therefore the new machine should be acquired.

Illustration 50: *(M.U., BMS, Oct. 2012)*

Company Maharaja Private Limited is planning an investment in new project. The investment budget of the company is Rs. 30,00,000. The company has following two investment alternatives:

Particulars	Project A	Project B
Investment	30,00,000	30,00,000
Useful Life	5 Years	6 Years
Cost of Capital	12%	12%

Cash inflows at the end of the year:		
Year 1	7,00,000	8,00,000
Year 2	10,00,000	8,00,000
Year 3	9,00,000	8,00,000
Year 4	8,00,000	8,00,000
Year 5	4,00,000	6,00,000
Year 6	–	2,00,000

Find which project the company should select on basis of: **(a)** Pay back Period Method **(b)** Net Present Value Method.

Discount factor @ 12%					
Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
0.893	0.797	0.712	0.636	0.567	0.507

Solution:

Type: Annual Cash Inflows are **Not** constant.

(a) Payback Period method: **(Rs. In Lakhs)**

Year	Project A		Project B	
	Cash Inflows	Cumulative Cash Inflows	Cash Inflows	Cumulative Cash Inflows
1	7	7	8	8
2	10	17	8	16
3	9	26	8	24
4	8	34	8	32
5	4	38	6	38
6	–	–	2	40
	Payback Period $= 3 + \left(\frac{30-26}{8}\right)$		Payback Period $= 3 + \left(\frac{30-24}{8}\right)$	
	$= 3 + \frac{4}{8}$		$= 3 + \frac{6}{8}$	
	$= 3 + 0.5$		$= 3 + 0.75$	
	$= 3.5$ years		$= 3.75$ years	

Suggestion:

On the basis of Payback Period Criterion; Project A should be selected as the Payback is lower.

(b) Net Present Value Method:

Year	PVF @ 12%	Project A		Project B	
		CI	PV of CI	CI	PV of CI
1	0.893	7,00,000	6,25,100	8,00,000	7,14,400
2	0.797	10,00,000	7,97,000	8,00,000	6,37,600
3	0.712	9,00,000	6,40,800	8,00,000	5,69,600
4	0.636	8,00,000	5,08,800	8,00,000	5,08,800
5	0.567	4,00,000	2,26,800	6,00,000	3,40,200
6	0.507	–	–	2,00,000	1,01,400
		Gross PV of CI	27,98,500		28,72,000
		Less: Cost of Asset	30,00,000		30,00,000
		NPV	(2,01,500)		(1,28,000)

Suggestion:

Based on NPV criteria both the projects are to be rejected as the NPV is negative.

Illustration 51: *(M.U., BMS, April 2013)*

Asha Ltd. is considering two mutually exclusive machines. Both require an initial outlay of ₹ 1,00,000 each and have a life of 5 years. The company's required rate of return is 10% and tax is

50%. The projects will be depreciated on a straight line basis. The net cash flows before taxes are expected to be generated by the projects as follows.

Year	Machine A ₹	Machine B ₹
1	40,000	60,000
2	40,000	30,000
3	40,000	20,000
4	40,000	50,000
5	40,000	50,000

Calculate and state which machine should be purchased and why?

(a) Pay back period.
(b) Pay back profitability.
(c) Profitability Index.
(d) Net Present Value.

Solution:

Machine – A

Year	Net Cash Flows Before Taxes	Income Tax @ 50%	NPAT	Depreciation	Cash Inflows
1	40,000	20,000	20,000	20,000	40,000
2	40,000	20,000	20,000	20,000	40,000
3	40,000	20,000	20,000	20,000	40,000
4	40,000	20,000	20,000	20,000	40,000
5	40,000	20,000	20,000	20,000	40,000

Machine – B

Year	Net Cash Flows Before Taxes	Income Tax @ 50%	NPAT	Depreciation	Cash Inflows
1	60,000	30,000	30,000	20,000	50,000
2	30,000	15,000	15,000	20,000	35,000
3	20,000	10,000	10,000	20,000	30,000
4	50,000	25,000	25,000	20,000	45,000
5	50,000	25,000	25,000	20,000	45,000

$$\text{Depreciation (SLM) p.a.} = \frac{OC - SV}{EL}$$

$$= \frac{1,00,000}{5}$$

$$= \text{Rs. } 20,000$$

(a) Pay Back Period:

Machine A:

Type: Annual Cash Inflows are constant

$$\text{Pay back period} = \frac{\text{Cost of the Asset}}{\text{Constant Annual Cash Inflows}}$$

$$= \frac{1,00,000}{40,000}$$

$$= 2.5 \text{ years}$$

Machine B:

Type: Annual Cash Inflows are not constant

Year	Cash Inflows	Cumulative Cash Inflows
1	50,000	50,000
2	35,000	85,000
3	30,000	1,15,000
4	45,000	1,60,000
5	45,000	2,05,000

$$\text{Pay back period} = 2 + \left(\frac{1,00,000 - 85,000}{30,000}\right)$$

$$= 2 + \frac{15,000}{30,000}$$

$$= 2 + 0.5$$

$$= 2.5 \text{ years}$$

(b) Pay back Profitability:

Machine – A:

$$\text{Pay back Profitability} = \text{Constant Annual Cash Inflows} \times \left(\text{Life of Asset} - \text{Pay back Period}\right)$$

$$= 40,000 \times (5 - 2.5)$$

$$= 40,000 \times 2.5$$

$$= \text{Rs. } 1,00,000$$

Machine – B:

$$\text{Pay back Profitability} = \text{Total Cash Inflows} - \text{Cost of Asset}$$

$$= 2,05,000 - 1,00,000$$

$$= \text{Rs. } 1,05,000$$

(c) Profitability Index (PI):

$$\text{Profitability Index} = \frac{\text{Gross PV of Cash Inflows}}{\text{PV of Cash Outflows}}$$

Machine – A	Machine – B
$= \frac{1,55,570}{1,00,000}$	$= \frac{1,51,640}{1,00,000}$
= 1.55:1	= 1.51:1

(d) Net Present Value:

Machine – A:

Year	PVAF @ 10%	Annual CI	Gross PV of CI
1 to 5	3.791*	40,000	1,51,640
	Less: Cost of Asset		1,00,000
	NPV		51,640

*Table Value of PVAF @ 10% for 5th Year

Machine – B:

Year	PVF @ 10%	CI	PVCI
1	0.909	50,000	45,450
2	0.826	35,000	28,910
3	0.751	30,000	22,530
4	0.683	45,000	30,735
5	0.621	45,000	27,945
	Gross PV of CI		1,55,570
	Less: Cost of Asset		1,00,000
	NPV		**55,570**

Summary of the Results:

Method	Machine A	Machine B
(a) Pay back period (years)	2.5	2.5
(b) Pay back profitability (Rs.)	1,00,000	1,05,000
(c) Profitability Index	1.55:1	1.51:1
(d) Net Present Value (Rs.)	51,640	55,570

greater in this case.

Illustration 53: *(MU, BMS, April 2014)*

A project requires an initial cash outflow of Rs. 10,00,000. It generates a cash inflow as follows:

Year end	1	2	3	4	5
Cash Inflow (Rs. lakhs)	6	3	2	5	5

Its cost of capital is 10%. Determine (a) payback period (b) discounted payback period (c) post payback profitability (d) Net Present value (e) Profitability index.

PV Factor @10% is as follows:

Year	1	2	3	4	5
	0.909	0.826	0.751	0.683	0.621

Solution:

Type: Cash Inflows are not constant.

(a) Payback period

(Rs. In Lakhs)

Year	Cash Inflows	Cumulative Cash Inflows
1	6	6
2	3	9
3	2	11
4	5	16
5	5	21

$$\text{Pay Back Period} = 2 + \left(\frac{10-9}{2}\right)$$

$$= 2 + \frac{1}{2}$$

$$= 2 + 0.5$$

$$\text{Pay Back Period} = 2.5 \text{ years}$$

(b) $$\text{Discounted Pay Back Period} = 3 + \left(\frac{10,00,000 - 9,43,400}{3,41,500}\right)$$

$$= 3 + \frac{56,600}{3,41,500}$$

$$= 3 + 0.166$$

Discounted PB = 3.166 years (approx)

(c) Post Payback Profitability = Total Cash Inflows – Initial Cash Outflows
= 21 lakhs – 10 lakhs
= Rs. 11 lakhs

Year	PVF @ 10%	Cash Inflows	PV of Cash Inflows	Cumulative PV of Cash Inflows
1	0.909	6,00,000	5,45,400	5,45,400
2	0.826	3,00,000	2,47,800	7,93,200
3	0.751	2,00,000	1,50,200	9,43,400
4	0.683	5,00,000	3,41,500	12,84,900
5	0.621	5,00,000	3,10,500	15,95,400
Gross PV Cash Inflows			15,95,400	
Less: Initial Cash Outflows			10,00,000	
(d) Net Present Value			**5,95,400**	

(e) $$\text{Profitability Index} = \frac{\text{Gross PV of CI}}{\text{PV of Cash Outflows}}$$

$$= \frac{15,95,400}{10,00,000}$$

PI = 1.595

PI = 1.6 (approx)

Type: Internal Rate of Return

Illustration 15:

Speedage Company Ltd. is considering a project which costs Rs. 5,00,000. The estimated salvage value is zero. Tax rate is 55%. The company uses straight line depreciation and the proposed project has cash inflows before depreciation and tax (CFBDT) as follows:

Year end	Cash Inflows (Rs.)
1	1,50,000
2	2,50,000
3	2,50,000
4	2,00,000
5	1,50,000

If the cost of capital is 12%, would you recommend the acceptance of the project under Internal Rate of Return Method?

Solution:

Year	CFBDT (Rs.)	Dep. (Rs.)	Net Earnings (Rs.)	Tax @ 55% (Rs.)	Net Earnings – Tax = EAT (Rs.)	CFAT = EAT + Dep. (Rs.)
1	1,50,000	1,00,000	50,000	27,500	22,500	1,22,500
2	2,50,000	1,00,000	1,50,000	82,500	67,500	1,67,500
3	2,50,000	1,00,000	1,50,000	82,500	67,500	1,67,500
4	2,00,000	1,00,000	1,00,000	55,000	45,000	1,45,000
5	1,50,000	1,00,000	50,000	27,500	22,500	1,22,500
					Total CFAT	7,25,000

$$\text{Fake Payback Period} = \frac{\text{Cash Outlays}}{\text{Average Annual Cash Inflows}}$$

$$= \frac{5,00,000}{\left(\frac{7,25,000}{5 \text{ yrs.}}\right)} = 3.448$$

As per Annuity Table the PV Factors closest to 3.448 against 5 years are

at 12% 3.605

at 14% 3.433

Year	CFAT (Rs.)	PV Factor @ 12%	PV of CFAT at 12% (Rs.)	PV Factor @ 14%	PV of CFAT at 14% (Rs.)
1	1,22,500	0.893	1,09,392.50	0.877	1,07,432.50
2	1,67,500	0.797	1,33,497.50	0.769	1,28,807.50
3	1,67,500	0.712	1,19,260.00	0.675	1,13,062.50
4	1,45,000	0.636	92,220.00	0.592	85,840.00
5	1,22,500	0.567	69,457.50	0.519	63,577.50
	Total PV of CFAT		5,23,827.50		4,98,720.00

$$IRR = D_1 + \frac{\text{PV of CFAT } D_1 - \text{PV of cash outlays}}{\text{PV of CFAT } D_1 - \text{PV of CFAT } D_2} \times (D_2 - D_1)$$

$$= 12\% + \frac{5,23,827.50 - 5,00,000}{5,23,827.50 - 4,98,720} \times (14\% - 12\%)$$

$$= 12\% + \frac{23,827.50}{25,107.50} \times 2\%$$

$$IRR = \boxed{13.89\%} \text{ (approx.)}$$

Suggestion: Since the IRR is higher than the cost of capital, the project is suggested to be accepted.

Illustration 16:

Chingari Ltd. is currently under examination of a project which yield the following returns over a period of time:

Year end	Gross Yield (Rs.)
1	8,000
2	8,000
3	9,000
4	9,000
5	7,500

The cost of the machinery to be installed works out to Rs. 20,000 and the machine is to be depreciated at 20% on Written Down Value (WDV) basis. Income Tax Rate is 50%. If the average cost of raising capital is 18%, would you recommend accepting the project under IRR Method.

Solution:

Assuming that the scrap value will be zero at the end of 5th year, therefore the entire remaining depreciable value of the asset in the 5th year will be charged as depreciation.

Year	CFBDT (Rs.)	Dep. @ 20% on WDV (Rs.)	Earnings After Dep. (Rs.)	Tax @ 50% (Rs.)	EAT (Rs.)	CFAT (Rs.)
1	2	3	2 – 3 = 4	5	4 – 5 = 6	2 – 5 = 7
1	8,000	4,000	4,000	2,000	2,000	6,000
2	8,000	3,200	4,800	2,400	2,400	5,600
3	9,000	2,560	6,440	3,220	3,220	5,780
4	9,000	2,048	6,952	3,476	3,476	5,524
5	7,500	8,192	(692)	–	(692)	7,500
TOTAL	41,500	20,000	21,500	11,096	10,404	30,404

$$\text{Fake Payback Period} = \frac{\text{Investment Outlays}}{\text{Average Annual Cash Inflows}}$$

$$= \frac{20,000}{\left(\frac{30,404}{5}\right)}$$

$$= \frac{20,000}{6,080.80} = 3.289$$

As per Annuity Table the PV Factors closest to 3.289 across the line of 5th year are;

PVF	Discount Rate
3.352	15%
3.274	16%

Year	CFAT (Rs.)	PVF @ 15%	PV of CFAT @ 15% (Rs.)	PVF @ 16%	PV of CFAT @ 16% (Rs.)
1	6,000	0.870	5,220.00	0.862	5,172.00
2	5,600	0.756	4,233.60	0.743	4,160.80
3	5,780	0.658	3,803.24	0.641	3,704.98
4	5,524	0.572	3,159.73	0.552	3,049.25
5	7,500	0.497	3,727.50	0.476	3,570.00
	TOTAL		20,144.00		19,657.00

$$IRR = D_1 + \frac{PV\ CFAT\ D_1 - PV\ OI}{PV\ CFAT\ D_1 - PV\ CFAT\ D_2} \times (D_2 - D_1)$$

$$= 15\% + \frac{20,144 - 20,000}{20,144 - 19,657} \times (16\% - 15\%)$$

$$= 15\% + \frac{144}{487} \times 1\%$$

$$IRR = \boxed{15.30\%}$$

Suggestion: Since the IRR is lower than the average cost of raising capital therefore the project should be rejected.

Illustration 17:

Calculate the IRR for the following projects and decide which is the most profitable project.

	Cash Inflows (CFAT)		
	Project X Rs.	Project Y Rs.	Project Z Rs.
Initial Cost	6,00,000	6,60,000	7,20,000
End of Year			
1	30,000	3,60,000	1,20,000
2	1,20,000	2,40,000	1,80,000
3	1,80,000	–	1,20,000
4	2,40,000	–	3,00,000
5	3,00,000	1,80,000	1,20,000
6	(60,000)	1,20,000	60,000
TOTAL	8,10,000	9,00,000	9,00,000

Solution:

Project X

$$\text{Fake Payback Period} = \frac{\text{Initial Outlay}}{\text{Average Annual Cash Inflows}}$$

$$= \frac{6,00,000}{\left(\frac{8,10,000}{6\ \text{yrs.}}\right)} = 4.444$$

As per Annuity Table across the line of 6th year:

PVF	Discount Rate
4.623	8%
4.355	10%

Year	CFAT (Rs.)	PVF @ 8%	PV CFAT @ 8% (Rs.)	PVF @ 10%	PV CFAT @ 10% (Rs.)
1	30,000	0.926	27,780	0.909	27,270
2	1,20,000	0.857	1,02,840	0.826	99,120
3	1,80,000	0.794	1,42,920	0.751	1,35,180
4	2,40,000	0.735	1,76,400	0.683	1,63,920
5	3,00,000	0.681	2,04,300	0.621	1,86,300
6	(60,000)	0.630	(37,800)	0.564	(33,840)
	Total CFAT		6,16,440		5,77,950

$$\text{IRR (Project X)} = 8\% + \frac{6,16,440 - 6,00,000}{6,16,440 - 5,77,950} \times (10\% - 8\%)$$

$$= 8\% + \frac{16,440}{38,490} \times 2\%$$

$$= \boxed{8.85\%}$$

Project Y

$$\text{Fake Payback Period} = \frac{\text{Initial Outlay}}{\text{Average Annual Cash Inflows}}$$

$$= \frac{6,60,000}{\left(\frac{9,00,000}{6}\right)} = 4.4$$

As per Annuity Table across the line of 6th year;

PVF	Discount Rate
4.623	8%
4.355	10%

NPV at both 8% and 10% will be positive.

Since IRR will be between a negative and a positive NPV; therefore using 12% and 14% discount factors; IRR using Trial and Error Method.

Year	CFAT (Rs.)	PVF @ 12%	PV CFAT @ 12% (Rs.)	PVF @ 14%	PV CFAT @ 14% (Rs.)
1	3,60,000	0.893	3,21,480	0.877	3,15,720
2	2,40,000	0.797	1,91,280	0.769	1,84,560
3	–	0.712	–	0.675	–
4	–	0.636	–	0.592	–
5	1,80,000	0.567	1,02,060	0.519	93,420
6	1,20,000	0.507	60,840	0.456	54,720
	Total CFAT		6,75,660		6,48,420

$$\text{IRR (Project Y)} = 12\% + \frac{6,75,660 - 6,60,000}{6,75,660 - 6,48,420} \times (14\% - 12\%)$$

$$= 12\% + \frac{15,660}{27,240} \times 2\%$$

$$\text{IRR (Project Y)} = 13.14\% \text{ (approximately)}$$

Project Z

$$\text{Fake Payback Period} = \frac{\text{Initial Outlay}}{\text{Average Annual Cash Inflows}}$$

$$= \frac{7,20,000}{\left(\frac{9,00,000}{6}\right)} = 4.8$$

As per Annuity Table across the line of 6th year;

PVF	Discount Rate
4.917	6%
4.623	8%

Year	CFAT (Rs.)	PVF @ 6%	PV CFAT @ 6% (Rs.)	PVF @ 8%	PV CFAT @ 8% (Rs.)
1	1,20,000	0.943	1,13,160	0.926	1,11,120
2	1,80,000	0.890	1,60,200	0.857	1,54,260
3	1,20,000	0.840	1,00,800	0.794	95,280
4	3,00,000	0.792	2,37,600	0.735	2,20,500
5	1,20,000	0.747	89,640	0.681	81,720
6	60,000	0.705	42,300	0.630	37,800
	Total CFAT		7,43,700		7,00,680

$$\text{IRR (Project Z)} = 6\% + \frac{7,43,700 - 7,20,000}{7,43,700 - 7,00,680} \times (8\% - 6\%)$$

$$= 6\% + \frac{23,700}{43,020} \times 2\%$$

$$= \boxed{7.10\%}$$

Summary:

Project	IRR
X	8.85%
Y	13.14%
Z	7.10%

Suggestion: Since the IRR of Project Y is higher than Project X and Project Z, hence Project Y is the most profitable project.

Illustration 18:

A company is considering the two mutually exclusive projects. The finance director considers that the project with higher NPV should be chosen; whereas the Managing Director thinks that one with higher rate of return should be considered. Both the projects have got an useful life of 5 years and the cost of capital is 10%. The initial outlay is Rs. 2 lakhs.

The future cash inflow from Project X and Y are as under:

Year	Project X (Rs.)	Project Y (Rs.)	PV Factor @ 10%	PV Factor @ 20%
1	35,000	1,18,000	0.91	0.83
2	80,000	60,000	0.83	0.69
3	90,000	40,000	0.75	0.58
4	75,000	14,000	0.68	0.48
5	20,000	13,000	0.62	0.41

You are required to evaluate the projects on PB, ARR, NPV, PI and IRR and explain the inconsistency, if any, in the ranking of the projects.

Solution:

(a) Pay Back Period Method:

Year	Project X		Project Y	
	Cash Inflows (Rs.)	Cumulative Cash Inflows (Rs.)	Cash Inflows (Rs.)	Cumulative Cash Inflows (Rs.)
1	35,000	35,000	1,18,000	1,18,000
2	80,000	1,15,000	60,000	1,78,000
3	90,000	2,05,000	40,000	2,18,000
4	75,000	2,80,000	14,000	2,32,000
5	20,000	3,00,000	13,000	2,45,000

Pay Back Period	
$= 2 \text{ years} + \left(\frac{2,00,000 - 1,15,000}{90,000}\right)$	$= 2 \text{ years} + \left(\frac{2,00,000 - 1,78,000}{40,000}\right)$
= 2.944 years or 2 years and 11.33 months or 2 years, 11 months and 10 days	= 2.55 years or = 2 years and 6.6 months or = 2 years, 6 months and 18 days

Accept: Project Y

(b) ARR:

Year	Project X			Project Y		
	Cash Inflows (Rs.)	Depreciation (Rs.)	Profit After Tax (Rs.)	Cash Inflows (Rs.)	Depreciation (Rs.)	Profit After Tax (Rs.)
1	2	3	2 – 3 = 4	5	6	5 – 6 = 7
1	35,000	40,000	(5,000)	1,18,000	40,000	78,000
2	80,000	40,000	40,000	60,000	40,000	20,000
3	90,000	40,000	50,000	40,000	40,000	Nil
4	75,000	40,000	35,000	14,000	40,000	(26,000)
5	20,000	40,000	(20,000)	13,000	40,000	(27,000)
			1,00,000			45,000

Assumption: Depreciation has been charged by Straight Line Method (SLM).

$$ARR = \frac{\text{Average Annual Profit After Tax}}{\text{Original Investment}} \times 100$$

(Based on Original Investment)

Project X

$$= \frac{\frac{1,00,000}{5}}{2,00,000} \times 100 = \boxed{10\%}$$

Project Y

$$= \frac{\frac{45,000}{5}}{2,00,000} \times 100 = \boxed{4.5\%}$$

$$ARR = \frac{\text{Average Annual Profit After Tax}}{\text{Average Investment}} \times 100$$

(Based on Average Investment)

Project X

$$= \frac{\frac{1,00,000}{5}}{\frac{2,00,000}{2}} \times 100$$

$$= \boxed{20\%}$$

Project Y

$$= \frac{\frac{45,000}{5}}{\frac{2,00,000}{2}} \times 100$$

$$= \boxed{9\%}$$

Accept: Project X

(c) Net Present Value:

Year	PV Factor @ 10%	Project X		Project Y	
		Cash Inflows (Rs.)	PV of Cash Inflows (Rs.)	Cash Inflows (Rs.)	PV of Cash Inflows (Rs.)
1	0.91	35,000	31,850	1,18,000	1,07,380
2	0.83	80,000	66,400	60,000	49,800
3	0.75	90,000	67,500	40,000	30,000
4	0.68	75,000	51,000	14,000	9,520
5	0.62	20,000	12,400	13,000	8,060

PV of Cash Inflows	2,29,150		2,04,760
Less: PV of Cash Outflows	2,00,000		2,00,000
Net Present Value	29,150		4,760

Accept: Project X

(d) Profitability Index = $\frac{\text{PV of Cash Inflows}}{\text{PV of Cash Outflows}}$

Project X

$= \frac{2,29,150}{2,00,000}$

$= 1.146$

Accept: Project X

Project Y

$= \frac{2,04,760}{2,00,000}$

$= 1.024$

(e) Internal Rate of Return (IRR):

Since two discounting factors are given in the question, we will find out IRR using the given data.

Project X

Year	Cash Inflows (Rs.)	PV Factor @ 10%	PV Cash Inflows @ 10% (Rs.)	PV Factor @ 20%	PV Cash Inflows @ 20% (Rs.)
1	35,000	0.91	31,850	0.83	29,050
2	80,000	0.83	66,400	0.69	55,200
3	90,000	0.75	67,500	0.58	52,200
4	75,000	0.68	51,000	0.48	36,000
5	20,000	0.62	12,400	0.41	8,200
		PV of Cash Inflows	2,29,150		1,80,650
		Less: PV of Cash Outflows	2,00,000		2,00,000
		Net Present Value	29,150		(19,350)

$$IRR = D_1 + \frac{PV_{CFATD_1} - PV_{\text{cash outlays}}}{PV_{CFATD_1} - PV_{CFATD_2}} \times (D_2 - D_1)$$

$$= 10\% + \frac{2,29,150 - 2,00,000}{2,29,150 - 1,80,650} \times (20 - 10)$$

$$= 10\% + \frac{29,150}{48,500} \times 10$$

$$= \boxed{16.01\% \text{ (approx.)}}$$

Project Y

Year	Cash Inflows (Rs.)	PV Factor @ 10%	PV Cash Inflows @ 10% (Rs.)	PV Factor @ 20%	PV Cash Inflows @ 20% (Rs.)
1	1,18,000	0.91	1,07,380	0.83	97,940
2	60,000	0.83	49,800	0.69	41,400
3	40,000	0.75	30,000	0.58	23,200
4	14,000	0.68	9,520	0.48	6,720
5	13,000	0.62	8,060	0.41	5,330
		PV of Cash Inflows	2,04,760		1,74,590
		Less: PV of Cash Outflows	2,00,000		2,00,000
		Net Present Value	4,760		(25,410)

$$IRR = 10\% + \frac{2,04,760 - 2,00,000}{2,04,760 - 1,74,590} \times (20 - 10)$$

$$= 10\% + \frac{4,760}{30,170} \times 10$$

$$= \boxed{11.58\% \text{ (approx.)}}$$

Accept: Project X

Summary:

Methods	Project X		Project Y	
	Rank		Rank	
(a) Pay Back Period	II	2.944 years	I	2.55 years
(b) ARR	I	10%	II	4.5%
(c) NPV	I	Rs. 29,150	II	Rs. 4,760
(d) PI	I	1.146	II	1.024
(e) IRR	I	16.01%	II	11.58%

Suggestion: Based on the above analysis Project X is suggested to be selected and Project Y to be rejected.

Illustration 19:

A company can make either of two investments at period t_o. Assuming a required rate of return of 10%, determine for each project:

(a) the pay back period,
(b) the discounted pay back period,
(c) the profitability index, and
(d) the internal rate of return.

You may assume straight line depreciation.

	P	Q
Cost of investment (Rs.)	2,00,000	2,80,000
Expected life (no salvage)	5 years	5 years
Projected net income (after depreciation, interest and taxes)		
Year	Rs.	Rs.
1	10,000	24,000
2	10,000	24,000
3	20,000	24,000
4	20,000	24,000
5	20,000	24,000

Solution:

(a) Pay Back Period:

(i) P

Year	PAT (Rs.)	Depreciation (Rs.)	CFAT (Rs.)	Cumulative CFAT (Rs.)
1	10,000	40,000	50,000	50,000
2	10,000	40,000	50,000	1,00,000
3	20,000	40,000	60,000	1,60,000
4	20,000	40,000	60,000	2,20,000
5	20,000	40,000	60,000	2,80,000

$$\text{Pay Back Period} = 3 \text{ years} + \left(\frac{2,00,000 - 1,60,000}{60,000}\right)$$

$$= 3.67 \text{ years or}$$

3 years and 8 months

(II) Q

Year	PAT (Rs.)	Depreciation (Rs.)	CFAT (Rs.)	Cumulative CFAT (Rs.)
1	24,000	56,000	80,000	80,000
2	24,000	56,000	80,000	1,60,000
3	24,000	56,000	80,000	2,40,000
4	24,000	56,000	80,000	3,20,000
5	24,000	56,000	80,000	4,00,000

Pay Back Period $= 3 \text{ years} + \left(\frac{2,80,000 - 2,40,000}{80,000}\right)$

$= 3.5$ years or

3 years and 6 months

Suggestion: Based on pay back period Project Q is suggested since it has a shorter pay back period.

(b) Discounted Pay Back Period:

(I) P

Year	PV Factor @ 10% (Re.)	Cash Inflows (Rs.)	PV Cash Inflows (Rs.)	Cumulative PV Cash Inflows (Rs.)
0	1.000	(2,00,000)	(2,00,000)	(2,00,000)
1	0.909	50,000	45,450	(1,54,550)
2	0.826	50,000	41,300	(1,13,250)
3	0.751	60,000	45,060	(68,190)
4	0.683	60,000	40,980	(27,210)
5	0.621	60,000	37,260	10,050

Pay Back Period $= 4 \text{ years} + \left(\frac{27,210}{37,260}\right)$

$= 4.73$ years

(ii) Q

Year	PV Factor @ 10% (Re.)	Cash Inflows (Rs.)	PV Cash Inflows (Rs.)	Cumulative PV Cash Inflows (Rs.)
0	1.000	(2,80,000)	(2,80,000)	(2,80,000)
1	0.909	80,000	72,720	(2,07,280)
2	0.826	80,000	66,080	(1,41,200)
3	0.751	80,000	60,080	(81,120)
4	0.683	80,000	54,640	(26,480)
5	0.621	80,000	49,680	23,200

Pay Back Period $= 4 \text{ years} + \left(\frac{26,480}{49,680}\right)$

$= 4.53$ years

Suggestion: Based on discounted pay back period Project Q is suggested, since it has a shorter pay back period.

(c) Profitability Index:

Year	PV Factor @ 10%	Project P		Project Q	
		CFAT (Rs.)	PV CFAT (Rs.)	CFAT (Rs.)	PV CFAT (Rs.)
1	0.909	50,000	45,450	80,000	72,720
2	0.826	50,000	41,300	80,000	66,080
3	0.751	60,000	45,060	80,000	60,080
4	0.683	60,000	40,980	80,000	54,640

5	0.621	60,000	37,260	80,000	49,680
		Present Value of Cash Inflows	2,10,050		3,03,200
		Less: PV of Cash Outlays	2,00,000		2,80,000
		Net Present Value	10,050		23,200

Profitability Index $= \frac{\text{PV Cash Inflows}}{\text{PV Cash Outflows}}$

Project P

$= \frac{2,10,050}{2,00,000}$

$= 1.05$

Project Q

$= \frac{3,03,200}{2,80,000}$

$= 1.08$

Suggestion: Based on PI Project Q is suggested, since the PI is greater than Project P.

(d) **Internal Rate of Return (IRR):**

Fake Pay Back Period $= \frac{\text{Initial Outlay}}{\text{Average Annual Cash Inflows}}$

(i) P $= \frac{2,00,000}{\left(\frac{2,80,000}{5}\right)} = 3.571$

As per Annuity table across the line of 5th year;

PVF	Discount Rate
3.791	10%
3.605	12%
3.433	14%

NPV at both 12% and 14% will be positive.

But since IRR will lie between a positive and negative NPV; therefore using 10% and 12% discount factors; IRR will be computed as follows:

IRR using Trial and Error Method

Year	CFAT (Rs.)	PVF @ 10%	PV CFAT @ 10% (Rs.)	PVF @ 12%	PV CFAT @ 12% (Rs.)
1	50,000	0.909	45,450	0.893	44,650
2	50,000	0.826	41,300	0.797	39,850
3	60,000	0.751	45,060	0.712	42,720
4	60,000	0.683	40,980	0.636	38,160
5	60,000	0.621	37,260	0.567	34,020
Total CFAT			2,10,050		1,99,400

IRR (P) $= 10\% + \frac{2,10,050 - 2,00,000}{2,10,050 - 1,99,400} \times (12\% - 10\%)$

$= 10 + \frac{10,050}{10,650} \times 2 = 11.88\%$ (approx.)

(ii) Q

Fake Pay Back Period $= \frac{2,80,000}{80,000}$

$= 3.5$

As per Annuity table across the line of 5th year;

PVF	Discount Rate
3.605	12%
3.433	14%

Year	CFAT (Rs.)	PV Annuity Factor @ 12%	PV CFAT @ 12% (Rs.)	PV Annuity Factor @ 14%	PV CFAT @ 14% (Rs.)
1 – 5	80,000	3.605	2,88,400	3.433	2,74,640

$$\text{IRR (Q)} = 12\% + \frac{2,88,400 - 2,80,000}{2,88,400 - 2,74,640} \times (14\% - 12\%)$$

$$= 13.22\% \text{ (approx.)}$$

Suggestion: Based on IRR Project Q is suggested, since it has a higher IRR as compared to Project P.

Illustration 20: