Portfolio Management

Cheat Sheets

Portfolio Management

PORTFOLIO MANAGEMENT: AN OVERVIEW

Diversification ratio	$$\text{Diversification ratio} = \frac{\sigma \text{ of equally weighted portfolio of n securities}}{\sigma \text{ of single security selected at random}}$$	**σ** = Volatility (Standard deviation)
Net asset value per share	$$\text{Net asset value per share} = \frac{\text{Fund Assets - Fund Liabilities}}{\text{Number of Shares Outstanding}}$$	

PORTFOLIO RISK AND RETURN: PART I

Holding Period Return (HPR) No cash flows	$$HPR = \frac{\text{Ending value - Beginning value}}{\text{Beginning value}}$$	
Holding Period Return (HPR) Cash flows occur at the end of the period	$$HPR = \frac{\text{Ending value} - \text{Beginning value} + \text{Cash flows received}}{\text{Beginning value}} = \frac{P_1 - P_0 + D_1}{\text{Beginning value}}$$	
Holding Period Return (HPR) Multiple years	$$HPR = [(1 + R_1) \times (1 + R_2)] - 1$$	**R_1** = Holding period return in year 1 **R_2** = Holding period return in year 2
Arithmetic mean return	$$\overline{R_i} = \frac{R_{i1} + R_{i2} + \ldots + R_{iT-1} + R_{iT}}{T} = \frac{1}{T}\sum_{t=1}^{T} R_{it}$$	**$\overline{R_i}$** = Arithmetic mean return **R_{it}** = Return in period **t** **T** = Total number of periods
Geometric mean return	$$\overline{R_{Gi}} = \sqrt{(1 + R_{i1}) \times (1 + R_{i2}) \ldots \times (1 + R_{i,T-1}) \times (1 + R_{i,T})} - 1 = \sqrt[T]{\prod_{t=1}^{T}(1 + R_{it})} - 1$$	**R_{it}** = Return in period **t** **T** = Total number of periods

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PORTFOLIO RISK AND RETURN: PART I

Internal Rate of Return (IRR)	$\sum_{t=0}^{N} \frac{CF_t}{(1 + IRR)^t} = 0$	**t** = Number of periods CF_t = Cash flow at time **t**
Time-weighted rate of return	$r_{TW} = [(1 + r_i) \times (1 + r_2) \times \ldots \times (1 + r_N)]^{\frac{1}{N}} - 1$	r_N = Holding period return in year **n**
Annualized return	$r_{annual} = (1 + r_{period})^c - 1$	**R** = Periodic return **C** = Number of periods in a year
Nominal rate of return	$(1 + r) = (1 + r_{rF}) \times (1 + \pi) \times (1 + RP)$	r_{rF} = Real risk-free rate of return π = Inflation **RP** = Risk premium
Real rate of return	$(1 + r_{real}) = (1 + r_{rF}) \times (1 + RP) = \frac{(1 + r)}{(1 + \pi)}$	r_{rF} = Real risk-free rate of return π = Inflation **RP** = Risk premium
Population variance	$\sigma^2 = \frac{\sum_{i=1 \ldots n}^{N} (X_i - \mu)^2}{N}$	X_i = Return for period i **N** = Total number of periods μ = Mean
Population standard deviation	$\sigma = \sqrt{\frac{\sum_{i=1 \ldots n}^{N} (X_i - \mu)^2}{N}}$	X_i = Return for period i **N** = Total number of periods μ = Mean
Sample variance	$S^2 = \frac{\sum_{i=1 \ldots n}^{n} (x_i - \overline{x})^2}{n - 1}$	X_i = Return for period i **N** = Total number of periods $\overline{X}$ = Mean of n returns
Sample standard deviation	$s = \sqrt{\frac{\sum_{i=1 \ldots n}^{n} (X_i - \overline{x})^2}{n - 1}}$	X_i = Return for period i **N** = Total number of periods $\overline{X}$ = Mean of n returns

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PORTFOLIO RISK AND RETURN: PART I

Covariance	$COV_{1,2} = \frac{\sum_{t=1}^{n}\{[R_{t,1} - \overline{R}_1][R_{t,2} - \overline{R}_2]\}}{n-1} = \rho_{1,2}\sigma_1\sigma_2$	**R_{t1} =** Return on Asset 1 in period **t** **R_{t2} =** Return on Asset 2 in period **t** **ρ =** Correlation **$\overline{R}$ =** Mean of respective assets
Correlation	$\rho_{xy} = \frac{Cov(r_x, r_y)}{\sigma_x\sigma_y}$	**$Cov(r_x, r_y)$ =** The covariance of returns, r_x and r_y **σ_x =** Standard deviation of Asset x **σ_y =** Standard deviation of Asset y
Utility function	$U = E(r) - \frac{1}{2}A\sigma^2$	**U =** Utility of an investment **E(R) =** Expected return **σ^2 =** Variance of the investment **A =** Risk aversion level
Portfolio return (Many risky assets)	$R_p = \sum_{i=1}^{N} w_iR_i \, , \; \sum_{i=1}^{N} W_i = 1$	**R_i =** Return of asset i **W_i =** Weight within the portfolio
Portfolio variance	$\sigma_p^2 = \sum_{i,j=1}^{N} w_iw_jCOV(R_i, R_j)$	**w =** Weights **R =** Returns **COV (Ri, Rj) =** Covariance of returns
Portfolio variance (Two-asset portfolio)	$\sigma_p^2 = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\,COV(R_1, R_2)$	**COV =** Covariance of returns on R_1 and R_2 **w_1 =** Portfolio weight invested in Asset 1 **w_2 =** Portfolio weight invested in Asset 2
Portfolio standard deviation (Two-asset portfolio)	$\sigma_p = \sqrt{w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\,COV(R_1, R_2)}$	
Portfolio return of two assets (when one asset is the risk-free asset)	$E(R_p) = w_1R_f + (1 - w_1)E(R_i)$	**R_f =** Returns of respective asset **R_i =** Returns of respective asset **W_1 =** Weight in asset 1 **$1 - w_1$** $= w_2$
Portfolio standard deviation of two assets (when one asset is the risk-free asset)	$\sigma_p = \sqrt{w_1^2\sigma_f^2 + (1 - w_1)^2\sigma_i^2 + 2w_1(1 - w_1)\rho_{1,2}\sigma_f\sigma_i} = (1 - w_1)\sigma_i$	**f =** Risk-free asset **i =** Asset **σ =** Standard deviation **w =** Weigh

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PORTFOLIO RISK AND RETURN: PART II

Capital Asset Pricing Model (CAPM)	**E(Ri) =** $R_F + \beta_i\,[E(R_M) - R_F]$	β_i = Return sensitivity of stock i to changes in the market return $E(R_M)$ = Expected return on the market $E(R_M) - R_F$ = Expected market risk premium R_F = Risk-free rate of interest
Capital allocation line	$E(R_p) = R_f + \left(\frac{E(R_M) - R_f}{\sigma_m}\right) \times \sigma_p$	$E(R_m)$ = Expected return of the market portfolio R_f = Risk-free rate of return σ_m = Standard deviation of the market portfolio σ_p = Standard deviation of the portfolio P
Expected return (Multifactor Model)	$E(Ri) - R_f = \beta_{i1} \times E(\text{Factor 1}) + \beta_{i2} \times E(\text{Factor 2}) + \ldots + \beta_{ik} \times E(\text{Factor k})$	β_{ik} = Stock *i*’s sensitivity to changes in the k^{th} factor **(Factor k)** = Expected risk premium for the k^{th} factor
Beta of an asset	$\beta_i = \frac{Cov(R_i, R_m)}{\sigma_m^2} = \frac{\rho_{i,m}\,\sigma_i\sigma_m}{\sigma_m^2} = \frac{\rho_{i,m}\,\sigma_i}{\sigma_m}$	σ = Standard deviation **m** = Market portfolio **i** = Asset portfolio $\frac{\rho_{i,m}\,\sigma_i}{\sigma_m}$ = Correlation between i and m
Portfolio beta	$\beta_p = \sum_{i=1}^{n} w_i\beta_i \quad \sum_{i=1}^{n} w_i = 1$	w_i = Weight of stock i β_i = Beta of stock i
Sharpe ratio	**Sharpe ratio =** $\frac{R_p - R_f}{\sigma_p}$	R_p = Portfolio return R_f = Risk-free rate of return σ_p = Standard deviation (volatility) of portfolio return
M² ratio	**M² ratio =** $(R_p - R_f)\frac{\sigma_m}{\sigma_p} - (R_m - R_f)$	R_p = Return of portfolio P R_m = Return of market portfolio R_f = Risk-free rate of return σ_m = Standard deviation of market portfolio σ_p = Standard deviation of portfolio P
Treynor ratio	**Treynor ratio =** $\frac{E(R_p) - R_f}{\beta_p}$	β_p = Portfolio beta R_p = Portfolio return R_f = Risk-free rate of return
Jensen’s alpha	$\alpha_p = R_p - [R_f + \beta_p\,(R_m - R_f)]$	R_p = Return of portfolio P R_m = Return of market portfolio R_f = Risk-free rate of return β_p = Portfolio beta

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