

FREEFELLOW

FORMULA SHEET

CFA LEVEL II

Chartered Financial Analyst

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FORMULAS

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TOPICS

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QUANTITATIVE METHODS

4 items

F-statistic (overall regression)

$$F = \frac{RSS/k}{SSE/(n-k-1)} = \frac{MSR}{MSE}$$

k = predictors, n = observations

Tests H_0 : all slope coefficients = 0**Adjusted R-squared**

$$\bar{R}^2 = 1 - \frac{n-1}{n-k-1}(1 - R^2)$$

n = observations, k = number of independent variables

Penalizes for adding irrelevant predictors

R-squared (coefficient of determination)

$$R^2 = \frac{RSS}{SST} = 1 - \frac{SSE}{SST}$$

RSS = regression sum of squares, SSE = error sum of squares

SST = total sum of squares. Fraction of variation explained.

Standard error of regression (SEE)

$$SEE = \sqrt{\frac{SSE}{n-k-1}} = \sqrt{MSE}$$

SSE = sum of squared errors, n = observations, k = independent variables

Measures typical prediction error of the model

ECONOMICS

4 items

Relative PPP

$$E(\% \Delta S_{d/f}) \approx \pi_d - \pi_f$$

Expected % change in spot rate \approx inflation differential

Holds better over long horizons

Covered Interest Rate Parity (CIP)

$$\frac{F}{S} = \frac{1+r_d}{1+r_f}$$

F = forward rate (d/f), S = spot rate (d/f)

r_d = domestic rate, r_f = foreign rate

No-arbitrage; holds in practice

International Fisher effect

$$r_{nom,d} - r_{nom,f} \approx E(\pi_d) - E(\pi_f)$$

Nominal interest rate differentials reflect expected inflation differentials

Combines Fisher effect with PPP

Unhedged foreign asset return (in domestic currency) $(1 + R_{DC}) = (1 + R_{FC})(1 + R_{FX})$; approx $R_{DC} \approx R_{FC} + R_{FX}$. R_{FX} = foreign-currency appreciation vs. domestic.

FINANCIAL STATEMENT ANALYSIS

2 items

FCFF from EBIT

$$FCFF = EBIT(1 - t) + D\&A - \Delta WC - CapEx$$

t = tax rate, D&A = depreciation & amortization

 ΔWC = change in working capital**Net pension expense components (ASC 715)**NPPC = Service Cost + Interest Cost - Expected Return + Amort PSC \pm

Amort Gain/Loss. IFRS (IAS 19): net interest on net pension liability replaces expected return.

CORPORATE ISSUERS

4 items

FCFE from FCFE

$$FCFE = FCFE - Int(1 - t) + \Delta Debt$$

Int = interest expense, t = tax rate, $\Delta Debt$ = net new borrowing.**FCFE constant-growth valuation** $V_0 = \frac{FCFE_1}{r_e - g}$. Requires $r_e > g$; g = sustainable FCFE growth. Gordon-growth analog using FCFE instead of dividends.**FCFE from net income**

$$FCFE = NI + NCC - \Delta WC - CapEx + \Delta Debt$$

NI = net income, NCC = non-cash charges (D&A, deferred tax), $\Delta Debt$ = net new borrowing.**MM Propositions I & II (with taxes)**Prop I: $V_L = V_U + tD$ - debt tax shield adds value.Prop II: $r_e = r_0 + (r_0 - r_d)(1 - t)\frac{D}{E}$; WACC declines with leverage. Theoretical optimum: 100% debt.

Build-up method for cost of equity (private company)

$r_e = r_f + \text{ERP} + \text{Size premium} + \text{Specific-company premium} \pm$
Industry premium. Used when CAPM fails for illiquid/private firms.

Sustainable growth rate

$$g = ROE \times b$$

b = retention ratio = 1 – payout ratio

ROE = net income / equity

Growth rate achievable without changing capital structure or issuing equity

Two-stage DDM

$$V_0 = \sum_{t=1}^n \frac{D_0(1+g_S)^t}{(1+r)^t} + \frac{V_n}{(1+r)^n}$$

$$V_n = \frac{D_{n+1}}{r-g_L}$$

g_S = high growth (stage 1), g_L = long-run growth (stage 2)

Residual income model

$$V_0 = B_0 + \sum_{t=1}^{\infty} \frac{(ROE_t - r_e)B_{t-1}}{(1+r_e)^t}$$

B_0 = book value, ROE = return on equity, r_e = cost of equity.

FIXED INCOME

Credit spread decomposition (term structure)

Observed Spread = Expected Loss + Credit Risk Premium +
Liquidity Premium. Expected loss = PD × LGD.

Option-Adjusted Spread (OAS)

$OAS = Z\text{-spread} - \text{Option value (bps)}$

Callable: OAS < Z-spread. Puttable: OAS > Z-spread.

Effective duration

$D_{\text{eff}} = \frac{P_{-\Delta y} - P_{+\Delta y}}{2P_0 \Delta y}$. Used for bonds with embedded options (callable, puttable, MBS).

Portfolio effective duration (market-value weighted)

$D_{\text{eff, port}} = \sum_i w_i D_{\text{eff, } i}$; w_i = market-value weight. Assumes parallel yield-curve shift; use KRDs for non-parallel.

DERIVATIVES

Option gamma

$\Gamma = \frac{\partial^2 V}{\partial S^2} = \frac{\partial \Delta}{\partial S}$. Highest ATM near expiry; long options are positive gamma, short are negative.

Put-call parity

$c + \frac{X}{(1+r)^T} = p + S_0$. Continuous: $c + Xe^{-rT} = p + S_0$. Same strike/expiry; European options.

Option vega

$\nu = \frac{\partial V}{\partial \sigma}$. Price change per 1-pp vol move. Long call or put = positive vega. Highest ATM with longer expiry.

Binomial option pricing (one period)

$c = \frac{\pi_u c_u + \pi_d c_d}{1+r}$; $\pi_u = \frac{(1+r) - d}{u - d}$, $\pi_d = 1 - \pi_u$ (risk-neutral probs). u, d = up/down factors.

ALTERNATIVE INVESTMENTS

Direct capitalization (real estate)

$V = \frac{NOI}{\text{Cap Rate}}$; NOI_1 = stabilized first-year NOI (after opex, before debt service/tax). Implicit: cap rate = r – g.

TVPI (Total Value to Paid-In)

$TVPI = \frac{\text{Distributions} + \text{Residual NAV}}{\text{Paid-in}} = \text{DPI} + \text{RVPI}$ (realized + unrealized multiples).

Pre-money and post-money valuation

Post-money = Pre-money + New investment

Investor share = $\frac{\text{Investment}}{\text{Post-money}}$

Price per share = pre-money / pre-money shares. PE / VC funding rounds.

Equity REIT NAV per share

$\text{NAV/share} = \frac{\text{Property value} + \text{Other assets} - \text{Total liabilities}}{\text{Shares outstanding}}$

Property value typically from cap-rate or DCF on stabilized NOI. Price/NAV reveals premium or discount.

PORTFOLIO MANAGEMENT

Fundamental Law of Active Management

$$IR = IC \times \sqrt{BR}$$

IC = information coefficient (skill), BR = breadth (independent bets), IR = information ratio.

Treynor ratio

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

R_p = portfolio return, R_f = risk-free rate, β_p = portfolio beta

Excess return per unit of systematic risk

Jensen's alpha

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

Actual return minus CAPM expected return

Positive α = outperformance after adjusting for systematic risk

M-squared (Modigliani-Modigliani)

$$M^2 = (R_p - R_f) \times \frac{\sigma_m}{\sigma_p} + R_f$$

Levered/delevered portfolio return at market's risk level

Expressed in % – directly comparable across portfolios

