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FORMULA SHEET

CFA Level I

Chartered Financial Analyst

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FORMULAS

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TOPICS

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QUANTITATIVE METHODS

10 items

Correlation coefficient

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

Ranges from -1 to +1; unitless measure of linear association

Holding Period Return (HPR)

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

P_1 = ending price, P_0 = beginning price, D_1 = cash distributions received

Population variance

$\sigma^2 = \frac{\sum_{i=1}^{N}(X_i - \mu)^2}{N}$

μ = population mean, N = population size

Future Value of ordinary annuity

$FV = PMT \times \frac{(1+r)^n - 1}{r}$

PMT = periodic payment, r = periodic rate, n = periods

Present Value (single sum)

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

FV = future value, r = periodic rate, n = number of periods

Sharpe ratio

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

R_p = portfolio return, R_f = risk-free rate, σ_p = portfolio std dev

Excess return per unit of total risk

Present Value of perpetuity

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

PMT = periodic payment, r = discount rate

Sample variance

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

$\bar{X}$ = sample mean, n = sample size (uses n-1 for unbiasedness)

Present Value of ordinary annuity

$PV = PMT \times \frac{1-(1+r)^{-n}}{r}$

PMT = periodic payment, r = periodic rate, n = periods

Bayes' Theorem

$P(A|B) = \frac{P(B|A) \cdot P(A)}{P(B)}$

Updates prior probability P(A) given new information B

$P(B) = P(B|A)P(A) + P(B|A^c)P(A^c)$

ECONOMICS

6 items

GDP expenditure approach

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

C = consumption, I = investment, G = government spending

X = exports, M = imports, (X-M) = net exports

Fisher effect

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

Approx: $r_{nom} \approx r_{real} + \pi$

r_nom = nominal rate, r_real = real rate, π = expected inflation

Money multiplier

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

Maximum deposit expansion from a given reserve base

$\Delta\text{Money supply} = m \times \Delta\text{Reserves}$

Price elasticity of demand

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

$|E_d| > 1$: elastic (revenue rises when P falls). $|E_d| < 1$: inelastic. $= 1$: unit-elastic (revenue maximized).

Breakeven and shutdown points

Breakeven: $P = ATC$ (price covers all costs).

Shutdown (short run): $P < AVC$. If $AVC < P < ATC$, keep operating short-run because contribution covers some fixed cost.

Cross-rate calculation

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

Multiply or divide quoted rates to derive a cross-rate. Bid-ask: use bid for one leg and ask for the other to be conservative.

CORPORATE ISSUERS

6 items

WACC

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

w = weights (market value), r = required returns

d = debt, p = preferred, e = equity, t = tax rate

FCFF

$FCFF = NI + NCC + Int(1-t) - \Delta WC - CapEx$

NI = net income, NCC = non-cash charges, Int = interest expense

ΔWC = change in working capital, t = tax rate

Free Cash Flow to Equity (FCFE)

$FCFE = FCFF - \text{Int}(1-t) + \Delta\text{Debt}$

Cash available to equity holders after all obligations and reinvestment

Degree of Total Leverage (DTL)

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

% change in EPS per 1% change in sales

Degree of Financial Leverage (DFL)

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

I = interest expense

% change in EPS per 1% change in EBIT

Degree of Operating Leverage (DOL)

$DOL = \frac{Q(P-V)}{Q(P-V)-F} = \frac{\text{Contribution margin}}{\text{EBIT}}$

Q = units, P = price, V = variable cost/unit, F = fixed costs

FINANCIAL STATEMENT ANALYSIS

6 items

Receivables turnover and DSO

$\text{Receivables turnover} = \frac{\text{Revenue}}{\text{Avg Accounts Receivable}}$

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

Days Sales Outstanding — average collection period

Current ratio

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

Measures short-term liquidity; higher = more liquid

Inventory turnover

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

Days on hand (DOH): $DOH = \frac{365}{\text{Inventory turnover}}$

Return on Equity (ROE)

$ROE = \frac{\text{Net income}}{\text{Avg total equity}}$

DuPont: ROE = Net margin × Asset turnover × Leverage. Drives sustainable growth: $g = b \times ROE$.

Return on Assets (ROA)

$ROA = \frac{\text{Net income}}{\text{Average total assets}}$

Alternative: $ROA = \text{Net profit margin} \times \text{Asset turnover}$

2-factor DuPont decomposition

3-factor DuPont decomposition

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

Net profit margin × Asset turnover × Financial leverage

EQUITY INVESTMENTS

6 items

Justified P/E (leading)

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

b = retention ratio (1-b = payout ratio), r = required return, g = ROE × b

Gordon Growth Model (DDM)

$V_0 = \frac{D_1}{r-g} = \frac{D_0(1+g)}{r-g}$

D_1 = next dividend, r = required return, g = constant growth rate

Requires r > g

Enterprise Value (EV)

$EV = \text{Market cap} + \text{Debt} + \text{Preferred} - \text{Cash}$

$EV/EBITDA$ = enterprise value multiple

Capital-structure-neutral valuation metric

Price-to-Book ratio

$\text{P/B} = \frac{\text{Market price per share}}{\text{Book value per share}}$

Justified P/B: $\frac{ROE-g}{r-g}$

P/B > 1 implies market values assets above book

Sustainable growth rate

$g = b \times ROE$

b = retention rate (1 - dividend payout). Maximum growth a firm can sustain without external financing.

P/E ratio (trailing & leading)

Trailing: $\frac{P_0}{EPS_0}$ — uses last 12 months EPS.

Leading: $\frac{P_0}{EPS_1}$ — uses next 12 months / forecast EPS. Forward-looking variant.

FIXED INCOME

6 items

Forward rate from spot rates

$(1+z_2)^2 = (1+z_1)(1+{}_1f_1)$

General: $(1+z_n)^n = (1+z_{n-1})^{n-1}(1+{}_{n-1}f_1)$

z = spot rate, f = implied forward rate

Bond price

$P = \sum_{t=1}^{n} \frac{C}{(1+r)^t} + \frac{FV}{(1+r)^n}$

C = coupon payment, r = periodic YTM, n = periods, FV = face value

Macaulay duration

$D_{Mac} = \frac{\sum_{t=1}^{n} t \cdot \frac{CF_t}{(1+r)^t}}{P}$

Weighted average time to receive cash flows; measured in years

Modified duration

$D_{Mod} = \frac{D_{Mac}}{1+r}$

$\%\Delta P \approx -D_{Mod} \times \Delta y$

r = periodic YTM, Δy = change in yield

Current yield

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

Simplest yield measure; ignores capital gains/losses and time value

Price value of a basis point (PVBP)

$PVBP = |P_{y+0.01\%} - P_y|$

Alternative: $PVBP = D_{\text{mod}} \times P \times 0.0001$

Dollar price change for a 1 bp yield move

DERIVATIVES

6 items

Forward contract price

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

With continuous dividends: $F_0 = S_0 e^{(r-q)T}$

S_0 = spot, r = risk-free rate, T = time, q = dividend yield

Put-call parity

$C + \frac{X}{(1+r)^T} = P + S_0$

C = call price, P = put price, S_0 = spot price, X = exercise price
r = risk-free rate, T = time to expiration

Intrinsic value and time value

Call intrinsic: $\max(S - X, 0)$; Put intrinsic: $\max(X - S, 0)$

Time value = Option price - intrinsic. ATM/OTM intrinsic = 0; deep ITM time value → 0 near expiry.

Lower bound on European options (no dividends)

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

Enforces no-arbitrage. Below these, the option is mispriced relative to the synthetic.

Option payoff at expiration

Long call: $\max(S_T - X, 0)$; Long put: $\max(X - S_T, 0)$

S_T = price at expiry, X = strike. Short positions are the negative of long. Subtract premium paid for profit.

Forward price with discrete income or cost

$F_0(T) = (S_0 - PV(I) + PV(C))(1+r)^T$

I = discrete income (dividends, coupons) over T; C = carrying cost (storage). PV at risk-free rate. Income reduces the forward; cost raises it.

ALTERNATIVE INVESTMENTS

6 items

Capitalization rate (Cap rate)

$V = \frac{NOI}{r_{cap}}$

NOI = net operating income (stabilized), r_cap = cap rate

Cap rate = NOI / Value (inverse: value = NOI / cap rate)

NAV per share

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

Used for mutual funds, ETFs, private equity fund valuation

Hedge fund fee structure (2-and-20)

Mgmt fee $= m \times AUM$ (e.g. 2%). Incentive fee $= p \times \max(0, \text{Profit above hurdle})$ (e.g. 20%).

Net investor return = gross - both fees.

Debt Service Coverage Ratio (DSCR)

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

Debt service = annual principal + interest. DSCR > 1 means cash flow covers debt; CRE lenders typically require ≥ 1.20–1.30.

Loan-to-Value (LTV)

$LTV = \frac{\text{Loan amount}}{\text{Property value}}$

Higher LTV = more leverage and credit risk. Typical max ≈ 80% commercial; 95%+ residential with mortgage insurance.

Net Operating Income (NOI)

$NOI = \text{Effective Gross Income} - \text{Operating Expenses}$

Excludes financing (interest), income tax, depreciation, and amortization. Foundation of cap-rate valuation.

Information ratio

$IR = \frac{R_p - R_B}{\sigma_{R_p - R_B}} = \frac{\alpha}{\text{Tracking error}}$

R_B = benchmark return, α = active return, TE = active risk

Jensen's alpha

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

Actual return minus CAPM-expected return

$\alpha > 0$ means manager added value beyond compensation for risk

Two-asset portfolio variance

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

w = weights, σ = std devs, ρ_{12} = correlation coefficient

Capital Market Line (CML)

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

Sharpe ratio of market is slope; uses total risk σ_p (not beta)

Treynor ratio

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

Excess return per unit of systematic risk (beta)

Compare with Sharpe (uses total risk σ_p)

CAPM / Security Market Line (SML)

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

$\beta_i = \frac{\text{Cov}(R_i, R_m)}{\sigma_m^2}$

Uses systematic risk only; SML plots expected return vs beta