Chapter-5: Capital Budgeting

- **Required Readings**:
- Brigham E.F. & Ehrhardt M.C. (2011). **Financial Management: Theory and Practice.** 13th Edition. South-Western, a part of Cengage Learning *(Chapter 10)*

- Ross S. A., Westerfield, R. W., & Jordan B. D. (2012). ***Fundamentals of Corporate Finance***. In Standard Edition. *(Chapter 9 to 11)*

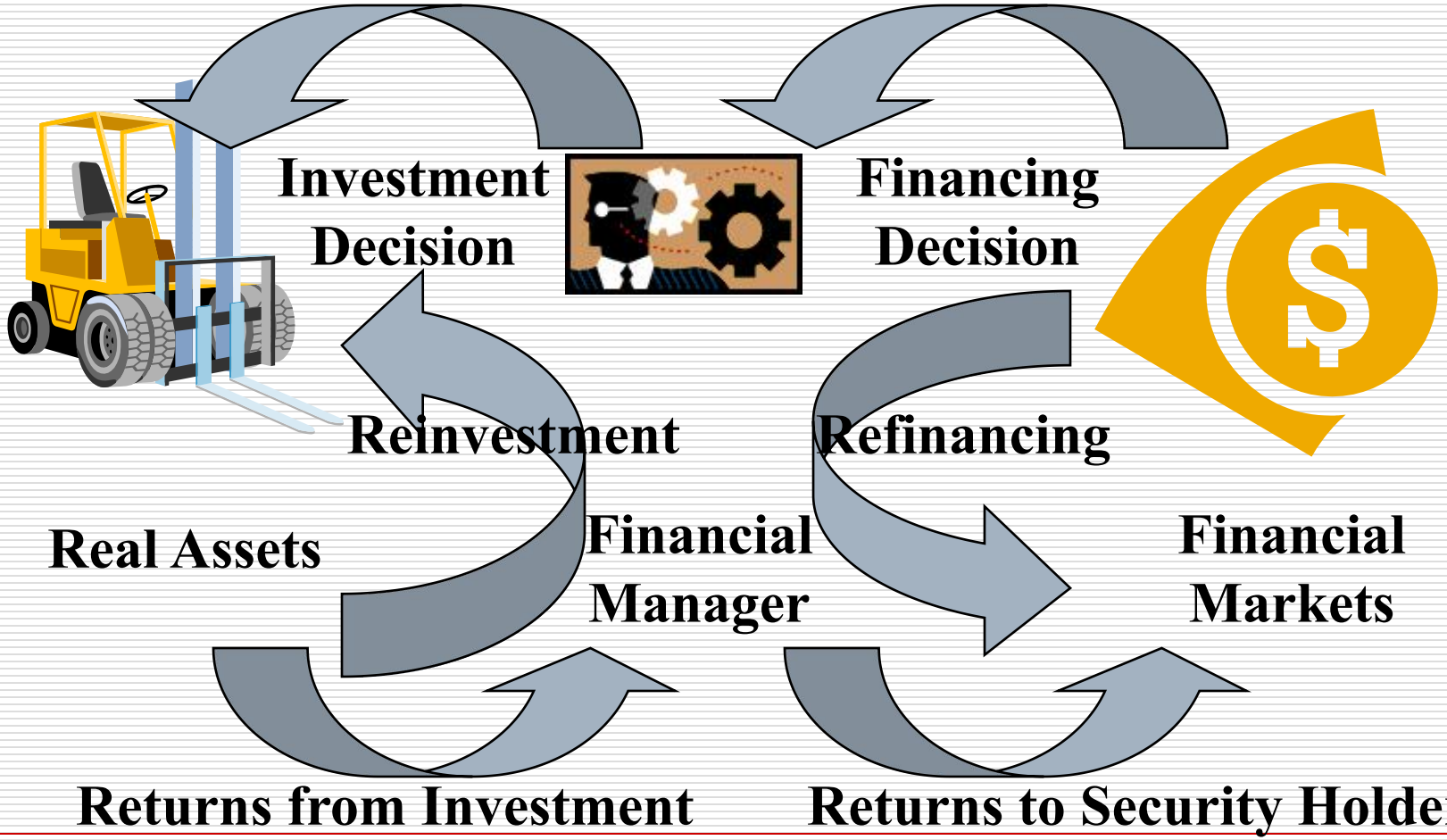
LEARNING OBJECTIVES

- Understand the nature and importance of investment decisions
- Explain the methods of calculating net present value (NPV) and internal rate of return (IRR)
- **Calculate, interpret, and evaluate the internal rate of return (irr) & NPV**
- Describe the non-DCF evaluation criteria: simple payback and accounting rate of return and interpret the result
- Illustrate the computation of the discounted payback
- Compare and contrast NPV and IRR and emphasize the superiority of NPV rule

Topics Covered:

- Introduction
- Types of Projects
- Why Capital Decisions are important?
- Techniques/Methods of Capital Budgeting
- Capital Rationing

Recall the Flows of funds and decisions important to the financial manager



Capital Budgeting is used to make the Investment Decision

Introduction

- **Investment** is the process of employing economic resources on **different activities** with the expectation of future cash **inflows** that will create **value/wealth to owners.**
  - Investment on *financial assets* is called ***portfolio investment.***
  - Investment of Real/P*roductive assets* is called *capital expenditure/capital budgeting*.

Nature of Investment Decisions

The **investment decisions** of a firm are generally known as the **capital budgeting, or capital expenditure decisions.**

A **capital expenditure** is an expenditure the benefits of which are expected to be received over a **period of time exceeding one year.**

The main characteristic of a **capital expenditure** is that the expenditure is incurred at **one point in time** whereas benefits of the expenditure are realized at different **points of time in future.**

- The firm's investment decisions would generally include **expansion, acquisition, modernisation** and **replacement** of the long-term assets.

- Decisions like the change in the **methods of sales distribution**, or an **advertisement campaign** or a **research and development programme** have long-term implications for the firm's expenditures and benefits, and therefore, they should also be evaluated as **investment decisions.**

- **Capital budgeting** is the process of **analyzing investment opportunities** and making long-term investment decisions i.e. it is a process making investment decisions in **capital expenditures.**

- **Capital Budgeting** involves evaluation and decision about projects. Which projects should be **accepted**? Here, our goal is to accept a project which **maximizes the shareholder wealth.**

Features of Investment Decisions

- The exchange of current funds for **future benefits**.
- The funds are invested in long-term assets.
- The future benefits will occur to the firm over a series of years.

Importance of Investment Decisions

- **Capital budgeting** decisions require **special attention** for the following reasons:
  - ✓ **Growth :** They influence the firm's growth in the long run.
  - ✓ **Funding :** They involve commitment of large amount of funds.
  - ✓ **Irreversibility:** They are irreversible, or reversible at substantial loss.
  - ✓ **Risky and Complexity** : They are among the complex decisions to make.

Con't...

I. ***Capital budgeting decisions influence the firm's growth in the end:*** it affects the rate and the direction of its growth.

- A wrong decision can prove disastrous for the survival of the firm; unwanted and/or unprofitable expansion of assets will result in heavy operating costs to the firm.

- On the other hand, inadequate investment in assets would make it difficult to the firm to compete successfully and maintain its market share.

Con't….

II. Capital budgeting decisions affect the risk of the firm: long-term commitment of funds may change the **risk complexity** of the firm.

- If the implemented investment decision increases average gain but causes frequent fluctuations in its earnings, the firm will become **more risky.**
- Therefore, capital budgeting decisions can shape the basic character (risk and return) of a firm.

III. Capital budgeting decisions involve huge funding requirements: investment decisions generally involve large amount of funds, which make them vital for the firm to plan its investment programs very carefully and make an advance arrangement for procuring finances both from **internal and external sources**.

Con't...

Iv. Capital budgeting decisions are the most* complex *decisions to make: they are among the firm's most difficult decisions.

- They are the assessments of future events, which are difficult to predict.
- It is a **very difficult and complex task to correctly predict/ forecast the future cash flows of an investment**.
- Economic, political, social and technological forces cause the uncertainty in cash flow estimation.

Con't…

***V. Capital budgeting decisions are* irreversible, *or reversible at substantial loss*:** due care must be taken in making capital budgeting decisions because it is very difficult to find a market for such huge capital items once they have been acquired.

- **The firm will incur heavy losses if such assets are scraped.**

Types of Projects

- **Independent** -- A project whose acceptance (or rejection) does not prevent the acceptance of other projects under consideration.
- ***Dependent*** -- A project whose **acceptance depends on the acceptance** of one or more other projects. These are the projects the ***acceptance of one will forces the*** acceptance of the other one.
- ***Mutually Exclusive*** -- A project whose **acceptance precludes** the acceptance of one or more alternative projects.

These are the projects which ***compete with each other in such a way that the acceptance of one will*** **exclude** the acceptance of the other one.

Investment Evaluation Criteria

- Three steps are involved in the evaluation of an investment:
  1. Estimation of cash flows **(inflows and outflows)**
  2. Estimation of the required rate of return (the opportunity cost of capital)
  3. Application of a decision rule for making the choice

Techniques of Capital Budgeting

- **Evaluation Criteria:**
- **Discounted Cash flow techniques**: are investment evaluation criteria that **consider the time value of money** or **the concept of present value** when evaluating alternative investment projects.
- **Discounted Cash Flow Techniques includes:**
- Net Present Value (NPV)
- Profitability Index
- Internal Rate of Return (IRR)
- Discounted Payback Period

Con't…..

- **Non-discounted Cash flow techniques**: are investment evaluation criteria that **do not consider** the time value of money concept when evaluating alternative investment projects. These are:
  - ✓ Simple pay back period
  - ✓ Accounting rate of return (ARR)

What is the Simple payback period?

The number of years required to recover a project's cost, as calculated from **cash inflows.**

or how long does it take to get the business's money back?

Con't....

- **Payback** is the number of years required to recover the original cash outlay invested in a project.

- If the project generates constant annual cash inflows, the payback period can be computed by dividing cash outlay by the annual cash inflow. That is:

$$\text{Payback} = \frac{\text{Initial Investment}}{\text{Annual Cash Inflow}} = \frac{C_0}{C}$$

Example

- Assume that a project requires an outlay of Rs 50,000 and yields annual cash inflow of Rs 12,500 for 7 years. The payback period for the project is:

$$\text{PB} = \frac{\text{Rs } 50{,}000}{\text{Rs } 12{,}000} = 4 \text{ years}$$

Con't....

- **Unequal cash flows** In case of unequal cash inflows, the payback period can be found out by **adding up the cash inflows** until the total is equal to the initial cash outlay.
- Suppose that a project requires a cash outlay of Rs 20,000, and generates cash inflows of Rs 8,000; Rs 7,000; Rs 4,000; and Rs 3,000 during the next 4 years. What is the project's payback?

  3 years + 12 × (1,000/3,000) months

  3 years + 4 months

Con't….

The decision rule for payback period:

- The shorter the payback period, is the better:
  - If the payback period calculated is **less than the maximum acceptable payback period (standard payback period set by the management of the firm**), **accept the project.**
  - If the calculated payback period is greater than the maximum acceptable payback period **(standard payback period set by the management of the firm**), **reject the project.**
  - If the calculated payback period is equal to the maximum acceptable payback period, may accept or reject the project.

Example ,……

- Chapter Five Capital Budgeting.doc Page-6

2. Accounting Rate of Return(ARR)

- The accounting rate of return (ARR) is also known as the **return on investment (ROI)** and
- The **accounting rate of return** is the ratio of the average after-tax profit divided by the **average investment**. The average investment would be equal to half of the original investment if it were depreciated constantly.

or

$$ARR = \frac{\text{Average income}}{\text{Average investment}}$$

$$ARR = \frac{\left[\sum_{t=1}^{n} EBIT_t (1-T)\right] / n}{(I_0 + I_n)/2}$$

- A variation of the ARR method is to divide average earnings after taxes by the **original cost** of the project instead of the average cost.

The accounting rate of return is found by the following formula:

$$ARR = \frac{\text{Average Income}}{\text{Average Investment}} \quad \text{Or}$$

$$ARR = \frac{\left[\sum_{t=1}^{n} EBIT_t(1-T)\right] \div n}{(I_0 + I_n) \div 2}$$

Where : ARR = Accounting Rate of Return

EBIT = Earning Before Interest and Taxes

T = Tax rate

n = Project's life time

I_0 = Initial Investment

I_n = Book Value of Investment at the end of n years assuming straight line depreciation method

Con't….

- ***The decision rule for Accounting Rate of Return (ARR):***
  - If the **calculated ARR** is **greater than the minimum acceptable rate of return** (standard rate of return established by the management of the firm), **accept the project.**
  - If the calculated **ARR is less than** the **minimum established rate of return**, **reject the project.**
  - If the ARR is equal to the minimum established rate of return, may accept or reject the project.

Example:

- A project requires an investment of $ 500,000 and has a scrap value of $ 20,000 after 5 years. It is expected to yield profits after depreciation and taxes during the five years amounting to **$40,000, $ 60,000, $ 70,000, $ 50,000, $ 20,000** (assume the target ARR is 12.5 %)
- **Solution:**
- Average profit = $ 240,000/

Net investment in the project

ARR = **Average annual net profit** x 100

Net investment in the project

ARR = 48,000 x 100%

260,000

= 18.46%

- **Since it is higher than the target figure, the project should be accepted.**

Example …….

- Chapter Five Capital Budgeting.doc page-11

Discounted Cash Flow Techniques

- **Discounted Cash flow techniques**: are investment evaluation criteria that **consider the time value of money** or **the concept of present value** when evaluating alternative investment projects.
- **Discounted Cash Flow Techniques includes:**

✓ Net Present Value (NPV)

✓ Profitability Index

✓ Internal Rate of Return (IRR)

✓ Discounted Payback Period

Discounted Cash Flow (DCF) Techniques

- The main DCF techniques for capital budgeting include: Net Present Value (NPV), Internal Rate of Return (IRR), discounted payback period and Profitability Index (PI).
  - Each requires estimates of **expected cash flows (and their timing) for the project.**
    - Including cash outflows (costs) and inflows (revenues or savings) – normally tax effects are also considered.
  - Each requires an estimate of the project's risk so that an appropriate discount rate (opportunity cost of capital) can be determined.
    - The discussion of risk will be deferred until later. For now, we will assume we know the relevant opportunity cost of capital or discount rate.
- ~~**Sometimes the above data is difficult to obtain – this is the main weakness of all DCF techniques.**~~

1. Net Present Value (NPV)

- This method takes into consideration the time value of money and attempts to calculate the return on investments by introducing the **factor of time element**.

Net Present Value (NPV)

NPV is the present value of an investment project's **net cash flows** minus the **project's initial cash outflow.**

$$NPV = \frac{CF_1}{(1+k)^1} + \frac{CF_2}{(1+k)^2} + \cdots \frac{CF_n}{(1+k)^n} - ICO$$

Method: NPV = $PV_{inflows} - PV_{outflows}$

Con't…

- *Where: CF1, CF2, CF3…..CFn= Stream of cash inflows:*

ICo= Incial Cash outflow

K= Cost of Capital /Opportunity Cost of Capital

NPV= PV of inflows – Cost

= Net gain in wealth

Steps in Computing the Net Present Value:

Step-I:-Estimation of the investment's/project's future cash flow based on realistic assumptions.

Step-II:-Determine an appropriate **rate of interest** that should be selected as the minimum required rate of return called ' **cut off rate or discount rate.**

Con't....

Step-III: Compute the **present value of total investment outlay**, i.e., cash outflows at the determined discount rate.

- If the total investment is to be made in the initial year, the present value shall be the same as the cost of investment.

Step-IV: Compute the present values of total **investment proceeds,** i.e., cash inflows, (profit before depreciation and after tax) at the above determined discount rate.

Con't…

Step-V: Calculate the **net present value** of each project by subtracting the **present value of cash inflows** from the present value of cash outflows for each project

Decision Rule:

- If the projects are **Independent projects**:
  - Accept the project when NPV is positive (NPV>0)
  - Reject the project when NPV is negative (NPV<0)
  - May accept or reject the project when the NPV is zero (NPV=0)

Con't...

- To select between **mutually exclusive projects**, projects should be ranked in order of **net present values;** i.e. the first preference should be given to the project having the **maximum positive net present value (NPV).**

Calculating Net Present Value

- Assume that Project *X* costs Rs 2,500 now and is expected to generate year-end cash inflows of Rs 900, Rs 800, Rs 700, Rs 600 and Rs 500 in years 1 through 5. The opportunity cost of the capital may be assumed to be 10 per cent.

$$\text{NPV} = \frac{\text{Rs } 900}{(1+0.10)^1} + \frac{\text{Rs } 800}{(1+0.10)^2} + \frac{\text{Rs } 700}{(1+0.10)^3} + \frac{\text{Rs } 600}{(1+0.10)^4} + \frac{\text{Rs } 500}{(1+0.10)^5} - \text{Rs } 2{,}500$$

$$= [\text{Rs } 900(\text{PVF}_{1,\,0.10}) + \text{Rs } 800(\text{PVF}_{2,\,0.10}) + \text{Rs } 700(\text{PVF}_{3,\,0.10}) + \text{Rs } 600(\text{PVF}_{4,\,0.10}) + \text{Rs } 500(\text{PVF}_{5,\,0.10})] - \text{Rs } 2{,}500$$

$$= [\text{Rs } 900 \times 0.909 + \text{Rs } 800 \times 0.826 + \text{Rs } 700 \times 0.751 + \text{Rs } 600 \times 0.683 + \text{Rs } 500 \times 0.620] - \text{Rs } 2{,}500$$

$$= \text{Rs } 2{,}725 - \text{Rs } 2{,}500 = +\text{Rs } 225$$

Con’t….

- Example-2……..Page-16

2. The Internal Rate of Return (IRR)

- The **internal rate of return (IRR)** is the rate that equates the initial investment outlay of a project with the **present value of periodic cash inflows** expected from the investment. i.e.

$$\mathbf{Pv_{outflows} = Pv_{inflows,\ i.e}\ NPV = Zero}$$

Con’t…

- The internal rate of return is the **true economic return earned by the asset** over its life.

- The internal rate of return is the discount rate that will cause the **net present value (NPV)** of a project to be **zero.**

Con't…

- **There are two ways to considered the computation of IRR; namely**

a. when the cash inflow is **annuity** then,

$$\textbf{IRR} = \frac{\textbf{Initial investment}}{\textbf{PV } \textit{Cash inflows}}$$

Con't...

- The internal rate of return (IRR) is the rate that equates the investment outlay with the present value of cash inflow received after one period.
- This also implies that the rate of return is the **discount rate** which makes **NPV = 0. i.e PV of inflows and PV of outflows are equal.**

$$C_0 = \frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} + \frac{C_3}{(1+r)^3} + \cdots + \frac{C_n}{(1+r)^n}$$

$$C_0 = \sum_{t=1}^{n} \frac{C_t}{(1+r)^t}$$

$$\sum_{t=1}^{n} \frac{C_t}{(1+r)^t} - C_0 = 0$$

Con't…

b. when cash inflows is **unevenly** then, IRR computed by using the following interpolation method formula:

- ***Steps in the calculation of IRR using trial and error:***
- **Step I** : Determine the cash flows from the project.
- **Step II** **:** Find out NPV using an arbitrary discount rate.
- The result could be either **negative or positive**. Assume the value is **positive**, this tells that the IRR is above the arbitrarily selected **discount rate.**

Con't...

- **Step III:** Find out **NPV** using a discount rate (again arbitrarily selected) which is ***above the previously selected rate*** till it gives a **value less than zero (negative).**
- **Step IV:** The above results confirm the fact that the (IRR) **true rate of return** is in between the two rates, **upper and lower rates.**
  - Therefore, the true rate can be approximated using the following formula of **linear interpolation:**

Con't…

$$r \approx A + (B - A)\frac{C}{(C - D)}$$

Where : r = Internal rate of return

A = Lower trial rate

B = Higher trial rate

C = NPV at the lower rate

D = NPV at the higher rate

Decision Criteria

If the IRR> the RRR then accept the project

If the IRR<the RRR then reject the project

If the IRR= the RRR then may accept or reject the project

Con’t…

- Example…….Page-21

3. Profitability Index

- **Very Similar to Net Present Value.**
- Instead of Subtracting the Initial Outlay from the PV of Inflows, the Profitability Index is the ratio of Initial Outlay to the PV of Inflows.

$$PI = \frac{\text{PV of Inflows}}{\text{Initial Outlay}}$$

Decision Rule:

- PI >1, is should be accepted and increases the value of the firm.
- PI <1, it should be rejected and decreases the value of the firm.
- PI =1, it is at break-even (may accept the project)

Con't

PI is the ratio of the present value of a project's future net cash flows to the project's initial cash outflow.

Method #1:

$$PI = \left[\frac{CF_1}{(1+k)^1} + \frac{CF_2}{(1+k)^2} + \cdots + \frac{CF_n}{(1+k)^n} \right] \div ICO$$

<< OR >>

Method #2:

$$PI = 1 + [\ NPV / ICO\ ]$$

Con't…

The Profitability Index *(PI) formula*

$$\text{Profitability Index} = \frac{\text{Present value of cash inflows}}{\text{Present value of cash outflows}}$$

$$PV = \frac{PV(C_t)}{C_o} = \sum_{t=1}^{n} \frac{C_t}{(1+k)^t} \div C_o$$

Decision Rule for PI method:

- ✓ Accept the project when PI>1
- ✓ Reject the project when PI<1
- ✓ May accept or reject the project when PI=1

Con’t….

- **Example --------- Page-24**

4. Discounted Payback Period

- Uses the same procedures as **payback period** and have all the merits and demerits of payback period except the use of ***discounted cash flows or time value of money.***

To find the discounted pay back

- (1) Find the PV of each cash inflow on the time line.
- (2) Find the payback using the discounted Cash Flow.

Capital Rationing

- **Capital rationing** is another methods that used to identify the **worth project** when there is **limited fund to finance the project** and when there is expectation of **independent projects**.
- **Capital rationing** occurs when a company chooses **not** to fund all **positive NPV** projects.

- It happens when a corporation is **unable to finance** its projects due to **limited finance.** In this case one can select the best project based on the net investment and net present value of the projects.

- in this case the company typically sets an **upper limit on the total amount** of capital expenditures that it will make in the upcoming year.

Example:

- Analyze the projects on the next page with NPV, IRR, and PI assuming the opportunity cost of capital is 10% and the firm is constrained to only invest $50,000 now (and no constraint is expected in future years).

Example (All $ numbers are in thousands)

Year	Proj. A	Proj. B	Proj. C	Proj. D	Proj. E
0	-$50	-$20	-$20	-$20	-$10
1	$60	$24.2	-$10	$25	$12.6
2	$0	$0	$37.862	$0	$0
NPV	$4.545	$2.0	$2.2	$2.727	$1.4545
IRR	20%	21%	14.84%	25%	26%
PI	1.0909	1.1	1.11	1.136	1.145

Capital Rationing Example: Comparison of Rankings

- NPV rankings (best to worst)
  - A, D, C, B, E
    - A uses up the available capital
    - Overall NPV = $4,545.45
- IRR rankings (best to worst)
  - E, D, B, A, C
    - E, D, B use up the available capital
    - Overall NPV = NPV_{E+D+B}=$6,181.82
- PI rankings (best to worst)
  - E, D, C, B, A
    - E, D, C use up the available capital
    - Overall NPV = NPV_{E+D+C}=$6,381.82
- The PI rankings produce the best set of investments to accept given the capital rationing constraint.

- ABC Company is a factory that is currently contemplating on investing two projects: Project A and Project B. The relevant operating cash flows for the two projects are presented below.
- **Required:** If the WACC = 10%, Evaluate the projects in terms of PBP, DPBP, NPV, PI & IRR

	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:

Techniques	**Project A**	**Project B**
Payback Period	3 years	2.5 years
Discounted Payback	3.8 years	3.3 years
Net Present Value (NPV)	11,071	10,924
Profitability Index (PI)	1.26	1.24
Internal Rate of Return (IRR)	19.9%	21.7%

Chapter End!!

Best Wish!!