Selected Equations and Data

**CHAPTER 1**

\[
\text{Value} = \frac{\text{FCF}_1}{(1 + \text{WACC})^1} + \frac{\text{FCF}_2}{(1 + \text{WACC})^2} + \frac{\text{FCF}_3}{(1 + \text{WACC})^3} + \cdots + \frac{\text{FCF}_\infty}{(1 + \text{WACC})^\infty}
\]

**CHAPTER 2**

EBIT = Earnings before interest and taxes = Sales revenues − Operating costs

EBITDA = Earnings before interest, taxes, depreciation and amortization

\[= \text{EBIT} + \text{Depreciation} + \text{Amortization}\]

Net cash flow = Net income + Depreciation and amortization

NOWC = Net operating working capital

\[= \text{Operating current assets} - \text{Operating current liabilities}\]

\[= \left( \text{Cash} + \text{Accounts receivable} + \text{Inventories} \right) - \left( \text{Accounts payable} + \text{Accruals} \right)\]

Total net operating capital = Net operating working capital + Operating long-term assets

NOPAT = Net operating profit after taxes = EBIT(1 − Tax rate)

Free cash flow (FCF) = NOPAT − Net investment in operating capital

\[= \text{NOPAT} - \left( \frac{\text{Current year's total net operating capital} - \text{Previous year's total net operating capital}}{\text{Current year's total net operating capital}} \right)\]

Operating cash flow = NOPAT + Depreciation and amortization

Gross investment in operating capital = Net investment in operating capital + Depreciation
\[ FCF = \text{Operating cash flow} - \text{Gross investment in operating capital} \]

\[ \text{Return on invested capital (ROIC)} = \frac{\text{NOPAT}}{\text{Total net operating capital}} \]

\[ \text{MVA} = \text{Market value of stock} - \text{Equity capital supplied by shareholders} \]
\[ = (\text{Shares outstanding})\text{(Stock price)} - \text{Total common equity} \]

\[ \text{MVA} = \text{Total market value} - \text{Total investor-supplied capital} \]
\[ = \left( \frac{\text{Market value of stock}}{+ \text{Market value of debt}} \right) - \text{Total investor-supplied capital} \]

\[ \text{EVA} = \left( \frac{\text{Net operating profit after taxes}}{\text{(NOPAT)}} \right) - \left( \frac{\text{After-tax dollar cost of capital used to support operations}}{\text{WACC}} \right) \]
\[ = \text{EBIT(1−Tax rate)} - \left( \frac{\text{Total net operating capital}}{\text{(WACC)}} \right) \]
\[ \text{EVA} = \left( \frac{\text{Total net operating capital}}{\text{(ROIC − WACC)}} \right) \]

**CHAPTER 3**

Current ratio = \[ \frac{\text{Current assets}}{\text{Current liabilities}} \]

Quick, or acid test, ratio = \[ \frac{\text{Current assets} - \text{Inventories}}{\text{Current liabilities}} \]

Inventory turnover ratio = \[ \frac{\text{Sales}}{\text{Inventories}} \]

DSO = Days sales outstanding = \[ \frac{\text{Receivables}}{\text{Average sales per day}} = \frac{\text{Receivables}}{\text{Annual sales/365}} \]

Fixed assets turnover ratio = \[ \frac{\text{Sales}}{\text{Net fixed assets}} \]

Total assets turnover ratio = \[ \frac{\text{Sales}}{\text{Total assets}} \]

Debt ratio = \[ \frac{\text{Total liabilities}}{\text{Total assets}} \]

Market debt ratio = \[ \frac{\text{Total liabilities}}{\text{Total liabilities + Market value of equity}} \]

Debt-to-equity ratio = \[ \frac{\text{Total liabilities}}{\text{Total assets} - \text{Total liabilities}} \]

Debt-to-equity = \[ \frac{\text{Debt ratio}}{1 - \text{Debt ratio}} \quad \text{and} \quad \text{Debt ratio} = \frac{\text{Debt-to-equity}}{1 + \text{Debt-to-equity}} \]

Equity multiplier = \[ \frac{\text{Total assets}}{\text{Common equity}} \]
Debt ratio = 1 - \frac{1}{Equity multiplier}

Times-interest-earned (TIE) ratio = \frac{EBIT}{Interest charges}

EBITDA coverage ratio = \frac{EBITDA + Lease payments}{Interest + Principal payments + Lease payments}

Net profit margin = \frac{Net income available to common stockholders}{Sales}

Operating profit margin = \frac{EBIT}{Sales}

Gross profit margin = \frac{Sales - Cost of goods sold}{Sales}

Return on total assets (ROA) = \frac{Net income available to common stockholders}{Total assets}

Basic earning power (BEP) ratio = \frac{EBIT}{Total assets}

ROA = Profit margin \times Total assets turnover = \frac{Net income}{Sales} \times \frac{Sales}{Total assets}

Return on common equity (ROE) = \frac{Net income available to common stockholders}{Common equity}

ROE = ROA \times Equity multiplier
\quad = Profit margin \times Total assets turnover \times Equity multiplier
\quad = \frac{Net income}{Sales} \times \frac{Sales}{Total assets} \times \frac{Total assets}{Common equity}

Price/earnings (P/E) ratio = \frac{Price per share}{Earnings per share}

Price/cash flow ratio = \frac{Price per share}{Cash flow per share}

Book value per share = \frac{Common equity}{Shares outstanding}

Market/book (M/B) ratio = \frac{Market price per share}{Book value per share}

\textbf{CHAPTER 4}

\text{FVN} = PV(1 + I)^N

\text{PV} = \frac{\text{FVN}}{(1 + I)^N}
\[ FV_{AN} = PMT \left( \frac{(1 + I)^N - 1}{I} \right) = PMT \left( \frac{(1 + I)^N - 1}{I} \right) \]

\[ FV_{Due} = FVA_{ordinary} (1 + I) \]

\[ PV_{AN} = PMT \left( \frac{1 - \frac{1}{I(1 + I)^N}}{I} \right) = PMT \left( \frac{1 - \frac{1}{(1 + I)^N}}{I} \right) \]

\[ PV_{Due} = PV_{Ordinary} (1 + I) \]

PV of a perpetuity = \( \frac{PMT}{I} \)

\[ PV_{Uneven\ stream} = \sum_{t=1}^{N} \frac{CF_t}{(1 + I)^t} \]

\[ FV_{Uneven\ stream} = \sum_{t=1}^{N} CF_t (1 + I)^{N-t} \]

\[ I_{PER} = \frac{I_{NOM}}{M} \]

\[ APR = (I_{PER})M \]

Number of periods = NM

\[ F V_{N} = PV (1 + I_{PER})^{Number\ of\ periods} = PV \left( \frac{1 + \frac{I_{NOM}}{M}}{M} \right)^{MN} \]

\[ EFF\% = \left( 1 + \frac{I_{NOM}}{M} \right)^{M} - 1.0 \]

\section*{Chapter 5}

\[ V_B = \sum_{t=1}^{N} \frac{INT}{(1 + r_d)^t} + \frac{M}{(1 + r_d)^N} \]

Semiannual payments: \( V_B = \sum_{t=1}^{2N} \frac{INT/2}{(1 + r_d/2)^t} + \frac{M}{(1 + r_d/2)^{2N}} \)

Yield to maturity: Bond price = \( \sum_{t=1}^{N} \frac{INT}{(1 + YTM)^t} + \frac{M}{(1 + YTM)^N} \)

Price of callable bond (if called at \( N \)) = \( \sum_{t=1}^{N} \frac{INT}{(1 + r_d)^t} + \frac{Call\ price}{(1 + r_d)^N} \)

Current yield = \( \frac{\text{Annual interest}}{\text{Bond's current price}} \)

Current yield + Capital gains yield = Yield to maturity

\[ r_d = r^* + IP + DRP + LP + MRP \]

\[ r_{RF} = r^* + IP \]

\[ r_d = r_{RF} + DRP + LP + MRP \]

\[ I_{PN} = I_1 + I_2 + \cdots + I_N \]

\[ N \]
CHAPTER 6

Expected rate of return \( \hat{r} = \sum_{i=1}^{n} P_i r_i \)

Historical average, \( \bar{r}_{\text{Avg}} = \frac{\sum_{t=1}^{n} \bar{r}_t}{n} \)

Variance = \( \sigma^2 = \sum_{i=1}^{n} (r_i - \hat{r})^2 p_i \)

Standard deviation = \( \sigma = \sqrt{\sum_{i=1}^{n} (r_i - \hat{r})^2 p_i} \)

Historical estimated \( \sigma = S = \sqrt{\frac{\sum_{t=1}^{n} (\bar{r}_t - \bar{r}_{\text{Avg}})^2}{n-1}} \)

CV = \( \frac{\hat{r}}{\sigma} \)

\( \hat{r}_p = \sum_{i=1}^{n} w_i \hat{r}_i \)

\( \sigma_p = \sqrt{\sum_{i=1}^{n} (r_{pi} - \hat{r}_p)^2 p_i} \)

Estimated \( \rho = R = \frac{\sum_{t=1}^{n} (\bar{r}_{iT} - \bar{r}_{I,\text{Avg}})(\bar{r}_{jT} - \bar{r}_{j,\text{Avg}})}{\sqrt{\sum_{t=1}^{n} (\bar{r}_{iT} - \bar{r}_{I,\text{Avg}})^2 \sum_{t=1}^{n} (\bar{r}_{jT} - \bar{r}_{j,\text{Avg}})^2}} \)

\( \text{COV}_{iM} = \rho_{iM} \sigma_i \sigma_M \)

\( b_i = \left( \frac{\sigma_i}{\sigma_M} \right) \rho_{iM} = \frac{\text{COV}_{iM}}{\sigma_M^2} \)

\( b_p = \sum_{i=1}^{n} w_i b_i \)

Required return on stock market = \( r_M \)

Market risk premium = \( \text{RP}_M = r_M - r_{RF} \)

\( \text{RP}_i = (r_M - r_{RF}) b_i = (\text{RP}_M) b_i \)

\( \text{SML} = r_i = r_{RF} + (r_M - r_{RF}) b_i = r_{RF} + \text{RP}_M b_i \)

CHAPTER 7

\( \hat{P}_0 = \text{PV of expected future dividends} = \sum_{t=1}^{\infty} \frac{D_t}{(1 + r_s)^t} \)

Constant growth: \( \hat{P}_0 = \frac{D_0 (1 + g)}{r_s - g} = \frac{D_1}{r_s - g} \)
\[ r_s = \frac{D_1}{P_0} + g \]

Capital gains yield = \[ \frac{\hat{P}_1 - P_0}{P_0} \]

Dividend yield = \[ \frac{D_1}{P_0} \]

For a zero growth stock, \[ \hat{P}_0 = \frac{D}{r_s} \]

Horizon value = Terminal value = \[ \hat{P}_N = \frac{D_{N+1}}{r_s - g} \]

\[ V_{ps} = \frac{D_{ps}}{r_{ps}} \]

\[ \hat{r}_{ps} = \frac{D_{ps}}{V_{ps}} \]

\[ r_{ps} = \text{Actual dividend yield + Actual capital gains yield} \]

**Chapter 8**

Exercise value = MAX[Current price of stock – Strike price, 0]

Number of stock shares in hedged portfolio = \[ N = \frac{C_u - C_d}{P_u - P_d} \]

\[ V_C = P[N(d_1)] - Xe^{-r_{RF}t}[N(d_2)] \]

\[ d_1 = \frac{\ln(P/X) + \left[ r_{RF} + \frac{\sigma^2}{2} \right]t}{\sigma \sqrt{t}} \]

\[ d_2 = d_1 - \sigma \sqrt{t} \]

Put–call parity: Put option = \[ V_C - P + Xe^{-r_{RF}t} \]

V of put = \[ P[N(d_1) - 1] - Xe^{-r_{RF}t}[N(d_2) - 1] \]

**Chapter 9**

After-tax component cost of debt = \[ r_d(1 - T) \]

\[ M(1-F) = \sum_{t=1}^{N} \frac{\text{INT}(1 - T)}{[1 + r_d(1 - T)]^t} + \frac{M}{[1 + r_d(1 - T)]^N} \]

\[ r_{ps} = \frac{D_{ps}}{P_{ps}(1 - F)} \]

Market equilibrium: Expected rate of return = \[ \hat{r}_M = \frac{D_1}{P_0} + g = r_{RF} + R P_M = r_M = \text{Required rate of return} \]

where \[ D_1, P_0, \text{and } g \] are for the market, not an individual company
Rep/Div = ratio of payouts via repurchases to payouts via dividends

\[ r_M = \frac{\text{Rep}}{\text{Div}} = \left(1 + \frac{\text{Rep}}{\text{Div}}\right) \frac{D_1}{P_0} + g, \] where \( g \) is long-term growth rate in total payouts for the market and

where \( D_1 \) and \( P_0 \) are for the market, not an individual company

CAPM: \( r_s = r_{RF} + b_i(RP_M) \)

DCF: \( r_s = \frac{\text{D_1}}{P_0} + \text{Expected g in dividends per share} \)

\[ r_s = \text{Company’s own bond yield} + \text{Judgmental risk premium} \]

\( g = (\text{Retention rate})(\text{ROE}) = (1.0 - \text{Payout rate})(\text{ROE}) \)

\[ r_e = \frac{\text{D_1}}{P_0(1-F)} + g \]

WACC = \( w_{dr_d}(1 - T) + w_{psrps} + w_s r_s \)

**Chapter 10**

\[ \text{NPV} = CF_0 + \frac{CF_1}{(1 + r)^1} + \frac{CF_2}{(1 + r)^2} + \cdots + \frac{CF_N}{(1 + r)^N} \]

\[ = \sum_{t=0}^{N} \frac{CF_t}{(1 + r)^t} \]

IRR: \[ \text{CF_0} + \frac{CF_1}{(1 + IRR)^1} + \frac{CF_2}{(1 + IRR)^2} + \cdots + \frac{CF_N}{(1 + IRR)^N} = 0 \]

\[ \text{NPV} = \sum_{t=0}^{N} \frac{CF_t}{(1 + IRR)^t} = 0 \]

MIRR: PV of costs = PV of terminal value

\[ \sum_{t=0}^{N} \frac{\text{COF}_t}{(1 + r)^t} = \sum_{t=0}^{N} \frac{\text{CF}_t(1 + r)^{N-t}}{(1 + \text{MIRR})^N} \]

\[ \text{PV of costs} = \frac{\text{Terminal value}}{(1 + \text{MIRR})^N} \]

\[ \text{PI} = \frac{\text{PV of future cash flows}}{\text{Initial cost}} = \frac{\sum_{t=1}^{N} \frac{CF_t}{(1 + r)^t}}{CF_0} \]

\[ \text{Payback} = \frac{\text{Number of years prior to full recovery} + \text{Unrecovered cost at start of year}}{\text{Cash flow during full recovery year}} \]
CHAPTER 11

Project cash flow = FCF = Investment outlay cash flow + Operating cash flow + NOWC cash flow + Salvage cash flow

Expected NPV = \[ \sum_{i=1}^{n} P_i(NPV_i) \]

\[ \sigma_{NPV} = \sqrt{\sum_{i=1}^{n} P_i(NPV_i - \text{Expected NPV})^2} \]

\[ CV_{NPV} = \frac{\sigma_{NPV}}{E(NPV)} \]

CHAPTER 12

Additional funds needed = Required asset increase - Spontaneous liability increase - Increase in retained earnings

AFN = \( (A^*/S_0)\Delta S - (L^*/S_0)\Delta S - MS_t(1 - \text{Payout ratio}) \)

Full capacity sales = \( \frac{\text{Actual sales}}{\text{Percentage of capacity at which fixed assets were operated}} \)

Target fixed assets/Sales = \( \frac{\text{Actual fixed assets}}{\text{Full capacity sales}} \)

Required level of fixed assets = \( (\text{Target fixed assets/Sales})(\text{Projected sales}) \)

CHAPTER 13

\( V_{op} = \text{Value of operations} = \text{PV of expected future free cash flows} \)

\[ = \sum_{i=1}^{m} \frac{FCF_i}{(1 + WACC)^t} \]

Horizon value: \( V_{op(\text{at time } N)} = \frac{FCF_{N+1}}{WACC - g} = \frac{FCF_N(1 + g)}{WACC - g} \)

Total value = \( V_{op} + \text{Value of nonoperating assets} \)

Value of equity = Total value – Preferred stock – Debt

Operating profitability (OP) = NOPAT/Sales

Capital requirements (CR) = Operating capital/Sales
EROIC<sub>t</sub> = Expected return on invested capital 
= NOPAT<sub>t+1</sub>/Capital<sub>t</sub> 
= NOPAT<sub>t</sub>(1 + g)/Capital<sub>t</sub> 
= OP<sub>t+1</sub>/CR<sub>t</sub>

For constant growth:

\[ V_{op(\text{at time N})} = \text{Capital}_N + \left[ \frac{\text{Sales}_N(1 + g)}{\text{WACC} - g} \right] \left[ \frac{\text{OP} - \text{WACC} \left( \frac{\text{CR}}{1 + g} \right)}{\text{WACC} - g} \right] \]

\[ = \text{Capital}_N + \frac{\text{Capital}_N(\text{EROIC}_N - \text{WACC})}{\text{WACC} - g} \]

\[ = \text{Capital}_N + \frac{\text{Capital}_N \left( \frac{\text{OP}_{N+1}}{\text{CR}_N} - \text{WACC} \right)}{\text{WACC} - g} \]

**CHAPTER 14**

Residual distribution = Net income − [(Target equity ratio)(Total capital budget)]

Number of shares repurchased = \( n_{\text{Prior}} - n_{\text{Post}} = \frac{\text{Cash}_{\text{Rep}}}{P_{\text{Prior}}} \)

\[ n_{\text{Post}} = n_{\text{Prior}} - \frac{\text{Cash}_{\text{Rep}}}{P_{\text{Prior}}} = n_{\text{Prior}} - \frac{\text{Cash}_{\text{Rep}}}{S_{\text{Prior}}/n_{\text{Prior}}} = n_{\text{Prior}} \left( 1 - \frac{\text{Cash}_{\text{Rep}}}{S_{\text{Prior}}} \right) \]

**CHAPTER 15**

\[ V_{op} = \sum_{t=1}^{\infty} \frac{\text{FCF}_t}{(1 + \text{WACC})^t} \]

\[ \text{WACC} = w_d(1 - T)r_d + w_s r_s \]

\[ \text{ROIC} = \frac{\text{NOPAT}}{\text{Capital}} = \frac{\text{EBIT}(1 - T)}{\text{Capital}} \]

\[ \text{EBIT} = PQ - VQ - F \]

\[ Q_{BE} = \frac{F}{P - V} \]

\[ V_L = D + S \]

MM, no taxes: \( V_L = V_U \)

MM, corporate taxes: \( V_L = V_U + TD \)

Miller, corporate and personal taxes: \( V_L = V_U + \left[ 1 - \frac{(1 - T_c)(1 - T_s)}{(1 - T_d)} \right] D \)

\[ b = b_U[1 + (1 - T)(D/S)] \]

\[ b_U = b/[1 + (1 - T)(D/S)] \]

\[ r_s = r_{RF} + RP_M(b) \]
\[ r_s = r_{RF} + \text{Premium for business risk} + \text{Premium for financial risk} \]

If \( g = 0 \):
\[ V_{op} = \frac{FCF}{WACC} = \frac{NOPAT}{WACC} = \frac{EBIT(1 - T)}{WACC} \]

Total corporate value = \( V_{op} \) + Value of short-term investments

\( S = \) Total corporate value – Value of all debt

\( D = w_d V_{op} \)

Cash raised by issuing debt = \( D - D_0 \)

\[ P_{Prior} = \frac{S_{Prior}}{n_{Prior}} \]

\[ P_{Post} = P_{Prior} \]

\[ n_{Post} = n_{Prior} \left[ \frac{V_{opNew} - D_{New}}{V_{opNew} - D_{Old}} \right] \]

\[ n_{Post} = n_{Prior} - \frac{(D_{New} - D_{Old})}{P_{Prior}} \]

\[ P_{Post} = \frac{V_{opNew} - D_{Old}}{n_{Prior}} \]

\[ NI = (EBIT - r_d D)(1 - T) \]

\[ EPS = \frac{NI}{n} \]

**CHAPTER 16**

Inventory conversion period = \( \frac{\text{Inventory}}{(\text{Cost of goods sold})/365} \)

Receivables collection period = DSO = \( \frac{\text{Receivables}}{\text{Sales}/365} \)

Payables deferral period = \( \frac{\text{Payables}}{(\text{Cost of goods sold})/365} \)

Cash conversion cycle = Inventory conversion + Average collection – Payables deferral period

Accounts receivable = Credit sales per day \( \times \) Length of collection period

\[ ADS = \frac{(\text{Units sold})(\text{Sales price})}{365} = \frac{\text{Annual sales}}{365} \]

Receivables = (ADS)(DSO)

Nominal annual cost of trade credit = \( \frac{\text{Discount percentage}}{100 - \text{Discount percentage}} \times \frac{365}{\text{Days credit is outstanding} - \text{Discount period}} \)
CHAPTER 17

Single-period interest rate parity:
- Forward exchange rate
- Spot exchange rate

\[ \text{Forward exchange rate} \cdot \frac{1 + r_h}{1 + r_f} \]

Expected t-year forward exchange rate

\[ \text{Expected t-year forward exchange rate} = (\text{Spot rate}) \left( \frac{1 + r_h}{1 + r_f} \right)^t \]

\[ P_h = (P_d)(\text{Spot rate}) \]

Spot rate \( \frac{P_h}{P_f} \)

CHAPTER 18

NAL = PV cost of owning − PV cost of leasing

CHAPTER 19

Price paid for bond with warrants

\[ \text{Price paid for bond with warrants} = \text{Straight-debt value of bond} + \text{Value of warrants} \]

Conversion price

\[ P_c = \frac{\text{Par value of bond given up}}{\text{Shares received}} = \frac{\text{Par value of bond given up}}{\text{Conversion ratio}} = \frac{\text{Par value of bond given up}}{P_c} \]

Conversion ratio

\[ \text{Conversion ratio} = CR = \frac{\text{Par value of bond given up}}{P_c} \]

CHAPTER 20

Amount left on table

\[ \text{Amount left on table} = (\text{Closing price} - \text{Offer price})(\text{Number of shares}) \]

CHAPTER 21

\[ r_{sL} = r_{sU} + (r_{sU} - r_d)(D/S) \]

\[ r_{sU} = w_s r_{sL} + w_d r_d \]

Tax savings = (Interest expense)(Tax rate)

Horizon value of unlevered firm

\[ \text{Horizon value of unlevered firm} = HV_{U,N} = \frac{\text{FCF}_{N+1}}{r_{sU} - g} = \frac{\text{FCF}_N(1 + g)}{r_{sU} - g} \]

Horizon value of tax shield

\[ \text{Horizon value of tax shield} = HV_{TS,N} = \frac{\text{TS}_{N+1}}{r_{sU} - g} = \frac{\text{TS}_N(1 + g)}{r_{sU} - g} \]

\[ V_{\text{Unlevered}} = \sum_{t=1}^{N} \frac{\text{FCF}_t}{(1 + r_{sU})^t} + \frac{HV_{U,N}}{(1 + r_{sU})^N} \]
\[ V_{\text{Tax shield}} = \sum_{t=1}^{N} \frac{TS_t}{(1 + r_{U})^t} + \frac{HV_{TS,N}}{(1 + r_{U})^N} \]

Value of operations: \[ V_{\text{op}} = V_{\text{Unlevered}} + V_{\text{Tax shield}} \]

FCFE = \[ \text{Free cash flow} - \text{After-tax interest expense} - \text{Principal payments} + \text{Newly issued debt} \]

FCFE = \[ \text{Net income} - \text{Net investment in operating capital} + \text{Net change in debt} \]

HV_{\text{FCFE,N}} = \frac{FCFE_{N+1}}{r_{L} - g} = \frac{FCFE_{N}(1 + g)}{r_{L} - g}

\[ V_{\text{FCFE}} = \sum_{t=1}^{N} \frac{FCFE_t}{(1 + r_{L})^t} + \frac{HV_{\text{FCFE,N}}}{(1 + r_{L})^N} \]

\[ S = V_{\text{FCFE}} + \text{Nonoperating assets} \]

\[ \frac{\text{Total value of shares to target shareholders}}{\text{Total post-merger value of equity}} = \frac{\text{Percent required by target stockholders}}{n_{\text{New}} + n_{\text{Old}}} \]

**Chapter 24**

\[ \hat{r}_p = w_A \hat{r}_A + (1 - w_A) \hat{r}_B \]

Portfolio SD: \[ \sigma_p = \sqrt{w_A^2 \sigma_A^2 + (1 - w_A)^2 \sigma_B^2 + 2w_A(1 - w_A)\rho_{AB}\sigma_A\sigma_B} \]

Minimum-risk portfolio: \[ w_A = \frac{\sigma_B(\sigma_B - \rho_{AB}\sigma_A)}{\sigma_A^2 + \sigma_B^2 - 2\rho_{AB}\sigma_A\sigma_B} \]

\[ \hat{r}_p = \sum_{i=1}^{N} (w_i \hat{r}_i) \]

\[ \sigma_p^2 = \sum_{i=1}^{N} \sum_{j=1}^{N} (w_i w_j \sigma_i \sigma_j \rho_{ij}) \]

\[ \sigma_p^2 = \sum_{i=1}^{N} w_i^2 \sigma_i^2 + \sum_{i=1}^{N} \sum_{j=i+1}^{N} w_i \sigma_i w_j \sigma_j \sigma_{ij} \]

\[ \sigma_p = \sqrt{(1 - w_{RF})^2 \sigma_M^2 + (1 - w_{RF})\sigma_M} \]

CML: \[ \hat{r}_p = r_{RF} + \left( \frac{\hat{r}_M - r_{RF}}{\sigma_M} \right) \sigma_p \]
\[ r_i = r_{RF} + \frac{(r_M - r_{RF})}{\sigma_M} (\frac{\text{Cov}(r_i, r_M)}{\sigma_M^2}) = r_{RF} + (r_M - r_{RF}) \left( \frac{\text{Cov}(r_i, r_M)}{\sigma_M^2} \right) \]

\[ b_i = \frac{\text{Covariance between Stock } i \text{ and the market}}{\text{Variance of market returns}} = \frac{\text{Cov}(r_i, r_M)}{\sigma_M^2} = \frac{\rho_{iM} \sigma_i \sigma_M}{\sigma_M^2} = \rho_{iM} \left( \frac{\sigma_i}{\sigma_M} \right) \]

SML: \[ r_i = r_{RF} + (r_M - r_{RF}) b_i = r_{RF} + (RPM_i) b_i \]

\[ \sigma_i^2 = b_i^2 \sigma_M^2 + \sigma_e^2 \]

APT: \[ r_i = r_{RF} + (r_1 - r_{RF}) b_{i1} + \cdots + (r_j - r_{RF}) b_{ij} \]

Fama-French: \[ r_i = r_{RF} + a_i + b_i(r_M - r_{RF}) + c_i(r_{SMB}) + d_i(r_{HML}) \]

**CHAPTER 25**

\[ CV = \frac{\sigma(\text{PV of future CF})}{E(\text{PV of future CF})} \]

Variance of project’s rate of return: \[ \sigma^2 = \frac{\ln(CV^2 + 1)}{t} \]

**CHAPTER 26**

MM, no taxes:

\[ V_L = V_U = \frac{\text{EBIT}}{\text{WACC}} = \frac{\text{EBIT}}{r_{sU}} \]

\[ r_{sL} = r_{sU} + \text{Risk premium} = r_{sU} + (r_{sU} - r_d)(D/S) \]

MM, corporate taxes:

\[ V_L = V_U + TD \]

\[ V_U = S = \frac{\text{EBIT} (1 - T)}{r_{sU}} \]

\[ r_{sL} = r_{sU} + (r_{sU} - r_d)(1 - T)(D/S) \]

Miller, personal taxes:

\[ V_U = \frac{\text{EBIT}(1 - T_c)}{r_{sU}} = \frac{\text{EBIT}(1 - T_c)(1 - T_s)}{r_{sU}(1 - T_s)} \]

\[ CF_L = (\text{EBIT} - I)(1 - T_c)(1 - T_s) + I(1 - T_d) \]

\[ V_L = V_U + \left[ 1 - \frac{(1 - T_c)(1 - T_s)}{1 - T_d} \right]D \]
Ehrhardt & Daves, impact of growth:

\[ V_U = \frac{FCF}{r_{SU} - g} \]

General case:

\[ V_L = V_U + V_{\text{Tax shield}} \]
\[ V_{\text{Tax shield}} = \frac{r_d TD}{r_{TS} - g} \]
\[ V_L = V_U + \left( \frac{r_d}{r_{TS} - g} \right) TD \]

Case for \( r_{TS} = r_{SU} \):

\[ V_L = V_U + \left( \frac{r_d TD}{r_{SU} - g} \right) \]

\[ r_{dL} = r_{SU} + (r_{SU} - r_d) \frac{D}{S} \]

\[ b = b_U + (b_U - b_D) \frac{D}{S} \]