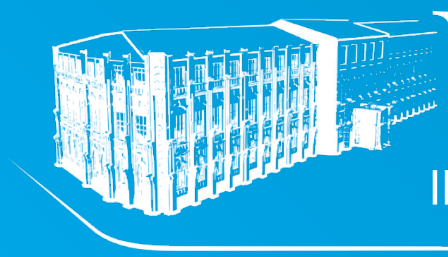


WESTMINSTER

INTERNATIONAL UNIVERSITY IN TASHKENT

An Accredited Institution of the University of Westminster (UK)

Lecture 5. Investment criteria

Investment criteria

- How should a firm make an investment decision

  What assets do we buy?

  What is the underlying goal?

  What is the right decision criterion?

- Capital Budgeting

Capital Budgeting:

The process of planning for purchases of long-term assets.

Example:

- **Suppose our firm must decide whether to purchase a new plastic molding machine for $125,000. How do we decide?**
- **Will the machine be profitable?**
- **Will our firm earn a high rate of return on the investment?**

Decision-making Criteria in Capital Budgeting

How do we decide if a capital investment project should be accepted or rejected?

Decision-making Criteria in Capital Budgeting

- The ideal evaluation method should:

a) include all cash flows that occur during the life of the project,
b) consider the time value of money, and
c) incorporate the required rate of return on the project.

Decision-making Criteria in Capital Budgeting

Firms invest in 2 categories of projects:

1) Independent projects – do not compete with each other. A firm may accept none, some, or all from among a group of independent projects.
2) Mutually exclusive projects – compete against each other. The best project from among group of acceptable mutually exclusive projects is selected.

Techniques in Capital Budgeting

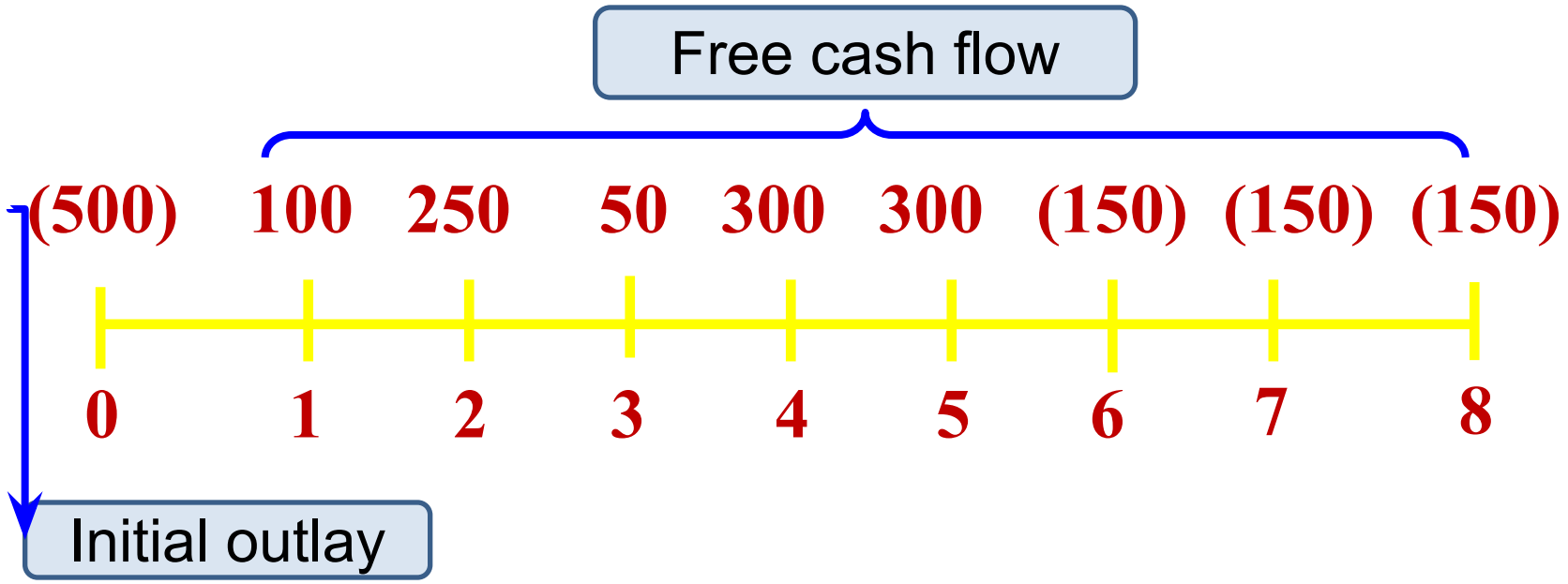
1) Payback period
2) Discounted Payback Period
3) Net Present Value (NPV)
4) Profitability Index (PI)
5) Internal Rate of Return (IRR)

1) Payback Period

- The **payback method** simply measures **how long** (in years and/or months) it takes to recover the initial investment.
- The payback period is calculated by adding the free cash flows up until they are equal to the initial fixed investment.
- The **maximum** acceptable payback period is determined by management.

Example:

How long will it take for the project to generate enough cash to pay for itself?



EXAMPLE:

Bennett Company is a medium sized metal fabricator that is currently contemplating two projects: Project A requires an initial investment of $42,000, project B an initial investment of $45,000. The relevant operating cash flows for the two projects are presented below.

	Project A	Project B
Initial investment	$42,000	$45,000
Year	Operating cash inflows	
1	$14,000	$28,000
2	14,000	12,000
3	14,000	10,000
4	14,000	10,000
5	14,000	10,000

EXAMPLE (CONT.)

Payback Period

Project A

Year	Cash flow
1	$14,000
2	$14,000
3	$14,000
4	$14,000
5	$14,000

Initial outlay = $42,000

Annual free cash flows:

Year 1 : $14,000, balance left : $28,000

Year 2 : $14,000, balance left : $14,000

Year 3 : $14,000, balance left : $0

So the payback period for this project is 3 years.

Payback Period

Project B

Year	Cash flow
1	$28,000
2	$12,000
3	$10,000
4	$10,000
5	$10,000

Initial outlay = $45,000

Annual free cash flows:

Year 1 : $28,000, balance left : $17,000

Year 2 : $12,000, balance left : $5,000

Year 3 : $10,000

- we know that the payback period is 2 years ++
- the remaining $5000 can be recaptured during year 3
- Payback period:

$$= 2 + \frac{\$\ 5{,}000}{\$\ 10{,}000}$$

= 2.5 year.

balance left in year 2

cash flow in year 3

So, the payback period for this project is 2.5 years.

PAYBACK PERIOD

- Is the payback period good?
- Is it acceptable?
- Firms that use this method will compare the payback calculation to some standard (the maximum acceptable payback period) set by the firm.

DECISION RULE :

ACCEPT if payback ≤ maximum acceptable payback period.
REJECT if payback > maximum acceptable payback period.

Pros and Cons of Payback Periods

- The **payback method** is widely used by large firms to evaluate small projects and by small firms to evaluate most projects.
- It is simple, intuitive, and considers free cash flows rather than accounting profits.
- It also gives implicit consideration to the true timing of cash flows and is widely used as a supplement to other methods such as Net Present Value and Internal Rate of Return.

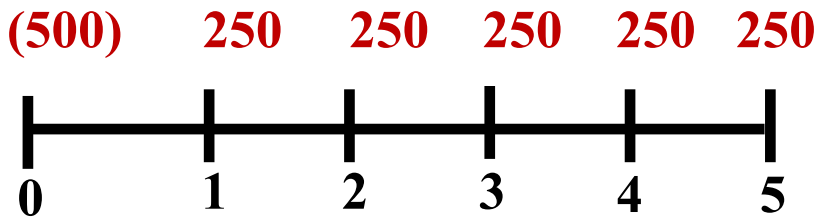
Pros and Cons of Payback Periods (cont.)

- One **major weakness** of the payback method is that the acceptable payback period is a subjectively determined number.
- It also fails to consider the principle of **wealth maximization** because it is not based on **discounted cash flows** (does not consider any required rate of return)and thus provides no indication as to whether a project adds to firm value.
- Thus, payback fails to fully consider the **time value of money** and does not consider all of the project's cash flows.

2) Discounted Payback Period

- The number of years needed to recover initial cash outlay from the discounted free cash flows.
- Discounts the cash flows at the firm's required rate of return.
- Payback period is calculated by adding up these discounted net cash flows until they are equal to the initial outlay.

Discounted Payback Period



Year	Free Cash Flow	Discounted CF (14%)
0	-500	
1	250	219.30
2	250	192.37
3	250	168.74

FCF
$(1 + k)^n$

Initial outlay = $500.00

Discounted free cash flows:

Year 1 : $219.30, balance left : $280.70

Year 2 : $192.37, balance left : $88.33

Year 3 : $168.74

- We know that the payback period is 2 years ++
- the remaining $88.33 can be recaptured during year 3

To determine the remaining period:

$$= 2 + \frac{\$\ 88.33}{\$\ 168.74}$$

= 2.52 year.

balance left in year 2

Discounted c/flow in year 3

So the payback period for this project is 2.52 years.

Discounted Payback Period

- Discounted payback period is 2.52 years.
- Is it acceptable?

ACCEPT if discounted payback ≤ maximum acceptable discounted payback period.

REJECT if discounted payback > maximum acceptable discounted payback period.

Discounted Payback Period

Advantages:

- Uses free cash flows
- Easy to calculate and to understand
- Considers time value of money

Disadvantages:

- Ignores free cash flows occurring after the payback period.
- Selection of the maximum acceptable discounted payback period is arbitrary.

Other Methods

3) Net Present Value (NPV)
4) Profitability Index (PI)
5) Internal Rate of Return (IRR)

Consider each of these decision-making criteria:

- All net cash flows.
- The time value of money.
- The required rate of return.

3) Net Present Value (NPV)

- Gives an absolute dollar value for a project by taking the present value of the benefits and subtracting the present value of the costs
- NPV = the total of all PV of the annual net cash flows – the initial outlay

$$NPV = \sum_{t=1}^{n} \frac{FCF_t}{(1+k)^t} - IO$$

FCF = Free cash flow

IO = Initial outlays

NET PRESENT VALUE (NPV)

Decision rule :

ACCEPT if NPV is positive { NPV ≥ 0 }

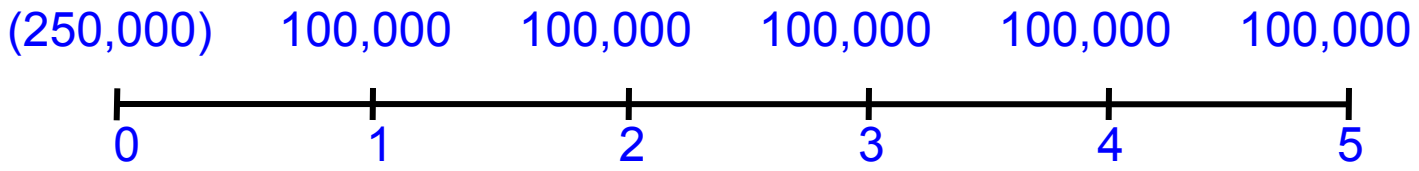
REJECT if NPV is negative { NPV < 0 }

Steps to calculate NPV

1. Find the PV for every cash flows discounted @ the investors required rate of return
2. Sum up the PV of all the cash flow involved
3. Minus the initial outlay from the total of PV of all cash flows

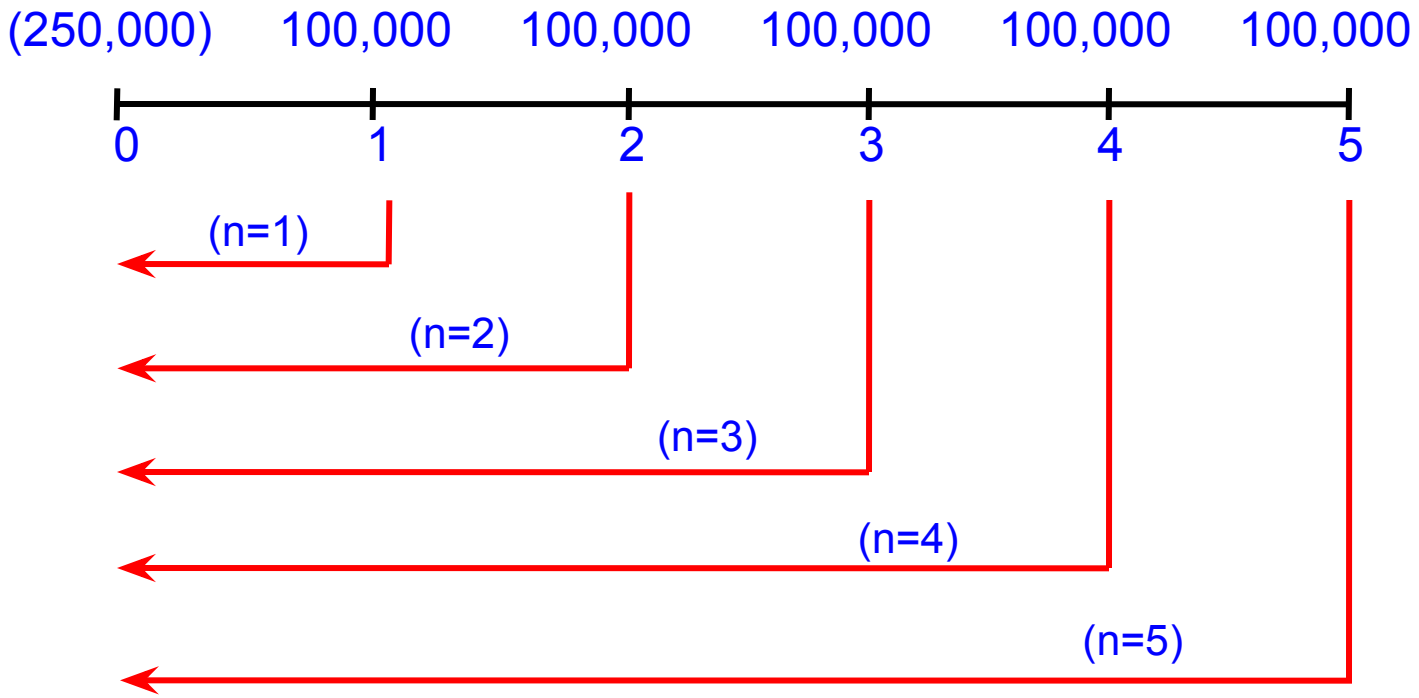
NPV Example

Suppose we are considering a capital investment that costs $250,000 and provides annual net cash flows of $100,000 for five years. The firm's required rate of return is 15%.



NPV Example

Suppose we are considering a capital investment that costs $250,000 and provides annual net cash flows of $100,000 for five years. The firm's required rate of return is 15%.



Solution:

$$NPV = \frac{100{,}000}{(1.15)^1} + \frac{100{,}000}{(1.15)^2} + \frac{100{,}000}{(1.15)^3} + \frac{100{,}000}{(1.15)^4} + \frac{100{,}000}{(1.15)^5} - 250{,}000$$

$$= 335215.50 - 250{,}000$$

$$= 85{,}215.50$$

Since the NPV is positive (≥ 0) , so we should accept this project.

Alternative Solution:

Since the amount of annual cash flow is equal for each period (an annuity), total PV can be determined as follows:

$n = 5 \quad k = 15\% \quad PMT = 100{,}000$

$$\text{PV of cash flows} = 100{,}000\ (PVIFA_{15\%,5})$$
$$= 100{,}000\ (3.352)$$
$$= \$335{,}200$$

$$NPV = \text{total PV} - IO$$
$$= 335{,}200 - 250{,}000$$
$$= \underline{\$85{,}200}$$

NPV > 0 , so ACCEPT

Net Present Value

Advantages:

- Uses free cash flows
- Recognizes the time value of money
- Consistent with the firm's goal of shareholder wealth maximization.

Disadvantages:

- Requires detailed long-term forecasts of a project's free cash flows.

4) Profitability Index (PI)

Also known as profit and cost ratio, i.e benefit/costs

Compares the benefits and costs of a project through division and comes up with a measure of the project's relative value—a benefit-cost ratio

$$PI = \frac{\text{Present value of future free cash flow}}{\text{Initial outlay}}$$

$$PI = \sum_{t=1}^{n} \frac{FCFt}{(1+k)^t} \Big/ IO$$

Profitability Index (PI)

Decision rule :

ACCEPT if PI is greater than or equal to one
{ PI ≥ 1.0}

REJECT if PI is less than one { PI < 1.0 }

Profitability Index

Advantages:

- Uses free cash flows
- Recognizes the time value of money
- Consistent with the firm's goal of shareholder wealth maximization.

Disadvantages:

- Requires detailed long-term forecasts of a project's free cash flows.

Example:

Emerald Corp. is considering an investment with a cost of $350,000 and future benefits of $100,000 every year for five years. If the company's required rate of return is 15%, based on the profitability index (PI), should the Emerald accept the project?

$$\sum PV = \frac{100{,}000}{(1.15)^1} + \frac{100{,}000}{(1.15)^2} + \frac{100{,}000}{(1.15)^3} + \frac{100{,}000}{(1.15)^4} + \frac{100{,}000}{(1.15)^5}$$

$$= 335{,}215.50$$

$$PI = 335{,}215.50 / 350{,}000$$

$$= 0.96 \text{ (Reject because PI < 1.0)}$$

5) Internal Rate of Return (IRR)

- The discount rate that equates the present value of the project's future free cash flows with the project's initial outlay.
- The return on the firm's invested capital. IRR is simply the rate of return that the firm earns on its capital budgeting projects.

Decision rule :

ACCEPT if IRR ≥ required rate of return

REJECT if IRR < required rate of return

Internal Rate of Return (IRR)

$$\sum_{t=1}^{n} \frac{FCF_t}{(1 + IRR)^t} = IO$$

$$0 = \sum_{t=1}^{n} \frac{FCF_t}{(1 + IRR)^t} - IO$$

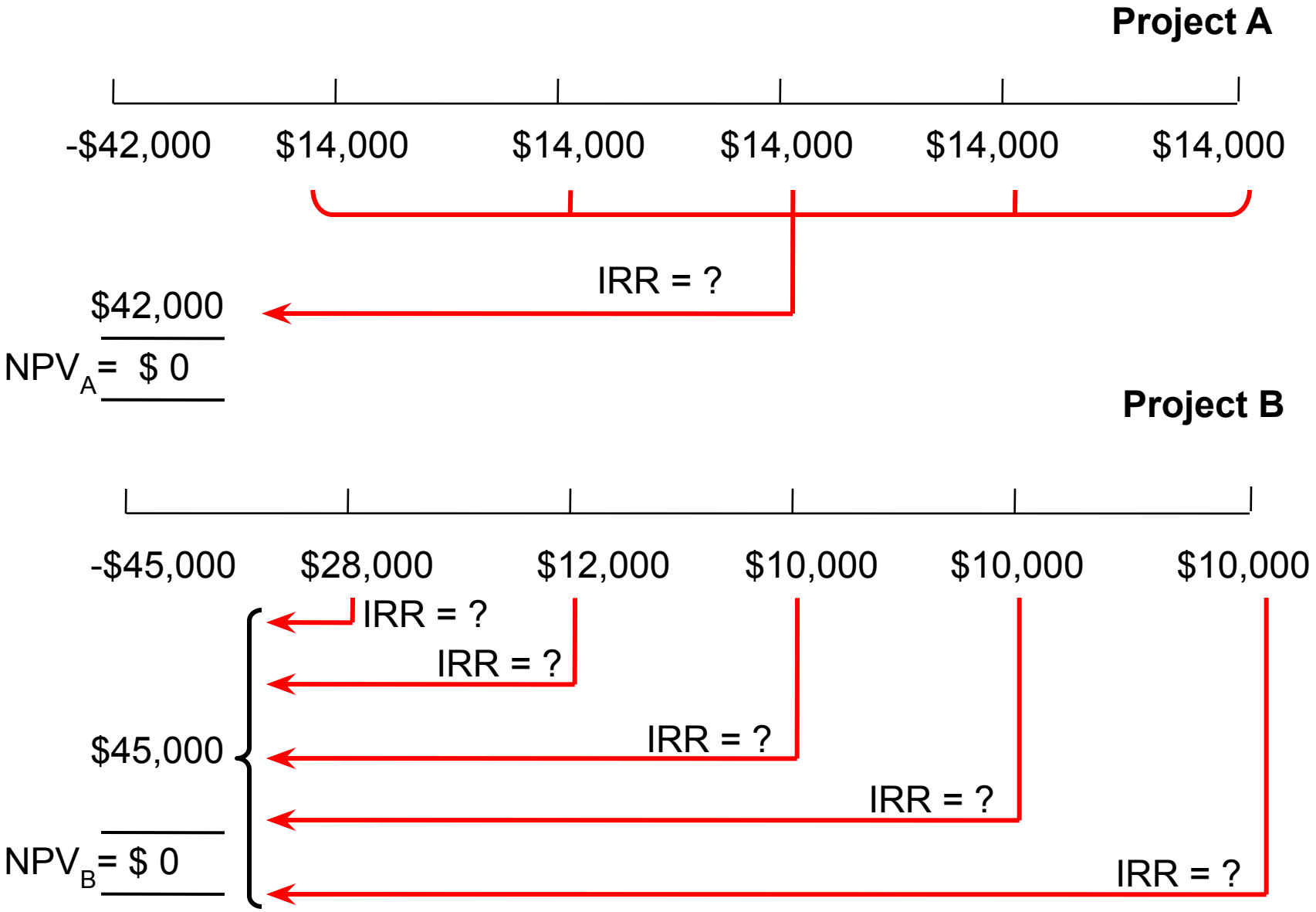
- IRR is the rate of return that makes the PV of the cash flows equal to the initial outlay.
- This looks very similar to our Yield to Maturity formula for bonds. In fact, YTM is the IRR of a bond.

CALCULATING IRR

- Bennett Company is a medium sized metal fabricator that is currently contemplating two projects: Project A requires an initial investment of $42,000, project B an initial investment of $45,000. The relevant operating cash flows for the two projects are presented below.

	Project A	Project B
Initial investment	$42,000	$45,000
Year	Operating cash inflows	
1	$14,000	$28,000
2	14,000	12,000
3	14,000	10,000
4	14,000	10,000
5	14,000	10,000

SOLUTION:


Project A
-$42,000
$14,000
$14,000
$14,000
$14,000
$14,000
IRR = ?
$42,000
NPV$_A$ = $ 0
Project B
-$45,000
$28,000
$12,000
$10,000
$10,000
$10,000
IRR = ?
IRR = ?
IRR = ?
IRR = ?
IRR = ?
$45,000
NPV$_B$ = $ 0

Calculating IRR

Method: trial and error

- Choose one rate and calculate the NPV using that rate.
- If your first NPV is positive (+) , choose another rate which is bigger to calculate the second NPV,
- If your first NPV is negative (-) , choose another rate which is smaller to calculate the second NPV,
- You are trying to determine what rate will give your NPV = 0
- Once you get one positive & one negative NPV you can do the interpolation.

Exp : $Rate_1$ = x%, NPV = $ a

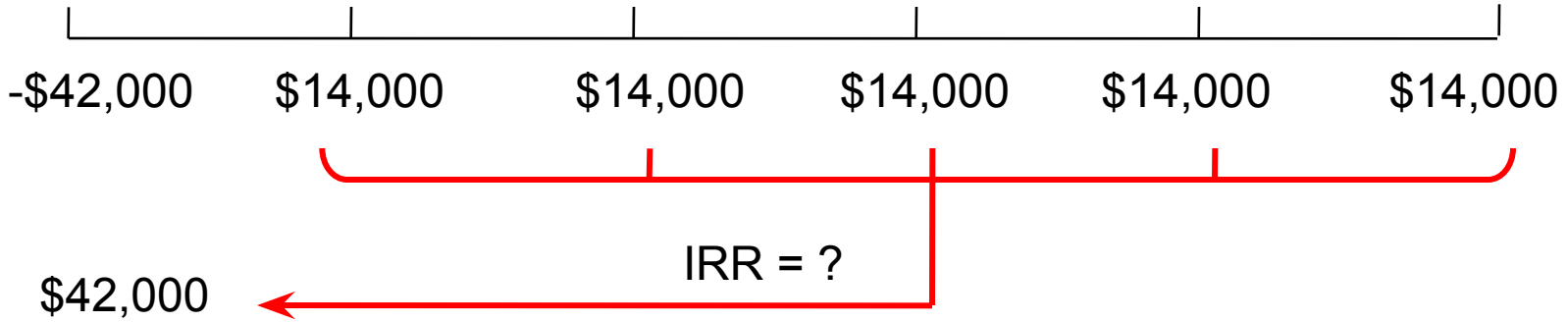
$Rate_2$ = y%, NPV = $ b

Interpolation: $\frac{x\% - IRR}{x\% - y\%} = \frac{a - 0}{a - b}$

IRR = ?

SOLUTION:

Project A



$42,000

NPV_A = $ 0

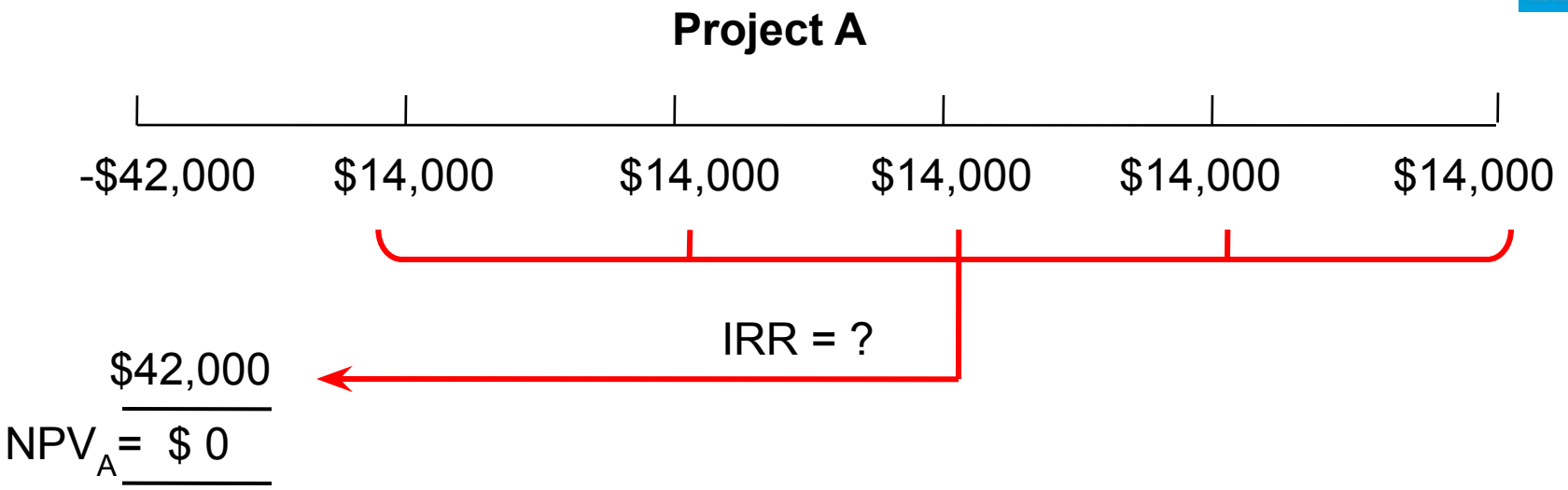
This is an annuity, so you can use the annuity formula to solve this problem.

Step 1 - Choose one rate and calculate the NPV using that rate. (you can pick up any rate you like)

Try IRR = 15%

NPV = 4930.17

SOLUTION:



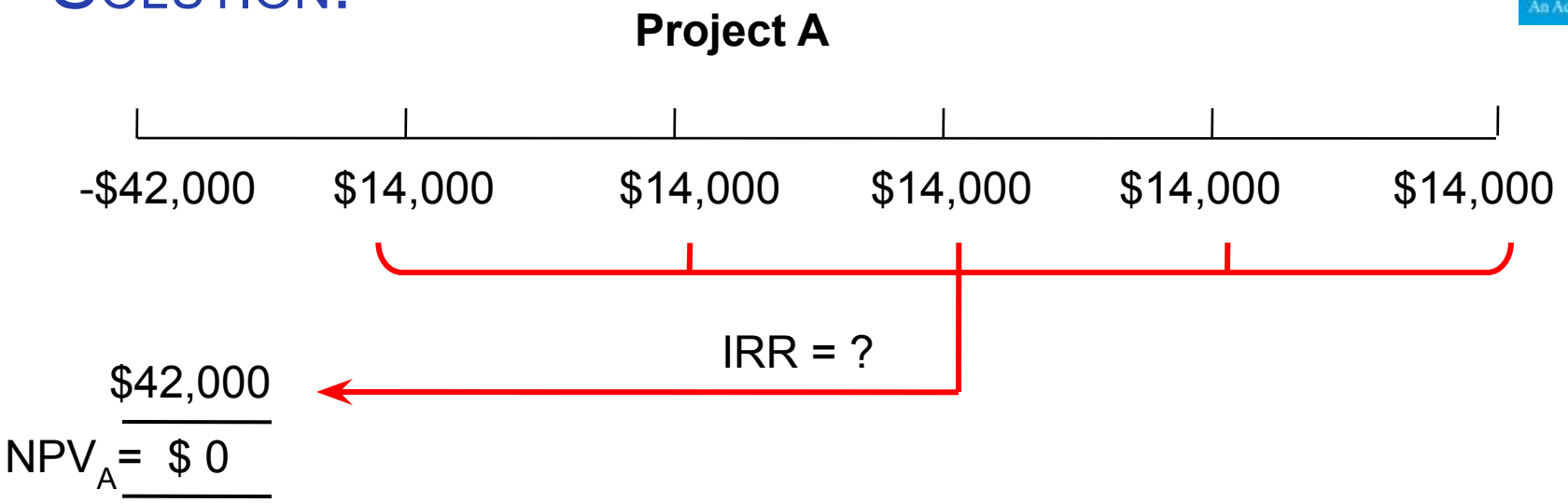
Step 2 - If your first NPV is positive (+) , choose another rate which is bigger to calculate the second NPV,

If your first NPV is negative (-) , choose another rate which is smaller to calculate the second NPV,

Because your first NPV is positive , next try IRR = 20%

NPV = - 131.43

SOLUTION:



Step 3 - Once you get one positive & one negative NPV you can do the interpolation.

Now you already have one positive NPV & one negative NPV, so you can start with the interpolation

Determine your : x%, y%, a & b

x = 15% a = 4930.17

y = 20% b = -131.43

Interpolation:

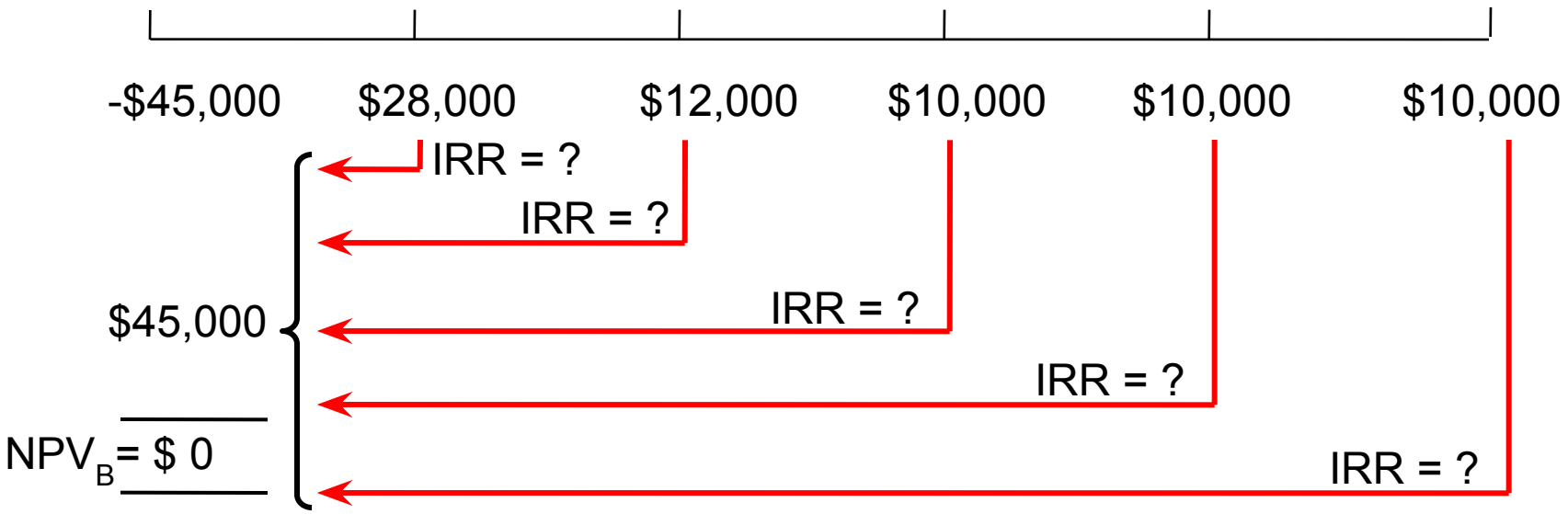
$$\frac{x\% - IRR}{x\% - y\%} = \frac{a - 0}{a - b}$$

$$\frac{15 - IRR}{15 - 20} = \frac{4930.17 - 0}{4930.17 - (-131.43)}$$

IRR = 19.87%

SOLUTION:

Project B



This is an uneven cash flows, so you have to discount back each cash flow individually.

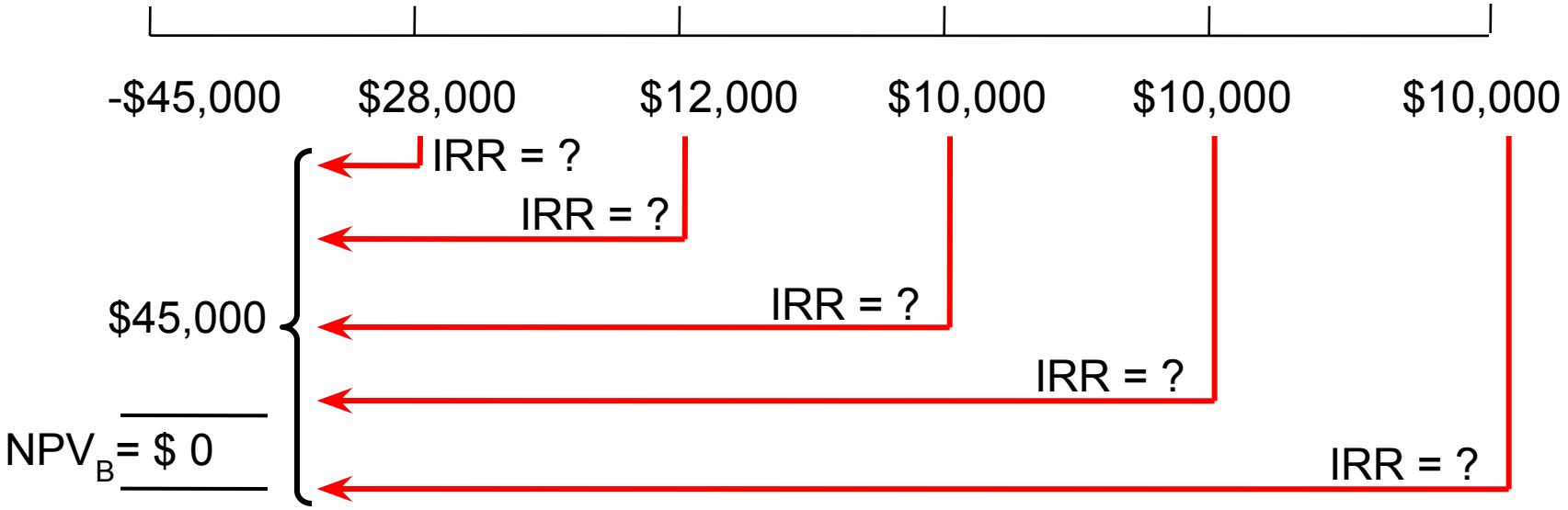
Step 1 - Choose one rate and calculate the NPV using that rate. (you can pick up any rate you like)

Try IRR = 15%

NPV = 5686.01

SOLUTION:

Project B



Step 2 - If your first NPV is positive (+) , choose another rate which is bigger to calculate the second NPV,

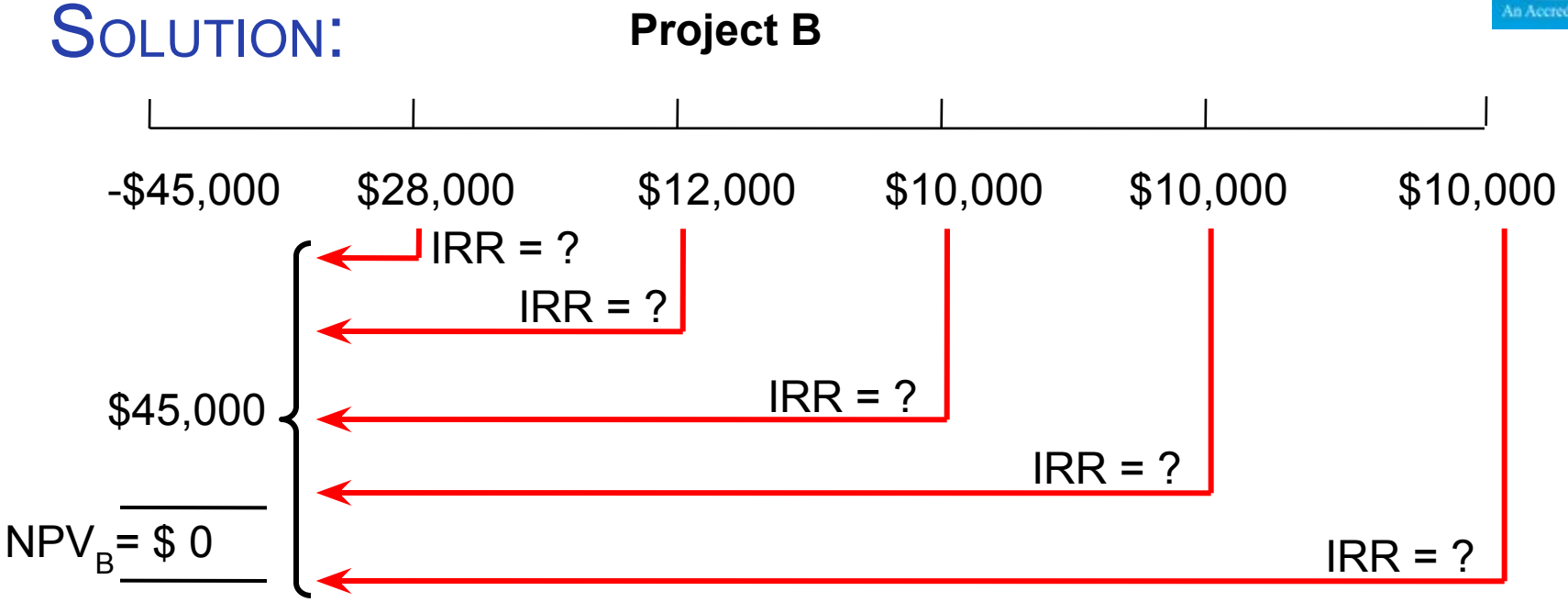
If your first NPV is negative (-) , choose another rate which is smaller to calculate the second NPV,

Because your first NPV is positive , next try IRR = 20%

NPV = 1295.01

Your NPV still positive… so you have to try again choosing a bigger rate!!

SOLUTION:



Step 2 - If your first NPV is positive (+) , choose another rate which is bigger to calculate the second NPV,

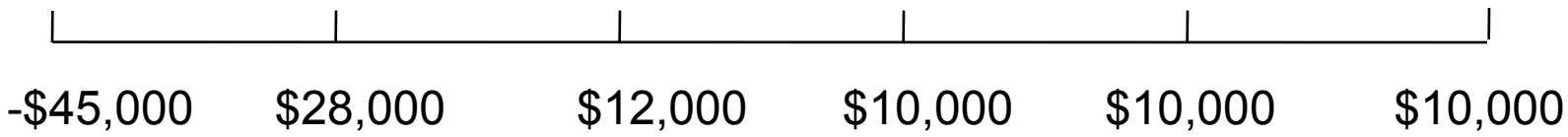
If your first NPV is negative (-) , choose another rate which is smaller to calculate the second NPV,

Because your first NPV is positive , next try IRR = 25%

NPV = - 2427.20

SOLUTION:

Project B



Step 3 - Once you get one positive & one negative NPV you can do the interpolation.

You already have two positive NPV & one negative NPV, so you can start with the interpolation. Choose NPV which is nearest to zero (0).

Determine your : x%, y%, a & b

x = 20% a = 1295.01
y = 25% b = - 2427.20

Interpolation:

$$\frac{x\% - IRR}{x\% - y\%} = \frac{a - 0}{a - b}$$

$$\frac{20 - IRR}{20 - 25} = \frac{1295.01 - 0}{1295.01 - (-2427.20)}$$

IRR = 21.74%

Internal Rate of Return

Advantages:

- Uses free cash flows
- Recognizes the time value of money
- Consistent with the firm's goal of shareholder wealth maximization.

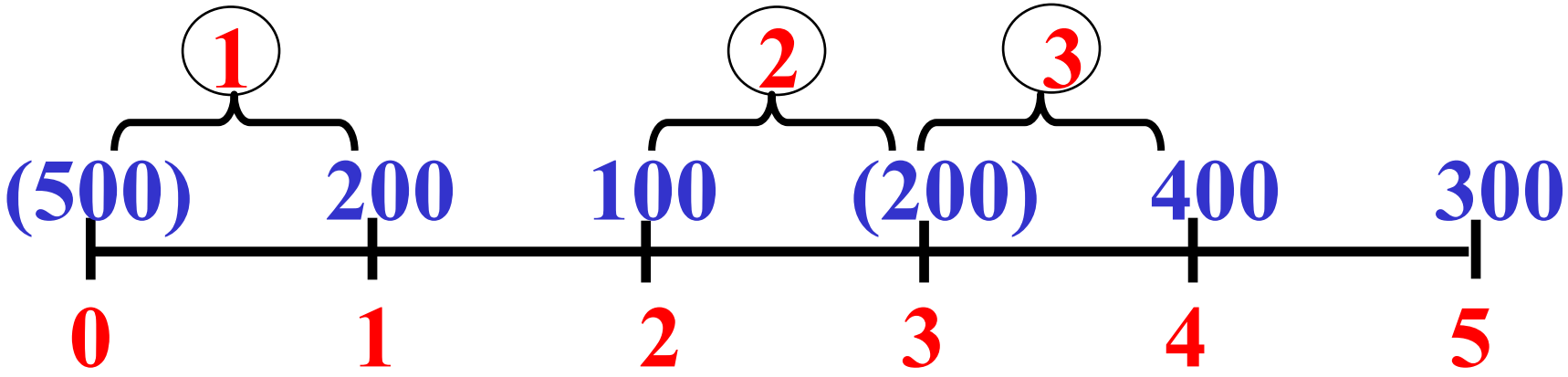
Disadvantages:

- Possibility of multiple IRRs
- Assumes cash flows over the life of the project are reinvested at the IRR.
- Requires detailed long-term forecasts of a project's free cash flows.

Complication with IRR

- IRR is a good decision-making tool as long as cash flows are conventional. **(- + + + ++)**
- *Problem:*

  If there are multiple sign changes in the cash flow stream, we could get multiple IRRs. **(- + + - + +)**



Modified Internal Rate of Return (MIRR)

- IRR assumes that all cash flows are reinvested at the IRR.
- Under IRR there are possibilities of multiple IRRs when the future cash flows switch between positive and negative.
- MIRR overcomes those disadvantages of IRR and provides a rate of return measure that assumes cash flows are reinvested at the required rate of return.

Modified Internal Rate of Return (MIRR)

READING

- R. Brealey, S. Myers and F. Allen. “Principles of Corporate Finance”, (2010) MacGraw Hill, 10th Edition (Chapter 5)
- Keown, A.J., et al., (2005). *Financial Management*. 3rd ed. Chapter 9
- Van Horne, J.C., Wachowicz, J.M., (2010). *Fundamentals of Financial Management*. 13th ed. Chapter 13