Appendix D
List of Formulas

After-tax IRR:

$$\text{IRR}_{\text{after-tax}} \cong \text{IRR}_{\text{before-tax}} \times (1 - t)$$

After-tax MARR:

$$\text{MARR}_{\text{after-tax}} \cong \text{MARR}_{\text{before-tax}} \times (1 - t)$$

Benefit–Cost Ratio:

$$\text{BCR} = \frac{\text{PW(benefits)}}{\text{PW(costs)}}$$

Book Value, Declining-Balance:

$$BV_{db}(n) = P(1 - d)^n$$

Book Value, Straight-Line:

$$BV_{sl}(n) = P - n\left(\frac{P - S}{N}\right)$$

Capital Tax Factor:

$$\text{CTF} = 1 - \frac{td(1 + i/2)}{(i + d)(1 + i)}$$

Capital Salvage Factor:

$$\text{CSF} = 1 - \frac{td}{(i + d)}$$

Capitalized Value:

$$P = \frac{\text{A}}{i}$$

Capital Recovery Formula:

$$A = (P - S)(A/P,i,N) + Si$$

Compound Interest:

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

Compound Interest Factors:

- **Compound Amount Factor**

  $$(F/P,i,N) = (1 + i)^N$$

- **Present Worth Factor**

  $$(P/F,i,N) = \frac{1}{(1 + i)^N}$$

- **Sinking Fund Factor**

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

- **Uniform Series Compound Amount Factor**

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

- **Capital Recovery Factor**

  $$(A/P,i,N) = \frac{i(1 + i)^N}{(1 + i)^N - 1}$$

- **Series Present Worth Factor**

  $$(P/A,i,N) = \frac{(1 + i)^N - 1}{i(1 + i)^N}$$

- **Arithmetic Gradient to Annuity Conversion Factor**

  $$(A/G,i,N) = \frac{1}{i} - \frac{N}{(1 + i)^N - 1}$$

- **Geometric Gradient Series to Present Worth Conversion Factor**

  $$(P/A,g,i,N) = \frac{(P/A,i^\circ,N)}{1 + g}$$

  $$(P/A,g,i,N) = \left(\frac{(1 + i^\circ)^N - 1}{i^\circ(1 + i^\circ)^N}\right)\frac{1}{1 + g}$$

  $$i^\circ = \frac{1 + i}{1 + g} - 1$$

Depreciation Amount, Straight Line:

$$D_{sl}(n) = \frac{P - S}{N}$$

Depreciation Amount, Declining Balance:

$$D_{db}(n) = BV_{db}(n - 1) \times d$$

Depreciation Rate:

$$d = 1 - \sqrt[n]{\frac{S}{P}}$$

Effective Interest Rate:

$$i_e = \left(1 + \frac{r}{m}\right)^m - 1 \text{ or}$$

$$i_e = (1 + i_s)^m - 1$$

Effective Interest Rate for Continuous Compounding:

$$i_e = e^r - 1$$

Expected Value of the Discrete Random Variable:

$$E(x) = \sum x_i p(x_i)$$

Financial Ratios:

- **Acid test ratio** $= \dfrac{\text{Quick assets}}{\text{Current liabilities}}$
- **Current ratio** $= \dfrac{\text{Current assets}}{\text{Current liabilities}}$
- **Equity ratio** $= \dfrac{\text{Total equity}}{\text{Total assets}}$
- **Inventory turnover** $= \dfrac{\text{Sales}}{\text{Inventories}}$
- **Return on total assets** $= \dfrac{\text{Profits after taxes}}{\text{Total assets}}$

Growth-Adjusted Interest Rate:

$$i^\circ = \frac{1 + i}{1 + g} - 1$$

Internal Rate of Return:

$$\sum_{t=0}^{T} \frac{(R_t - D_t)}{(1 + i^*)^t} = 0 \text{ or}$$

$$\sum_{t=0}^{T} \frac{R_t}{(1 + i^*)^t} = \sum_{t=0}^{T} \frac{D_t}{(1 + i^*)^t}$$

Linear Interpolation:

$$x^* = x_1 + (x_2 - x_1)\left[\frac{y^* - y_1}{y_2 - y_1}\right]$$

Modified Benefit–Cost Ratio:

$$\text{BCRM} = \frac{\text{PW(benefits)} - \text{PW(operating costs)}}{\text{PW(capital costs)}}$$

Payback Period:

$$\text{Payback period} = \frac{\text{First cost}}{\text{Annual savings}}$$

Real Dollars:

$$R_{0,N} = \frac{A_N}{I_{0,N}/100}$$

$$R_N = \frac{A_N}{(1 + f)^N}$$

$$R_N = A_N(P/F,f,N)$$

Real MARR:

$$\text{MARR}_\text{R} = \frac{1 + \text{MARR}_\text{C}}{1 + f} - 1$$

Real Interest Rate:

$$i' = \frac{1 + i}{1 + f} - 1$$

Real IRR:

$$\text{IRR}_\text{R} = \frac{1 + \text{IRR}_\text{C}}{1 + f} - 1$$

Simple Interest Amount:

$$I_s = PiN$$