Lesson 8

Techniques of Capital Investment Decisions

Objectives of the lesson

After studying this lesson, students will be able to:

- Develop understanding of the non-discounting techniques of capital budgeting,
- Understand discounting based techniques of capital budgeting decisions, and
- Learn applications of these techniques in investment decisions.

1.0 Introduction

Capital budgeting methods are the instruments of appraising the project proposal. The project appraisal or feasibility examination of investments proposals needs answer to certain question, such as – how many years it will take to get investment back, how much profit it will generate, or whether investment in a project will be profitable, what will be the timing of future benefits of the investment, and what will be the rate of return that will equate discounted cash flows and the investment. The answer to these questions can be explored with the appropriate use of the method of project evaluation.

2.0 Methods of Project Appraisal

The methods of project appraisal are classified in two categories, viz., non-discounting techniques, and discounting cash flow techniques. The non-discounting techniques are (i) pay-back period method, and (ii) accounting or average rate of return method; and discounting cash flow techniques include (i) present value/ net present value method, (ii) internal rate of return method, (iii) present value index/ profitability index method, and (iv) discounted pay-back period method.

3.0 Non-Discounting Techniques

3.1 Pay-Back Period Method

Pay-back period (PBP) refers to time required to get investment back. The PBP is nothing but number of years/ months/ days required to get back the amount invested in the project. To find out PBP, the two important covenants required are: (i) initial outlay/ initial investment/ original investment**,** and (ii) cash inflows. Here, cash flow means net profit after tax but before depreciation.

The PBP is calculated by way of establishing the relationship between the amount of investment and the annual cash flows. While calculating PBP, the nature of annual cash flows should be identified. It can be (i) even cash flows, and (ii) uneven cash flows.

In case of even cash flows, PBP is calculated by the following formula.

$$\text{Pay Back Period} = \frac{\text{Initial Investment}}{\text{Annual Cash Inflow}}$$

In case of uneven cash flows, PBP is calculated in two steps, (i) calculation of cumulative cash flows, and (ii) calculate PBP by following formula.

$$\text{Pay Back Period} = \text{Completed years} + \frac{\text{Unrecovered Investment}}{\text{Cash Inflow in next year}} \text{ X } 12$$

Decision Criteria: If two or more projects are given for appraisal, considered to be mutually exclusive to each other for selection, the project having lower PBP is considered better because it has faster recovery of initial investment.

Besides PBP, we can also calculate post pay-back period (PPBP) and post pay-back period profit (PPBPP). PPBP is calculated as:

$$\text{PPBP} = (\text{Estimated Life} - \text{PBP})$$

Decision Criteria: Project having higher PPBP is better.

PPBPP is calculated in two ways:

Case of Even CFs: $\text{PPBPP} = (\text{PPBP} * \text{ACF}) + \text{Scrap}$

Case of Uneven CFs: $\text{PPBPP} = (\text{CF in PPBP} + \text{Scrap})$

Decision Criteria: Project having higher PPBPP is better.

In case of alternative projects with different outlay, the decision is taken on the basis of PPBPP Index, which is calculated as:

$$\text{PPBPP Index} = \frac{\text{PPBPP}}{\text{Initial Investment}} 100$$

Decision Criteria: Project having higher PPBPP Index is better.

3.2 Accounting or Average Rate of Return (ARR) Method

The accounting/ average rate of return (ARR), also called as unadjusted rate of return measures the average annual net income of the project as percentage of investment. it is calculated as:

$$\text{ARR} = \frac{\text{Average Annual Cash Inflow} - \text{Depreciation}}{\text{Investment}} 100$$

or

$$\text{ARR} = \frac{\text{Average Annual Net Income}}{\text{AverageInvestment}} 100$$

Average annual net income is average of the net profit after depreciation, interest and tax generated by the project over its lifetime. It is calculated as:

$$\text{Average Annual Cash Inflow} = \frac{\text{Total Cash Inflow during Lifetime of Asset}}{\text{Life of Asset}}$$

Investment can be initial investment (including installation cost), or it can be average investment over the useful life of project. The average investment is calculated as:

$$\text{Average Investment} = \frac{\text{Opening Investment} - \text{Closing Investment}}{2}$$

Decision Criteria: Project having higher ARR is better.

4.0 Discounting Techniques

4.1 Present Value Method

Under this method, the initial outlay or investment available in terms of present value is compared with the present value of future earnings (cash inflows) out of the project. The reason to find out the present value of future earnings is that the comparison in between inflows and outflows should be meaningful as well as effective. The present value of the initial outlay cannot be converted into the future value for comparison. Even otherwise the conversion takes place, the comparison cannot be meaningful. For this purpose, the future earnings are converted into the present value terms at appropriate rate of discounting. The rate at which the future earnings are discounted is known as required rate of return. The discounting rate is generally the cost of capital invested in project.

Decision Criteria: If the present value of future cash inflows is greater than the present value of initial investment, the proposal is accepted.

Net Present Value (NPV) Method

The net present value is the excess of the sum of present value of future cash inflows over present value of future cash outflows. Symbolically,

$$\text{NPV} = \sum\text{PV of Cash Inflows} - \sum\text{PV of Cash Outflows}$$

If the present value of future cash inflows are equal to the present value of initial investment; the proposal can be accepted. Here NPV will be Zero. This is termed as Cut off Point.

Decision Criteria: (i) NPV ≥ 0 (ii) Project with high NPV is better.

Initial Outlay = Present value of Benefits⇒Zero NPV ⇒Project can be accepted.

Present Value Index / Profitability Index Method

The major lacuna of the net present value method is that it does not provide appropriate base to rank the proposals when amount of investment in alternative investment proposal differ. The present value index method (also termed as profitability index method) provide logical base to rank such proposals. PV Index is calculated as:

$$\text{Present Value Index} = \frac{\text{Present value of cash Inflows}}{\text{Present value of cash Outflows}}$$

Decision Criteria: (i) Present Value Index (PI) ≥ 1 (ii) Project with high PI is better.

4.2 Internal Rate of Return Method

The internal rate of return (IRR), also known as time adjusted rate of return (TARR) is that rate of interest at which the net present value (NPV) of a project is zero. In other words, it is the rate which equates the present value of cash inflows to the present value of the cash outflows. IRR is calculated in two ways.

(i) Case of Even Cash Inflows:

Step 1: Calculate Present Value Factor (V)

$$V = \frac{\text{Net Investment}}{\text{Average Annual Savings}}$$

Step 2: Consider PVF_A table and identify V_1 and V_2 (higher and lower value) and r_1 and r_2 (lower and higher rate)

Step 3: Calculate Internal Rate of Return (IRR)

$$IRR = r_1 + \frac{(V_1 - V)}{(V_1 - V_2)}(r_2 - r_1)$$

Decision Criteria: IRR ≥ Required ROR, known as Cut-off Rate

(ii) Case of Uneven Cash Inflows:

Step 1: Calculate PV Factor (V)

$$V = \frac{\text{Net Investment}}{\text{Average Annual Savings}}$$

Step 2: Consider PVF_A table and identify V_1 and V_2 (higher and lower value) and r_1 and r_2 (lower and higher rate)

Step 3: Consider PVF_{Re} table and find PVF_{Re} at r_1 and r_2

Step 4: Calculate PV of Cash Inflows at r_1 and r_2.

$PVCFr_1$ must be more than or equal to Net Investment.

If not, use Trial and Error Approach.

Step 5: Calculate IRR

$$IRR = r_1 + \frac{(PVCFr_1 - NI)}{(PVCFr_1 - PVCFr_2)}(r_2 - r_1)$$

Decision Criteria: IRR ≥ Required Rate of Return (RoR). The required rate of return known as cut off rate.

The important difference between NPV and IRR method is, while under NPV method the discounting is known (the firm's cost of capital), under IRR method the rate that makes NPV zero has to be found out.

Summary

Among several appraisal criterion of capital investment proposals, some are based on non-discounting techniques, while some follow discounted cash flow techniques. The payback period of an investment enables the manager to calculate the number of years required to recover the initial capital outlay in the project. Although this is a rough measure of liquidity of the project, it makes a poor job of measuring profitability as it ignores cash flows occurring after the payback period and the time value of money using a crudely determined subjective cut-off point to appraise a project.

The accounting rate of return is the ratio of average profit after tax to average book value of the investment. A kin to payback period, the criterion ignores the time value of money. Although it considers the returns over the entire life of the project and therefore is a measure of profitability, it depends largely on accounting income rather than cash flows. In addition, any company using ARR needs to determine a yardstick to compare the returns of any project. In most cases, the yardsticks themselves suffer from subjectivity.

The net present value is the present value of the project's net cash flows less the initial outflow. A project is acceptable only when its NPV is greater than or equal to zero. The internal rate of return is the discount rate that equates the present value of the net cash flows of the project with the initial cash outlay. Any project is acceptable if the internal rate of return is greater than or equal to the required rate of return, usually the company's cost of capital.

Self Check Questions

1. What is Capital Budgeting? Explain various techniques of Capital Budgeting.
2. What are discounting techniques of capital budgeting? In what manner discounted cash flow technique are useful in capital budgeting decisions
3. What do you understand by Internal Rate of Return? How is it different from present value method? Explain.
4. What do you understand by internal rate of return (IRR)? How is it different from required rate of return (RRR)? Explain by giving suitable examples.

Practical Problems on Capital Investment Decisions

Illustration # 1: A firm is planning to purchase a new machine costing Rs. 5,00,000. The expected life of machine is ten years. The machine is expected to generate sales revenue of Rs. 6,00,000 p.a. The variable cost is 50% of sales and annual fixed cost (other than depreciation) is Rs. 25,000. Assuming 50% corporate tax rate, calculate PBP and Post PBP Profit, and advise the management whether the machine should be purchased.

Solution:

Calculation of Cash Flow

	Amount (Rs.)	Amount (Rs.)
Annual Sales revenue		6,00,000
Less: Variable cost (@50% of Sales)	3,00,000	
Fixed Cost	25,000	
Depreciation	50,000	3,75,000
Profit before Tax		2,25,000
Less: Tax (@ 50%)		1,12,500
Profit after tax		1,12,500
Add: Depreciation		50,000
Annual Cash Inflow		1,62,500

$$\text{Depreciation} = \frac{\text{Investment}}{\text{Estimated Life}} = \frac{5,00,000}{10} = 50,000$$

$$\text{PBP} = \frac{\text{Initial Investment}}{\text{Annual Cash Inflow}}$$

$$\text{PBP} = \frac{5,00,000}{1,62,500} = 3.08 \text{ Years}$$

$$\text{Post PBP Profit} = (\text{Estimated Life} - \text{PBP}) * \text{Annual Cash Flow}$$

$$\text{Post PBP Profit} = (10 - 3.08) * 1,62,500 = 11,24,500$$

Firm should purchase the machine.

Illustration # 2: A company wishes to replace its existing machine having book value of Rs. 24,000. The existing machine has remaining life of four years and no salvage value. The cost of new machine is Rs. 1,12,000, life is four years, and estimated residual value is Rs. 16,000. The vendor of new machine is ready to take old machine back for Rs. 12,000. The new machine will perform same operations the old machine is performing; however, improved technology of new machine will enable the firm to reap cash benefits (before depreciation and tax) of Rs. 56,000 p.a. in material, labor, and other expenses. Corporate tax rate applicable to the company is 40%. Examine feasibility of proposal by calculating PBP and Post PBP Profit.

Solution:

Calculation of Cash Flow

	Amount (Rs.)	Amount (Rs.)
Initial Cash Outflow (Year 0)		
Cost of New Machine		1,12,000
Less: Sale Proceed of Old Machine	12,000	
Tax Saving on Loss on Old Machine (WN-1)	4,800	16,800
Net Cash Outflow (Additional Investment)		95,200
Annual Cash Inflow (Year 1-4)		
Annual Savings in Expenses		56,000
Less: Additional Depreciation (WN-2)		18,000
Profit before Tax		38,000
Less: Tax @ 40%		15,200
Profit after Tax		22,800
Add: Additional Depreciation		18,000
Additional Annual Cash Flow		40,800
Terminal Cash Inflow (Year 4)		
Salvage Value of New Machine		16,000

WN-1: Tax Saving on Loss on Old Machine

Book Value	24,000
Sale Proceed	12,000
Loss on Sale	12,000
Tax Saving on Loss (@ 40%)	4,800

WN-2: Additional Depreciation

Depreciation on New Machine $= \frac{\text{Cost} - \text{Salvage}}{\text{Estimated Life}} = \frac{112000 - 16000}{4}$	24,000
Depreciation on Old Machine $= \frac{\text{Book Value} - \text{Salvage}}{\text{Estimated Life}} = \frac{24000 - 0}{4}$	6,000
Additional Depreciation	18,000

$$\text{PBP} = \frac{\text{Addl. Investment}}{\text{Addl. Annual Cash Inflow}} = \frac{95200}{40{,}800} = 2.333 \text{ Years}$$

$$\text{Post PBP Profit} = (\text{Estimated Life} - \text{PBP}) * \text{Annual Cash Flow} + \text{Salvage}$$

$$\text{Post PBP Profit} = (4 - 2.333) * 40{,}800 + 16{,}000 = 84{,}013$$

Firm should purchase the machine.

Illustration # 3: A company is planning to purchase an innovative machine costing Rs. 6,00,000. Its operation will result in to increase in net working capital by Rs. 60,000. The expected annual profits from machine are Rs. 60,000, Rs. 65,000, Rs. 70,000, Rs. 75,000, and Rs. 80,000. The expected salvage value is Rs. 40,000 and cost of capital is 12%. Using ARR method, suggest the company whether machine should be purchased.

Solution:

$$\text{Average Annual Income} = \frac{\sum \text{Annual Income after Tax}}{\text{Number of Years}}$$

$$\text{Average Annual Income} = \frac{60000 + 65000 + 70000 + 75000 + 80000}{5} = 70000$$

$$\text{Average Investment} = \frac{\text{Net Investment}}{2}$$

$$\text{Average Investment} = \frac{(\text{Cost} - \text{Salvage})}{2} + \text{Salvage} + \text{Net Working Capital}$$

$$\text{Average Investment} = \frac{(600000 - 40000)}{2} + 40000 + 60000$$

$$\text{Average Investment} = 280000 + 40000 + 60000 = 380000$$

$$\text{ARR} = \frac{\text{Average Annual Net Income}}{\text{Average Investment}} * 100 = \frac{70000}{380000} * 100 = 18.42\%$$

Company should purchase the machine.

Illustration # 4: A company is considering an investment proposal having cost outlay of Rs. 50,000. The profit before depreciation expected from the investment over its life time is Rs. 10,000, Rs. 11,000, Rs. 14,000, Rs. 15,000, and Rs. 25,000. Assuming 35% tax rate, no salvage value, and 8% Cost of capital, evaluate the proposal by calculating (i) PBP, (ii) ARR, (iii) Discounted PBP, (iv) NPV, and (iv) Profitability Index.

Solution:

Calculation of PAT and ACF

Year	PBD	Dep.	PBT	Tax @35%	PAT	ACF (PAT+Dep.)	CCF
1	10,000	10,000	0	0	0	10,000	10,000
2	11,000	10,000	1,000	350	650	10,650	20,650
3	14,000	10,000	4,000	1,400	2,600	12,600	33,250
4	15,000	10,000	5,000	1,750	3,250	13,250	46,500
5	25,000	10,000	15,000	5,250	9,750	19,750	66,250
Total			25,000		16,250	66,250	

$$\text{PBP} = \text{Completed years} + \frac{\text{Unrecovered Investment}}{\text{Cash Inflow in Next Year}} * 12$$

$$\text{PBP} = 4 + \frac{3500}{19750} * 12 = 4 \text{ Years and } 2.13 \text{ Months}$$

$$\text{ARR} = \frac{\text{Average Annual Net Income}}{\text{Average Investment}} * 100 = \frac{16250/5}{50000/2} * 100 = 13\%$$

Calculation of PV of Cash Inflows

Year	ACF	PVF_{Re}@ 8%	PVCF	Cum. PVCF
1	10,000	0.926	9,260	9,260
2	10,650	0.857	9,127	18,387
3	12,600	0.794	10,004	28,391
4	13,250	0.735	9,739	38,130
5	19,750	0.681	13,450	51,580
Total			51,580	

$$\text{NPV} = \sum \text{PV of Cash Inflows} - \sum \text{PV of Cash Outflows}$$

$$\text{NPV} = 51580 - 50000 = 1580$$

$$\text{Discounted PBP} = 4 + \frac{11870}{13450} * 12 = 4 \text{ Years and } 10.59 \text{ Months}$$

Not encouraging; can be considered, if urgent.

Illustration # 5: Singh Brothers is considering the purchase of a new machine. Two alternative machines A and B, each costing Rs. 4 lakh have been suggested. The vendor of machine B has mentioned clearly in quotation that machine will need overhauling at the end of year 2, and tentative expense will be Rs. 30,000. The earnings after tax but before depreciation expected from A are Rs. 40,000, Rs. 1,20,000, Rs. 1,60,000, Rs. 2,40,000, and Rs. 1,60,000. The PAT expected from B are Rs. 40,000, Rs. 80,000, Rs. 1,20,000, Rs. 40,000, and zero. Firm's target rate of return on investment is 10%. You are required to compare the alternatives by calculating (i) PBP (ii) Discounted PBP (iii) Unadjusted RoR, and (iv) NPV

Solution:

Calculation of PBP

Machine A:

$$\text{PBP} = \text{Completed years} + \frac{\text{Unrecovered Investment}}{\text{Cash Inflow in Next Year}} * 12$$

Machine A:

$$\text{PBP} = 3 + \frac{80000}{240000} * 12 = 3 \text{ Years and } 4 \text{ Months}$$

Machine A

Year	CF	CCF	PVF @ 10%	PVCF
Inflows				
1	40,000	40,000	0.909	36,360
2	1,20,000	1,60,000	0.826	99,120
3	1,60,000	3,20,000	0.751	1,20,160
4	2,40,000	5,60,000	0.683	1,63,920
5	1,60,000	7,20,000	0.621	99,360
				5,18,920
Outflow (Investment)				
0	400,000			4,00,000

Machine B:

$$\text{PBP } = 2 + \frac{150000}{200000} * 12 = 2 \text{ Years and 9 Months}$$

Machine B is better.

Calculation of Discounted PBP

Machine A:

$$\text{PBP } = 3 + \frac{400000 - 255640}{163920} * 12 = 3 \text{ Years and 10.57 Months}$$

Machine B:

$$\text{PBP } = 3 + \frac{424780 - 391440}{81960} * 12 = 3 \text{ Years and 4.88 Months}$$

Machine B

Year	PAT	Dep.	CF	CCF	PVF @ 10%	PVCF
Inflows						
1	40,000	80,000	1,20,000	1,20,000	0.909	1,09,080
2	80,000	80,000	1,60,000	2,80,000	0.826	1,32,160
3	1,20,000	80,000	2,00,000	4,80,000	0.751	1,50,200
4	40,000	80,000	1,20,000	6,00,000	0.683	81,960
5	0	80,000	80,000	6,80,000	0.621	49,680
						5,23,080
Outflow (Investment)						
0			4,00,000		1.000	4,00,000
2			30,000		0.826	24,780
			4,30,000			4, 24,780

Machine B is better.

Calculation of Unadjusted RoR

$$\text{ARR} = \frac{\text{Average Annual Net Income}}{\text{Average Investment}} * 100$$

Machine A:

$$\text{ARR} = \frac{720000/5}{400000/2} * 100 = 72\%$$

Machine B:

$$\text{ARR} = \frac{680000/5}{430000/2} * 100 = 63.26\%$$

Machine A is better.

Calculation of NPV

$$\text{NPV} = \sum\text{PV of Cash Inflows} - \sum\text{PV of Cash Outflows}$$

Machine A: $\text{NPV} = 5{,}18{,}920 - 400000 = 118920$

Machine B: $\text{NPV} = 5{,}23{,}080 - 424780 = 98300$

Machine A is better.

Illustration # 6: From the following information, calculate NPV of competitive projects and suggest which of the two projects should be accepted. Cost of capital is 10%.

Project A: Investment – Rs. 20,000, Estimated Scrap Value – Rs. 1,000, and Estimated Cash Flows – Rs. 5,000, Rs. 10,000, Rs. 10,000, Rs. 3,000 and Rs. 2,000
Project B: Investment – Rs. 30,000, Estimated Scrap Value – Rs. 2,000, and Estimated Cash Flows – Rs. 20,000, Rs. 10,000, Rs. 5,000, Rs. 3,000 and Rs. 2,000

Solution:

Calculation of NPV

Year	Project A			Project B		
	CF	PVF @ 10%	PVCF	CF	PVF @ 10%	PVCF
1	5,000	0.909	4,545	20,000	0.909	18,180
2	10,000	0.826	8,260	10,000	0.826	8,260
3	10,000	0.751	7,510	5,000	0.751	3,755
4	3,000	0.683	2,049	3,000	0.683	2,049
5	2,000	0.621	1,242	2,000	0.621	1,242
Scrap	1,000	0.621	621	2,000	0.621	1,242
Total PV CF			24,227			34,728
Investment			20,000			30,000
NPV			4,227			4,728

Based on NPV Machine B is found better.

As investment in two projects is different, the decision should not be taken on the basis of NPV only, rather, it should be based on Profitability Index.

$$\text{PI} = \frac{\sum \text{PV of Cash Inflows}}{\sum \text{PV of Cash Outflows}} * 100$$

Project A:

$$\text{PI} = \frac{4{,}227}{20{,}000} * 100 = 21.14\%$$

Project B:

$$\text{PI} = \frac{4{,}728}{30{,}000} * 100 = 15.76\%$$

Machine A is better.

Illustration # 7: A company is contemplating two assets A and B costing Rs. 60000 and Rs. 80000. The life of asset A is 3 years, and earnings after tax expected from it is Rs. 10,000 p.a. Asset B is expected to last for 4 years and give after tax cash benefit of Rs. 32,500 p.a. Evaluate the alternatives by calculating (i) PBP, (ii) Unadjusted RoR, (iii) NPV, (iv) IRR. Expected rate of return of the industry is 15%.

Solution:

Pay Back Period

Asset A:

$$\text{Annual Cash Flow} = (\text{EAT} + \text{Depreciation}) = 10{,}000 + \frac{60{,}000}{3} = 30{,}000$$

$$\text{PBP} = \frac{\text{Investment}}{\text{Annual Cash Inflow}} = \frac{60{,}000}{30{,}000} = 2 \text{ Years}$$

Asset B:

$$\text{PBP} = \frac{\text{Investment}}{\text{Annual Cash Inflow}} = \frac{80{,}000}{32{,}500} = 2.46 \text{ Years}$$

Asset A is better.

Unadjusted Rate of Return

Asset A:

$$\text{ARR} = \frac{\text{Average Annual Net Income}}{\text{Average Investment}} * 100 = \frac{10{,}000}{60{,}000/2} * 100 = 33.33\%$$

Asset B:

$$\text{ARR} = \frac{\text{Annual Cash Flow} - \frac{\text{Investment}}{\text{N}}}{\text{Average Investment}} * 100 = \frac{32{,}500 - \frac{80000}{4}}{80{,}000/2} * 100 = 31.25\%$$

Asset A is better.

Net Present Value

$$\text{NPV} = \sum\text{PV of Cash Inflows} - \sum\text{PV of Cash Outflows}$$

Asset A:

$$\text{NPV} = (\text{Annual Cash Inflows} * \text{PVFA}_{@15\%,3\text{ Years}}) - \text{ Cash Outflows}$$

$$\text{NPV} = (30{,}000 * 2.283) - 60{,}000 = 8{,}490$$

$$\text{PI} = \frac{\sum\text{PV of Cash Inflows}}{\sum\text{PV of Cash Outflows}} = \frac{68{,}490}{60{,}000} = 1.14$$

Asset B:

$$\text{NPV} = (\text{Annual Cash Inflows} * \text{PVFA}_{@15\%,4\text{ Years}}) - \text{ Cash Outflows}$$

$$\text{NPV} = (32{,}500 * 2.855) - 80{,}000 = 12{,}788$$

$$\text{PI} = \frac{\sum\text{PV of Cash Inflows}}{\sum\text{PV of Cash Outflows}} = \frac{92{,}788}{80{,}000} = 1.16$$

Asset B is better.

Internal Rate of Return

Asset A:

$$\text{V} = \frac{\text{Net Investment}}{\text{Average Annual Savings}} = \frac{60{,}000}{30{,}000} = 2$$

As per PVF_A table (for 3 years) V_1 and V_2 (closer to $\text{V} = 2$) are 2.042 at 22% (r_1) and 1.981 at 24% (r_2).

$$\text{IRR} = \text{r}_1 + \frac{(\text{V}_1 - \text{V})}{(\text{V}_1 - \text{V}_2)}(\text{r}_2 - \text{r}_1) = 22 + \frac{(2.042 - 2.000)}{(2.042 - 1.981)}(24 - 22) = 23.38\%$$

Asset B:

$$\text{V} = \frac{\text{Net Investment}}{\text{Average Annual Savings}} = \frac{80{,}000}{32{,}500} = 2.462$$

As per PVF_A table (for 4 years) V_1 and V_2 (closer to $\text{V} = 2.462$) are 2.491 at 22% (r_1) and 2.404 at 24% (r_2).

$$\text{IRR} = 22 + \frac{(2.491 - 2.462)}{(2.491 - 2.404)}(24 - 22) = 22.67\%$$

Asset A is better.

Illustration # 8: A company has to select one of the two projects. The cost of project A is Rs. 22,000 and its expected cash flows are Rs. 12,000, Rs. 4,000, Rs. 2,000, and Rs. 10,000. Project B has cost outlay of Rs. 20,000 and is expected to give cash flows of Rs. 2,000, Rs. 2,000, Rs. 4,000, and Rs. 20,000 during its lifetime. Using time adjusted rate of return (TARR) method suggest which project should be selected.

Solution:

Project A:

$$\text{V} = \frac{\text{Net Investment}}{\text{Average Annual Savings}}$$

$$\text{V} = \frac{22000}{7000} = 3.143$$

As per PVF_A table (for 4 years) V_1 and V_2 (closer to $\text{V} = 3.143$) are 3.170 at 10% (r_1) and 3.037 at 12% (r_2).

Year	Project A					
	Cash Inflows	PVF_{Re} @10%	PVCF @10%	Cash Inflows	PVF_{Re} @12%	PVCF @12%
1	12000	0.909	10908	12000	0.893	10716
2	4000	0.826	3304	4000	0.797	3188
3	2000	0.751	1502	2000	0.712	1424
4	10000	0.683	6830	10000	0.636	6360
		∑PVCF @ 10%	22544		∑PVCF @ 12%	21688
		Net Investment	22000		Net Investment	22000
		NPV @ 10%	544		NPV @ 12%	(312)

$$\text{IRR} = \text{r}_1 + \frac{(\text{PVCFr}_1 - \text{NI})}{(\text{PVCFr}_1 - \text{PVCFr}_2)}(\text{r}_2 - \text{r}_1)$$

$$\text{IRR} = 10 + \frac{(22544 - 22000)}{(22544 - 21688)}(12 - 10)$$

$$\text{IRR} = 10 + \frac{544}{856} * 2 = 11.27\%$$

Project B:

$$\text{V} = \frac{\text{Net Investment}}{\text{Average Annual Savings}}$$

$$V = \frac{20000}{7000} = 2.857$$

As per PVF_A table (for 4 years) V_1 and V_2 (closer to $V = 2.857$) are 2.914 at 14% (r_1) and 2.855 at 15% (r_2).

Year	Project B					
	Cash Inflows	PVF_{Re} @14%	PVCF @14%	Cash Inflows	PVF_{Re} @10%	PVCF @10%
1	2000	0.877	1754	2000	0.909	1818
2	2000	0.769	1538	2000	0.826	1652
3	4000	0.675	2700	4000	0.751	3004
4	20000	0.592	11840	20000	0.683	13660
		∑PVCF @ 14%	17832		∑PVCF @ 10%	20134
		Net Investment	20000		Net Investment	20000
		NPV @ 14%	(2168)		NPV @ 10%	134

Since NPV @ r_1 (14%) is less than net investment, for calculating IRR, trial and error approach will be used.

Here, the new rate (Trial Rate – 10%) will be r_1 and 14% will be r_2.

$$IRR = r_1 + \frac{(PVCFr_1 - NI)}{(PVCFr_1 - PVCFr_2)}(r_2 - r_1)$$

$$IRR = 10 + \frac{(20134 - 20000)}{(20134 - 17832)}(14 - 10)$$

$$IRR = 10 + \frac{134}{2302} * 4 = 10.23\%$$

Since IRR of Project A (11.27%) is more than Project B (10.23%), Project B is preferred.