CFA Level I Formula Sheet

147 formulas across 9 topics · July 2026 edition · interactive version with calculators at **cfa-practice-platform.pages.dev/cfa-level-1/formula-sheet**

Quantitative Methods

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Present value of a single sum

$$PV = \frac{FV}{(1+r)^n}$$

FV = future value · r = periodic discount rate · n = number of periods

Future value of an ordinary annuity

$$FV = PMT\left[\frac{(1+r)^n - 1}{r}\right]$$

PMT = payment each period · r = periodic rate · n = number of periods

Present value of an ordinary annuity

$$PV = PMT\left[\frac{1-(1+r)^{-n}}{r}\right]$$

PMT = payment each period · r = periodic discount rate · n = number of periods

Present value of a perpetuity

$$PV = \frac{PMT}{r}$$

PMT = constant periodic payment · r = discount rate

Holding period return

$$HPR = \frac{P_1 - P_0 + D_1}{P_0}$$

P0 = beginning price · P1 = ending price · D1 = cash distribution received

Sharpe ratio

$$S_p = \frac{R_p - R_f}{\sigma_p}$$

Rp = portfolio return · Rf = risk-free rate · sigma_p = portfolio standard deviation

Geometric mean return

$$R_G = \left[\prod_{i=1}^{n}(1+R_i)\right]^{1/n} - 1$$

R1, R2, R3 = periodic returns

Effective annual rate

$$EAR = \left(1 + \frac{r_{stated}}{m}\right)^m - 1$$

r_stated = stated annual rate · m = compounding periods per year

Continuous compounding

$$FV = PV\,e^{rT} \qquad EAR = e^r - 1$$

r = continuously compounded rate · T = years

Annuity due values

$$PV_{due} = PV_{ordinary} \times (1+r) \qquad FV_{due} = FV_{ordinary} \times (1+r)$$

r = periodic rate

Arithmetic mean

$$\bar{X} = \frac{1}{n}\sum_{i=1}^{n} X_i$$

X_i = observation · n = number of observations

Harmonic mean

$$\bar{X}_H = \frac{n}{\sum_{i=1}^{n}\frac{1}{X_i}}$$

X_i = observation (e.g. price paid per share) · n = count

Weighted mean

$$\bar{X}_w = \sum_{i=1}^{n} w_i X_i \qquad \sum w_i = 1$$

w_i = weight (portfolio share) · X_i = value (asset return)

Sample variance and standard deviation

$$s^2 = \frac{\sum_{i=1}^{n}(X_i - \bar{X})^2}{n-1} \qquad s = \sqrt{s^2}$$

X_i = observation · X-bar = sample mean · n - 1 = degrees of freedom

Coefficient of variation

$$CV = \frac{s}{\bar{X}}$$

s = standard deviation · X-bar = mean return

Target downside deviation

$$s_{target} = \sqrt{\frac{\sum_{X_i \le B}(X_i - B)^2}{n-1}}$$

B = target return · X_i <= B = only observations below target

Sample covariance

$$s_{XY} = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{n-1}$$

X_i, Y_i = paired observations

Correlation coefficient

$$\rho_{XY} = \frac{Cov(X,Y)}{\sigma_X\,\sigma_Y}$$

Cov(X,Y) = covariance · sigma = standard deviations

Expected value and variance of a random variable

$$E(X) = \sum p_i X_i \qquad \sigma^2 = \sum p_i\,[X_i - E(X)]^2$$

p_i = probability of scenario i · X_i = outcome in scenario i

Bayes' formula

$$P(A \mid B) = \frac{P(B \mid A)\,P(A)}{P(B)}$$

P(A) = prior probability · P(B|A) = likelihood of the new information · P(A|B) = updated (posterior) probability

Combinations and permutations

$${}_nC_r = \frac{n!}{(n-r)!\,r!} \qquad {}_nP_r = \frac{n!}{(n-r)!}$$

n = items available · r = items chosen

Standard error of the sample mean

$$s_{\bar{X}} = \frac{s}{\sqrt{n}}$$

s = sample standard deviation · n = sample size

Confidence interval for the mean

$$\bar{X} \pm z_{\alpha/2}\,\frac{\sigma}{\sqrt{n}}$$

z = 1.645 (90%), 1.96 (95%), 2.58 (99%) · sigma/sqrt(n) = standard error

t-test for a population mean

$$t = \frac{\bar{X} - \mu_0}{s/\sqrt{n}} \qquad df = n - 1$$

mu_0 = hypothesized mean · s = sample standard deviation · df = degrees of freedom

Time-weighted rate of return

$$r_{TW} = \left[(1+r_1)(1+r_2)\cdots(1+r_n)\right]^{1/n} - 1$$

r_i = holding-period return between cash-flow dates

Economics

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GDP expenditure approach

$$GDP = C + I + G + (X - M)$$

C = consumption · I = investment · G = government spending · X - M = net exports

Money multiplier

$$m = \frac{1}{\text{reserve requirement}}$$

Reserve requirement = required reserve ratio

Fisher relation

$$r_{nominal} = (1 + r_{real})(1 + \pi) - 1$$

real rate = required real return · inflation = expected inflation

Price elasticity of demand

$$E_d = \frac{\%\Delta Q_d}{\%\Delta P}$$

% change in quantity demanded · % change in price

Cross-price elasticity of demand

$$E_{cross} = \frac{\%\Delta Q_d^A}{\%\Delta P^B}$$

Positive = substitutes · Negative = complements

Income elasticity of demand

$$E_I = \frac{\%\Delta Q_d}{\%\Delta I}$$

Positive = normal good · Negative = inferior good

GDP deflator

$$\text{Deflator} = \frac{\text{Nominal GDP}}{\text{Real GDP}} \times 100$$

Nominal GDP = current prices · Real GDP = base-year prices

Quantity theory of money

$$M\,V = P\,Y$$

M = money supply · V = velocity · P = price level · Y = real output

Fiscal multiplier

$$\text{Multiplier} = \frac{1}{1 - MPC(1-t)}$$

MPC = marginal propensity to consume · t = tax rate

Unemployment and participation rates

$$u = \frac{\text{unemployed}}{\text{labor force}} \qquad LFPR = \frac{\text{labor force}}{\text{working-age population}}$$

Labor force = employed + actively seeking

Covered interest rate parity (forward rate)

$$F_{f/d} = S_{f/d} \times \frac{1+r_f}{1+r_d}$$

S, F = spot and forward (price/base) · r_f, r_d = interest rates of price and base currencies

Real exchange rate

$$\text{Real } S_{f/d} = S_{f/d} \times \frac{P_d}{P_f}$$

S = nominal exchange rate · P = price levels

Currency cross rate

$$\frac{A}{C} = \frac{A}{B} \times \frac{B}{C}$$

A/B, B/C = quoted pairs sharing currency B

Growth accounting equation

$$\Delta Y \approx \Delta A + \alpha\,\Delta K + (1-\alpha)\,\Delta L$$

Delta A = total factor productivity growth · alpha = capital's share of income

Saving-investment identity

$$S = I + (G - T) + (X - M)$$

G - T = government deficit · X - M = net exports

Corporate Issuers

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Weighted average cost of capital

$$WACC = w_d r_d(1-t) + w_p r_p + w_e r_e$$

wd, wp, we = capital weights · rd, rp, re = component costs · t = tax rate

Free cash flow to the firm

$$FCFF = NI + NCC + Int(1-t) - WCInv - FCInv$$

NI = net income · NCC = non-cash charges · Int = interest expense · t = tax rate · WCInv and FCInv = reinvestment

Degree of operating leverage

$$DOL = \frac{Q(P-V)}{Q(P-V)-F}$$

Q = units sold · P = price · V = variable cost per unit · F = fixed operating costs

Degree of financial leverage

$$DFL = \frac{EBIT}{EBIT - Int}$$

EBIT = earnings before interest and taxes · interest = fixed financing cost

Cost of preferred stock

$$r_p = \frac{D_p}{P_p}$$

D_p = fixed preferred dividend · P_p = current preferred price

After-tax cost of debt

$$r_{d,\,after\text{-}tax} = r_d(1-t)$$

r_d = yield on new debt · t = marginal tax rate

Bond yield plus risk premium

$$r_e = r_d + \text{risk premium}$$

r_d = yield on the firm's long-term debt · premium typically 3-5%

Net present value

$$NPV = \sum_{t=0}^{n} \frac{CF_t}{(1+r)^t}$$

CF_t = cash flow at time t (CF_0 usually negative) · r = required return

Internal rate of return

$$\sum_{t=0}^{n} \frac{CF_t}{(1+IRR)^t} = 0$$

CF_t = project cash flows

Payout and retention ratios

$$\text{Payout} = \frac{\text{Dividends}}{NI} \qquad b = 1 - \text{Payout}$$

b = retention (plowback) ratio

Breakeven quantities

$$Q_{OBE} = \frac{F}{P-V} \qquad Q_{BE} = \frac{F+Int}{P-V}$$

F = fixed operating costs · Int = fixed financing costs · P - V = contribution margin per unit

Return on invested capital

$$ROIC = \frac{NOPAT}{\text{Average invested capital}}$$

NOPAT = EBIT x (1 - t) · Invested capital = debt + equity

Net working capital

$$NWC = \text{Current assets} - \text{Current liabilities}$$

Excludes cash in some liquidity-management contexts

Degree of total leverage

$$DTL = DOL \times DFL = \frac{Q(P-V)}{Q(P-V) - F - Int}$$

DOL = operating leverage · DFL = financial leverage

Financial Statement Analysis

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Current ratio

$$\text{Current ratio} = \frac{\text{current assets}}{\text{current liabilities}}$$

Current assets · Current liabilities

Days sales outstanding

$$DSO = \frac{365}{\text{receivables turnover}}$$

Receivables turnover = revenue / average receivables

Inventory turnover

$$\text{Inventory turnover} = \frac{COGS}{\text{average inventory}}$$

COGS = cost of goods sold · average inventory

Three-factor DuPont ROE

$$ROE = \frac{NI}{\text{Sales}} \times \frac{\text{Sales}}{\text{Assets}} \times \frac{\text{Assets}}{\text{Equity}}$$

Net profit margin = NI / sales · Asset turnover = sales / assets · Financial leverage = assets / equity

Cash flow interest coverage

$$\text{Coverage} = \frac{CFO + \text{Int paid} + \text{Tax paid}}{\text{Int paid}}$$

CFO = cash flow from operations · interest paid · taxes paid

Quick ratio

$$\text{Quick ratio} = \frac{\text{Cash} + \text{ST investments} + \text{Receivables}}{\text{Current liabilities}}$$

Excludes inventory and prepaid items

Cash ratio

$$\text{Cash ratio} = \frac{\text{Cash} + \text{ST investments}}{\text{Current liabilities}}$$

The most conservative liquidity measure

Receivables turnover

$$\text{Receivables turnover} = \frac{\text{Revenue}}{\text{Average receivables}}$$

Higher = faster collection

Payables turnover and days payable

$$\text{Payables turnover} = \frac{\text{Purchases}}{\text{Average payables}} \qquad DPO = \frac{365}{\text{turnover}}$$

Purchases = COGS + increase in inventory

Days of inventory on hand

$$DOH = \frac{365}{\text{Inventory turnover}}$$

Inventory turnover = COGS / average inventory

Asset turnover ratios

$$\text{Total asset turnover} = \frac{\text{Revenue}}{\text{Average total assets}}$$

Fixed-asset turnover uses average net PP&E · Working-capital turnover uses average working capital

Cash conversion cycle

$$CCC = DOH + DSO - DPO$$

DOH = days inventory · DSO = days receivable · DPO = days payable

Profitability margins

$$\text{Gross} = \frac{\text{Gross profit}}{\text{Rev}} \quad \text{Operating} = \frac{EBIT}{\text{Rev}} \quad \text{Net} = \frac{NI}{\text{Rev}}$$

Each margin isolates one cost layer

Return on assets

$$ROA = \frac{NI}{\text{Average total assets}}$$

Operating ROA uses EBIT in the numerator

Solvency ratios

$$\frac{\text{Debt}}{\text{Equity}} \qquad \frac{\text{Debt}}{\text{Capital}} \qquad \frac{\text{Avg assets}}{\text{Avg equity}}$$

Debt = interest-bearing obligations · Capital = debt + equity

Interest coverage

$$\text{Interest coverage} = \frac{EBIT}{\text{Interest payments}}$$

EBITDA coverage variant uses EBITDA

Five-factor DuPont ROE

$$ROE = \frac{NI}{EBT} \times \frac{EBT}{EBIT} \times \frac{EBIT}{\text{Rev}} \times \frac{\text{Rev}}{\text{Assets}} \times \frac{\text{Assets}}{\text{Equity}}$$

Tax burden = NI/EBT · Interest burden = EBT/EBIT

Basic earnings per share

$$EPS = \frac{NI - \text{Preferred dividends}}{\text{Weighted average shares outstanding}}$$

Weighted shares reflect issuance and buyback timing

Diluted EPS (if-converted)

$$\text{Diluted } EPS = \frac{NI - D_{pref} + D_{conv\,pref} + Int_{conv}(1-t)}{\text{WAS} + \text{new shares from conversion}}$$

Treasury-stock method handles options/warrants

LIFO to FIFO conversion

$$Inv_{FIFO} = Inv_{LIFO} + \text{LIFO reserve} \qquad COGS_{FIFO} = COGS_{LIFO} - \Delta\text{LIFO reserve}$$

LIFO reserve = disclosed difference between methods

Inventory flow identity

$$\text{Ending inventory} = \text{Beginning} + \text{Purchases} - COGS$$

Rearrange to solve for any missing piece

Effective tax rate

$$\text{Effective tax rate} = \frac{\text{Income tax expense}}{\text{Pre-tax income}}$$

Differs from statutory rate via permanent differences

FCFE from FCFF

$$FCFE = FCFF - Int(1 - t) + \text{Net borrowing}$$

Net borrowing = debt issued - debt repaid

Equity Investments

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Gordon growth model

$$V_0 = \frac{D_1}{r - g}$$

D1 = next dividend · r = required return · g = constant growth rate

Sustainable growth rate

$$g = b \times ROE$$

Retention ratio = 1 - dividend payout ratio · ROE = return on equity

Justified leading P/E

$$\frac{P_0}{E_1} = \frac{1 - b}{r - g}$$

Payout ratio = dividends / earnings · r = required return · g = sustainable growth

Residual income

$$RI = NI - r \times B_0$$

NI = net income · r = required return on equity · Beginning book value

Enterprise value

$$EV = \text{Mkt cap} + \text{Debt} + \text{Pref} - \text{Cash}$$

Market cap · debt · preferred stock · cash and equivalents

Preferred stock valuation

$$V_0 = \frac{D_p}{r}$$

D_p = fixed perpetual dividend · r = required return

Two-stage dividend discount model

$$V_0 = \sum_{t=1}^{n} \frac{D_t}{(1 + r)^t} + \frac{1}{(1 + r)^n} \cdot \frac{D_{n+1}}{r - g_L}$$

g_L = long-run growth in stage two · D_n+1 = first stable-stage dividend

Justified trailing P/E

$$\frac{P_0}{E_0} = \frac{(1 - b)(1 + g)}{r - g}$$

b = retention ratio · g = sustainable growth

Price multiple definitions

$$\frac{P}{B} = \frac{\text{Price}}{\text{Book value/share}} \qquad \frac{P}{S}, \frac{P}{CF} \text{ analogous}$$

Book value = common equity · Sales and CF are usually trailing

EV / EBITDA

$$\frac{EV}{EBITDA} = \frac{\text{Mkt cap} + \text{Debt} + \text{Pref} - \text{Cash}}{EBITDA}$$

Capital-structure neutral, useful across leverage levels

Price-weighted index

$$\text{Index} = \frac{\sum_i P_i}{\text{Divisor}}$$

Divisor adjusts for splits and membership changes

Margin call price

$$P_{call} = P_0 \times \frac{1 - \text{initial margin}}{1 - \text{maintenance margin}}$$

Initial margin = equity at purchase · Maintenance margin = minimum equity

FCFE valuation model

$$V_0 = \frac{FCFE_1}{r - g}$$

FCFE = free cash flow to equity · r = required equity return

Leveraged position return

$$R_{levered} = \frac{R_{asset}}{\text{margin fraction}} \text{ (ignoring costs)}$$

Margin fraction = equity / position value · Leverage ratio = 1 / margin

Herfindahl-Hirschman index

$$HHI = \sum_{i=1}^{n} s_i^2$$

s_i = market share of firm i (as decimal or percent)

Annual coupon bond price

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

coupon = annual coupon payment · y = yield to maturity · n = years · face = par value

Current yield

$$\text{Current yield} = \frac{\text{annual coupon}}{\text{price}}$$

Annual coupon · bond price

Modified duration

$$ModDur = \frac{MacDur}{1+y}$$

Macaulay duration · yield per period

Price value of a basis point

$$PVBP = ModDur \times P \times 0.0001$$

Modified duration · full price

Effective duration

$$EffDur = \frac{P_{-} - P_{+}}{2\,P_0\,\Delta y}$$

P- = price if yields fall · P+ = price if yields rise · P0 = initial price · delta y = yield shock

Zero-coupon bond price

$$P = \frac{F}{(1+\frac{y}{2})^{2n}}$$

F = face value · y = annual yield · n = years

Money duration

$$MoneyDur = ModDur \times P_{full}$$

P_full = full (dirty) price including accrued interest

Approximate convexity

$$Conv \approx \frac{P_{-} + P_{+} - 2P_0}{P_0\,(\Delta y)^2}$$

P-, P+ = reprices after down/up yield shocks

Price change with duration and convexity

$$\frac{\Delta P}{P} \approx -ModDur\,\Delta y + \tfrac{1}{2}\,Conv\,(\Delta y)^2$$

Delta y = change in yield (decimal)

Macaulay duration

$$MacDur = \frac{\sum_t t \cdot PV(CF_t)}{\sum_t PV(CF_t)}$$

t = time of each cash flow · PV(CF) = discounted cash flow

Implied forward rate from spot rates

$$(1+z_2)^2 = (1+z_1)(1+f_{1,1})$$

z = spot (zero) rates · f_1,1 = one-year rate one year forward

Yield spread measures

$$\text{G-spread} = y_{corp} - y_{govt} \qquad \text{Z-spread: constant add-on to eac}$$

OAS = Z-spread - option value

Bond equivalent yield

$$BEY = 2 \times y_{semiannual}$$

y_semiannual = yield per six-month period

Accrued interest and full price

$$AI = C_{period} \times \frac{t}{T} \qquad P_{full} = P_{flat} + AI$$

t/T = fraction of period elapsed · Flat (clean) price is what gets quoted

Floating-rate note margins

$$\text{Quoted margin vs. required margin} \Rightarrow \text{price vs. par}$$

Quoted margin = contractual spread over the reference rate · Required margin = market-demanded spread

Expected credit loss

$$\text{Expected loss} = PD \times LGD$$

LGD = 1 - recovery rate, times exposure

Holding period return of a bond

$$HPR = \frac{\text{Coupons} + \text{Reinvestment income} + P_{sell} - P_{buy}}{P_{buy}}$$

Three sources: coupons, reinvestment, price change

Derivatives

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Forward contract price

$$F_0 = S_0(1+r)^T$$

S0 = spot price · r = risk-free rate · T = time to expiration

Long call payoff at expiration

$$\text{Payoff} = \max(S_T - X,\, 0)$$

ST = underlying price at expiration · X = exercise price

Put-call parity implied call price

$$c = p + S_0 - \frac{X}{(1+r)^T}$$

c = call price · p = put price · S0 = spot price · X = exercise price · r = risk-free rate · T = time

Long put payoff at expiration

$$\text{Payoff} = \max(X - S_T,\, 0)$$

ST = underlying price at expiration · X = exercise price

Forward price with costs and benefits

$$F_0 = [S_0 - PV(\text{benefits}) + PV(\text{costs})]\,(1+r)^T$$

Benefits = dividends, coupons, convenience yield · Costs = storage, insurance

FRA settlement value

$$\text{Payoff} = \frac{NP \times (\text{rate}_{mkt} - \text{rate}_{FRA}) \times \frac{days}{360}}{1 + \text{rate}_{mkt} \times \frac{days}{360}}$$

NP = notional principal · Settlement is discounted because it pays at period start

Put-call-forward parity

$$c - p = \frac{F_0 - X}{(1+r)^T}$$

F_0 = forward price for the same expiry

Risk-neutral probability (binomial)

$$\pi = \frac{1 + r - d}{u - d}$$

u, d = up and down gross moves · r = periodic risk-free rate

Option profit and breakevens

$$\Pi_{call} = \max(S_T - X, 0) - c_0 \qquad BE_{call} = X + c_0,\;\; BE_{put} =$$

c0, p0 = premiums paid

Futures daily settlement

$$\text{Daily gain/loss} = (f_t - f_{t-1}) \times \text{multiplier} \times \text{contracts}$$

Gains credit the margin account daily

Covered call and protective put

$$\text{Covered call} = S - c \qquad \text{Protective put} = S + p$$

Covered call caps upside for income · Protective put floors downside for a premium

Swap as combined bonds

$$V_{payer\ fixed} = V_{floating\,bond} - V_{fixed\,bond}$$

At initiation both legs are priced to equal value

Alternative Investments

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NAV per share

$$NAV = \frac{\text{assets} - \text{liabilities}}{\text{shares outstanding}}$$

Assets · liabilities · shares outstanding

Loan-to-value ratio

$$LTV = \frac{\text{loan amount}}{\text{property value}}$$

Loan amount · property value

Capitalization rate valuation

$$V = \frac{NOI}{\text{cap rate}}$$

NOI = stabilized net operating income · cap rate = market capitalization rate

Debt service coverage ratio

$$DSCR = \frac{NOI}{\text{debt service}}$$

NOI = net operating income · debt service = principal plus interest due

Hedge fund fee structure (2 and 20)

$$\text{Total fee} = \text{AUM} \times m + \max\left[0,\ (\text{gain} - \text{hurdle}) \times i\right]$$

m = management fee (e.g. 2%) · i = incentive fee (e.g. 20%) · Hurdle and high-water mark limit incentive fees

Private equity carried interest

$$\text{Carry} = 20\% \times (\text{exit value} - \text{committed capital}) \text{ above hurdl}$$

Typical structure: 20% carry over an 8% hurdle · Distribution waterfall sets the order

Net operating income

$$NOI = \text{Rental income} - \text{Operating expenses (excl. financing}$$

Vacancy and collection losses reduce effective income

Commodity futures return decomposition

$$R_{total} = R_{spot} + R_{roll} + R_{collateral}$$

Roll yield positive in backwardation, negative in contango

Contango and backwardation

$$F > S \Rightarrow \text{contango} \qquad F < S \Rightarrow \text{backwardation}$$

Driven by storage costs vs. convenience yield

Fund-of-funds fee layering

$$\text{Net return} = [(R_{gross} - \text{fees}_{underlying})] - \text{fees}_{FoF}$$

A second 1-and-10 layer is common

Levered real estate return

$$R_{equity} = \frac{NOI - \text{debt service} + \Delta V}{\text{Equity invested}}$$

Delta V = property appreciation

Portfolio Management

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CAPM expected return

$$E(R_i) = R_f + \beta_i\left[E(R_m) - R_f\right]$$

Rf = risk-free rate · beta_i = systematic risk · E(Rm) - Rf = market risk premium

Capital Market Line

$$E(R_p) = R_f + \frac{E(R_m) - R_f}{\sigma_m}\sigma_p$$

Rf = risk-free rate · E(Rm) = market return · sigma_m = market risk · sigma_p = portfolio risk

Two-asset portfolio expected return

$$E(R_p) = w_1 R_1 + (1 - w_1) R_2$$

w1 = weight in asset 1 · R1 and R2 = expected asset returns

Two-asset portfolio standard deviation

$$\sigma_p = \sqrt{w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1 w_2 \rho_{12}\sigma_1\sigma_2}$$

w1 and w2 = asset weights · sigma1 and sigma2 = asset standard deviations · rho = correlation

Treynor ratio

$$T_p = \frac{R_p - R_f}{\beta_p}$$

Rp = portfolio return · Rf = risk-free rate · beta_p = portfolio beta

Jensen's alpha

$$\alpha_p = R_p - [R_f + \beta_p(R_m - R_f)]$$

The bracketed term is the SML benchmark

M-squared (Modigliani) measure

$$M^2 = R_f + S_p\,\sigma_m$$

S_p = portfolio Sharpe ratio · sigma_m = market standard deviation

Information ratio

$$IR = \frac{R_p - R_b}{\sigma_{(R_p - R_b)}}$$

R_b = benchmark return · Denominator = std. dev. of active returns

Beta from covariance

$$\beta_i = \frac{Cov(R_i, R_m)}{\sigma_m^2} = \rho_{i,m}\frac{\sigma_i}{\sigma_m}$$

Both forms appear on the exam

Total risk decomposition

$$\sigma_i^2 = \beta_i^2 \sigma_m^2 + \sigma_\varepsilon^2$$

beta^2 x sigma_m^2 = systematic part · sigma_e^2 = firm-specific part

Roy's safety-first ratio

$$SF = \frac{E(R_p) - R_L}{\sigma_p}$$

R_L = minimum acceptable (threshold) return

Investor utility function

$$U = E(R) - \tfrac{1}{2} A\,\sigma^2$$

A = risk-aversion coefficient (higher = more averse)

Tracking error

$$TE = \sigma_{(R_p - R_b)}$$

Also called active risk

Capital allocation line

$$E(R_c) = R_f + \frac{E(R_p) - R_f}{\sigma_p}\,\sigma_c$$

The slope is the risky portfolio's Sharpe ratio

Value at risk (VaR)

$$5\%\ VaR = -(\mu - 1.65\,\sigma) \times \text{portfolio value}$$

VaR is a minimum loss at a given probability over a horizon
