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IRR Assignment

CSS 2005

Cash outflow = Rs 40,000
Inflow = Rs 11,652 each year
years (n) = 5
Interest rate = 10%.

a) Find NPV
To calculate the NPV, we use the following formula:
NPV = PV of inflows − PV of Outflows

PV of Outflows = Rs 40,000
PV of inflows for each year is calculated as follows:

n (years)	Cashflow	PV @10%
0	(40,000)	-
1	11,652	$11,652 \div (1.1) = 10592.7$
2	11,652	$11,652 \div (1.1)^2 = 9629.7$
3	11,652	$11,652 \div (1.1)^3 = 8754.3$
4	11,652	$11.652 \div (1.1)^4 = 7958.4$
5	11,652	$11.652 \div (1.1)^5 = 7234.9$
		44170

NPV = 44170 − 40000
= Rs 4170

b) Find IRR

IRR is calculated using the following formula:

$$IRR = r_a + \frac{NPV_a}{NPV_a - NPV_b} \cdot (r_b - r_a)$$

where r_a = lower discount rate choosen

r_b = higher discount rate choosen

NPV_a = NPV at r_a

NPV_b = NPV at r_b

One of the rules to calculate IRR is to have one negative NPV. Since the NPV for a project considered by stars corporation has a positive NPV at $r = 10\%$. Let us assume another interest rate at 20%. NPV and r have an inverse relationship hence, higher r might yield a lower NPV.

NPV at $r = 20\%$ is calculated as:

n	Cashflow	PV@20%
0	(40,000)	–
1	11,652	$11,652/(1.2) = 9710$
2	11,652	$11,652/(1.2)^2 = 8091.6$
3	11,652	$11,652/(1.2)^3 = 6743$
4	11,652	$11,652/(1.2)^4 = 5619.2$
5	11,652	$11,652/(1.2)^5 = 4682.6$
		34846

NPV = 34846 − 40000

= (5172)

~~IRR~~ For IRR, let

$r_a = 10\%$ $\quad NPV_a = 4170$

$r_b = 20\%$ $\quad NPV_b = -5172$

Computing these values into IRR equation:

$$IRR = r_a + \frac{NPV_a}{NPV_a - NPV_b}(r_b - r_a)$$

$$= 0.1 + \frac{4170}{4170 - (-5172)}(0.2 - 0.1)$$

$$IRR = 14.4\%$$

CSS 2013. Q9:

Cash outflow = $800,000

n = 4 years, tax bracket = 50%.

Cash inflow: $y_1 = \$200,000$, $y_2 = \$250,000$

$y_3 = \$300,000$ and $y_4 = \$400,000$

a) If required rate of return = 15%., what is NPV and is it acceptable?

To calculate the NPV, we ~~first~~ use the following formula:

NPV = PV of inflows − PV of outflows

PV of inflows with rate 15% for 4 years is calculated as follows:

n	Cashflow	PV @ 15%
0	(800,000)	–
1	200,000	$200,000/(1.15) = 173913$
2	250,000	$250,000/(1.15)^2 = 189035.9$
3	300,000	$300,000/(1.15)^3 = 197254.8$
4	400,000	$400,000/(1.15)^4 = 228701.2$
		788905

NPV = 788905 − 800000
= −11094

Since the NPV is negative, this project is not acceptable. This means that the expected cashflows from the project will not provide a return greater than the required rate of return of 15%.

b) Find its Internal Rate of Return (IRR)

IRR is calculated using the following formula:

$$IRR = r_a + \frac{NPV_a}{NPV_a - NPV_b}(r_b - r_a)$$

Since NPV was negative at r = 15%. Lets assume a lower NPV at 5%. As NPV and rate of interest (r) have an inverse relationship, a lower ~~NPV~~ r may yield a positive NPV.

Calculation for NPV at r = 5% is

as follows:

n	Cashflow	PV@5%.
0	(800,000)	—
1	200,000	$200,000 \div (1.05) = 190476.1$
2	250,000	$250,000 \div (1.05)^2 = 226757.3$
3	300,000	$300,000 \div (1.05)^3 = 259151.2$
4	400,000	$400,000 \div (1.05)^4 = 329080.9$
		1005465

$NPV = 1005465 - 800000$

$= 205465$

For IRR, let

$r_a = 5\%$. $NPV_a = 205465$

$r_b = 15\%$. $NPV_b = -11094$

$$IRR = r_a + \frac{NPV_a}{NPV_a - NPV_b}(r_b - r_a)$$

$$= 0.05 + \frac{205465}{205465 - (-11094)}(0.15 - 0.05)$$

$$= 0.594$$

$IRR = 59.4\%$.

(P.T.O)

CSS 2018 (A&A)

ABC Company considers a new project:
Cash outflows: $y_0 = 700,000$ & $y_1 = 1,000,000$
Cash outflows: $y_2 = 250,000$, $y_3 = 300,000$,
y_4 to $y_{10} = 400,000$ (anually)

a) Calculate NPV when $r = 15\%$. Is it acceptable?

To calculate NPV, we use the following formula:

NPV = PV of inflows − PV of outflows.

PV of inflows and outflow at rate 15% from y_0 to y_3 is as follows:

n	Cashflow	PV@15%
0	(700,000)	–
1	(1,000,000)	$1,000,000 \div (1.15) = 869565.2$
2	250,000	$250,000 \div (1.15)^2 = 189035.9$
3	300,000	$300,000 \div (1.15)^3 = 197254.8$

Since y_4 to y_{10} has a constant cashflow received annually at the rate of 15%, it can be calculated using Present Value Annity Ordinary formula:

$$\text{PV of Annunity} = P\left[\frac{1-(1+i)^{-n}}{i}\right]$$

where P = cashinflow, i = interest rate and n = number of years

Computing values of ABC company into the equation above:

$$PV = 400{,}000\left[\frac{1-(1+0.15)^{-6}}{0.15}\right]$$

$$= 1513793$$

PV inflows = 189035.9 + 197254.8 + 1513793

= 1900083

PV outflows = 700,000 + 869565.2

= 1569565

NPV = 1900083 − 1569565

= 330,518

Since the NPV is positive, this project is acceptable. The present value of benefits exceeds the present value of costs at the rate of return at 15%.

b) Find its Internal Rate of Return (IRR)

IRR is calculated using the following formula:

$$IRR = r_a + \frac{NPV_a}{NPV_a - NPV_b}(r_b - r_a)$$

Since NPV was positive at r = 15%. Let us assume a higher NPV at 25%. As NPV and interest rate (r) have ~~an~~ inverse relationship, a higher r may yield a lower NPV. Calculations for NPV at 25% are as follows:

PV of inflows and outflows at r=25%.
From y_0 to y_3:

n	cashflow	PV@ 25%
0	(700,000)	-
1	(1,000,000)	$1000,000 \div (1.25) = 800000$
2	₹250,000	$250,000 \div (1.25)^2 = 160000$
3	300,000	$300,000 \div (1.25)^3 = 153600$

Since y_4 to y_{10} has a constant cashflow at r=25%. PV can be calculate using
PV Annuity Ordinary $= P\left[\frac{1-(1+i)^{-n}}{i}\right]$

$$= 400,000\left[\frac{1-(1+0.25)^{-6}}{0.25}\right]$$

$$= 1180569.6$$

PV inflows $= 160,000 + 153,600 + 1,180,569.6$
$= 1,494,169.$

PV outflows $= 700,000 + 800,000$
$= 1,500,000$

NPV = PV of inflows − PV of outflows
$= 1,494,169 - 1,500,000$
$= -5831$

For IRR let $r_a = 25\%$, $r_b = 25\%$,
$NPV_a = 330,518$, $NPV_b = -5831$

$$IRR = 0.15 + \frac{330518}{330518 - (-5831)}(0.25 - 0.15)$$

$$= 24.8\%$$

Example #1.

Cash outflow: Rs 213,000, n= 4 years

Cash inflow: y_1 = 65200, y_2 = 96000 y_3 = 73100

y_4 = 55,400

Find IRR.

Solution:

To calculate IRR, the following formula is used:

$$IRR = r_a + \frac{NPV_a}{NPV_a - NPV_b}(r_b - r_a)$$

where r_a = lower discount rate,

r_b = higher discount rate,

NPV_a = NPV at r_a, and

NPV_b = NPV at r_b.

For lower discount rate, let r_a = 10%.

NPV& will be calculated as:

n	Cash flow	PV@10%
0	(213,000)	—
1	65,200	65,200 ÷ (1.1) = 59272.7
2	96,000	96,000 ÷ $(1.1)^2$ = 79338.8
3	73,100	73,100 ÷ $(1.1)^3$ = 54921.1
4	55,400	55,400 ÷ $(1.1)^4$ = 37838.9
		Rs. 231371

NPV_a = PV of Inflow − PV of Outflow

= 231371 − 213000

NPV_a = Rs. 18371

For higher discount rate, let $r_b = 20\%$.
NPV calculations is as follows:

n	Cashflow	PV@20%
0	(213,000)	–
1	65,200	$65200 \div (1.2) = 54333.3$
2	96,000	$96000 \div (1.2)^2 = 66666.6$
3	73,100	$73100 \div (1.2)^3 = 42303.2$
4	55,400	$55400 \div (1.2)^4 = 26716.8$
		Rs. 190020

$NPV_b = 190020 - 213000$
$= Rs. -22980$

$$IRR = r_a + \frac{NPV_a}{NPV_a - NPV_b}(r_b - r_a)$$

$$= 0.1 + \frac{18371}{18371 - (-22980)}(0.20 - 0.10)$$

$= 0.144$
$= 14.4\%$.

P.T.O

Example #2.

Cash outflow: Rs 500,000. n = 4 years
Cash inflow: Rs. 160,000 each year
Sale of equipment at n=4 : Rs 50,000
Interest rate = 10%. Calculate IRR.

Solution:

IRR is calculated using the following formula

$$IRR = r_a + \frac{NPV_a}{NPV_a - NPV_b}(r_b - r_a)$$

where r_a = lower discount rate,
r_b = higher discount rate,
NPV_a = NPV at r_a, and
NPV_b = NPV at r_b

For lower discount rate, let r_a = 10%.
NPV will be calculated as:

n	Cashflow	PV@10%
0	(500,000)	—
1	160,000	$160,000/(1.1) = 145454.5$
2	160,000	$160,000/(1.1)^2 = 132231.4$
3	160,000	$160,000/(1.1)^3 = 120210.3$
4	160,000 + 50,000	$210,000/(1.1)^4 = 143432.8$
		Rs. 541329

NPV = PV inflows − PV outflows
= 541329 − 500000
= Rs. 41329

For higher discount rate, let $r_b = 20\%$.
NPV_b is calculated as follows:

n	Cashflows	PV@ 20%
0	(500,000)	—
1	160,000	$160,000 \div (1.2) = 133333.3$
2	160,000	$160,000 \div (1.2)^2 = 111111.1$
3	160,000	$160,000 \div (1.2)^3 = 92592.5$
4	210,000	~~$160,000 \div (1.2)^4$~~ $210,000 \div (1.2)^3 = 101273.1$
		Rs. 438310

$NPV_b = 438,310 - 500,000$
$= Rs - 61690$

$$IRR = r_a + \frac{NPV_a}{NPV_a - NPV_b}(r_b - r_a)$$
$$= 0.1 + \frac{41329}{41329 - (-61690)}(0.20 - 0.10)$$

$$= 0.14$$

$IRR = 14\%$