

Module 9

Net Present Value and Other Investment Rules

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Key Concepts and Skills

- Be able to compute payback and discounted payback and understand their shortcomings
- Be able to compute the internal rate of return and profitability index, understanding the strengths and weaknesses of both approaches
- Be able to compute net present value and understand why it is the best decision criterion

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Chapter Outline

- 1 Why Use Net Present Value?
- 2 The Payback Period Method
- 3 The Internal Rate of Return (IRR)
- 4 Problems with the IRR Approach
- 5 The Profitability Index
- 6 The Practice of Capital Budgeting

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Pizza Wagon

Introduction

- Olive is made redundant at the age of 57.
- She cannot draw her pension until she is 60.
- She decides to run her own business for 3 years.
- This will be a catering service.
- She intends to sell pizzas for £4 each.
- Ingredients will cost £1 each.
- She intends to buy a parcel van (£ 19,500) and convert it to a mobile kitchen and sales facility.
- It will be called 'The Pizza Wagon'.
- Her business plan income and expenditure are shown in the next slide.

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Pizza Wagon (Continued)				
	<i>Year 1</i>	<i>Year 2</i>	<i>Year 3</i>	<i>3-Year Period</i>
No. of pizzas sold	<u>15,000</u>	<u>20,000</u>	<u>25,000</u>	<u>60,000</u>
	£	£	£	£
Sales revenue	60,000	80,000	100,000	240,000
Cost of ingredients	<u>15,000</u>	<u>20,000</u>	<u>25,000</u>	<u>60,000</u>
Gross profit	<u>45,000</u>	<u>60,000</u>	<u>75,000</u>	<u>180,000</u>
Van depreciation	6,500	6,500	6,500	19,500 (straight-line)
Van running costs	9,000	9,000	9,000	27,000
Site fees	11,000	14,000	19,000	44,000
Advertising	5,000	4,000	4,000	13,000
Administration	<u>3,500</u>	<u>3,500</u>	<u>3,500</u>	<u>10,500</u>
Total overheads	<u>35,000</u>	<u>37,000</u>	<u>42,000</u>	<u>114,000</u>
Net profit	<u>10,000</u>	<u>23,000</u>	<u>33,000</u>	<u>66,000</u>

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Details of Van Payment
• Olive has no business track record. • She is unable to buy van on credit terms. • She needs to use £19,500 cash to pay for the van at the start of year 1.

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Owner's Point of View

- Olive is satisfied with budget projections.
- £10,000 is much less than her current income of about £15,000. But if she is careful, she believes she can survive her first year by living simply.
- Years 2 and 3 look considerably better compared to her current income.

However, Olive is shocked at end of year 1 that she is running short of working capital!!! Can you see why?

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Conversion of Profit to Cash Flow

	Year 1	Year 2	Year 3	3-Year Period
	£	£	£	£
NET PROFIT	10,000	23,000	33,000	66,000
ADJUSTMENT*	-13,000	+6,500	+6,500	-
NET CASH FLOW	- 3,000	+29,500	+39,500	+66,000
<u>*Calculation of adjustment</u>				
Depreciation	6,500	6,500	6,500	19,500
Less: van payment	<u>19,500</u>	<u>-</u>	<u>-</u>	<u>19,500</u>
	<u>-13,000</u>	<u>+6,500</u>	<u>+6,500</u>	<u>-</u>

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What is Capital Investment Appraisal (CIA)?

Capital Investment Appraisal is about deciding, which fixed assets to acquire or which long-term projects to invest in, e.g. factories, machinery, offices, etc.

Typically,

- large amounts of money are involved over long periods of time.
- the cost of reversing a CIA decision is very high.

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Capital Investment Appraisal (CIA)

ARR = Accounting Rate of Return

Profit-based

PBP = Payback Period

NPV = Net Present Value

Cash-flow based

IRR = Internal Rate of Return

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Accounting Rate of Return

This method expresses the expected average annual profits as a percentage of the initial investment.

$$\text{ARR} = \frac{\text{average annual profit}}{\text{initial investment}} \times 100$$

Companies using ARR may have a predetermined threshold percentage below which projects will not be accepted.

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Accounting Rate of Return

- Depreciation may be calculated several ways.
- Income may vary from year to year.
- Time value of money is ignored.



So why would I ever want to use this method anyway?

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Accounting Rate of Return

Reconsider the \$16,000 investment being considered by FasTek. The annual after-tax net income is \$2,100. Compute the accounting rate of return.

$$\text{Accounting rate of return} = \frac{\$2,100}{\$16,000} = 13.13\%$$

Cash flow	\$ 4,100
Depreciation	<u>2,000</u>
Income	<u>\$ 2,100</u>
Depreciation = (\$16,000 - 0) ÷ 8 years	

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Limitations of ARR

- Profits are based on subjective opinions.
- Profits depend on depreciation method used.
- Profits can be manipulated by creative accounting.

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1 Why Use Net Present Value?

- Accepting positive NPV projects benefits shareholders.
 - NPV uses cash flows
 - NPV uses all the cash flows of the project
 - NPV discounts the cash flows properly

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The Net Present Value (NPV) Rule

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

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Calculating NPV with Spreadsheets

- 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*.
 - Add the initial investment after computing the NPV.

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Year	0	1	2	3
Cash Flows	-165000	63120	70800	91080
Required Return	0.12			
NPV - Incorrect	\$11,274.48			
NPV - Correct	\$12,627.41			

$$\text{NPV}(12\%, Y1, Y2, Y3) + (165000) = 12,627.41$$

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Net Present Value

- ❶

Discount the future net cash flows from the investment at the required rate of return.
- ❷

Subtract the initial amount invested from sum of the discounted cash flows.

FasTek is considering the purchase of a conveyor costing \$16,000 with an 8-year useful life with zero salvage value that promises annual net cash flows of \$4,100. FasTek requires a 12 percent compounded annual return on its investments.

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Net Present Value with Equal Cash Flows

Present value factors
for 12 percent

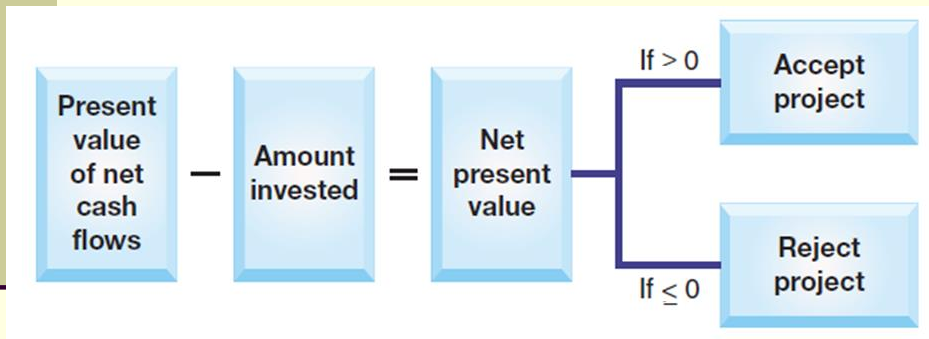
Year	Cash Flows	Present Value of \$1 Factor	Present Value of Cash Flows
1	\$ 4,100	0.8929	\$ 3,661
2	4,100	0.7972	3,269
3	4,100	0.7118	2,918
4	4,100	0.6355	2,606
5	4,100	0.5674	2,326
6	4,100	0.5066	2,077

A positive net present value indicates that this project earns more than 12 percent on the investment.

Total	\$ 32,800	\$ 20,367
Amount to be invested		(16,000)
Net present value of investment		\$ 4,367

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NPV rule:



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Net Present Value with Uneven Cash Flows

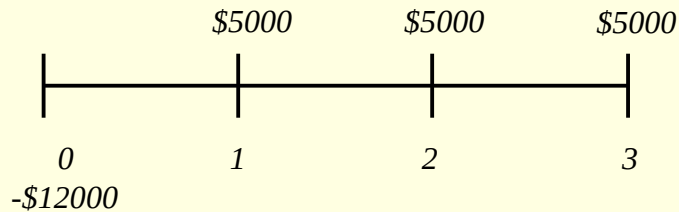
	Net Cash Flows			Present Value of 1 at 10%	Present Value of Net Cash Flows		
	A	B	C		A	B	C
Year 1	\$ 5,000	\$ 8,000	\$ 1,000	0.9091	\$ 4,546	\$ 7,273	\$ 909
Year 2	5,000	5,000	5,000	0.8264	4,132	4,132	4,132
Year 3	5,000	2,000	9,000	0.7513	3,757	1,503	6,762
Totals	\$15,000	\$15,000	\$15,000		12,435	12,908	11,803
Amount invested					(12,000)	(12,000)	(12,000)
Net present value ...					\$ 435	\$ 908	\$ (197)

Although all projects require the same investment and have the same total net cash flows, project B has a higher net present value because of a larger net cash flow in year 1.

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NPV: Example

Consider the following project:



The rate of NPV for this project is 10%

$$NPV = -12000 + \frac{\$5000}{(1+R)} + \frac{\$5000}{(1+R)^2} + \frac{\$5000}{(1+R)^3}$$

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2 Payback Period

The payback period of an investment is the time expected to recover the initial investment amount.

Managers prefer investing in projects with shorter payback periods.



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Payback period

- Disadvantages:
 - Ignore Time Value
 - Ignore later the cash inflow
 - bias the long-term project
- Advantages:
 - Easy to understand
 - Use cashflow instead

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Computing Payback Period with Even Cash Flows

FasTek is considering buying a new machine that will be used in its manufacturing operations. The machine costs \$16,000 and is expected to produce **annual net cash flows** of \$4,100. The machine is expected to have an 8-year useful life with no salvage value.

Calculate the payback period.

$$\text{Payback period} = \frac{\text{Cost of Investment}}{\text{Annual Net Cash Flow}}$$

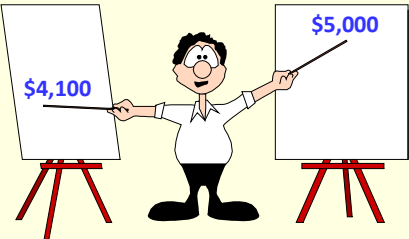
$$\text{Payback period} = \frac{\$16,000}{\$4,100} = 3.9 \text{ years}$$



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Computing Payback Period
with Uneven Cash Flows

In the previous example, we assumed that the increase in cash flows would be the same each year. Now, let's look at an example where the cash flows vary each year.



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Computing Payback Period
with Uneven Cash Flows

FasTek wants to install a machine that costs \$16,000 and has an 8-year useful life with zero salvage value. Annual net cash flows are:

Payback is about 4.2 years.

Year	Annual Net Cash Flows	Cumulative Net Cash Flows
0	\$ (16,000)	\$ (16,000)
1	3,000	(13,000)
2	4,000	(9,000)
3	4,000	(5,000)
4	4,000	(1,000)
5	5,000	4,000
6	3,000	7,000
7	2,000	9,000
8	2,000	11,000

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Using the Payback Period

The payback period has two major shortcomings:

- It ignores the time value of money; and
- It ignores cash flows after the payback period.

Consider the following example where both projects cost \$5,000 and have five-year useful lives:

Year	Project One Net Cash Inflows	Project Two Net Cash Inflows
1	\$ 2,000	\$ 1,000
2	2,000	1,000
3	2,000	1,000
4	2,000	1,000
5	2,000	1,000,000

Would you invest in Project One over Project Two just because it has a shorter payback period?

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3 The Internal Rate of Return

- 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

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Internal Rate of Return (IRR)

The interest rate that makes . . .

- ①
$$\begin{array}{ccc} \text{Present} & & \text{Present} \\ \text{value of} & = & \text{value of} \\ \text{cash inflows} & & \text{cash outflows} \end{array}$$
- ② The net present value equals zero.

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Internal Rate of Return (IRR)

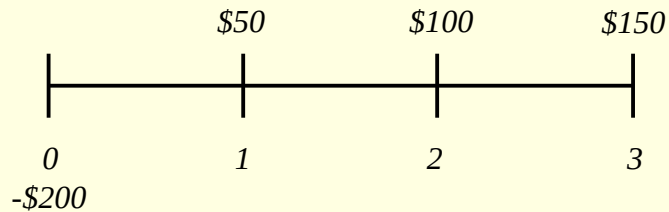
- Disadvantage:
 - IRRs
 - Problems with mutually exclusive investments
- Advantage:
 - Easy to communicate

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IRR: Example

Consider the following project:



The internal rate of return for this project is 19.44%

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

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4 The Profitability Index (PI)

$$PI = \frac{\text{Total PV of Future Cash Flows}}{\text{Initial Investment}}$$

- Minimum Acceptance Criteria:
 - Accept if $PI > 1$
- Ranking Criteria:
 - Select alternative with highest PI

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The Profitability Index

- Disadvantages:
 - Problems with mutually exclusive investments
- Advantages:
 - It can be useful if the investment limited capital
 - It is very easy to understand and communication

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5 The Practice of Capital Budgeting

- Varies by industry:
 - Some firms use payback, others use accounting rate of return
 - (ARR=Average Net Income after tax/Initial investment).

Common methods are IRR or NPV.

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Example of Investment Rules

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

	Net Cash Flows			Present Value of I at 10%	Present Value of Net Cash Flows		
	A	B	C		A	B	C
Year 1	\$ 5,000	\$ 8,000	\$ 1,000	0.9091	\$ 4,546	\$ 7,273	\$ 909
Year 2	5,000	5,000	5,000	0.8264	4,132	4,132	4,132
Year 3	5,000	2,000	9,000	0.7513	3,757	1,503	6,762
Totals	\$15,000	\$15,000	\$15,000		12,435	12,908	11,803
Amount invested					(12,000)	(12,000)	(12,000)
Net present value ...					\$ 435	\$ 908	\$ (197)

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Summary – Discounted Cash Flow

- **NPV**
 - Consider time value of money
 - Accept the project if the NPV is positive
- **IRR**
 - 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非傳統現金流(-, +, +, +, -, + or alternatively +, -, -, +, -)
- **PI**
 - Benefit-cost ratio
 - Take investment if PI > 1
 - May be used to rank projects in the presence of capital rationing

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Summary – Payback Criteria

- 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

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Thanks

End

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