Formulas

Standardized Bid-Ask Spread = (Ask – Bid) / Ask

Long (Purchasing) Margin Calls:

How far can the stock price fall to before a margin call?

$$\frac{(\text{Shares x Price} - \text{Amt Borrowed})}{(\text{Shares x Price})} = \text{Maintenance Margin}$$

Short Margin Calls:

How much can the stock price rise to before a margin call?

$$\frac{\text{Initial margin } \textbf{equity} + \text{ sale proceeds} - (\text{Shares x Price})}{(\text{Shares x Price})} = \text{Maintenance Margin}$$

Fisher's equation:

$$(1+\mathrm{r}) = \frac{(1+R)}{(1+i)}$$

where

r = real rate of return

R= nominal rate of return

i= expected Inflation rate

Real after-tax rate:

$$(1+\mathrm{r}_{\mathrm{AfterTax}}) = \frac{1+R(1-t)}{(1+i)}$$

Holding Period Return:

$$HPR = \frac{P_1 - P_0 + D_s}{P_0}$$

HPR = Holding Period Return

P_0 = Beginning price

P_1 = Ending price

D_s = Dividends during the holding period.

Holding period return (HPR) given sub-period returns:

$$HPR = (1+r_1)\times(1+r_2)\times\cdots\times(1+r_n)-1$$

Arithmetic mean: $\bar{R} = \frac{(R_1 + \cdots + R_T)}{T}$

Geometric Mean : $\bar{R}' = \sqrt[n]{(1+r_1)\times(1+r_2)\times\ldots\times(1+r_n)} \; -1$

Annualized Holding Period Return:

$$\text{Annualized HPR} = \left(1 + \text{HPR}\right)^{\frac{1}{\text{Years}}} - 1$$

$SharpeRatio = \frac{(\overline{R - rf})}{SD}$ =Average Excess Return / SD of Excess Return

Expected Portfolio P's Return given two constituents Debt (D) and Equity (E):

$$E(r_P) = w_D E(r_D) + w_E E(r_E)$$

Portfolio's variance given two constituents Debt and Equity:

$$\sigma_P^2 = w_D^2\sigma_D^2 + w_E^2\sigma_E^2 + 2w_D w_E Cov(r_D, r_E)$$

Relationship between covariance and correlation:

$Cov(r_D, r_E) = \rho(r_D, r_E) * \sigma_D * \sigma_E$

$\rho(r_D, r_E)$ = Correlation coefficient of returns

σ_D = Standard deviation of returns for Security D

σ_E = Standard deviation of returns for Security E

Risk Premium: $R_{rp} = R_{raw} - R_f$

where R_{raw} is investor's required rate of return, R_f is risk free rate and R_{rp} is security's risk premium

CAPM model: $E(R_j) = R_f + \beta_j [E(R_{market}) - R_f]$

Where $E(R_j)$ is security i's required rate of return; $E(R_{market})$ is the expected market return; R_f is the risk free rate; β_j is the beta for stock j.

Implication of CAPM:

Security j's risk premium = β_j * Market Risk Premium

(Security j's required rate of return – risk free rate) = β_j (market expected rate – risk free rate)

Portfolio's Beta:

$\beta_{Port} = W_1 * \beta_1 + W_2 * \beta_2 + \ldots + W_n * \beta_n$

Preferred Stock Valuation:

$$V_o = \frac{D}{k}$$

Where D is the constant dividend, k is the discount rate (or required rate of return)

Common Stock Valuation:

$$\textit{Current Intrinsic Price} = V_o = \frac{D_o(1+g)}{k-g} = \frac{D_1}{k-g}$$

Where g = constant perpetual growth rate = ROE * Retention Ratio
D_0= is the "just paid" dividend at current

D_1= is the next dividend in the future
k= required rate of return

Growth rate: $g = ROE \times b$

g = growth rate in dividends

ROE = Return on Equity for the firm

=net income/common equity

b = plowback or retention ratio

= (1- dividend payout ratio)

= % of earnings reinvested back to the firm for future growth—retained earnings

Dividend = EPS * PayoutRate where PayoutRate = 1- Plowback ratio

P/E ratio = Current Price / EPS

Where EPS:

$$= \frac{\text{Net Income - Dividends on Preferred Stock}}{\text{Average Outstanding Shares}}$$

Coupon rate=coupon payment /1000

Current yield = coupon payment/ purchasing price

Holding-Period Return: Single Period：

$$HPR = [(P_1 – P_0) + C] / P_0$$

where
C = coupon payments
P_1 = price in one period
P_0 = purchase price

Annualized Holding Period Yield:

$$\text{Annualized HPY} = \left(1 + \frac{\text{change in market Price} + \text{Coupons}}{\text{beginning market Price}}\right)^{\frac{1}{\text{Years}}} - 1$$

$$\text{Accrued Interest} = \frac{\text{Annual Coupon}}{2} * \frac{\text{Days since last coupon payment}}{\text{Days between coupon payments}}$$

Macaulay's Duration: $D = \sum_{t=1}^{T} t \times w_t$

where $w_t = \left[CF_t / (1+y)^t\right] / Price$ and $CF_t = CashFlow\ for\ period\ t$

Duration of a perpetuity bond: (1+y) / y , where y is the yield to maturity or market yield

Duration/Price Relationship:

$$\frac{\Delta P}{P} = -D^* \left[\frac{\Delta(1+y)}{1+y}\right]$$

Where y is yield to maturity.

Modified Duration:

$$MD = \frac{D}{1+y}$$

where D is the McCauley's Duration

Modified Duration-Price Relationship:

$$\frac{\Delta P}{P} = -MD^* \Delta y$$

Duration with Convexity-Price Relationship :

$$\frac{\Delta P}{P} = -\frac{D}{1+y} * \Delta y + \tfrac{1}{2}\left[Convexity \times (\Delta y)^2\right]$$

Modified Duration with Convexity-Price Relationship :

$$\frac{\Delta P}{P} = -MD * \Delta y + \frac{1}{2}[Convexity \times (\Delta y)^2]$$

Bond Portfolio Duration:

$$\boldsymbol{D_P = w_1D_1+w_2D_2+\ldots+w_nD_n}$$

where w_1 = market value of $Bond_1$/ market value of the entire bond portfolio, D is Macaulay duration.

Bond Portfolio Convexity:

$$\boldsymbol{C_P = w_1C_1+w_2C_2+\ldots+w_nC_n}$$

where w_1 = market value of $Bond_1$/ market value of the entire bond portfolio, *C* is bond convexity.

Payoffs and Profits at Expiration – Calls Holder

Current Stock Price = S_T Exercise Price = X

Payoff to Call Holder (Payoff is not the total profit, Payoff is the option value at expiration)

$(S_T - X)$ if $S_T > X$

0 if $S_T \leq X$ (let it expire)

Actual profit to Call Holder (after considering cost)

Payoff – Purchase Option Price (premium)

$(S_T – X – P)$ if $S_T > X$

$0 – P$ if $S_T \leq X$ (let it expire)

Payoffs and Profits at Expiration – Calls Writer

Payoff to Call Writer

$-(S_T - X)$ if $S_T > X$

0 if $S_T \leq X$ (let it expire)

<u>Actual Profit to Call Writer</u>

Payoff + Premium

$-(S_T - X) + P$ if $S_T > X$

$0 + P$ if $S_T \leq X$ (let it expire)

Payoffs and Profits at Expiration – Puts Holder

<u>Payoffs to Put Holder</u>

0 if $S_T \geq X$ (let it expire)

$(X - S_T)$ if $S_T < X$

<u>Actual Profit to Put Holder</u>

Payoff – Premium

$0 - P$ if $S_T \geq X$ (let it expire)

$(X - S_T) - P$ if $S_T < X$

Payoffs and Profits at Expiration – Puts Writer

<u>Payoffs to Put Writer</u>

0 if $S_T \geq X$ (let it expire)

$-(X - S_T)$ if $S_T < X$

Profits to Put Writer

Payoff + Premium

0+P if $S_T \geq X$ (let it expire)

-(X - S_T)+P if $S_T < X$

Put Call Parity

$$C + \frac{X}{(1+r_f)^T} = S_0 + P$$