PROFESSIONAL CAREER CLUB

FREE CERTIFICATION PREP

FORMULA SHEET

CFA Level I

Chartered Financial Analyst · Complete formula reference

92 formulas **9** subject areas

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HOW TO USE THIS SHEET

This sheet covers every quantitative relationship you are expected to know at Level I, grouped the way the exam groups them. It is a revision tool, not a substitute for the curriculum — use it after you have learned a topic, to compress it.

Read it actively. Cover the formula, read the name, and write the formula from memory. If you cannot, that topic is not revised. Level I punishes recall gaps far more than it punishes conceptual gaps.

The ▸ notes are the things that actually cost marks: sign conventions, which denominator, when a formula does not apply. Those are the traps the item set writers reach for.

Suggested rhythm: one section per sitting, then 20 practice questions from that section on the Professional Career Club question bank before you move on.

QUANTITATIVE METHODS · 14 formulas

The plumbing for everything else. If time value of money is shaky, fixed income and equity will both feel harder than they are.

Present value (single sum)

```
PV = FV / (1 + r)^n
```

Where: r = periodic rate, n = number of periods.

▸ *Match r and n to the same period. A 12% annual rate compounded quarterly means r = 3% and n = 4 per year — this single slip causes more wrong answers than any concept.*

Future value of an ordinary annuity

```
FV = PMT × [ ((1 + r)^n − 1) / r ]
```

Where: PMT = level payment at the end of each period.

▸ *For an annuity due (payments at the start), multiply the ordinary-annuity answer by (1 + r).*

Present value of an ordinary annuity

```
PV = PMT × [ (1 − (1 + r)^-n) / r ]
```

Where: PMT = level payment, r = discount rate per period.

▸ *This is the mortgage / bond-coupon workhorse. Recognise it whenever a question gives you equal payments over a fixed horizon.*

Present value of a perpetuity

```
PV = PMT / r
```

Where: PMT = level payment forever.

▸ *The base case for the Gordon growth model — swap r for (r − g) and you have a growing perpetuity.*

Population variance

$$\sigma^2 = \Sigma(X_i - \mu)^2 / N$$

Where: μ = population mean, N = population size.

▸ *Divides by N, not N − 1. The exam will hand you a population and hope you reach for the sample formula.*

Sample variance

$$s^2 = \Sigma(X_i - \bar{X})^2 / (n - 1)$$

Where: $\bar{X}$ = sample mean, n = sample size.

▸ *The (n − 1) is Bessel's correction — it removes downward bias. Sample formula ⇒ n − 1, always.*

Sharpe ratio

$$S_p = (R_p - R_f) / \sigma_p$$

Where: σ_p = total standard deviation of the portfolio.

▸ *Uses total risk. Meaningless (and misleading) when excess return is negative — a rare but favourite Level I trap.*

Holding period return

$$HPR = (P_1 - P_0 + D_1) / P_0$$

Where: D_1 = any cash distribution received during the period.

- *Do not drop the dividend. Price return and total return differ by exactly D_1 / P_0.*

Bayes' theorem

$$P(A|B) = P(B|A) \times P(A) / P(B)$$
$$P(B) = P(B|A)P(A) + P(B|A^c)P(A^c)$$

Where: P(A) = prior, P(A|B) = updated (posterior) probability.

- *Build the denominator with the total-probability rule first. Nine out of ten Bayes errors are a wrong denominator, not a wrong idea.*

Correlation coefficient

$$\rho(X,Y) = Cov(X,Y) / (\sigma_X \times \sigma_Y)$$

Where: Bounded between −1 and +1, unitless.

- *Correlation is linear association only. A perfect non-linear relationship can still show ρ near zero.*

Geometric mean return

$$R_G = [\ \Pi(1 + R_t)\ ]^{(1/n)} - 1$$

Where: Compounded average over n periods.

- *Geometric ≤ arithmetic, always, and the gap widens with volatility. Use geometric to describe past performance, arithmetic to forecast a single future period.*

Money-weighted return (IRR)

$$\Sigma\ CF_t / (1 + r)^t = 0$$

Where: Outflows negative, inflows positive, t = 0 … N.

- *Sensitive to the timing and size of client cash flows, so it measures the investor. Time-weighted measures the manager — that is the distinction the exam tests.*

Time-weighted return

$$(1 + TWR) = \Pi(1 + r_i)$$

Where: r_i = sub-period return between external cash flows.

- *GIPS-preferred because it strips out cash-flow timing the manager does not control.*

Fisher relation (exact)

$$(1 + R_{nominal}) = (1 + R_{real})(1 + i)$$

Where: i = inflation rate.

- *Approximate form R_nom ≈ R_real + i is fine for small numbers. In high-inflation questions (think emerging markets) use the exact multiplicative form.*

EXAM TIPS — QUANTITATIVE METHODS

- TVM questions are calculator questions. Know your BA II Plus cold — clear TVM between problems (2ND → CLR TVM) or the previous question will contaminate the next.
- Sign convention: outflows negative, inflows positive. If the calculator gives you a nonsense answer, this is the first thing to check.
- Learn the difference between money-weighted and time-weighted as a sentence, not a formula: "MWR judges the investor, TWR judges the manager."

ECONOMICS · 6 formulas

Low weight, high certainty. These few relationships come up almost verbatim.

GDP — expenditure approach

```
GDP = C + I + G + (X − M)
```

Where: C = consumption, I = investment, G = government spending, X − M = net exports.

▸ *Imports are subtracted because they were already counted inside C, I and G — they are not domestic output.*

Money multiplier

```
m = 1 / reserve requirement
Δ Money supply = m × Δ Reserves
```

Where: Maximum deposit expansion from a given reserve injection.

▸ *It is a ceiling, not a prediction — leakage into cash holdings and excess reserves means the real-world multiplier is smaller.*

Fisher effect

```
(1 + r_nom) = (1 + r_real)(1 + π)
r_nom ≈ r_real + π
```

Where: π = expected inflation.

▸ *Expected inflation, not realised. Unexpected inflation is what transfers wealth from lenders to borrowers.*

Breakeven and shutdown points

```
Breakeven:  P = ATC
Shutdown (short run):  P < AVC
```

Where: ATC = average total cost, AVC = average variable cost.

▸ *If AVC < P < ATC, keep operating in the short run — you are losing money, but the contribution still covers part of the fixed cost. Shutting down loses more.*

Price elasticity of demand

```
E_d = %ΔQ_d / %ΔP
```

Where: Sign is negative; the exam usually asks about the absolute value.

▸ *|E_d| > 1 elastic ⇒ cutting price raises revenue. |E_d| < 1 inelastic ⇒ cutting price lowers revenue. |E_d| = 1 ⇒ revenue is maximised.*

Cross-rate calculation

```
A/C = (A/B) × (B/C)
```

Where: Chain quoted rates so the middle currency cancels.

▸ *With bid–ask spreads, you always transact on the side that is worse for you. Take the bid on one leg and the ask on the other, then sanity-check that the dealer profits.*

EXAM TIPS — ECONOMICS

- Write the currency units next to every number in an FX question. Rates are quoted price/base, and inverting them is the single most common exchange-rate error.
- Elasticity, breakeven and shutdown are near-guaranteed marks. Do not let a low topic weight persuade you to skip them.

CORPORATE ISSUERS · 6 formulas

Cost of capital and leverage. The two leverage measures are almost always tested as a pair.

Weighted average cost of capital

```
WACC = w_d·r_d·(1 − t) + w_p·r_p + w_e·r_e
```

Where: Weights are market-value based, not book-value based.

▸ *Only debt gets the (1 − t) shield — preferred dividends are not tax-deductible. Using book weights is the classic distractor.*

Free cash flow to the firm (from net income)

```
FCFF = NI + NCC + Int(1 − t) − ΔWC − CapEx
```

Where: NCC = non-cash charges, Int = interest expense.

▸ *Interest is added back after tax because FCFF is pre-financing — it belongs to debt and equity holders together.*

Free cash flow to equity

```
FCFE = FCFF − Int(1 − t) + ΔDebt
```

Where: ΔDebt = net new borrowing.

▸ *Going from FCFF to FCFE, you strip out what the lenders take and add back what they lend. Get the sign of ΔDebt right: net borrowing is positive.*

Degree of operating leverage

```
DOL = Q(P − V) / [Q(P − V) − F] = Contribution margin / EBIT
```

Where: Q = units, P = price, V = variable cost per unit, F = fixed costs.

▸ *Driven by fixed costs. High fixed-cost businesses (airlines, semiconductors) have violent DOL.*

Degree of financial leverage

```
DFL = EBIT / (EBIT − I)
```

Where: I = interest expense.

▸ *The % change in EPS for a 1% change in EBIT. Driven by debt, not by the cost structure.*

Degree of total leverage

```
DTL = DOL × DFL = Q(P − V) / [Q(P − V) − F − I]
```

Where: Combined sensitivity of EPS to a 1% change in sales.

▸ *Note it multiplies, not adds. Total leverage compounds — this is why levered, fixed-cost businesses blow up in downturns.*

EXAM TIPS — CORPORATE ISSUERS

- DOL and DFL are evaluated at a specific output level. Change Q and the ratio changes — the exam loves asking you to recompute after a sales shift.
- When a question gives you both book and market values of debt and equity, it is testing whether you know WACC uses market weights.

FINANCIAL STATEMENT ANALYSIS · 8 formulas

Ratio mechanics. Learn which averages go in the denominator — that is where the marks hide.

Return on equity (3-factor DuPont)

```
ROE = (NI / Sales) × (Sales / Assets) × (Assets / Equity)
```

Where: Net profit margin × asset turnover × financial leverage.

▸ *This is the decomposition that lets you say why ROE moved. A rising ROE driven purely by the leverage term is a warning, not an achievement.*

Return on equity (2-factor)

```
ROE = Net income / Average total equity
```

Where: Average of opening and closing equity.

▸ *Stock (balance sheet) over flow (income statement) ⇒ average the stock. Applies to ROA and every turnover ratio too.*

Return on assets

```
ROA = Net income / Average total assets
ROA = Net profit margin × Asset turnover
```

Where: Measures how efficiently the whole asset base generates profit.

▸ *Some texts add back after-tax interest to the numerator so the measure is capital-structure neutral. Read the question stem for which version it wants.*

Current ratio

```
Current ratio = Current assets / Current liabilities
```

Where: Short-term liquidity coverage.

▸ *A high current ratio can mean bloated inventory or uncollected receivables. Quick ratio strips inventory out for exactly this reason.*

Inventory turnover and days on hand

```
Inventory turnover = COGS / Average inventory
DOH = 365 / Inventory turnover
```

Where: COGS, not revenue — inventory is carried at cost.

▸ *Using sales in the numerator is the standard distractor. If turnover collapses, inventory is piling up: obsolescence risk.*

Receivables turnover and DSO

```
Receivables turnover = Revenue / Average receivables
DSO = 365 / Receivables turnover
```

Where: DSO = average collection period in days.

▸ *Revenue here, cost there. Rising DSO with flat sales means the company is buying growth with looser credit terms.*

Cash flow interest coverage

```
Coverage = (CFO + Interest paid + Tax paid) / Interest paid
```

Where: CFO = cash flow from operations.

▸ *Add interest and tax back because they were already deducted in arriving at CFO. Cash-based coverage is harder to manipulate than EBIT-based coverage.*

Cash return on assets

```
Cash ROA = CFO / Average total assets
```

Where: Cash-based counterpart to ROA.

▸ *When accrual ROA is healthy but cash ROA is not, earnings quality is the story — that gap is the whole point of the ratio.*

EXAM TIPS — FINANCIAL STATEMENT ANALYSIS

- Rule of thumb: income-statement item over balance-sheet item ⇒ average the balance-sheet item.
- Sustainable growth ties FSA to equity: g = b × ROE. Expect it to appear in an equity valuation question, not an FSA one.
- For ratio comparisons across firms, check the accounting policies first (LIFO vs FIFO, capitalising vs expensing). A ratio difference may be an accounting difference.

EQUITY INVESTMENTS · 21 formulas

The largest formula block at Level I. Dividend discount, multiples and market mechanics.

Gordon growth model

$$V_0 = D_1 / (r - g) = D_0(1 + g) / (r - g)$$

Where: D_1 = next year's dividend, g = constant growth rate.

▸ *Requires r > g, and requires g to be genuinely perpetual. If the question hands you D_0, you must grow it one period first.*

Justified leading P/E

$$P_0 / E_1 = (1 - b) / (r - g)$$

Where: b = retention ratio, so (1 − b) = payout ratio.

▸ *Leading uses (1 − b); trailing uses (1 − b)(1 + g). Mixing them up is the single most common equity error at Level I.*

Justified trailing P/E

$$P_0 / E_0 = (1 - b)(1 + g) / (r - g)$$

Where: Uses last year's realised earnings.

- *The extra (1 + g) is what turns E_0 into E_1. Derive it from the leading version instead of memorising both.*

P/E ratio (trailing and leading)

$$\text{Trailing: } P_0 / EPS_0 \quad \text{(last 12 months)}$$
$$\text{Leading: } P_0 / EPS_1 \quad \text{(next 12 months)}$$

Where: EPS_0 = realised, EPS_1 = forecast.

- *Leading P/E is forward-looking and preferred for valuation; trailing is observable and preferred for screening.*

Sustainable growth rate

$$g = b \times ROE$$

Where: b = retention rate = 1 − payout ratio.

- *The growth a firm can fund internally without issuing new equity or changing leverage. Growth above this requires external financing.*

Enterprise value

$$EV = \text{Market cap} + \text{Debt} + \text{Preferred} - \text{Cash}$$
$$EV / EBITDA = \text{enterprise value multiple}$$

Where: Cash is subtracted because an acquirer gets it back.

- *EV/EBITDA is capital-structure neutral, which is why it beats P/E when comparing firms with different leverage.*

Equity value per share from enterprise value

$$P_0 = (EV - \text{Debt} + \text{Cash}) / \text{Diluted shares}$$

Where: Reverses the EV bridge back to equity.

- *Diluted shares, not basic. Options and convertibles are real claims on the equity.*

Price-to-book

$$P/B = \text{Market price per share} / \text{Book value per share}$$
$$\text{Justified } P/B = (ROE - g) / (r - g)$$

Where: Book value = common equity, excluding preferred.

- *P/B > 1 whenever ROE > r — the firm earns more than its cost of equity. That equivalence is worth memorising outright.*

Residual income

$$RI_t = NI_t - (r \times BV_{t-1})$$

Where: r = cost of equity, BV = opening book value of equity.

- *Charges a rent on equity capital. Residual income can be negative even when net income is positive — that is the entire insight.*

Two-stage dividend discount model

$$V_0 = \Sigma\, D_t/(1 + r)^t + [D_{n+1}/(r - g\_s)] / (1 + r)^n$$

Where: g_s = stable growth after the explicit horizon.

- *The terminal value is a value at time n, so it gets discounted n periods, not n + 1. Off-by-one here is the classic slip.*

Terminal value via Gordon growth on FCFF

$$TV_n = FCFF_{n+1} / (WACC - g)$$

Where: FCFF discounted at WACC because it belongs to all capital providers.

- *FCFF pairs with WACC and gives firm value. FCFE pairs with cost of equity and gives equity value directly. Never cross the streams.*

Single-stage FCF perpetuity (enterprise value)

$$EV = FCF_0 \times (1 + g) / (WACC - g)$$

Where: g = terminal growth rate.

- *Terminal g cannot exceed long-run nominal GDP growth. If a question implies it does, that is the answer they want you to reject.*

Arbitrage pricing theory

$$E(R_i) = R_f + \Sigma \beta_{i,k} \times \lambda_k$$

Where: λ_k = risk premium per unit of exposure to factor k.

▸ *APT is multi-factor and makes no assumption about the market portfolio — that is its advantage over CAPM. It does not tell you what the factors are.*

Carhart four-factor model

$$E(R_i) - R_f = \beta_{i,M}[E(R_m) - R_f] + \beta_{i,S} \cdot SMB + \beta_{i,V} \cdot HML + \beta_{i,W} \cdot WML$$

Where: SMB = size, HML = value, WML = momentum.

▸ *Fama–French three-factor plus momentum. A manager whose "alpha" disappears once these factors are added was selling beta.*

Total return on an equity security

$$R_{total} = (P_1 - P_0 + D_1) / P_0 = R_{price} + D_1/P_0$$

Where: Price return plus dividend yield.

▸ *Over long horizons the dividend component is a large share of total return — a favourite qualitative statement.*

Price return

$$R_{price} = (P_1 - P_0) / P_0$$

Where: Capital appreciation only.

▸ *Most headline indices are price indices. Total-return indices include reinvested dividends and sit meaningfully higher over time.*

Average daily volume

$$ADV = \Sigma V_i / n$$

Where: V_i = shares traded on day i over an n-day window.

▸ *Liquidity proxy. Position size relative to ADV is what drives market impact — this idea reappears throughout Level III.*

Free float

$$Float = Shares\ outstanding - Restricted\ shares$$

Where: Restricted = insider lock-ups, strategic stakes, treasury, government holdings.

▸ *Float-adjusted market cap is what most index providers weight on, so a low-float company has less index weight than its headline market cap implies.*

Implied price via comparables

$$P_{target} = M_{peer} \times F_{target}$$

Where: M_peer = peer median multiple, F_target = the target's own fundamental (EPS, BVPS…).

▸ *Comparables inherit the market's mispricing. If the whole sector is expensive, your "fair value" is expensive too.*

Cumulative voting

$$V = S \times N$$

Where: S = shares held, N = board seats up for election.

▸ *Cumulative voting lets a minority holder concentrate all votes on one candidate — it protects minority representation. Straight voting does not.*

Voting power in a dual-class structure

$$VP = (S_A \cdot v_A + S_B \cdot v_B) / \Sigma S_i v_i$$

Where: v = votes attached to each share in that class.

▸ *Economic ownership and voting control come apart here. Founders can hold a small cash-flow stake and still control the board — a standard governance red flag.*

EXAM TIPS — EQUITY INVESTMENTS

- Almost every DDM error is one of three things: using D_0 where D_1 belongs, discounting the terminal value one period too many, or applying constant growth to a company that plainly does not have it.

- Justified multiples come from the Gordon model. If you can derive P/E and P/B from $V_0 = D_1/(r - g)$, you never have to memorise them.
- Cash-flow / discount-rate pairing: FCFF ⇄ WACC ⇄ firm value. FCFE ⇄ cost of equity ⇄ equity value. Dividends ⇄ cost of equity ⇄ equity value.

FIXED INCOME · 14 formulas

Pricing, then yield, then risk. Duration and convexity carry the most marks.

Bond price

$$P = \Sigma\, C/(1 + r)^t + FV/(1 + r)^n$$

Where: C = coupon per period, r = periodic YTM, n = number of periods.

▸ *A bond is an annuity plus a lump sum. Price and yield always move in opposite directions.*

Current yield

$$\text{Current yield} = \text{Annual coupon} / \text{Price}$$

Where: Simplest yield measure.

▸ *Ignores capital gain or loss and time value. For a discount bond it understates the true return; for a premium bond it overstates it.*

Macaulay duration

$$D_{Mac} = \Sigma\, [\, t \times CF_t/(1 + r)^t \,] / P$$

Where: Weighted average time to receipt of cash flows, in years.

▸ *A zero-coupon bond has Macaulay duration exactly equal to its maturity. That single fact anchors the whole concept.*

Modified duration

$$D_{Mod} = D_{Mac} / (1 + r)$$
$$\%\Delta P \approx -D_{Mod} \times \Delta y$$

Where: r = periodic YTM, Δy = change in yield (decimal).

▸ *The minus sign is not decoration. A 0.5% rise in yield on a duration-7 bond is roughly a 3.5% price fall.*

Effective duration

$$\text{EffDur} = (P_- - P_+) / (2 \times P_0 \times \Delta y)$$

Where: P_- = price if yields fall, P_+ = price if yields rise.

▸ *Use effective, not modified, whenever cash flows can change with yields — callables, putables, MBS. Modified duration is meaningless for those.*

Effective / approximate convexity

$$\text{Convexity} = (P_- + P_+ - 2P_0) / (P_0 \times (\Delta y)^2)$$

Where: Same three prices as effective duration.

▸ *Positive convexity is a free lunch: prices rise more than duration predicts and fall less. Callable bonds go negatively convex near the call price.*

Price change with convexity adjustment

$$\%\Delta P \approx -\text{ModDur} \times \Delta y + \tfrac{1}{2} \times \text{Convexity} \times (\Delta y)^2$$

Where: Second-order correction to the duration estimate.

▸ *The convexity term is always positive (for positively convex bonds), so duration alone always understates the price gain and overstates the loss.*

Forward rate from spot rates

$$(1 + z_2)^2 = (1 + z_1)(1 + {}_1f_1)$$
$$(1 + z_n)^n = (1 + z_{n-1})^{(n-1)} \times (1 + {}_{n-1}f_1)$$

Where: z = spot rate, f = implied forward rate.

▸ *Read the notation carefully: ${}_2f_3$ means a 3-year rate starting in 2 years. Getting the subscripts backwards is the entire difficulty here.*

Price value of a basis point

```
PVBP = |P at (y + 0.01%) − P at y|
PVBP = D_Mod × P × 0.0001
```

Where: Dollar price change for a 1 bp yield move.

- *Same idea as DV01, which you will meet again at Level III for hedging. Money terms, not percentage terms.*

Floating-rate note price (discount margin)

```
PV = Σ [(MRR + QM)·FV/m] / (1 + (MRR + DM)/m)^t + FV / (1 + (MRR + DM)/m)^N
```

Where: QM = quoted margin, DM = required discount margin, m = periods per year.

- *If DM = QM the FRN prices at par. DM > QM (credit has deteriorated) prices it at a discount.*

Bond equivalent yield (money market)

```
BEY = [(FV − PV) / PV] × (365 / days)
```

Where: days = days to maturity.

- *A 365-day, add-on yield. Discount-basis quotes (T-bills) use 360 days and the face value as the base — convert before you compare.*

Debt-to-EBITDA

```
Debt / EBITDA = Total debt / EBITDA
```

Where: Total debt = all interest-bearing debt.

- *Lower is stronger. This is the leverage ratio credit analysts quote first, and it reappears in private debt at Level III.*

EBITDA-to-interest coverage

```
Coverage = EBITDA / Interest expense
```

Where: Higher is stronger.

- *Leverage tells you how much debt; coverage tells you whether it can be serviced. Rating agencies want both.*

Portfolio effective duration

```
D_eff,port = Σ w_i × D_eff,i
```

Where: w_i = market-value weight of each bond.

- *Market-value weights, and it assumes a parallel yield-curve shift. For non-parallel shifts you need key rate durations.*

EXAM TIPS — FIXED INCOME

- Duration is a first derivative, convexity a second. Duration alone is only accurate for small yield moves — the exam signals a large move when it wants the convexity term.
- Callable ⇒ negative convexity at low yields, and OAS < Z-spread. Putable ⇒ the reverse. Learn the direction, not just the definition.
- Every "which bond has the highest duration" question resolves the same way: longer maturity, lower coupon, lower yield ⇒ higher duration.

DERIVATIVES · 9 formulas

No-arbitrage pricing. Put-call parity is the single highest-yield relationship in the topic.

Put-call parity

```
C + X/(1 + r)^T = P + S_0
```

Where: Same strike, same expiry, European options.

- *Memorise it as "fiduciary call = protective put". Rearranging it gives you every synthetic position the exam can ask for.*

Forward contract price

```
F_0 = S_0(1 + r)^T
With continuous dividends:  F_0 = S_0·e^((r − q)T)
```

Where: q = dividend yield.

▸ *Cost of carry. Anything the asset pays you (dividends, coupons) lowers the forward price; anything it costs you (storage) raises it.*

Forward price with discrete income or cost

$$F_0(T) = [S_0 - PV(I) + PV(C)] \times (1 + r)^T$$

Where: I = discrete income over T, C = carrying cost.

▸ *Income out, cost in — the signs are the whole formula. Present-value them at the risk-free rate before compounding forward.*

Option payoff at expiration

```
Long call:  max(S_T - X, 0)
Long put:   max(X - S_T, 0)
```

Where: S_T = spot at expiry, X = strike.

▸ *Payoff is not profit. Subtract the premium paid (or add the premium received) to get profit — the exam alternates between the two words deliberately.*

Intrinsic value and time value

```
Call intrinsic:  max(S - X, 0)
Put intrinsic:   max(X - S, 0)
Time value = Option price - Intrinsic value
```

Where: Intrinsic value is never negative.

▸ *Time value is largest at the money and decays to zero at expiry. Deep in- or out-of-the-money options have almost none.*

Lower bounds on European options (no dividends)

$$c \geq \max(S_0 - X(1 + r)^{-T}, 0)$$
$$p \geq \max(X(1 + r)^{-T} - S_0, 0)$$

Where: Enforced by no-arbitrage.

▸ *Below these bounds you can construct a riskless profit. This is why deep-ITM European puts can trade below intrinsic value while calls cannot.*

Value of a long forward during its life

$$V_t = (F_t - F_0) / (1 + r)^{(T - t)}$$

Where: F_t = today's forward price for the same expiry, F_0 = the price you locked in.

▸ *Value at initiation is zero; price is not. That price/value distinction is tested nearly every sitting.*

Swap fixed rate at initiation

$$s^* = [1 - D(t_n)] / \Sigma D(t_i)$$

Where: $D(t_i)$ = discount factor for settlement date i.

▸ *The fixed rate is set so the swap is worth zero at inception. It is a weighted average of the forward rates, not a forecast.*

Swap value after initiation (fixed receiver)

```
V = PV(fixed leg) - PV(floating leg)
```

Where: PVs computed with current discount factors.

▸ *On any reset date the floating leg is worth par (notional). That shortcut collapses most swap-valuation questions into one line.*

EXAM TIPS — DERIVATIVES

- Every derivatives price at Level I comes from one idea: two portfolios with identical payoffs must cost the same today. If a question feels hard, build the replicating portfolio.
- Forwards and futures are priced identically at Level I. The difference (daily settlement, interest on margin) is acknowledged and then assumed away.
- Long option = limited loss, unlimited (calls) or large (puts) gain. Short option = the mirror image. Draw the payoff diagram — it is faster than reasoning it out.

ALTERNATIVE INVESTMENTS · 6 formulas

Real estate valuation and fund fee mechanics. Small topic, very predictable questions.

Net asset value per share

```
NAV = (Total assets − Total liabilities) / Shares outstanding
```

Where: Used for mutual funds, ETFs and fund valuation.

- *ETFs can trade at a premium or discount to NAV; the creation/redemption mechanism is what keeps the gap small.*

Net operating income

```
NOI = Effective gross income − Operating expenses
```

Where: EGI = potential gross income less vacancy and credit losses.

- *NOI excludes financing costs, income tax, depreciation and amortisation. Deducting mortgage interest from NOI is the standard trap.*

Capitalisation rate

```
V = NOI / r_cap
r_cap = NOI / Value
```

Where: NOI = stabilised first-year net operating income.

- *Implicitly, cap rate = discount rate − growth. So a falling cap rate means rising values — cap rate compression is the property equivalent of multiple expansion.*

Loan-to-value

```
LTV = Loan amount / Property value
```

Where: Higher LTV = more leverage and more credit risk.

- *Roughly 80% is the commercial ceiling; residential can exceed 95% with mortgage insurance. Lenders covenant on LTV and DSCR together.*

Debt service coverage ratio

```
DSCR = NOI / Debt service
```

Where: Debt service = annual principal + interest.

- *DSCR > 1 means cash flow covers debt. Commercial lenders typically require 1.20–1.30 — below 1.0 the property cannot pay its own mortgage.*

Hedge fund fees (2-and-20)

```
Management fee = m × AUM
Incentive fee = p × max(0, profit above hurdle)
```

Where: m ≈ 2%, p ≈ 20%.

- *Order matters. Whether the incentive fee is charged on returns net or gross of the management fee changes the answer — read the stem. A high-water mark means past losses must be recovered before incentive fees resume.*

EXAM TIPS — ALTERNATIVE INVESTMENTS

- Almost every real estate question reduces to NOI. Build NOI correctly and the cap rate, DSCR and LTV steps are arithmetic.
- Fee questions are pure sequencing. Write the order down — management fee, hurdle, high-water mark, then incentive — before you compute anything.

PORTFOLIO MANAGEMENT · 8 formulas

CAPM, risk measures and the performance ratios. These recur at Level II and Level III essentially unchanged.

Capital market line

```
E(R_p) = R_f + [(E(R_m) − R_f) / σ_m] × σ_p
```

Where: Slope = the market's Sharpe ratio.

▸ *CML uses total risk (σ) and only holds for efficient portfolios. SML uses beta and holds for any asset. Do not swap them.*

CAPM / security market line

$$E(R_i) = R_f + \beta_i[E(R_m) - R_f]$$
$$\beta_i = Cov(R_i, R_m) / \sigma^2_m$$

Where: Prices systematic risk only.

▸ *Unsystematic risk earns nothing because it can be diversified away for free. A plot above the SML means undervalued (positive alpha).*

Beta from correlation

$$\beta_i = \rho_{i,m} \times (\sigma_i / \sigma_m) = Cov(R_i, R_m) / \sigma^2_m$$

Where: ρ = correlation with the market.

▸ *A volatile stock with low market correlation can have a low beta. High σ does not mean high β — a favourite conceptual question.*

Two-asset portfolio variance

$$\sigma^2_p = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\sigma_1\sigma_2\rho_{12}$$

Where: ρ_{12} = correlation between the two assets.

▸ *The diversification benefit lives entirely in the last term. At ρ = 1 there is none; at ρ < 1 portfolio risk is less than the weighted average of the parts.*

Information ratio

$$IR = (R_p - R_B) / \sigma(R_p - R_B) = \alpha / \text{Tracking error}$$

Where: R_B = benchmark return.

▸ *Active return per unit of active risk. Sharpe judges the total portfolio; IR judges the active bets inside it.*

Treynor ratio

$$T_p = (R_p - R_f) / \beta_p$$

Where: Excess return per unit of systematic risk.

▸ *Use Treynor when the portfolio is one sleeve of a larger diversified whole — only its systematic risk matters then. Use Sharpe when it is someone's entire wealth.*

Jensen's alpha

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

Where: Actual return minus CAPM-required return.

▸ *α > 0 means the manager beat the return their risk entitled them to. It is the only one of these measures expressed in return units rather than as a ratio.*

M-squared

$$M^2 = (R_p - R_f) \times (\sigma_m / \sigma_p) + R_f$$

Where: Levers or de-levers the portfolio to the market's volatility.

▸ *Expressed in percent, so it is directly comparable across portfolios and directly comparable to the market return itself. Same ranking as Sharpe, friendlier units.*

EXAM TIPS — PORTFOLIO MANAGEMENT

- Sharpe and M^2 rank portfolios identically — M^2 just restates Sharpe in percentage terms. Treynor and Jensen rank on beta instead, so they can disagree with Sharpe for an undiversified portfolio.
- If a question stresses that the portfolio is NOT well diversified, it wants a total-risk measure (Sharpe). If it is one component of a diversified whole, it wants a systematic-risk measure (Treynor or Jensen).

FINAL WEEK CHECKLIST

Know cold, no thinking required

- TVM on the calculator, including annuity due and uneven cash flows.
- Duration → price change, with and without the convexity adjustment.
- Put-call parity, and the four synthetics you can rearrange out of it.
- DuPont, in both the 3-factor and 5-factor forms.
- Gordon growth, and the justified P/E and P/B that fall out of it.

The traps that actually cost people the exam

- Periodic vs annual rates. Divide r, multiply n. Every single time.
- D_0 vs D_1 in any dividend model.
- Sample (n − 1) vs population (N) variance.
- COGS in inventory turnover, revenue in receivables turnover.
- Effective duration for bonds with embedded options — never modified duration.
- Payoff vs profit on options. The premium is the difference.

How to revise from here

- Do not re-read. Do questions, get them wrong, and read only the topic you got wrong.
- Time yourself at 90 seconds per question. Level I is a speed exam as much as a knowledge exam.
- Track your errors by type, not by topic. "I misread the question" and "I did not know the formula" need completely different fixes.