<u>CHE374</u>

Cheat Sheet

Relevant: Weeks 1 - 8

Week 1 - Time Value of Money

Future Value	$F = P(1+i)$
Simple Interest	$F_N = P(1+iN)$
Compound Interest	$F = P(1+i)^N$
Subperiod Compounding	$F = P(1+\frac{r}{m})^{mN}$
Eff. Annual Interest Rate	$i_e = (1+\frac{r}{m})^m - 1 = (\frac{F}{P})^{\frac{12}{N}} - 1$ Eq. 2, only T-bills
Continuously Compounding	$i_e = \lim\limits_{m\to\infty}(1+\frac{r}{m})^m - 1 = e^r - 1$
Continuous Compounding	$r = \lim\limits_{m\to\infty}((i_e+1)-1)m = \ln(1+i_e)$
Future Interest Rates	$(1+r_{1,x})^{\frac{x}{12}} = (1+r_{1,k})^{\frac{k}{12}}(1+r_{k,x})^{\frac{x-k}{12}}$ $r_{a,b}$ is the rate from time a to b

Week 2 - Cash-flow Analysis

Arithmetic Gradient	$A_n = A' + (N-1)G$ A': the original, G: amnt added, N: # of periods
Geometric Gradient	$A_n = A'(1+g)^{N-1}$
Compound Amount	$(F/P,i,N) = (1+i)^N, (P/F,i,N) = \frac{1}{(1+i)^N}$
Perpetuity	$(P/A,i) = \frac{1}{i}, \quad (A/P,i) = i$
Annuity	$(P/A,i,N) = \frac{1}{i}(1-\frac{1}{(1+i)^N})$
Arithmetic Growth	$(P/G,i,N) = \frac{1}{i^2}\left(1-\frac{1+iN}{(1+i)^N}\right)$
Geometric Growth	$(P/G,i,g,N) = \frac{1-(\frac{1+g}{1+i})^N}{i-g}$

Week 3 - Mortgages and Bonds

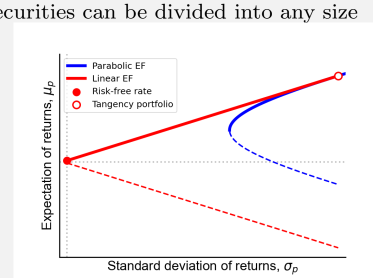
Loan to Value Ratio	$LTV = \frac{Principle}{HouseValue}$
Ammortization Period	# of years it takes to pay off the loan.
Mortgage Term	# of years the interest rate is fixed, after which the rate is renegotiated
Face/Par Value	Value received at bond maturity
Coupon Rate	Interest rate paid annually on the bond

Week 4 - Risk, Reward, and Arbitrage

Return vector	$\vec{R_i} = \begin{bmatrix} r_{t_1} \\ \vdots \\ r_{t_n} \end{bmatrix}, \quad r_{t_j} = \frac{1}{\Delta t}\ln\left(\frac{P_{t_j}}{P_{t_{j-1}}}\right)$ A portfolio of n stocks, the returns of project i at t_j
Volatility	$\sigma = \sqrt{Var(\vec{R_i})} = \sqrt{\frac{1}{n-1}\sum_{i=1}^n (r_i - \bar{r})^2}$
Average Return	$\bar{r} = \frac{1}{n}\sum_{i=1}^n r_i$
Covariance	$Cov(\vec{R_i}, \vec{R_j}) = \frac{1}{n-1}\sum_{i=1}^n (r_i - \bar{r_i})(r_j - \bar{r_j})$
Covariance Matrix	$\Sigma = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \cdots & \sigma_{1n} \\ \sigma_{21} & \sigma_{22} & \cdots & \sigma_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \sigma_{n1} & \sigma_{n2} & \cdots & \sigma_{nn} \end{bmatrix}$
Covariances	$\sigma_{ij} = \sigma_{ji} = Cov(\vec{R_i}, \vec{R_j})$ $\sigma_{ii} = Var(\vec{R_i})$
Portfolio	$\vec{X} = \begin{bmatrix} x_1 \\ \vdots \\ nx_n \end{bmatrix}$ We invest x_i in each stock.
Portfolio Return	$\mathbb{E}[\vec{R_p}] = \sum_{i=1}^n x_i \mathbb{E}[\vec{R_i}]$
Portfolio Volatility	$\sigma_p = \sqrt{\vec{X}^T \times \Sigma \times \vec{X}}$

CAPM Assumptions

- Correlation & volatility of/between assets are fixed
- Investors aim to make as much money as possible
- Investors are rational and risk-averse
- Investors have the same info at the same time
- Investors have accurate conception of possible returns, i.e. the probability beliefs of investors match the true distribution of returns.
- No taxes or transaction costs
- Actions of investors do not influence prices
- Investors can lend and borrow unlimited amounts at the risk free rate
- Securities can be divided into any size



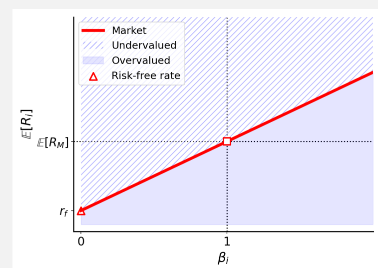
Efficiency Frontier & Capital Market Line

Minimize $\sigma_p^2 = \vec{X}^T\Sigma\vec{X}$

While $\sum_{i=1}^n x_i = 1$, $\sum_{i=1}^n x_i\mathbb{E}[R_i] = \mathbb{E}[R_p]$, $\sum_{i=1}^n x_i\sigma_i = \sigma_p$

Week 4 - Contd.

Leveraging	$\mathbb{E}[R_p] = w\cdot\mathbb{E}[R_m] + (1-w)\cdot r_f$ w is the weight of MP $\sigma_p = \sqrt{w^2\sigma_m^2 + (1-w)^2\cdot\sigma_f}, \ \sigma_f = 0$
Systematic Risk	$\beta_i = \frac{Cov(R_i,R_m)}{Var(R_m)} = \frac{\sigma_{i,m}}{\sigma_m^2} = \frac{\rho_{i,m}\sigma_i}{\sigma_m}$
Asset Expected Return	$\mathbb{E}[R_i] = r_f + \beta_i(\mathbb{E}[R_m] - r_f)$



Security Market Line (Asset Expected Return Plotted)

Forwards/Futures	Contract to buy/sell assets at a future date at a price agreed upon today
Expected Value	$\mathbb{E}[P] = \sum_{i=1}^n P_i \cdot p_i$ p_i is the probability of P_i occurring
Expected Return	$\mathbb{E}[R] = \frac{\mathbb{E}[P]}{P_0} - 1 = \frac{\sum_{i=1}^n P_i\cdot p_i}{P_0} - 1$