Chapter 2 Risk Management

1) $\textbf{VaR}_{\textbf{t days}}$ = Z Score x $SD_{t\ days}$

2) $\textbf{SD}_{\textbf{t days}}$ = $SD_{1\ day}$ x $\sqrt{t\ days}$

$\textbf{VaR}_{\textbf{t days}}$ = Z Score x $SD_{1\ day}$ x $\sqrt{t\ days}$

i.e.

$\textbf{VaR}_{\textbf{t days}}$ = Z Score x $SD_{t\ days}$

$\textbf{VaR}_{\textbf{t days}}$ = $VaR_{1\ day}$ x $\sqrt{t\ days}$

1) Dividend Growth Model

$$P(0)=\frac{D(1)}{(k-g)}$$

With growth,

$$P(0)=\frac{D_0(1+g)}{(k-g)}$$

2) PE Multiple Approach

$$P(0)=\frac{bE(1)}{(k-g)}$$

or

$$P(0)=\frac{bE_0(1+g)}{(k-g)}$$

3) $$ABI=\frac{(\text{No. of Advancing Stocks-No. of Declining Stocks})}{\text{Total Issues Traded}}$$

Total Issues Traded= Advancing Stocks + Declining Stocks + Stocks

4) $$\text{Confidence Index}=\frac{\text{Avg YTM (Best Grade Bonds)}}{\text{Avg YTM (Intermediate Grade Bonds)}}$$

5) **RSI = (% Change in Stock price) / (% Change in Index)**

6) Arithmetic (Simple) Moving Average (AMA):

$$AMA_{n,t}=\frac{1}{n}\left[P_t+P_{t-1}+\ldots+P_{t-(n-1)}\right]$$

i. e.

$$AMA_{n,t}=\frac{\text{Total of the closing prices in a data}}{\text{number of observation}}$$

7) Exponential (Weighted) Moving Average (EMA):

EMA= [CP x e]+ [Previous EMA x (1-e)]

CP= Current Closing Price, e = exponent in decimals=2/n+1

8) Run Test Analysis:

1. Total Number of Runs (r)
2. Number of positive price changes (n1)
3. Number of negative price changes (n2)
4. Mean (μ) $=\frac{2n1\ n2}{n1+n2}+1$
5. Standard Deviation (σ)$=\sqrt{\frac{2n1n2(2n1n2-n2-n2)}{(n1+n2)^2\ (n1+n2-1)}}$
6. Lower limit: [μ - t (σ)]
7. Upper limit: [μ + t (σ)]

Where, t = value from t table at the confidence level (5%) for given degrees of freedom (between 5.76596)

9) Explain Buy and Sell Signals Provided by Moving Average Analysis

Buy Signal	**Sell Signal**
Stock price line rise through the moving average line when graph of the moving average line is flattering out.	Stock price line falls through moving average line when graph of the moving average line is flattering out.
Stock price line falls below moving average line which is rising.	Stock price line rises above moving average line which is falling.
Stock price line which is above moving average line falls but begins to rise again before reaching the moving average line	Stock price line which is slow moving average line rises but begins to fall again before reaching the moving average line.

1) Internal Rate of Return Factor:

$$\text{Internal rate of Return Factor} = \frac{\text{Net initial investment}}{\text{Annual cash inflow}}$$

2) CAPM:

$Rx = Rf + \beta_x (Rm - Rf)$

3) Valuation

1. Dividend Based:

i. Single Period Holding

$$\frac{D_1}{(1+K_e)^1} + \frac{P_1}{(1+K_e)^1}$$

ii. Multi Period Holding

a. Zero Growth Model:

$$P = \frac{D}{K_e}$$

b. Constant Growth Model:

$$P = \left[\frac{D_0(1+g)}{K_e - g}\right]$$

c. Variable Growth Model:

- **Two Stage Dividend Discount Model**

$$P_0 = \left[\frac{D_0(1+g_1)}{(1+K_e)^1} + \frac{D_1(1+g_1)}{(1+K_e)^2} + \ldots \frac{D_{n-1}(1+g_1)}{(1+K_e)^n}\right] + \frac{P_n}{(1+Ke)^n}$$

- **Three Stage Dividend Discount Model**

$$P_0 \left[\frac{D_0(1+g_n)}{(K_e - g_n)} + \frac{D_0 H_1 (g_n + g_c)}{k_e + g_n}\right]$$

- **H Model**

$$\left[\frac{D_0(1+g_1)}{(1+K_e)^1}+\frac{D_1(1+g_1)}{(1+K_e)^2}+\frac{D_2(1+g_1)}{(1+K_e)^3}\right]+\left[\frac{D_3(1+g_2)}{(1+K_e)^4}+\frac{D_4(1+g_2)}{(1+K_e)^5}+\ldots+\frac{D_{n-1}(1+g_2)}{(1+K_e)^n}\right]+\frac{P_n}{(1+Ke)^n}$$

2. Earning Based

i. Gordons Model

$$\frac{EPS_1(1-b)}{Ke-br}$$

ii. Walters Model

$$P=\frac{D+\frac{r}{K_e}(E-D)}{K_e}$$

iii. PE Multiplier

Market Price = EPS x PE Ratio

$$EPS=\frac{\text{PAT-Preference Dividend}}{\text{No. of Equity Shares}}$$

3. Enterprise Value

EV = Market Value of Equity

+ Market Value of Preferred Equity
+ Market Value of Debt
+ Minority Interest
- Cash and Investments.

i.Enterprise value to EBITDA Multiple

$$\text{Enterprise Multiple}=\frac{\text{Enterprise Value}}{\text{EBITDA}}$$

ii.Enterprise value to Sales multiple

$$\text{Enterprise Multiple}=\frac{\text{Enterprise Value}}{\text{Sales}}$$

4) Free Cash Flows to Firm (FCFF):

1. Based on its Net Income:

FCFF= EAT + I(1-t) + D -/+ Capex -/+ ∆WC

2. Based on Operating Income or Earnings Before Interest and Tax (EBIT):

FCFF= EBIT (1-t) + D -/+ Capex -/+ ∆ Non Cash WC

3. Based on Earnings before Interest, Tax, Depreciation and Amortization (EBITDA):

FCFF= EBITDA (1-t) + D* tax rate -/+ Capex -/+ ∆Non Cash WC

4. Based on Free Cash Flow to Equity (FCFE):

FCFF= FCFE +I (1-t) + Principal Prepaid– New Debt + Pref. Dividend

5. Free Cash Flows to Equity (FCFE)

FCFE = EAT + D -/+ Capex -/+ ∆WC+ New Debt- Debt Repayment

Capital Expenditure

Capex = Closing FA + Fixed Asset Sold + Depreciation – Opening FA

5) One Stage, Two Stage and Three Stage Model for the Valuation of the firm

1. For one stage Model:

Intrinsic Value = Present Value of Stable Period Free Cash Flows to Firm

2. For two stage Model:

Intrinsic Value = Present value of Explicit Period Free Cash Flows to Firm
+ Present Value of Stable Period Free Cash Flows to a Firm,

or

Intrinsic Value = Present Value of Transition Period Free Cash Flows to Firm
+ Present Value of Stable Period Free Cash Flows to a Firm

3. For three stage Model:

Intrinsic Value = Present value of Explicit Period Free Cash Flows to Firm
+ Present Value of Transition Period Free Cash Flows to Firm
+ Present Value of Stable Period Free Cash Flows to Firm

6) Right Share

Ex-Right Price of shares

$$\text{Ex-Right Price } (P_1) = \frac{nP_0 + n_1 S}{n + n_1}$$

Value of the Right

$$\text{Value of right} = \frac{\text{No. of right shares}}{\text{Total Holding (Old+New)}} \times (\text{Market price} - \text{Subscription price})$$

$$\text{Value of right} = \frac{n_1(Po - S)}{n + n_1}$$

Alternatively

$$\text{Value of right} = P_0 - P_1$$

$$\text{Ex Right Price } (P_1) = \text{Market Price before right issue (Po)} - \text{Value of the Right}$$

7) Value Preference Shares

1. Value of the redeemable preference shares

$$\frac{\text{Dividend}_1}{(1+r)^1} + \frac{\text{Dividend}_2}{(1+r)^2} + \ldots + \frac{(\text{Dividend}_n + \text{Maturity Value})}{(1+r)^n}$$

2. Value of the irredeemable preference shares

$$MP = \frac{\text{Preference Dividend}}{\text{Required return on Preference Shares}}$$

8) Value of bond

$$BV = I \times PVAF_{YTM,\, n} + RV \times PVF_{YTM,\, n}$$

Where,

BV = Value of the bond or Theoretical Market Price or Intrinsic Value of the bond [Present value of all the future cash flows]

I = Annual interest payable on the bond

RV = Redemption value of the bond. [May be at par, premium or discount]

n = maturity period of bond

YTM = yield to maturity or required rate of return or going rate on new bond with same risk

Bond's Value with semi-annual interest rate

$$BV=\frac{I}{2} \times PVAF_{\frac{YTM}{2}, 2n} + RV \times PVF_{\frac{YTM}{2}, 2n}$$

9) Current Yield

$$\text{Current Yield}=\frac{\text{Interest}}{\text{Market price}} \times 100$$

10) Yield to Maturity

1. Average Method

$$YTM=\frac{C+\frac{(RV-MV)}{n}}{\frac{(RV+MV)}{2}}$$

2. Discounted Cash Flow Method (IRR Method)

$BV= I \times PVAF_{YTM, n} + RV \times PVF_{YTM, n}$

Where,

BV = Theoretical Value of Bond

I = Annual Interest/Coupon Amount

PVAF = Present Value Annuity Factor

YTM = Yield to Maturity (Investors Required Rate of Investors)

PVF = Present Value Factor

11) Duration of Bond

1. Macaulay's Duration of bond

$$\text{Mac D}=\sum \text{Weight} \times \text{Year}$$

Where,

Weight = Weight of a Present Value of cash flows in Total Present Value

Alternative 1

$$\text{Mac D}=\frac{\sum PV \times Yr}{\sum PV}$$

Draft Format

Year	Cash flows	PVF@ YTM	Present Value(PV)	PV x Year
1	Interest			

2	Interest			
3	Interest			
4	Interest + Principal			
			$\sum PV$	$\sum PV \times Yr$

Alternative 2

$$\text{Mac D} = \frac{1+YTM}{YTM} - \frac{(1+YTM)+t\,(c-YTM)}{c\,[(1+YTM)^t-1]+YTM}$$

Where,

c= coupon rate, **t**= Time to maturity, **YTM** = yield to maturity

Alternative 3

$$\text{MacD} = \frac{\sum \frac{t*c}{(1+i)^t} + \frac{n*M}{(1+i)^n}}{P}$$

Where,

n= no. of cash flows,

c= coupon rate

t= Time to maturity,

i= Required yield,

M= Maturity Value,

P= Bond Price

2. Modified Duration (%) or Volatility of the Bond

$$\text{Volatility or Mod D} = \frac{\text{Macaulay's Duration}}{\left(1+\frac{YTM}{n}\right)}$$

Where, n = no. of compounding in a year

12) Convexity

$$\text{Convexity} = \frac{PV_+ + PV_- - 2PV_0}{2PV_0 \times (\Delta Yield)^2}$$

$$\%\Delta PV \approx (-\text{AnnModDur} \times \Delta Yield) + \left[\text{Convexity} \times (\Delta Yield)^2\right]$$

Where,

PV_+=Bonds price when yield increases

PV_-=Bonds price when yield decreases

PV_0=Initial Bond Price at given yield

ΔYeild=Change in Yield

AnnModDur=Annual Modified Duration

13) Convertible Bonds

1. Conversion Ratio:

The number of shares each convertible bond converts into. It may be expressed per bond.

2. Conversion Value:

Conversion Value**=**Market price per common share x Conversion ratio

3. Conversion Premium:

The amount by which the price of a convertible security exceeds the current market value of the common stock into which it may be converted.

CP = Market price of Convertible Bond – Conversion Value

CP = MP – CV

4. Conversion Premium Ratio:

Ratio which shows at what premium the convertible bond is trading in the market.

$$\text{Conversion Premium Ratio}=\frac{MV}{CV}-1$$

5. Straight Value of the Bond:

It is the price where the bond would trade if it were not convertible to stock. Its then is equivalent to non-convertible bond.

6. Minimum Value of the Convertible Bond:

A convertible bond should at the lowest trade at the higher of either the conversion value or straight value.

7. Downside Risk:

Downside risk is the % premium over the straight value of the bond.

$$DR\ (\%)=\left(\frac{MP}{SV}-1\right)\times 100$$

8. Conversion Parity Price or Market Conversion Price:

Price at which the investor will neither gain nor lose on buying the bond and exercising it.

$$CPP = \frac{MP}{N} \times 100$$

9. Favourable Income Differential Per Share

It represents extra income earned in Bond over dividend income in shares.

$$FID = \frac{\text{Interest from Bond} - (\text{Dividend from Equity x CR})}{\text{Conversion Ratio}}$$

10. Premium Payback Period:

It represents the time in which we recover premium paid (to purchase the Convertible Bond) using extra income of interest.

$$PPP = \frac{\text{Conversion Premium}}{\text{Favourable Income Differential}}$$

1) Return of Investment in Single Security or Single Asset

$$R=\frac{\text{Forecasted Dividend+Forecasted Capital Appreciation}}{\text{Initial Investment}}$$

$$R=\frac{D+CA}{II}$$

2) Expected Return:

$$\bar{R}=\sum_{i=1}^{n} R_i P_i$$

3) Portfolio Return

$$R_p=\sum_{i=1}^{n} \bar{R}_i W_i$$

$$R_p=W_1R_1+W_2R_2+\ldots W_nR_n$$

4) Return of security under CAPM

$$R_i=R_f+\beta_i(R_m-R_f)$$

$$R_p=R_f+\beta_p(R_m-R_f)$$

5) The Arbitrage Pricing Theory Model

Stocks/Portfolios Returns according to APT will be

$$R_j = R_f + \beta_1\lambda_1 + \beta_2\lambda_2 + \beta_3\lambda_3 + \cdots + e_i$$

Where,

$\lambda_1, \lambda_2, \lambda_3$ are average risk premium for each of the factors in the model

$\beta_1, \beta_2, \beta_3$ are betas of the security for each of the factors

6) Single index model

The single index model equation is:

$$\mathbf{R_i= \alpha_i+ \beta_i R_m+\epsilon_i}$$

Where,

R_i=expected return on security i

α_i=alpha coefficient or intercept of the straight line

β_i=beta coefficient or slope of the line

R_m=the rate of return on market index

ϵ_i=unsystematic risk of the security

7) **Total Risk = Systematic Risk + Unsystematic Risk**

8) **Beta**

1. Regression Analysis

$$\beta_i = \frac{\sum XY - n\bar{X}\bar{Y}}{\sum Y^2 - n\bar{Y}^2}$$

Where,

β_i=Beta of the stock i

X=Return(%)from the stock,

Y=Return(%) from the market

$\bar{X}$=Expected or Mean value of returns from stock

$\bar{Y}$=Expected or Mean value of returns from market

n=number of observation

2. Correlation Analysis

$$\beta_i = \frac{Corr_{xy}\sigma_x\sigma_y}{\sigma_y^2} \text{ or } \frac{Corr_{xy}\sigma_x}{\sigma_y} \text{ or } \frac{Cov_{xy}}{\sigma_y^2}$$

Where,

β_i=beta of the stock i

$Corr_{xy}$=Correlation between returns of the stock and returns of the market

σ_x=standard deviation of returns of the stock i

σ_y=standard deviation of returns of the market index

σ_y^2=variance of the market index

Cov_{xy}=Covariance of stock x and y

3. Portfolio Beta Using Weighted Average Method

$$\beta_p = \sum W_i\beta_i$$

Where,

β_p=Portfolio Beta

β_i=Beta of the each asset in the portfolio

W_i=weight of each asset in the portfolio

Value of Beta	Interpretation	Example
β < 0	Asset generally moves in the opposite direction as compared to the index	Gold, which often moves opposite to the movements of the stock market
β = 0	Movement of the asset is uncorrelated with the movement of the benchmark	Fixed-yield asset, whose growth is unrelated to the movement of the stock market
0 < β < 1	Movement of the asset is generally in the same direction as, but less than the movement of the benchmark	Stable, "staple" stock such as a company that makes soap. Moves in the same direction as the market at large, but less susceptible to day-to-day fluctuation.
β = 1	Movement of the asset is generally in the same direction as, and about the same amount as the movement of the benchmark	A representative stock or a stock that is a strong contributor to the index itself.
β > 1	Movement of the asset is generally in the same direction as, but more than the movement of the benchmark	Volatile stock, such as a tech stock, or stocks which are very strongly influenced by day-to-day market news.

9) Covariance:

$$Cov_{ab} = \frac{\sum [R_a - \overline{R_a}][R_b - \overline{R_b}]}{N}$$

$$Cov_{im} = \sigma_i \sigma_m r_{im}$$

10) Coefficient of correlation

$$r_{ab} = \frac{Cov_{ab}}{\sigma_a \sigma_b}$$

Where,

COV_{ab} = Covariance between a and b

R_a = Return on stock a

R_b = Return on stock b

$\bar{R}_a$ = Expected or mean return on stock a

$\bar{R}_b$ = Expected or mean return on stock b

β_x = Beta of the stock x

$Corr_{xy}$ = correlation between returns of the stock and returns of the market

σ_x = Standard Deviation of returns of the stock i

σ_y = Standard Deviation of returns of the market index

σ_y^2 = Variance of the market index

Cov_{xy} = Covariance of stock x and y

11) Risk of Single Security

1. Without probability

$$\sigma = \sqrt{\frac{\sum (R-\overline{R})^2}{N}}$$

N = Number of observations

2. With probability

$$\sigma = \sqrt{\sum_{i=1}^{n} [(R-\overline{R})^2 p}$$

p = probability of ith return

12) Risk of Portfolio having 2 securities/assets

$$\sigma_p^2 = w_a^2\sigma_a^2 + w_b^2\sigma_b^2 + 2w_a w_b(r_{ab}\sigma_a\sigma_b)$$

Where,

σ_p^2=portfolio variance,

w_a=proportion of funds invested in first security,

w_b=proportion of funds invested in second security,

σ_a=Standard deviation of first security

σ_b=Standard deviation of second security

r_{ab}=correlation coefficient between the returns of the two securites

13) Risk of Portfolio having 3 securities/assets

$$\boldsymbol{\sigma_p^2} = w_a^2\sigma_a^2 + w_b^2\sigma_b^2 + w_c^2\sigma_c^2 + 2w_a w_b(r_{ab}\sigma_a\sigma_b) + 2w_b w_c(r_{bc}\sigma_b\sigma_c) + 2w_c w_a(r_{ca}\sigma_c\sigma_a)$$

$$\sigma_p^2 = \sum_{i=1}^{n}\sum_{i=1}^{n} w_i w_m \sigma_i \sigma_m r_{im}$$

$$\sigma_p^2 = \sum_{i=1}^{n}\sum_{i=1}^{n} w_i w_m Cov_{im}$$

Where,

σ_p^2=portfolio variance,

w_i=proportion of funds invested in first security,

w_m=proportion of funds invested in second security,

Cov_{im}=covariance between the pair of securities a and b

n = Total number of securities in the portfolio

14) Single Index Model

Security Variance (σ_i^2)

$\sigma^2 = \beta_i^2 \sigma_m^2 + \epsilon_i^2$

Where,

σ^2=total variance

$\beta_i^2 \sigma_m^2$=systematic variance

$\sigma_{\epsilon i}^2$=unsystematc variance

Portfolio variance (σ_p^2)

$$\sigma_p^2 = \left[\left(\sum W_i \beta_i\right)^2 \sigma_m^2\right] + \left[\sum (W_i \epsilon_i)^2\right]$$

Portfolios Alpha and Beta

$$\alpha_p = \sum_{i=1}^{N} w_i \alpha_i$$

$$\beta_p = \sum_{i=1}^{N} w_i \beta_i$$

15) Three market Lines:

1. Capital Market Line

$$R_i = R_f + \frac{\sigma_i}{\sigma_m}(R_m - R_f)$$

σ_i=Standard deviation of the security

σ_m=Standard deviation of the market

2. Security market line

$R_i = R_f + \beta_i(R_m - R_f)$

SML is the graphical representation of Capital Asset Pricing Model

3. Security Characteristic Line

$r_i = \alpha_i + \beta_i R_m$

Where,

r_i=expected return on security i

r_i=alpha

$\beta_i R_m$=component of return due to market movement

16) Optimum Portfolio Theory

1. Find out the "excess return to beta" ratio for each stock under consideration using Treynor ratio.
2. Rank them from the highest to the lowest.
3. Proceed to calculate C_i for all the stocks/portfolios according to the ranked order using the following formula:

$$C_i=\frac{\sigma_m^2 \sum_{i=1}^{N} \frac{(R_i-R_f)\beta_i}{\sigma_{ei}^2}}{1+\sigma_m^2 \sum_{i=1}^{N} \frac{\beta_i^2}{\sigma_{ei}^2}}$$

Where,

σ_m^2=Variance of the market index

σ_{ei}^2=Vriance of the stock's movement that is not associated with the movement of market index i.e stock's unsystematic risk.

4. Determine the relative Z_i investment of each stock in the selected portfolio

$$Z_i=\frac{\beta_i}{\sigma_{ei}^2}\left(\frac{R_i-R_f}{\beta_i}-C^*\right)$$

5. Find out the weight of X_i each stock in the selected portfolio

$$X_i=\frac{Z_i}{\sum_{j=1}^{N} Z_i}$$

17) Portfolio Evaluation Measures

1. Sharpe ratio=$\frac{R_i-R_f}{\sigma_i}$

2. Treynor ratio= $\frac{R_i-R_f}{\beta_i}$

3. Jensen's Alpha = Actual Return-Required return [CAPM return]

Jensen's Alpha=Ri-(Rf+β(Rm-Rf)

18) Minimum Variance Portfolio

$$W_A=\frac{\sigma_B^2-Cov_{A,B}}{\sigma_A^2+\sigma_B^2-2Cov_{A,B}}$$

$W_B=1-W_A$

Where,

W_A=Weight of security A in minimum variance portfolio

W_B=Weight of security B in minimum variance portfolio

19) Constant Proportion Portfolio Insurance Policy

Equity Value = Multiplier x [Portfolio Value - Floor Value]

20) The covariance of returns between securities i and j

$Cov_{ij}=\beta_i\beta_j\sigma_m^2$

21) Fixed Income Portfolio

– Arithmetic Average Rate of Return

$AARR = \frac{\sum R_i}{N}$

R_i = Returns of respective period

N = no. of periods

– **Time Weighted Rate of Return**

$TWRR = [(1+R_1)(1+R_2)........(1+R_n)] – 1$

– MWRR (IRR), 0 = PV of CIF – PV of COF

– **Annualised Return**

$ARR = (1+R) \times \frac{365}{\text{No. of days}}$

R= Entire return for holding period

1) Net Assets Value

$$NAV = \frac{\text{(Total Assets-Total Liabilities)}}{\text{No. of Units}}$$

2) Holding Period Return

$$HPR = \frac{(NAV_1 - NAV_2) + CG + I}{NAV_0}$$

Return in case the dividend and capital gains are reinvested

$$HPR = \frac{(N_1 - NAV_1) + (N_0 - NAV_0)}{(N_0 - NAV_0)}$$

3) Return earned by Mutual Funds

$$r_2 = \frac{1}{\text{1-Initial exp.}} \times r_1 + \text{recurring exp.}$$

Where,

r_2 = Return desired by Investor

r_1 = Return earned by Mutual Funds

4) Expense Ratio

$$ER = \frac{\text{Expenses incurred per unit}}{\text{Average NAV}}$$

$$ER = \frac{\text{Expenses}}{\text{Average value of portfolio}}$$

1) Forwards [OTC Market]

Basis	Time Value of Money	Derivatives
Annual	$A=P(1+r)^t$	$F=S(1+r)^t$
Multiple	$A=P\left(1+\frac{r}{n}\right)^{nt}$	$F=S\left(1+\frac{r}{n}\right)^{nt}$
Continuous	$A=Pe^{rn}$	$F=Se^{rn}$

– Hedging with Futures

$$N=\frac{\text{Value to be hedged}}{\text{Futures Contract Value}}\times\text{Risk to be reduced}$$

Contract Values = Futures Value × Lot Size

2) Binomial Model

$$\text{Option Value}=\frac{C_u x\ p+C_d x\ (1-p)}{(1+r)}$$

Where,

P is the probability of price moving upwards

r is the risk free rate of interest

t is the time interval

C_u is the options value at upper level

C_d is the options value at lower level

Also, P can be calculated using this formula

$$p=\frac{(1+r)-d}{u-d}$$

Where,

$$u=\frac{\text{stock price at upper level}}{\text{spot price}},$$

$$d=\frac{\text{stock price at lower level}}{\text{spot price}}$$

or,

u= volatility of price moving upwards,
d= volatility of price moving downwards.

3) Risk Neutral Method

$$\text{Spot Price} = \frac{\text{Stock Price at upper level x p+Stock Price at lower level x(1-p)}}{1+r}$$

$$\text{Spot Price} = \frac{Su \times p + Sd \times (1-p)}{1+r}$$

Where,

S_u is the Stock Price at upper level

S_d is the Stock Price at lower level

4) Black Scholes Model

$C_o = S \times N(d_1) - Ke^{-rt} \times N(d_2)$

Where,

$$d_1 = \frac{\ln\left(\frac{S}{K}\right) + \left(r + \frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}}, \quad d_2 = d_1 - \sigma\sqrt{t}$$

S=current stock price

K=strike price of the option

t=time remaining until expiration

r=current continuously compounded risk free interest rate

σ=standard deviation of continuously compounded annual return

ln=natural logarithm

N(x)=Standard normal cumulative distribution function

e=exponential function

Adjusting for Dividends

Call Option= $C_o = Se^{-yt} \times N(d_1) - Ke^{-rt} \times N(d_2)$

Put Option= $P_o = Ke^{-rt} \times [1 - N(d_2)] - Se^{-yt} \times [1 - N(d_1)]$

Where,

$$d_1 = \frac{\ln\left(\frac{S}{K}\right) + \left(r - y + \frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}}, \quad d_2 = d_1 - \sigma\sqrt{t}$$

5) Put Call Parity Theory

$S + P_0 = C_0 +$ PV of Exercise price of the stock

Where,

S = Current price of the underlying asset

P = Price (Premium) of the put option

C_0 = Price (Premium) of the call option

6) Portfolio Replicating Theory

Δ= Number of units of the underlying asset bought = (Cu - Cd)/(Su - Sd)

Where,

Δ= Delta/ Hedge Ratio

Cu = Value of the call if the stock price is Su

Cd = Value of the call if the stock price is Sd

According to the Replicating Portfolio Model, value of the option can be calculated as follows

Call Option

C_0=Buy Delta Stock-Borrowing required to replicate the portfolio

Where,

C_0=value of the call option

Borrowing needed to replicate the option=PV of [Δ x S_d-Option value at S_d]

Put Option

P_0=Investment required –Sell Delta Stock

Where,

P_0=value of the put option

Lending needed to replicate the option=PV of [Δ x S_u+Option value at S_u]

7) Option Greeks

Options Greeks

Greeks	Symbol	Represents	Formula,
Delta	δ	Delta represents the change in the Option value with ₹1 change in the Stock Price	$\text{Delta}(\delta) = \frac{\Delta Vo}{\Delta So}$
Gamma	γ	Gamma represents the change in the Options Delta with ₹1 change in the Stock Price	$\text{Gamma}(\gamma) = \frac{\Delta \delta}{\Delta So}$
Rho	ρ	Rho represents the change in the Options Value with 1% change in the Interest Rates	$\text{Rho}(\rho) = \frac{\Delta Vo}{\Delta r}$
Theta	θ	Theta represents the change in the Options Value with 1 day change in the time to expiry	$\text{Theta}(\theta) = \frac{\Delta Vo}{\Delta t}$
Vega	ν	Vega represents the change in the Options Value with 1% change in the volatility of the stock	$\text{Vega}(\vartheta) = \frac{\Delta Vo}{\Delta \sigma}$

Where, Vo= value of the option, So= Spot price of the stock, r= rate of Interest, t= time to expiration

8) Intrinsic Value [IV] & Time Value [TV]

1. Intrinsic Value

For a call option, IV= Max (0, S-K)

For a put option, IV= Max (0, K-S)

2. Time Value

Time value = Option Premium – Intrinsic Value

9) Option Payoff

Position	Option	Payoff	Effect
Long (Holder of the option)	Call	Payoff= Max (0,S-K)	Limited Loss, Unlimited Profit
	Put	Payoff= Max (0,K-S)	Limited Profit, Limited Loss
Short (Writer of the option)	Call	Payoff= Min (0,K-S)	Limited Profit, Unlimited Loss
	Put	Payoff= Min (0,S-K)	Limited Loss, Limited Profit

Break Even = Break-even price is the price at which your net payoff is "0"

	Call	Put
Long	S-K-P=0	K-S-P=0
Short	K-S+P=0	S-K+P=0

10) Write a short note on Factors affecting Option Valuation

Factors Affecting Option Valuation (Option Premium)

Factor		Call	Explanation	Put	Explanation
Stock Price	Increase	▲	For a given strike price(55) increase in the stock price(60,70,80) increases the demand for call hence higher premium and vice-versa	▼	For a given strike price(55) increase in the stock price(30,40,50) decreases the demand for put hence lower premium and vice-versa
	Decrease	▼		▲	
Exercise Price	Increase	▼	For a given stock price (55) increase in the strike price (30,40,50) decreases the demand for call hence lower premium and vice-versa	▲	For a given stock price (55) increase in the strike price (60,70,80) increases the demand for put hence higher premium and vice-versa
	Decrease	▲		▼	
Time to Expiration	More	▲	More the time to expiry, more are the chances for Option to be In The Money, hence higher premium & vice-versa	▲	More the time to expiry, more are the chances for Option to be In The Money, hence higher premium & vice-versa
	Less	▼		▼	
Volatility	More	▲	More the volatility, more are the chances for Option to be In The Money, hence higher premium & vice-versa	▲	More the volatility, more are the chances for Option to be In The Money, hence higher premium & vice-versa
	Less	▼		▼	
Interest Rate	Increase	▲	Increase in interest rate increases the interest income that can be earned on money saved in buying call option, which increases demand for call and premium thereon	▼	Increase in interest rate increases the opportunity cost of interest income on put option which decreases demand for put and premium thereon (however less practical)
	Decrease	▼		▲	

1) Premium/Discount

Premium/(Discount) in Base Currency	Premium/(Discount) in Counter Currency
$\frac{F-S}{S}$ or $\frac{F}{S}-1$	$\frac{S-F}{F}$ or $\frac{S}{F}-1$
Where, F = Forward exchange rate S = Spot exchange rate N= Number of months of the forward contract	Where, F = Forward exchange rate, S = Spot exchange rate N= Number of months of the forward contract

2) Interest Rate Parity Theory

When Exchange Rates are in **Direct Quote**

$$\frac{1+r_d}{1+r_f} = \frac{F}{S}$$

When Exchange Rates are in **Indirect Quote**

$$\frac{1+r_f}{1+r_d} = \frac{F}{S}$$

Where,

r_d = Rate of interest in domestic market

r_f = Rate of interest in foreign market

F= Forward rate of the foreign currency

S= Spot rate of the foreign currency

3) Purchasing Power Parity Theory

$$F = S \times \frac{1+i_d}{1+i_f}$$

Where,

i_d = Inflation rate in domestic market

i_f = Inflation rate in foreign market

F = Forward rate for foreign currency

S = Spot rate for foreign currency

4) International Fisher Effect

$\Delta S \approx Rd - Rf$

Or

$$F = S \times \frac{1+Rd}{1+Rf}$$

Where,

Rd= Nominal Interest rate of domestic country

Rf = Nominal Interest rate of foreign country

5) Broken Period Forward Rate

Broken Period Forward Rate			
For broken period the convenient way is to interpolate the rates between the two standard day			
Spot ₹/$ 47.0725/745	**1m ₹/$ 133/140**	**3m 145/160**	**6m 155/175**
Bid Rate	145 + (155-145) x 25/90	148	47.0725+0.0148 = **47.0873**
Ask Rate	160 + (175-160) x 25/90	164	47.0745+0.0164 = **47.0909**
Spot ₹/$ 47.0725/745	**1m ₹/$ 140/133**	**3m 160/145**	**6m 175/155**
Bid Rate	160 + (175-160) x 25/90	164	47.0725-0.0164 = **47.0561**
Ask Rate	145 + (155-145) x 25/90	148	47.0745-0.0148 = **47.0597**

6) Nostro, Vostro and Loro Account

Nostro, Vostro & Loro Account			
Nostro Account	"**Our** account with **your** bank"	Nostro accounts are generally held in a foreign country (with a foreign bank), by a domestic bank (from our perspective, our bank). It obviates that account is maintained in that foreign currency.	State Bank of India account in Bank of America is a Nostro Account for State Bank of India
Vostro Account	"**Your** account with **our** bank"	Vostro accounts are generally held by a foreign bank in our country (with a domestic bank). It generally maintained in Indian Rupee (if we consider India)	State Bank of India account in Bank of America is a Vostro Account for Bank of America
Loro Account	"**Your** account with **their** bank"	Loro accounts are generally held by a 3rd party bank, other than the account maintaining bank or with whom account is maintained.	State bank of India account in Bank of America is Loro Account for ICICI Bank

1) Forward Rate Agreement

$$\text{Settlement} = \frac{(N)(RR-FR)\left(\frac{dtm}{DY}\right)}{[1+RR\left(\frac{dtm}{dy}\right)]} \times 100$$

Where,

N = the notional principal amount of the agreement;

RR = Reference Rate for the maturity specified by the contract prevailing on the contract settlement date; typically LIBOR or MIBOR

FR = Agreed-upon Forward Rate; and

dtm = maturity of the forward rate, specified in days (FRA Days)

DY = Day count basis applicable to money market transactions which could be 360or 365 days.

If LIBOR > FR the seller owes the payment to the buyer, and if LIBOR<FR the buyer owes the seller the absolute value of the payment amount determined by the above formula.

2) Value of the Swap

$V_{swap} = B_{fl} – B_{fix}$

3) Adjusted Net Present Value

APV= NPV+PV of Tax Shield on Interest +PV of Interest Subsidies

Methods of Valuation

1) Asset Based

Book Value = Total Assets – Long Term Debt

- Total Assets = Fixed Assets + Intangible Assets + Current Assets – Current Liabilities
- This can also be equated to share capital plus free reserves

2) Earnings Based

Value of the Equity = $\frac{EAT}{K_e}$

Value of the Company = $\frac{EBITDA}{K_o}$

3) Enterprise Value Based

Enterprise Value=Market Value of Equity
+Market Value of Preference
+Market Value of Debt
+Minority Interest
- Cash & Cash Equivalent

4) Other Methods

1. Economic Value Added

EVA = NOPAT – (Invested Capital * WACC)
Or

EVA = NOPAT – Capital Charge

2. Market Value Added

MVA = Market Value – Book Value

3. Shareholders Value Analysis

Steps involved in SVA computation:

1. Arrive at the Future Cash Flows (FCFs) by using mix of the ‘value drivers’
2. Discount these FCF using WACC
3. Add the terminal value to the present values computed in step (b)

4. Add market value of non-core assets
5. Reduce the value of debt from the result in step (d) to arrive at value of equity