Economic Comparisons

Money based – P, A, F
Interest based - i
Time based - n

Rate of Return

- Rate of return is the rate of interest paid on the unpaid balanced borrowed money or the rate of interest earned on the unrecovered balance of an interest (loan) so that the final payment or receipt brings the balance to ZERO with interest considered.

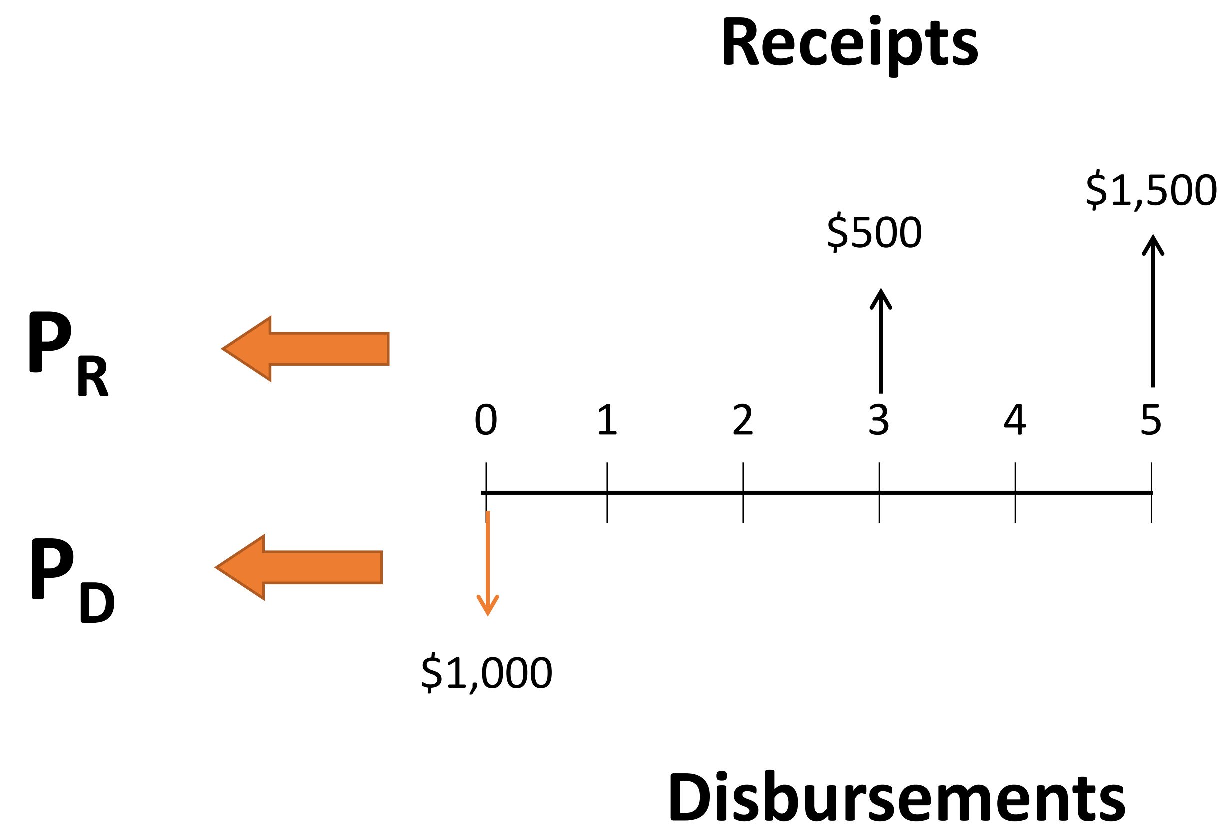
- To determine the rate of return value (i) of a project, the present worth of disbursements P_D is equaled to the present worth of receipts P_R.
- $P_D = P_R$ **OR** $P_R - P_D = 0$
- In this analysis, investments are disbursements and incomes are receipts. The equivalent Uniform-Annual-Worth method can also be used.
- $EUAW_D = EUAW_R$ **OR** $EUAW_R - EUAW_D = 0$

- The (i) value which makes the relations correct may be referred to by several titles:
  - Rate of Return (ROR);
  - Internal Rate of Return (IRR);
  - Breakeven Rate of Return;
  - Profitability Index; or
  - Return on Investment (ROI)
- It is customarily represented as (i*) (i star)

Example

- If you invest \$1,000 now and are promised receipts of \$500 three years from now and \$1,500 five years from now. Find out the rate of return (i).

  - Draw cash flow
  - Apply equation (e.g., $P_R - P_D = 0$)
  - Solve equation to find (i) – It is better to know the trial and error approach for future problems



$$-1{,}000 + 500\left[\frac{1}{(1+i)^3}\right] + 1{,}500\left[\frac{1}{(1+i)^5}\right] = 0$$

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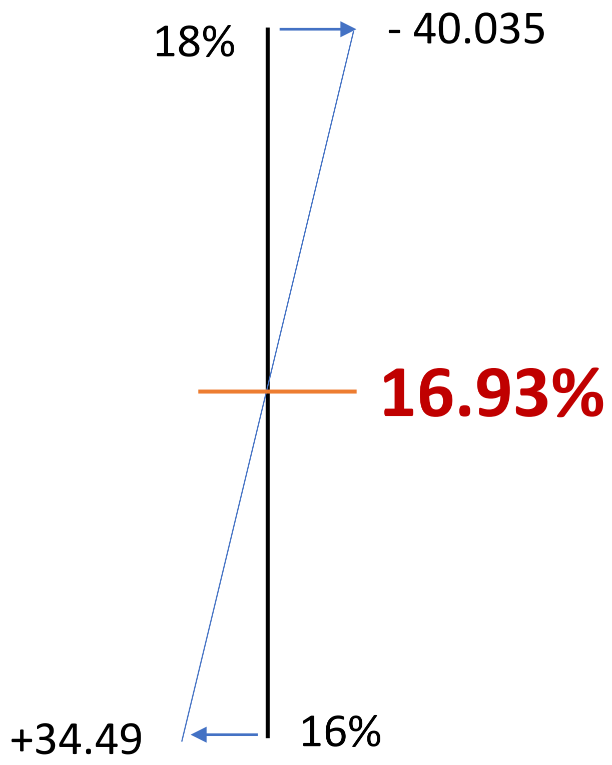
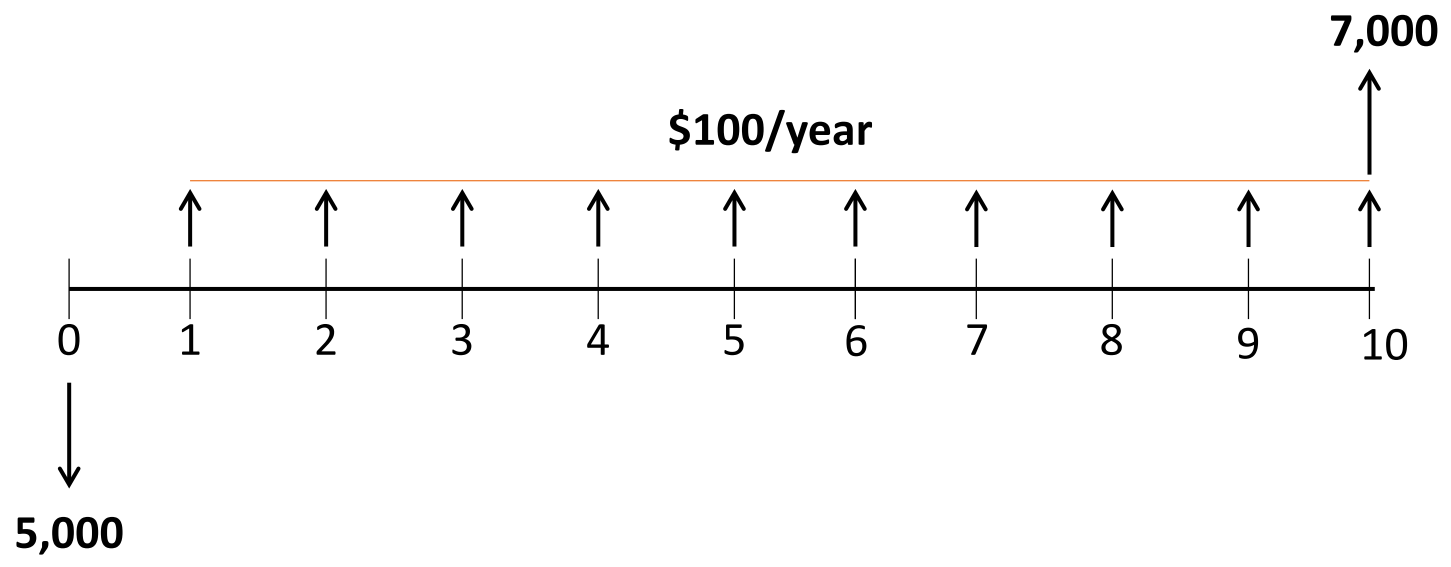
- Let i= 16% → P= + 34.49
- Let i= 18% → P= - 40.035



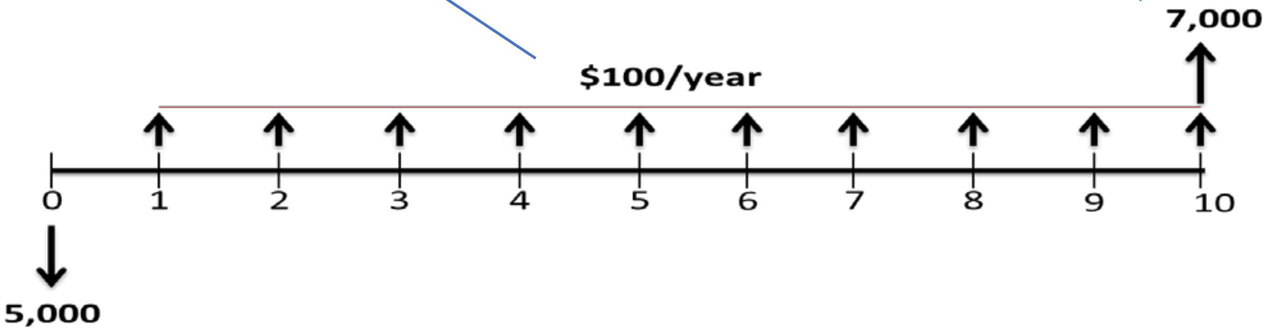
Example

- If $5,000 is invested now in common stock that is expected to yield $100 per year for 10 years and $7,000 at the end of 10 years, what is the rate of return?



$$P = A\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]$$

$$P = F\left[\frac{1}{(1+i)^n}\right]$$



$$-5{,}000 + 100\left[\frac{(1+i)^{10} - 1}{i(1+i)^{10}}\right] + 7{,}000\left[\frac{1}{(1+i)^{10}}\right] = 0$$

- Let i= 4% → P= + 540
- Let i= 5% → P= + 69.54
- Let i= 6% → P= - 355.27

i* = 5.16%

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Determination and use of Payback Period

The payback period of an asset or project is the number of years it must be retained or be economically useful to recover the initial investment with a stated return.

It should never be used as a method equivalent to PW, EUAW, or rate of return to select between alternatives.

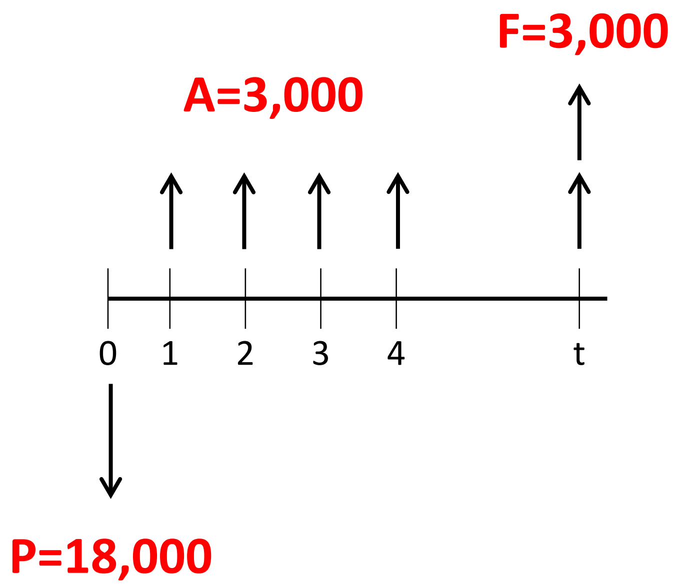
$0 = -P + \sum_{i=1}^{n} cf_i \quad (P/F, i\%, t)$

cf_t *is the net cash flow at end of year t*

Example

- A semi automatic machine purchased for \$18,000 is expected to generate annual revenues of \$3,000 and have salvage value =\$3,000 during the 10 years of anticipated ownership. If a 15% per year required return is imposed on purchase. Compute the payback period?

Solution



$$0 = -18{,}000 + 3{,}000\left[\frac{1.15^{n} - 1}{0.15 \times (1.15)^{n}}\right] + 3{,}000\left[\frac{1}{(1.15)^{n}}\right]$$

n=15.3 years which is > 10 years→ the machine will not return the required 15% per year