

Rate of Return

- **Rate of return methods**

- 1- Internal rate of return (IRR).
- 2- External rate of return (ERR).

- a. **Internal rate of return(IRR)**

For single alternative

To find (IRR) consider

- a. $(P_w, A_w, F_w) = 0$, for the cash flow.
- b. Assume value of i that give $(P_w, A_w, F_w) = 0$, by using interpolation.

When $IRR > MARR$

The investment will be attractive.

For multiple alternatives

Use incremental method to compare.

- b. **External rate of return (ERR).**

For single alternative

ERR can be calculated by eq.1

$$(+)\ F_w(MARR) = (-)F_w(ERR) \dots\dots\dots(1)$$

(Hint: ERR used for F_w only)

When $ERR > MARR$

The investment will be attractive .

For multiple alternative

Use incremental method to compare.

Economic Analysis

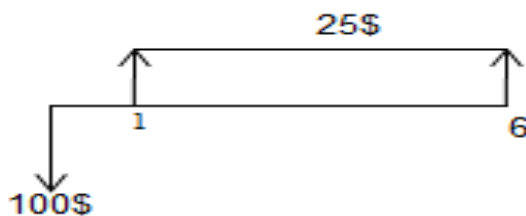
- **Problem 52, Page 390**

Consider the following cash flow profile and assume MARR is 10% per year

EOY	0	1	2	3	4	5	6
NCF	-100\$	25\$	25\$	25\$	25\$	25\$	25\$

- Determine the ERR for this project.
- Is this project economically attractive?

Solution



$$(+)\text{ Fw(MARR)} = (-)\text{ Fw(ERR)}$$

$$25 (F/A10,6) = 100(1 + i)^6$$

$$25(7.71561) = 100(1 + i)^6$$

$$\left(\frac{25(7.71561)}{100}\right)^{\frac{1}{6}} = 1 + i$$

$$\text{ERR} = 11.57\%$$

$$\text{ERR} = 11.57\% > \text{MARR} = 10\%$$

That mean attractive

Economic Analysis

- **Problem**

Consider the following cash flow profile and assume MARR is 10% per year.

EOY	0	1	2	3	4	5	6
NCF	-70000	30,000\$	30,000\$	30,000\$	30,000\$	30,000\$	32,000\$

- a) Determine the IRR for this project.
- b) Is this project economically justified?

Solution

a) $Pw(10\%) = -70,000 + 30,000(P/A10,5) + 32,000(P/A10,6) =$

$$-70,000 + 30,000(3.79079) + 32,000(0.56447) = 61788 \$$$

$$Pw(30\%) = 9698.4 \$$$

$$Pw(40\%) = -70,000 + 30,000(P/A40, 5) + 32,000(P/A40, 6) =$$

$$-70,000 + 30,000(2.03516) + 32,000(0.13281) = -4694.4\$$$

$$\text{When } 30\% \rightarrow 9698.4 \$$$

$$i \rightarrow 0$$

$$40\% \rightarrow -4694.4\$$$

By interpolation

$$IRR = 36.74 \%$$

b)

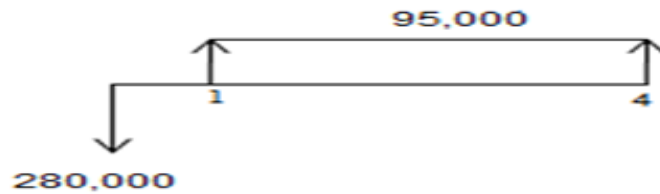
$$IRR = 36.74 \% > MARR = 10\%$$

There for justified

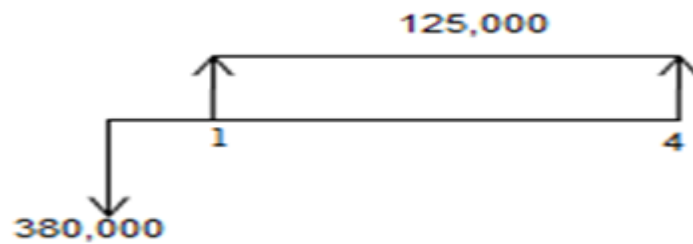
- Problem 36, Page .387

MARR =10%, determine the IRR.

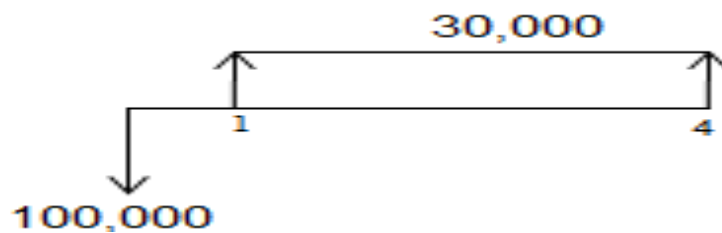
Vendor B



Vendor A



Incremental A-B



$$P_w(10\%) = -100,000 + 30,000(P/A10,4)$$

$$-100,000 + 30,000(3.16987) = -4903.9 \$$$

$$P_w(5\%) = -100,000 + 30,000(P/A5,4)$$

$$-100,000 + 30,000(3.54595) = 6378.5 \$$$

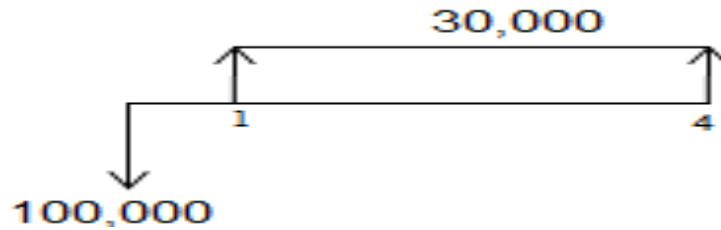
→ IRR = 7.82% < MARR = 10%

→ Select vendor B

- Problem 63, Page. 392

(Same as data of problem 36), MARR=10%, determine the ERR.

Incremental A –B



$$(+)\text{ Fw(MARR)} = (-)\text{ Fw(ERR)}$$

$$30,000 (\text{F/A}10, 4) = 100,000(1 + i)^4$$

$$30,000(4.6410) = 100,000(1 + i)^4$$

$$\left(\frac{30,000(4.6410)}{100,000}\right)^{\frac{1}{4}} = 1 + i$$

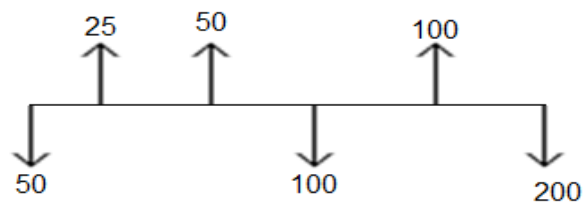
$$\text{ERR} = 8.62\%$$

$$\text{ERR} = 8.62\% < \text{MARR} = 10\%$$

Select vendor B

Problem

MARR= 10%



a) Determine the ERR for this project.

b) Is this project economically attractive?

Solution

$$(+)\text{ Fw(MARR)} = (-)\text{ Fw(ERR)}$$

$$(+)\text{ Fw(MARR)} = 25(\text{F/P}10,4)+50(\text{F/P}10,3)+100(\text{F/P}10,1)$$

$$= 25(1.46410)+50(1.33100)+100(1.10000)=213.1525\$$$

Economic Analysis

$$(-)Fw(ERR) = 200 + 100(F/P \ i, 2) + 50(F/P \ i, 5)$$

$$= 200 + 100(1 + i)^2 + 50(1 + i)^5, (1 + i) = x$$

$$213.1525\$ = 200 + 100x^2 + 50x^5$$