CFA
三级公式表

高顿CFA/FRM研究院 | 编著

适用于2022年CFA三级考试

PART 1 Capital Market Expectations

Reading 3 Framework and Macro Considerations

□ 泰勒法则(Taylor rule)

$$i^* = r_{neutral} + \pi_e + 0.5(\hat{Y}_e - \hat{Y}_{trend}) + 0.5(\pi_e - \pi_{target})$$

i^*：目标名义政策利率(Target nominal policy rate)
$r_{neutral}$：经济增长和通货膨胀符合预期时的实际中性政策利率(Neutral real policy rate)
$\hat{Y}_e$：实际GDP预期增长率(Expected real GDP growth rates)
$\hat{Y}_{trend}$：实际GDP趋势增长率(Trend real GDP growth rates)
π_e：预期通货膨胀率(Expected inflation rates)
π_{target}：目标通货膨胀率(Target inflation rates)

Reading 4 Forecasting Asset Class Returns

□ 格林诺德-克罗纳模型(Grinold-Kroner model)

$$E(R_e) \approx \frac{D}{P} + (\%\Delta E - \%\Delta S) + \%\Delta P/E$$

$E(R_e)$：权益投资预期收益率(Expected equity return)
$\frac{D}{P}$：股息率(Dividend yield)
$\%\Delta E$：总盈利预期变化率(Expected percentage change in total earnings)
$\%\Delta S$：流通股股数预期变化率(Expected percentage change in shares outstanding)
$\%\Delta P/E$：市盈率预期变化率(Expected percentage change in the price-to-earnings ratio)

□ 国际资本资产定价模型(ICAPM)

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

$$RP_i = \beta_{i,M} RP_M = \rho_{i,M}\sigma_i(\frac{RP_M}{\sigma_M})$$

$\beta_{i,M}$：权益市场i对于全球市场组合的敏感度
RP_M：全球市场组合相对于无风险资产的风险溢价

Reading 4 Forecasting Asset Class Returns

□ 辛格-特哈尔模型(Singer-Terhaar model)

假设1：完全一体化 (Fully integrated market)	$RP_i^G = \beta_{i,GM} RP_{GM} = \rho_{i,GM}\sigma_i(\frac{RP_{GM}}{\sigma_{GM}})$	RP_i^G：全球均衡风险溢价(Global equilibrium risk premium) $(\frac{RP_{GM}}{\sigma_{GM}})$：全球市场组合的夏普比率
假设2：完全分割 (Completely segmented markets)	$RP_i^S = 1 \times RP_i^S = 1 \times \sigma_i(\frac{RP_i^S}{\sigma_i})$	RP_i^S：分割市场均衡风险溢价(Segmented market equilibrium risk premium) $(\frac{RP_i^S}{\sigma_i})$：分割的权益市场的夏普比率
真实情况	$RP_i = \varphi RP_i^G + (1-\varphi) RP_i^S$	φ：一国权益市场与全球市场的一体化程度(The degree to which the asset is globally integrated)

Reading 4 Forecasting Asset Class Returns

□ 资本化率(Capitalization rates)

长期 $E(R_{re}) = Cap\ rate + NOI\ growth\ rate$

短期 $E(R_{re}) = Cap\ rate + NOI\ growth\ rate\ - \%\Delta Cap\ rate$

□ 预测汇率变化(Forecasting exchange rates)

$$E(\%\Delta S_{d/f}) = (r^d - r^f) + (Term^d - Term^f) + (Credit^d - Credit^f) + (Equity^d - Equity^f) + (Liquid^d - Liquid^f)$$

□ 平滑收益率的波动性预测(Estimated volatility from smoothed returns)

$$R_t = (1-\lambda)r_t + \lambda R_{t-1}$$

$$Var(r) = \left(\frac{1+\lambda}{1-\lambda}\right) Var(R) > Var(R)$$

R_t：当前观测到的收益率
r_t：当前的真实收益率
R_{t-1}：上一期观测到的收益率

PART 2 Asset Allocation

Reading 5 Introduction to Asset Allocation

□ 风险预算 （Risk budgeting）

$$Marginal\ contribution\ to\ risk\ (MCTR) = Asset\ beta\ relative\ to\ portfolio \times Portfolio\ standard\ deviation$$

$$Absolute\ contribution\ to\ risk\ (ACTR) = Asset\ weight\ in\ portfolio \times MCTR$$

An asset allocation is optimal when: $\frac{R_i - R_f}{MCTR_i} = \frac{R_p - R_f}{\sigma_p}$

$R_i - R_f$ = excess return of asset i

$MCTR_i$ = MCTR of asset I

$\frac{R_p - R_f}{\sigma_p}$ = Sharpe ratio of the portfolio

Reading 6 Principles of Asset Allocation

☐ 目标函数 （Objective function）

$$U_m = E(R_m) - 0.005 \times \lambda \times \sigma_m^2$$

$\sigma_m^2 = the\ expected\ variance\ of\ return\ for\ asset\ mix\ m\lambda$
$= the\ investor's\ risk\ aversion\ coefficient R_m$
$= the\ return\ for\ asset\ mix\ m U_m$
$= the\ investor's\ utility\ for\ asset\ mix\ (allocation)\ m$

☐ 盈余最优化 （Surplus optimization）

$$U_m^{LR} = E(R_{s,m}) - 0.005 \times \lambda \times \sigma_s^2$$

$U_m^{LR} = the\ surplus\ objective\ function's\ expected\ value$
$E(R_{s,m}) = the\ expected\ surplus\ return\ for\ asset\ mix\ m$
σ_s^2
$= the\ expected\ variance\ of\ surplus\ return\ for\ asset\ mix\ m\lambda$
$= the\ investor's\ risk\ aversion\ coefficient$

PART 3 Derivatives and Currency Management

Reading 8 Option Strategies

□ 持保看涨期权（Covered call）

$$Covered\ call = short\ call + long\ stock$$

$$Profit = S_T - S_0 - Max(0, S_T - X) + C_0$$

$$Max.\ Profit = X - S_0 + C_0$$

$$Max.\ Loss = S_0 - C_0$$

$$Breakeven = S_0 - C_0$$

□ 保护性看跌期权（Protective put）

$$Protective\ Put = long\ put + long\ stock$$

$$Profit = S_T - S_0 + Max(0, X - S_T) - P_0$$

$$Max.\ Profit = Unlimited$$

$$Max.\ Loss = X - S_0 - P_0$$

$$Breakeven = S_0 + P_0$$

Reading 8 Option Strategies

□ 牛市看涨价差（Bull call spread）

$$Bull\ call\ spread = long\ call\ at\ X_L + short\ call\ at\ X_H$$

$$Profit = Max(0, S_T - X_L) - Max(0, S_T - X_H) - (C_L - C_H)$$

$$Max.\ Profit = X_H - X_L - (C_L - C_H)$$

$$Max.\ Loss = (C_L - C_H)$$

$$Breakeven = X_L + (C_L - C_H)$$

□ 牛市看跌价差（Bull put spread）

$$Bull\ put\ spread = long\ put\ at\ X_L + short\ put\ at\ X_H$$

$$Profit = Max(0, X_L - S_T) - Max(0, X_H - S_T) - (P_L - P_H)$$

$$Max.\ Profit = P_H - P_L$$

$$Max.\ Loss = X_H - X_L + (P_L - P_H)$$

$$Breakeven = X_H - (P_H - P_L)$$

Reading 8 Option Strategies

- 熊市看涨价差（Bear call spread）

$$Bear\ call\ spread = long\ call\ at\ X_H + short\ call\ at\ X_L$$

$$Profit = Max(0,\ S_T - X_H) - Max(0,\ S_T - X_L) - (C_H - C_L)$$

$$Max.\ Profit = (C_L - C_H)$$

$$Max.\ Loss = X_H - X_L + (C_H - C_L)$$

$$Breakeven = X_L + (C_L - C_H)$$

- 熊市看跌价差（Bear put spread）

$$Bull\ put\ spread = short\ put\ at\ X_L + long\ put\ at\ X_H$$

$$Profit = Max(0,\ X_H - S_T) - Max(0,\ X_L - S_T) - (P_H - P_L)$$

$$Max.\ Profit = X_H - X_L - (P_H - P_L)$$

$$Max.\ Loss = (P_H - P_L)$$

$$Breakeven = X_H - (P_H - P_L)$$

Reading 8 Option Strategies

□ 跨式组合（Straddle）

$$Straddle = long\ call + long\ put$$

$$Profit = Max(0, S_T - X) + Max(0, X - S_T) - (C_0 + P_0)$$

$$Max.\ Profit = Unlimited$$

$$Max.\ Loss = C_0 + P_0$$

$$Breakeven = X + (C_0 + P_0)\ or\ X - (C_0 + P_0)$$

□ 双限期权（Collar）

$$Collar = long\ stock + short\ call + long\ put$$

$$Profit = (S_T - S_0) + Max(0, X_L - S_T) - Max(0, S_T - X_H) - (P_0 - C_0)$$

$$Max.\ Profit = X_H - S_0 - (P_0 - C_0)$$

$$Max.\ Loss = S_0 - X_L + (P_0 - C_0)$$

$$Breakeven = S_0 + (P_0 - C_0)$$

Reading 9 Swap, Forwards, and Futures Strategies

□ 互换名义本金（Swap notional principal）

$$Swap\ notional\ principal = B \times \frac{MDUR_T - MDUR_B}{MDUR_S}$$

B：组合的市场价值

$MDUR_T$：投资者的目标修正久期

$MDUR_B$：组合的修正久期

$MDUR_S$：利率互换的修正久期

□ 国债期货交割价格（Principal invoice amount）

$$Principal\ invoice\ amount = \frac{Futures\ settlement\ price}{100} \times CF \times Contract\ size$$

$Futures\ settlement\ price$：期货单位报价

CF：转换因子

Contract $size$：合约规模

□ 期货对冲比率（BPVHR）

$$BPVHR = \frac{BPV_T - BPV_P}{BPV_F} = \frac{BPV_T - BPV_P}{BPV_{CTD}} \times CF$$

$$BPVHR = \frac{-BPV_P}{BPV_F} = \frac{-BPV_P}{BPV_{CTD}} \times CF\ (BPV_T = 0)$$

BPV_P：组合的美元久期

BPV_F：国债期货的美元久期

BPV_T：目标美元久期

Reading 9 Swap, Forwards, and Futures Strategies

□ 目标β（Beta adjustment）

$$N_f = \frac{\beta_T - \beta_S}{\beta_f} \times \frac{S}{F}$$

β_T：目标贝塔值

β_f：期货的贝塔值

β_S：持有组合的贝塔值

F：每份期货合约的价值

S：持有组合的市场价值

□ 有效贝塔（Effective β）

$$Effective\ \beta = \frac{\Delta Value\ of\ new\ portfolio}{\Delta\ Value\ of\ market}$$

△Value of new portfolio：新组合的价值变动

△Value of market：市场价值的变动

□ 指数基金期货合约（Number of futures for synthetic index fund）

$$N_f = \frac{\beta_T}{\beta_f} \times \frac{S}{F}$$

β_T：目标贝塔值

β_f：期货的贝塔值

F：每份期货合约的价值

S：持有组合的市场价值

Reading 9 Swap, Forwards, and Futures Strategies

□ 方差互换名义本金（Variance notional for variance swaps）

$$Variance\ notional = \frac{Vega\ notional}{2 \times Strike\ price}$$

Variance notional：方差互换名义本金

Vega notional：互换本金

Strike price：合约约定的方差

□ 方差互换结算金额（Settlement amount & value of variance swap）

$$N_{vega} = \frac{\sigma^2 - X^2}{2 \times Strike\ price} = N_{var}(\sigma^2 - X^2)$$

N_{var}：方差互换名义本金

σ：实际波动率

X：合约约定的波动率

Strike price：行权价格

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Reading 10 Currency Management

□ 本币回报（Domestic-Currency return）

$$R_{DC} = (1 + R_{FC})(1 + R_{FX}) - 1$$

R_{FC}：外币回报

R_{FX}：汇率回报

□ 投资组合波动率分解（Portfolio volatility decomposition）

$$\sigma^2(R_{DC}) \approx \sigma^2(R_{FC}) + \sigma^2(R_{FX}) + 2\sigma(R_{FC})\sigma(R_{FX})\rho(R_{FC}, R_{FX})$$

$\sigma(R_{FC})$：外币资产回报的标准差

$\sigma(R_{FX})$：汇率回报的标准差

$\rho(R_{FC}, R_{FX})$：外币资产回报和汇率回报的相关系数

PART 4 Fixed Income

Reading 11 Overview of Fixed-Income Portfolio Management

□ 预期收益率分解

票息收益 $Yield\ income = \dfrac{Annual\ coupon\ payment}{Current\ bond\ price}$

收敛收益率 $Rolldown\ return = \dfrac{Bond\ price_{End} - Bond\ price_{Beginning}}{Bond\ price_{Beginning}}$

由基准利率变动导致的债券价格变动 $E(\Delta P) = (-ModDur \times \Delta Yield) + [0.5 \times Convexity \times (\Delta Yield)^2]$

由利差变动导致的债券价格变动 $E(\Delta P) = (-ModDur \times \Delta Spread) + [0.5 \times Cconvexity \times (\Delta Spread)^2]$

预期收益率

$$
\begin{aligned}
E(R) \approx\ & Yield\ income\ + Rolldown\ return \\
& +E\ (\Delta price\ due\ to\ investor's\ views\ of\ benchmark\ yield) \\
& -E\ (\Delta price\ due\ to\ investor's\ views\ of\ yield\ spreads) \\
& +E\ (Currency\ gains\ or\ losses)
\end{aligned}
$$

Reading 11 Overview of Fixed-Income Portfolio Management

□ 杠杆

杠杆收益率 $r_p = r_I + \frac{V_B}{V_E}(r_I - r_B)$

期货杠杆倍数 $Leverage = \frac{Notional\ value - Margin}{Margin}$

Reading 12 Liability-Driven and Index-Based Strategies

- 久期匹配

凸度 $Convexity = \frac{Macaulay\ duration^2 + Macaulay + Dispersion}{(1 + cash\ flow\ yield)^2}$

- 衍生品覆盖

国债期货份数 $N_f = \frac{BPV_{Liability} - BPV_{Asset}}{BPV_{futures}}$

国债期货久期 $BPV_{futures} \approx \frac{BPV_{CTD}}{CF_{CTD}}$

利率互换名义本金 $NP = (BPV_{Liability} - BPV_{Asset}) \times \frac{100}{BPV_{Swap}}$

Reading 13 Yield Curve Strategy

□ 动态收益率曲线

曲线利差 $Butterfly\ Spread = 2 \times Medium - term\ yield - long - term\ yield - short - term\ yield$

关键利率久期 $KeyRateDur_K = -\frac{\Delta\%P}{\Delta r_k}$

有效久期 $EffDur = \sum_{k=1}^{n} KeyRateDur_k$

□ 套息策略

单一资产的本币收益率 $R_{DC} = (1 + R_{FC})(1 + R_{FX}) - 1$

资产组合的本币收益率 $R_{DC} = \sum_{i=1}^{n} \omega_i (1 + R_{FC})(1 + R_{FX}) - 1$

Reading 14 Fixed-Income Active Management: Credit Strategies

□ 信用风险

期权调整利差	$OAS = Z - spread - Option\ value\ (\%)$
利差变动导致的债券价格变动率	$\%\Delta Price^{Spread} \approx -(EffSpreadDur \times \Delta Spread) + \frac{1}{2} \times EffSpreadCon \times (\Delta Spread)^2$
久期利差乘数	$DTS \approx EffSpreadDur \times Spread$
超额利差	$ExcessSpread \approx Spread_0 \times t - (EffSpreadDur \times \Delta Spread)$
预期超额利差	$E(ExcessSpread) \approx Spread_0 \times t - (EffSpreadDur \times \Delta Spread) - POD \times LGD \times t$

PART 5 Equity Portfolio Management

Reading 16 Passive Equity Investing

□ 有效股数 (Effective number of stocks)

HHI (Herfindahl–Hirschman Index) $$HHI = \sum_{i=1}^{n} \omega_i^2$$

有效股票数量 (Effective number of stocks) $$N = \frac{1}{\sum_{i=1}^{n} \omega_i^2} = \frac{1}{HHI}$$

□ 跟踪误差 (Tracking error)

跟踪误差 (Tracking error) $$Tracking\ error_p = \sqrt{Variance_{(R_p - R_b)}}$$

□ 超额收益 (Excess return)

超额收益 (Excess return) $$Excess\ return_p = R_p - R_b$$

Reading 17 Active Equity Investing: Strategies

□ 风格因子 (Style factors)

当期风格因子
(Current style factor)

$$f_{i,t} = \beta_{i,0} + \beta_{i,1} Normalized\ yield_t + \varepsilon_{i,t}$$

预期风格因子
(Subsequent style factor)

$$f_{i,t+1} = \beta_{i,0} + \beta_{i,1} Normalized\ yield_t + \varepsilon_{i,t}$$

□ 基于净值分析基金风格 (Returns-based style analysis)

基金收益的约束多元回归方程
(Constrained multivariate regression)

$$r_t = \alpha + \sum_{s=1}^{m} \beta^s R_t^s + \varepsilon_t$$

Reading 18 Active Equity Investing: Portfolio Construction

□ 超额收益 (Active return)

超额收益 (Active return)	$R_A = \sum_{i=1}^{N} \Delta W_i R_i$
事后超额收益 (Ex post active return)	$R_A = \sum (\beta_{pk} - \beta_{bk}) \times F_k + (\alpha + \varepsilon)$
预期超额收益 (Expected active return)	$E(R_A) = IC\sqrt{BR}\sigma_{R_A}TC$

□ 主动投资 (Active investment)

主动投资比率 (Active share)	$Active\ Share = \frac{1}{2}\sum_{i=1}^{n} \lvert Weight_{portfolio,i} - Weight_{benchmark,i} \rvert$
主动投资风险 (Active risk)	$\sigma_{R_A} = \sqrt{\sigma^2\left(\sum (\beta_{pk} - \beta_{bk}) \times F_k\right) + \sigma_e^2}$

Reading 18 Active Equity Investing: Portfolio Construction

□ 绝对风险 (Absolute risk)

主动收益方差 (Portfolio variance)	$V_p = \sum_{i=1}^{n}\sum_{j=1}^{n} x_i\ x_j C_{ij}$
每种资产对组合方差的贡献 (Contribution of each asset to portfolio variance)	$CV_i = \sum_{j=1}^{n} x_i x_j C_{ij} = x_i C_{ip}$
两部分方差 (Variance of two components)	$V_p = Var\left(\sum_{i=1}^{K}(\beta_{ip} \times F_i)\right) + Var(\varepsilon_p)$

Reading 18 Active Equity Investing: Portfolio Construction

□ 相对风险 (Relative risk)

主动收益方差
(Portfolio active variance)

$$AV_p = \sum_{i=1}^{n}\sum_{j=1}^{n}(x_i - b_i)(x_j - b_j)RC_{ij}$$

每种资产对组合方差的贡献
(Contribution of each asset to portfolio active variance)

$$CAV_i = (x_i - b_i)RC_{ip}$$

□ 几何平均收益率 (Geometric return)

几何平均收益率 (Geometric return)

$$R_g = R_a - \frac{\sigma^2}{2}$$

PART 6 Alternative Investment

Reading 19 Hedge Fund Strategies

□ 条件性因子风险模型（Conditional factor risk model)

对冲基金i在t时间段的收益率

(Return of hedge fund i in period t)

$$(Return\ on\ HFi)_t = \alpha_i + \beta_{i,1}(Factor\ 1)_t + \beta_{i,2}(Factor\ 2)_t + \ldots + \beta_{i,K}(Factor\ K)_t + D_t\beta_{i,1}(Factor\ 1)_t + D_t\beta_{i,2}(Factor\ 2)_t + \ldots + D_t\beta_{i,K}(Factor\ K)_t + (error)_{i,t}$$

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PART 7 Private Wealth Management

Reading 22 Topics in Private Wealth Management

□ 税务筹划（Tax Planning）--- Assets Location

账户类型	在账户中	提取时
Taxable account	各种投资收益正常缴税	• 无需缴税 • $FV = (1 + R')^n$
Tax-deferred account (TDA)	各种投资收益不交税	• Taxed at ordinary income tax rate • $FV = (1 + R)^n \times (1 - t)$
Tax-exempt account (TEA)	各种投资收益不交税	• 无需缴税 • $FV = (1 + R)^n$

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Reading 22 Topics in Private Wealth Management

□ 税务筹划（Tax Planning）--- 税后投资回报的计算

Pre-tax holding period return

- $R = \frac{(Vlaue_{end} - Value_{beg}) + income}{Value_{beg}}$

After-tax holding period return

- $R' = \frac{(Vlaue_{end} - Value_{beg}) + income - tax}{Value_{beg}} = R - \frac{tax}{Value_{beg}}$

Tax due = $\sum_{i=1}^{n} transactions_i \times t_i$

$transactions_i$ refer to realized capital gains or losses, dividends, interest payments, etc.

Cumulative after-tax return

- $R'_G = [(1 + R'_1)(1 + R'_2)\cdots(1 + R'_n)]^{1/n} - 1$

If after-tax returns (R'_i) are calculated monthly, the R'_G, can be calculated by geometrically linking the monthly returns.

After-tax Post-Liquidation Return

- $R_{PL} = [(1 + R'_1)(1 + R'_2)\cdots(1 + R'_n) - \frac{\text{liquidation tax}}{\text{final value}}]^{1/n} - 1$

Liquidation tax
= (final value − tax basis) × capital gains tax rate

Reading 22 Topics in Private Wealth Management

□ 税务筹划（Tax Planning） --- 税后投资回报的计算

Tax alpha

- $\alpha_{tax} = x' - x$

After-tax excess return, �′=�′−�′

R'= portfolio after-tax return

B'= benchmark after-tax return

Pre-tax excess return, $x = R - B$

R = portfolio pre-tax return

B = benchmark pre-tax return

Tax-efficiency ratio

- TER = $\frac{R'}{R}$

R′= after-tax holding period return

R = pre-tax holding period return

Reading 22 Topics in Private Wealth Management

□ 赠与以及遗产传承（Gift and Estate Planning）

Relative Value

RV of tax-free gift compared to the bequest

- $RV_{Tax-free\ gift} = \frac{FV_{Gift}}{FV_{Bequest}} = \frac{[1+r_g(1-t_g)]^n}{[1+r_e(1-t_e)]^n(1-T_e)}$

T_e is the estate tax rate

r_g is the pretax return of gift recipient

r_e is the pretax return of estate

t_g and t_e are the effective tax rates on investment returns

RV of taxable gift compared to the bequest

- $RV_{Taxable\ gift} = \frac{FV_{Gift}}{FV_{Bequest}} = \frac{[1+r_g(1-t_g)]^n(1-T_g)}{[1+r_e(1-t_e)]^n(1-T_e)}$

Assuming the gift taxes are paid by recipient

T_g is the gift tax rate

T_e is the estate tax rate

r_g is the pretax return of gift recipient

r_e is the pretax return of estate

t_g and t_e are the effective tax rates on investment returns

Reading 23 Risk Management for Individuals

□ 人力资本（Human Capital）

$$HC_0 = \sum_{t=1}^{N} \frac{p\,(s_t)\,w_{t-1}(1+g_t)}{(1+r_f+y)^t}$$

$p\,(s_t)$ = the probability of surviving to year (or age) t
w_t = the income from employment in period t
g_t = the annual wage growth rate
r_f = the nominal risk-free rate
y = risk premium associated with occupational income volatility
N = the length of working life in years

□ 计算人寿保险保额（Estimation of Life Insurance Needs）

Human Life Value Method

1. PMT=[pretax salary × (1 − indivdual tax rate) − living expense + employer contribution]/(1 − insurance tax rate)
2. $I/Y = [\frac{(1+\text{Discount Rate})}{(1+\text{Growth Rate})} - 1] \times 100$
3. 用期初模式，计算PV。

Needs Analysis Method

1. Total capital needs = 存活配偶和子女的生活支出现值-收入现值
2. Total financial needs = total capital needs + total cash needs
3. Life insurance need = total financial needs - total capital available

PART 8 Portfolio Management for Institutional Investors

Reading 24 Portfolio Management for Institutional Investors

□ 捐赠支出规则（Spending rule for university endowments)

$$Spending_{t+1} = w \times [Spending_t \times (1 + inflation)] + \{(1 - w) \times (spending\,rate \times average\,AUM)\}$$

w = weight of the prior year's spending amount

AUM :assets under management

$inflation$: Higher Education Price Index (HEPI)

- Constant growth rule (w = 1)
- Market value rule (w = 0)
- Hybrid rule (0 < w < 1).

Reading 24 Portfolio Management for Institutional Investors

□ 资产负债表管理（Balance sheet management for banks and insurers ）

$$\%\Delta E = \%\Delta A(M) - \%\Delta L(M-1)$$

$\%\Delta E$ = percentage change in the value of equity
$\%\Delta A$ = percentage change in the value of assets
$\%\Delta L$ = percentage change in the value of liabilities
M = leverage multiplier (financial leverage), A / E

$$D_E = D_A(M) - D_L(M-1)\frac{\Delta i}{\Delta y}$$

D_E = modified duration of the institution's equity capital
D_A = modified duration of the institution's assets
D_L = modified duration of the institution's liabilities
M = leverage multiplier (financial leverage), A / E
$\frac{\Delta i}{\Delta y}$ = correlation (or sensitivity) of changes in yields of assets and liabilities.

Reading 24 Portfolio Management for Institutional Investors

☐ 资产负债表管理（Balance sheet management for banks and insurers ）

$$\sigma^2_{\frac{\Delta E}{E}} = M^2\sigma^2_{\frac{\Delta A}{A}} + (M-1)^2\sigma^2_{\frac{\Delta L}{L}} - 2(M)(M-1)\,\rho\,\sigma_{\frac{\Delta A}{A}}\sigma_{\frac{\Delta L}{L}}$$

$\sigma_{\frac{\Delta E}{E}}$ = standard deviation of percentage change in the value of equity

$\sigma_{\frac{\Delta A}{A}}$ =standard deviation of percentage change in the value of assets

$\sigma_{\frac{\Delta L}{L}}$= standard deviation of percentage change in the value of liabilities

M= leverage multiplier(financial leverage), A / E

ρ = correlation of percentage value changes in assets and liabilities

PART 9 Trading, Performance Evaluation and Manager Selection

Reading 25 Trade Strategy and Execution

□ 执行落差 (Implementation shortfall)

$$IS = Paper\ return - Actual\ return$$
$$= Execution\ cost + Opportunity\ cost + Fixed\ fees$$
$$= Delay\ cost + Trading\ cost + Opportunity\ cost + Fixed\ fees$$

$$Paper\ return = (P_n - P_d) \times S$$
$$Actual\ return = (P_n - P_j) \times S_j - Fixed\ fees$$
$$Execution\ cost = (P_j - P_d) \times S_j$$
$$Opportunity\ cost = (P_n - P_d) \times (S - S_j)$$
$$Delay\ cost = (P_a - P_0) \times S_j$$
$$Trading\ cost = (P_j - P_0) \times S_j$$

S = the total order shares
S_j = the total number of shares of executed orders
P_n = the current price
P_d = the decision price
P_j = the execution price
P_0 = the arrival price

□ 评估交易执行 (Evaluating trade execution)

$$Cost\ (\$) = side \times (\overline{P} - P^*) \times shares$$
$$Cost\ (bps) = side \times \frac{\overline{P} - P^*}{P^*} \times 10{,}000\ bps$$
$$Market - adjusted\ cost = arrival\ cost - \beta \times index\ cost$$
$$Index\ cost = side \times \frac{Index\ VWAP - Index\ arrival\ price}{Index\ arrival\ price}$$
$$Added\ value = arrival\ cost - est.\ pre - trade\ cost$$

$Side$ = +1 for a buy order, −1 for a sell order
$\overline{P}$ = the execution price
P^* = the benchmark price

Reading 26 Portfolio Performance Evaluation

□ 权益回报归因 （Equity return attribution）

Brison model:

$$Active\ return = Portfolio\ return - Benchmark\ return$$
$$= Allocation\ effect + Security\ selection\ effect + Interaction\ effect$$

$$Portfolio\ return = \sum_{i=1}^{i=n} w_i R_i$$

$$Benchmark\ return = \sum_{i=1}^{i=n} W_i B_i$$

$$Allocation\ effect = (w_i - W_i) \times B_i \quad \text{(BHB model)}$$

$$Allocation\ effect = (w_i - W_i) \times (B_i - B) \quad \text{(BF model)}$$

$$Selection\ effect = W_i \times (R_i - B_i)$$

$$Interaction\ effect = (w_i - W_i) \times (R_i - B_i)$$

w_i = portfolio sector weight
R_i = portfolio sector return
W_i = benchmark sector weight
B_i = benchmark sector return
B = benchmark total return

Carhart model:

$$R_p - R_f = a_p + b_{p1}RMRF + b_{p2}SMB + b_{p3}HML + b_{p4}WML + E_p$$

$$RMRF = Market\ risk\ premium = R_{market} - R_{risk-free}$$

$$SMB = Size\ \text{factor} = R_{small} - R_{big}$$

$$HML = \text{Value factor} = R_{value} - R_{growth}$$

$$WML = \text{Momentum factor} = R_{winner} - R_{loser}$$

Reading 26 Portfolio Performance Evaluation

□ 评估基准质量（Evaluating benchmark quality）

$P = M + S + A$

$B = M + S$

$E = S + A$

$\rho_{S,A}$ should be close to zero, $\rho_{E,S}$ should be positive

M = Market index return

S = Style return

A = Active return

B = Benchamrk return

□ 业绩评价（Performance appraisal）

$$Sharpe\ ratio = \frac{\overline{R_A} - \overline{R_f}}{\widehat{\sigma_A}}$$

$$Treynor\ ratio = \frac{\overline{R_A} - \overline{R_f}}{\widehat{\beta_A}}$$

$$Information\ ratio = \frac{E_{(r_P)} - E_{(r_B)}}{\sigma_{(r_P - r_B)}}$$

$$Appraisal\ ratio = \frac{\alpha}{\sigma_\varepsilon}$$

$$Sortino\ ratio = \frac{E_{(r_p)} - r_T}{\sigma_D}$$

$$UC(m,B,t) = \frac{R(m,t)}{R(B,t)},\ if\ R(B,t) \geq 0$$

$$DC(m,B,t) = \frac{R(m,t)}{R(B,t)},\ if\ R(B,t) < 0$$

$$Capture\ ratio = \frac{UC(m,B,t)}{DC(m,B,t)}$$

PART 10 Ethical and Professional Standards

Reading 35 Overview of the Global Investment Performance Standards

□ 时间加权收益率（Time-weighted return）

未经外部现金流调整的时间加权收益率
(TWR with no external cash flows)

$$r_t = \frac{V_1 - V_0}{V_0}$$

经外部现金流调整的时间加权收益率
(TWR with external cash flows)

$$r_{twr} = \left(1 + r_{t,1}\right) \times \left(1 + r_{t,2}\right) \times \cdots \times \left(1 + r_{t,n}\right) - 1$$

□ 修正迪茨法（Modified Dietz method）

使用修正迪茨法计算的时间加权收益率
(TWR with the modified Dietz method)

$$r_{ModDietz} = \frac{V_1 - V_0 - CF}{V_0 + \sum_{i=1}^{n}(CF_i \times w_i)}$$

根据外部现金流对投资组合收益率真实影响天数计算的权重
(Proportion of the measurement period, in days, that each cash flow has been in the portfolio)

$$w_i = (CD - D_i)/CD$$

Reading 35 Overview of the Global Investment Performance Standards

□ 修正内部收益率法（Modified IRR method）

使用修正内部收益率法计算的时间加权收益率
(TWR with the modified IRR method)

$$Ending\ Value = V_1 = \sum_{i=1}^{n} [CF_i \times (1+r)^{w_i}] + V_0 \times (1+r)$$

□ 离散的度量（Dispersion measures）

等权重标准差
(Equal-weighted standard deviation)

$$S_c = \sqrt{\frac{\sum_{i=1}^{n}(r_i - \bar{r}_c)^2}{n}}$$

资产加权标准差
(Asset-weighted standard deviation)

$$S_{C_{aw}} = \sqrt{\sum_{i=1}^{n}(r_i - \bar{r}_{proxy})^2 \times w_i}$$