

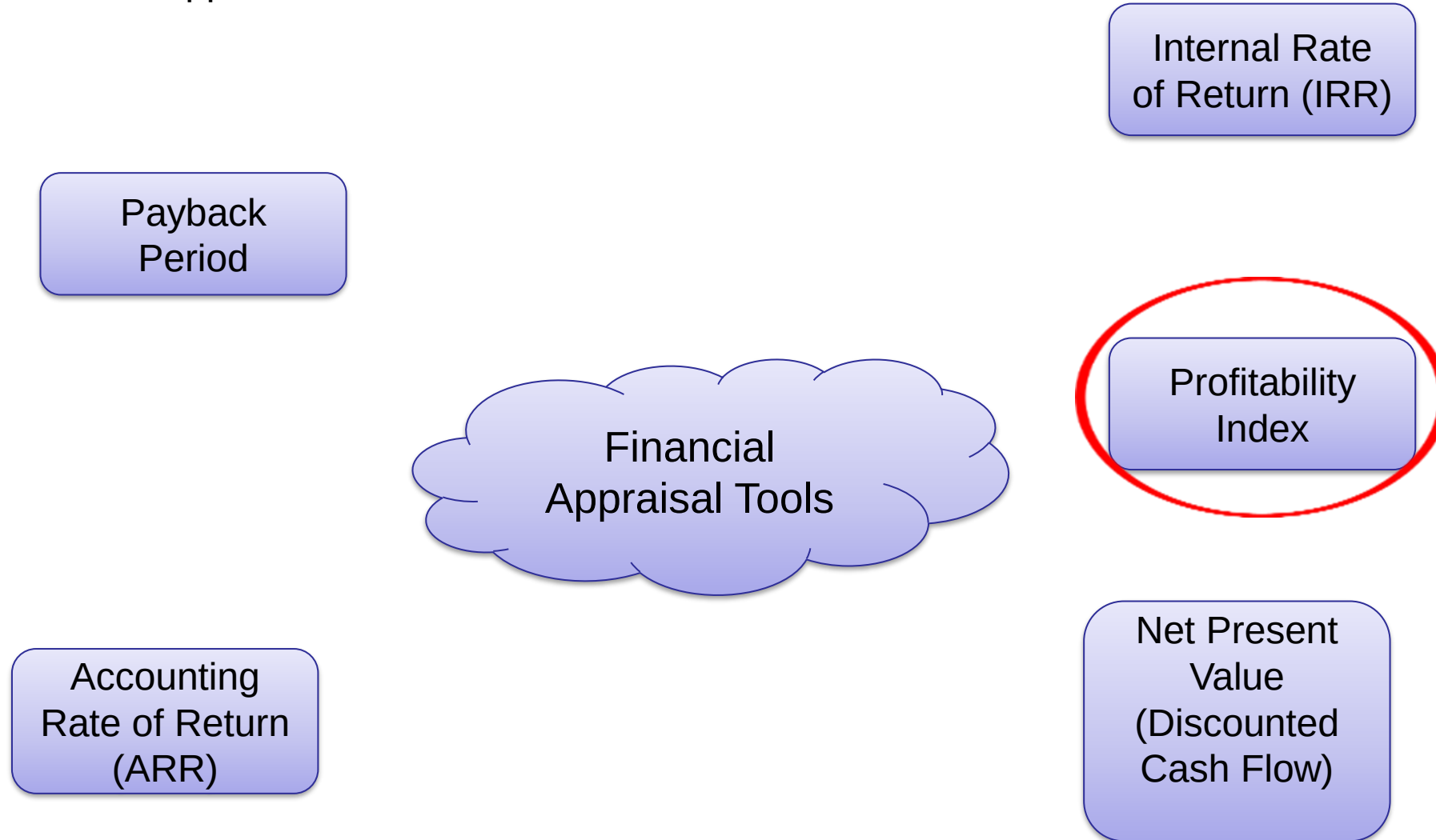
# Finance Management & Planning

## Project Appraisal (Week 4)

This Week

- Any Questions on NPV and payback
- Profitability index
- Internal Rate of Return.

## Financial Appraisals Tools



## Financial Appraisals Tools

### Profitability Index

- Profitability index is a calculation of the potential profit of the proposed project.
- The rule is that a profitability index or ratio greater than 1 indicates that the project should proceed.
- A profitability index or ratio below 1 indicates that the project should be abandoned.
- Profitability index is a variation of the NPV rule
- The formula for PI is the present value of future cash flows divided by the initial cost of the project.

## Profitability Index

### Example

Project A has an investment of £10,000 with a positive cashflow of £4000 per annum, the companies WACC is 8%  
Calculate the PI?

Project A

|                         | Investment | Yr1      | Yr2      | Yr3      | Yr4      | Yr5      |
|-------------------------|------------|----------|----------|----------|----------|----------|
| Present Value           | (10,000)   | 4000     | 4000     | 4000     | 4000     | 4000     |
| Payback                 | 2.5 Years  |          |          |          |          |          |
| Discount Rate ( WACC)   | 8%         |          |          |          |          |          |
| Denominator             | 1.00       | 0.926    | 0.857    | 0.794    | 0.735    | 0.681    |
| Future Value            | (10,000)   | 3,704.00 | 3,428.00 | 3,176.00 | 2,940.00 | 2,724.00 |
| NPV                     | 5,972      |          |          |          |          |          |
| NPV ( Excel Calculated) | 5,971      |          |          |          |          |          |

Profitability Index =  $\frac{\text{NPV of Cash Flows}}{\text{Investment}}$  =  $\frac{15,971}{10,000}$  = 1.60

## Profitability Index

- Example

|                          | Project A | Project B |
|--------------------------|-----------|-----------|
| • Project Investment     | £10,000   | £500,000  |
| • Net Cash Flow per year | £ 5,000   | £166,667  |

- Each Project has a life span of 5 years

- Calculate Payback , NPV and PI

- WACC is 15%

## Profitability Index

Does this change your stance on which project should proceed ?

| Project A               |            |       |       |       |       |       |
|-------------------------|------------|-------|-------|-------|-------|-------|
|                         | Investment | Yr1   | Yr2   | Yr3   | Yr4   | Yr5   |
| Present Value           | (10,000)   | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 |
| Payback                 | 2 Year     |       |       |       |       |       |
| Discount Rate           | 15.00%     |       |       |       |       |       |
| Denominator             | 1.00       | 0.870 | 0.756 | 0.658 | 0.572 | 0.497 |
| Future Value            | (10,000)   | 4,350 | 3,780 | 3,290 | 2,860 | 2,485 |
| NPV                     | £6,765     |       |       |       |       |       |
| NPV ( Excel Calculated) | £6,761     |       |       |       |       |       |
|                         |            |       |       | PI    | 1.68  |       |

| Project B               |            |         |         |         |         |         |
|-------------------------|------------|---------|---------|---------|---------|---------|
|                         | Investment | Yr1     | Yr2     | Yr3     | Yr4     | Yr5     |
| Present Value           | (500,000)  | 166,667 | 166,667 | 166,667 | 166,667 | 166,667 |
| Payback                 | 3 Years    |         |         |         |         |         |
| Discount Rate ( WACC)   | 15.00%     |         |         |         |         |         |
| Denominator             | 1.00       | 0.870   | 0.756   | 0.658   | 0.572   | 0.497   |
| Future Value            | (500,000)  | 145,000 | 126,000 | 109,667 | 95,334  | 82,833  |
| NPV                     | £58,834    |         |         |         |         |         |
| NPV ( Excel Calculated) | £58,694    |         |         |         |         |         |
|                         |            |         |         | PI      | 1.12    |         |

## Profitability Index

- Exercise
- Calculate the PI and payback for the following 3 projects
- WACC is 8%
- Which Project has the stronger return?

| Project | Investment | 1     | 2     | 3     | 4     | 5     |
|---------|------------|-------|-------|-------|-------|-------|
| A       | (100,000)  | 25000 | 25000 | 25000 | 25000 | 25000 |
| B       | (100,000)  | 5000  | 20000 | 25000 | 30000 | 45000 |
| C       | (100,000)  | 45000 | 35000 | 30000 | 10000 | 5000  |

| NPV    |
|--------|
| -182   |
| -5,701 |
| 6,242  |

| PI   | Payback    |
|------|------------|
| 1.00 | 4.00 Years |
| 0.94 | 4.44 Years |
| 1.06 | 2.33 Years |

## Profitability Index

- **Strengths**

- Takes account of the time value of money
- Reviews liquidity of projects
- Simple calculation

- **Weaknesses**

- Ignores the sizes of projects
- How do you define your companies cost of capital

A company can invest in one of the projects below, calculate the NPV, PI for each project and advise which Project should proceed based on the financial information given and the calculations from last week ?

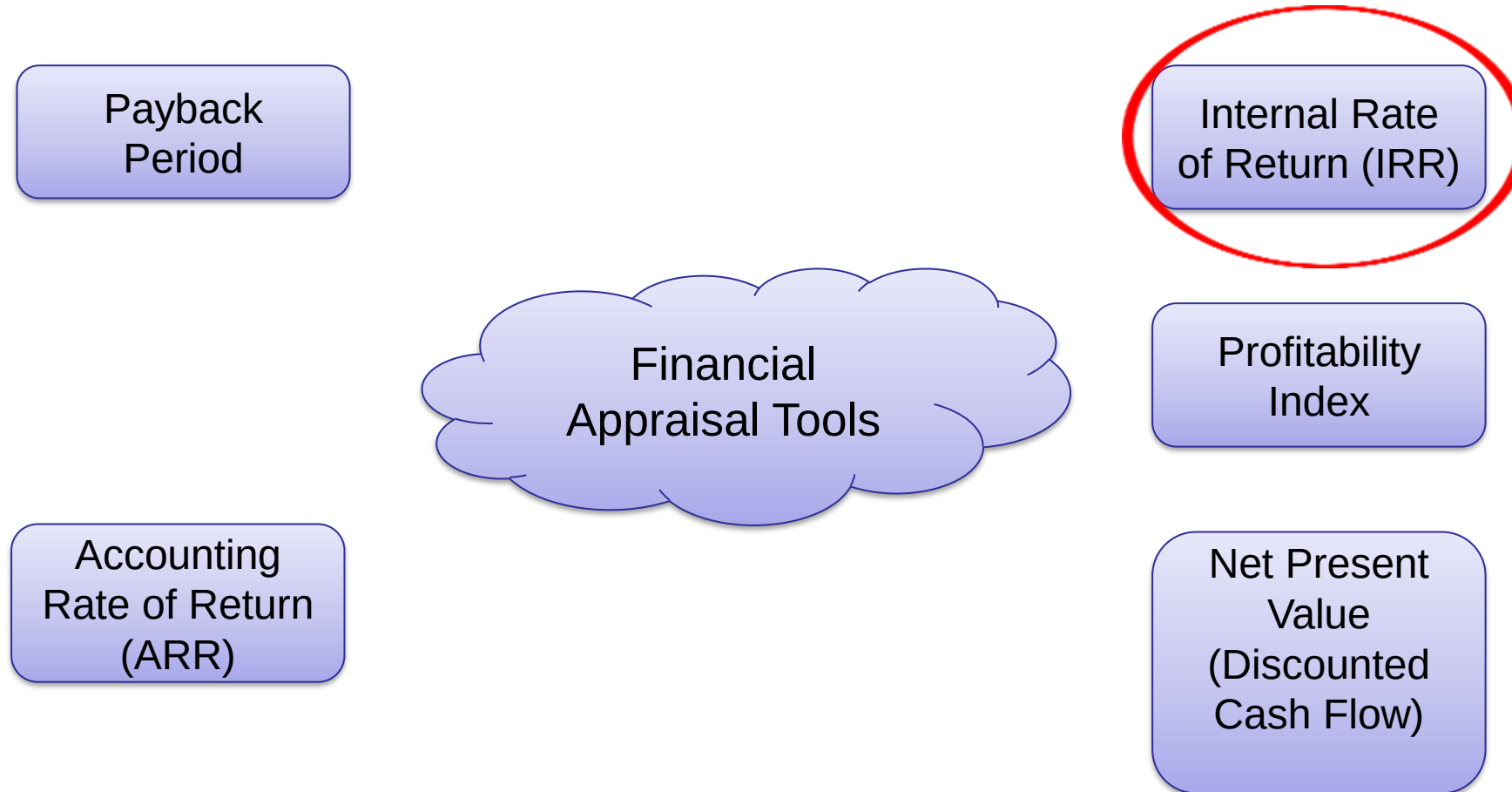
Discount Rate ( WACC) of 10% for NPV Calculations

| Project <u>A</u>   |         | <u>B</u>      |         | <u>C</u>      |         |
|--------------------|---------|---------------|---------|---------------|---------|
| Project Investment |         | 350,000       |         | 350,000       |         |
|                    |         |               |         |               |         |
|                    |         | Net Cash Flow |         | Net Cash Flow |         |
| Year 1             | 100,000 | Year 1        | 40,000  | Year 1        | 200,000 |
| Year 2             | 110,000 | Year 2        | 100,000 | Year 2        | 150,000 |
| Year 3             | 104,000 | Year 3        | 210,000 | Year 3        | 240,000 |
| Year 4             | 112,000 | Year 4        | 260,000 | Year 4        | 40,000  |
| Year 5             | 138,000 | Year 5        | 160,000 | Year 5        | 10,000  |

|                    |                  |                  |               |                  |               |
|--------------------|------------------|------------------|---------------|------------------|---------------|
| Project <u>A</u>   |                  | Project <u>B</u> |               | Project <u>C</u> |               |
| Project Investment | 350,000          |                  | 350,000       |                  | 350,000       |
|                    | Net Cash Flow    |                  | Net Cash Flow |                  | Net Cash Flow |
| Year 1             | 100,000          | Year 1           | 40,000        | Year 1           | 200,000       |
| Year 2             | 110,000          | Year 2           | 100,000       | Year 2           | 150,000       |
| Year 3             | 104,000          | Year 3           | 210,000       | Year 3           | 240,000       |
| Year 4             | 112,000          | Year 4           | 260,000       | Year 4           | 40,000        |
| Year 5             | 138,000          | Year 5           | 160,000       | Year 5           | 10,000        |
|                    | 0                |                  | 0             |                  | 0             |
| Payback            | 3 Years 4 Months | Payback          | 3 Years       | Payback          | 2 Years       |
| 72,140             |                  | NPV              | 203,715       | NPV              | 169,630       |
| 1.21               |                  | PI Index         | 1.58          | PI Index         | 1.48          |

# Reflections on NPV and PI calculations ?

## Financial Appraisals Tools



## Financial Appraisals Tools

### Internal Rate of Return (IRR)

- IRR calculates discount rate that causes the net present value of future cashflows from an investment to equal zero.

Formula

#### Internal Rate of Return:

$$= R1 + [ (NPV1 \times (R2 - R1)\% \div (NPV1 - NPV2) ]$$

Where:

- R1 = Lower discount rate
- R2 = Higher discount rate
- NPV1 = Higher Net Present Value (derived from R1)
- NPV2 = Lower Net Present Value (derived from R2)

Ignore the Formula

Internal Rate of Return (IRR)

Example

Project A has an investment of £10,000 with a cashflow In of £4000 per annum  
Calculate the Payback Period?

Project A

|               | Investment | Yr1  | Yr2  | Yr3  | Yr4  | Yr5  |
|---------------|------------|------|------|------|------|------|
| Present Value | (10,000)   | 4000 | 4000 | 4000 | 4000 | 4000 |

Payback Period - 2 ½ Years

## Internal Rate of Return (IRR)

### Example

Project A has an investment of £10,000 with a cashflow In of £4000 per annum

### Project A

|               | Investment | Yr1  | Yr2  | Yr3  | Yr4  | Yr5  |
|---------------|------------|------|------|------|------|------|
| Present Value | (10,000)   | 4000 | 4000 | 4000 | 4000 | 4000 |

|         |           |
|---------|-----------|
| Payback | 2.5 Years |
|---------|-----------|

Calculate NPV based on a Discount Rate of 8% and the Profitability Index

|               |          |      |      |      |      |      |
|---------------|----------|------|------|------|------|------|
| Present Value | (10,000) | 4000 | 4000 | 4000 | 4000 | 4000 |
|---------------|----------|------|------|------|------|------|

|         |           |
|---------|-----------|
| Payback | 2.5 Years |
|---------|-----------|

|                       |    |
|-----------------------|----|
| Discount Rate ( WACC) | 8% |
|-----------------------|----|

|             |      |      |      |      |      |      |
|-------------|------|------|------|------|------|------|
| Denominator | 1.00 | 1.08 | 1.17 | 1.26 | 1.36 | 1.47 |
|-------------|------|------|------|------|------|------|

|              |          |          |          |          |          |          |
|--------------|----------|----------|----------|----------|----------|----------|
| Future Value | (10,000) | 3,703.70 | 3,429.36 | 3,175.33 | 2,940.12 | 2,722.33 |
|--------------|----------|----------|----------|----------|----------|----------|

|     |       |
|-----|-------|
| NPV | 5,971 |
|-----|-------|

Profitability Index =  $\frac{\text{NPV of Cash Flows}}{\text{Investment}}$  =  $\frac{15,971}{10,000}$  = 1.60

## Internal Rate of Return (IRR)

### Excel Formula

|                                    |                                                                          |          |          |                 |          |          |
|------------------------------------|--------------------------------------------------------------------------|----------|----------|-----------------|----------|----------|
| Project A                          |                                                                          |          |          |                 |          |          |
|                                    | Investment                                                               | Yr1      | Yr2      | Yr3             | Yr4      | Yr5      |
| Present Value                      | (10,000)                                                                 | 4000     | 4000     | 4000            | 4000     | 4000     |
| Payback                            | 2.5 Years                                                                |          |          |                 |          |          |
| Discount Rate                      | 8.00%                                                                    |          |          |                 |          |          |
| Denominator                        | 1.00                                                                     | 1.08     | 1.17     | 1.26            | 1.36     | 1.47     |
| Future Value                       | (10,000)                                                                 | 3,703.70 | 3,429.36 | 3,175.33        | 2,940.12 | 2,722.33 |
| NPV                                | 5,971                                                                    |          |          |                 |          |          |
| NPV ( Excel Calculated)            | 5,971                                                                    |          |          |                 |          |          |
| Internal Rate of Return            | 28.65%                                                                   |          |          |                 |          |          |
| IRR =                              | Excel Formula = '(range of Cashflow so C4 to H4, Guessed Discount Rate ) |          |          |                 |          |          |
| so the formula in this instance is |                                                                          |          |          | IRR=(C4:H4,20%) |          |          |

## Internal Rate of Return (IRR)

### Manual Calculation

| WACC | Project | Investment | 1    | 2    | 3    | 4    | 5    | NPV     |
|------|---------|------------|------|------|------|------|------|---------|
| 15%  | A       | (10,000)   | 4000 | 4000 | 4000 | 4000 | 4000 | 3408.62 |
| 30%  | A       | (10,000)   | 4000 | 4000 | 4000 | 4000 | 4000 | -257.72 |

|                          |  |     |         |
|--------------------------|--|-----|---------|
|                          |  | %   | Value   |
| Diff                     |  | 15% | 3666.34 |
|                          |  |     |         |
| Movement for each %      |  |     | 244     |
|                          |  |     |         |
| To get to an NPV of zero |  |     | 13.95   |

|     |       |
|-----|-------|
| IRR | 28.95 |
|-----|-------|

| Test   |         |            |       |       |       |       |       |        |
|--------|---------|------------|-------|-------|-------|-------|-------|--------|
| WACC   | Project | Investment | 1     | 2     | 3     | 4     | 5     | NPV    |
| 28.95% | A       | (10,000)   | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 | -57.52 |

|       |        |
|-------|--------|
| Excel | 28.65% |
|-------|--------|

## Internal Rate of Return (IRR)

Project A has an investment of £10,000 with a cashflow In of £4000 per annum

Calculate IRR Rate

### Project A

|               | Investment | Yr1  | Yr2  | Yr3  | Yr4  | Yr5  |
|---------------|------------|------|------|------|------|------|
| Present Value | (10,000)   | 4000 | 4000 | 4000 | 4000 | 4000 |

|         |           |
|---------|-----------|
| Payback | 2.2 Years |
|---------|-----------|

|               |       |
|---------------|-------|
| Discount Rate | 8.00% |
|---------------|-------|

|             |      |      |      |      |      |      |
|-------------|------|------|------|------|------|------|
| Denominator | 1.00 | 1.08 | 1.17 | 1.26 | 1.36 | 1.47 |
|-------------|------|------|------|------|------|------|

|              |          |          |          |          |          |          |
|--------------|----------|----------|----------|----------|----------|----------|
| Future Value | (10,000) | 3,703.70 | 3,429.36 | 3,175.33 | 2,940.12 | 2,722.33 |
|--------------|----------|----------|----------|----------|----------|----------|

|     |       |
|-----|-------|
| NPV | 5,971 |
|-----|-------|

|                         |       |
|-------------------------|-------|
| NPV ( Excel Calculated) | 5,971 |
|-------------------------|-------|

|                         |        |
|-------------------------|--------|
| Internal Rate of Return | 28.65% |
|-------------------------|--------|

## Internal Rate of Return (IRR)

- Example

|                         | Project A | Project B |
|-------------------------|-----------|-----------|
| • Project Investment    | £10,000   | £500,000  |
| •Net Cash Flow per year | £ 5,000   | £166,667  |
| •Payback Period         | 2 years   | 3 Years   |

- Calculate the IRR based on the Cashflows for the next 5 years.
- Which Project has the higher Internal Rate of Return ?

## Internal Rate of Return (IRR)

### Project A

|                          | Investment | Yr1   | Yr2   | Yr3   | Yr4   | Yr5   |
|--------------------------|------------|-------|-------|-------|-------|-------|
| Present Value            | (10,000)   | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 |
| Payback                  | 2 Year     |       |       |       |       |       |
| Discount Rate ( WACC)    | 41.04%     |       |       |       |       |       |
| Denominator              | 1.00       | 1.41  | 1.99  | 2.81  | 3.96  | 5.58  |
| Future Value             | (10,000)   | 3,545 | 2,513 | 1,782 | 1,264 | 896   |
| NPV                      | 0          |       |       |       |       |       |
| IRR ( Excel Calculated ) | 41.04%     |       |       |       |       |       |

### Project B

|                          | Investment | Yr1     | Yr2     | Yr3     | Yr4     | Yr5     |
|--------------------------|------------|---------|---------|---------|---------|---------|
| Present Value            | (500,000)  | 166,667 | 166,667 | 166,667 | 166,667 | 166,667 |
| Payback                  | 3 Years    |         |         |         |         |         |
| Discount Rate ( WACC)    | 19.86%     |         |         |         |         |         |
| Denominator              | 1.00       | 1.20    | 1.44    | 1.72    | 2.06    | 2.47    |
| Future Value             | (500,000)  | 139,054 | 116,016 | 96,795  | 80,758  | 67,378  |
| NPV                      | 0          |         |         |         |         |         |
| IRR ( Excel Calculated ) | 19.86%     |         |         |         |         |         |

## Internal Rate of Return (IRR)

- Exercise
- Calculate the IRR based on the following 3 projects using Excel
- Which project has the highest Internal Rate of Return?

| Project | Investment | 1     | 2     | 3     | 4     | 5     | IRR   |
|---------|------------|-------|-------|-------|-------|-------|-------|
| A       | (100,000)  | 25000 | 25000 | 25000 | 25000 | 25000 | 7.9%  |
| B       | (100,000)  | 5000  | 20000 | 25000 | 30000 | 45000 | 6.3%  |
| C       | (100,000)  | 45000 | 35000 | 30000 | 10000 | 5000  | 11.2% |

## Internal Rate of Return (IRR)

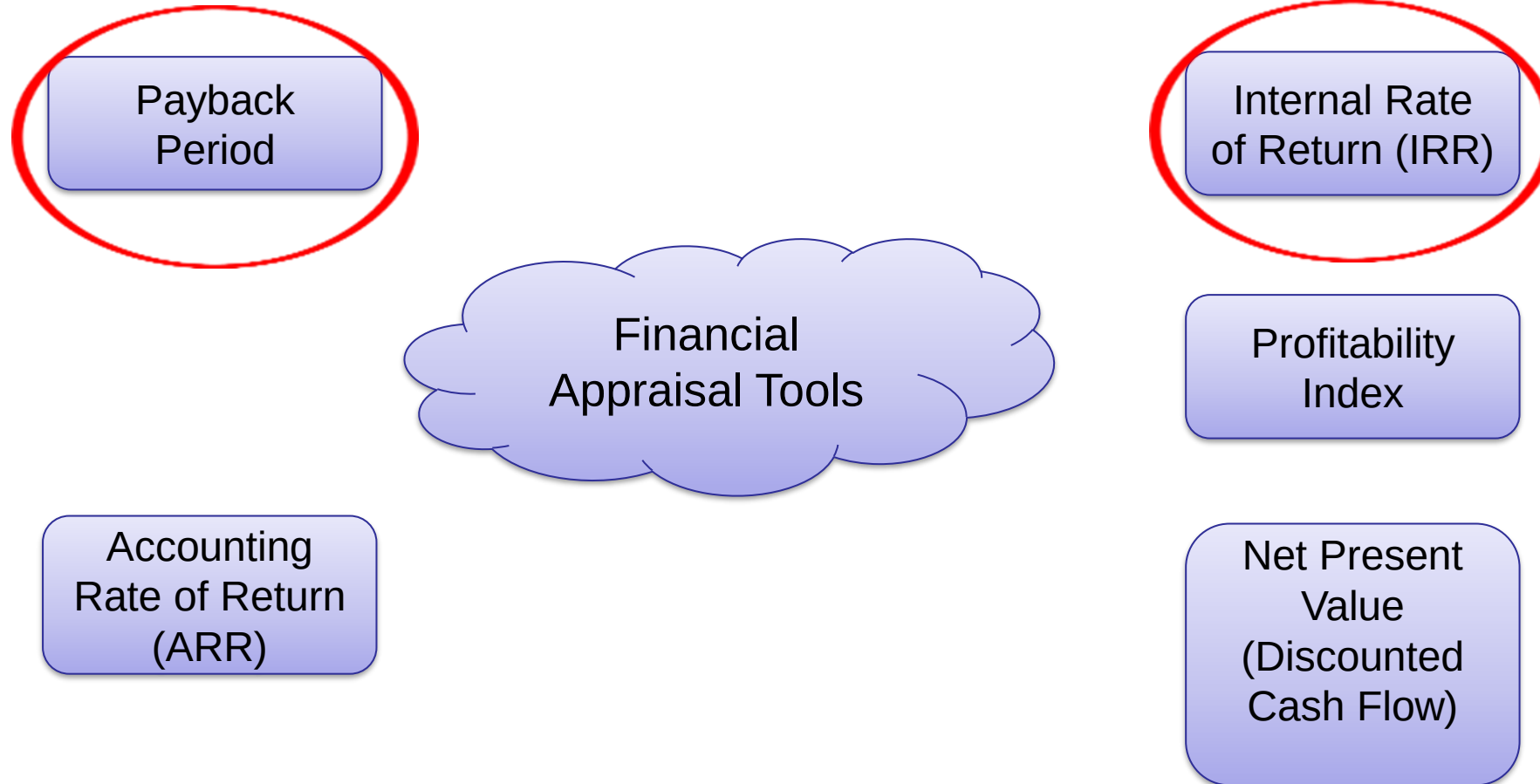
### •Strengths

- Takes account of the time value of money
- Reviews liquidity of projects
- Excel simplifies the process

### •Weaknesses

- Doesn't allow for a clear comparison of different size projects
- Can be tedious to calculate manually

## Financial Appraisals Tools



Next Week

BCR

Capital Rationing