MECH 431 Formula Sheet

Engineering Costs and Cost Estimating

Engineering Costs:

- Fixed - Constant regardless of output activity
- Variable - Depends on output activity
- Marginal - Variable cost of one more unit
- Average - Total cost divided by number of units
- Total - Total Fixed + Total Variable
- Sunk - Money already spend, result of a past decision
- Opportunity - Next best benefit forgone
- Recurring - Repeating expense that is known, anticipated
- Non-Recurring - One-of-a-kind, Irregular
- Incremental - Cost differences between alternatives
- Cash - Costs associated with cash transactions
- Book - Cost effects from past decisions
- Life-Cycle - Costs over various phases of a product's life

Estimating Models:

- Per-Unit - Per-unit factor
- Segmenting - Divide & conquer
- Cost Indices - Historical changes based on ratio

$$\frac{\text{Cost at time A}}{\text{Cost at time B}} = \frac{\text{Index value at time A}}{\text{Index value at time B}}$$

- Power-Sizing - Accounts for Economies of Scale

$$\frac{\text{Cost of equipment A}}{\text{Cost of equipment B}} = \left(\frac{\text{Capacity of equipment A}}{\text{Capacity of equipment B}}\right)^x$$

- Learning Curve - Relationship between repetition and performance

$$T_N = T_i \times N^b$$

$b = \log_2(\text{learning curve expressed as a decimal})$

for N completed units.

Interest and Equivalence

Simple Interest:

$$F = P(1 + in)$$

Single-Payment Compound Interest:

$$F = P(1 + i)^n$$

Single-Payment Present Worth:

$$P = F(1 + i)^{-n}$$

Effective Annual Interest Rate for a nominal interest rate (r) and m compounding subperiods:

$$i_a = \left(1 + \frac{r}{m}\right)^m - 1 \qquad i_a = (1 + i)^m - 1$$

Uniform Series Compound Amount/Sinking Fund:

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

Uniform Series Capital Recovery/Present Worth:

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

Arithmetic Gradient Present Worth:

$$P = G\left[\frac{(1 + i)^n - in - 1}{i^2(1 + i)^n}\right]$$

Arithmetic Gradient Uniform Series:

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

Geometric Gradient Present Worth:

$$P = A_1\left[\frac{1 - (1 + g)^n(1 + i)^{-n}}{i - g}\right] \quad \text{for } i \neq g$$

$$P = A_1 n(1 + i)^{-1} \quad \text{for } i = g$$

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https://github.com/DonneyF/formula-sheets