3 Profitability Index (PI)

$$PI = \frac{PV\ of\ \ future\ cash\ flow}{initial\ \ investment} = \frac{\sum_{t=1}^{N} \frac{CF_t}{(1+r)^t}}{CF_0}$$

= relative profitability of the project

= present value per dollar of initial investment

3 Profitability Index (PI)

Example: Find the Profitability Index (PI) of these projects when cost of capital = 12%

Year	Expected Net Cash Flows	
	Project X	Project Y
0	-10,000	-10,000
1	6,500	3,500
2	3,000	3,500
3	3,000	3,500
4	1,000	3,500

4 Payback Period

= the number of years required to recover the fund invested in a project from its operating cash flows

$$\text{Payback} = \begin{array}{c}\text{Number of years}\\ \text{prior to full}\\ \text{recover}\end{array} + \frac{\text{Unrecovered cost at start of year}}{\text{Cash flow during full recovery year}}$$

Regular vs. Discounted

Payback Period ?

4 Payback Period

Example: Find the regular and discounted payback period of these projects given cost of capital = 12%

Year	Expected Net Cash Flows	
	Project X	Project Y
0	-10,000	-10,000
1	6,500	3,500
2	3,000	3,500
3	3,000	3,500
4	1,000	3,500

Question?