Unit - 4

Capital Budgeting & Depreciation

Formula -

Internal rate of return (IRR)

$$i \simeq \frac{\left[\sum_{t=1}^{n} f(t)\right] - A}{\sum_{t=1}^{n} t f(t)}$$

Net present value -

i) $Npv = F_1(1+i)^{-1} + F_2(1+i)^{-2} + F_3(1+i)^{-3} + \dots + F_n(1+i)^{-n} - F_0 = A$

ii) $Npv = -F_0 + F_1(1+i)^{-1} + F_2(1+i)^{-2} + F_3(1+i)^{-3} + \dots$

Problems

1. An investment of ₹ 10000 and return Rs.3000 at the end of year I & II and RS : 3500 at the end of year III & IV. Calculate the [IRR] Internal rate of return.

6 max

Solution -

Year (t)	f (t)	t f(t)
1	3000	3000
2	3000	6000
3	3500	10500
4	3500	14000
	$\Sigma f(t) = 13000$	$\Sigma t f(t) = 33500$

$$i \approx \frac{\left(\sum_{t=1}^{4} f(t)\right) - A}{\sum_{t=1}^{4} t f(t)} = \frac{13000 - 10000}{33500}$$

$$= \frac{3000}{33500}$$

$i \approx = 0.0895 \times 100$

~~$i \approx 0.10845$~~

$i \approx 8.95\%$

$i = 9\%, 10\%, 11\%, 12\%$

NPV at 9%

$i = \frac{9}{100} = 0.09$

$NPV = f_1(1+i)^{-1} + f_2(1+i)^{-2} + f_3(1+i)^{-3} + f_4(1+i)^{-4}$

$= 3000(1+0.09)^{-1} + 3000(1+0.09)^{-2} + 3500(1+0.09)^{-3} + 3500(1+0.09)^{-4}$

$= 10,459.$

NPV at 10%

$i = \frac{10}{100} = 0.1$

$NPV = 3000(1+0.1)^{-1} + 3000(1+0.1)^{-2} + 3500(1+0.1)^{-3} + 3500(1+0.1)^{-4}$

$= 10226.761$

$= 10227$

NPV at 11%

$i = \frac{11}{100} = 0.11$

$$NPV = 3000(1+0.11)^{-1} + 3000(1+0.11)^{-2} + 3500(1+0.11)^{-3} + 3500(1+0.11)^{-4}$$

$= 10,002$

NPV at 12 %.

$i = \frac{12}{100} = 0.12$

$$NPV = 3000(1+0.12)^{-1} + 3000(1+0.12)^{-2} + 3500(1+0.12)^{-3} + 3500(1+0.12)^{-4}$$

$= 9786$

∴ IRR is at 11% of Rs. 10,002 — 10000 nearest amount is 10000.

2. A Project is expected to provide the cashflow indicates below investment of Rs. 100000 in this project. If the cost of the capital $j_1 = 7\%$; $j_2 = 14\%$.

(2) 4 mark

7 %
14 %

Year	1	2	3	4
cashflow	40000	25000	35000	30000

Solution –

Given investment $f(0) = 100000$

$F_1 = 40000$ $F_2 = 25000$ $F_3 = 35000$ $F_4 = 30000$

$i = 7\% = \frac{7}{100} = 0.07$

$$NPV = -f_0 + f_1(1+i)^{-1} + f_2(1+i)^{-2} + f_3(1+i)^{-3} + f_4(1+i)^{-4}$$

$$= -100000 + 40000(1+0.07)^{-1} + 25000(1+0.07)^{-2} + 35000(1+0.07)^{-3} + 30000(1+0.07)^{-4}$$

$= -100000 + 110676.2$

$= 10,676.2$

NPV at 7% $= 10676$

$i = 14\% \quad \frac{14}{100} = 0.14$

$$NPV = -100000 + 40000(1+0.14)^{-1} + 25000(1+0.14)^{-2} + 35000(1+0.14)^{-3} + 30000(1+0.14)^{-4}$$

(1.14)

$$= -100000 + 35087.7 + 19236.6 + 23624.0 + 17762.4$$

$$= -100000 + 95710.7$$

$$= -4289.3$$

NPV at 14% = −4289

Project① 6% 4 mark
Project②① 8% 6 mark
Project ①② 6% 6 mark

3. An investor his presented with alternative project A & B at the end of year cash flow of each Project required an investment of ₹ 200000. Which Project could be choosen if $j_1 = 6\%$, $j_2 = 8\%$.

Year	1	2	3	4
Project A	80000	70000	60000	35000
project B	30000	40000	40000	150000

Solution -

Investment $f(0) = 200000$

Project A $\quad f_1 = 80000 \quad f_2 = 70000 \quad f_3 = 60000 \quad f_4 = 35000$

$$NPV = -f_0 + f_1(1+i)^{-1} + f_2(1+i)^{-2} + f_3(1+i)^{-3} + f_4(1+i)^{-4}$$

$i = 6\% \quad \frac{6}{100} = 0.06$

(1.06)

$$= -200000 + 80000(1+0.06)^{-1} + 70000(1+0.06)^{-2} + 60000(1+0.06)^{-3} + 35000(1+0.06)^{-4}$$

$$= -200000 + 215871.6$$

NPV at 6% = 15871

Project B : $f_1 = 30000$ $f_2 = 40000$ $f_3 = 40000$ $f_4 = 150000$

$i = 6\% \quad \frac{6}{100} = 0.06$

$$NPV = -200000 + 30000(1+0.06)^{-1} + 40000(1+0.06)^{-2} + 40000(1+0.06)^{-3} + 150000(1+0.06)^{-4}$$

$= -200000 + 216300.3$

NPV at 6% $= 16300.3 = 16300$

Project A = $f_1 = 80000$ $f_2 = 70000$ $f_3 = 60000$ $f_4 = 35000$

$i = 8\% \quad \frac{8}{100} = 0.08$

$$NPV = -200000 + 80000(1+0.08)^{-1} + 70000(1+0.08)^{-2} + 60000(1+0.08)^{-3} + 35000(1+0.08)^{-4}$$

$= -200000 + 207443.6$

NPV at 8% $= 7443.6 = 7443.$

Project B = $f_1 = 30000$ $f_2 = 40000$ $f_3 = 40000$ $f_4 = 150000$

$i = 8\% \quad \frac{8}{100} = 0.08$

$$NPV = -200000 + 30000(1+0.08)^{-1} + 40000(1+0.08)^{-2} + 40000(1+0.08)^{-3} + 150000(1+0.08)^{-4}$$

$= -200000 + 204078.8$

NPV at 8% $= 4078.8 = 4078$

6 mark

4. An investment of Rs. 5 million expected to produce the following cash flow at the end of each year. Find the internal rate of return (IRR) for the following table.

Year	1	2	3	4
Cash flow	1.25	2.00	2.50	0.75

Solution -

Year (t)	f(t)	t f(t)
1	1.25	1.25
2	2.00	4.00
3	2.50	7.50
4	0.75	3.00
	$\Sigma f(t) = 6.5$	$\Sigma t f(t) = 15.75$

$$i \simeq \frac{\left[\sum_{t=1}^{4} f(t) - A\right]}{\sum_{t=1}^{4} t f(t)}$$

Investment (A) = 5

$$i \simeq \frac{6.5 - 5}{15.75}$$

$i \simeq 0.095$

$i \simeq (0.095 \times 100)$

$i \simeq 9.5$

$i = 10\%$, $i = 11\%$, $i = 12\%$, $i = 13\%$.

NPV at 10%.

$i = \frac{10}{100} = 0.1$

$f_1 = 1.25$ $f_2 = 2.00$ $f_3 = 2.50$, $f_4 = 0.75$

$NPV = f_1 (1+i)^{-1} + f_2 (1+i)^{-2} + f_3 (1+i)^{-3} + f_4 (1+i)^{-4}$

$= 1.25 (1+0.1)^{-1} + 2.00 (1+0.1)^{-2} + 2.50 (1+0.1)^{-3} + 0.75 (1+0.1)^{-4}$

NPV at 10% = 5.16

NPV at 11%

$i = \frac{11}{100} = 0.11$

$NPV = 1.25\,(1+0.11)^{-1} + 2.00\,(1+0.11)^{-2} + 2.50\,(1+0.11)^{-3} + 0.75\,(1+0.11)^{-4}$

$= 1.12 + 1.62 + 1.82 + 0.49$

NPV at 11% = 5.05

NPV at 12%

$i = \frac{12}{100} = 0.12$

$NPV = 1.25\,(1+0.12)^{-1} + 2.00\,(1+0.12)^{-2} + 2.50\,(1+0.12)^{-3} + 0.75\,(1+0.12)^{-4}$

$= 1.11 + 1.59 + 1.77 + 0.47$

NPV at 12% = 4.94

NPV at 13%

$i = \frac{13}{100} = 0.13$

$NPV = 1.25\,(1+0.13)^{-1} + 2.00\,(1+0.13)^{-2} + 2.50\,(1+0.13)^{-3} + 0.75\,(1+0.13)^{-4}$

$= 1.10 + 1.56 + 1.73 + 0.45$

NPV at 13% = 4.84

∴ IRR is at 11%

Capitalised cost -

The capitalised cost of an asset may be defined of its original cost, C, plus the Present value of an unlimited number of replacement plus present value of an unlimited number of maintainance cost and it is denoted by K.

$$K = C + \frac{C-S}{(1+i)^n - 1} + \frac{M}{i}$$

$$= C + \frac{C-S}{i^*} + \frac{M}{i}$$

Where C = original cost

S = Scrap value

n = No of years

M = Maintainance cost

i = Rate per year

The concept of capitalised cost can be used to decide which of several alternatives in economics. The best different asset may produce revenue at different rates.

If U_1, U_2 are the number of products produced per unit of time by the machine 1 & 2 having capitalised cost K_1, K_2 then $\frac{K_1}{U_1} = \frac{K_2}{U_2}$.

5. A certain machine cost of Rs.25000 and last 6 years after which time it has a scrap value of Rs.5000 and the maintainance cost of Rs.800.

4 mark

If the money is worth of 8% per annum. Find the capitalised cost of the machine.

Solution:

Original cost = 25000

Scrap value = 5000

Maintainance cost = 800

i = 8%

n = 6yrs

$$K = C + \frac{C-S}{(1+i)^n - 1} + \frac{M}{i}$$

$$= 25000 + \frac{25000 - 5000}{(1+0.08)^6 - 1} + \frac{800}{0.08}$$

$$= 25000 + \frac{20000}{0.5868} + 10000$$

$$K = 69083.1$$

6. Machine A cost of Rs. 36000 will cost of 15 years and will have a scrap value of 4800 at that time. If the cost of maintainance is Rs. 3000. A machine Z is a cost of Rs. 40000 will last 20 years and will have a scrap value 4000 at the time and its annual maintainance is Rs. 2400 if the money is worth of 11% which machine should be purchased.

Solution -

Machine A -

$C = 36000$, $S = 4800$, $M = 3000$, $n = 15$, $i = 11\%$

Capitalised cost of A

$$K = C + \frac{C-S}{(1+i)^n - 1} + \frac{M}{i}$$

$$= 36000 + \frac{36000 - 4800}{(1+0.11)^{15} - 1} + \frac{3000}{0.11}$$

$$= 36000 + \frac{31200}{3.7845} + 27272.7$$

Machine A $= 71516.8$

Machine Z -

$C = 40000$, $S = 4000$, $M = 2400$, $n = 20$, $i = 11\%$

Capitalised cost of Z

$$K = 40000 + \frac{40000 - 4000}{(1+0.11)^{20} - 1} + \frac{2400}{0.11}$$

$$= 40000 + \frac{36000}{7.0623} + 21818.18$$

Machine Z $= 66915.67$

Machine Z will be purchased.

7. A machine cost of 40000 and scrap value is Rs. 5000 after 10 years it produced 2000 units of output per annum and the annual maintainance cost is Rs. 1500. How many can increasing it

productivity 3000 units per years. If its period service and the maintainance cost remains unchange for the annual income of 12 %.

Solution-

$C = 40000, S = 5000, M = 1500, n = 10$ years, $i = 12\%$.

$U_1 = 2000, U_2 = 3000$

$$\frac{K_1}{U_1} = \frac{K_2}{U_2}$$

Let, the amount spent in increasing the productivity = x

$$\frac{C + \frac{C-S}{(1+i)^n - 1} + \frac{M}{i}}{U_1} = \frac{C + x + \frac{(C-S)+x}{(1+i)^n - 1} + \frac{M}{i}}{U_2}$$

$$\frac{40000 + \frac{(40000-5000)}{(1+0.12)^{10} - 1} + \frac{1500}{0.12}}{2000} = \frac{40000 + x + \frac{35000 + x}{(1+0.12)^{10} - 1} + \frac{1500}{0.12}}{3000}$$

2.1058 + 12500 2.1058 +12500

$$\frac{69120.76}{2000} = \frac{40000 + x + 16620.07 + 0.4748x + 12500}{3000}$$

$$34560.3 = \frac{69120.07 + 1.4748x}{3}$$

$40000+x + \frac{35000+x}{2.1058} +$

$34560.3 \times 3 = 69120.07 + 1.4748x$

$40000 + x + 16620.76 + 0.4748x + 12500$

$103680.9 - 69120.07 = 1.4748x$

$34560.83 = 1.4748x$

$$x = \frac{34560.83}{1.4748}$$

$x = 23432.78$

Depreciation -

*The cost of the asset allocated to the accounting Period in which is generally called depreciation Or another way of periodic expenses of an product is called depreciation.

Depreciation schedule -

*. It shows the yearly depreciation expenses the book value at the end of the each year and the accumulated till date.

C = Original cost

S = Scrap value

N = Estimated useful lifetime of the asset in a year.

R_K = depreciation expenses for the year $(1 \leq K \leq n)$

B_K = Book value of the asset $(0 \leq K \leq n)$

D_K = Accumulated depreciation expenses at the end of each year $(0 \leq K \leq n)$.

$D_0 = 0, \quad D_n = C - S$

$D_K + B_K = C$

Straightline method -

i) $R = \frac{C-S}{n}$

ii) $B_K = C(1-d)^K$

iii) Depreciation expenses for K^{th} yr.

$R_K = B_{K-1} \times d$

8. A machine cost of ₹ 40000 is estimated to have a useful time of 5 years and the scrap value is ₹ 5000. Prepare a depreciation schedule using a straightline method.

4 mark

Solution -

Given $C = 40000$

$S = 5000$

$n = 5$

$$R = \frac{C-S}{n}$$

$$= \frac{40000 - 5000}{5}$$

$$= \frac{35000}{5}$$

$$= 7000$$

Depreciation schedule

End of year	yearly depreciation (R)	Accumulated depreciation (D_K)	Book value ($B_K - D_K$)
0	0	0	40000
1	7000	7000	33000
2	7000	14000	26000
3	7000	21000	19000
4	7000	28000	12000
5	7000	35000	5000

9. The car cost of Rs. 24000 depreciates at 25% of its value each year. Make a depreciation schedule for the past 3 years. Find the book value at the end of 5 year and the depreciation expenses for the 6 year.

6 mark

Solution -

Depreciation schedule -

End of year	Yearly depreciation (R)	Accumulated depreciation (D_K)	Book value ($B_K - D_K$)
0	0	0	24000
1	$24000 \times \frac{25}{100} = 6000$	6000	18000
2	$18000 \times \frac{25}{100} = 4500$ (+)	10500	13500
3	$13500 \times \frac{25}{100} = 3375$	13875	10125

i) Book value for 5 years

$$B_K = C(1-d)^K$$

$$B_5 = 24000 \left(1 - \frac{25}{100}\right)^5$$

0.75

$$B_5 = 5695.31$$

ii) Depreciation expenses for 6th years

$$R_K = B_{K-1}(d)$$

$$R_6 = B_{6-1} \times \left(\frac{25}{100}\right)$$

$$= B_5 \times \frac{25}{100}$$

$$= 5695.31 \times \frac{25}{100}$$

$$R_6 = 1423.82$$

10. A machine cost of Rs. 40000 to have a useful life time of 5 years and the scrapvalue 5000. Determine the rate of depreciation and construct the depreciation schedule for the machine using constant percentage method.

4 mark

Solution-

Given $C = 40000$

$S = 5000$

$n = 5$ years

Method - constant percentage method depreciation

$S = C(1-d)n$

$5000 = 40000 (1-d) 5$

$\frac{5000}{40000} = (1-d)5$

$(0.125)^{1/5} = 1-d$

$0.125^\wedge(1 \div 5)$

$0.6597 = 1-d$

$0.6597 - 1 = -d$

$-(0.6597-1) = d$

$d = -0.6597 + 1$

$d = 0.34$

End of year	Depreciation	Acc… Depreciation	… Value
0	0	0	40000
1	(40000 × 0.34) 13600	13600	26400
2	(26400 × 0.34) 8,976	22576	17424
3	(17424 × 0.34) 5,924	28500	11500
4	(11500 × 0.34) 3,910	32410	7590
5	(7590 × 0.34) 2580	34990	5010