Engineering Economy Cheatsheet

- Terminology:
  - i : Interest rate in %
  - N : no. of compounding periods/interest period
  - P : Present value of money
  - F : Future worth of money
  - A : End of period cashflow or annuity
  - G : Arithmetic gradient (amount by which cash flow is increased at the end of every period)

- Future worth of a single present value:

$$F = P * (1+i)^N = P\left(\frac{F}{P}, i\%, N\right)$$

  - $(i+i)^N$ is called Single Payment Compound Amount Factor
  - $(1+i)^{-N}$ is called Single Payment Present Worth Factor

- Present value of uniform annuity:

$$P = A\left(\frac{(1+i)^N - 1}{i*(1+i)^N}\right) = A\left(\frac{P}{A}, i\%, N\right)$$

  - $\left(\frac{(1+i)^N-1}{i*(1+i)^N}\right)$ is called Series Present Worth Factor
  - The reciprocal of the above is called Capital Recovery Factor

- Future worth of annuity:

$$F = A\left(\frac{(1+i)^N - 1}{i}\right) = A\left(\frac{F}{A}, i\%, N\right)$$

  - $\left(\frac{(1+i)^N-1}{i}\right)$ is known as Uniform Series Compound Amount Factor
  - The reciprocal of the above is known as Sinking Fund Factor

- **Deffered annuities**:
  If the annuity is deferred for J periods $(J < N)$, the present equivalent at time zero will be

$$P_0 = A\left(\frac{P}{A},\ i\%,\ N-J\right)\left(\frac{P}{F},\ i\%,\ J\right)$$

- **Present value of G**:

$$P = G\underbrace{\left(\frac{1}{i}\right)\left[\frac{(1+i)^N-1}{i*(1+i)^N} - \frac{N}{(1+i)^N}\right]}_{Gradient\ To\ Present\ Worth\ Conversion\ Factor} = G\left(\frac{P}{G},\ i\%,\ N\right)$$

- **Annual worth of G**:

$$A = G* \underbrace{\left[\frac{1}{i} - \frac{N}{(1+i)^N-1}\right]}_{\text{Gradient to uniform series conversion factor}} = G\left(\frac{A}{G},\ i\%,\ N\right)$$

- **Present value of geometric gradient series**:

$$P_g = A_1\left[\frac{1-\left(\frac{1+g}{1+i}\right)^N}{i-g}\right] = A_1\left(\frac{P}{A},\ g\%,\ i\%,\ N\right),\ g \neq i$$

  where:
  $A_1 =$ initial annual amount
  $g =$ geometric growth rate of gradient series
  - For $i = g$

$$P_g = A_1\left(\frac{N}{1+i}\right)$$

- **Present value with varying interest rate given G at end of Nth period**:

$$P = \frac{F_N}{\prod_{k=1}^{N}(1+i)^k}$$

Methods for making economic studies