FreeFellow

FORMULA SHEET

CAIA Level II

Chartered Alt. Investment Analyst

18 FORMULAS

7 TOPICS

freefellow.org/caia-level2/formulas

INSTITUTIONAL ASSET OWNERS

2 items

Kelly criterion (optimal fraction to bet)

Binary: $f^* = \frac{p(b+1)-1}{b}$. Continuous: $f^* = \frac{\mu - r_f}{\sigma^2}$. Maximizes log-wealth; often run at $f^*/2$ or $f^*/4$ for drawdown control.

Risk parity portfolio weights

Inverse-vol approx: $w_i \propto \frac{1/\sigma_i}{\sum_j 1/\sigma_j}$. Equal RISK per asset (not equal capital). Full form uses MRC: $\text{MRC}_i = w_i(\Sigma w)_i/\sigma_p$. Typically levered 2-3x.

ASSET ALLOCATION

2 items

Brinson active-return decomposition (allocation + selection)

Active return = Allocation + Selection + Interaction.
Allocation: $\sum_i (w_{p,i} - w_{b,i}) R_{b,i}$
Selection: $\sum_i w_{b,i}(R_{p,i} - R_{b,i})$

Isolates sector tilts vs security picks.

Surplus and surplus return (asset-liability framework)

$$S_t = A_t - L_t$$
$$R_S = \frac{R_A \cdot A - R_L \cdot L}{A - L}$$

Surplus = assets minus liabilities; surplus risk = vol of R_S. Pension and insurer programs optimize on surplus Sharpe, not pure-asset Sharpe.

RISK AND RISK MANAGEMENT

4 items

Tracking error

$$\text{TE} = \sigma(R_p - R_b) = \sqrt{\text{Var}(R_p - R_b)}$$

Stdev of active return. Sets the active-risk budget for benchmark-relative managers. Information ratio = active return / TE.

Kaplan-Schoar PME (KS-PME)

$\text{KS-PME} = \frac{\sum_t D_t/M_t}{\sum_t C_t/M_t}$. D_t = distributions, C_t = contributions, M_t = public index. >1.0 means PE beat benchmark; <1.0 means underperformed.

Parametric VaR (normal)

$$\text{VaR}_\alpha = -(\mu + \sigma \cdot z_\alpha)$$

$z_{0.95} = -1.645$, $z_{0.99} = -2.326$. Reported as positive loss. Underestimates HF / PE tails; use Modified VaR or CVaR for fat tails.

Expected loss (credit risk)

$$\text{EL} = \text{PD} \times \text{LGD} \times \text{EAD}$$

PD = probability of default. LGD = loss given default = 1 − recovery. EAD = exposure at default. Basel pillar 1; private-credit underwriting.

METHODS AND MODELS

4 items

Hedge fund fund-of-funds effective fee

Fees compound: FoF 1-and-10 on top of HF 2-and-20 ⇒ ~3% mgmt + ~28% of gross alpha. Creates a hurdle the FoF must beat net-of-fees; drove post-2008 FoF decline.

Convertible arbitrage delta hedge

Hedge ratio = convertible delta × conversion ratio. Short Δ shares per bond; rebalance as delta moves (gamma). P/L from gamma, carry, spread tightening, rising IV.

Merger arbitrage annualized return

$R_{\text{arb}} = \frac{P_{\text{offer}} - P_{\text{current}}}{P_{\text{current}}} \times \frac{365}{\text{Days to close}}$. Conditional on close; multiply by P(completion) for risk-adjusted.

Modified Internal Rate of Return (MIRR)

$$\text{MIRR} = \left(\frac{FV(+\text{CF at } r_r)}{|PV(\text{-CF at } r_f)|}\right)^{1/T} - 1$$

Reinvests positives at r_r, discounts negatives at r_f. Avoids multiple-IRR issues from non-conventional flows.

ACCESSING ALTERNATIVE INVESTMENTS

2 items

Trend-following signal (simple moving average crossover)

Long when $MA_{\text{short}} > MA_{\text{long}}$; short when reversed. Position size = $\frac{\text{Target vol}}{\sigma_t} \times \text{Signal}$. Vol targeting keeps portfolio vol constant.

Commodity futures total return decomposition

$R_{\text{futures}} = R_{\text{spot}} + R_{\text{roll}} + R_{\text{collateral}}$; $R_{\text{roll}} = \frac{F_{\text{near}} - F_{\text{next}}}{F_{\text{near}}}$. Positive in backwardation, negative in contango.

DUE DILIGENCE AND SELECTING MANAGERS

1 item

Information ratio and Fundamental Law

$$\text{IR} = \frac{\alpha}{\omega} = \frac{\text{Active return}}{\text{Tracking error}}$$

Fundamental Law: $\text{IR} \approx \text{IC}\sqrt{\text{Breadth}}$. IC = skill correlation, breadth = independent bets per year.

VOLATILITY AND COMPLEX STRATEGIES

3 items

Conditional Value-at-Risk (CVaR / Expected Shortfall)

$\mathrm{CVaR}_\alpha = E[L \mid L \geq \mathrm{VaR}_\alpha]$; for normal returns: $\mu + \sigma \cdot \dfrac{\phi(z_\alpha)}{1-\alpha}$. Coherent (sub-additive); used in Basel III.

Omega ratio

$\Omega(r) = \dfrac{\int_r^\infty (1 - F(x))\,dx}{\int_{-\infty}^r F(x)\,dx}$. Prob-weighted gains above threshold r over losses below. Captures all moments; preferred for skewed/fat-tailed returns.

Long-short market-neutral PnL

$R_{\text{port}} = w_L R_L - w_S R_S - c_{\text{borrow}} w_S - c_{\text{fin}} w_L$

Dollar-neutral: $w_L = w_S$. Beta-neutral: $\beta_L w_L = \beta_S w_S$. Alpha is cross-sectional; PnL hinges on borrow cost.