BONDS ①

- Coupon rate = Discount rate
  i.e market value = Face value
  (Par value Bond)

- B_0 = P.V of all future C.I

- Inverse relationship between price of bond and market interest rate

Yield

- Current yield = $\frac{\text{Annual Interest} \times 100}{\text{market price}}$

- Realised yield

$$FV = PV(1+r)^n$$

$$\text{Total cash inflow} = \text{market price}\,(1+r)^n$$

- Yield to maturity

$$YTM\ (\text{approx}) = \frac{Int + \frac{(RV - MP)}{N}}{\frac{RV + MP}{2}}$$

RV → Redemption value
MP → market price
N → No of years

- ~~Intrinsic~~ value = fair value
  Intrinsic
  = Equilibrium value = Present value
  = Theoretical value

Bond Forward

$$(1+YTM)^2 = (1+r_1)(1+r_2)$$

Bond Duration

Macaulay's Duration

$$= \frac{\Sigma t \times PVCI}{\Sigma PV \text{ of all } CI}$$

t = year in which respective cashflow is received

Modified duration (volatility) = $\frac{\text{macaulay Duration}}{1+YTM\ (\text{existing})}$

Expected change in bond price = Modified Duration (+/−) × expected change in Int rate (−/+)

Convexity (C)

$$C = \frac{V_+ + V_- - 2V_0}{2V_0 \times (\Delta YTM)^2}$$

$$\text{convexity Effect} = C \times (\Delta YTM)^2 \times 100$$

Expected price using Duration and convexity

If YTM falls:

Expected V = (V_0 + ΔYTM × modified Duration × V_0) + (convexity Effect × V_0)

If YTM rises:

Expected V = (V_0 − ΔYTM × modified Duration × V_0) + (convexity Effect × V_0)

V_0 → Bond price at existing YTM
V_+ → Higher bond price at lower YTM
V_- → lower bond price at higher YTM
C = convexity
[change in bond price due to duration + convexity effect]

Interest coverage ratio = $\frac{EBIT}{Interest}$

Single stage Dividend model (GORDON)

$$P_0 = \frac{D_1}{ke - g}$$

where,

$D_1 = D_0(1+g)$
$g = r \times b$

where,

D_0 = Dividend of last year (year 0)
D_1 = Expected Dividend of next year (year 1)
r = return on retained earnings
b = 1 - Payout ratio (ie retention ratio)

ke (cost of equity) can be calculated by using the following in order of sequence

- capital asset pricing model

$$ke = R_F + [R_m - R_F]\beta$$

R_F → Risk free rate, R_m = market rate

- Gordon's formula

$$ke = \frac{D_1}{P_0} + g$$

- Earnings yield

$$k_E = \frac{EPS}{MPS} \times 100 \quad (MPS = EPS \times P/E)$$

~~PE = EPS/MPS~~ ie $1/PE$ ratio

- Dividend yield

$$ke = \frac{D_1}{P_0} \times 100$$

$\boxed{EPS = ROE \times \text{Book value per share}}$

Walter's model

$$P_0 = \frac{D + \left[\frac{r}{ke}\right] \times [EPS - DPS]}{ke}$$

r → ROE — optimum payout ratio
$r > ke$ 0%
$r < ke$ 100%
$r = ke$ (Indifferent)

Firm & Equity

$V(F) = V(D) + V(P) + V(E)$

where,
$V(F)$ = market value of firm/enterprise
$V(E)$ = market value of Equity shares
$V(D)$ = market value of Debt
$V(P)$ = market value of Pref sh (if any) generally NIL

Free cash flow to Equity (FCFE) Approach

FCFE = PAT (after Interest and preference dividend)
+ Depreciation (Non cash exp)
(-) Increase in working capital
(+) Decrease in working capital
(-) Increase in net fixed assets
+ decrease in net fixed assets
(-) Borrowings/Pref shares repaid
+ Borrowings taken/Pref sh issued

FCFE discounted at ke

$$V(E) = \frac{FCFE_1}{ke - g} \quad \Big| \quad V(E) + V(D) + V(P) = V(F)$$

free cash flow to firm (FCFF)

FCFF = PAT (After Int and pref Dividend)
+ Depreciation (Non cash expense)
+ Interest (1-t)
+ preference Dividend
(-) Inc in working capital
+ Decrease in working capital
(-) Inc in net fixed asset
+ Dec in net fixed asset

FCFF discounted at WACC (Ko)

$$V(F) = \frac{FCFF_1}{WACC - g} \quad \Big| \quad V(F) = V(E) + V(D) + V(P)$$

Debt ratio → FCFE (1-D) from everywhere and no separate borrowings to be shown

$$WACC = Kd \times \frac{D}{(D+E+P)} + Kp \times \frac{P}{(D+E+P)} + Ke \times \frac{E}{(D+E+P)}$$

$kd = Int(1-t)$, KP = Pref DIV (%), ke = CAPM/Gordon

Earnings growth model : $P_0 = E_1/(ke - g)$

P/E multiple approach: P_0 = EPS × Implied P/E ratio

PE ratio (Implied) = $\frac{1}{ke} \times 100$

$\boxed{\text{(CA) assumes RoE as Ke}}$

Yield method

$$VPS = \frac{\text{Actual yield \%}}{\text{Expected (Normal) yield \%}} \times \text{Paid up value per share}$$

Actual yield (%) = Actual yield (Rs) / Paid up eq sh cap

No method given: Actual yield = (PAT - Pref DIV) ie return for eq sh

Normal yield (%)	xx
(+) Risk adj (if entity risk > industry risk)	xx
(-) Risk adj (if entity risk < industry risk)	(xx)
Adjusted normal yield (%)	xx

Post issue MP/sh = $\frac{\text{Post issue market capitalisation}}{\text{Post issue number of shares}}$

* Pre issue mcap [Pre issue MPS x Pre issue NOS]	XX
(+) Net issue proceeds [shares issued x issue price] - issue expense	XX
(+/-) NPV on projects where issue proceeds are invested	XX
(+/-) NPV on Bond repayment out of issue proceeds	XX
(+/-) NPV on surplus funds out of issue proceeds	XX
POST ISSUE MARKET CAP	XXX
÷ Post issue NOS	XX
Post issue market price per share	XXX

RIGHTS

Ex right price: $\frac{\text{cum right price} \times \text{No of sh} + (\text{Rights issue price} \times \text{right shares allotted})}{\text{No of shares held pre rights} + \text{right shares allotted}}$

cum rights price: market price prevailing before record date

value of rights alone: Ex Right price - Right issue price

Coverage ratio = $\frac{\text{PAT} + \text{Int (w or w/o tax)}}{\text{Int} + \text{pref Dividend}}$

Capital gearing ratio = $\frac{\text{Debentures} + \text{PSC}}{\text{ESC} + \text{Reserves}}$

RUNS TEST

Number of + signs: N_1

Number of - signs: N_2

Sign changes (including 1st observation): R

$\mu = \frac{2N_1N_2}{N_1+N_2} + 1$ [r within range then market satisfies weak form of efficient market hypothesis]

$\sigma = \sqrt{\frac{2N_1N_2 \times (2N_1N_2 - N_1 - N_2)}{(N_1+N_2)^2 \times (N_1+N_2-1)}}$ / $\sigma = \sqrt{\frac{(\mu-1)(\mu-2)}{N_1+N_2-1}}$

Lower limit: $[\mu - t \times \sigma]$

Upper limit: $[\mu + t \times \sigma]$

t at certain degrees should be given in the question //

Buyback

2

Buyback will generally increase the EPS which in turn will increase MPS [MPS = EPS x P/E ratio]

Unless otherwise mentioned, we assume Net profit and P/E ratio remains the same PRE and POST buyback

Exponential moving Average

Exponent adj $= \frac{2}{n+1}$

1) Exponent Adjustment = [current day price - EMA of previous day] x Exponent factor

2) current day EMA = EMA of previous day ± Exponent adjustment

EMA increasing, BULLISH Trend

Convertibles [Conversion ratio = face value / Conversion price]

Conversion value = Conversion ratio x MPS of Equity sh

Straight value = PV of future coupons + PV of redemption value

Intrinsic value = Higher of conversion value or Straight value

Conversion premium = market price of convertible bond - Conversion value

Downside risk / premium over Straight value = market price of bond - Straight value

Conversion Parity price / Market conversion price = $\frac{\text{Market price of Bond}}{\text{Conversion ratio}}$

Income differential = Annual int per bond - [Annual dividend/sh x conversion ratio]

Premium payback period = $\frac{\text{Conversion premium (per bond)}}{\text{Favourable income diff}}$

Warrants

Theoretical price / Intrinsic value of warrant $= \left[\text{Market price of Eq sh} - \text{Exercise price}\right] \times$ Exercise ratio

Warrant premium = Market price of warrant − Theoretical value of warrant

Annualized return / Bond Equivalent yield (BEY)

Annualized return BEY $= \frac{F-P}{P} \times 100 \times \frac{365}{\text{Days}}$ (OR) $\frac{12}{\text{months}}$

F = face value
P = Issue/purchase price.

(Simple interest principles)

If effective rate of return using compounding then $\left[1 + \frac{BEY}{M}\right]^{1 \times M}$

M = No of times compounding happens [ie 2 for halfyr, 4 for qtrly].

First leg $= NV \times \frac{DP}{100} \times \frac{100 - \text{Initial m}}{100}$.

REPO

— first transaction (loan taken/sale)

Clean price XX
(+) Accrued Int XX
Dirty price XX
(−) margin (XY)
Proceeds XX

— second transn (Repayment/Re-purch).

Proceeds XX
+Int on repo XY
Repayment XY

Clean: Ex − Int price
Dirty price: cum − Int price//

Du pont analysis

ROE(%) = NP margin × Assets T/O × Equity multiplier

Equity multiplier → Total assets / Equity

Market value added (MVA)

a) If mv of Eq sh is given in question

MVA = mv of Equity − Shareholder funds
[No of sh × MPS] − [ESC + R&S]

b) If mv of firm is given in question

Market value of firm XX
(−) Invested Capital (XX)
XX

Mergers & Acquisitions

→ P/E ratio = MPS/EPS
i.e EPS = MPS/PE ratio
ie MPS = EPS × P/E ratio

→ Post merger EPS = Post merger PAT / Post merger No of sh

$= \frac{\text{Pre PAT (A)} + \text{Pre PAT (T)} + \text{Synergy}}{\text{Pre shares (A)} + \text{Pre sh (T)} \times ER}$

→ Exchange ratio

Based on positive parameter → [Target (T)] / [Acquirer (A)]

Based on negative parameter → Acquirer / Target

→ Post merger BVPS = Post Net assets / Post shares

(ESC + R&S)

Value of original shareholder

1) Calculate value per share of original sh in merged entity

→ $\frac{V_A + V_T}{N_{AT}}$

2) Calculate value of original shareholder

Shareholder of Acquirer = Value per sh (Step) × NA

Shareholder of Target = value per sh (Step 1) × $[N_T \times ER]$

Economic value added

(EVA) = NOPAT − [Capital eyed × WACC]

NOPAT = EBIT (1 − t) or PAT + Int (1 − t)) + PFDD

CE = ESC + PSC + R&S − FA + Debt + Intangible not w/o + PFDD

WACC $= kd \times \frac{D}{(D+E)} + Ke \times \frac{E}{(D+E)}$

EVA Dividend = EVA / No of eq sh

Financial leverage = PBIT/PBT

Capital Adequacy ratio = $\frac{\text{Capital + Reserves}}{\text{Risk weighted assets (RWA)}}$

→ loan = Equated Annual Installments × PVAF (int, yrs)

EAI = $\frac{\text{loan}}{\text{PVAF(int, yrs)}}$

PORTFOLIO MANAGEMENT

Single security return (R_x) = $\frac{P_1 - P_0 + D}{P_0} \times 100$

Single security risk (σ) = $\sqrt{\frac{\Sigma(X-\bar{X})^2}{N}}$ where, $\bar{X} = \Sigma X/N$

X → % p.a return i.e $\frac{P_1 - P_0 + D}{P_0} \times 100$

Calculation of $\bar{x}$ and σ_n when prob are given

$\bar{x} = \Sigma pX$

$\sigma_x = \sqrt{\Sigma p(x-\bar{x})^2}$ → first square, then multiply by P

→ If cum bonus / dividend is given, take ex bonus exdividend (P_0 or P_1) for return and risk calc

Multi year returns

Simple return (R_x) → $\frac{P_n - P_0 + D}{P_0} \times 100 \times \frac{1}{N}$

Compounded return (R_x) ⇒ $P_n = P_0(1+R_n)^n$

Portfolio return

$R_{xy} = W_x R_x + W_y R_y$

Portfolio risk

$\sigma_{xy} = \sqrt{W_x^2 \cdot \sigma_x^2 + W_y^2 \cdot \sigma_y^2 + 2W_x \cdot W_y \cdot (\sigma_x \cdot \sigma_y \cdot cor_{xy})}$

$\sigma_x \cdot \sigma_y \cdot cor_{xy}$ ↓ $\boxed{covar_{xy}}$

$cor_{xy}(r) = \frac{\text{covariance } xy}{\sigma_x \cdot \sigma_y}$

$cov(xy) = \frac{\Sigma(x-\bar{x})(y-\bar{y})}{N}$ OR $\Sigma p(x-\bar{x})(y-\bar{y})$

$cov(xy) = r_{xy} \times \sigma_x \cdot \sigma_y$

Conditional shortcut

In case, correlation is +1

$\sigma_{AB} = W_A \cdot \sigma_A + W_B \cdot \sigma_B$

In case, correlation is −1

$\sigma_{AB} = W_A \cdot \sigma_A - W_B \cdot \sigma_y$

[ensure first term is a larger term]

• coefficient of variation = $\frac{\sigma_x}{\bar{x}}$

Minimum variance portfolio

$W_x = \frac{\sigma_y^2 - covar(xy)}{\sigma_x^2 + \sigma_y^2 - 2covar(xy)}$

$W_y = 1 - W_x$

Capital Asset Pricing Model [CAPM]

$K_E = R_F + [R_m - R_F] \times \beta$

β → measure of systematic risk

$\beta = \frac{\text{systematic risk of security}}{\text{systematic risk of market}}$

$\beta = r_{sm} \times \frac{\sigma_s}{\sigma_m}$

$\beta = \frac{covar_{sm}}{\cancel{\sigma_s} \times \sigma_m} \times \frac{\cancel{\sigma_s}}{\sigma_m} = \frac{covar_{sm}}{\sigma_m^2}$

β → write till 3 decimals

Total risk of market (σ_m) = systematic risk of market

Systematic risk of security = Total risk of security (σ_s) $\times r_{sm}$

Risk free security

$\beta = 0$ | covar$_{RF \cdot m} = 0$ | cor$_{RF \cdot m} = 0$

Market

$\beta = 1$

If only 2 observations are available with equal probability,

$$\beta = \frac{\text{change in returns of security}}{\text{change in returns of market}}$$

Portfolio beta

$\beta_{xy} = W_x \cdot \beta_x + W_y \cdot \beta_y$

Lines

Security market line

$Ke = RF + [Rm - RF] \times \beta$

Put Rm and RF → which are constant and you get SML

Characteristic line

Regression line

$$\boxed{\alpha = \bar{x} - \beta\bar{m}}$$

$x - \bar{x} = \beta(m - \bar{m})$

$x = \bar{x} + \beta m - \beta\bar{m}$

$x = \bar{x} - \beta\bar{m} + \beta m$

$$\boxed{x = \alpha + \beta m}$$

Capital market line

$Ke = RF + (Rm - RF) \times \sigma_s / \sigma_m$

$$\boxed{Ke = RF + \left[\frac{Rm - RF}{\sigma m}\right] \times \sigma_s}$$

where

$\frac{Rm - RF}{\sigma m}$ → Market reward to risk ratio / Risk return trade off / slope / sharpe ratio

Coefficient of determination $= [corr]^2 / r^2$
↳ Systematic risk / Total risk

Systematic & unsystematic risk

Total risk = Systematic risk + Unsystematic risk

Systematic risk $= r^2_{sm} \times \sigma^2_s$ [numerator of β in sq terms]

OR

$= \beta^2_s \times \sigma^2_m$

Residual variance / unsystematic risk = Total risk − Systematic risk

$[E^2_A] = \sigma^2_A - [\beta^2_A \cdot \sigma^2_m]$

Random error $[E_n] = \sqrt{\text{unsystematic risk}}$

$= \sqrt{E^2 A}$

$= E_A$

Methods to calculate co-variance

→ $covar_{(x,y)} = \frac{\Sigma(x-\bar{x})(y-\bar{y})}{N}$ or $\Sigma P(x-\bar{x})(y-\bar{y})$

→ $covar_{(x,y)} = r_{xy} \times \sigma_x \cdot \sigma_y$

→ $covar_{(x,y)} = \beta_x \cdot \beta_y \cdot \sigma^2 m$

Portfolio risk as per Sharpe

$\sigma_{xy} = \sqrt{\text{Systematic risk} + \text{unsystematic risk}}$

$$= \sqrt{\underbrace{\beta^2_{xy} \cdot \sigma^2_m}_{\text{systematic}} + \underbrace{W^2_x \cdot E^2_x + W^2_y \cdot E^2_y}_{\text{unsystematic}}}$$

→ $\beta_{xy} = W_x \cdot \beta_y + W_y \cdot \beta_y$

Performance evaluation measures

1) Sharpe Ratio $= \frac{R_x - RF}{\sigma_x}$

2) Treynor's ratio $= \frac{R_x - RF}{\beta_x}$

3) Jensen's Alpha $= R_x - Ke$

R_x → Actual / Forecasted return → $\frac{\Sigma x}{N}$ / ΣPx

4

Arbitrage Pricing Theory [APT]
[multifactor model]

$$K_E = R_F + \lambda_{F1}\beta_{F1} + \lambda_{F2}\beta_{F2} + \lambda_{F3}\cdot\beta_{F3} + \ldots$$

where,

λ can be calculated by either of following

$$\lambda_{F1} = R_{F1} - R_F$$

OR

$$\lambda_{F1} = \text{Actual}_{F1} - \text{Expected}_{F1}$$

Portfolio beta under APT

Factor 1: $\beta_{xy}^{F1} = W_x \cdot \beta_x^{F1} + W_y \cdot \beta_y^{F1}$

factor 2: $\beta_{xy}^{F2} = W_x \cdot \beta_x^{F2} + W_y \cdot \beta_y^{F2}$

Portfolio (ke)

$$K_e^{ABCD} = R_F + \lambda_{F1} \times \beta_{F1}^{ABCD} + \lambda_{F2} + \beta_{F2}^{ABCD} + \lambda_{F3}\beta_{F3}^{ABCD} + \ldots$$

Private company valuation

1. find β_E [equity beta] of proxy co.
2. find unlevered β [Asset β] for proxy co

$$\beta_A = \beta_D \times \frac{D(1-t)}{D(1-t)+E} + \beta_E \times \frac{E}{E+D(1-t)}$$

In absence of information, $\beta_D = 0$

3. β_A for our entity / new project [β_A same as above]
4. $\beta_A = \beta_E \times \dfrac{E}{D(1-t)+E}$ [$\beta_D = 0$ assumed]

   Using the above, calculate β_E

5. Apply β_E in CAPM to get ke

Alternatively, WACC can also be calculated as follows

$$WACC = K_D \times \frac{D}{D+E} + K_E \times \frac{E}{D+E}$$

$$WACC = R_F + [R_m - R_F] \times \beta_A$$

Sharpe's optimal portfolio → refer Ajay agarwal concept notes on page 79

MUTUAL FUNDS

→ Net Asset Value (NAV)

$$NAV = \frac{\text{Net assets (fair value/mv)}}{\text{No of units}}$$

→ Annualized yield (% p.a) [RMF]

$$= \frac{NAV_1 - NAV_0 + DI}{NAV_0} \times 100 \times \frac{12}{N}$$

BUSINESS VALUATION

→ Refer Ajay Agarwal's concept notes

FOREIGN EXCHANGE AND RISK MANAGEMENT

Bid rate → Banker's price to BUY the base currency

Ask rate → Banker's price to sell the base currency

Spread = Ask rate (Higher) − Bid rate (lower)

→ Inverse of Bid → will give ask and
Inverse of ask → will give bid

Inflation rate parity theory

$$\frac{F}{S} = \frac{(1+i_{₹})^n}{(1+i_{\$})^n}$$ (For Rs/$ quote)

F → Expected future rate, S → spot rate
i → inflation rate, n → no of years

Exchange rate are for less than a year, then

$$\frac{F}{S} = \frac{(1+i_{₹} \times m/12)}{(1+i_{\$} \times m/12)}$$

Return

$$\left[(1 \pm r\,bond)(1 \pm r_{\$}) - 1\right]$$

Interest rate parity theory

$$\frac{F}{S} = \frac{(1 + r_{I} \times m/12)}{(1 + r_{\$} \times m/12)}$$

$r \rightarrow$ interest rate

Forward discount/premium

Premium → expensive in forward market than in spot market

Discount → cheaper in forward market than in spot market

One currency at premium then other will be at disc

$$\text{Forward premium/discount [ON BASE currency]} = \frac{F-S}{S} \times 100 \times \frac{12}{M}$$

$$\text{Forward premium/discount [on NON BASE currency]} = \frac{S-F}{F} \times 100 \times \frac{12}{M}$$

INTEREST RATE RISK MANAGEMENT

Interest rate futures (Bond future)

Bond price = 100 − Rate of interest p.a (w/o applying N/12)

Strategy → Borrower → SELL
Lender → BUY

$$\text{No of contract} = \frac{\text{Desired borr/lending}}{\text{Future contract (lot size)}} \times \frac{\text{Borr/lending tenure}}{\text{Futures tenure}}$$

Settlement future contract tenure

$$[CSP - (P)\% \times M/12 \times \text{contract size} \times \text{No of contracts}$$

Effective Int = Interest in spot ± Gain/loss in future
(C.O = Negative
C.I = Positive)

$$\text{Effective Int (\%)} = \frac{\text{Effective Int (Rs)}}{\text{Borr (Rs)}} \times 100 \times \frac{12}{M}$$

Forward rate Agreement (FRA)

Borrower → Buys Interest FRA
lender → sells Interest FRA

FRA terminology

FRA 5 × 8 → (A) + Actual tenure of borrowing/lending

(A) Date of entering into FRA upto date of actual borrowing/lending

Time value adjustment

If settlement needs to be done earlier PV can be found by taking prevailing SPOT RATE on date of settlement as discount factor

Arbitrage using Forward rates

1) Calculate theoretical FRA rate:
2) Compare theoretical FRA with actual FRA
3) Strategies

Interest rate options

- Interest rate cap → Protection to floating rate borrowers

$$\text{Notional principal} \times [\text{LIBOR on reset date} - \text{cap rate}] \times \text{months}/12$$

- Interest rate floor → Protection to lender from falling int rate

$$\text{Notional principal} \times (\text{floor rate} - \text{LIBOR on reset date}) \times \text{months}/12$$

Option strategy: collar

Borrower: Buy CAP + Sell floor
Lender: Buy floor + Sell cap

Time value adj on premium

Upfront premium = x (x) PVAF (%; years)

x → Equalised annual premium

DF → fixed int rate when the cap/floor is taken

5

Derivatives Analysis and Valuation

Futures

Theoretical future price (F)

F = Spot price (S) + Cost of carry (C)

i) For a non dividend paying stock

$F = S(1+r)$

(F more than a year, annual compounding)

$F = S[1 + r \times M/12]$

(F < 1 year, no compounding effect)

m → number of months

Continuous compounding

Annual compounding : $F = S(1+r)^N$

$F = S(1 + r/m)^{N \times m}$ → General Half yearly / Daily

m → frequency of compounding

N → Number of years after which future value is to be calculated

$F = S \cdot e^{rN}$ $\boxed{e = 2.71828 \quad \log e = 0.4343}$

r → Int rate % per annum

N → number of years (not months)

ii) For a dividend paying stock

$F = S(1 + r \times m/12) - D(1 + r \times t/12)$

m → no of months for entire future contract

t → no of months in future contract after dividend is received

In case dividend is at end of F.C

$F = S(1 + r \times m/12) - D$

In case dividend at start,

$F = (S-D)(1 + r \times m/12)$

Index Futures Hedging

1) Strategy : offsetting (reverse) position

2) Maturity

3) No of contracts = $\frac{\text{Equity portfolio} \times \beta}{\text{Contract size}}$

(Nifty Futures price × No of nifty per contract)

4) Gain/loss on settlement

Index futures with dividend

$F = S(1 + (r-d) \times m/12)$

$F = S \cdot e^{(r-d) \cdot n}$

COMMODITY FUTURES

Theoretical future price = Spot price + cost of carry ~~me~~ + storage cost − convenience yield

$\boxed{e^0 = 1}$

Hedge ratio (β)

$\beta = r_{SF} \times \sigma_S / \sigma_F$

S → spot market, F → futures market

No of contract = $\frac{\text{Portfolio} \times \beta}{\text{Future contract size}}$

$\boxed{1\,MT = 1000\,kgs}$

MARGINS

Initial margin = Average daily absolute change + 3 × standard deviation of these absolute changes

OPTIONS

Call option → Right to buy [Sx > Xp]

Put option → Right to sell [Sx < Xp]

PAYOFF

Call : Sx − Xp

Put : Xp − Sx

Net pay-off

Net Pay-off = Payoff − upfront premium

= Payoff + upfront premium

In the money → Positive pay off → option is likely to be exercised

At the money → spot price = exercise price

Out of money → No pay-off → option not likely to be exsd.

Option strategies [Same exe price and same expiry date]

Straddle: Buy 1 call + Buy 1 put

Strip: Buy 1 call + Buy 2 puts

Strap: Buy 2 call + buy 1 put

Strangle: Buy 1 call + buy 1 put
↳ (diff ex price / diff expiry date)

Butterfly → Going long at two ex prices and selling two call options at the middle ex price

OPTION VALUATION

i) Theoretical option value

$C_0 = S_0 - PV \text{ of } XP$

$P_0 = PV \text{ of } XP - S_0$

→ ans cannot be negative
→ If int rate is not given, then ignore PV calcn

ii) Binomial option valuation

(a) Replicating portfolio approach

$S_0 X - B = \text{Investment today} \quad —(0)$

$N_1: S_1 X - (1+r)B = C_1 \quad —(1)$

$N_2: S_2 X - (1+r)B = C_2 \quad —(2)$

Solve eqn (1) and (2) and put X & B in eqn (a)

Investment today = premium in case of call option (since payoffs are same)

(b) Risk less hedge approach → [buying x sh & selling 1 call opt]

→ $S_0 X - C_0 = \text{Investment today} \quad (i)$

→ N_1 and N_2: $S_1 X - C_1 = S_2 X - C_2$

→ find X and substitute in N1/N2 to find portfolio value after 1 yr

→ Take PV of that and put in eqn (i)

(c) Risk neutral probabilities

Let probability of upmove be p and downmove be 1 − p

$$S_0 = \frac{S_1 p + S_2 (1-p)}{(1 + r \times m/12)}$$

Using p and 1 − p, calculate value of call option today:

$$C_0 = \frac{C_1 p + C_2 (1-p)}{(1 + r \times m/12)}$$

Call Put Parity theory

$P_0 + S_0 = C_0 + PV \text{ of } XP$

P_0 → Put option premium
S_0 → Spot price today
C_0 → Call option premium, XP → Exercise price

In American options,
C_1 = Higher of (a) PV of future payoff
(b) $S_1 - XP$ (exercise at N1)

Black Scholes model

$$C_0 = S_0 \times N(D_1) - \frac{XP}{e^{rt}} \times N(D_2)$$

$$D_1 = \frac{\log\left[\frac{S_0}{XP}\right] + \left[r + \frac{\sigma^2}{2}\right] \times t}{\sigma\sqrt{t}}$$

$$D_2 = D_1 - \sigma\sqrt{t}$$

Steps

① Calculate $\log[S_0/XP] = \dfrac{\log_{10}(S_0/XP)}{\log_{10} e}$ [Change of base]

② Calculate D1 and D2

③ Calculate normal distribution values of D1 and D2

④ Calculate e^{rt}

⑤ Substitute above values and find C_0

With dividend

Adjusted $S_0 = S_0 - PV \text{ of dividend}$
$= S_0 - \dfrac{D}{e^{rt}}$

Interest rate risk management

Interest rate futures (Bond futures)

Bond price = 100 − Rate of interest p.a

Strategy: Borrower: Sell
Lender: Buy

$$\text{No of contract} = \frac{\text{Desired borr/len}}{\text{Future cont size}} \times \frac{\text{Borr/lending tenure}}{\text{Futures tenure}}$$

Settlement :-

$\{(SP - FP)\% \times m/12 \times \text{Contract size}\} \times \text{No of contracts}$

m → futures contract tenure.