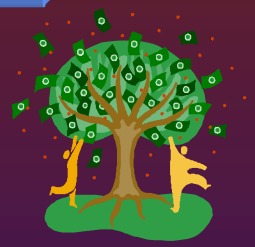
Rate of Return(ROR)

Rate of return calculations usually involve trial and error solutions

Equations can be written in terms of P, F, or A



Example: An investment of $20,000 in a certain machine will generate income of $7000 per year for 3 years, at which time the machine can be sold for $8000. If the company's MARR is 15% per year, should it buy the machine?

Solution: The ROR equation is: $0 = -20{,}000 + 7000(P/A,i,3) + 8000(P/F,i,3)$

Solve for i by trial and error or Excel: $i = 18.2\%$ per year

Thus, since i >MARR, the investment should be made

Multiple ROR Values

Multiple values of i may exist when there is more than one sign change in net cash flow(CF). Such cash flow is called non-conventional.

Two rules apply to multiple i values:

Descarte's rule states that the number of real i values is less than or equal to the number of sign changes in net cash flow

Norstrom's criterion states that if the cumulative cash flow starts off negatively and has only one sign change, there is only one i value

Example-No. of i Values

Determine the maximum number of i values for the cash flow below

Year	Expense	Income	Net cash flow	Cumulative CF
0	-12,000	-	-12,000	-12,000
1	-5,000	+ 3,000	-2,000	-14,000
2	-6,000	+9,000	+3,000	-11,000
3	-7,000	+15,000	+8,000	-3,000
4	-8,000	+16,000	+8,000	+5,000
5	-9,000	+8,000	-1,000	+4,000

Solution:

The sign on the net cash flow changes twice, indicating two possible i values

The cumulative cash flow begins negatively with one sign change

Therefore, there is only one i value(i = 4.7%)

ROR on a Bond %

Bonds have conventional cash flows(1 sign change). Therefore, have one i value

Example: A $10,000 bond with 6% interest payable quarterly is for sale for $8000. If the bond matures in 5 years, what is the ROR (a) per quarter (b) per year

Solution: (a) $I = \dfrac{10{,}000(0.06)}{4} = \$150$ per quarter

The rate of return equation is: $0 = -8000 + 150(P/A,i,20) + 10{,}000(P/F,i,20)$

By trial and error or Excel, i = 2.8% per quarter

(b) Nominal i per year = 2.8(4) = 11.2% per year

Effective i per year = $(1 + 0.028)^4 - 1$ = 11.7% per year