CFA Level I

Study Session **11**

LOS 36:

Capital Budgeting

- Capital Budgeting Process

- Principals of Capital Budgeting & Cash flow estimation

- Evaluation and Selection of Capital Project

- Key Evaluation Methods

  - NPV – Net Present Value

  - IRR – Internal Rate Of Return

  - PBP- Payback Period

  - DPBP - Discounted Pay Back Period

  - PI – Profitability Index

  - ARR – Accounting Rate Of Return

  - Problem Associated with each methods

  - Relation between NPV, Company Value and Stock Price

Capital budgeting process

▸ **Capital Budgeting** is a process used to determine and select the most profitable projects for a period greater than one year.

▸ **Steps in capital Budgeting**

1. Idea construction
2. Analysis of different project proposals
3. Construct the capital budget for the firm
4. Scrutinize decisions and carry out post-audit

Types of Capital Projects

▶ **Replacement** projects (wastage or obsolescence or cost reduction)

▶ **Expansion** projects(economies of scale)

▶ **Development** of new products and services (backward and forward integration)

▶ **Mandatory** projects(safety and environment)

▶ Other projects(corporate perks, R&D)

Principles of Capital Budgeting

- **Cash Flows:**
    - Conventional cash flows - first cash outflow followed by cash inflows
    - Non conventional cash flows – first cash outflow followed by inflow or outflow of cash.
- **Sunk-costs** (costs involved in construction of idea) : not considered
- **After tax cash flow**
- **Opportunity cost**: cash flows that a firm loses by taking a project under analysis
- **Externalities** :cannibalization
- **Timing** of cash flows is important
- **Financing Cost**: not considered as a part of cash flows, as they are already considered in projects rate of return(avoid double counting).

Independent Vs. Mutually Exclusive Projects

▶ **Independent projects :** projects that are unrelated to each other and allow for each project to be evaluated based on its own profitability. i.e., if projects x and y are independent, and both projects are profitable, then the firm could accept both projects.

Independent projects, on the other hand, do not compete with the firm's resources. A company can select one or the other or both, so long as minimum profitability thresholds are met.

▶ **Mutually exclusive** : If projects A and B were mutually exclusive, the firm could accept either X or Y Project, but not both.

▶ **Sequential projects :** Some projects must be undertaken in a certain sequence, so that investing in a project today creates the opportunity to invest in other projects in the coming future.

Unlimited Funds Vs. Capital Rationing

▶ **Capital rationing** occurs when management places a constraint on the size of the firm's capital budget during a particular period. The firm's capital budget and cost of capital must be determined simultaneously to best allocate the firm's capital. The selected project should be more profitable than the funds the company has and aim at maximizing shareholders wealth.

▶ **Unlimited funds** imply firm can raise desired amount for all profitable projects simply by paying the required rate of return.

Net Present Value (NPV)

The NPV is the sum of the present values of all the expected incremental cash flows(after-tax cash flows) if a project is undertaken.

▸ Consider a project with riskless future cash flows CF_1, CF_2, CF_3, .., CF_n.

▸ These cash flows can be positive or negative depending on whether they are benefits/revenues or costs/expenses.

▸ Also, suppose there is an initial cost CF_0 the project.

▸ The Net Present Value of this project is the present value of future cash flows minus the initial cost:

$$\text{NPV} = -CF_0 + \frac{CF_1}{(1+k)^1} + \frac{CF_2}{(1+k)^2} + \dots + \frac{CF_n}{(1+k)^n} = \sum_{t=0}^{n} \frac{CF_t}{(1+k)^t}$$

where:
CF_0 = Initial investment outlay at time 0
CF_t = After-Tax cash flow at time t
k   = Required rate of return

Question

A firm is reviewing a $ 10,000 investment opportunity that will last 5 years and has the below data:

▸ Annual after-tax cash flows are expected to be $ 3,000

▸ Cost of capital is 9.70%

Determine the project's net present value (NPV) ?

A. -$ 1,460

B. $ 1,460

C. $0

D. $ 1,245

NPV Decision Rule

- For **independent Projects:**
  - Accept projects where NPV > 0 (increase in shareholders wealth)
  - Do not accept projects where NPV < 0 (decrease in shareholders wealth)
  - Projects where NPV = 0 (no affect on shareholders wealth)

- **Key features:**
  - NPV uses cash flows: cash flows can be used for dividends, capital budgeting or debt repayments. Earnings – accounting construct; do not represent cash flows
  - NPV uses all cash flows of the project: Do not ignore cash flows beyond a certain date;
  - NPV discounts cash flows properly: Avoid ignoring the time value of money when handling cash flows

Question

Rank the below projects in the order of highest NPV to lowest NPV, given that k = 11.56%

Year	Project A	Project B	Project C	Project D	Project E
0	1,000	2,500	1,750	4,000	2,000
1	100	500	200	1400	300
2	250	900	300	1400	400
3	450	1200	600	1400	700
4	650	1200	700	1400	700
5	-	700	800	1400	700

Answer: DBACE

Alternative Decision Rules:

Pay Back Period(PBP)

▸ Payback period is the number of years it takes to cover the initial cost of investment.

▸ Shorter the payback , period better it is.

Payback period = Full years until recovery +

Unrecovered cost at the beginning of last year
_____
cash flow during the last year

Year	A	B	C
0	-Rs. 100	-Rs. 100	-Rs. 100
1	20	50	40
2	30	30	50
3	50	20	30
4	60	60	60,000
Payback	3 years	3 years	2.2 years

PBP– Benefits and drawbacks

Benefits:

▸ Good measure of liquidity, but decisions cannot be based solely on PBP.

Drawbacks

▸ PBP ignores time value of money and cashflows beyond the pay back period.(not a good measure of profitability)

Discounted Pay Back Period (DPBP)

▸ Discounted pay back period calculates no. of years, present value of cash flows equal to the initial investment outlay.

▸ Suppose discount rate is 10%

Year	payback	Discount payback
0	-Rs. 100	-Rs. 100
1	50	50/1.1 =45.45
2	50	50/1.1^2 = 41.32
3	20	20/1.1^3 = 15.03
Payback	2 years	3 years

▸ It addresses the problem of time value of money.

Profitability Index (PI)

▸ Present value of future cash flows divided by initial cash outlay

$$PI = \frac{PV\ future\ CF}{CF0} = 1 + \frac{NPV}{CFo}$$

▸ The PI indicates the value you are receiving in exchange of one unit of currency invested.

▸ For independent projects:

  ▸ Accept all projects where PI > 1

  ▸ Do not accept where PI < 1

Average rate of return (ARR)

▸ Average accounting rate of return is defined as average net income divided by average book value.

	Year 1	Year 2	Year 3
Sales	20000	25000	30000
Expense	8000	15000	20000
Gross profit	12000	10000	10000
Depreciation	5000	5000	5000
EBT	7000	5000	5000
Taxes(50%)	3500	2500	2500
PAT	3500	2500	2500

Assume a co. invests 15000 in an asset depreciated on straight line basis at 5000 yearly. Calculate AAR?

▶ Answer: 9.99%

Internal Rate Of Return(IRR)

- **IRR(i)** is the discount rate at which NPV of the net cash flows equal to zero. This is the same as the "yield to maturity" on a bond

- IRR criterion:

  - Accept if and only if $i > r$ (required rate of return)

  - Do not accept if $r > i$

$$\frac{CF1}{(1+k)^1} + \frac{CF2}{(1+k)^2} + \cdots + \frac{CFn}{(1+k)^n} = CF0 \ or \ NPV = 0$$

Internal Rate of Return

▸ IRR is the rate of return such that:

$$NPV = -C_0 + C_1/(1+IRR) + C_2/(1+IRR)^2 + C_3/(1+IRR)^3 + \ldots + C_t/(1+IRR)^t = 0$$

▸ How to compute IRR?

    ▸ Trial and error

    ▸ Solver / spreadsheet / calculator

▸ Example:

    ▸ A: (-100; + 60; + 60; 0)

    ▸ B: (-100; 0; 0; +140)

    Compute NPV for r=0; r=10%; r=20%

Issues with the IRR

▸ **Pitfall 1**: If positive cash flows precedes negative cash flows (borrowing) the IRR rule gives the opposite answer.

e.g. suppose a project pays Rs. 1000 today and requires a cash flow of Rs. 1100 tomorrow.

Find IRR by solving: Rs. 1000 – Rs. 1100/(1+IRR) = 0

=> IRR = 10%

NPV Rule = Rs. 1000 – Rs. 1100 / (1+r) > 0

=> r > 10% => r > IRR

When positive CFs come first, IRR rule needs to be applied backward.

- Pitfall 2: There may be multiple IRRs (or none at all).
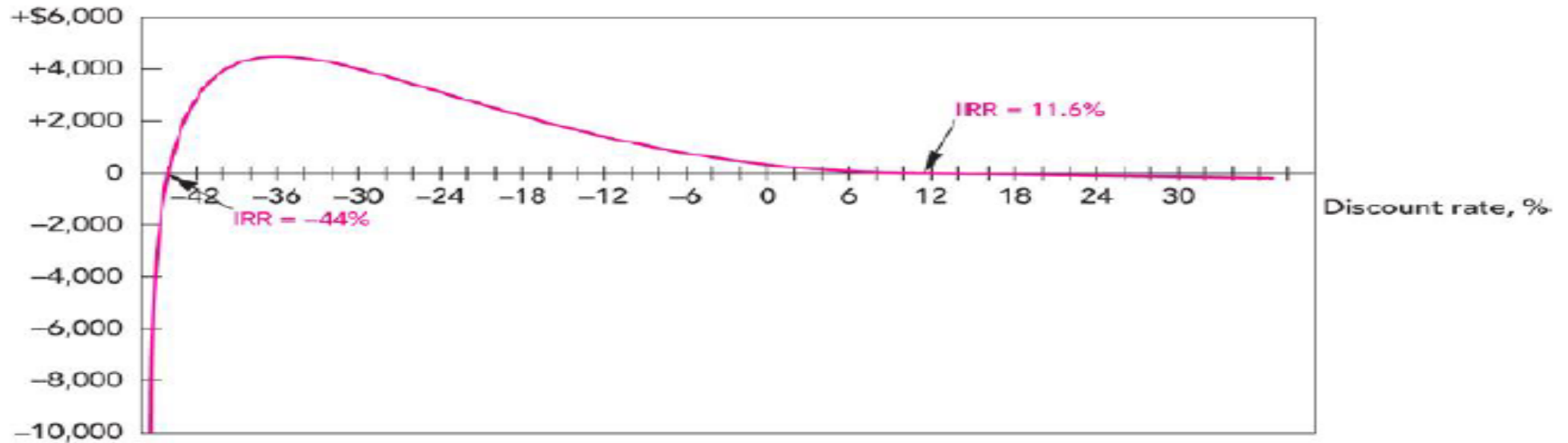
In this case, the NPV rule would tell manager to invest in this project if the discount rate is between -44% and 11.6%.
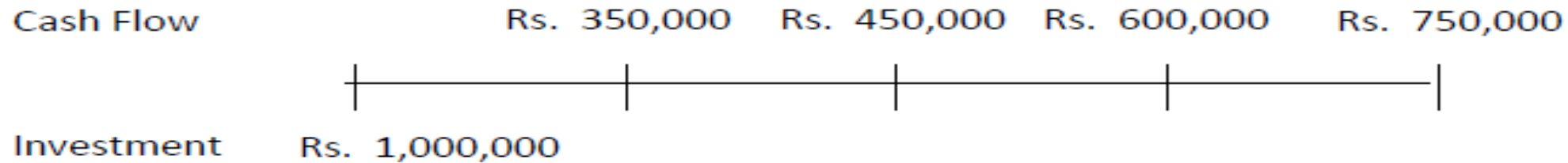
- If a project has one initial negative cash flow (cost) and all positive cash flow afterwards, it's guaranteed to have at most one IRR.
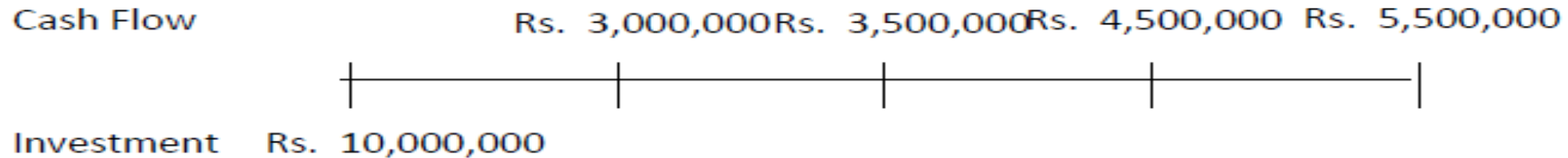
Issues with the IRR

Pitfall 3: In the case of mutual exclusive projects, IRR does not tell us which project to choose.

Project A

Cash Flow   Rs. 350,000   Rs. 450,000   Rs. 600,000   Rs. 750,000

Investment   Rs. 1,000,000

NPV = Rs. 467,937
IRR= 33.66%

Project B

Cash Flow   Rs. 3,000,000 Rs. 3,500,000 Rs. 4,500,000 Rs. 5,500,000

Investment   Rs. 10,000,000

NPV = Rs. 1,358,664
IRR=20.88%

Which one would you pick ?

▸ Assume that you can pick only one of these two projects. Your choice will clearly vary depending upon whether you look at NPV or IRR. You have enough money currently on hand to take either. Which one would you pick?

❑ Project A. It gives me the bigger bang for the buck and more margin for error.

❑ Project B. it creates more dollar value in my business.

If you pick A, what would your biggest concern be?

If you pick B, what would your biggest concern be?

Capital Rationing & Uncertainty

▶ If a business has limited access to capital, has a stream of surplus value projects and faces more uncertainty in its project cash flows, it is much more likely to use IRR as its decision rule.

⇒ small, higher-growth companies and private business are much more likely to use IRR.

▶ If a business has substantial funds on hand, access to capital, limited surplus value projects, and more certainty on its project cash flows, it is much more likely to use NPV as its decision rule.

⇒ As firms go public and grow, they are much more likely to gain from using NPV.

NVP Profile

NPV profile is a graph showing a project's NPV at different discount rates.
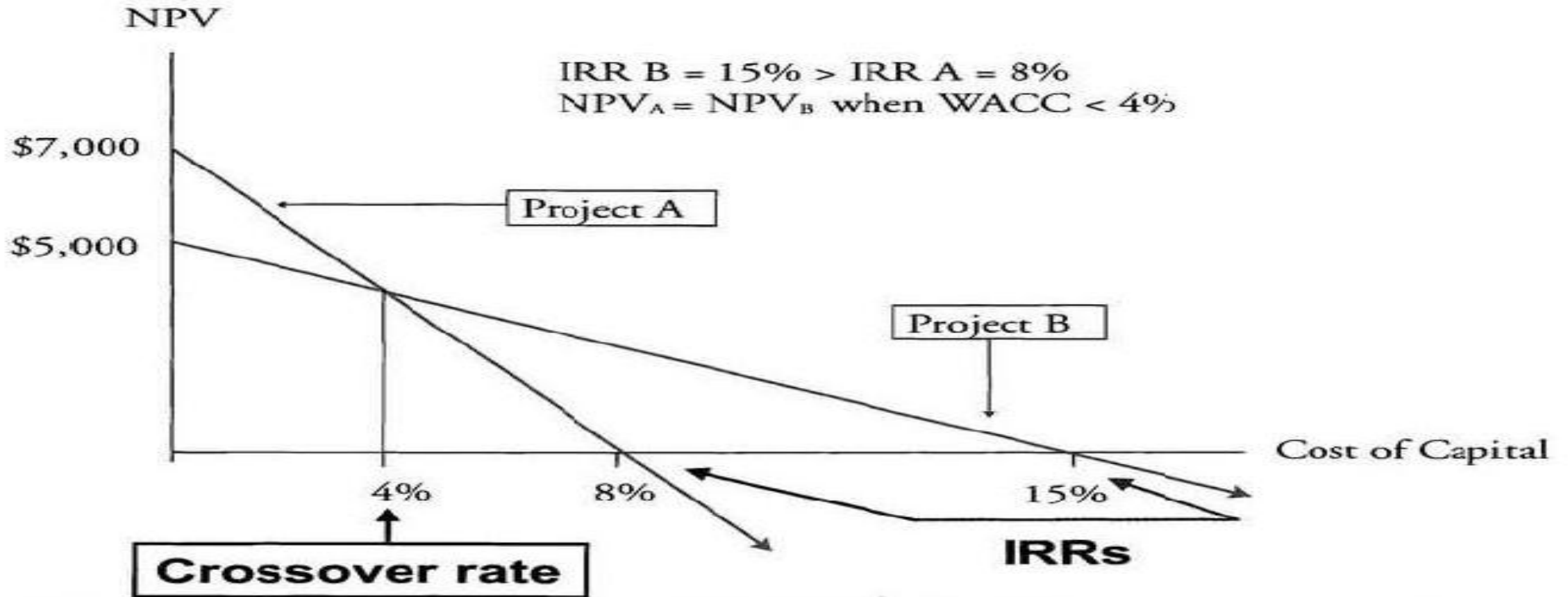
IRR vs. NPV Project Rankings

Disadvantages of the IRR:

▶ The possibility of producing rankings of mutually exclusive projects different from those from NPV analysis

▶ The possibility that a project has multiple IRRs or no IRR.

  ▶ Multiple IRR will exist when there is unconventional cash flow pattern.

For **mutually exclusive projects**, IRR and NPV project rankings may differ, when:

- Projects have different timing of CFs

- The projects (CF_0) are different sizes

- Accept projects having higher NPV

For **independent conventional projects**, IRR and NPV will never conflict.

Relationship Between NPV and Stock Price

▸ NPV is a direct measure of the expected change in shareholder wealth from a project.

▸ Estimate increase in share value as NPV divided by number of shares

Example: Company A is investing 700 million in project B. Company is expected to generate future after tax cash flows of 900 million. Total outstanding shares are 100 million at a current price of 20. This is a recent information about the company. What would be the effect on the value and share price of the company?

▶ Answer- 200, 22