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CA FINAL – NEW SYLLABUS

Simplified!

AFM CONCEPT BOOK

- ✓ Simplified Notes - Concepts In, Stress Out :)
- ✓ Relevant examples - for better understanding
- ✓ 100% COMPATIBLE with Simplified SFM Ques Bank
- ✓ Completely exam oriented
- ✓ Compact - Perfect for last day revision

Finance Acharya
Jatin Nagpal (CA, FRM)

A Big thanks to ...

The Almighty – I bow down to your gentle feet. Nothing can be achieved without your ultimate blessing.

My Parents & Elder brother – Whose continuous support & efforts made this book possible.

My Teachers and guides – The one who enlightens the path and make us capable of walking on that path.

Team Krivi – Everyone for your relentless efforts.

And yes.... **TO YOU ALL STUDENTS** – For showering us with your love, faith and support.

Every effort has been taken to avoid any error or omission in this book. However, if you still find any error or omission then please share it at any of the following-

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AFM Chapter Index

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Update About AFM "Additions"

A few topics have been added in AFM such as:

- Advanced Capital Budgeting
- Real options, Credit derivatives
- Some topics in Corporate Valuation etc.

A small booklet containing these additions will be provided soon. (These Additions only account 5-10% of your AFM Syllabus. Please cover the rest of the subject till we provide these additions)

HOW TO READ THIS BOOK?

1. This book has Active cross-referencing with Simplified AFM Ques book.

Relevant ques number from Simplified AFM Ques book is mentioned at the right side of the topic.

Ex: Breaking down Total risk (TR) into SR & USR (19, 28, 29, 30, 31)

First read the concept from this concept book and then practice these ques from Simplified Ques book.

2. This book contains AFM Practical Concepts.

For Theory -> Download our Simplified AFM Theory book.

Simplified AFM Theory book can be downloaded for FREE from our Telegram channel.

3. For best results, follow Simplified AFM Ques Bank for Ques.

It can be downloaded for FREE from our Telegram Channel 'Krivii Eduspace - Jatin Nagpal (CA, FRM)'

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Chapter 2

Risk Management

Chapter Index

Part A – Understanding & Calculating VAR
Part B – Risk VS Exposure

---- Student's Space for Summary chart and notes ----

PART A: Understanding & calculating VAR

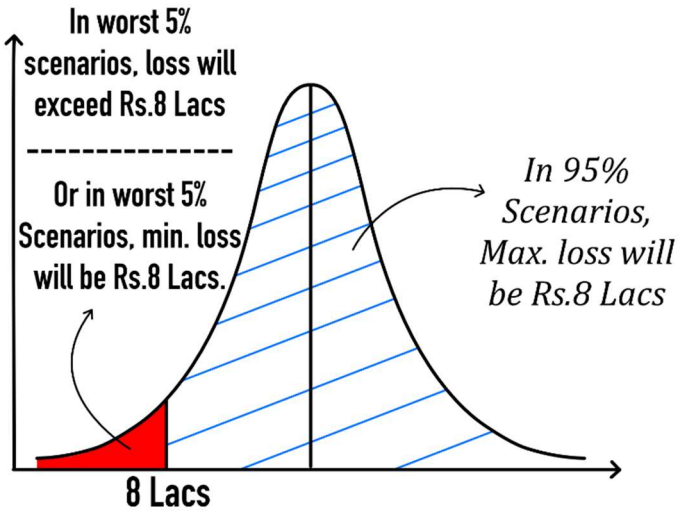
1. Calculating risk using VAR (Value at Risk)

I) INTERPRETATION OF VAR

Illus: 95% 1-day VAR = ₹8 lacs. This means that

i) In 95% scenarios, the maximum loss that one would incur in a day = ₹8 lacs

ii) In 5% of the worst scenarios, the minimum loss that would be incurred in a day = ₹8 lacs



II) CALCULATION OF VAR

In 'Pre-Chapter – Getting friends with ND' we derived that:

VAR = μ – z.SD ...(where μ = mean return)

The formula remains same, with one major change -> Here we assume that μ = 0

∴ The above formula becomes: --> VAR = z.SD

III) VAR HAS 2 DIMENSIONS:

a. Confidence level – Are we calculating risk (VAR) at 95% confidence level, 97.5% or 99% etc.

b. Time period – Are we calculating risk (VAR) for 1-day, 10-days or a year.

IV) CONFIDENCE LEVEL (CL) or Z-SCORE

z-score is calculated from normal distribution corresponding to confidence level at which VAR is calculated.

Learn the following z-scores. For any other confidence level (CL), refer ND table.

	Confidence level ->	90%	95%	97.5%	99%	99.9%
	Z – score ->	1.28	1.65	1.96	2.33	3.09

V) TIME PERIOD (1,2,3)

Variance is proportional to time. ∴ SD is proportional to square root of time.

Hence, this implies that **'VAR IS ALSO PROPORTIONAL TO SQUARE ROOT OF TIME'.**

If 1-day VAR = 6.2%, then → 10-days VAR = 1-day VAR x $\sqrt{t}$ = 6.2% x $\sqrt{10}$ = 19.606%

Ex 1: 10-days variance = 225. ∴ 10-day SD = $\sqrt{225}$ = 15

i. Calculate 1-day variance.

ii. Calculate 1-day standard deviation.

Ans: i) 225/10 = 22.5

ii) 1st method → 1-day SD = Sq. root of 1-day variance = $\sqrt{22.5}$ = 4.74%

2nd method → 1-day SD = 10 days SD / $\sqrt{time}$ = 15 /$\sqrt{10}$ = 4.74%

Hence, Standard is proportional to square root of time.

Ex 2: 1-year SD = 34%. Find 1-day & 10-days 95% VAR. Assume 252 trading days in a year.

Ans: 1-day SD = 34%/$\sqrt{252}$ = 2.14%

1-day 95% VAR = z.SD = 1.645 x 2.14% = 3.5236%

10-days SD = 34% x $\sqrt{10/252}$ = 6.77%

10-days 95% VAR = 1.645 x 6.77% = 11.14%

or Directly, 10-days 95% VAR = 1-day 95% VAR x $\sqrt{10}$ = 11.14% (approx.)

2. Some notes on VAR

1) RELATIVE VAR VS ABSOLUTE VAR

VAR can be expressed in: % → Relative VAR

Amount → Absolute VAR

Ex: James invested ₹1 crore in stock market. 1-day 95% VAR of his portfolio = 6.4%

Relative VAR = 6.4%

Absolute VAR = 1 crore x 6.4% = ₹640,000

II) NUMBER OF DAYS

If nothing is mentioned in question, then assume **252 TRADING DAYS IN A YEAR.**

Also, **1-week = 5 days. And 2-weeks = 10 days** (as Sat & Sun are trading holidays).

III) CONFIDENCE LEVEL (CL) VS SIGNIFICANCE LEVEL (SL)

Significance level = 100 – confidence level

A 90% confidence level means significance level = 10%.

Confidence Level ->	90%	95%	97.5%	99%	99.9%
Significance level ->	10%	5%	2.5%	1%	0.1%
Z-Score ->	1.28	1.65	1.96	2.33	3.09

IMP! When VAR is denoted as VAR(1%), VAR(5%) etc. then this 1% or 5% etc. represents significance level always.

(As no one is interested in calculating VAR at such a low confidence level.)

3. PORTFOLIO VAR (4,5,6)

I) SD IN VAR FORMULA (σ)

SD in above formula = SD of the asset whose risk is calculated. When we calculate risk of:

- stock/foreign currency/bond etc. = Take SD of that stock/foreign currency/bond respectively
- Portfolio = Take SD of that portfolio

II) PORTFOLIO VAR: Method 1

Portfolio VAR = z.SD

where SD = SD of the portfolio.

Recall portfolio Varinace formula → $\sigma_P^2 = (w_a\sigma_a)^2 + (\omega_b\sigma_b)^2 + 2\omega_a\omega_b(\sigma_a\sigma_b r_{a,b})$

III) PORTFOLIO VAR: Method 2

Direct calculation

$VAR_p^2 = (VAR_a)^2 + (VAR_b)^2 + 2VAR_aVAR_b(r_{a,b})$

NOTE! – Take absolute VAR (i.e. VAR in amount) in above formula.

IV) RISK REDUCTION IN VAR DUE TO DIVERSIFICATION (or Benefit of diversification)

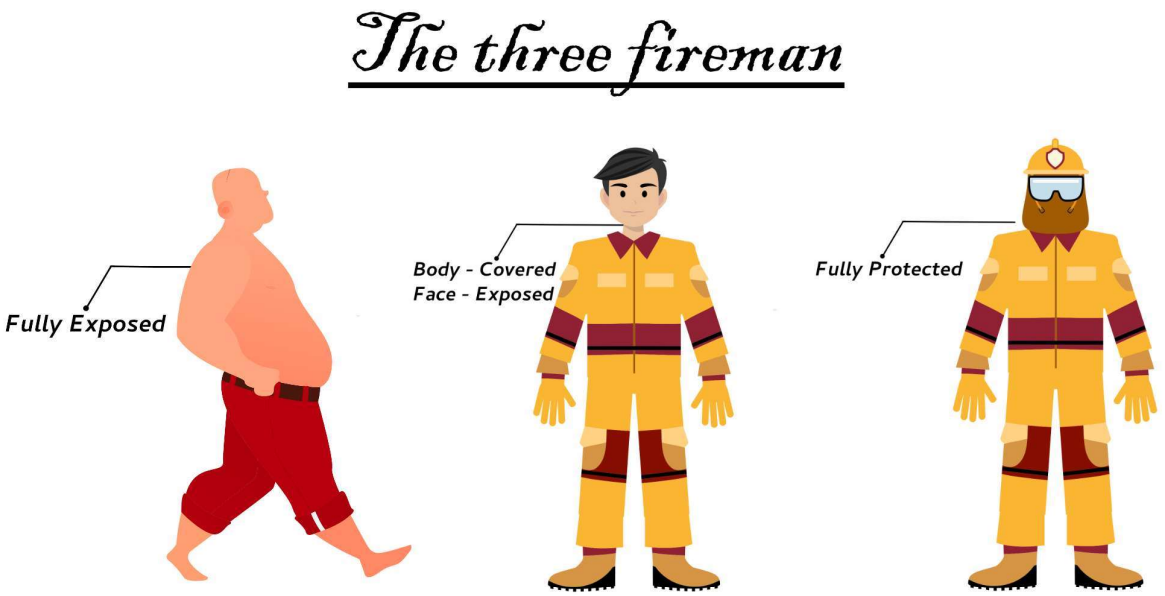
= Sum total of VAR of individual components – VAR of portfolio

= $VAR_A + VAR_B - VAR_{Portfolio}$

PART B: Risk vs Exposure

1. Understanding Exposure

(English meaning of EXPOSURE = unprotected)



- Not wearing any Fire suit. NOT PROTECTED AT ALL.
- Completely exposed to the risk of Fire.

- Wearing Fire suit. Body is protected/covered.
- But not wearing helmet. Face is still exposed/unprotected.

- Wearing complete Fire suit, along with the helmet.
- Fully covered/protected From the risk of Fire.

2. Exposure vs Risk

Ex 1: (Stock market) James has invested ₹1 crores in Ultratech cement ltd.'s stock. Find his exposure if:

Exposure = ₹ 1 crore i.e. unprotected portion.

But risk = how much you can lose on this investment of ₹1 crore within a given time frame, say 1 day or 1 week etc. Certainly, this amount will be far less than 1 crores.

ii) Find exposure if James partially hedged his position using futures. He shorted ₹80 lacs of futures contract.

Since ₹80L out of ₹1 crore is protected using futures contract. Hence, exposure (unprotected) = ₹20 lacs.

Ex 2: An exporter has $2L receivable in 3 months and also $1.5L payable in 3 months . Find his exposure.

Ans: Exposure = $200,000 - $150,000 = $150,000

Chapter 5A

Equity Valuation

Chapter Index

PART A – Dividend Discount Model (DDM)
PART B – Other Valuation Models
PART C – Special/Discrete Topics

---- Student's Space for Summary chart and notes ----

PART A: Dividend Discount Model (DDM)

BASIC NOTATIONS

DPS = Dividend per share	EPS = Earning per share
g = growth rate	Ke = Required return on equity
b = retention ratio	r = return on equity (also denoted by ROE)
PV = Present Value	CMP = Current market price (also denoted by P_0 or MPS)
CY = Current year	PY = Previous year

1. Gordon Model / Dividend Discount Model (DDM) / Growth Model

As per Gordon, if you invest in a share, then you will receive **DIVIDENDS TILL PERPETUITY.**

So, Value = PV of Dividends

(Gordon model is simply PV of future dividends. Super easy if you are comfortable with calculating PV)

I) CASE 1 – DIVIDENDS WILL GROW AT A CONSTANT RATE (1,3,7a, 7b)

$$\text{Value} = \frac{DPS_1}{Ke - g}$$ (i.e. PV of perpetual growth series)

II) CASE 2 – WHEN GROWTH RATE CHANGES – 2 STAGE DDM (8, 11, 12, 13)

Ex : Growth rate is said 15% for first 2 years & then it stabilizes to 6% p.a.

$$\text{Value (in this case)} = \frac{DPS_1}{(1+ke)} + \frac{DPS_2}{(1+Ke)^2} + \frac{DPS_3}{Ke-g} \times \frac{1}{(1+Ke)^2}$$

III) PRICE AT THE END OF NTH YEAR IS GIVEN (23a, 23b)

Value = PVCI. Simply calculate PV of CFs i.e. Dividend + Sales proceeds. That will be the value of share.

Ex. DPS_1 = ₹5. DPS_2 = ₹7. Expected sale price after two years = ₹200. Find value today if Ke = 15%.

A: $\text{Value} = (PVC1) = \frac{5}{1.15} + \frac{7+200}{1.15^2} = ₹141$

IV) SPECIAL NOTE – DIVIDENDS

a. Value = PV of **FUTURE** dividends (DPS_1). So only FUTURE DIVIDENDS matters. Past dividends are never discounted

b. IF DPS_1 IS NOT DIRECTLY GIVEN: $DPS_1 = DPS_0 (1+g)$

or $DPS_1 = EPS_1 (1-b)$

C.

NEXT YEAR DIVIDEND OR D1 IS ALSO KNOWN AS	CURRENT YEAR DIVIDEND OR D_0 ARE ALSO KNOWN AS
Dividend yet to be paid	Dividend paid
Dividend at the end of year 1	Last year dividend
Expected dividend	Dividend as on today

d. Dividend generally given in "Historical" Financial Statements (Balance Sheet, Income Statement) is DPS_0.

e. Dividend rate % → Calculated on Face-value.

Dividend yield % → Calculated on Market-Price.

2. Growth Rate (2)

Growth rate = b*r (b = retention ratio and r = return on equity)

Note: If growth rate = 12% p.a. Then what does it imply? Dividend will grow at 12%? Or EPS will grow at 12%?

Ans -> Both. **(UNLESS DIVIDEND PAY-OUT RATIO IS CHANGING).**

II) WHEN G = 0 (NO GROWTH) (6)

No growth (g = 0): Value = $\frac{DPS_0}{Ke}$ or $\frac{EPS_0}{Ke}$

1. g = b*r. If g = 0, then it means retention ratio (b) = 0 (as r cannot be 0).
2. No growth means -> $EPS_0 = EPS_1$ & $DPS_0 = DPS_1$
3. Also, retention ratio = 0. So $EPS_1 = DPS_1$.

III) WHEN G IS NEGATIVE (9)

Value = $\frac{DPS_0 (1 + -g)}{Ke - (-g)}$ => $\frac{DPS_0 (1 - g)}{Ke + g}$

ADVICE - It does not matter whether it is -> Normal growth, No growth or Negative growth.

The formula for all these cases is same i.e. Value = $\frac{DPS_0 (1 + g)}{Ke - g}$

Simply put the value of g in the above formula and you'll get the answer.

IV) WHEN G > KE (4)

If long-term growth rate > Ke, then it not possible to calculate value via Gordon growth model.

In exam simply write – ' g > ke, hence it is not possible to use Gordon growth model.'

V) CALCULATING G USING HISTORICAL DIVIDEND DATA (10)

Sometimes details related to growth rate is not directly given in ques, but historical DPS data is given.

In such cases, we can estimate CAGR (compounded annual **GROWTH RATE**) using historical DPS data.

Ex:

Year	2018	2019	2020	2021	2022
DPS	15	17	20	22	24

Calculate growth rate from the given data.

A: $DPS_{2018}(1+g)^4 = DPS_{2022}$

$15(1+g)^4 = 24$ => g = 0.1246 or 12.46%

3. Return on Equity

ROE tells us how much the company is able to earn for its equity shareholders.

$$ROE = \frac{\text{Earnings available for Equity Shares}}{\text{Equity Shares Funds (PUSC + R\&S)}}$$

Ex: If shareholders invested ₹1000 in a company & the company generates an ROE of 18%.

This means that the co. was able to earn 1000x18% = ₹180 for its shareholders.

(Now this 180 may be paid to shareholders as dividend or maybe retained by the co.)

II) RETURN ON EQUITY (ROE) VS REQUIRED RETURN

	Return on Equity	Required / expected return on equity
•	This is what the **MANAGEMENT** of the company is **ABLE TO EARN** on the equity shareholder's funds.	This is what the **EQUITY SHAREHOLDERS** of the co. **WANT TO EARN** on their investment in the company.
•	Used to estimate the future earnings of the co. & in estimating the growth rate of the company.	This is used as a discount rate to calculate the VALUE that the investors will be willing to pay.
•	$ROE = \frac{\text{Earnings available for ESHs}}{\text{ESH's Funds}}$	There are several ways to calculate the Required rate on equity such as CAPM etc.

4. Dividend policy

Let us say company has ₹100 as retained earnings. ESHs' require 15% return on this i.e. Ke = 15%.

If co. is can earn more than 15%, then retain entire ₹100 and invest it itself.

If co. can earn < 15% (i.e. ROE < 15%) then its better to distribute it & let SHs' invest themselves.

	Scenario	Preference	Optimum Dividend	Optimum Retention
1.	If ROE > Ke	Co. should invest (as it can earn better)	0%	100%
2.	If ROE < Ke	SHs shall invest themselves (Co. pay dividends)	100%	0%
3.	If ROE = Ke	Indifference point	Any (0-100%)	Any (0-100%)

5. Cost of equity (Ke)

I) AS PER CAPM

$Ke = R_F + (R_M - R_F) \times Beta$ (more detail in Portfolio Chapter)

II) USING EXISTING MARKET PRICE TO CALCULATE KE

$P_0 = DPS_1 / (Ke - g)$

Simply put all the values in the above equation & calculate Ke.

Ex: CMP of Kadak ltd. is ₹150. It paid a dividend per share of ₹12. Find Ke if growth rate of the co. is 6%.

A: $\text{Value} = \frac{DPS_0 (1 + g)}{Ke - g}$

$150 = \frac{12 \times 1.06}{Ke - 0.06}$ => $Ke - 0.06 = \frac{12.72}{150}$ => Ke = 0.1448 or 14.48%

IMP! Why are we not solving Ke using direct formula (i.e. $Ke = DPS_1/P_0 + g$)?

Reason: Above formula works only if the ques is straight-forward. But fails miserably if ques is twisted.

Ex : Calculate Ke if CMP = ₹50. DPS1 = ₹2. DPS2 = ₹4. Dividend will grow at 6% p.a. after that.

Ans: Step 1: Write the Equation

$\text{Value} = \frac{DPS_1}{1+Ke} + \frac{DPS_2}{(1+Ke)^2} + \frac{DPS_3}{Ke - g} \times \frac{1}{(1+Ke)^2}$

- $50 = \frac{2}{1+Ke} + \frac{4}{(1+Ke)^2} + \frac{4 \times 1.06}{Ke - 0.06} \times \frac{1}{(1+Ke)^2}$

Step 2: Solve Ke using Hit & trial. Just like IRR

Let Ke = 15%

Value = $\frac{2}{1.15} + \frac{4}{1.15^2} + \frac{4 \times 1.06}{0.15 - 0.06} \times \frac{1}{1.15^2}$ = ₹40.39

Similarly, Value if Ke is 12% = ₹58.20

IRR = Lower% + $\frac{\text{(Change in \%)}}{\text{(Change in value)}}$ x (Required Value – Value @ Lower%)

IRR = 12% + $\frac{(3\%)}{(40.39 - 58.20)}$ x (50 – 58.20) = 13.38%

Hence, cost of equity (Ke) = 13.38%

Ex: DPS_1 = ₹5. DPS_2 = ₹7.

We expect to sell shares at the end of 2nd year for ₹200. Calculate Ke if CMP (Current market price) = ₹141.

Ans: Value = $\frac{DPS_1}{1+Ke} + \frac{DPS_2 + \text{Sale price}}{(1+Ke)^2}$

$141 = \frac{5}{(1 + ke)} + \frac{7 + 200}{(1 + Ke)^2}$

Using Hit & Trial like above, we can calculate Ke = 15%.

Note from Finance Acharya Jatin Nagpal –

So now you can see that a ques for calculating Ke using market price of share can be framed in many different types. It is completely impractical to cram formulas for each type. (Also, if the ques is twisted differently then all the crammed formulas will go useless!).

That's why you must always prefer conceptual approach over formula approach.

6. Tiny topics (Wheels)

I) OVER-VALUED OR UNDER-VALUED?

If current market price (CMP) < Intrinsic Value → under values

If CMP > Intrinsic Value → over-valued. (Sell)

If CMP = Intrinsic Value → correctly valued (Hold)

II) HOLDING PERIOD RETURN (HPR) (22a, b)

a. Dividend Yield = $\frac{\text{Dividend received during the year}}{\text{PRICE at which investment is made}} = \frac{D_1}{P_0}$

b. Capital Gain Yield = $\frac{\text{Capital gain}}{\text{PRICE at which investment is made}} = \frac{P_1 - P_0}{P_0}$

c. Holding Period Yield (HPY) = $\frac{\text{Total return}}{\text{Initial investment}} = \frac{D_1 + (P_1 - P_0)}{P_0}$

III) CONCEPT OF FLOATATION COST (21)

Flotation cost means the cost that is incurred to issue new securities in the market.

(Obviously, this cost is relevant only when a company is issuing a new security).

If floatation cost is given, then deduct the floatation cost from the issue price and take the net price.

i.e. Net Price = Issue price x (1 – floatation cost).

IV) PV OF GROWTH OPPORTUNITY (PVGO) (19)

PVGO = Value with growth (-) Value without growth

PART B: Other Valuation Models

1. Walter model (14, 15, 16)

Value as per Walter Model = $\frac{DPS}{Ke} + \frac{r \times REPS}{Ke^2}$

Where : RPES = Retained Earnings per share r = return on equity

Note: A very critical assumptions of Walter model: **DPS, EPS, Ke, ROE, REPS ALL ARE ASSUMED TO BE CONSTANT.**

2. Earnings Growth Model (Only use this if question specifically mentions!!) (17)

Value of share = $\frac{\text{Next year earnings}}{\text{Discount rate} - \text{Growth rate}}$ or $\frac{EPS_1}{Ke - g}$ or $\frac{EPS_0(1+g)}{Ke - g}$

3. PE Multiple Approach (Rarely used! Only use this if question specifically mentions!) (18a, b)

PE Ratio = $\frac{MPS}{EPS}$

-> **MPS = EPS x PE RATIO**

Under this approach, PE ratio will not be given.

We will have to use the formula -> **PE ratio = 1/Ke**

4. H – MODEL (31)

Value = $\frac{DPS_0 (1 + G_n)}{Ke - g} + \frac{DPS_0 \times H \times (G_a - G_n)}{Ke - g}$

Where, G_a = Abnormal growth rate

G_n = Normal growth rate

H = Years of abnormal growth ÷ 2

5. Yield approach (A/cing Method) (Ques Covered in bonds)

Value = $\frac{\text{Actual yield \%}}{\text{Expected yield\%}} \times$ Paid up value per share

* Actual Yield % = $\frac{\text{Yield on Equity share}}{\text{Equity share capital}} \times 100$

* Expected yield % = Yield on similar company ± risk premium of company.

PART C: Special / Discrete Topics

1. Home-made dividend (24)

A scenario where you need at least a minimum dividend p.a.

But if actual dividend < Required dividend → Then sell some shares to get required CF.

Ex. Minimum required dividend = ₹5,000.

But dividend received = ₹4,000 only.

Current share price = ₹250.

So, sell 1,000/250 = 4 shares to get balance ₹1,000.

2. Value of company due to a new project NPV (20)

New value of company = Existing value ± NPV of new project.

Ex: CMP of Toolkit ltd. = ₹60 per share. The co. has won a new contract which is expected to have an NPV of ₹30 crores. Find new MPS if there are 10 crores outstanding shares.

A: Method 1 – Preferred

Current total market value of co. = 60 x 10 crores = ₹600 crores.

New value = Existing Market value + NPV of new project = 600 + 50 = ₹650 crores.

New Market Price per Share = ₹650/10 = ₹65/share

Method 2:

New MPS = CMP + NPV per share

= 60 + 50 crores / 10 crores = 60 + 5 = ₹65

3. Taxes (26)

Let us say there are two identical countries. India 1 & India 2.

		India 1	India 2
	Gross Salary	1,00,000	70,000
(-)	30% tax in India 1	(30,000)	
	NIL tax in India 2 (i.e. tax-free)		---
=	Net Salary	70,000	70,000

Ques 1 - Which country should you prefer?

Ans: Indifferent. Prefer any as "Net Salary" in both the countries is same. Since, ultimately, you'll get ₹70,000 in our bank account in either case.

Ques 2 – It let's say that you require ₹200,000 as salary in India 1 (taxable country – 30% tax rate) then how much salary would you demand in India 2 (Tax-free country)?

Ans: After-tax salary in India if Gross salary is ₹200,000 = 200,000 x 0.7 ₹1,40,000

Therefore, required salary in India 2 (Tax-free country) = ₹1,40,000

Ex: Currently dividends are taxed at 20% in the hands of shareholder.

You are an equity shareholder of Urdhav ltd. Your current required return from the company is 15%.

What would be your new required return, if the govt. makes an amendment related to dividend tax and

Case 1 – Makes dividends completely tax-free.

Case 2 – Tax rate on dividends is reduced to 10%.

Case 3 – Tax rate on dividends is increased to 30%.

Ans: Concept – Current **NET** required return (after tax) = 15% x (1-0.2) = 12%

So, I will require a NET return of 12% from the co. irrespective of the dividend tax rates.

Case 1: If dividends are completely tax-free, then required return = 12%.

Case 2: If 10% dividend tax is levied, then required return = 12% ÷ (1 – 0.1) = 13.33%

Case 3: If 30% dividend tax is levied, then required return = 12% ÷ (1 – 0.3) = 17.14%

4. When Bonus shares are Expected (29)

Value = PVCI

Due to Bonus our dividend & cash flow receipts may increase.

Ex: Currently I have 4 shares. DPS = ₹5/share

Total current dividend = 5x4 =₹20.

Received Bonus 1 : 4. New shares = 4 + 1 = 5 shares.

-> New total dividend = 5x5 = ₹25 (Assuming DPS remain same).

Imp: Bonus will also affect our sale proceeds. For instance, in the above ex if you sell your shares for ₹100 per share, then total sale proceeds will be = 5 x 100 = ₹500 ~~(& not 4 x 100 = ₹400)~~

5. Cal. Operating Profits & Making Income Statement (25)

- ASSET TURNOVER RATIO = $\frac{\text{Sales}}{\text{Total assets}}$

- OPERATING PROFIT RATIO = $\frac{\text{Operating Profit}}{\text{Total Sales}}$ or $\frac{\text{Sales} - \text{Operating costs}}{\text{Total Sales}}$

Operating costs does not include costs like Interest expense. These are financing costs.

II) FORMAT OF INCOME STATEMENT

	Particulars	Amount (₹)
	Total Sales	xxx
(-)	Operating Costs	(xxx)
=>	**Operating Profits or EBIT (Earning before Interest and tax)**	**xxx**
(-)	Interest expenditure	(xx)
=>	**EBT (Earning before tax)**	**xxx**
(-)	Tax expense	(xxx)
=>	**EAT (Earning after tax)**	**xxx**
(-)	Preference Dividend	(xx)
=>	**Earnings available for Equity shareholders**	**xxx**
(-)	Equity Dividend	(xxx)
=>	**Retained Earnings**	**xxx**

Chapter 5B

Bonds (Fixed Income)

Chapter Index

PART A – Valuation of Bonds + Basic Concepts
PART B – Bond Yield (Req. Return)
PART C – Duration, MD, Convexity
PART D – Tiny Topics
PART E – Convertible Bonds

---- Student's Space for Summary chart and notes ----

PART A: Valuation of Bonds + Basic concepts

1. INTRODUCTION

I) Article ltd. issued 8%, 3 years debentures of ₹1,500 each to Mr. CA Principle What does this means?

Interest rate / coupon rate on debenture = 8%

Maturity / life / Tenor of bond = 3 years (This is represented by 'n')

Face value of the bond = ₹1,500

Note: Face value is the amount on which interest is paid. This is not the price or value of the bond.

In this case, the interest that will be paid = 1500 x 8% = 120

II) IMPORTANT ASSUMPTIONS (IF INFORMATION IS MISSING IN QUES)

If life is missing in ques → Assume Perpetuity

Face value is missing → ₹100 or ₹1000 as per the framing of ques.

Redeemable value (RV) is missing in ques → Redeemable at par

III) SOME USEFUL SHORT-FORMS THAT WE WILL USE THROUGHOUT THIS CHAPTER

Interest -> Int or I

Redeemable value -> RV

Number of 'Periods' to maturity -> n

Required yield or Discount rate of bond -> kd

1% = 100 basis points (bps). Ex: 50 bps = 0.5%, 200 bps = 2% and so on.

2. BOND VALUATION: TYPE 1 (Where examiner plays with Cash flows)

Remember – Value of a financial asset = PVCI. The same is true for bonds as well.

I) NORMAL BOND (PLAIN VANILLA BOND) (1)

Interest paid yearly / quarterly etc. and Principal redeemed at maturity.

Value = Interest x PVAF (kd%, n periods) + Redeemable value x PVF (kd%, n^{th} period)

II) PERPETUAL / IRREDEEMABLE BOND

Interest received till perpetuity. Principal never paid back.

Value = Interest / Kd (PV of perpetual Cash flows)

III) ZERO COUPON BOND OR DEEP DISCOUNT BONDS

No interest paid. Only face value of maturity is received at maturity.

Value = RV ÷ $(1 + Kd)^n$

IV) CHANGING / VARIABLE COUPON RATE (2)

The coupon rate of bond changes over the life of the bond AS PER CONTRACT.

Ex 1: Weak & Power ltd. issued 5-year Bonds of ₹100 face value. The coupon rate for the first 2 years is 14% and for years 3-5 is 16%. Find the value of bond if the required rate of return is 12%.

Ans:

Year	Cash flow
1	100 x 14% = 14
2	100 x 14% = 14
3	100 x 16% = 16
4	100 x 16% = 16
5	100 x 16% = 16
5	Principal = 100

$$\text{Value} = \frac{14}{(1.12)^1} + \frac{14}{(1.12)^2} + \frac{16}{(1.12)^3} + \frac{16}{(1.12)^4} + \frac{16}{(1.12)^5} + \frac{100}{(1.12)^5} = ₹111.04$$

Important - Do not get confused!

- VARIABLE COUPON BOND VS FLOATING COUPON BONDS

In variable coupon bond the coupon rate changes as per **contract i.e. the coupon rate is already defined in the contract.** However, in case of floating rate bond the coupon changes as per **prevailing market rate.**

- Also, do not confuse this type with 'Changing discount rate' or 'forward rates'. In case of changing discount rate, the coupon paid on bond remains same but the discount rate (Kd) changes over period.

V) SELF-AMORTIZING BONDS (4)

Some principal amount is every year. Interest paid on the balance amount.

$$\text{Value} = \frac{\text{Int.} + \text{Principal repaid}}{(1+kd)^1} + \frac{\text{Int on balance amount} + \text{Principal repaid}}{(1+kd)^2} + \ldots\ldots\ldots\ldots\ldots$$

VI) SPECIAL CASE 1 – INTEREST IS COMPOUNDED (RE-INVESTED) AT KD. (8)

Interest is compounded every year and received as a lumpsum amount at maturity along with principal.

Illus: If you deposit ₹100 today and interest on deposit is 14% p.a. What will be the future value after 3 years?

Ans: $FV = PV \times (1+r)^n = 100 \times (1.14)^3 = ₹148.15$

Ex 2: Shana ltd. issued a 14%, 3-year bond of ₹100 Face value. The interest will be paid cumulatively after 3 years along with the original principal amount of ₹100. Find the value of the bond if your required return = 12%.

Ans: Total Amount receivable after 3 years = $100 \times (1.14)^3 = 148.15$

Value of bond = PVCI = $\frac{148.15}{(1.12)^3}$ = ₹105.45

VII) SPECIAL CASE 2 - INTEREST IS COMPOUNDED AND RE-INVESTED AT A DIFFERENT RATE. (25)

Simply calculate future value of cash flows using the reinvestment rate. Discount it to get bond value.

Ex 3: Blue Bear ltd. issued a 12% 3-year bond. You believe that interest payments can be re-invested at 8% p.a. Find the bond value if required yield to maturity is 11.75%. Assume face value = 100.

Ans:

Year	Cash flow	Future value @ end of 3 years
1	100 x 12% = 12	$12 \times (1.08)^2 = 14$
2	100 x 12% = 12	$12 \times (1.08)^1 = 12.96$
3	12 + 100 = 112	$112 \times (1.08)^0 = 112$
		Total = 138.96

Value of bond = PVCI = $138.96 / (1.1175)^3$ = ₹99.57

3. BOND VALUATION: TYPE 2 (Where examiner plays with discount rate)

I) SPOT RATES CHANGES OVER PERIOD

Ex 4: Find value of a 10%, 4-year bond with face value = ₹100. Required yield is as follows

Years	Spot rate or Zero rate
1	8%
2	9%
3 years and above	11%

Ans: The bond will pay coupon of ₹10 p.a. (i.e. 100 x 10%).

$$\text{Value} = PVCI = \frac{10}{1.08^1} + \frac{10}{1.09^2} + \frac{10}{1.11^3} + \frac{10+100}{1.11^4} = ₹97.448$$

II) FORWARD RATES (19, 20a &b)

Ex 5: Find value of a 10%, 4-year bond with face value = ₹100. Required yield is as follows

Years	Forward rates (FR)
1	8%
2	9%
3 years and above	11%

Ans: The bond will pay coupon of ₹10 p.a. (i.e. 100 x 10%).

$$\text{Value} = PVCI = \frac{10}{1.08} + \frac{10}{1.08 \times 1.09} + \frac{10}{1.08 \times 1.09 \times 1.11} + \frac{10+100}{1.08 \times 1.09 \times 1.11 \times 1.11} = ₹101.25$$

III) CREDIT RATINGS (7)

In such ques we are not provided with kd directly. Rather info about credit rating of bond and credit spread is given.

Illus: Credit spreads of different bonds as per its credit rating is given below. T-Bill rate is 5.8%

Rating	Spread	Required Yield
AAA	T-Bill rate + 0.8%	5.8% + 0.8% = 6.6%
AA	AAA + 1.2%	6.6% + 1.2% = 7.8%
A	AA + 1.95%	7.8% + 1.95% = 9.75%
BBB	A + 2.2%	9.75% + 2.2% = 11.95%

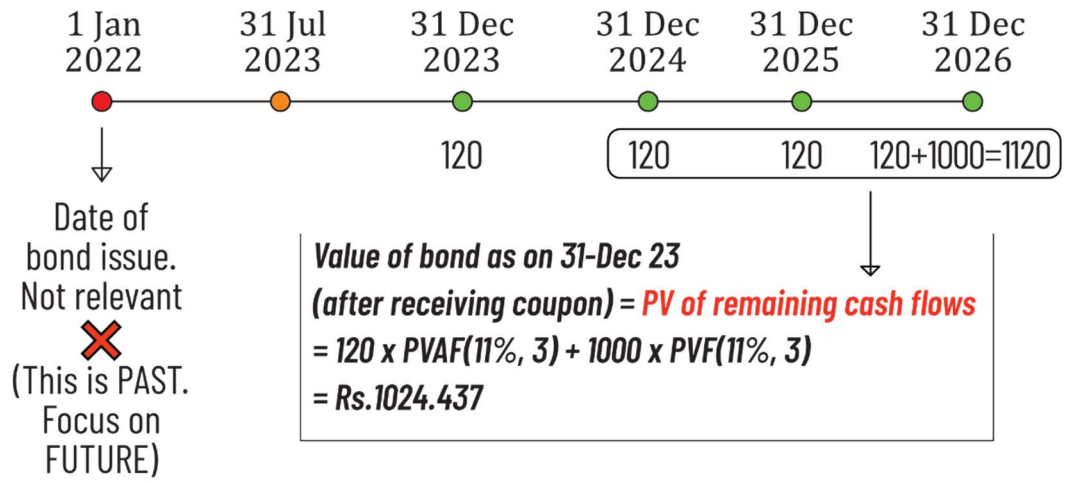
4. BOND VALUATION: TYPE 3 (Valuation in b/w coupon dates) (50)

We will understand this with the help of an example.

Ex 6: A 5-year bond was issued on 1-Jan-22. It will make annual coupon payment of ₹120 p.a. on its face value of ₹1000. Find the value of bond on 1-July-23. Required return on bond = 11% p.a.

Ans: Step 1 – Find the bond value as on next coupon date.

In this case, we want to calculate bond value as on 1 July, 2023. So, next coupon date = 31 Dec, 2023.



Value of bond as on 31 Dec 23 = PV of **remaining cash flows**

$$= \frac{120}{1.11^1} + \frac{120}{1.11^2} + \frac{120 + 1000}{1.11^3} = ₹1024.437$$

- Now informally speaking, what I have on 31 Dec 23 = A bond worth ₹1024.437 + Coupon of ₹120.

Total = 1024.437 + 120 = ₹1144.437

Step 2: Value as on 1 July 23 = PVCI = ₹1144.437 / $1.11^{6/12}$ = ₹1086.25

Hence, value of bond as on 1 July 23 = ₹1086.25.

II) CLEAN PRICE VS DIRTY PRICE

Clean price = Exclusive of accrued interest

Dirty price = Inclusive of accrued interest = Clean price + Accrued interest

In the above example, Dirty price = ₹1086.25.

Accrued interest = 1000 x 12% x 6/12 = ₹60

So, Clean price = 1086.25 – 60 = ₹1026.25

5. BOND VALUATION: TYPE 4 (Floating rate bond)

I) INTRODUCTION

In case of floating rate bond, the coupon rate is linked to a benchmark rate such as LIBOR, MIBOR etc.

Illus: A 5-year Floating coupon rate bond with interest rate = LIBOR + 2%.

This means that coupon amount is not fixed for entire 5-years (unlike traditional bonds). Instead coupon amount shall be decided as per the prevailing LIBOR.

II) PROCESS OF RESETTING COUPON RATE.

A floating rate bond's coupon rate reset at pre-defined intervals. Let us understand it with an example.

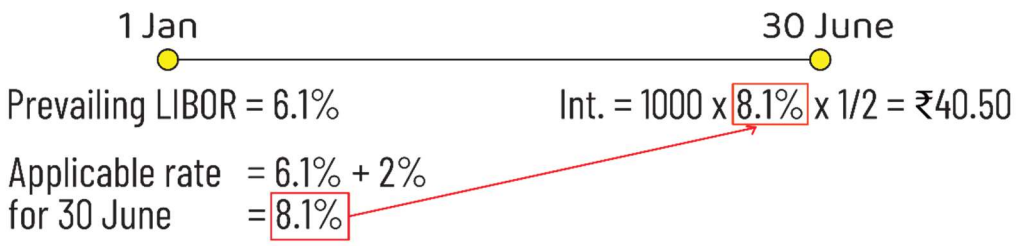
Ex 7: A floating rate bond is issued on 1st Jan at LIBOR + 2%. It will pay interest semi-annually. Find the interest that bond holder will receive on 30th June and 31st Dec respectively if LIBOR turns out as following:

Date	LIBOR
1 Jan	6.1%
30 June	6.4%
31 Dec	5.95%

Face value of bond = ₹1000.

A: The coupon amount to be paid on next reset date is decided on previous date.

i.e. interest to be paid on 30 June will be decided as per the prevailing LIBOR on 1 Jan.



Date	Applicable LIBOR rate	Rate applicable	Interest amount
30 June	6.1% (i.e. 1 Jan LIBOR)	6.1% + 2% = 8.1%	1000 x 8.1% x ½ = ₹40.50
31 Dec	6.4% (i.e. 30 Jun LIBOR)	6.4% + 2% = 8.4%	1000 x 8.4% x ½ = ₹40.50

III) VALUE OF FLOATING RATE BOND ON RESET DATE (3)

A floating rate bond always trades at par **on the reset date (i.e. date on which the coupon rate is reset).**

This is because on reset date -> Market yield = Coupon rate.

So, in the above example, we can say that the bond will trade at par on 1 Jan, 30 June and 31 Dec.

IV) VALUE OF FLOATING RATE BOND IN BETWEEN RESET DATES

Ex 8: In the above example, calculate value of bond 1st March. 4-months LIBOR on that date is 6.3% p.a.

Ans: Cash flow as on 30 June = Par value of floating bond + Coupon amount

= 1000 + 40.5 = ₹1040.5

$\therefore$ Value on 1st March = PVCI = $\frac{1040.5}{1 + 0.083 \times 4/12}$ = ₹1012.49

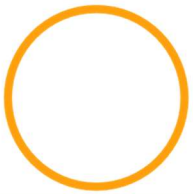
6. BOND VALUATION: TYPE 5 (Different compounding periods) (9)

	Half-yearly	Quarterly	Monthly
Interest per period	Int p.a. ÷ 2	Int p.a. ÷ 4	Int p.a. ÷ 12
Yield per period	Yield p.a. ÷ 2	Yield p.a. ÷ 4	Yield p.a. ÷ 12
Number of periods	n x 2	n x 4	n x 12

Ex 9: A co. issued 12%, 4 years debentures of FV = ₹1000. The required yield on similar bonds is 9%. Find the value of the bond if interest is paid (i) Half yearly (ii) Quarterly (iii) Monthly

Ans:

	Half-yearly	Quarterly	Monthly
Interest per period	120/2 = 60	120/4 = 30	120/12 = 10
Yield per period	9% / 2 = 4.5%	9% / 4 = 2.25%	9% / 12 = 0.75%
Number of periods	4 x 2 = 8	4 x 4 = 16	4 x 12 = 48
Bond value	60.PVAF(4.5%, 8)	30.PVAF(2.25%, 16)	10.PVAF(0.75%, 48)
	+ 1000.PVF(4.5%,8)	+ 1000.PVF(2.25%,16)	+ 1000.PVF(0.75%, 48)
	= ₹1098.93	= ₹1099.84	= ₹1100.46



PART B: Bond Yield (req. return)

1. INTRODUCTION TO YIELD / REQUIRED RETURN / KD / YTM

I) DISCOUNT RATE (also known as Required return, Cost of debt – Kd, YTM etc.)

- **EXPECTATION** of investor or the required / desired rate of return of investor.
- It is the rate **USED TO CALCULATE THE PRESENT VALUE** of cash inflows from an asset.
- Depends on several market factors such as risk-free rate, risk factor of the company, inflation etc.
- Can change from time to time due to change in market factors.

II) COUPON RATE – Rate at which Interest is calculated on the debenture. It is paid as per the contract.

Illus: Debenture – Face value = ₹100. Coupon rate = 7%.

Interest on debenture = 100 x 7% = ₹7

2. Relation between Yield & Value of bond.

I) INVERSE RELATION

Bond Value and yield has an **inverse relation.** So, if **yield increases -> Bond value falls and vice-versa.**

Illus: Brinjal ltd. issues 10%, 4-years bonds if FV ₹1000 each.

Value if yield is 10% = 1,000

Value if yield is 12% = 939.25 -> when yield increases, value of bond falls.

Value if yield is 8% = 1066.24 -> when yield decreases, value of bond rises.

II) THE PAR, THE PREMIUM & THE DISCOUNT

If YTM = Coupon rate -> Bond will trade at PAR

If YTM > Coupon rate -> Bond will trade at DISCOUNT

If YTM < Coupon rate -> Bond will trade at PREMIUM

3. How to calculate yield?

There are two ways to calculate yield.

A) Using approx. formula B) Using IRR Technique

I) APPROX. FORMULA – WITHOUT TAXES (10)

$$YTM = \frac{\text{Interest} + (RV - CMP) \div \text{No. of periods}}{(RV - CMP) \div 2}$$

Note: There are two types of taxes. Tax on interest income received by the bond-holder (income tax) and capital gain tax. If nothing is mentioned, always assume 'INTEREST RATE TAX'.

II) IRR METHOD (10)

$$\text{Value} = \underbrace{\frac{\text{Int. 1}}{(1+kd)^1} + \frac{\text{Int. 2}}{(1+kd)^2} + \ldots\ldots\ldots\ldots + \frac{\text{Int. n}}{(1+kd)^n} + \frac{\text{Redeemable value}}{(1+kd)^n}}_{\text{PVCI}}$$

PVCO

Using the IRR technique of Hit & trial, you can solve for Kd.

NOTES:

1. IRR is a better method (as it provides more accurate answer). But in exam you can use approx. method as well as it saves a lot of time (unless specifically mentioned to use IRR).
2. When calculating yield, should we take the actual price of the bond or its Intrinsic value?
   We require **bond price** to calculate yield.
   IF NOTHING IS GIVEN IN QUES -> THEN ALWAYS ASSUME VALUE = PRICE
3. Do not use approx. method to reverse calculate bond value.

III) YIELD OF PERPETUAL BOND (12, 13)

$$\text{Price of a perpetual bond} = \frac{\text{Interest per period}}{Kd}$$

(Simply put all values & calculate kd.)

IV) YIELD OF ZCB (11)

$$\text{Price of ZCB} = \frac{\text{Redeemable Value}}{(1 + Kd)^n}$$

(Simply put all values & calculate kd.)

V) YIELD ON SIMILAR BOND

If Bond A and Bond B are 2 similar bonds. YTM of Bond A = 12%. Then YTM of Bond B should also be 12%.

So, if ques gives details of Bond A & asks to calculate YTM of similar bond -> then it will be = Bond A YTM.

4. Role of taxes when calculating YTM

I) IMPACT OF TAXES

Taxes reduce the amount of cash that you will receive from an investment. (Remember: Value = PVCI)

TWO TYPES OF TAXES

Interest rate tax		**Capital gain tax**	
Interest (before tax)	xxx	Sale/ redemption value	xxx
Less: Tax on interest	(xx)	Less: Tax on capital gain*	(xx)
Cash flow net of tax	xxx	CG tax = (RV - Purchase price) x Tax%	
		=> Cash flow net of tax	xxx

- Always take CF net of tax when calculating bond value or yield (we are concerned with what CF we get)

II) CALCULATING YTM – WHEN TAXES ARE GIVEN IN QUES (15, 16, 17)

YTM (post-tax) = Int (net of **income** tax) + (RV* - CMP) ÷ No. of periods

(RV* - CMP) ÷ 2

where: RV* = Redemption value (net of **capital gain** tax)

III) CHOOSE A BOND (Taxable bond vs Tax-free bond)

Bond 1 - Taxable bond with net yield = 12%

Bond 2 – Tax free bond with yield = 12%

Ans: Indifferent as yield on both the bonds are same. (Same as 'treatment of taxes' covered in Equity).

5. Misc. Points

i) Current yield = Interest / Bond price (14)

ii) Yield spread = Bond yield – risk free rate

iv) If Beta of bond is given in ques, then Market price of bond = Bond value x Beta of bond (19)

V) FLOATATION COST – IF floatation cost is given in ques, then take **NET PROCEEDS** instead of CMP.

Net proceeds = Issue price – Floatation cost

VI) YTM OF SEMI-ANNUAL BOND (18)

First calculate yield for 6 months. Give final answer in p.a. form. (6m yield x 2).

Similarly, for quarterly interest paying bonds (yield per quarter x 4) and so on.

PART C: Duration, MD, Convexity

1. DURATION of bond (DoB)

DoB = weighted average time period until which the initial investment is fully recovered.

1) CALCULATION OF MACAULAY DURATION (33)

$$\text{Macaulay's duration} = \frac{\text{Weighted amount (w x PVCI)}}{\text{PVCI (or bond value)}}$$

Let us understand it with an example.

Ex 10: Calculate the Macaulay's duration of the following bond.

9%, 4 years bond of face value ₹1000. Current market yield = 10%.

Ans :

Year	Cash flow	PV of CF (Kd = 10%)	Weighted amount (w x PVCI)
1	90	81.818	81.818 x 1 = 81.818
2	90	74.38	74.38 x 2 = 148.76
3	90	67.618	67.618 x 3 = 202.854
4	1000 + 90 = 1090	744.485	744.485 x 4 = 2977.94
	Total =	₹968.30	₹3411.372

Note: Bond value = PVCI = ₹968.30

$$\text{Macaulay's duration} = \frac{\text{Weighted amount (w x PVCI)}}{\text{PVCI (or bond value)}} = \frac{3411.372}{968.30} = 3.523 \text{ years}$$

Shortcut method of calculating Bond duration

$$\text{Duration} = \frac{1}{\text{Bond value}} \times \left[\frac{1 \times \text{Interest}}{(1+kd)^1} + \frac{2 \times \text{Int}}{(1+Kd)^2} + \ldots\ldots\ldots\ldots\ldots + \frac{n \times \text{Int.}}{(1+kd)^n} + \frac{n \times \text{Maturity value}}{(1+kd)^n} \right]$$

Calculating above example using shortcut method

$$\text{Duration} = \frac{1}{968.30} \times \left[\frac{1 \times 90}{1.10^1} + \frac{2 \times 90}{1.10^2} + \frac{3 \times 90}{1.10^3} + \frac{4 \times (90 + 1000)}{1.10^4} \right]$$

$$= \frac{3411.372}{968.30} = 3.523 \text{ years}$$

II)	**NOTES ABOUT MACAULAY'S DURATION**
i)	Macaulay's Duration is always calculated in **'years'.**
ii)	In exam you can always use the Shortcut formula mentioned above (full marks will be awarded).
	In fact, author strongly recommends using shortcut formula to save time.
	Further, using 'Memory functions on calculator' you can even calculate Duration in < 60 seconds.
III)	**DURATION OF ZCB** (32)
	Duration of ZCB is always equal to its Maturity (no need to calculate).
IV)	**RELATIONSHIP OF DURATION OF BOND WITH:** (34)
I.	**With Yield** - There is an inverse relation between Duration of bond & yield.
II.	**With Coupon rate** - There is an inverse relation between the Duration & coupon rate.
III.	**With Tenure** - There is a direct relation between the Bond's duration & tenure.
Note:	**Always use Bond value to calculate the duration of bond (& not market price)**

2. Modified duration (MD)

I)	**THE CONCEPT OF SENSITIVITY OF BOND (WITH RESPECT TO YIELD)** (30)
-	Value of bond changes due to change in yield.
-	An investor investing in bonds would want to know how much the bond value will change due to 1% change in the yield.
-	This is known as sensitivity of bond w.r.t yield.
-	This is given by 'Modified duration' (MD).
	$\text{Modified Duration (or Sensitivity of bond)} = \frac{\text{Duration of Bond}}{1 + y/n}$
	where y = yield p.a. & n = number of compounding in a year.
	(take yield in decimals in above equation).
II)	**INTERPRETATION OF MD**
-	If MD = 2.6, then it means that bond value will change by 2.6% due to 1% change in yield.
-	So, if yield increases by 1%, then bond value will fall by 2.6%.
	Similarly, if yield falls by 1%, then bond value will increase by 2.6%.

This leads us to the following equation:

% Change in Value of Bond = – Modified Duration x % change in yield

(why minus sign along with the MD? Ans: Because Bond value & yield has inverse relationship.)

Ex 11: A bond has a Modified duration of 3.6 & current value of ₹980. Find new value if yield increases by 1.4%.

Ans: % change in value of bond = -3.6 x 1.4% = -5.04%

Therefore, new bond value = 980 x (100 – 5.04%) = ₹930.608

III) MODIFIED DURATION OF A PERPETUAL BOND

MD of perpetual bond = $\frac{1 + Y}{Y}$

Where Y = Yield of bond

IV) IS THE BOND VALUE CALCULATED BY USING MD 100% PRECISE?

No, Modified duration is an approx. concept. It gives us a very good estimate but it is not 100% precise.

The concept of Duration of bond is completed by another concept 'Convexity of bond'.

(we'll study more about convexity later on in this chapter.)

V) APPLICATION OF DURATION OF BOND (DOB)

i) Interest rates are expected to fall in future -> **Sell short duration and Buy long duration bonds.**

(Because fall in yield means -> Increase in bond value. & value of Long duration bonds will increase more).

ii) Interest rates are expected to rise in future -> **Buy short duration and Sell long duration bonds.**

(Because rise in yield means -> Fall in bond value. & value of short duration bonds will fall less).

iii) Uncertain about future movements in yield but are risk averse.

Prefer short duration bonds as they carry less risk than long duration bonds.

VI) DURATION OF BOND PORTFOLIO (35, 36)

Duration of bond portfolio = Weighted average duration of individual bonds in the portfolio

Weights = based on **'Current market price of the bond'** (& not the face value of bond).

If no information about the current market price is given, then use the purchase price as current price.

(ICAI has wrongly solved a ques – Ques 36 by taking weights based on face value instead of Market price)

3. Convexity

I) INTRODUCTION (31)

- We earlier saw that value given by Modified duration is a good approx. of original value but it is not 100% precise. To get a more accurate measure of value, we ADD convexity adjustment to the MD.
- Convexity adjustment includes 2 steps:

  Step 1 – Calculate convexity of the bond.

  Step 2 – **ADD** convexity adjustment to bond value calculated using MD.
- Let us understand convexity calculation using below example:

Ex 12: A 3-year, 15% bond was issued with a face value of ₹1000. Prevailing yield to maturity (YTM) is 14% p.a.
Calculate new bond value if yield changes to (a) 13% (b) 15%

i) Calculate it using full revaluation concept.

ii) Calculate it using MD.

iii) Calculate it using MD and Convexity.

iv) Also give your comments.

Ans: Value of bond = Int x PVAF(YTM %, n) + RV x PVF(YTM %, n)

i) Value at 14% ytm (V_0) = 150 x PVAF(14%, 3) + 1000 x PVF(14%, 3) = ₹1023.216

Value at 13% ytm (V_+) = 150 x PVAF(13%, 3) + 1000 x PVF(13%, 3) = ₹1047.22

Value at 15% ytm (V_-) = 150 x PVAF(15%, 3) + 1000 x PVF(15%, 3) = ₹1000

ii) $$\text{Duration} = \frac{1}{1023.216} \times \left[\frac{1 \times 150}{1.14^1} + \frac{2 \times 150}{1.14^2} + \frac{3 \times (150 + 1000)}{1.14^3} \right] = 2.63 \text{ years}$$

$$\text{MD} = \frac{\text{Duration}}{(1 + y/n)} = \frac{2.63}{1 + 0.14/1} = 2.307$$

- Calculating new value using M.D.

  Change in bond value = - Modified duration x Change in yield

	Yield = 13%	Yield = 15%
Change in bond value	-2.307 x -1% = 2.307%	-2.307 x 1% = -2.307%
New bond value	1023.16 + 2.307% = ₹1046.82	1023.16 - 2.307% = ₹999.61

iii) Using MD + convexity

Step 1: Convexity of bond = $\frac{V_+ + V_- - 2V_0}{2V_0 \times (\Delta \text{ yield})^2} = \frac{1047.22 + 1000 - (2 \times 1023.216)}{2 \times 1023.216 \times (0.01)^2} = 3.85$

Where, V_+ = Value of bond at lower yield

V_- = Value of bond at upper yield

V_0 = Value of bond at existing YTM

Δ Yield = Change in yield **(always take in decimals and not in %)**

Step 2: Value of bond = Value as per MD + Convexity adjustment

where **convexity adjustment = Convexity x $(\Delta \text{ yield})^2$**

		Yield = 13%	Yield = 15%
	Change in bond value	-2.307 x -1% = 2.307%	-2.307 x 1% = -2.307%
(+)	Convexity adjustment	3.85 x $(-0.01)^2$ = 0.000385 or 0.0385%	3.85 x $(0.01)^2$ = 0.0385%
=	Net change in bond value	2.3455%	-2.2685%
	New bond value	1023.16 + 2.3455% = ₹1047.22	1023.16 - 2.2685% = ₹1000

iv) There was some difference when calculating the bond value using full revaluation and as per MD.

However, this difference was almost entirely eliminated when we used convexity along with MD.

Clearly, convexity adjustment helps in improving the precision of bond value as calculated using MD.

4. Bond immunization (37, 38, 39, 40)

We now know that the value of bonds (or bond portfolio) can change due to a change in interest rates.

However, there is a strategy to immunize or save your portfolio from changes in value.

Bond immunization can be achieved when:

Duration of assets = Duration of liabilities

or Investors time horizon = Weighted average duration of bond (or bond portfolio)

Notes:

1. If yield changes, then duration of bonds will change and hence we will have to re-immunize our portfolio.

In that case, we must re-calculate the new duration of our bonds and calculate new weights accordingly.

PART D: Tiny Topics

1. Holding period return (HPR) (same as equity shares)

I) WHEN DEBENTURES ARE SOLD/PURCHASED ONLY ONCE

- Interest yield = $\frac{\text{Interest received during the year}}{\text{PRICE at which investment is made}} = \frac{\text{Int.}}{P_0}$

- Capital gain yield = $\frac{\text{Capital gain}}{\text{PRICE at which investment is made}} = \frac{P_1 - P_0}{P_0}$

- Holding Period Yield (HPY) = $\frac{\text{Total return}}{\text{Initial investment}} = \frac{\text{Int} + (P_1 - P_0)}{P_0}$
  (i.e. Int Yield + CG yield)

II) WHEN DEBENTURES ARE PURCHASED /SOLD MORE THAN ONCE (27)

In such a case: Each investment = cash outflow

Interest + sale of debenture = cash inflow

→ Solve for IRR to get the return earned.

2. BOND STRIPS (28, 29)

Bond value has 2 components -> Interest receipts and Principal receipts.

Value = Interest x PVAF (Kd%, n) + RV x PVF(kd%, n)

INTEREST STRIP PRINCIPAL STRIP

Ex 13: Bond -> FV = ₹100, coupon = 8%, yield = 5%, tenure = 6 years. Find the value of Interest & Principal strip.

Ans: Interest strip = 8 x PVAF (5%, 6 periods) = ₹40.61

Principal strip = 100 x PVAF (5%, 6^{th} period) = ₹74.62

Total bond value = Interest strip + Principal strip = 40.61 + 74.62 = ₹115.22

3. Callable and Puttable bonds

I) CALLABLE BONDS

The tenure of a bond is defined by the underlying bond agreement.

However, sometimes the bond deed contains a term that the company can buy back the bonds (i.e. call them) before the maturity.

\# ICAI treatment in case of callable bonds (21, 23)

- Tenure of the bond = Call years
- RV = amount at which company can call the bonds
- Yield = Yield as per call years.

This is known as **YIELD TO CALL**.

II) PUTTABLE BONDS

Here, investor has the choice to redeem the bond (at a pre-determined price) before the maturity.

\# ICAI treatment in case of puttable bonds (22, 24)

- Tenure of the bond = Put years
- RV = amount at which investor can redeem the bonds
- Yield = Yield as per put years.

This is known as **YIELD TO PUT**.

III) YIELD TO CALL (YTC) AND YIELD TO PUT (YTP)

The formula is exactly same as YTM formula. Just that we will take call value or put value instead of RV.

Also, number of periods to be taken = Call years or put years respectively.

$$YTC = \frac{\text{Interest} + (\text{Call value} - CMP) \div \text{No. of periods}}{(\text{Call value} + CMP) \div 2}$$

$$YTP = \frac{\text{Interest} + (\text{Put value} - CMP) \div \text{No. of periods}}{(\text{Put value} + CMP) \div 2}$$

IV) YIELD TO WORST (YTW)

YTW = Lowest yield amongst all the available yields. (b/w YTM, YTC etc.)

5. Bond Refunding (41a, 41b, 41c)

7. Bond refunding - Whether we should refund existing bonds and issue new bonds in its place?

This is a simple NPV decision. If NPV of bond refunding is positive, then accept it. Else reject.

NPV = PVCI – PVCO

Step 1:	Calculation of initial outlay	(₹ in Million)
*	Face Value of old bonds	xxx
(+)	Call premium (net of tax) (Note 1)	xx
(-)	Proceeds from new issues	(xxx)
(+)	Issue cost of new shares	xx
(+)	Over-lapping interest (Net of tax)	xx
(-)	Tax savings on unamortized discount & issue cost (Note 2)	(xx)
	Cash outflow as on today (or PVCO):	xxx

Step 2:	Calculation of savings p.a.	Old	New
*	Interest (net of tax)	xxx	xxx
(-)	Tax savings on unamortized Discount & issue cost	(xx)	(xx)
	Net cash outflow p.a. =	xxx	xxx

Annual savings = Net cash outflow under old bonds – Net cash outflow under new bonds

NPV = PV of savings – PVCO (Note 4)

Notes:

1. Call premium per bond = Call price – Face value of old bonds
   or Face value of old bonds x Call premium %
2. Tax savings on unamortized discount & issue cost = Discount & issue cost of old bonds x Remaining life / Total life x Tax rate
3. Rate to be used for discounting = Kd (i.e. After-tax cost of debt).
   If Kd is not directly given in ques, then use after tax interest cost of **NEW BONDS** -> Interest (1-tax)

PART E: Convertible Bonds

1. Convertible bonds (42 - 47)

- The bond deed may include that the bonds can be converted after a certain period.

This conversion can be optional or mandatory (as per the bond deed).

- Conversion ratio – It means the number of shares that will be issued upon conversion of bond.

For eg: A conversion ratio of 30 means -> Upon conversion you will receive 30 shares for every 1 bond.

We will understand the treatment of convertible bonds with the help of a master example.

Ex 14: **MASTER EXAMPLE:**

Face Value	₹1,000	Market price of Convertible Debenture	₹900
Conversion Ratio	30	Straight Value of Debenture	₹700

8.5% Fully Convertible (into Equity shares) Debentures.

Market Price of Equity Share-₹25, Expected Dividend per Share- ₹1

Calculate:

I) FAIR CONVERSION VALUE OF DEBENTURE AS ON TODAY OR STOCK VALUE OF BOND.

Ans: Fair conversion value means the value that you will get if you convert your shares today only.

Fair conversion value = CMP of shares x Number of shares that will be issued upon conversion

Fair conversion value 25 x 30 = ₹750

II) MARKET CONVERSION PRICE OR CONVERSION PARITY PRICE OF EQUITY SHARES.

That price of equity shares at which market value of convertible bond (CB) is equal to the fair conversion value of CB.

i.e. Fair conversion value of CB = Market value of CB

MPS x No. of shares = Market value of CB

$$\Rightarrow \text{Conversion parity price} = \frac{\text{Market value of CB}}{\text{No. of shares}}$$

=> Conversion parity price = 900/30 = ₹30

III) CONVERSION PARITY PRICE PREMIUM PER EQUITY SHARE.

Premium means extra element. The conversion parity price of share is generally higher than the MPS.

This difference is known as Conversion parity price premium.

(in ₹) Conversion parity price premium = Conversion parity price – MPS

(in %) Conversion parity price premium % = (Conversion parity price – MPS_/ MPS

(in ₹) Conversion Parity price premium = 30 – 25 = ₹5

(in %) Conversion Parity price premium (in %) = (30 – 25)/25 = 20%

IV) DOWNSIDE RISK OR PREMIUM OVER STRAIGHT VALUE OF DEBENTURE.

Downside Risk = Market price of convertible bond - Price of NCB

or

Downside risk in % (2 alternates – CHOOSE ANY ONE)

Using **NON** convertible bond as base	Using convertible bond as base
Downside risk / Market price of NCB	Downside risk / Market price of CB

Downside risk = 900 – 700 = ₹200

Downside risk (%) = 200/700 = 28.57% or 200/900 = 22.22%

V) PREMIUM IN CASE OF CONVERTIBLE BOND

The extra amount that you are paying for CB over the fair value of the bond.

Premium of CB = Market price of CB – Fair conversion value of bond

in % = Premium of CB / Fair conversion value of bond

=> Premium of CB = 900 – 750 = ₹250

=> in % = 250 / 750 = 33.33%

VI) FAVOURABLE INCOME DIFFERENTIAL PER SHARE.

Option 1 - If bond is not converted -> Interest income = 8.5% x 1000 = ₹85

Option 2 - Convert bond and get 30 shares/bond (as per conversion ratio) -> Dividend = 30x1 = ₹1

=> Favourable Income difference = 85 – 30 = ₹55

=> Favourable Income differential Per share = 55/30 = ₹1.8333 per share

VII) PREMIUM PAYBACK PERIOD

(Remember: Payback period = Investment / Cash flow p.a. → It tells us in how many years our investment will be recovered.)

Concept: You want to buy 30 shares. Practically, you have 2 options.

Option 1 – Buy a CB (& get 30 shares on conversion). Cost = 1 x 900 = ₹900

Option 2 – Directly buy 30 shares from market. Cost = 30 x 25 = ₹750

Additional cost (of option 1 over 2) = 900 – 750 = 150

Option 1 is more expensive. Prefer option 1 only if income under option 1 > income under option 2.

Additional income under option = 85 – 30 = ₹55 (calculated above).

$$\text{Premium payback period} = \frac{\text{Additional initial investment}}{\text{Additional cash flow p.a.}}$$

It tells us in how many years the additional amount will be recovered.

Premium payback period = 150/55 = 2.73 years

VIII) SHOULD YOU EXERCISE CONVERSION RIGHT?

If straight value of bond < Conversion value, then exercise. Else not.

Ex: If straight value of a bond is ₹1020 and its conversion value is only ₹980, then it won't make any sense to exercise conversion. But if conversion value is ₹1200, then prefer conversion.

#	Student's Space

Chapter 5C

Rights, MMI, EV

Chapter Index

Part A – Rights, Money Market Instruments, Warrants, Pref. Shares

PART A: Rights, MMI, Warrants, EV, Pref. shares

1. Money Market Instruments (MMI)

I) DISCOUNT VS YIELD

A. Discount is always on face value.

Ex: 30% discount on Shirt. Price = ₹5000. Discount = 5000 x 30% = ₹1500. Effective price = ₹3500.

B. Yield is always on 'Price'.

Ex: You purchased a share at ₹200. It paid a dividend of ₹5/share. Find dividend **YIELD**.

Dividend yield = $\frac{\text{Dividend}}{\text{Price}} = \frac{5}{200} = 2.5\%$

Common notations

F = Face value P = Price or Issue price M = Actual days to maturity

II) Commercial Bills, Certificate of Deposit (CDs), Commercial Paper, Treasury Bill (T-Bills)

- These are issued at discount and the face value is payable at maturity.

- Yield or effective rate = $\frac{F - P}{P} \times \frac{\text{Days or Months in a year}}{M} \times 100$

- Discount = $\frac{F - P}{F} \times \frac{\text{Days or Months in a year}}{M} \times 100$

III) Price when yield or Interest rate is given in ques

Price (= PVCI) = $\frac{\text{Face value}}{(1 + \text{rate} \times M/365)}$

Ex: Z ltd. issued 91-days commercial paper worth ₹10 crores at a yield of 12.04% p.a. Find issue price.

Net amount of commercial paper price = $\frac{10 \text{ crores}}{(1 + 0.1204 \times 91/365)} = ₹9.7086 \text{ crores}$

IV) REPO TRANSACTION

Repo means – Repurchase agreement.

It is a sort of loan arrangement but instead of keeping your security as collateral, you sell it to the lender and simultaneously contract to buy it back at a slightly higher price. The difference between sale price and re-purchase price represents interest cost.

Ex: Small Bank ltd. entered into a repo for 14 days @5.65% with Massive Bank ltd. in its securities worth ₹8.536 crores. Initial margin = 2%. Calculate -

i) Amount of loan that will be provided under repo aka 1st leg of repo.

ii) Amount that will be repaid on maturity aka 2nd leg of repo.

Ans:	Market value of securities =	₹8.536 Crores
(-)	Initial margin @ 2% =	(₹0.17072 crores)
=	Value of 1st leg of swap =	₹8.36528 crores

ii)	Value of 1st leg =	₹8.36528 crores
(+)	Interest under repo = 8.36528 x 5.65% x 14/360	₹0.01838 crores
=	Value of 2nd leg of swap =	₹8.38366 crores

2. Warrants

Warrant provides an option (right) to purchase Equity shares of a co. at a specified price per share.

Theoretical Value of warrant = (CMP – E) x n

Where – CMP = current market price, E = Exercise price & n = no. of shares.

☞ Since warrant is a right (not a compulsion) – Its value can never be negative.

Hence, minimum value of warrant = 0. If value comes negative using above formula, then take it as 0.

3. Rights

Right issue provides a right to an existing shareholder to purchase additional shares at discounted price.

i) Ex-right price = $\frac{nP_0 + n_1P_1}{n + n_1}$

Where n = no. of existing equity shares, P_0 = CMP

n_1 = no. of new shares offered P_1 = Right issue price

ii) Theoretical value of right = Ex-right price – Cost of right share

4. Value of preference shares

Hint – Value = PVCI

Preference share valuation is just like bonds. These shares provides a fixed rate of dividend every year and are redeemed at maturity.

Value (=PVCI) = Interest x PVAF(r%, n) + Redeemable value x PVF(r%, n)

Chapter 6

Portfolio Management

Chapter Index

PART A – Portfolio Basics
PART B – Required Return (CAPM, CML, SML etc.)
PART C – Beta, TR = SR + USR
PART D – Tiny Topics
PART E – Special Topics(Sharpe cut-off, rebalancing.....)

---- Student's Space for Summary chart and notes ----

PART A: Portfolio Basics

1. Introduction

I) QUICK FORMULAS RECALL (from Pre-chapter Data analysis)

1. Mean = $\frac{\text{Sum of all items}}{\text{Number of items}}$ or $\text{Item}_1 \times \text{Prob.} + \text{Item}_2 \times \text{Prob.} + \ldots\ldots\ldots + \text{Item}_n \times \text{Prob.}$

2. SD = $\sqrt{\frac{\sum(x-\bar{x})^2}{n}}$ or $\sqrt{\sum P(x-\bar{x})^2}$

- SD = Measure of **TOTAL RISK**. Higher SD = More risk
- Variance = Square of Standard deviation (σ^2)
- The standard deviation can never be negative. It can be zero but can never be negative.

3. Co-Variance = $\frac{\sum (x-\bar{x})(y-\bar{y})}{N}$ or $\sum P(x-\bar{x})(y-\bar{y})$ (5)

- Covariance = Correlation(a,b) x σ_a x σ_b
- Covariance = Beta_a x Beta_b x Variance of market portfolio (new formula !!)

- Covariance of an item with itself = Variance

4. $\text{Correlation}_{(x,y)} = \frac{\text{Covariance}_{(x,y)}}{\sigma_x \sigma_y}$ (3)

- Correlation of an item with itself is always = +1
- Since σ_x, σ_y are always positive. Therefore, sign of correlation depends on the sign of covariance.

If Cov = +ve --> Correlation will be +ve. But if Cov = -ve --> Correlation will be -ve.

II) COMMON SHORT-FORMS

Rm = Return of market Rf = Risk-free security return

Rp = Return of portfolio Rs = Return of security

Wa = Weight of asset 'A'

III) **CHOOSE ANY ONE SHARE**

Case 1: SBI – Average return = 12%, SD = 8%

Nestle - Average return = 15%, SD = 8%

Ans: Nestle. (Same risk – Higher return)

Case 2: SBI – Average return = 15%, SD = 12%

Nestle - Average return = 15%, SD = 8%

Ans: Nestle. (Same return – Lower risk).

Case 3: SBI – Average return = 12%, SD = 10%

Nestle - Average return = 16%, SD = 12%

Ans: Here we can use -> Risk per unit of return (i.e. 1% return earn krne k liye kitna risk lena pad rha h?)

Risk per unit of return of SBI = 10/12 = 0.83%

Risk per unit of return of Nestle = 12/16 = 0.75%

=> Choose Nestle (as we have to take less risk per unit of return compared to SBI)

☞ This 'Risk per unit of return' is popularly known as Coefficient of Variation

$$\text{Coefficient of Variation (CV)} = \frac{\text{Standard Deviation}}{\text{Average Return}}$$

Clearly, Lower the Better!

Case 4:

Security ->	A	B	C	D	E
Return ->	10%	14%	12%	11%	8%
Risk (σ) ->	6%	8%	9%	6%	5%

Ans: In such a case, we **SHALL NOT APPLY** Coefficient of Variation (CV).

Rather, we will use Efficient frontier by Harry Markowitz. (we will study this in later part of this chapter)

2. Return of security & portfolio

I) RETURN OF INDIVIDUAL SECURITY (denoted by R_S)

a) R_S when historical returns are given

Use Average return = $\sum$ Return $_i$ ÷ Number of periods

b) R_S when future returns & their respective probabilities are given

Use expected return = $\sum R_i$ x Probability $_i$

c) Holding period Return (%) = $\frac{(P1 - P0) + D1}{P0}$ (Concept is already covered in stocks & bonds)

We can use any of the above method to find return (as per framing of the ques.)

II) RETURN OF PORTFOLIO (denoted by R_P)

Return of portfolio = weighted average return of components

$R_P = W_aR_a + W_bR_b + \ldots$

III) CALCULATION OF MARKET RETURN (6)

Theoretically, market portfolio consists of all the marketable assets.

∴ Market return = $\frac{(\text{Total P1} - \text{Total P0}) + \text{Total Dividend}}{\text{Total P0}}$

3. Risk of stock & portfolio

Risk is given by Standard deviation

I) RISK OF STOCK

Risk of stock = SD of stock = $\sqrt{\frac{\sum(x-\bar{x})^2}{n}}$ or $\sqrt{\sum P(x - \bar{x})^2}$

II) RISK OF PORTFOLIO

Risk of portfolio = SD of portfolio

Calculate return of portfolio of each year (x). Use the return data to calculate portfolio SD.

SD = $\sqrt{\frac{\sum(x-\bar{x})^2}{n}}$ or $\sqrt{\sum P(x - \bar{x})^2}$

III) PORTFOLIO VARIANCE – SHORTCUT FORMULA (1,2,4,7)

- σ_p^2 with 2 stocks = $(w_a\sigma_a)^2 + (w_b\sigma_b)^2 + 2w_aw_b(\sigma_a\sigma_b r_{a,b})$
- σ_p^2 with 3 Stocks = $(w_a\sigma_a)^2 + (w_b\sigma_b)^2 + (w_c\sigma_c)^2 + 2w_aw_b.Cov_{(a,b)} + 2w_aw_c.Cov_{(a,c)} + 2w_bw_c.Cov_{(b,c)}$
- σ_p^2 with 4 Stocks = $(w_a\sigma_a)^2 + (w_b\sigma_b)^2 + (w_c\sigma_c)^2 + (w_d\sigma_d)^2 + 2w_aw_b.Cov_{(a,b)} + 2w_aw_c.Cov_{(a,c)} + 2w_aw_d.Cov_{(a,d)} + 2w_bw_c.Cov_{(b,c)} + 2w_bw_d.Cov_{(b,d)} + 2w_cw_d.Cov_{(c,d)}$

- SD of portfolio (σ_p) = √Variance

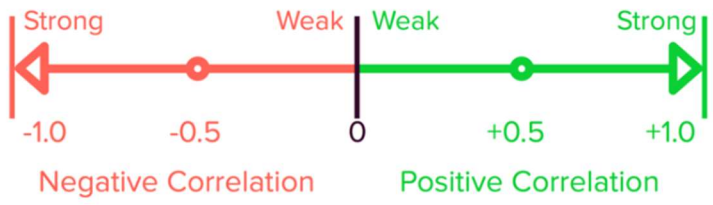
- Remember that $Cov_{(a,b)} = \sigma_a\ \sigma_b\ r_{(a,b)}$

So, above formula can also be written as:

$\sigma_p^2 = (w_a\sigma_a)^2 + (w_b\sigma_b)^2 + 2w_aw_b(\sigma_a\sigma_b r_{a,b})$

Similarly, for portfolio with 3 stocks, 4 stocks etc.

4. Role of correlations in a portfolio (8)



Higher the correlation, more the portfolio SD (risk) and hence lesser the benefit of diversification.

I) SHORTCUTS FOR CALCULATING SD – Only applicable when Portfolio consists of only 2 securities

i. When r = +1 -> $\sigma_p = w_a\sigma_a + w_b\sigma_b$

i.e. When r = +1 → SD of portfolio = Weighted average SD **(i.e. MAXIMUM POSSIBLE RISK)**

ii. When r = 0 -> $\sigma_p = \sqrt{(w_a^2\sigma_a^2 + w_b^2\sigma_b^2)}$

iii. When r = -1 -> $\sigma_p = w_a\sigma_a - w_b\sigma_b$

SD can never be negative. So, if SD comes out to be negative using the above shortcut formula, then ignore the negative sign.

II) EXCEPTION

The above shortcuts discussed are only applicable if there are only 2 shares in our portfolio.

☞ However, if r = +1, then SD of portfolio = always equal to weighted average SD.

Since there is no benefit of diversification in this case.

- Therefore, if there are 3 shares in our portfolio: $\sigma_p = w_a\sigma_a + w_b\sigma_b + w_c\sigma_c$
- If there are 4 shares in our portfolio: $\sigma_p = w_a\sigma_a + w_b\sigma_b + w_c\sigma_c + w_d\sigma_d$

& so on.....

5. Risk reduction in portfolio

Risk of a portfolio is not weighted average risk. Due to benefit of diversification, the risk is reduced at portfolio level. This is known as risk reduction.

Ex: σ_a = 12%, σ_b = 18%, r(a,b) = 0.4

Weight of A = Weight of B = 50%

Ans: Weighted average risk = 12% x 0.5 + 18% x 0.5 = 15%

But portfolio risk is:

$\sigma_{a+b}^2 = (0.12 \times 0.5)^2 + (0.18 \times 0.5)^2 + 2 \times 0.5 \times 0.5 \times (0.12 \times 0.18 \times 0.4) = 0.01602$

$\sigma_{a+b} = 0.1266$ i.e. 12.66%

$\therefore$ Risk reduced = Weighted average risk – Actual risk of portfolio

= 15% - 12.66% = 2.34%

b) Will there be any risk reduction if r = +1?

When r = +1, portfolio risk = weighted average risk

Hence, no risk reduction in this case. i.e. we can say that portfolio risk is maximum when r = +1.

6. Portfolio of a Risk-free security and Risky security (9a & b)

Risk of risk-free security = 0 (obviously). Therefore, its SD = 0.

- Portfolio return = Weighted average return
- Portfolio risk = σ_{Risky} x Weight of risky asset

Proof:

$\sigma_p^2 = (w_{risky}\,\sigma_{risky})^2 + (w_{rf}\,\sigma_{rf})^2 + 2w_{risky} \cdot w_{rf}(\sigma_{risky} \cdot \sigma_{rf} \cdot r_{a,b})$

$\sigma_p^2 = (W_{risky}\,\sigma_{risky})^2 + 0 + 0$ (As $\sigma_{rf} = 0$)

-> $\sigma_p = \sigma_{Risky} \times W_{risky}$

Ex: Portfolio of Mr. Sawdhan consists of a risky asset and a risk-free asset.

	Expected return	Weight	SD of return (Risk)
Risky asset	14%	70%	22%
Risk-free security	6%	-	-

i) Find the expected return on the portfolio.

ii) Also calculate the portfolio risk (i.e. portfolio sd)

Ans: i) Portfolio return = Weighted average return = 6% x 0.3 + 14% x 0.7 = 11.6%

ii) Portfolio risk (σ_p) = $\sigma_{Risky} \times W_{risky}$ = 22% x 0.7 = 15.4%

Note: If ques is silent, always assume Rf investment rate = Rf borrowing rate.

7. Variance – Covariance matrix

A matrix (table) that contains various securities, its variance and covariance amongst securities.

Var-Cov Matrix	A	B	C
A	$Var_{(a)}$	$Cov_{(a,b)}$	$Cov_{(a,c)}$
B	$Cov_{(a,b)}$	$Var_{(b)}$	$Cov_{(b,c)}$
C	$Cov_{(a,c)}$	$Cov_{(b,c)}$	$Var_{(c)}$

PART B: Required Return (CAPM, CML, SML etc.)

1. Types of risks

I) TOTAL RISK = σ^2 = SYSTEMATIC RISK + UNSYSTEMATIC RISK

	SYSTEMATIC RISK	UNSYSTEMATIC RISK OR IDIOSYNCRATIC RISK
	Market risk / Undiversifiable risk	Diversifiable risk / specific risk / Residual risk
1.	Risk due to broad factors such as global recession, pandemic, war, political instability etc.	This risk arises due to industry or company specific factors such as strike, loss due to theft etc.
2.	Cannot be eliminated by diversification.	It can be controlled via diversification.
3.	Eg: A global pandemic affects all the businesses, let it be cars, hotels, banking etc.	Eg: A local strike in a factory of a company does not impact a well-diversified portfolio.

2. Market portfolio

I) INTRODUCTION TO MARKET PORTFOLIO

- Theoretically, **Market portfolio** = A portfolio consisting of all the marketable securities.
- It is perfectly diversified and hence **no unsystematic risk** is left in the market portfolio.
- Practically, we may use a market index such as Nifty or Sensex as a proxy for market portfolio.

II) RISK OF MARKET PORTFOLIO

Total risk = Systematic risk + Unsystematic risk

Since, USR = 0 in case of market portfolio

Total risk of market portfolio = Systematic risk

or SD of market portfolio (σ_m) = Systematic risk

III) MARKET RISK PREMIUM

Let's say that Return on Govt bonds (Rf) = 6%.

Return on market portfolio say S&P 500 (Rm) = 14%

Then additional return for investing in Market portfolio = 14 – 6 = 8%.

This additional return is also known as **'Market risk premium (MRP)'**.

MRP = Rm – Rf.

3. Risk of Individual security

An individual security contains both systematic risk (SR) and unsystematic risk (USR).

I) HOW TO MEASURE THE SYSTEMATIC RISK CONTAINED IN A SECURITY

Two Ways to measure SR of a security

	Relative Measure	Absolute measure
Ex:	Golu's weight is 1.4 times the weight of an average Indian.	Weight of an average India = 60 Kg. Golu's weight = 60 x 1.4 = 84 Kg
	Here, Golu's weight is defined in relative terms.	Here, Golu's weight is defined in Absolute terms.
-	We use Beta as a Relative measure of SR in a security.	For absolute measure, we will use Sharpe's Index Model (covered later on in this chapter).

II) BETA = RELATIVE MEASURE OF SYSTEMATIC RISK IN A SECURITY

- Beta tells us about the sensitivity of a stock w.r.t. the market portfolio.
- Beta -> If market changes by 1%, then how much will the stock change?
- Note that Beta is always measured in "**TIMES**" (& not in percentage)
- By its very definition, **Beta of market portfolio = 1**

Illus: Beta of Delta Corp = 1.8. If stock market fell by 1%, then what is the expected fall in Delta corp.

Expected fall in Delta Corp = 1% x 1.8 = 1.8%

Hence, Delta corp is 1.8 times riskier than the market portfolio.

4.1 PRICING MODELS – CAPM (12a,b,c, 13)

Required return as per CAPM = Rf + (Rm – Rf) x Beta

I) WHAT DOES CAPM TELLS US?

CAPM tells us **REQUIRED RETURN** (discount rate/Fair return) for a stock (& not the actual return).

i.e. it tells us 'कि कितनी return मिलनी चाहिए किसी stock से |'

II) OVER-VALUED AND UNDER-VALUED AS PER CAPM

Illus: Required return from a stock as per CAPM is 15%.

Case 1: You can earn a return of 20% on this stock.

Great! You can earn extra return. You will surely buy it. This stock is UNDERVALUED.

Case 2: You can earn a return of 10% on this stock.

This is less than your required return. You won't buy it. This stock is OVERVALUED.

III) **NOTES**

1. CAPM can be used to calculate required return from a security as well as from a portfolio.

   CAPM = Rf + (Rm – Rf) x Beta -> Use **Beta of security** if you want to calculate security return

   -> Use **Beta of portfolio** if you want to cal. portfolio return

2. If more than 1 Risk-free rate is given in ques -> Take average and use average risk-free rate.

3. (Rm – Rf) is also known as Market risk premium.

   Beta x (Rm – Rf) is also known as Security risk premium.

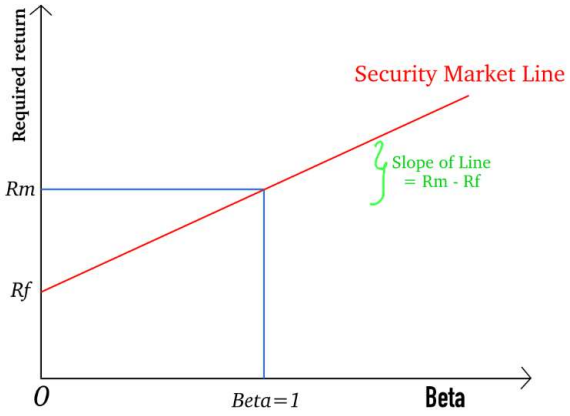
4.2 Security Market Line (SML) (10a, 14)

SML is simply the graphical representation of CAPM showing relation between Required return & Beta.

(Remember straight line equation: y = a + bx)

Req. Return = Rf + (Rm – Rf) x Beta

y = a + b (slope) x



- **Slope of SML** = (Rm - Rf) i.e. MRP

- **When Beta = 0**

  Required return = Rf + (Rm - Rf) x 0 => Rf (i.e. Risk-free return)

- **When Beta = 1**

  Required return = Rf + (Rm - Rf) x 1 => Rm (i.e. Market return)

II) **OVER-VALUED AND UNDER-VALUED AS PER SML (SAME FOR CAPM AS WELL)**

Position of stock	Comment	Over / Under-valued	Final decision
Below SML line	Stock return < Required return	Over-valued	Sell
Above SML line	Stock return > Required return	Under-valued	Buy
On the SML line	Stock return = required return	Correctly-valued	Hold

Ex: Write the security market line: (i) Rf = 4% & Rm = 9%.

(ii) As per SML, what should be the required return of a stock with Beta of 1.5?

Ans: Required return = Rf + (Rm – Rf) x Beta

Required return = 4% + 5% x Beta

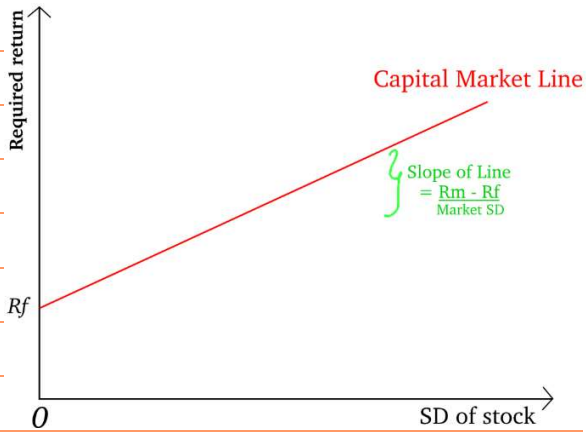
ii) Required return if Beta is 1.5 = 4% + 5% x 1.5 = 11.5%

4.3 Capital Market line (CML) (10b)

It shows the relation between Required return of a stock & its standard deviation.

Required return (as per CML) = $Rf + \frac{(Rm - Rf)}{\sigma_m} \sigma_s$

- Slope of CML = $\frac{Rm - Rf}{\sigma_m}$



Note: Over-valued & under-valued concept of CML is same as that of CAPM or SML. Hence, not covered again.

Ex: Find the required return as per CML of a stock with SD of 24% if:

Rf = 5%, Market return = 14%, SD of market = 18%

Ans: Required return as per CML = $5\% + \frac{(14\% - 5\%)}{18\%} \times 24\% = 17\%$

4.4 Sharpe Index model or Single Index model

Return = α + Beta x Rm + ε

Where α = Alpha intercept. Alpha is NOT risk-free rate (this is just a mathematical intercept)

Do not confuse this alpha with Jenson's alpha. These two are completely different concepts.

ε = Error term or return on account of unsystematic risk

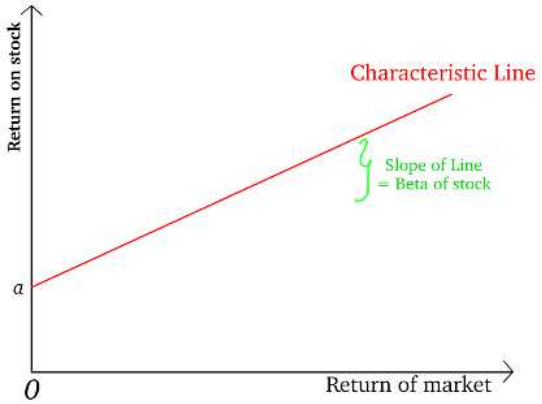
4.5 Characteristic Line (CL)

CL describes the relation between Return of Security (Rs) & Market return (Rm).

Graphical representation of Single Index model.

As per SL:

Rs = α + Beta x Rm



1) **Notes:**

i. Take 'average return' if more than 1 return is given in ques.

i.e. Average Rm, Average Rs etc.

ii. Slope of Characteristic line = Beta of stock

iii. If ques asks to frame Characteristic line ->

Then put value of α and Beta. But do not put value of Rs and Rm.

Ex: If = 4.6 and Beta = 1.2, then CL -> Rs = 4.6 + 1.2Rm

5. Performance measurement of portfolio (15a & b, 16)

We use several ratios to measure the performance of a portfolio. Four most popular ratios are:

All of these ratios are -> 'Higher the better'

1. Sharpe's Ratio = $\frac{Rp - Rf}{\sigma_p}$ (also known as Reward to variability ratio)

2. Treynor ratio = $\frac{Rp - Rf}{Beta_p}$ (also known as Reward to volatility ratio)

3. Jenson's Alpha = Actual return – CAPM return

4. Market risk-return relationship = $\frac{Rm - Rf}{\sigma_m}$

PART C: Beta, TR = SR + USR

1. Beta

I) BETA CALCULATION (17, 18a, 18b, 20, 27)

Change formula	Correlation formula	Covariance formula
Beta = Change in security return / Change in market return	$r_{s,m} \times \sigma_{security} / \sigma_{market}$	$Covariance_{(s,m)} / Variance_{(market)}$

II) NOTES

1. Always use security return figures to calculate Beta (& not price figures directly).
2. Change formula can be used only if 2 period data is given. If data of more than 2 periods is given, then either use correlation formula or covariance formula.
3. Covariance formula and correlation formula are same.

$$\text{Beta} = \frac{\text{Covariance}(s,m)}{\text{Variance}(m)} = \frac{r(s,m) \times \sigma_s \times \sigma_m}{\sigma_m^2} = \frac{r(s,m) \times \sigma_s}{\sigma_m}$$

4. Beta of portfolio = Weighted average beta of components. (22b, 23)
5. Since beta represents systematic risk, we cannot diversify it by building a portfolio.
6. Beta of market = 1 (obviously)

6. Types of stocks

Beta > 1 = Aggressive stocks or risky stocks. These are more risky than the market portfolio.

Beta < 1 = Defensive stocks or less risky stocks. These are less risky than the market portfolio.

Beta = 1 : Neutral stocks. These are as risky as the market portfolio.

7. Can there be negative beta stocks?

Generally, NO! Because there is hardly any company which has opposite relation with the economy such that when market rises, it falls and when market falls, it rises.

Ex: Beta of my portfolio = 1.4. Find Rp if Rm = 15%. (22a)

Ans: Rp = 15% x 1.4 = 21%

Ex: Beta of my stock is 0.8. Find Rs if market fell by 4%.

Ans: fall in stock = 4% x 0.8 = 3.2%

2. Managing Beta using Risk-Free security (24)

Recall: Beta of portfolio (consisting of risky assets and risk-free assets) = W_{risky} x $Beta_{risky}$

I) PORTFOLIO MANAGER WILL BRING NEW RISK-FREE INVESTMENT

Ex: Let us say that current beta of our existing risky portfolio = 1.5. Value of portfolio = 20 lacs.
New desired beta = 1.2. How much new risk-free investment should be brought in?

A: Let amount of new risk-free investment be 'X'.

Then: New portfolio value = 20L + X

Weight of risky assets (W_{risky}) = 20L / (20L + X)

Portfolio beta = W_{risky} x $Beta_{risky}$

$$1.2 = 1.5 \times \frac{20L}{20L + X}$$

20L + X = 25L

X = 5 lacs

Portfolio manager should bring in 5 lacs of risk-free investment to achieve target beta of 1.2.

II) EXISTING PORTION OF PORTFOLIO WILL BE SOLD TO ACHIEVE DESIRED BETA VALUE

Ex: Current beta of our existing risky portfolio ($Beta_{risky}$)= 1.5. Value of portfolio = 20 lacs. How much of existing portfolio should be sold and invested in Rf securities to achieve target beta of 1.2?

A: Let amount of existing portfolio sold and invested in risk-free securities be 'X'.

Then: New portfolio value = 20L

Weight of risky assets (W_{risky}) = (20L – X) / 20L

Portfolio beta = W_{risky} x $Beta_{risky}$

$$1.2 = 1.5 \times \frac{20L - X}{20L}$$

16L = 20L – X

X = 4 lacs

Portfolio manager should sell 4 lacs of existing portfolio to achieve target beta of 1.2.

3. Breaking down Total risk (TR) into SR & USR (19, 28, 29, 30, 31)

I) AT SECURITY LEVEL: Total Risk (TR) = σ_s^2 (i.e. Variance)

(Note that Sharpe's index model uses variance as a measure of total risk)

Systematic Risk (SR)	Unsystematic risk (USR)
• SR = $Beta_s^2 \times \sigma_m^2$	Unsystematic risk = Total risk – Systematic risk
(i.e. Beta of security x variance of **MARKET**)	
or	Note: Since TR (i.e. Variance) as well as SR are both
• SR = $r_{s,m}^2 \times \sigma_s^2$	in square form, the USR that we get is also in square
(i.e. Coeff^n of determination x variance of **SECURITY**)	form.

II) AT PORTFOLIO LEVEL: Total Risk (TR) = σ_p^2 (i.e. Variance)

(Same as TR at security level. Just that will use portfolio beta rather than security beta)

Systematic Risk (SR)	Unsystematic risk (USR)
• SR = $Beta_p^2 \times \sigma_m^2$	Unsystematic risk = Total risk – Systematic risk
(i.e. Beta of portfolio x variance of **MARKET**)	or
or	$USR_p = USR_a W_a^2 + USR_b W_b^2$
• SR = $r_{p,m}^2 \times \sigma_p^2$	(No need to square USR again as it is already in
(i.e. Coeff^n of determination x **PORTFOLIO** variance)	square form.)

III) NOTES

1. Generally, USR given in ques is already in square form. Also, the USR that we calculate using 'TR – SR' is already in square form. Hence, do not square again.
   (Imp - Don't forget to take squares if USR is not given in square form.)

2. Why is there no '2WaWb USR_a USR_b r(a,b)' component in the calculation of portfolio USR?

Ans: Because there is no correlation between the Unsystematic factors. Hence, this component is zero.

PART D: Tiny topics

1. Modern portfolio theory (MPT) or Harry Markowitz model (32a & b)

- It is used for selecting efficient securities.
- Use this concept only if there are > 2 securities in ques. (In case of 2 securities use Coeff of variation).
- Markowitz analysed the risk and return of various securities and he classified them as efficient securities or inefficient securities.

II) EFFICIENT SECURITIES

CASE 1: A security which offers maximum return for a given risk is efficient.

Ex:	Security ->	A	B	C
	Return ->	15%	20%	12%
	Risk ->	8%	8%	8%
	Efficient?	No	Yes	No

CASE 2: A security which has minimum risk for a given return.

Ex:	Security ->	X	Y	Z
	Return ->	15%	15%	15%
	Risk ->	14%	18%	12%
	Efficient?	No	No	Yes

II) INEFFICIENT SECURITIES

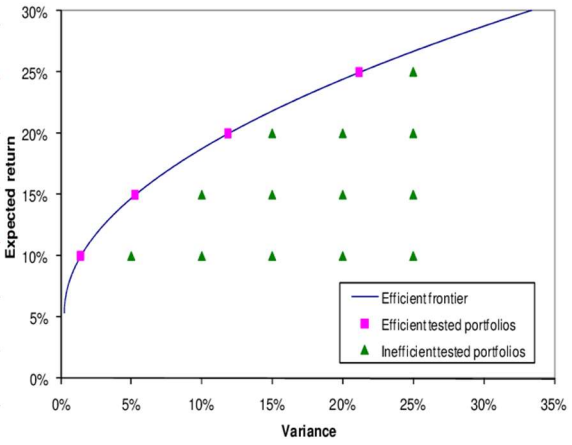
All securities other than efficient securities are inefficient.

III) EFFICIENT FRONTIER

We can plot all the securities on a graph.

x-axis = Risk of security (in terms of Variance or SD)

y-axis = Return of security



The pink securities are the efficient ones.

If we join a line connecting all the efficient securities, then we will get efficient frontier.

2. Arbitrage Pricing Theory (APT) (35a, 35b, 36, 37)

I) AT SECURITY LEVEL

Return as per APT = Rf + Risk premium of every factor x Beta of that factor

i.e. = $Rf + \beta_1 \times \text{Factor 1}_{\text{Risk premium}} + \beta_2 \times \text{Factor 2}_{\text{Risk premium}} + \ldots\ldots\ldots\ldots$

Where risk premium of a factor = Actual value of factor (%) x Expected Value of that value (%)

II) AT PORTFOLIO LEVEL

Beta of a factor = Weighted average beta of components

Rest everything is same.

3. Optimum Weights

You want to invest in 2 securities, say A & B. You want to construct a portfolio of these 2 securities in a way that the risk of the portfolio is minimum. This can be given by Minimum Variance formula.

I) MINIMUM VARIANCE FORMULA (33)

$$\text{Weight of A} = \frac{\sigma_b^2 - \text{Covariance}(a,b)}{\sigma_a^2 + \sigma_b^2 - 2\text{Covariance}(a,b)}$$

Weight of B = 1 – Weight of A

II) SHORTCUT: ONLY IF CORRELATION BETWEEN A & B = -1 (34)

$$\text{Weight of A} = \frac{\sigma_b}{\sigma_a + \sigma_b}$$

4. Bifurcating portfolio return

I) ACTIVE RETURN or EXCESS RETURN OF PORTFOLIO = Portfolio return (-) Market return

II) BIFURCATING EXCESS RETURN

- Excess return due to skill of manager = Actual return (-) required return*

(*Required return is calculated generally as per CAPM).

- Excess return due to higher risk = Excess return (-) Extra return due to skill

PART E: Special Topics (Sharpe cutoff, Rebalancing...)

1. Levered and Unlevered Beta

I) WHEN BETA OF DEBT IS NOT GIVEN (I.E. WE ASSUME DEBT BETA = 0)

Complete video on this topic is available on YouTube. Search 'Krivi Eduspace Levered beta'

Notes: Unlevered Beta (B_{UL}) = Beta of company without any debt (leverage). It is also called Asset beta.

Levered beta (B_L) = Beta of company with debt (leverage). It is also called Equity beta.

Levered beta is also called Geared beta or Equity beta.

Unlevered beta is also called ungeared beta or Asset beta.

$$B_L = B_{UL}\left\{1 + \frac{Debt(1-tax)}{Equity}\right\}$$

II) USING PROXY FIRM BETA

Complete video on this topic is available on YouTube. Search 'Krivi Eduspace Levered beta'

Steps to solve:

1. Find unlevered Beta using proxy firm info.
2. Calculate Levered beta using the Unlevered beta calculated in step 1.

Ex: Let us say there are 2 companies in the chemical business (same of line of business).

Co. X is a private unlisted co. with D:E ratio = 1:4 and applicable tax rate = 20%.

Whereas Co. Y is a listed co. with D:E ratio = 1:2 and applicable tax rate = 30%.

Since, Co. X is an unlisted co., so we are unable to find its beta directly. Beta of Co. Y is known and is equal to 1.89. You are required to calculate the equity beta of Co. X.

A: Step 1 – Find Unlevered beta of Co. Y

$$B_L = B_{UL}\left\{1 + \frac{Debt(1-tax)}{Equity}\right\}$$

$$1.89 = B_{UL}\left\{1 + \frac{1\,(1-0.3)}{2}\right\} \quad \Rightarrow B_{UL} = 1.4$$

Step 2 – Find Levered beta of Co. X using Unlevered Beta calculated above.

$$B_L = B_{UL}\left\{1 + \frac{Debt(1-tax)}{Equity}\right\}$$

$$B_L = 1.4\left\{1 + \frac{1\ (1-0.2)}{4}\right\} \quad \Rightarrow B_{UL} = 1.68$$

Hence, Levered beta or equity beta of Co. X is 1.68.

III) CALCULATING CO. BETA WHEN BETA OF DEBT IS GIVEN. (38, 39)

Company's asset beta = Weighted average beta of equity and debt.

$$\text{Asset Beta} = \text{Beta}_{Equity} \times \frac{E}{E + D(1-t)} + \text{Beta}_{Debt}\left[\frac{D\ (1-tax)}{E + D\ (1-tax)}\right]$$

Notes:

1. Debt amount is taken 'Net of tax'.
2. Technically speaking, this formula and the above formula (of levered beta) are same.

Because if Beta of Debt = 0, then

$$\text{Asset Beta} = \text{Beta}_{Equity} \times \frac{E}{E + D(1-t)} + 0 \times \left[\frac{D\ (1-tax)}{E + D\ (1-tax)}\right]$$

$$\text{Asset Beta} = \text{Beta}_{Equity} \times \frac{E}{E + D(1-t)}$$

$$\text{Beta}_{Equity} = \text{Beta}_{Asset}\left\{\frac{E + D(1-t)}{E}\right\}$$

$$\text{Beta}_{Equity} = \text{Beta}_{Asset}\left\{1 + \frac{D(1-t)}{E}\right\}$$

(Hence, the 2 formulas are same if $B_{Debt} = 0$)

3. Sometimes beta of debt is not directly given in ques. In such cases, it can be calculated as:

$$\text{Debt Beta} = \frac{Kd - Rf}{Rm - Rf}$$

(Where Kd = cost of debt and Rm = market return)

4. Finally, if Debt beta is not directly given, and also information required to calculate it is not available, then simply assume debt beta = 0.

2. Portfolio Rebalancing

I) TYPE 1 – WHEN DESIRED WEIGHT (RATIO) OF EACH STOCK IS GIVEN. (42)

Desired weight required of each stock in the portfolio. For ex: I may want that weight of each stock in my portfolio should be equal.

Step 1: Ascertain the required weight of each stock. It may be directly given in the ques or you may have to calculate it.

Step 2: Calculate total value of portfolio on the rebalancing date (V_P)

New amount of each stock = V_P x Required weight

II) TYPE 2 – CONSTANT RATIO MIX POLICY OR CONSTANT PROPORTION MIX POLICY (41)

Here we decide to invest our total portfolio amount into aggressive (equity) securities and conservative securities (bonds). The proportion (ratio) of both the components is decided.

Some notations for easier understanding:

Value of aggressive securities (equity) = V_A

Value of conservative securities (bonds) = V_C

Value of portfolio = V_P

Step 1: Calculate the opening amount to be invested in aggressive and conservative securities.

For ex: If you want to invest ₹200,000 EQUALLY in equity and debt, then

V_A = 200,000 x 0.5 = ₹100,000

V_C = 200,000 x 0.5 = ₹100,000

Step 2: Recalculate Value of equity and Value of debt.

Ex: Price of equity on the date of purchase = ₹20. Now new price of equity = ₹22.

Then new value of Aggressive (equity) portfolio = (1,00,000 / 20) x 22 = ₹1,10,000

Step 3: Calculate total portfolio value: $V_P = V_A + V_D$

and bifurcate this value as per the original required weights.

Using above ex: VP = 1,10,000 + 1,00,000 = ₹2,10,000

Required V_A = 2,10,000 x 0.5 = 1,05,000

V_D = 2,10,000 x 0.5 = 1,05,000

Hence, transfer ₹5,000 (i.e. 1,10,000 – 1,05,000) from equity to debt to reach the required weight.

III)	**TYPE 3 – CONSTANT PROPORTION INSURANCE POLICY (CPIP)** (40)
	In this case, the investor decides a floor value below which her portfolio should not fall.
	Total portfolio amount is invested partly in aggressive securities (equities) and partly in conservative securities (debt or risk-free securities).
Ex:	Total amount to be invested (V_P) = ₹10L.
	Floor value of investor (V_{floor}) = ₹8L.
	Multiplier (for aggressive securities) = 2
Ans:	Step 1: Calculate the opening values
	Amount in Aggressive securities (equity) $V_A = (V_P - V_{Floor}) \times$ Multiplier = (10L – 8L) x 2 = 4L
	Amount in Conservative securities (debt) V_C = Balance amount = $V_P - V_A$ = 10L – 4L = 6L
Step 2:	Calculate new values on rebalancing date
	Calculate new value of equity and debt using the info given in ques.
	For ex: If equity Index on investment date was 20,000 and index on rebalancing date is 24,000.
	Then New value of equity = (4L / 20,000) x 24,000 = ₹4,80,000
Step 3:	Rebalancing portfolio (same as step 1)
•	New V_P = VA + VC = 4.8L + 6L = 10.8L
	VA = (VP – Vfloor) x Multiplier = (10.8L – 8L) x 2 = 5.6L
	VC = Balance amount = VP – VA = 10.8L – 5.6L = 5.2L
	Hence, sell ₹80,000 (6L – 5.2L) of conservative securities and buy ₹80,000 worth of equity.
	NOTES:
1.	If floor value % is not directly given in ques, then you can calculate it as:
	$\frac{\text{Current value – Minimum value (as given in ques)}}{\text{Current value}} \times 100$
IV)	**TYPE 4 – BUY AND HOLD POLICY OR DO-NOTHING POLICY**
	(Easiest) Closing value of portfolio = Number of shares (or units) x Closing value per share (or unit)

3. Sharpe's Optimal portfolio (43)

(Complete video is available on YouTube. Search 'Krivi Eduspace sharpe optimal portfolio')

Step 1: Rank the securities based on Treynor ratio (recall Treynor ratio = $\frac{R_P - R_F}{\beta_P}$)

Step 2: Calculate C_i and decide cut-off

$$C_i = \frac{\sigma_m^2 \times \Sigma (\text{Treynor ratio} \times A)}{1 + (\sigma_m^2 \times \Sigma A)}$$

where $A = \beta^2 / \sigma_e^2$

Step 3: Cut off point is the highest value of Ci and is represented by C*.

Stocks which have Treynor ratio greater than C* are selected.

Step 4: Deciding weights

$$\text{Weight} = \frac{Z_i}{\Sigma Z_i} \quad \text{Where } Z_i = \beta / \sigma_e^2 \times (\text{Treynor ratio} - C^*)$$

4. Corner Theorem (44)

Concept – Portfolios on minimum variance set have **LINEAR RELATION BETWEEN THEM.**

Ex: Two portfolio – Portfolio X and Portfolio Y lies on minimum variance set.

	Weight A	Weight B	Weight C
Portfolio X	0.20	0.50	0.30
Portfolio Y	0.30	0.30	0.40

Another Portfolio Z is also on minimum variance set. Weight of stock A (Wa) in portfolio Z is 0.5.

Determine the weight of Stock B (Wb) & Weight of C (Wc). No restrictions on short-selling.

Ans: Method 1 – Intuitive

When Wa increased by 0.1 -> Wb decreased by 0.2 & Wc increased by 0.1.

Hence, if weight of A increases by 0.3 (ie. New weight = 0.2 + 0.3 = 0.5), then

Wb will decrease by 0.2 x 3 = 0.6, and Wc will increase by 0.1 x 3 = 0.3

	Weight A	Weight B	Weight C
Portfolio Z	0.2 + 0.3 = 0.5	0.5 – 0.6 = -0.1	0.3 + 0.3 = 0.6

	Method 2 - Mathematically (in terms of linear equations)
	Since there is a linear relation between weights of different stocks, so we can use linear equation
	line -> y = a + bx (where m = slope and C = intercept)
	Wb = a + b.Wa
i.	0.5 = a + 0.2b
ii.	0.3 = a + 0.3b
	Subtracting ii from i
	0.2 = -0.1b
	b = -2
	Putting value of a in equation i
	0.5 = a + (-2x0.2) => a = 0.9
	Equation of critical line becomes:
	Wb = 0.9 - 2Wa
->	So, if Wa = 0.5, then Wb will be:
	Wb = 0.9 – 2x0.5 = -0.1
	Wa + Wb + Wc = 1
	0.5 + (-0.1) + Wc = 1 => Wc = 0.6

Chapter 8

Mutual Funds

Chapter Index

Part A – Basics of Mutual Fund
Part B – Advanced Topics

---- Student's Space for Summary chart and notes ----

PART A: Basics of Mutual fund

1. Introduction

- Mutual means 'common'. Mutual fund means a common fund in which a large number of people pools money. This money is then invested in stocks, bonds etc.
- Investors in mutual fund are allotted **'UNITS'** (just like investors of a company are allotted shares).
- **UNITS CAN BE ISSUED IN FRACTIONS (UNLIKE SHARES). TAKE UNITS IN 2 DECIMALS.**
- Likewise, Investors who invests in mutual fund are known as 'Unit-holders'.

II) MECHANISM OF MUTUAL FUND (MF)

Step 1 – Investors invests in mutual fund. Say 10 lac people invested ₹5,000 (on an average).
So, Total fund value = 10 lac x 5000 = ₹500 crores

Step 2 – Fund invests this ₹500 crores in stocks, bonds etc. and earns a return of say 15%.
Gross Return earned by fund = 500 x 15% = ₹75 crores.

Step 3 – Fund also had to incur some expenses (such as salary, rent, marketing exp etc.). Let us say that total expenses during the year were ₹2 crores.

Step 4 – Net return earned by fund = Gross return (-) Expenses = 75 – 2 = ₹73 crores.
Net return in % = 73/500 = 14.6%

Note: The net return (of ₹73 crores) in above example belongs to **UNITHOLDERS.**
MF may distribute these earnings to unitholders or may retain & re-invest it (just like a normal co.)

III) ILLUSTRATIVE BALANCE SHEET OF A MUTUAL FUND

Liabilities		Assets	
Funds contributed by unitholders	xxx	Investment in shares, bonds, other financial	
(Similar to equity – though not exactly like that)		instruments etc.	xxx
		Accrued Dividend	xx
External liabilities		Accrued interest on bonds	xx
Outstanding salary	xxx	Cash balance	xx
Other outstanding operational exp	xxx	Prepaid expenses	xx
Total :	xxx	Total :	xxx

2. Net asset value (NAV) of MF

NAV is also simply called as 'Value' sometimes.

- NAV = $\frac{\text{MV of all assets (-) MV of EXTERNAL liabilities}}{\text{Number of units of Mutual fund}}$ (just like net-worth of a co.)

- NAV per unit = Total NAV of fund ÷ Number of units

II) ILLUSTRATIVE NAV CALCULATION (1,2,5)

	Market Value of shares, bonds and other investment	xxx
	Accrued interest or Dividend (on bonds etc.)	xxx
	Closing Cash balance (discussed below in detail)	xxx
	Other assets	xxx
(-)	External liabilities:	
	Outstanding salaries	(xxx)
	Other outstanding expenses / payables etc.	(xxx)
=>	NAV = A – B (Total assets – Total external liabilities)	xxx

III) NOTES

1. Take Book value if Market Value is not available.
2. Only unpaid liabilities are deducted while calculating NAV. Ex: Salary if unpaid is a liability and hence must be deducted. But salary if already paid is no longer a liability (it is an expense). Don't deduct again.
3. NAV is updated on daily basis (as price of shares, bonds etc. held as investment by MF keeps on changing).
4. An investor can buy or sell units of MF at the prevailing NAV (± entry or exit load – discussed later)

IV) CALCULATION OF CLOSING CASH BALANCE (6,7a&b)

	Opening cash balance	xxx
+	New units issued (net of floatation cost)	xxx
+	Sale of securities	xxx
+	Dividend / Interest received on investment	xxx
(-)	Purchase of securities	(xxx)
(-)	Income distributed to unitholders (this can be dividend distribution or CG distribution etc.)	(xxx)
(-)	Management and other expenses paid	(xxx)
	Closing cash balance =	xxx

3. Expenses

I) UNITS CAN BE ISSUED IN FRACTIONS

Ex: NAV of Dtek MF = ₹40.7. Calculate number of units allotted if an investor invests ₹50,000 in this fund.

AUTHOR NOTE – ALWAYS TAKE UNITS IN 2 DECIMALS.

A: Number of units = 5,000/40.7 = 122.85 units.

II) EXPENSE RATIO or MANAGEMENT EXPENSE RATIO (MER) (9)

$$\text{Expense Ratio} = \frac{\text{Expenses Incurred (per unit)}}{\text{Average NAV}}$$

where Average NAV = $\frac{\text{Opening + Closing NAV}}{2}$

- It includes all the management & operational expenses such as management remuneration etc.
- It does not include brokerage cost for **TRADING THE PORTFOLIO**.

III) ENTRY LOAD or FRONT-END LOAD (10)

It is an additional amount charged by MF at the time of purchasing the units.

Prevailing NAV + Entry load = Issue price

Ex : Current NAV = ₹10. Entry load = 5%

i) How much ₹ will an investor require to purchase 1 unit of this fund?

ii) How many units will be allotted if ₹10,000 is invested in such MF.

Ans: i) Investor will require 10 + 5% = ₹10.5 to buy one unit.

ii) 10,000/10.5 = 952.38 units.

IV) EXIT LOAD or BACK-END LOAD (11)

It is an amount charged by MF at the time of selling the units by investor.

Prevailing NAV - Exit load = Redemption price

Ex : Current NAV = ₹20. I hold 500 such units. Find my sale proceeds if company charges exit load of 5%.

Ans : Amount per unit = 20 x 0.95 = ₹19

Sale proceeds = 500 x 19 = ₹9,500

V) RELATION BETWEEN INVESTOR'S RETURN & REQUIRED RETURN FROM MF (14a&b, 15)

$$\frac{\text{Return Earned by Investor} + \text{Recurring Expenses}}{1 - \text{Initial Expenses}} = \text{Return on Mutual Fund}$$

4. Dividends – Received & Paid by MF

A car co. -> Business of manufacturing cars -> Earns income from sale of cars

A MF -> Business of investing in shares, bonds etc. -> i) Dividend receipt (from invested shares)

ii) Interest receipt (from invested bonds)

iii) Capital gain (Sale price – Purchase price)

II) IMPORTANT NOTES

1. Do Not confuse

Dividends **RECEIVED** by MF is the 'Operational income' of Mutual fund.

2 What about the Dividends **PAID** by Mutual fund?

Dividend paid by MF to its unitholders is often called **DISTRIBUTION**. (Just like a normal co. pays dividends).

3. The MF may or may not distribute its earnings (just like a normal co.)

III) ILLUSTRATIVE INCOME STATEMENT OF A MF

•	Income	₹ in crores
i)	Dividends received from investment in shares (this is operational income of MF)	26
ii)	Interest receipts (from investment in bonds)	42
iii)	Capital gain from sale of shares and bonds	104
iv)	Other income	3
	A. Total income	175
(-)	Expenses	
	Salaries	12
	Other operational expenses	3
	B. Total expenses:	15
=	Net Income = A – B (feel it like Net profit of a normal co.)	160
(-)	Distribution by MF to unitholders (feel it like dividends paid by co.)	120
	Balance retained by MF	40

IV) EFFECT ON NAV WHEN DIVIDEND IS 'RECEIVED' BY MF

Dividend receipt on investment is an income of mutual fund and will increase its cash balance.

Hence, NAV of fund will increase.

Ex : Kion MF has following assets and liabilities

Investment in shares	₹50 crores
Cash balance	₹2 crores

	O/S Expenses ₹0.6 crores
(i)	Find NAV of MF given that number of units = 2 crores
(ii)	Find new NAV if the fund receives dividends of ₹4 crores.
A:	i) Existing NAV = $\frac{(50 + 2) - 0.6}{2}$ = 25.7
ii)	**Dividend is received by MF. It will increase its cash balance.**
	New Cash Balance = 2 + 4 = 6 crores
	New NAV = $\frac{(50 + 6) - 0.6}{2}$ = 27.7
	Alternatively, we can also above part (ii) directly as:
	Dividend received by MF on per unit basis = 4 crores / 2 crores = ₹2 per unit
	Hence, new NAV = 25.7 + 2 = 27.7
V)	**EFFECT ON NAV IN CASE OF 'DISTRIBUTION' BY MF (i.e. Dividend paid by MF to unitholders)** (8)
	Distribution to unitholders will decrease the cash balance of MF. Hence, NAV of fund will fall.
Ex :	Bestie MF has following assets and liabilities :
	Investment ₹400 crores
	Cash balance ₹60 crores
	External liabilities Nil
(i)	Find existing NAV if number of units = 50 crores.
(ii)	Find new NAV if MF pays-out a dividend of ₹40 crores to its unitholders.
A:	i) Existing NAV = (400 + 60)/50 = 9.2
ii)	New cash balance = 60 – 40 = ₹20 crores
	New NAV = (400 +20)/50 = 8.4
	Alternatively, we could have calculated distribution per unit = 40/50 = 0.8
	Hence, new NAV = 9.2 – 0.8 = ₹8.4
VI)	**V. IMP – DIVIDEND PAID TO 'SHAREHOLDERS'**
	If in ques it is written that dividend is paid to **'SHAREHOLDERS'** then it means dividend is **RECEIVED** by MF.

Logic – MF does not have shareholders. (It has Unitholders).

Illustration – Kranti MF bought shares of Intel ltd. So, now Kranti MF is a shareholder for Intel ltd.

So now if Intel pays any dividend, then Kranti MF will receive it (just like other shareholders.)

5. Return and Fees of Mutual fund

I) RETURN CALCULATION (3,4,12,13)

1. Holding period return (HPR) = $\frac{(NAV_1 - NAV_0) + \text{Income distributed}}{NAV_0}$

Income distributed can be Capital gain distribution or Dividend/Interest distribution.

2. Annual return or Effective yield p.a. = HPR x $\frac{12 / 365}{\text{No. of days / month}}$

II) TRACKING ERROR (TE)

Tracking error refer to the deviation of fund's return from the benchmark return.

Some reasons for TE include: Transaction cost, fees charged by AMCs, fund expenses, cash holding etc.

$$\text{Tracking error} = \sqrt{\frac{\Sigma (d - \bar{d})}{n - 1}}$$

where: d = differential return (i.e. Benchmark return – Actual return of fund)

$\bar{d}$ = Average of differential returns

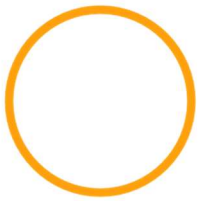
n = number of observations

III) MANAGEMENT FEES

There are generally two types of fees charged by a fund.

Fixed management fees – These must be paid in all the circumstances.

Incentive fees – It is paid only when fund value crosses a defined benchmark.



PART B: Advanced Topics

1. Different types of plans (v.imp) (23,24,25)

I) DIVIDEND PAY-OUT PLAN

The dividend is paid to unitholders in cash. Since cash is paid out -> NAV per unit falls.

II) DIVIDEND RE-INVESTMENT PLAN (16a&b)

Dividend is declared as usual . But instead of paying it in cash, new units are issued to unitholders at existing NAV ie. at ex-dividend NAV.

Number of new units issued = $\frac{\text{Number of units held} \times \text{Dividend per unit}}{\text{Ex-dividend NAV per unit}}$

III) GROWTH PLAN

No dividend is paid whatsoever. Since, no cash is paid as dividend, NAV of fund keeps on increasing.

Ex: Opening NAV = ₹40. During the year fund earned ₹8 per unit . Closing NAV = 40+8 = ₹48.

IV) BONUS PLAN

No dividends are paid whatsoever. However Bonus units are issued from time to time .

Ex: I currently hold 50,000 units of a MF. The MF announced a bonus of 1:4. Find new number of units.

Bonus units = 50,000 x 1/4 = 12500. New total units = 50,000 + 12,500 = 62,500

or directly -> New units = 50,000 x 5/4 = 62,500

2. Dividend Equalisation Reserve (22)

I) CONCEPT

MF earns income throughout the year but distributes it at the end of the year.

- EXISTING INVESTOR EXITS

Redemption price = Opening NAV + Her share of income in the fund till date.

- NEW INVESTOR JOINS THE FUND

He must bring his share of income at the time of entering.

Purchase price = Opening NAV + Bring in your share of income

- This share of income is known as **EQUALISATION AMOUNT.**
- All this undistributed income is handled via **DIVIDEND EQUALISATION RESERVE (DER) ACCOUNT.**
- When a new investor brings in Equalisation amount -> **ADD** it to DER A/c
- When an existing investor exits & takes away his share of equalisation amount -> **REDUCE** it from DER.

- If Entry or exit load is given -> Then calculate it on Opening NAV (without considering DER amount).

Ex: NAV of Union MF on 1st May was ₹15 per unit. Total number of units = 10 crores. The fund earned an income of ₹40 crores in April and ₹25 crores during May. I want to sell my units on 31 May.

i) What price should I get if: Case a – Exit load is 0

Case b – Exit load is 2%.

ii) Also, calculate the Dividend equalisation reserve amount on total and per unit basis if total of 10 lacs units were re-purchased (redeemed) on 31 May.

A: Case A - No exit load

	NAV as on 1st April	15
(+)	Income to be paid (equalisation amount) = (40 + 25) / 10	6.5
	Redemption price =	21.5

Case B – Exit load = 2%

	NAV as on 1st April	15
(-)	Exit load @ 2%	(0.3)
(+)	Income to be paid (equalisation amount) = (40 + 25) / 10	6.5
	Redemption price =	21.2

ii)

	Dividend equalisation reserve	Units	Income	Income/Unit
	Opening Balance	10 crores	40 crores	4
(+)	May Income	--	25 crores	2.5
=	Balance on 31 May (before redemption)	10 crores	65 crores	6.5
(-)	Units re-purchased	(0.1 crores)	(0.65 crores)	6.5
=	Closing balance (after distribution)	9.9 crores	64.35 crores	6.5

II) CALCULATING CLOSING NAV IN CASE OF DER A/c

	Opening NAV of fund	xxx
(+)	Income earned during the period	xxx
(+)	Portfolio appreciation during the period	xxx
(+)	Proceeds from issue of new units (Number of units x Issue price)	xxx
(-)	Units Repurchase (number of units x Re-purchase price)	(xxx)
(-)	Income distributed during the period	(xxx)
	Closing NAV of fund:	xxx

$$\text{Closing NAV per unit} = \frac{\text{Closing NAV of fund}}{\text{Closing number of units}}$$

Chapter 9A

Derivatives – Futures

Chapter Index

PART A – Basics of Futures
PART B – Pricing Futures
PART C – Arbitrage, Speculation & Hedging

---- Student's Space for Summary chart and notes ----

PART A: Basics of Futures

In Layman terms -> Derivative is something that derives its value from something else.

For ex: Curd, Butter, Cheese etc. are all derived from Milk and hence are called Milk Derivatives.

Similarly, we have Financial derivatives that derives its value from an underlying financial asset.

Ex: Stock Derivatives derives its value from the underlying stock. These includes Stock futures, stock options etc.

Index Derivatives are based on Index value.

Interest rate derivatives are based on the interest rate movements. These includes Interest rate Swaps, FRAs etc.

2. FUTURES - Basics

A futures contract is a contract to buy/sell an item at a future date.

TODAY - Price, quantity and other contractual terms are fixed today only.

ON SETTLEMENT DATE – The contract can be settled either by way of:

Net settlement or Physical delivery.

Illus: You owe me ₹1000 and I owe you ₹200.

	Net settlement	Physical delivery
-	You pay me ₹ 800 only (net balance)	I pay you ₹200 & you pay me ₹1000
-	For detailed illustration on net settlement, refer 'Fin Fundas – I love ~~You~~ betting'.	For a detailed illustration on physical delivery, refer 'Fin Fundas – Wheat farmer case'

II) DIFFERENCE BETWEEN SPOT DELIVERY & FORWARD

	SPOT CONTRACT a.k.a CASH MARKET	FUTURES CONTRACT
i.	A contract to buy/sell an item is entered today.	A contract to buy/sell an item is entered today.
ii.	Price is fixed today.	Price is fixed today.
iii.	Quantity is decided today.	Quantity is decided today.
iv.	**Delivery is given today only (T+2)**	**Delivery will be given on expiry date.**
v.	**Payment is made today only.**	**Payment will be made on the expiry date.**

III) FUTURES BASIC TERMINOLOGY

1. Quantity which is decided today is known as 'Lot size.'
2. Period after which delivery will be made is known as 'Expiry or Due date or Maturity'
3. Price that is fixed today is known as the 'Price of futures contract'

IV) FOR BEST UNDERSTANDING OF FUTURES

Think of Futures as Betting -> सट्टेबाज़ी

Imagine that in the end everything will be settled on net basis.

Long futures (F+) -> Upside betting (profit if price increases).

Short futures (F-) -> Downside betting (profit if price fall)

3. Mechanics of Futures

I) TYPES OF FUTURES CONTRACT

Futures contract is just a form of betting and we can bet on a lot of different items. It can be:

Stock futures, Index futures, currency futures, commodity futures etc.

II) LOTS – IN CASE OF FUTURES CONTRACT

In stock market (i.e. cash market), you can even purchase a single share. But in case of futures market, one must deal in lots. (Lot size is decided by stock exchange).

Ex: One lot of Nifty = 75, One lot of Reliance ltd = 500.

4. Squaring Off / Settling / Closing Futures Position (1,3)

Squaring off futures is same as squaring off a stock position.

If Bought shares (S^+) -> Then sell shares (S^-) to square off

If Sold shares (S^-) -> Then buy shares (S^+) to square off.

Similarly, while trading futures:

If bought futures (F^+) -> Then sell futures (F^-) to square off.

If Sold futures (F^-) -> Then long futures (F^+) to square off.

Ex: Mr. Abc bought a futures contract at ₹425. Find his gain / (loss) if he later squares off his position at ₹435. Lot size = 500 shares.

A:

Bought future at	₹425
Sold future at	₹435
Gain / (loss) per share	₹10
Total Gain = ₹10 x 500 =	₹5,000

5. Margin requirements (6a, 6b)

(Refer Fin Fundas – I Love ~~you~~ Betting)

1. INITIAL MARGIN

- It is like a security deposit that must be deposited before entering into futures contract.
- Both the parties - long futures & short futures must deposit this margin money.
- This margin money is refunded at the time of closing of position (after adjusting for P&L).

2. If Initial Margin is not given in ques, then calculate it as -> Initial Margin = $\mu + 3\sigma$

where: μ = Daily absolute change σ = standard deviation

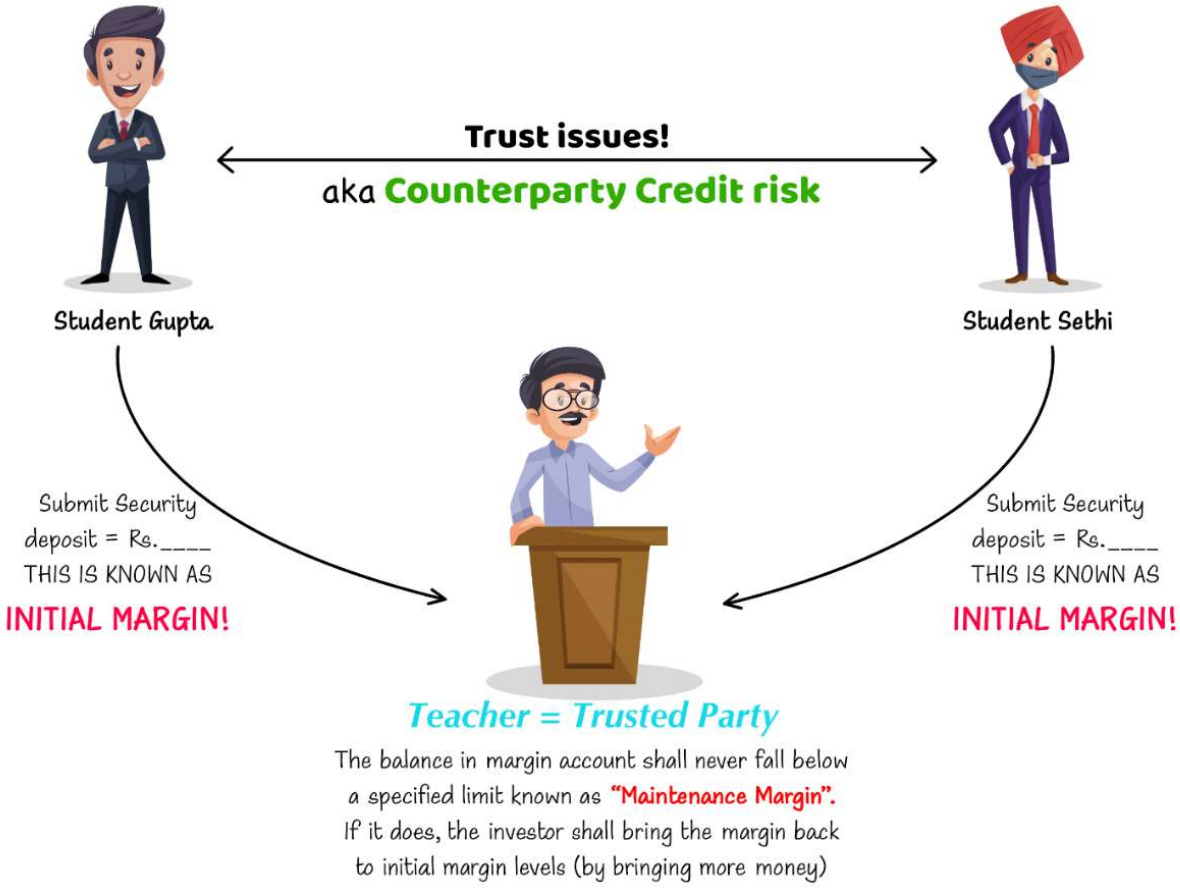
3. MARK TO MARKET (MTM)

- Think of it like a profit/loss account. Refer example below for better understanding.
- If MTM balance > initial margin level, then investor can withdraw the additional amount.

In exam -> Do NOT withdraw this amount unless specifically mentioned in ques.

4. MAINTENANCE MARGIN

If balance in margin account falls below maintenance margin, then the balance in margin account must be brought back to initial margin level (by depositing more money).



Ex: The contract price of December Nifty futures contract on a particular-day was ₹1310. The minimum trading lot on Nifty futures is 100. The initial margin is 8% and the maintenance margin is 6%.

The index closed at the following levels on the next five days.

Day	1	2	3	4	5
Closing Price	1340	1360	1300	1280	1305

1. Calculate the mark to market cash flows and daily closing balances in the a/c of
(i) an investor who has gone long at 1310 and **(ii)** an investor who has gone short at 1310.

2. Calculate the met profit or loss on each of the contracts.

A 6b:

Lot value	= 1310 x 100	= 1,31,000
Initial margin	= 1,31,000 x 8%	= 10480
Maintenance margin	= 131000 x 6%	= 7860

i) Long investor

Day	Opening Bal.	Mark to market	Margin call	Closing Bal.
1	10480	3000	-	13480
2	13480	2000	-	15480
3	15480	-6000	-	9480
4	9480	-2000	3000	10480
5	10480	2500	-	12980

ii. Short investor

Day	Opening Bal.	Mark to market	Margin call	Closing Bal.
1	10480	-3000	3000	10480
2	10480	-2000	-	8480
3	8480	6000	-	14480
4	14480	2000	-	16480
5	16480	-2500	-	13980

2. Calculation of Profit / (loss)

Long = (1305 – 1310) x 100 = (500)

Short = (1310 – 1305) x 100 = 500

PART B: Pricing Futures

1. Pricing a Futures contract

I) INTRODUCTION

Pricing of Derivatives is done using 'Principal of No Arbitrage' (refer annexure Section 3 for more)

Principal of No arbitrage (also known as Law of one price) says:

'Two bundle of assets with same underlying cash flows shall have same price'.

Illus: Mr. Manager will receive bonus after 3 months. He is optimistic about 'RIL' shares which are currently trading at ₹2000. But he don't want to wait for next 3 months as he is afraid that price will rise by that time.

He has two options:

	OPTION 1 – Borrow & Buy	OPTION 2 – Buy futures
-	Borrow ₹2000 today for a period of 3 months. (Interest rate = 6% p.a.)	Enter into a futures contract to buy Reliance shares after 3 months.
-	Use this borrowed amount to buy Reliance shares today only at ₹2000.	As per Principal of No Arbitrage, the cost of these 2 alternatives must be same.
-	Repay loan after 3 months (i.e. when bonus is received). Amount to be repaid:	∴ Futures price = ₹2030.
	$2000 \times (1 + 0.06 \times 3/12)$ = ₹2030	

☞ We can say that **PRICE OF FUTURES CONTACT**, also known as **FAIR FUTURES PRICE (FFP)** is -

FFP = SR (1 + rt) (... simple interest)

or FFP = $SR (1 + r)^n$ (... compound interest)

or FFP = $SR e^{rt}$ (... continuous compounding)

Hence, FFP = SR + Cost of carry

This is known as 'Cost of carry model'.

II) ASSUME 'SIMPLE INTEREST RATE' UNLESS SPECIFICALLY MENTIONED IN QUES.

Ques specifically mention 'continuously compounded (cc)' or or give value of 'e' → CC rate

Ques mentions 'compounded annually or monthly etc.' → Compound interest

If nothing is specifically mentioned → Assume simple interest

III) SOLVING e^a ON CALCULATOR

Alternate 1 (Preferred)

Step 1: Divide power of e with '4096'.

Step 2: Add '1'.

Step 3: Press 'x =' 12 times on calculator

Alternate 2 (bit lengthy)

Step 1: Enter '2.71828' and press '√' button 12 times

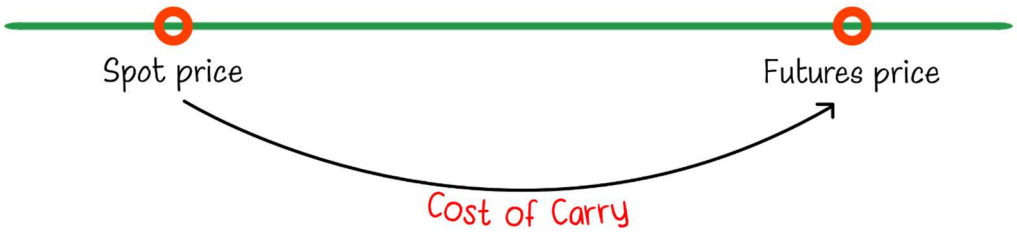
Step 2: Subtract '1'

Step 3: Multiply with power

Step 4: Add 1

Step 5: Press 'x =' 12 times on calculator

IV) COST OF CARRY MODEL FOR PRICING FUTURES



'Cost of Carry' model for pricing Futures

» Cost of carry may include:

Add: Interest cost (it is always incurred)

Add: Storage cost (incurred only in case of commodities such as stell, oil etc. which needs to be stored)

Less: Any income received (such as dividend in case of dividend paying stock)

Less: Convenience yield (in case of commodities)

We shall discuss these all one by one.

V) PRACTICE EXAMPLE (BASIC)

Ex: Calculate fair futures price (FFP) if:

Eg: (Simple interest) SR = ₹250, rf = 4% p.a., period = 3-month.

Ans: FFP = SR (1 + rt) = 250 x (1 + 0.04 x 3/12) = ₹252.5

Eg: (Compound interest) SR = 850, rf = 5% p.a. compounded annually, period = 1 month.

Ans: Futures price = SR $(1+r)^n$

$= 850 \times (1+0.05)^{1/12} = 850 \times 1.004074 =$ ₹ 853.463

Eg: (Continuous compounding) SR = ₹250, rf = 4% continuously compounded, period = 3-months.

Ans: Futures price = SR x e^{rt}

$= 250 \times e^{0.04 \times 3/12} = 250 \times 1.010050167 =$ ₹252.5125

2. FFP – When Storage cost incurred (in case of commodities like steel, oil etc.)

- The storage cost incurred in case of commodities increases the 'cost of carry'.
- Hence, it is **ADDED** while calculating FFP.

Illus: Tata Motors requires steel after 3 months. Mr. Manager is afraid that the price of the steel may rise in 3 months period. Current market price = ₹40,000 per ton. It can invest and borrow at 6% p.a.

He has two options:

	OPTION 1 – Borrow & Buy	OPTION 2 – Buy futures contract
i.	Buy steel today at ₹40,000 per ton.	Enter into a futures contract to buy steel after 3-months.
ii.	Store this steel for 3-months. Storage cost to be paid to warehouse after 3 months = ₹500.	As per Principal of No Arbitrage, the cost of two alternatives must be same. Hence, futures price in this case = 41,100.
iii.	Cash outflow after 3 months -	
	Repay loan = 40,000 x (1 + 0.06 x 3/12) = 40,600	
+	Pay storage cost = 500 = 500	
	= 41,100	

☞ ***FFP = SR + Interest + Future Value (FV) of storage cost***

Ex: Find FFP of 3 months futures contract on silver. SR/gram = ₹600.

i) Storage cost of ₹5 will be incurred at the time of storing the silver i.e., today only. Rf = 7% p.a.

ii) Storage cost of ₹6 will be incurred at the end of 3-months. Rf = 7% p.a.c.c.

iii) Storage cost of ₹5 will be incurred today. Rf = 7% p.a.c.c.

iv) Storage cost of 1% p.a.c.c. will be incurred. Rf = 7% p.a. cc.

v) Storage cost of ₹2 will be incurred at the end of every month. Rf = 7% p.a. cc

A Futures price = SR + Interest + FV of storage cost

i) Future price = (600 + 5) x (1 + 0.07x3/12) = 615.5875 per gram

ii) Futures price = $600 \times e^{0.07 \times 3/12} + 6$

= 610.62 + 6

= 616.62

iii) Future price = $(600 + 5) \times e^{0.07 \times 3/12}$

= 605 x 1.0177

= 615.7085 per gram

iv) Future price = $600 \times e^{(r+s)t}$

= $600 \times e^{(0.07 + 0.01) \times 3/12}$

= 600 x 1.0202

= 612.12

v) FV of storage cost = $2e^{0.07 \times 2/12} + 2e^{0.07 \times 1/12} + 2$

= 2x1.01175 + 2x1.00585 + 2

= 2.0235 + 2.0117 + 2

= ₹6.0352

Futures price = $600 \times e^{0.07 \times 3/12} + 6.0352$

= 600 x 1.0177 + 6.0352

= 616.6552

3. FFP – When Dividend (or any other income) is received

Ex: Infosys stock is currently trading at ₹1000. I will bonus receive bonus after 3-moths. But I am afraid that the share price of Infosys will increase by then. I can, however, borrow at 6% p.a.

- Infosys share will give a dividend of ₹50 after 3 months.

I have two options:

	OPTION 1 – Borrow & Buy	OPTION 2 – Buy Futures contract
i.	Buy 1 share of Infosys today by borrowing ₹1000 @ 6% p.a. for 3 months.	Enter into a futures contract to buy Infosys share after 3-months.
ii.	After 3 months - Repay loan = 1000 x (1 + 0.06 x 3/12) = 1015 Less: Dividend received after 3 months = (50) Net amount to be paid after 3 months = 965	As per Principal of No Arbitrage, the cost of two alternatives must be same. Hence, futures price in this case = 965.

Hence, FFP when dividend (or any other income) is received

☞ ***FFP = SR + Interest - Future Value (FV) of Dividend received***

Notes ...

1. Do not consider any dividend expected to be received after the period of futures contract.
   For example – In the above scenario, we are planning to buy Infosys share after '3 months'.
   Now, if it is expected that Infosys will pay a dividend after 6 months, then it will not be considered.

2. Income is generally denoted by 'y'.

-> **DIVIDEND RATE % VS DIVIDEND YIELD %**

Dividend yield treatment is covered above. But if ques mentions 'Dividend rate'.
Then first calculate dividend in amount = Face value of share x Dividend rate.
Then subtract FV of dividend (just like when dividend is given in amount).

Ex : A stock is currently trading at ₹150. Find 3-months futures price on the stock in the following cases:

i. A dividend of ₹4 will be received today. Rf = 5% p.a.c.c

ii. A dividend of ₹5 will be received after 1 month. Rf = 5% p.a.c.c.

iii. Dividend of ₹2 will be received after 1-month, another ₹4 will be received after 2 months. Rf = 5% p.a.c.c.

iv. Dividend yield on stock = 3% p.a.c.c. Rf = 5% p.a.c.c.

A: Futures price = SR + Interest – FV of dividend

i. Futures price $= 150 \times e^{0.05\times3/12} - (4 \times e^{0.05\times3/12})$

$= 151.8868 - 4.0503$

$= 147.8365$

or alternatively, directly we can do -

Futures price $= (150 - 4) \times e^{0.05\times3/12}$

$= 146 \times 1.01258$

$= 147.836$

ii. Futures price $= 150e^{0.05\times3/12} - 5e^{0.05\times2/12}$

$= 151.8868 - 5.0418$

$= 146.845$

iii. FV of dividends $= 2e^{0.05 \times 2/12} + 4e^{0.05 \times 1/12}$

$= 2.0167 + 4.0167 = 6.0334$

Futures price $= 150 \times e^{0.05\times3/12} - 6.0334$

$= 151.8868 - 6.0334$

$= 145.853$

iv. Futures price $= 150\ e^{(0.05 - 0.03) \times 3/12}$

$= 150\ e^{0.02 \times 3/12}$

$= 150 \times 1.005$

$= 150.75$

4. FFP – When Convenience Yield (CY) is given (in case of commodities)

Benefits in case of stocks = Dividend yield

Benefits in case of commodity = Convenience yield (cy)

The treatment is quite similar as well.

What is Convenience yield?

Having **physical possession** of an asset might provide some convenience (imagine – benefit) which is not available if you merely hold a futures contract on that asset. This convenience is denoted by convenience yield (CY).

☞ ***FFP = SR + Interest - Future Value (FV) of Convenience yield***

Ex: Gold Spot is trading at ₹52,000. Find Gold 3-month futures price if Storage cost of ₹1500 will be incurred at the time of storage. If Gold futures are trading at ₹53,631, find convenience yield. Rf = 4% p.a.

Ans: Futures price = (SR + PV of storage cost – PV of convenience yield) $(1 + r)^n$

$53631 = (52000 + 1500 - CY)(1 + 0.04 \times 3/12)$

$53100 = 53500 - CY$

$CY = ₹400$

5. When Storage cost / Income (or CY etc.) is given in % (5)

(ex: Dividend yield % given, or convenience yield % given).

CONCEPT: Add Storage cost (sc) % to the Rf %.

Reduce income (y) % or convenience yield % from Rf %.

- Simple interest: $FR = SR[1 + (r + sc - y)t]$
- Compound interest: $FR = SR[1 + (r + sc - y)]^n$
- Continuously compounded: $FR = SR\, e^{(r + sc - y)t}$

IMP! Income yield (y) can only be reduced from Rf if '**COMPOUNDING FREQUENCY OF BOTH RF & Y IS SAME**'

If compounding frequency is not same, then 1st calculate income in ₹ and then subtract its FV.

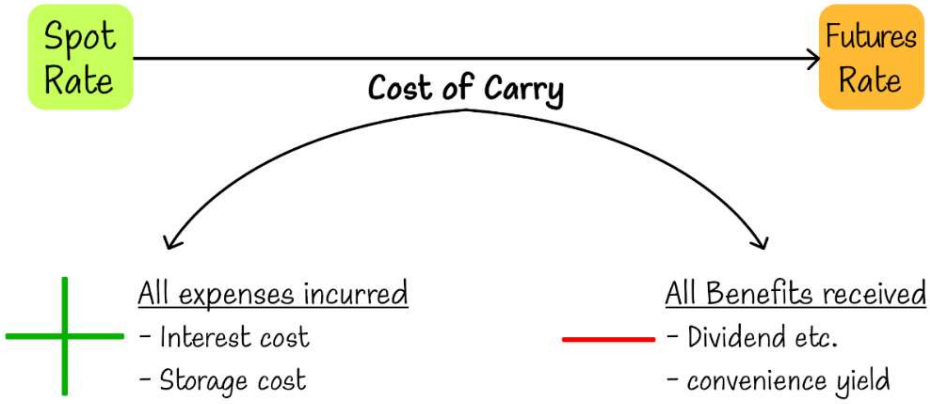
Similarly, storage cost can be added to rf % if compounding frequency of the both are same.

If not same, then first calculate storage cost in amount, and then add its FV.

6. Summary

From above understanding, we can now say:

FR = SR + INTEREST + FV OF STORAGE COST (-) FV OF ANY INCOME (-) FV OF CONVENIENCE YIELD



This is known as 'cost of carry model'.

- COST OF CARRY INCLUDES:

Interest cost (it is always incurred)

\+ Storage cost (incurred only in case of commodities such as stell, oil etc. which needs to be stored)

(-) Any income received during the period (ex: dividend)

(-) Less: Convenience yield

Note: CALCULATING COST OF CARRY WHEN FR & SR IS GIVEN.

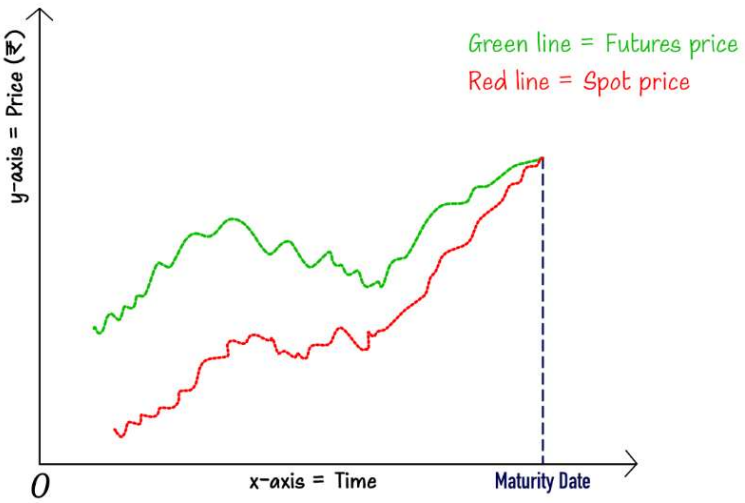
Futures price = SR + Cost of carry

» Cost of carry = Futures price – SR

8. Principle of Convergence

The principle says that on maturity:
Futures price = Spot price.

Reason:
Futures price = SR $(1+r)^n$
At maturity, n = 0.
∴ Futures price = SR (1) = SR



PART C: Arbitrage, Speculation & Hedging

1. Introduction to Arbitrageurs, Speculators & Hedgers!

Arbitrageur

शानी

Speculator

निडर

Hedger

डरपोक

1. Arbitrageur – Aims to earn a sure-shot risk-less profit.

   Never invests even a single rupee from own pocket, but rather borrow!

   Typical arbitrage is done by Simultaneous buying and selling to exploit price difference.

2. Speculator (सट्टेबाज़) – Takes risk and may earn a profit if analysis is right. But may also incur loss.

3. Hedger – Too afraid to take the risk and hence wants to transfer risk to someone else (via hedging).

2. Arbitrage (16a &b , 21)

FFP = SR $(1 + r)^n$

Now, if actual futures price prevailing in the market ≠ Fair futures price, then arbitrage is possible.

I) GENERAL RULES FOR ARBITRAGE

a. **Buy Low, Sell High** - Buy cheaper bundle and Sell expensive bundle.

b. **Never Invest your own money** – So, if you require funds to buy something, then BORROW AT RF.

c. **Never keep your money idle** – If you have some funds, then always keep them invested at Rf.

d. **Amount of Arbitrage profit =** Amount of mispricing

SCENARIO – TCS Spot rate = ₹2000. Period = 3 months. Interest rate = 6% p.a.

Fair futures price (FFP) = 2000 x (1 + 0.06 x 3/12) = ₹2030

II) CASE 1 - FUTURES PRICE = ₹2050

Actual futures price > FFP. So, sell futures (as it is overvalued) and Buy stock (by borrowing at Rf).

	ACTION TODAY	AFTER 3 MONTHS
i.	Sell futures contract today at ₹2050.	i) Settle Futures contract
ii.	Simultaneously, borrow ₹2000 at 6%.	Sell TCS shares at ₹2050 (contracted price): 2050
iii.	Use this borrowed money to purchase the TCS	ii) Settle loan (Cash outflow)
	shares at ₹2000.	Repay loan = 2000 x (1 + 0.06x3/12) = (2030)
		Arbitrage profit = ₹20

CROSS-CHECK (Just for your knowledge. do not show in exam.)

Arbitrage profit earned should be equal to amount of mispricing.

Amount of mispricing (in futures price) = 2050 – 2030 = ₹20

Arbitrage profit earned = ₹20

II) CASE 2 - FUTURES PRICE = ₹2015

Actual futures price < FFP. Buy futures (as it is undervalued) and Sell stock (& invest sale proceeds at Rf).

	ACTION TODAY	AFTER 3 MONTHS
i.	Buy futures contract today at ₹2015.	i) Settle Futures contract
		Buy TCS shares at ₹2015 (contracted price): (2015)
ii.	Simultaneously, sell TCS shares at ₹2000.	ii) Investment proceeds (cash inflow)
iii.	Invest this ₹2000 at 6% p.a. for 3 months.	Investment Proceeds: 2000 x (1 + 0.06x3/12): 2030
		=> Arbitrage profit = 15

III) PRACTICAL NOTE (Not much relevant for exam)

TRANSACTION COSTS MAY MAKE SMALL ARBITRAGE TRADES UNPROFITABLE!

Ex: Fair futures price = ₹760. Actual futures price = ₹760.60. Transaction costs (brokerage etc.) = ₹2

Is Arbitrage practically viable?

A: Profit from arbitrage trade = Amount of mispricing = 760.6 – 760.0 = 0.6

Less: Transaction costs = (2)

Net profit / (loss) = (1.4)

Hence, arbitrage is not possible due to transaction costs.

3. Speculator

Same as concept of 'Squaring off futures'. If long futures -> then short futures to square off.

If short futures then long futures to square off.

Ex: Mr. A bought 4-months futures contract on TCS. Spot rate of TCS today = ₹2500. Rf = 9% p.a.

i) Find futures price.

ii) Mr. A squares off his position after 1-month, when TCS spot rate = 2600. Find Profit / loss if lot size = 800.

iii) Assuming that the position was not squared off after 1-month . But it was off at maturity ie . after 4- months. SR of TCS after 4-months = ₹2750.

A: F = SR (1 + rf) = 2500 x (1 + 0.09 x 4/12) = ₹2575

ii) TCS Futures price after 1 month = 2600 x (1 + 0.09 x 3/12) = ₹2658.5

Profit / (loss) = (2658.5 – 2575) x 800 = ₹66,800.

iii) Futures price at expiry = Spot Rate (as per principle of convergence)

FP after 4-months = SR = ₹2750

Profit / (loss) = (2750 – 2575) x 800 = ₹1,40,000

4. Hedging using Stock Futures

Take opposite position in futures to hedge.

Position in stock (aka cash market position)	Required futures position (for hedging)
Long	Short
Short	Long

$$\text{Number of futures contracts} = \frac{\text{Number of shares}}{\text{Lot size}}$$

Ex: I have 500 shares of Reliance ltd (RIL). which is currently trading at ₹2500. A futures contract on RIL stock is trading at ₹2540. What should I do to hedge my stock position. Lot size of futures = 250.

- Show the impact of hedging if on next day stock price fell by 2%. RIL futures price on next day = ₹2490.

A: We must SHORT RIL futures to hedge a long position in the stock.

$$\text{Number of contracts to be shorted} = \frac{\text{Number of shares}}{\text{Lot size}} = \frac{500}{250} = 2 \text{ contracts}$$

ii)

Impact of hedging	Gain / (loss)
Loss on stock position = 500 x 2500 x 2%	(25,000)
Gain on stock position = 250 x 2 x (2540 – 2490)	25,000
Net profit / (loss)	Nil

5. Hedging Using Index Futures (4, 9a, 12, 13a&b, 15)

Sometimes Futures contract on a stock may not directly available. In such cases, we can use Index futures to hedge our stock or portfolio. To hedge -> Take reverse position in Index futures.

I) NUMBER OF INDEX FUTURES CONTRACT

a. Amount of Index futures to be traded = Value to be hedged (V_h) x Beta

b. Calculate Value of 1 Futures contract = Lot size x Price of Index (I_{FP})

c. Number to contracts to be traded = $\frac{\text{Amount of Index futures to be traded}}{\text{Value of 1 contract}}$

or Directly (in exam follow direct method to save time):

Number to contracts to be traded = $\frac{V_h \times \text{Beta}}{I_{FP} \times \text{Lot size}}$

Ex: Mr. Texas holds a portfolio of shares of ₹20 Lacs. Beta of this portfolio = 1.5.

i) Illustrate how a complete hedge can be obtained using Nifty futures. Nifty futures are currently trading at ₹20,000 Lot size = 75.

ii) Calculate the net gain or loss if Nifty falls by 10%.

A: i) Amount of Nifty futures to be shorted = V_h x Beta = 20 Lacs x 1.5 = ₹30 Lacs

Value of 1 Nifty futures contract = Nifty futures price x Lot size = 20,000 x 75 = ₹15 Lacs

Number to contracts to short = $\frac{\text{Amount of Index futures to be traded}}{\text{Value of 1 contract}} = \frac{30 \text{ lacs}}{15 \text{ lacs}}$ = 2 contracts.

OR Number to contracts to be traded = $\frac{V_h \times \text{Beta}}{I_{FP} \times \text{Lot size}} = \frac{20 \text{ lacs} \times 1.5}{20{,}000 \times 75}$ = 2 contracts

ii)

Calculation of Gain / (loss) if Nifty falls by 10%	Gain / (loss)
Loss on portfolio = 20 lacs x 10% x 1.5	(3,00,000)
Gain on short index position = (20,000 x 75) x 2 x 10%	3,00,000
Net Gain / (loss)	Nil -> Completely hedged

Ex: What if I want to hedge only 50% of stock position in the above example?

A: In such case V_h (i.e. Value to be hedged) = 20 Lacs x 50% = ₹10 lacs

Number to contracts to be shorted = $\frac{V_h \times \text{Beta}}{I_{FP} \times \text{Lot size}} = \frac{(20L \times 50\%) \times 1.5}{20{,}000 \times 75}$ = 1 contract

III) MODIFYING BETA USING INDEX FUTURES (9b, 14)

In the above example we hedged the portfolio using Index futures. Alternatively, we can say that we made the Beta of portfolio '0' using Index futures.

- We can **MODIFY (I.E. INCREASE OR DECREASE)** our portfolio beta using Index futures.

$$\text{Number to contracts to be traded} = \frac{V_h \times (T_B - C_B)}{I_{FP} \times \text{Lot size}}$$

Where: V_h = Value to be hedged T_B = Target Beta

C_B = Current Beta I_{FP} = Index futures price

Ex: (Continuing the same Mr. Texas example) Hedge the portfolio of Mr. Texas or alternatively, we can say reduce the portfolio beta to '0'.

A: Number to contracts to be traded = $\frac{V_h \times (T_B - C_B)}{I_{FP} \times \text{Lot size}} = \frac{20\text{ L} \times (0 - 1.5)}{20{,}000 \times 75}$ = -2 contracts (short 2 contracts)

Note: Minus 2 contracts means -> short 2 contracts

Ex: (Continuing the same Mr. Texas example) What should be done to Increase portfolio Beta to 2.25?

A: Number to contracts to be traded = $\frac{V_h \times (T_B - C_B)}{I_{FP} \times \text{Lot size}} = \frac{20\text{ L} \times (2.25 - 1.5)}{20{,}000 \times 75}$ = +1 contract (Long 1 contract)

Note: +1 contract means -> Long 1 contract.

IV) PORTFOLIO OF EQUITY + CASH (& risk-free assets)

Beta of cash and risk-free assets is '0'.

Ex: A portfolio of ₹50L includes equities worth ₹45L with Beta = 1.5. Balance is held as cash or is invested in short-term risk-free securities. Nifty futures is currently trading at 10,000. Lot size = 75.

Type 1 – Reduce **PORTFOLIO BETA** to 1.2.

A: **CAUTION. SLIP POINT ->** Beta of equity = 1.5. But we have to reduce portfolio beta to 1.2

So, 1st calculate portfolio beta = weighted average beta = 1.5 x 45/50 + 0 = 1.35

Number to contracts = $\frac{V_h \times (T_B - C_B)}{I_{FP} \times \text{Lot size}} = \frac{50\text{L} \times (1.2 - 1.35)}{10{,}000 \times 75}$ = -1 contract i.e. short 1 contract

Type 2 – Reduce EQUITY BETA to 1.2.

We already have equity beta. So, no need to change anything here. However, beware that value of equity is ₹45 lacs only. So, Value to be hedged = ₹45 Lacs (and not ₹50 lacs).

Number to contracts = $\frac{V_h \times (T_B - C_B)}{I_{FP} \times \text{Lot size}} = \frac{45L \times (1.2 - 1.5)}{10{,}000 \times 75}$ = -1.8 or 2 approx.

i.e. short 2 contracts

V) PORTFOLIO OF EQUITY AND FUTURES (18)

Ex: Consider Mr. Texas portfolio of ₹20 lacs consisting of equity stocks. Beta of portfolio = 1.5

Calculate new beta of portfolio if Mr. Texas goes long on 1 Nifty futures contract. Value of Nifty futures contract = ₹15 lacs.

A: Beta = Weighted average beta = $\frac{20L \times 1.5 + 15L \times 1}{20L} = 2.25$

EXPLANATION

Both equity position and futures position have some Beta. So, in numerator we consider both stock position's beta and futures position's beta. But unlike shares, no money is required to enter into futures contract. Hence, in denominator the total portfolio value remains same i.e. ₹20 Lacs only.

Additional note

If Beta of share or portfolio is not given in ques, then calculate it as:

Beta = $\frac{\%\text{ change in value of portfolio (or stock)}}{\%\text{ change in of market portfolio (index)}}$

V) SOME NOTES ON HEDGING

1. Use 'Actual futures price' for the purpose of hedging. If actual FP is not given in ques, then calculate fair futures price (FFP) and use that.
2. In case if answer is in decimals then number of futures contract should be rounded off to upper number.

6. Hedging in case of commodity futures (17a & b)

I) HEDGE RATIO

Airline co. wants to hedge its oil requirements -> Buy futures (F+)

Problem -> Airline requires Aviation turbine fuel (ATF). But futures are not directly available on ATF.

Then what to do? Futures are available on crude oil. But oil futures & ATF Spot does not change by exactly same amount.

Solution -> Know the 'Sensitivity of Spot rate w.r.t to change in Futures price.'

This is given by Hedge ratio (HR) = $\frac{r_{(s,f)} \times \sigma_s}{\sigma_f}$

This is just like Beta (in case of stocks). It tells us that if FP change by 1%, then by what % will SR change.

where: $r_{(s,f)}$ = correlation coefficient between spot rate and futures price

σ_s = SD of Spot rate σ_f = SD of futures price

Ex: Correlation between oil futures and Aviation turbine fuel (ATF) spot rate is 0.9. SD of oil futures = 16%.

SD of ATF spot = 18%.

i) Find hedge ratio.

ii) Find value of oil futures to be traded if airline wants to hedge its requirement of ATF worth ₹40 crores.

A: Hedge ratio (HR) = $\frac{r_{(s,f)} \times \sigma_s}{\sigma_f} = \frac{0.9 \times 18}{16} = 1.0125$

This means if oil futures price change by 1%, then spot rate is expected to change by 1.0125%.

ii) Value of oil futures = Value of spot x Hedge ratio = 40 crores x 1.0125 = ₹40.5 crores.

Hence, buy oil futures of ₹40.5 crores.

II) HEDGE EFFICIENCY (r square OR r^2)

Hedge efficiency is given by r^2 or coefficient of determination. It tells us:

'What % of variation in dependent variable is explained by variation in independent variable.'

Ex: Calculate and interpret hedge efficiency if correlation between oil futures & ATF is 0.9.

A: Hedge efficiency = $r^2 = 0.9^2 = 0.81$ or 81%.

This means that 81% of variation in ATF spot is explained by variation in oil futures price.

Balance 19% is due to some other factors.

PART D: Other Tiny Topics

1) NET SETTLEMENT = PHYSICAL DELIVERY

(First refer Fun Fundas – Airlines are worried)

Ex: Rider & Michael are two traders. As per Rider, price of 'Axis bank' will cross ₹500 in 1-month time frame, whereas Michael believes that it will fall much below ₹500. So, they entered into 1-month forward contract.

i) Determine what position Rider and Michael shall take.

ii) Illustrate financial impact via 'Net settlement' if price after 1-month turns out to be:

a) 520 c) 470

iii) Illustrate the financial impact If the settlement happened via 'Physical delivery' in part (ii) above.

A: i) Rider -> Bullish. Buy futures (F+) Michael -> Bearish. Sell futures (F-)

ii) Gain / (loss) under 'Net settlement'

Price after 1 month	Gain / (loss) to Rider (F+)	Gain / (loss) to Michael (F-)
520	+20	-20
470	-30	+30

iii) Gain / (loss) under 'Physical delivery'

Rider -> Rider has bought future i.e. he has committed to buy shares at ₹500 in future.

On expiry, he must buy shares at the contractual price and can then sell in open market.

Purchase price = ₹500	Selling price = Prevailing market price	Gain / (loss)
500	520	+20
500	470	-30

Michael -> Michael has sold futures i.e. he has committed to sell shares at ₹500 in future.

On expiry he must buy shares from open market and sell it at contractual rate of ₹500.

Sale price = ₹500	Purchase price = Prevailing market price	Gain / (loss)
500	520	-20
500	470	+30

II) FORWARD VS FUTURES CONTRACT

No difference for practical ques solving. Only Theoretical difference at your level.

	FORWARD CONTRACT	FUTURES CONTRACT
i.	Traded in over-the-counter (OTC) markets.	Futures contract are traded on stock exchanges.
ii.	Can be tailored to meet specific requirements. Delivery date, lot size etc. is decided by the parties.	Standardised - delivery date, lot size etc. is decided by the stock exchange and cannot be modified.
iii.	These contracts are less liquid.	Futures are far more liquid.
iv.	MTM requirement is mutually decided b/w parties.	Strict MTM requirements are decided by exchange.
v.	Higher counter-party risk.	Lower (or negligible) counterparty risk.

III) BASIS (22)

Basis = Spot price – Futures price

If Futures price > SR, i.e. basis is negative -> It is known as contango.

If Futures price < SR, i.e. basis is positive -> It is known as backwardation.

Towards maturity, basis = 0 (due to principle of convergence)

IV) CONCEPT OF OPEN INTEREST (7, 8)

Open interest refers to number of contracts 'Open' in the market i.e. contracts that have not yet been settled.

Format to calculate open interest

Parties	Lots	Nature of trade	Open interest

Open Interest calculation can only be understood practically with the help of example.

Refer Ques from Simplified AFM Ques Bank

Chapter 9B

Derivatives – Options

Chapter Index

PART A – Basics of Options
PART B – Pricing Options (Valuation of options)
PART C – Strategies and other Tiny topics

---- Student's Space for Summary chart and notes ----

PART A: Basics of Options

1. Introduction

(Must refer 1st Fun Fundas -> Diwali Lottery)

I) INFORMAL UNDERSTANDING: Options = Lottery

Option premium: You always need to pay option premium (lottery ticket) to purchase option (lottery). This premium (ticket price) is Non-refundable.

Payoff: Call option = Upside lottery. You'll gain if stock price > Strike price on expiry.

Put option = Download lottery. You'll gain if stock price < Strike price on expiry.

II) FORMAL UNDERSTANDING (Don't cram)

Options is a right (but not an obligation) to buy or sell a security at a specified price (known as strike price) after a specified period (known as expiry).

At Expiry -> The contract may be settled via:

a. Net settlement (already discussed in Diwali lottery example)

b. Physical delivery

III) PHYSICAL DELIVERY

a. CALL OPTION - Call option means a right (but not an obligation) to buy shares at Strike price.

b. PUT OPTION - Put option means a right (but not an obligation) to sell shares at Strike price.

IN SHORT, CALL OPTION = RIGHT TO BUY

PUT OPTION = RIGHT TO SELL

IV) V. IMP - GUIDANCE NOTE FROM AUTHOR

For proper understanding of this chapter, think of options as 'Lottery' only.

Do not focus much on the 'Physical delivery' aspect.

This simple thing will make your chapter a whole lot easier.

V) NOTATIONS

Item	Notation	Item	Notation
Call buy	C+	Put buy	P+
Call sell	C-	Put sell	P-
Option premium	OP	Strike price = Exercise price	K or E
Current stock price	S_0	Stock price on expiry	S_T
Period of expiry	T or t		

VI) Imp! Option selling = Writing option

Sometimes option selling is also called as 'option writing.'

Option writer = Option seller.

VII) NOTE – Timing of premium & reward

The price of lottery ticket is always paid today i.e. at the time of buying of lottery.

Whereas reward of lottery is announced at maturity (i.e. after some period).

Similarly, option premium is paid today only i.e. at the time of buying options.

But option is exercised at maturity (if exercised).

2. Understanding – Call Buyer

- Think – Upside lottery buyer
- Payoff = Max [S_T – K, 0]
- Breakeven at K + OP.
- Viewpoint = Bullish

Ex: Nick Leeson purchased a 3-weeks call option on HCL Tech with strike price (K) = ₹850 at a premium of ₹28.

i. Interpret the position of Nick Leeson.

ii. What will his payoff and profit if HCL share price on expiry is:

i) ₹780 ii) ₹878 iii) ₹890

iii. Breakeven point

iv. Profit diagram of call buyer.

Ans: i) Nick has purchased a call option and paid premium of ₹28. This premium is Non-refundable.

Earn if HCL price on expiry (S_T) > strike price of ₹850.

But if S_T < strike price of ₹850, then lottery fusss!

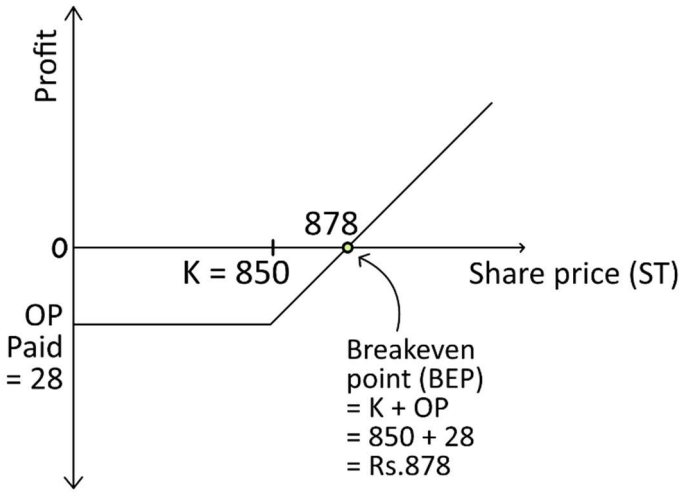
मिलेगा तो कुछ नहीं लेकिन जो option premium pay किया था वो भी जायेगा! ☹)

ii.

HCL Price on expiry (S_T)	Option exercised?	Payoff	Profit/(loss)
780	Option lapsed	0	0 – 28 = (28)
878	Exercised	28	20 – 28 = 0
890	Exercised	40	40 – 28 = 12

iii. Breakeven point for call buyer = K + OP = 850 + 28 = ₹878

iv. Profit diagram of call buyer



3. Understanding – Call Seller

- Think – Upside lottery Seller
- Payoff = Opposite off call seller
- Breakeven (same as call buyer) = K + OP
- Viewpoint = Bearish or not bullish.

Ex: Barings bank sold a 3-weeks call option on HCL Tech with strike price (K) = ₹850 at a premium of ₹28.

i. Interpret the position of Barings bank.

ii. What will the payoff and profit if HCL share price on expiry is:

i) ₹780 ii) ₹878 iii) ₹890

iii. Breakeven point

iv. Profit diagram of call Seller.

Ans: i) Barings has sold call option and received premium of ₹28. This premium is Non-refundable.

If HCL price on expiry (S_T) crosses ₹850, then it will have to PAY the call buyer.

But if S_T remains below ₹850, then Baring need not to pay anything.

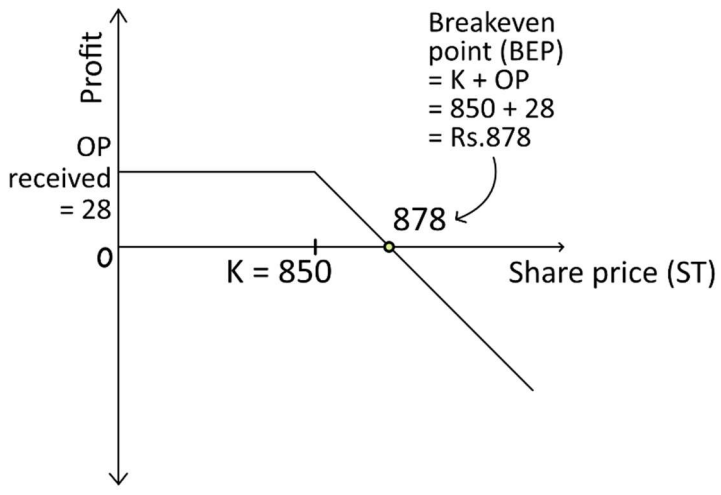
देना तो कुछ नही। पर option premium तो मिल गया। Full on masti! 😆

ii.

HCL Price on expiry (S_T)	Option exercised?	Payoff	Profit/(loss)
780	Option lapsed	0	28 – 0 = 28
878	Exercised	-28	28 – 28 = 0
890	Exercised	-40	28 – 40 = -12

iii. Breakeven point = Same as call buyer = K + OP = 850 + 28 = ₹878

iv. Profit diagram of call seller



4. Understanding – Put Buyer

- Think – Downside lottery buyer
- Payoff = Max [K – S_T, 0]
- Breakeven at K – OP.
- Viewpoint = Bearish

Ex: Lisa Leeson purchased a 3-weeks put option on HCL Tech with strike price of ₹850 at a premium of ₹24.

i. Interpret the position of Lisa Leeson.

ii. What will her payoff and profit if HCL share price on expiry is:

i) ₹780 ii) ₹890

iii. Breakeven point.

iv. Profit diagram of put buyer.

Ans: i. Lisa has purchased a put option (downside lottery) and paid option premium of ₹24 (non-refundable).

- Lisa will be rewarded if HCL price on expiry (S_T) < strike price of ₹850.
- But if S_T > strike price of ₹850, then Lisa will not be paid anything (lottery fusss !!)

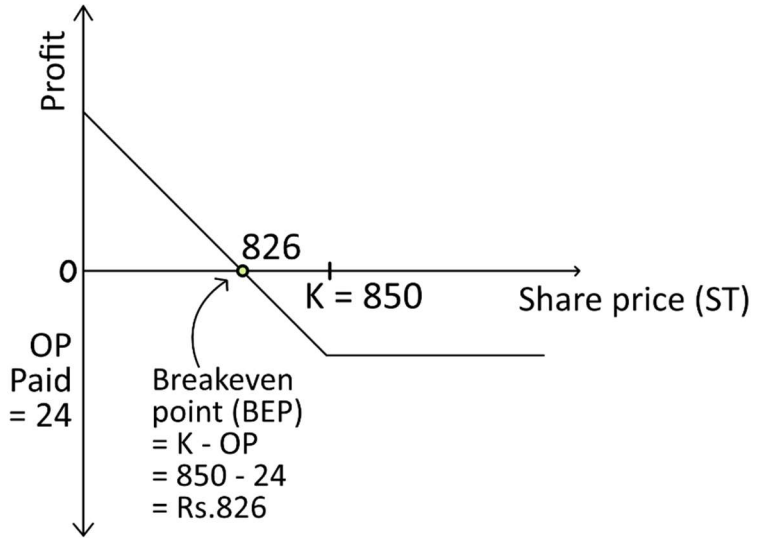
मिलेगा तो कुछ नहीं लेकिन जो option premium pay किया था वो भी जायेगा! ☹)

ii.

HCL Price on expiry (S_T)	Option exercised?	Payoff	Profit/(loss)
780	Option Exercised	850 – 780 = 70	70 – 24 = 46
890	Lapsed	0	0 – 24 = (24)

iii. Breakeven point in case of put = K – OP = 850 – 24 = ₹826

iv. Profit diagram of Put buyer



5. Understanding – Put Seller

- Think – Downside lottery Seller
- Payoff = Opposite of Put buyer
- Breakeven (same as put buyer) = K – OP.
- Viewpoint = Bullish or not bearish.

Ex: SG sold a 3-weeks put option on HCL Tech with an exercise price of ₹850 at a premium of ₹24.

i. Interpret the position of SG.

ii. What will its payoff and profit if HCL share price on expiry is:

i) ₹780 ii) ₹890

iii. Breakeven point.

iv. Profit diagram of put seller.

Ans: i) SG has sold a put option (downside lottery) and received premium = ₹24. This premium is non-refundable.

- If HCL price on expiry (S_T) < strike price of ₹850, then SG will have to pay put buyer.
- But if S_T > strike price of ₹850, then SG need not to pay anything.

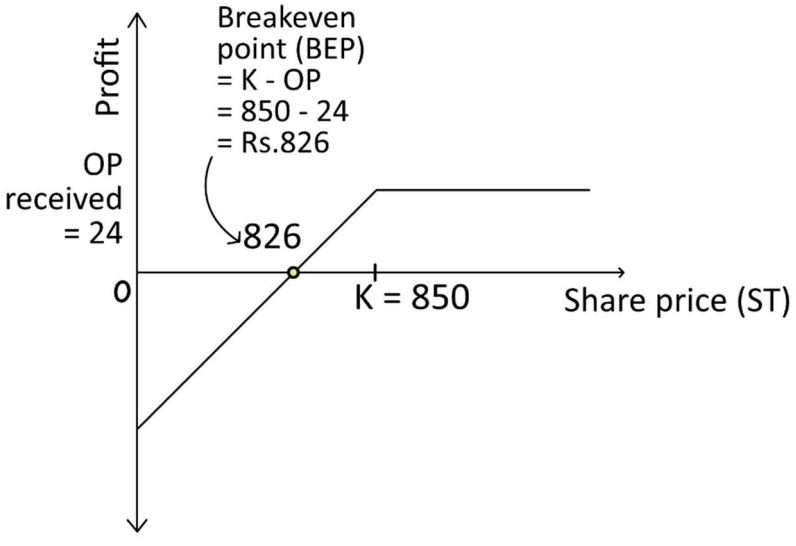
देना तो कुछ नही। पर option premium तो मिल गया। Full on masti! 😆

ii.

HCL Price on expiry (S_T)	Option exercised?	Payoff	Profit/(loss)
780	Option Exercised	-70	24 – 70 = (46)
890	Lapsed	0	24 – 0 = 24

iii. Breakeven point in case of put (same as put buyer) = K – OP = 850 – 24 = ₹826

iv. Profit diagram of Put Seller



6. Some Basic Points

I) OPTION PREMIUM VS FUTURES MARGIN

Do not confuse 'option premium (OP)' with margin paid on futures.

OPTION PREMIUM = You pay this amount to buy option today (lottery ticket price). It is non-refundable.

MARGIN MONEY = This is like a security deposit. It is refundable (after adjusting for Profit or loss).

II) MARGIN REQUIREMENT IN OPTIONS

OPTION BUYER -> Pays the option premium upfront. Need not to pay anything more.

So, no security deposit is required to be deposited by Option buyer. Hence, no margin requirements.

OPTION SELLER -> Receives option premium and remains liable to pay to option buyer (in case option is exercised). Hence, we require security deposit from option seller. So, the option seller must deposit margin.

III) PAYOFF FORMULAS

For call buyer = Max $[S_T - K, 0]$

For call seller = opposite of call buyer.

For put buyer = Max $[K - S_T, 0]$

For put seller = opposite of put buyer.

IV) PAYOFF VS PROFIT

PAYOFF = Cash flow on the expiry.

PROFIT = You net profit/loss after adjusting for option premium.

Net Profit for option buyer = Payoff – Premium paid

Net Profit for option seller = Premium received – Payoff

V) BREAKEVEN POINT OF OPTIONS

For call options = OP + Premium paid

For Put options = OP - Premium paid

VI) ROLE OF VOLATILITY IN OPTIONS

Option buyer = Loves volatility. He loves wide swings in price. Because he has no liability whatsoever.

But a big opportunity to earn if price moves by big amounts.

Option seller = Hates volatility. He hates wide swings in price. He prefers low volatility scenarios (as high volatility poses a big risk for them).

VII) RISK NATURE

Option buyer -> Risk averse. Want to take limited risk.

Option seller -> Risk taker or less risk averse.

VIII) EUROPEAN OPTIONS VS AMERICAN OPTIONS

European option -> Can be exercised only on maturity.

American options -> Can be exercised even before maturity.

(For basic understanding treat them as same. Later we will explore more on this topic.)

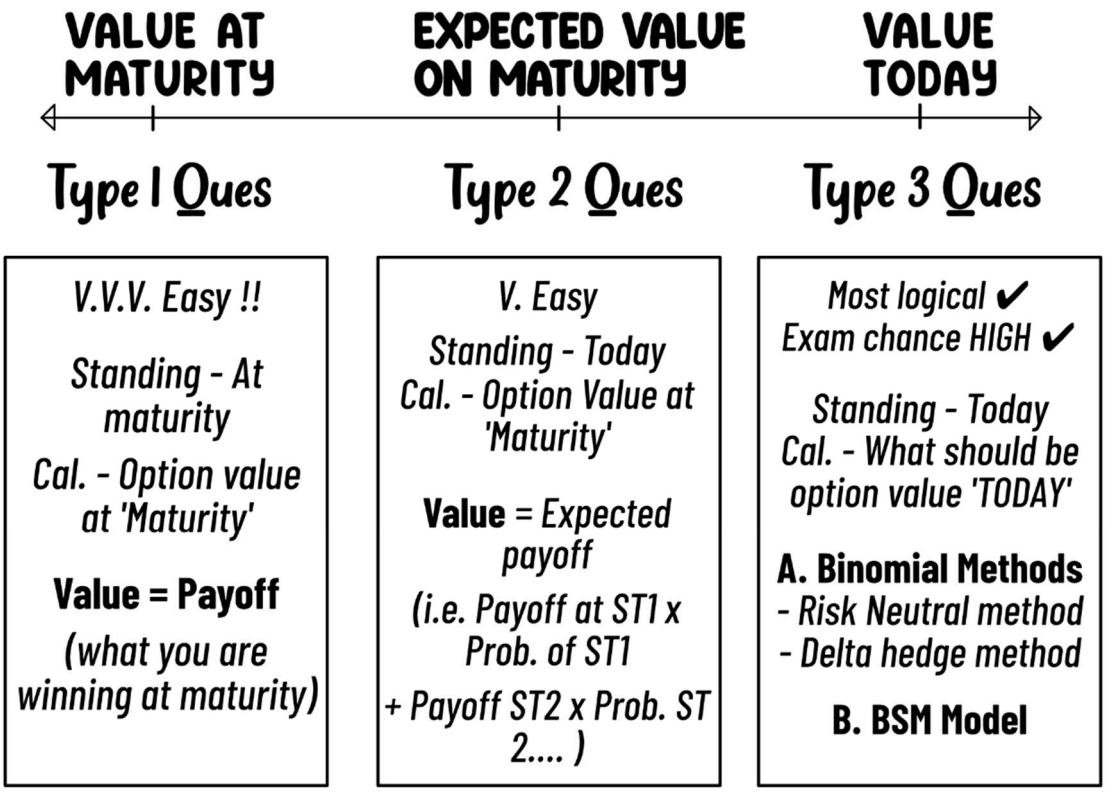
PART B: Pricing Options (Valuation of options)

1. Option Valuation – 3 Types

Option premium is also called Option Value or Option price.

Now we will learn how to calculate this option premium (i.e. if you want to buy or sell an option then at what price should you buy or sell it.)

THREE TYPES OF QUES ON OPTION VALUATION



2. Type 1 - Value of option at Maturity (5a & b)

Value at maturity = Payoff of option (simple).

Ex: You bought a call option on Fb ltd. with maturity = 30 April. Strike price of option = ₹1400.

Find the value of call option **AT MATURITY** if stock price on maturity i.e. 30 April is ₹1560.

Ans: Value of option at maturity = Payoff from that option = 1560 – 1400 = ₹160

3. Type 2 - 'Expected' Value of option –on maturity (3, 4)

Under this case different expected stock prices at maturity along with its probability will be given.

Step 1 - Calculate payoff under scenario.

Step 2 – Expected value of option = $Payoff_1 \times Probability_1 + Payoff_2 \times Probability_2 + \ldots$

Ex:

Stock price at maturity (S_T)	-	60	75	80	90	100	120
Probability	-	0.05	0.15	0.1	0.3	0.25	0.15

A call option the said stock is available with strike price of ₹80.

Calculate the **EXPECTED VALUE OF OPTION AT MATURITY**.

Ans:

ST	Probability	Call payoff	Call payoff x Probability
60	0.05	0	0
75	0.15	0	0
80	0.1	0	0
90	0.3	10	10 x 0.3 = 3
100	0.25	20	20 x 0.25 = 5
120	0.15	40	40 x 0.15 = 6
		Total:	14

4. Value of option as on Today

We can find option value / price / premium today by using binomial mode or BSM Model.

I) BINOMIAL MODEL

- Under a binomial model, we assume that the stock price will move **ONLY ONCE** during the period under consideration. Further, the stock can either go up or go down.
- In one line, we can say that under binomial mode, we assume that the stock can only take one of the two given prices at the end of the period.

THERE ARE TWO METHODS (FOR OUR PURPOSE) OF BINOMIAL MODEL

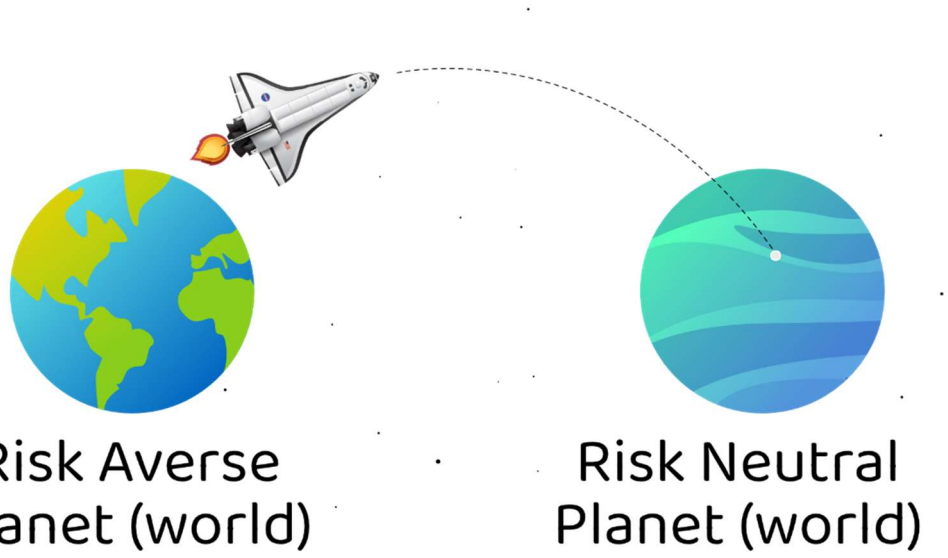
- Risk Neutral Pricing
- Delta Hedge approach

II) BSM MODEL

This can be seen as an advanced form of Binomial model.

In BSM we assume that stock price can change continuously or infinite times (which is quite practical).

5. Risk Neutral Pricing (Binomial Model) (10)



FOR RISK NEUTRAL PRICING, WE MUST MOVE FROM:

RISK ADVERSE WORLD (THAT WE LIVE IN) TO A THEORETICAL RISK-NEUTRAL WORLD (RNW).

I) RISK NEUTRAL PRICING

1. We assume that all assets in the risk-neutral world will provide risk-free return i.e. Expected return = Rf.
2. The discount rate that is used in risk-neutral world is risk-free rate i.e. Rf.

VALUE OF OPTION = PV OF EXPECTED CASH FLOWS (Just like equity, bonds etc.)

SPECIAL NOTE: Discount rate for calculating PV = Risk-free rate. (as we are cal. value in RNW)

Ex: A 1-year call option with strike price of ₹505 is available on Big Sun ltd stock. Current stock price = ₹500.

Expected stock price after 1 year (S_T)	Probability
580	64.29%
440	35.71%

Find the value of call option today if risk-free rate is 6% p.a.

Ans: Value of call as on today = (PVCI) = PV of expected cash flows

ST	Probability	Call payoff (i.e. Cash flow)
580	64.29%	75
440	35.71%	0

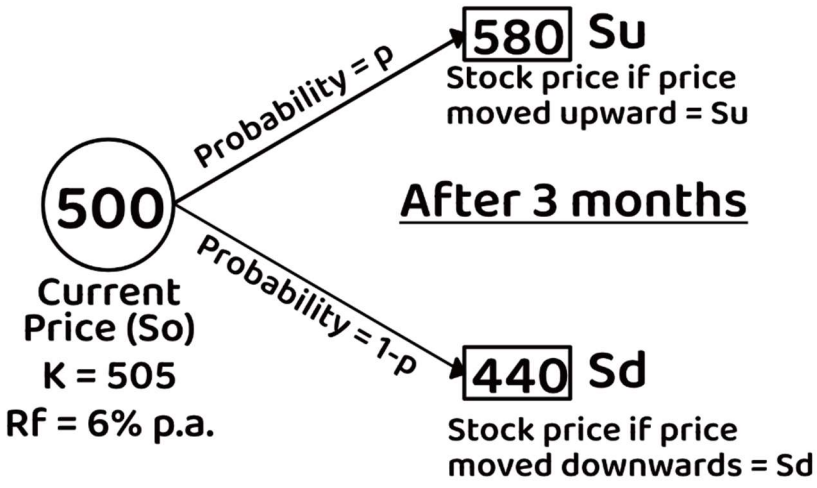
Value = PV of expected cash flows = $\frac{75 \times 64.29\%}{1.06}$ = ₹45.49

II) CALCULATING PROBABILITIES (concept & understanding)

In the above example the probabilities were directly given in ques. Now we'll learn how to calculate these probabilities.

Ex: Calculate the probabilities in the previous example (assuming it was not given in ques).

Ans: Pictorial representation of previous ques.



i) Let probability of stock price going up (to ₹580) be 'p'.

Probability that stock price will fall down (to ₹440) = '1-p'

Therefore, Expected value of stock after 1-year (S_T) = 580p + 440(1-p) ... (1)

ii) Since we are pricing in risk-neutral world, So expected return of each asset = Rf.

☞ Value of stock after 1-year (S_T) = 500(1+rf) = 500 x 1.06 = ₹530 ... (2)

From (1) and (2), we can say

580p + 440(1-p) = 530

580p + 440 – 440p = 530

p(580 – 440) = 530 – 440

$$p = \frac{530 - 440}{580 - 440}$$ => p = 64.29% and 1-p = 35.71%

We can generalize above conclusion as:

$$p = \frac{S_0 (1+Rf) - S_D}{S_U - S_D}$$

III) CRUX – 2 STEPS FOR EXAM

Step 1: Calculate Risk-Neutral probabilities (directly using formula)

$$p = \frac{S_0 (1+Rf)^n - S_D}{S_U - S_D}$$

Where: S_D = Downside stock price
S_U = Upside stock price

Step 2: Calculate value of option (= PVCI)

$$\text{Value of Option} = \text{PVCI} = \frac{\text{Upside payoff} \times p + \text{Downside Payoff} (1-p)}{(1 + Rf)^n}$$

Where: Upside payoff = Payoff from option if stock price moves upward.

Downside payoff = Payoff from option if stock price moves downward.

IV) If Rf is given as continuously compounded rate

In case of continuous compounding, use e^{rt} in place of (1+r). Rest everything remains same.

So, formulas become:

$$p = \frac{S_0 e^{rt} - S_D}{S_U - S_D}$$

$$\text{Value of Option} = \text{PVCI} = \frac{\text{Upside payoff} \times p + \text{Downside Payoff} (1-p)}{e^{rt}}$$

V) MAHA IMPORTANT 🔔

The above formula is for Risk-Neutral probabilities.

This is what we require to calculating values in risk-neutral world.

SLIP POINT – Sometimes examiner intentionally gives real world probabilities to confuse students.

DO NOT USE those Real world probabilities.

Calculate your own risk-neutral probabilities (using above formula) and use it to find option value.

Ex: An investor is interested in purchasing AB ltd.'s shares. The investor expects that there is a 70% chance that the price will go up to ₹650 or a 30% chance that it will go down to ₹450, 3-months from now.

-> These are Investor's expectations based on 'Real-world probability.'

Do not use it calculate option value.

VI) ALTERNATE FORMULA OF PROBABILITY CALCULATION

We just learned that:

$$p = \frac{S_0 (1+rf)^n - S_D}{S_U - S_D}$$

Dividing both numerator and denominator by S_0, we get

$$p = \frac{(1 + rf)^n - d}{u - d}$$

Where: d = downmove factor = $S_D \div S_0$

u = upmove factor = $S_U \div S_0$

Ex: Stock price today (S_0) = ₹500. It can move up to ₹580 in a year or fall down to ₹440. Calculate risk-neutral probabilities. Risk-free rate = 6% p.a.

Ans: d = downmove factor = 440 / 500 = 0.88

u = upmove factor = 580/500 = 1.16

$$p = \frac{(1 + rf)^n - d}{u - d} = \frac{1.06 - 0.88}{1.16 - 0.88} = 0.6429 \text{ or } 64.29\%$$

$1 - p = 35.71\%$

Note: Which formula to use in exam?

Ans: You can use any formula. We believe the first one (mentioned earlier) is bit faster though.

6. Two-Stage Binomial model (13)

This is exactly like 1-stage binomial model (which we just discussed).

But it is more like solving three ques in one single ques. 😅

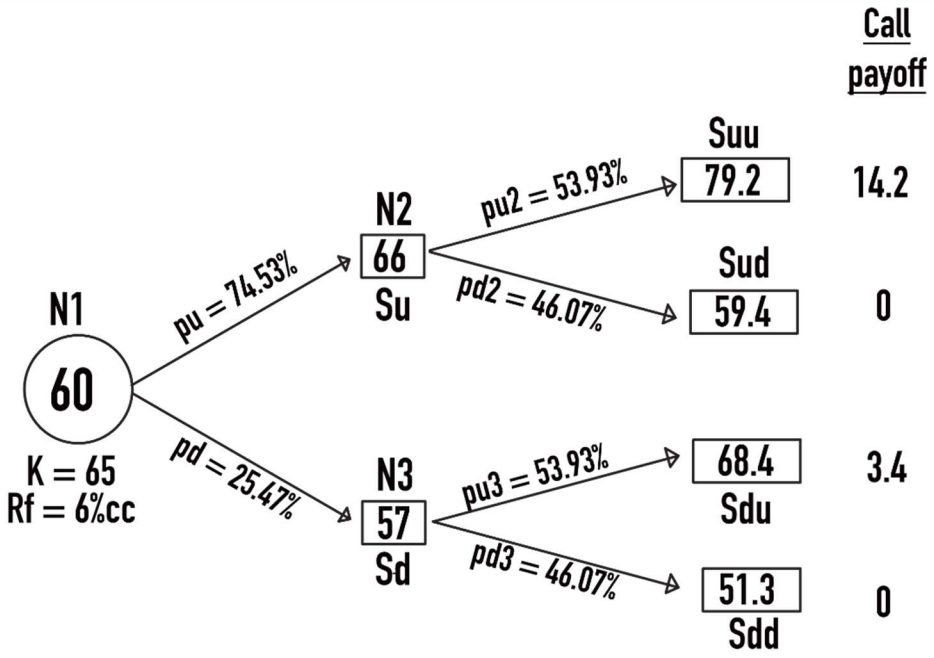
Ex: Consider a 2-year call option on a stock with strike price of ₹65. The stock is currently trading at ₹60.

Consider two periods of 1-year each. The stock can move either 10% up or 5% down in the first period.

The stock is expected to move 20% up or 10% down in the second period.

Calculate the value of call option each node. Risk-free rate = 6% p.a.c.c. Given $e^{0.06}$ = 1.0618.

Ans: First – make diagram of the entire scenario.



1) STEP 1 – Calculate Probability at each node

For second period

$p = \frac{e^{rt} - d}{u - d} = \frac{1.0618 - 0.95}{1.10 - 0.95} = 74.53\%$

So, 1-p = 25.47%

For second period

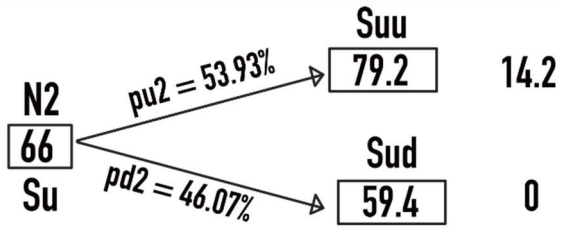
$p = \frac{e^{rt} - d}{u - d} = \frac{1.0618 - 0.90}{1.20 - 0.90} = 53.93\%$

so, 1-p = 46.07%

II) **STEP 2 – Treat each Node as a separate ques.**

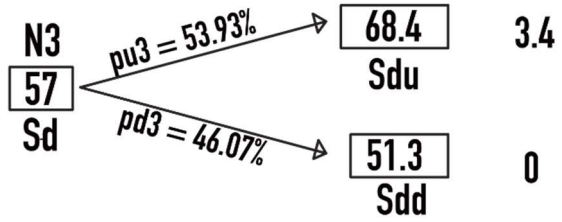
Value of Option = PVCI = $\frac{\text{Upside payoff} \times p + \text{Downside Payoff} (1-p)}{(1 + Rf)^n}$

A. Calculating value at Node 2



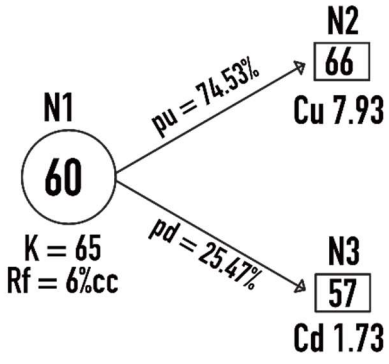
Value of call at N2 = $\frac{14.2 \times 53.93\% + 0}{e^{0.06}} = \frac{8.4206}{1.0618} = ₹7.93$

B. Calculating value at Node 3



Value of call at N3 = $\frac{3.4 \times 53.93\% + 0}{e^{0.06}} = \frac{1.8336}{1.0618} = ₹1.73$

C. Calculating value at Node 1



When you are standing at N1, then after 1-year -> Value of your call will be either 7.93 or 1.73.

Value today = PVCI = $\frac{7.93 \times 74.53\% + 1.73 \times 25.47\%}{e^{0.06}} = \frac{6.35086}{1.0618} = ₹5.98$

7. Delta-hedge approach (11, 12)

I) UNDERSTANDING DELTA

Delta = Change in option value due to ₹1 change in stock price.

$$\text{Delta of option} = \frac{\text{Change in option price}}{\text{Change in stock price}}$$

Ex:

Stock price	Call price	Put price
200	15	20
220	27	12

Calculate delta of call and delta of put.

Ans:

$$\text{Delta of Call} = \frac{\text{Change in call price}}{\text{Change in stock price}} = \frac{27 - 15}{220 - 200} = +0.6$$

$$\text{Delta of Put} = \frac{\text{Change in put price}}{\text{Change in stock price}} = \frac{12 - 20}{220 - 200} = -0.4$$

NOTES:

1. Delta of call is always **POSITIVE** (call option value increases if price of stock increases).
2. Delta of Put is always **NEGATIVE** (Put value falls due to increase in stock price).
3. Delta of share = +1 (always, obviously).
4. (Extra coverage – Not for exam) Delta of futures is also +1.

DELTA OF OPTIONS SELLER:

Option seller is in opposite position of option buyer. So for option seller, delta effect is opposite.

i.e. call seller -> Negative Delta

Put seller -> Positive delta

II) DELTA OF PORTFOLIO

Delta of portfolio = Sum total of delta of individual positions

Ex: You bought 100 shares and also bought 200 call options on that share. Find delta of portfolio if delta of call option is 0.6.

Ans: Delta of portfolio = Sum total of delta of individual components

$= 100 \times 1 + 200 \times 0.6 = 220$

III) DELTA-HEDGE PORTFOLIO

If delta of a portfolio = 0, then it means:

'If stock price changes by ₹1 then total portfolio value will change by 0.'

In other words, our portfolio will not be affected by any change in value of stock.

Such a portfolio will provide us a **RISK-LESS GUARANTEED RETURN.**

Ex: Sold 100 Call options on XYZ ltd with delta = 0.4. How many shares should I buy to construct a delta-hedged portfolio.

Ans:

Position	Delta
Sell 100 call options	(100) x 0.4 = -40
Buy 100 x Delta shares = 100 x 0.4 = 40 shares	40 x 1 = +40
	Total Delta = 0 → Delta hedged.

In other words, our portfolio will not be affected by change in share price.

Ex: A stock is currently trading at ₹200. It can move up to ₹230 or fall down to ₹180 in 1-year time frame. A 1-year call option with strike price of ₹210 is available on this stock. Find the value of call if rf = 5% p.a. Use Delta-neutral approach.

Ans:

Step 1 – Calculate delta of option

$$\text{Delta of call} = \frac{\text{Change in call payoff}}{\text{Change in stock price}} = \frac{20 - 0}{230 - 180} = 0.4$$

Step 2 – Construct a delta hedged portfolio

Sell 100 call options and Buy 100 x Delta shares i.e. 100 x 0.4 = 40 shares.

Since our portfolio is delta-hedged, so it means it will not get affected by any change in share price.

AUTHOR NOTE - PROOF (NOT REQUIRED IN EXAM):

i) Portfolio Value if S_T = 230:	40 shares = 40 x 230 =	₹9,200	
	100 calls sold = 100 x (20) =	(₹2000)	₹7200
ii) Portfolio Value if S_T = 230:	40 shares = 40 x 180 =	₹7,200	
	100 calls sold = 100 x (0) =	(₹0)	₹7200

Hence, value of portfolio at expiry will remain same (₹7200) irrespective of the share price.

Step 3 – Calculate value of option

AUTHOR NOTE: This portfolio will offer us a **GUARANTEED** cash flow of ₹7200 after 1-year.

So, cost of portfolio today = PV of cash flows **DISCOUNTED AT RISK-FREE RATE.**

$40 \times 200 - 100 \times C_0 = 7200 / 1.05$

$8{,}000 - 100C_0 = 6857.14$

C_0 = ₹11.43

IV) DELTA-HEDGE PORTFOLIO IN CASE OF PUT OPTIONS

Since put options have negative delta, so in order to construct a delta hedged portfolio -

BUY 100 put options and Buy 100 x Delta shares. (Rest everything is same as call).

Ex: A stock is currently trading at ₹300. It can move up to ₹330 or fall down to ₹290 in 1-year.

A 1-year put option with strike price of ₹310 is available on this stock. Find value of put if rf = 6% p.a.

Ans: Step 1 – Calculate delta of option

Delta of Put = $\frac{\text{Change in Put payoff}}{\text{Change in stock price}} = \frac{0 - 20}{330 - 290} = -0.5$

Step 2 – Construct a delta hedged portfolio

BUY 100 put options and Buy 100 x Delta shares i.e. 100 x 0.5 = 50 shares.

Step 3 – Portfolio cash flow at expiry

Portfolio Value if S_T = 330:	50 shares = 50 x 330 =	₹16,500	
	100 Put buy = 100 x 0 =	Nil	₹16,500

Author Note: Portfolio value will remain same irrespective of S_T. So, no need to show value at S_T = 290.

Step 4 – Calculation of option value

Cost of constructing this portfolio today = PV of ₹16,500 discounted at Rf.

$50.S_0 + 100.P_0 = 16{,}500 / 1.06$

$50 \times 300 + 100P_0 = 15{,}566$

P_0 = ₹5.66

8. Minimum Value of option (1, 2)

Only use this concept when ques specifically ask to calculate **MINIMUM** value.

I) EUROPEAN OPTIONS

Min. value of call option = $S_0 - Ke^{-rt}$

Min. value of put option = $Ke^{-rt} - S_0$

II) AMERICAN OPTIONS

Min. value of call option = $S_0 - K$

Min. value of put option = $K - S_0$

If value of option is less than minimum value, then arbitrage will be possible.

Ex: Current stock price (S0) = ₹500. An American call option with exercise price (K) of ₹450 is currently trading at ₹20. Show how arbitrage is possible.

Ans: Buy call option (for ₹20) and immediately ask option seller to pay ₹50 (500 – 450).

Hence, earning an arbitrage profit of ₹30 (i.e. 50 – 20).

So, as per Principle of No Arbitrage -> The min. price of American call should be ₹50 (i.e. $S_0 - K$)

III) IMPLICATION OF AMERICAN OPTION

If ques mentions nothing -> Assume European option (Nothing special to be done).

If ques specifically mentions 'American' option, then:

Step 1) Calculate value exactly like European option (no difference here).

Step 2) Check that Option value is not less than the Minimum value (as discussed above).

Step 3) If option Value < Minimum value, then give note that value cannot be less than minimum value. Hence, take value = Minimum value.

9. Black Scholes Merton Model (BSM Model)

Problem with Binomial model -> We assume that stock prices will change only 'once' in a given time frame.

However, in real world, stock prices change continuously.

Solution -> This problem was solved by BSM model.

BSM model assumes that stock price can change infinite time i.e. Limit n -> ∞.

II) BSM FORMULA

Value of Call option = $S_0 N(d_1) - Ke^{-rt} N(d_2)$

Value of Put option = $Ke^{-rt}[1 - N(d_2)] - S_0[1 - N(d_1)]$

i. Where, $N(d_1)$ and $N(d_2)$ are cumulative probabilities from normal distribution.

ii. d_1 and d_2 are z-scores.

Where: $d_1 = \frac{\ln(S_0 / K) + (rf + \sigma^2/2).t}{\sigma\sqrt{t}}$ And $d_2 = d_1 - \sigma\sqrt{t}$

III) INTUITIVE UNDERSTANDING OF BSM FORMULA

Minimum value of call option = $S_0 - Ke^{-rt}$

This is the minimum value of call. The actual option premium will depend on the 'probability' that the option will be exercised and what will be the expected payoff if the option is exercised.

Hence, we can say that it's a game of probabilities. This probability is incorporated by multiplying with the probability given by $N(d_1)$ and $N(d_2)$. ∴ Value of Call option = $S_0 N(d_1) - Ke^{-rt} N(d_2)$

IV) CALCULATING VALUE OF e^a and Ln(a)

For e^a	Find $e^{0.06}$	For Ln (a)	Find Ln (1.061836)
Enter power (i.e. 'a')	Enter '0.06'	Enter 'a'	Enter 1.061836
÷ 4096	÷ 4096	√ 12 times	√ 12 times
+ 1	+ 1	− 1	− 1
'x =' 12 times	'x =' 12 times	x 4096	x 4096
	Ans: 1.0618		Ans: 0.06

10. How to find d1 and d2? (14, 15, 16, 17)

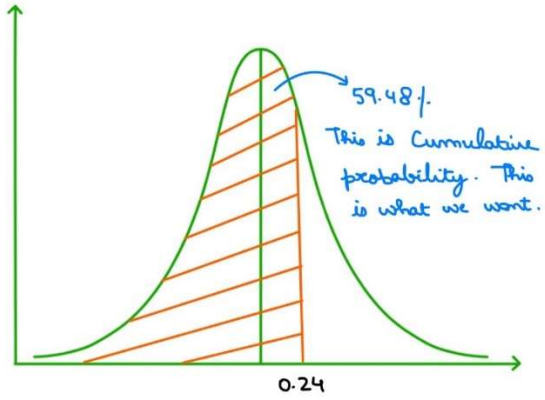
1. We can get the values of d1 and d2 from the Normal distribution table.

Let's say, I get d1 = 0.24, then value of N(d1) can be taken from Normal distribution table (as shown below)

Cumulative Area from normal distribution table.

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0										
0.1										
0.2					0.5948	0.5987				
...										

So, if d1 = 0.24, then cumulative probability of to the left of 0.24 i.e. N(d1) = 0.5948 or 59.48%



2. HOW TO CALCULATE 0.246 FROM ABOVE TABLE?

Value at 0.24 = 59.48%

Value at 0.25 = 59.87%

$\therefore$ Value at 0.246 = 59.48% + $\frac{(59.87 - 59.48)}{0.01} \times 0.006$ = 59.714

II) DIFFERENT TYPES OF ND TABLE

We want -> **CUMULATIVE AREA** (as shown above)

- Table type 1 -> Cumulative probability table

This is same as discussed on previous page. This is what we want. Cumulative Probability = Table value

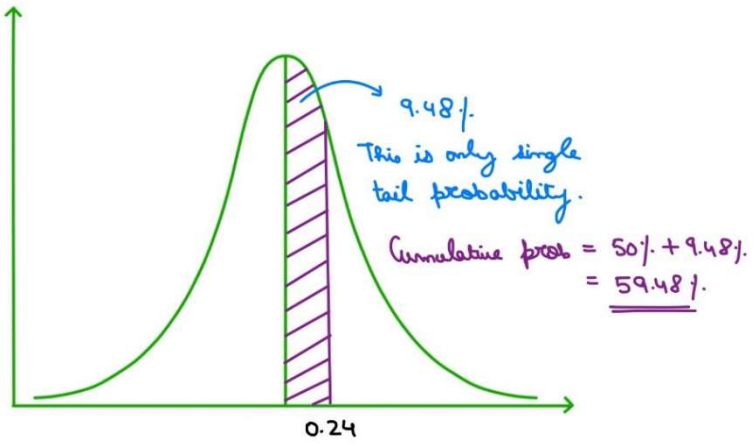
- 

TABLE TYPE 2 -> SINGLE TAIL PROBABILITY TABLE

In case of only one tail probability, Cumulative probability = 50% + Table value

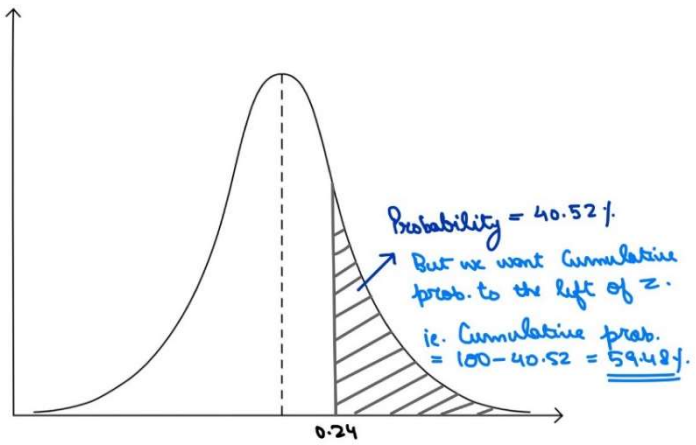


TABLE TYPE 3 -> Area to the left or right (one tail)

In case if only probability to the right (or left), one tail is given, then:

Cumulative probability = 100% - Table value

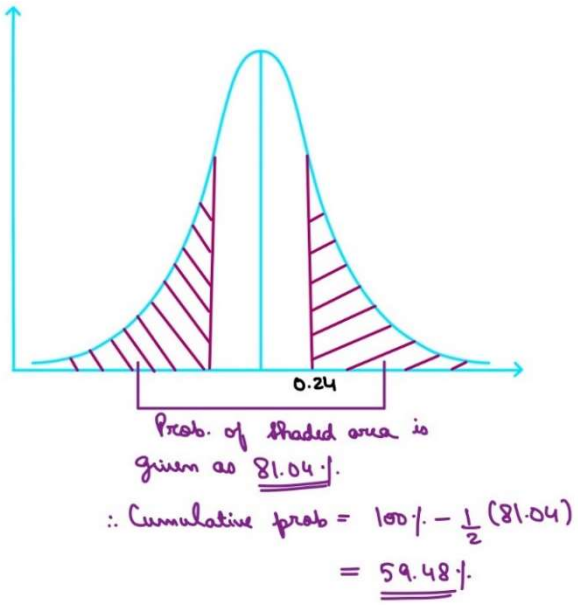


TABLE TYPE 4 -> Area to the left and right (two tail)

Cumulative probability = 100% - ½(Table value)

11. BSM in case of Dividend paying stocks

If dividend is given in ques -> Find ex-dividend stock price before calculating option price using BSM.

Step 1: Find S*

where $S^* = S_0 - PV$ of dividends ... Where dividend is given in amount

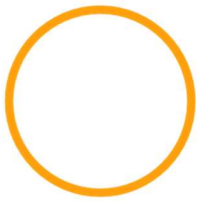
or $S^* = S_0 e^{-yt}$ ... Where dividend is given in % i.e. dividend yield is given

Step 2: Use S* in place of S_0 in the entire BSM formula. (Including in the formula for d1 and d2).

Value of Call option = $S^* N(d_1) - Ke^{-rt} N(d_2)$

Value of Put option = $Ke^{-rt}[1 - N(d_2)] - S^*[1 - N(d_1)]$

Where: $d_1 = \dfrac{\ln(S^*/K) + (rf + \sigma^2/2).t}{\sigma\sqrt{t}}$



PART C: Strategies and Other Tiny topics

1. Option Strategies (18, 19, 20)

Here we will buy or sell more than 1 option.

Two basic steps

Step 1: Calculate Net premium paid or received from all the options.

Step 2: Calculate payoff from each option (separately).

Total payoff = Sum of individual payoff.

Net profit = Total payoff – Premium paid.

Ex: A trader bought 2 lots of call options and 1 lot of put option on the stock of Tech Fi ltd. Stock is currently trading at ₹1600. Details are as follows:

	Strike price	Premium paid	Lot size
Call option	1700	160	500
Put option	1400	90	500

i) Find the profit or loss from this strategy if price on maturity (S_T) turns out to be:

Case a – ₹1550 Case b – ₹1950 Case c – ₹1100

ii) Find the breakeven points of the above strategy.

Ans: i) Calculation of premium paid

Call premium: 160 x 500 x 2 = 1.6L

Put premium: 90 x 500 = 0.45L

Total = 2.05L

- Calculation of payoff and profit

S_T	Call Payoff	Put Payoff	Total Payoff	Net Profit / (loss) = Payoff – prem.
1550	0	0	0	(2.05L)
1950	250 x 500 x 2 = 2.5L	0	2.5L	2.5L – 2.05L = 0.45L
1100	0	300 x 500 x 1 = 1.5L	1.5L	1.5L – 2.05L = (0.55L)

ii) Breakeven points

In such cases, 2 breakeven points exists

1st – 1700 + (160x2 + 90)/2 = 1905

2nd – 1400 – (160x2 + 90) = 990

2. Intrinsic & Extrinsic Value (IV, EV)

We can bifurcate option value into – Intrinsic value (IV) and extrinsic value (EV).

Total Value of option = IV + EV

Ex: A Call option with strike price = ₹500 is trading at ₹70 (It means option premium = ₹70).

Bifurcate the value of option into IV and EV if current stock price = ₹550.

Ans: Intrinsic value (IV) = How much you are already winning today or your current payoff = 550 – 500 = ₹50

Extrinsic value (EV) = Option premium - IV = 70 – 50 = ₹20

II) CAN IV BE NEGATIVE?

No. Since Payoff under option can never be negative. So, IV can never be negative.

It can be zero (if you are not winning anything today) but can never be negative.

III) CRUX

1. IV of call option = Max [S_0 – K, 0]
2. IV of put option = Max [K – S_0, 0]
3. EV of any option = Option price – IV
4. IV of any OTM option = 0. Hence, in such case, EV = Option value.
5. EV IS ALSO KNOWN AS TIME VALUE OR VOLATILITY PREMIUM

3. In the Money (ITM), Out of the Money (OTM) & At the Money (ATM)

I) INFORMAL UNDERSTANDING

Illus: Consider a call option with K = ₹500

i) If S_0 = ₹560 - Then call buyer is winning the game (as on today). This is known as 'In the money'. (ITM)

ii) If S_0 < ₹500, say ₹470 - Then call buyer is losing as of now. This is known as 'out of money'. (OTM)

iii) If S_0 = ₹500 i.e. S_0 = k, then it is known as ATM option.

Similarly for put options.

II) **FORMAL UNDERSTANDING**

For call option	For put option
When S_0 > K = ITM	When S_0 < K = ITM
When S_0 = K = ATM	When S_0 = K = ATM
When S_0 < K = OTM	When S_0 > K = OTM

4. Put call parity Theory (PCP)

Value of call + PV of Strike price = S_0 + Value of Put

Ex: A stock is currently trading at ₹850. A 6-months call on this stock with strike price of ₹860 is trading at ₹40. Find the value of put if risk-free rate is 7% p.a.

Ans: As per PCP: Value of call + PV of strike price = S_0 + Value of put

$$40 + \frac{860}{1 + 0.07 \times 6/12} = 850 + \text{Value of put}$$

Value of put = ₹20.92

II) **V. IMP NOTE**

PCP relation only holds true if Both call and put options are:

- On the same stock
- Have same strike price
- Have same maturity

III) **SIGNIFICANCE OF PCP**

For exam — i) If you are required to calculate both value of call and put, then you can use PCP.

ii) If ques is specifically designed on PCP, then of course it is to be used.

In practical world — If PCP does not hold, then arbitrage is possible. So, PCP must hold true as per PONA.

5. Option Greeks

1. Delta = Change in value of option due to 1₹ change in the value of the underlying asset.
2. Gamma = Change in option delta due to ₹1 change in the value of the underlying asset.
3. Vega = Change in option value due to 1% change in volatility of the underlying asset.
4. Theta (time decay) = Change in option price given a 1-day decrease in time to expiration.
5. Rho = Change in option price due to a 1% change in risk-free rate.

6. Expiry Day Cash Flow (EDCF)

Only relevant if option is physically settled.

Call option = 'Right to buy' at strike price

Put option = 'Right to Sell' at strike price

If Call is exercised -> Call buyer will buy stock at strike price.

Call buyer -> Pay strike price to buy stock. This is cash outflow for call buyer.

Call seller -> Opposite of call buyer. Cash inflow.

If Put is exercised -> Put buyer will sell stock at strike price.

Put buyer -> Sell stock at strike price. This is cash inflow for put buyer.

Put seller -> Opposite of put buyer. Cash outflow.

Ex: Lalu bought a call option on Zeb ltd. from Kalu at a strike price of ₹60. Calculate EDCF of stock price on expiry is (i) ₹65 (ii) ₹70

Ans:

Case	S_T	Call exercised?	EDCF of call buyer	EDCF of call seller
1	55	No	-	-
2	70	Yes	(60)	60

Student's Space

Chapter 10A

Forex

Chapter Index

PART A – Basics of Forex
PART B – Exchange Rate Theories (PPPT, IRPT)
PART C – Netting, Lead, Lagging and MMO
PART D – Rate of forward contracts
PART E – Forex Decisions, Credit, Hedge, Int. cash mgt.
PART F – Other Topics – Nostro-Vostro, Forex Exposure

---- Student's Space for Summary chart and notes ----

PART A: Basics of Forex

1. Introduction

I) HOME CURRENCY (HC) VS FOREIGN CURRENCY (FC)

Currency of your country = Home currency (HC)

All other currencies = Foreign currency (FC)

For India -> HC = ₹ Other currencies (such as $, €, £ etc) = FC

For US -> HC = $ Other currencies (such as ₹, €, £ etc) = FC

II) SPECIAL TIP – FC IS NOT MONEY

Always see FC as a financial asset and not as 'money'.

Ex: You want to buy a car of ₹10 Lacs.

	CASE 1 – YOU HAVE TCS SHARES WORTH ₹10L	CASE 2 – YOU HAVE $ WORTH ₹10L
-	Car dealer won't accept TCS shares. He wants ₹.	Car dealer will not accept $. He wants ₹.
-	So, 1st Sell your TCS shares and get ₹.	So, 1st Sell your $ and get ₹.
-	Use this ₹ to pay car dealer.	Use this ₹ to pay car dealer.

Conclusion – Only HC is Money & all the FC are merely Financial Assets (just like share etc.)

2. Basics of Exchange rates

I) WHAT IS EXCHANGE RATE

Interpret -> 1 Share of Ashok Leyland (AKL) = ₹160

This is the Price Tag of AKL share. i.e. you can buy or sell AKL shares at ₹160.

We need price tag of share (i.e. AKL on left hand side) whenever buying/selling AKL shares.

Similarly -> 1 $ = ₹80

This is the **PRICE TAG OF $** i.e. you can buy or sell $ at ₹80/$.

We need Price tag of $ (i.e. $ on LHS) whenever buying or selling $s.

II) ONE-WAY QUOTE & TWO-WAY QUOTE

One-way Quote - 1$ = ₹70 (Bid rate and ask rate are same)

Two-way Quote - 1$ = ₹70 — 70.5 (Bid rate & Ask rate is different)

- Bid rate of **BANK** or Buying rate
- Ask rate or offer rate or Selling rate of **BANK**

- Bid rate is always < Ask rate (as bank will obviously buy at lower rate and sell at higher rate.)

III) BID-ASK SPREAD

The difference between bid rate and ask rate is known as Bid-Ask spread.

Bid-ask spread = Ask rate (-) Bid rate

in % = $\frac{\text{Ask rate (-) Bid rate}}{\text{Bid rate}} \times 100$

Ex: 1$ = ₹ 70 — 70.5

Ans: Then bid-ask spread = 70.5 — 70 = ₹0.5

IV) QUOTE CONVERSION

Ex: 1$ = ₹80

Then 1 ₹ = 1/80 $

Crux: Take reciprocal in case of 1-way quote.

Ex: 1$ = 80 — 80.5

1₹ ≠ $\frac{1}{80} - \frac{1}{80.5}$ ✗✗

Because, this means -> 1₹ = 0.0125 — 0.0124

But Bid rate can never be less than ask rate !! So, this is wrong.

Correct quote -> 1₹ = $\frac{1}{80.5} - \frac{1}{80}$ ✓✓

Crux: In case of 2-way quote -> Take reciprocal and switch places.

3. Currency Conversion

I) Rule of CURRENCY CONVERSION in case of 1-Way Quote

Imp! Before proceeding with currency conversion –> always write the quote in both the forms

Ex: If 1$ = ₹70 -> This is price tag of $ (given in question)

Also write price tag of ₹ -> ₹1 = 1/70$ (you can either write it in rough or as part of ans)

Ex: 1 $ = ₹70. Calculate amount to be received or paid when

i) Selling 100$ ii) Selling ₹14000

Ans: **RULE:** When buying or selling $ --> **MULTIPLY** with price tag of $ (i.e. $ on LHS)

Similarly, when buying or selling ₹ --> **MULTIPLY** with price tag of ₹ (i.e. ₹ on LHS)

i) Selling $ -> Multiply with price tag of $ (1$ = ₹70)

100$ = 100 x 70 = ₹7000

ii) Selling ₹ -> Multiply price tag of ₹ (1₹ = 1/70 $)

₹ 1,40,000 = 1,40,000 x 1/70 = $2000

II) 2 Step Rule of CURRENCY CONVERSION in case of 2-Way Quote

Caution – This is an easy but still a slippery area. Always always follow this 2 steps rule in exam.

Students often get overconfident and make mistake in this area (8 marks gone to gutter ☹)

Step 1: (Same as above) 'Multiply' with the price tag of the currency which is bought or sold.

Step 2: Since bid rate and ask rates are separately given. So, you must identify the correct rate.

- If customer is buying → Bank is selling → Ask-rate of bank.
- If customer is selling → Bank is buying → Bid-rate of bank.

Ex: 1$ = 70 – 71. Calculate amount to be received or paid when

i) Buying $2,000 (iii) Selling ₹50,000

ii) Selling $2,000 (iv) Buying ₹50,000

Ans: 1st write the quote in both the forms.

1$ = ₹70 – 71

1 ₹ = 1/71 – 1/70 $

i) Buying $2,000.

Step 1 – Buying $. So, pick price tag of $ --> 1 $ = ₹70 – 71

Step 2 – We are buying $. So, bank is selling it. Rate applicable = Ask rate = 71.

=> 2000 x 71 = ₹1,42,000.

ii) Selling $2000 --> 2000 x 70 = ₹1,40,000.

iii) Selling ₹50,000.

Step 1 – Pick price tag of ₹

Step 2 – We are selling ₹. So, bank is buying it. Rate applicable = Bid rate = 1/71.

=> 50,000 x 1/71 = $704.23

iv) Buying ₹50,000 --> 50,000 x 1/70 = $714.26

4. Cross Rates

I) CROSS RATES – IN CASE OF 1 WAY QUOTE

Simply multiply rates to get the desired quote.

Ex: 1$ = ₹50 (₹/$)

1£ = 1.4$ ($/£)

Find 1£ = ₹?

Ans: $\frac{₹}{£} = \frac{₹}{\$} \times \frac{\$}{£}$ = 50 x 1.4 = ₹70.

II) CROSS RATES – IN CASE OF 2 WAY QUOTE

Same as above. Multiply all the bid rates with other bid rates & all the ask rates with other ask rates.

Ex: 1$ = £0.762 - 0.770 (£/$)

1£ = ₹82.3 - 82.9 (₹/£)

1¥ = ₹0.461 - 0.468 (₹/¥)

Find ¥/$.

Ans: $\frac{¥}{\$} = \frac{£}{\$} \times \frac{₹}{£} \times \frac{¥}{₹}$

¥/$ = 0.762 x 82.3 x 1/0.468 – 0.77 x 82.9 x 1/0.461 = 134 – 138.47

5. Other points related to exchange rate

I) EXCHANGE MARGIN OR COMMISION

This is a margin that is charged from customer by the bank.

Buying commission = rate (-) % of commission.

Selling commission = rate (+) % of commission.

If given in amount, then directly add or subtract such commission.

⚠ Exchange margin is not applicable in case of inter-bank dealings.

In case of cross rates – Exchange margin is added / deducted in final cross rate.

II) EXPECTED RATE

Expected rate = Rate x probability (Just like you cal. any other expected value)

III) CURRENCY PAIRS

Sometimes quotes may be given as 'Currency pairs' i.e. as per ISO standard.

Ex: USD/INR → It means ₹/$ (& not $/₹)

How to identify currency pairs?

- All Capitals
- 3 alphabets
- No Symbols (₹, £) ✗
- Currencies are separated by '/' (i.e. slash)
- Stronger / Weaker currency (Stronger currency is denoted first, followed by weaker currency)

Most popular currencies pairs:

USD/INR	EUR/USD	EUR/CAD
USD/CHF	EUR/INR	EUR/JPY
USD/CAD	EUR/GBP	EUR/AUD
GBP/INR	GBP/USD	

IV) BASE CURRENCY AND PRICE CURRENCY

The currency on LHS is known as 'Base currency' and the currency on RHS is known as 'Price currency'.

For practical purpose -> Use the 2-step rule which is discussed earlier. Don't get confused with this.

Ex: 1$ = ₹80 → Base currency = $, Price currency = ₹

V) DIRECT AND INDIRECT QUOTE

Direct quote = When FC is on LHS.

Indirect quote = When HC is on LHS.

Ex: 1 share of Ashok Leyland = ₹160 -> This is direct quote.

But 1 ₹ = 1/160 or 0.00625 shares of Ashok Leyland -> This is Indirect quote.

Ex: Similarly, 1$ = ₹80 -> This is direct quote for INDIANS and Indirect Quote for Americans.

1₹ = 1/80 or 0.0125$ -> This is direct quote for Americans and Indirect Quote for Indians.

VI) INCORRECT CURRENCY PAIRS QUOTE

- USD / INR = 80 -> This is a currency pair. This means 1$ = ₹80.
- USD / ₹ = 80 -> Technically this is not a currency pair (as both the currencies in a currency pair should be represented by 3 Capital letters as per ISO standard). But as per our common-sense, we know that it means 1 $ = ₹80 (& not other way around).

VII) INTER-BANK MARKET AND RETAIL MARKET

- Inter-bank market = When 1 bank buys or sell FC to another bank.
- Retail market = When a customer buys or sell FC to a bank. Exchange margin is applicable in such cases.

The final rate is known as '**MERCHANT RATE**.'

Merchant rate = Inter-bank rate ± Exchange margin

Ex: 1 $ = ₹80 – 80.5. Exchange margin = 0.5%.

i) A customer wants to buy $1000 from Bank A. Find ₹ payable.

ii) Let us say that Bank A currently does not have $1000. So, Bank A buys $1000 from Bank B. Find ₹ payable.

Ans: i) Customer wants to buy $1000. So, Bank's selling rate (Ask rate) will be applicable.

1$ = 80.5 + 0.5% = ₹80.9025

Total ₹ payable = 80.9025 x 1000 = ₹80,902.5

ii) Bank A wants to buy $ from another Bank B – Since Bank B is selling $. So selling rate will be applicable.

1$ = 80.5. Total ₹ Payable by bank A = 80.5 x 1000 = ₹80,500.

6. Currency Forwards

I) INTRODUCTION

Just like we can buy or sell stock Forwards. Similarly, we can buy/sell forward on any currency.

Ex: You bought 3-months $ forward at ₹82.

Interpretation – You'll come after 3 months and buy $ at ₹82 per $.

Contract = entered today. Rate = fixed today.

But $ will NOT be purchased today. It will be purchased after 3m.

II) FORWARD PREMIUM & DISCOUNT

If forward rate (FR) > Spot rate (SR) --> Premium

FR < SR --> Discount.

- Premium or Discount = Forward rate – Spot rate
  -> If this is positive = Premium
  -> If FR – SR is negative = Discount

- Premium or discount % = $\frac{\text{Forward rate} - \text{Spot rate}}{\text{Spot rate}} \times \frac{12}{\text{Months}}$

Ex: 1$ = ₹70 (Spot Rate) 1$ = ₹72 (6 months Forward Rate)

Ans: $ forward is > $ Spot. ∴ $ is trading at premium.

- Premium (in amount) = 72 – 70 = ₹2
- Premium (in %) = 2/70 = 2.86% For 6-month i.e. 5.72% p.a.

Ex: SR -> 1$ = ₹70

12-m FR -> = ₹77

i) Calculate premium of $ and % of forward premium.

ii) Calculate discount of ₹ and % of forward discount.

Ans: For $ (Author Note – Consider price tag of $ when calculating premium or discount of dollar)

$ premium = 77 – 70 = 7

$ premium % = $\frac{77 - 70}{70}$ = **10%**

For ₹ (Author Note – Consider price tag of ₹ when calculating premium or discount of rupee)

Spot rate of ₹ -> 1/70 = 0.0142857

12 months FR of ₹ -> 1/77 = 0.012987

₹ Discount = 0.012987 – 0.0142857 = -0.0012987

₹ Discount % = $\frac{0.012987 - 0.0142857}{0.0142857}$ = **-9.09%**

Author Note – The % of ₹ premium and the % of ₹ discount is not same.

Main reason – Change in base. Ex: 80 -> 100 is 25% increase, but 100 -> 80 is 20% decrease.

For exam – Students may assume forward premium % = Discount % (after giving a note)

III) CALCULATING FORWARD RATE USING PREMIUM OR DISCOUNT %

Sometimes in exam FR may not be given directly. Rather premium or discount % will be given.

Ex: Spot rate - 1 $ = ₹80.

Find 3-m FR if $ premium = 4% p.a.

Ans: 3 months FR = SR + premium

= 80 (1 + 0.04 x 3/12) = ₹80.8

IV) NOTES

1. Do not forget that 4% in above example is '4% p.a.'.

   So, premium for 3 months = 4% x 3/12 = 1%

2. If premium or discount is not given in annualized form -> take premium or discount % as it is.

   Ex: 3-m premium = 1%. Spot rate – 1$ = ₹80

   Now, this premium is already for 3 months. So, FR = 80 (1 + 0.01) = ₹80.8

3. If discount is given in ques, then it will of course be subtracted from the spot rate.

V) APPRECIATION VS DEPRECIATION

- India won a cricket match against Pakistan. -> This means Pakistan lost the match.

  (For 1 team to win, the other one must lose)

- Similarly, if $ is appreciating against ₹ -> Then this means that ₹ is depreciating against $.

- So, if $ is at 4% premium (appreciation), then ₹ will be at 4% discount (depreciating).

VI) SWAP POINTS

Swap points = Difference between FR & SR.

Ex: 1FF = $0.02493 --- $0.02497 (SR)

1FF = $0.02496 --- $0.02502 (FR)

Swap points = 0.00003 ----- 0.00005 → It is quoted as 3/5.

Notes:

1. **Swap points are added or deducted from last decimal point in reverse order.**
2. Swap points do not carry positive or negative signs.

- If swap points are in increasing order --> It denotes **PREMIUM** --> **ADD** it to SR to get FR.
- If swap points are in decreasing order --> It denotes **DISCOUNT** --> **SUBTRACT** it from SR to get FR.

7. Exam focused points related to Forward

I) CONTRACTED OR BOOKED RATE

The FINAL rate after considering exchange margin, commission etc. No further adjustment to be done.

II) IDENTIFYING QUOTE

- 1£ = ₹ 92.50 – 92.75 ₹ -> Basic way of presentation

1£ = ₹ 92.50 / 75 -> In such cases, start replacing from last digits. i.e. = 92.50 – 92.75

1£ = ₹92.5025 / 7500 -> Replacing last 4 digits, we'll get = ₹ 92.5025 – 92.7500

III) IDENTIFYING CORRECT DATE

- Spot/Aug 1£ = 92.60 – 92.90 -> This means forward rate for August.
- Spot / 10 Sep 1£ = 92.75 – 93.00 -> This means forward rate of 10th Sep.

IV) BROKEN PERIOD RATE

Ex: Required swap points for 2.5 months → 2m swap points 70 90

3m swap points 160 186

Ans: Swap points for Bid rate = $70 + \frac{(160 - 70)}{30} \times 15 = 115$

Swap points for Ask rate = $90 + \frac{(186 - 90)}{30} \times 15 = 138$

∴ Swap points for 2 m 15 days = 115/138

8. ROI in case of Foreign Investment

I) DOMESTIC INVESTMENT

- In case of Domestic Investment, say in Nifty, an Indian Investor will get return on only Nifty.

* No currency risk/return in case of Domestic Investment.

Ex: Invested in Nifty at 10,000. Sold when Nifty at 10,500. Find return %.

Ans: Return = $\frac{10{,}500 - 10{,}000}{10{,}000} = 5\%$

II) FOREIGN INVESTMENT

- In case of foreign investment, say where an Indian invested in S&P 500 Index, return will be earned on both investment & foreign currency. (Also risk on both, investment & forex).

Ex: An investor invested in S&P 500 (US stock Index) when value of S&P was 2000. $ at the time of investment was ₹70/$. He later sold his investment when S&P was at 2100. $ at the time of selling was ₹71.4/$.
Find his total (effective) return on investment.
Bifurcate this total return into return on foreign assets and return on foreign currency.

Ans: METHOD 1 --> CONVERT IN HC & THEN CALCULATE

Investment amount in ₹	=	2000 x 70	=	1,40,000
Investment proceeds in ₹	=	2100 x 71.4	=	1,49,940
Effective return	=	$\frac{1{,}49{,}940 - 1{,}40{,}000}{1{,}40{,}000}$	=	7.1%

METHOD 2 --> USING FORMULA METHOD

Return on foreign asset (R_{FA})	= (2100 – 2000)/2000	= 5%
Return on foreign currency (R_{FC})	= (71.4 – 70) / 70	= 2%
Effective total return	***= (1 + R_{FA}) (1 + R_{FC}) - 1***	
	= (1 + 0.05) (1 + 0.02) – 1	= 7.1%

Crux: You can either use i) Direct method (i.e. convert in HC and then calculate return)
ii) Formula method -> Effective return = (1 + R_{FA}) (1 + R_{FC}) - 1

PART B: Exchange Rate Theories (PPPT, IRPT)

1. Purchasing Power Parity Theory (PPPT)

As per this theory, the price of a commodity in to different markets must be same.

(Assuming no taxes, transaction cost etc.)

Ex: You can buy a pen for $20 today in US. The price of the same pen in India is ₹1000.

(i) Calculate Implied Exchange Rate.

(ii) Find forward rate of $. If inflation in India is 5% p.a. & that in US is 2% p.a.

Ans : Implied exchange rate --> $20 = ₹1000

$1 = ₹50

$$SR\ (₹/\$) = \frac{\text{Price in India (₹)}}{\text{Price in US (\$)}}$$

ii) After 1-year

Price of pen in India after 1 year = ₹1000 x 1.05 = ₹1050.

Price of pen in US after 1 year = $20 x 1.02 = $20.4

-> As per PPPT --> $20.4 = ₹1050

$1 = ₹51.47

Hence, forward rate of $ after 1-year = ₹51.47.

or Directly → FR of $\frac{₹}{\$}$ = $\frac{SR\ (1 + ₹\ Inflation)}{(1 + \$\ Inflation)}$

II) FORWARD PREMIUM AND DISCOUNT

Currency with higher inflation will be at discount and currency with lower inflation will be at premium.

(Informal Tone - Jis country me Inflation kam, wo country achi. Uski currency premium pr hogi.)

III) INTEREST RATE PERIOD

If FR is to be calculated < 1 year -> (1 + inflation x months / 12)

If FR is to be calculated > 1 year -> $(1 + \text{inflation})^n$

2. Geographical Arbitrage

I) TYPE 1 - When Bid – Ask rate of 2 banks are different such that -

Selling rate of 1 bank is even less than the buying rate of another bank.

For Arbitrage -> Buy low and sell

Ex: $ quotes are as follows:

Bank A = ₹ 80 – 80.25

Bank B = ₹ 80.50 – 80.75

Ans: Here, Ask rate (selling rate) of Bank A > Bid rate (buying rate) of Bank B.

Buy $10,000 from Bank A = 10,000 x 80.25 = ₹8,02,500

Sell $ 10,000 to Bank B = 10,000 x 80.50 = ₹8,05,000

Arbitrage profit = ₹2500

Profit per $ = 2500/ 10,000 = ₹0.25

II) TYPE 2 - TRIANGULAR ARBITRAGE

Let us say you have ₹ and you want to buy $.

Method 1 – Directly go to bank and buy $ (by giving ₹). (Informally we'll call it 'Direct market')

Method 2 – Go to bank & buy say €. Now convert € to $. (Informally - 'Indirect or cross market')

Now, in order to prevent arbitrage, cost of buying $ in Direct and Indirect market should be same.

If it is not same, then arbitrage is possible.

For Arbitrage -> Buy low, Sell high.

Ex: You can buy ¥ directly from Tokyo at ₹1.8/¥. Alternatively, you can also buy ¥ from US markets at ¥140/$. Construct arbitrage if ₹/$ = ₹70. You have ₹14L which can be used for arbitrage purpose.

Ans:

Rate of ¥/₹ in direct market = ¥1.8

Rate of ₹ in Indirect market → ¥/₹ = $/₹ x ¥/$ = 1/70 x 140 = ¥2

☞ Price tag of ₹ in cross market = ¥2 (expensive)

But price tag in direct market = ¥1.8 (cheap)

∴ We must buy ₹ in direct market. & Then Indirectly sell in cross market at a higher rate.

-- In exam, directly start from here. (Do above analysis in mind or in rough) --

Step 1.	Sell ₹ Indirectly (₹→ $ → ¥)		
	Sell ₹14L and get $	= 14,00,000 / 70	= $20,000
	Use $20,000 to buy ¥ from US market	= 20,000 x 140	= ¥28,00,000
Step 2.	Buy ₹ directly in Tokyo against ¥	= 28,00,000 / 1.8	= ₹15,55,555
	Hence, arbitrage profit = ₹15,55,555 – ₹14,00,000 = ₹1,55,555		
Ex:	If in the above example, if ₹/¥ is ₹2.2. Construct arbitrage (considering everything else is same)		
Ans: ☞	Now, price tag of ₹ in direct market (¥2.2) > Price tag in Indirect market (¥2) Sell ₹ in Direct market at higher price and Buy ₹ back from Indirect market at lower rate.		
Step 1:	Sell ₹ directly in market against ¥	= 14,00,000 x 2.2	= ¥30,80,000
Step 2:	Buy ₹ indirectly (¥ → $ → ₹)		
	Sell ¥30.8L and get $	= 30,80,000 / 140	= $22,000
	Use $22,000 to buy ₹	= 22,000 x 70	= ₹15,40,000
	Arbitrage profit = 15,40,000 – 14,00,000 = ₹1,40,000		

3. Interest Rate Parity Theory (IRPT)

Investment opportunities across different markets must be same.

An Indian investor wants to invest ₹70,000. He has 2 options.

Option 1 – Invest in India. Rf in India = 7% p.a.

After 1 year -> Investment proceeds = ₹70,000 x 1.07 = ₹74,900

Option 2 – Invest in US. US Rf = 3% p.a. Current exchange rate is ₹70/$.

Amount invested today (in $) = 70,000 / 70 = $1,000.

After 1 year -> Investment proceeds = $1000 x 1.03 = $1030

As per IRPT, both opportunities should be same.

$1030 = ₹74900

1$ = ₹74,900 --> 1$ = ₹72.72 (i.e. 1-year Forward rate of $ should be ₹72.72).

1030

$$FR\ \frac{₹}{\$} = \frac{SR\ (1 + ₹\ Rf)}{(1 + \$\ Rf)}$$

II) INTEREST RATE PERIOD

If FR is to be calculated < 1 year -> (1 + rf x months / 12)

If FR is to be calculated > 1 year -> $(1 + rf)^n$

Ex: Spot rate - 1$ = ₹80

Interest rate in US = 4% p.a.

Interest rate in India = 7% p.a.

i) Calculate 6 months forward rate.

ii) Calculate 3 years forward rate.

Ans: 6m FR $\frac{₹}{\$} = \frac{SR\ (1 + ₹\ Rf \times 6/12)}{(1 + \$\ Rf \times 6/12)} = \frac{80 \times (1 + 0.07 \times 6/12)}{(1 + 0.04 \times 6/12)} =$ ₹81.176

\- 3 years FR $\frac{₹}{\$} = \frac{SR\ (1 + ₹\ Rf)^3}{(1 + \$\ Rf)^3} = \frac{80 \times (1 + 0.07)^3}{(1 + 0.04)^3} =$ ₹87.125

III) COVERED INTEREST RATE ARBITRAGE

If actual forward rate ≠ Fair forward rate then arbitrage is possible.

If actual forward rate of base currency > Fair forward rate → Invest in Base currency.

If actual forward rate of base currency < Fair forward rate → Invest in Other currency.

Ex: Construct arbitrage if in above example, the prevailing 1-year forward rate is:

Case 1 – ₹75/$ Case 2 – ₹71/$

Ans: CASE 1 – ACTUAL FORWARD RATE = ₹75/$.

Since actual forward rate > Fair forward rate, So we'll invest in US and borrow from India.

Today – Borrow ₹10,000 from India and Invest in US. $ Invested = 10,000 / 70 = $142.86

After 1 year – $ Investment proceeds = 142.86 x 1.03 = $147.15

Convert this investment in ₹ at forward rate = 147.15 x 75 = ₹11,036.25

Repay ₹ borrowing = 10,000 x 1.07 = ₹10,700

Arbitrage profit = 11,036.25 – 10,700 = ₹336.25

CASE 2 – ACTUAL FORWARD RATE = ₹71/$.

Since actual forward rate < Fair forward rate. So, we'll not invest in US. Invest in India & borrow from US

Today – Borrow ₹10,000 from US and Invest in India. $ borrowed = 10,000/70 = $142.86

After 1 year – Investment proceeds (from ₹ investment) = 10,000 x 1.07 = ₹10,700

Convert this investment in $ at forward rate = 10,700 / 71 = $150.70

Repay $ loan = 142.86 x 1.03 = $147.15

Arbitrage profit = 150.70 – 147.15 = $3.55 or 3.55 x 71 = ₹252.05

IV) INTEREST RATES & FORWARD RATES – INVERSE RELATION

IRPT shows that currency and interest rates have **INVERSE RELATION.**

(Informal Tone – Jis country me interest rate kam, us country ki currency premium pr hogi).

4. Premium Or Discount when Exchange Rates are not given

$$FR_{₹/\$} = \frac{SR\,(1 + ₹\ Rf)}{(1 + \$\ Rf)}$$

$$\frac{FR}{SR} = \frac{(1 + ₹\ Rf)}{(1 + \$\ Rf)}$$

Subtracting by 1 on both sides-

$$\frac{FR}{SR} - 1 = \frac{(1 + ₹\ Rf)}{(1 + \$\ Rf)} - 1 \rightarrow \frac{FR - SR}{SR} = \frac{(1 + ₹\ Rf)}{(1 + \$\ Rf)} - 1$$

Hence, premium or discount as per IRPT = $\frac{(1 + ₹\ Rf)}{(1 + \$\ Rf)} - 1$

Using similar logic, we can also say -

Premium or discount as per PPPT = $\frac{(1 + ₹\ inflation)}{(1 + \$\ inflation)} - 1$

Finally, we can say that -

Premium or discount = $\frac{(1 + ₹\ Rf)}{(1 + \$\ Rf)} - 1 = \frac{(1 + ₹\ inflation)}{(1 + \$\ inflation)} - 1$

PART C: Netting, Lead, Lagging and MMO

1. Netting (or Matching)

We can Net our receivables & payables if following 2 conditions are met.

Condition 1 – Receivables and payables must be in the **SAME CURRENCY.**

Condition 2 – Receivables and payables must be standing at the **SAME POINT OF TIME.**

In this section we will use various terms like 'Natural netting', 'Jugaad netting' and 'Artificial netting'. These have been coined by the Author Finance Acharya Jatin Nagpal to make things easy & interesting. These are not Industry terms and hence should not be used in the exam.

Short-form which we'll use extensively in this section -> R&P = Receivables and Payables.

I) Scenario 1 – NATURAL NETTING (R&P are netted automatically)

When R&P are in same currency and are standing at the same point of time. Netting happens naturally.

Ex: $ receivable after 1 year = $4,00,000

$ payable after 1 year = $2,50,000

∴ Net exposure = $1,50,000 (receivable)

Hence, $2,50,000 is netted off. Net (balance) exposure left = $1,50,000 receivable.

Notes:

1. Long vs Short exposure
   - Net $ receivable = Long exposure.
   (Since we have $ receivable. We will benefit if price of $ increases. This is same as Long position)
   - Similarly, if Net $ is payable, then we'll have net short exposure in $.

2. We love Netting – Because Netting reduces our exposure without incurring much cost.
3. Always do netting even if nothing is mentioned in ques.

2. Leading and Lagging

I) Scenario 2 – JUGAAD NETTING (R&P standing at different time)

Here, we have R&P in same currency → Condition 1 satisfied.

But R&P are standing at different time → Condition 2 not satisfied.

For Netting --> Lead (advancing) or Lag (postponing) receivable or Payables.

Ex:	Details of receivables and Payables	Forward rates on £ are as follows:
	Receivable £15,000 after 3 months	3 months forward = ₹91/£
	Payable £20,000 after 4 months	4 months forward = ₹92/£

Should you Lag your receivables if interest rates in India is 6% p.a. No interest is earned on £ investment.

Ans: Here, we have 2 options.

Option 1 – Lag receivables by 1 month to Net the R&P.

Net R&P (£15,000) and obtain forward cover for only balance £5,000.

Amount paid under forward after 4 months = 5,000 x 92 = ₹4,60,000.

Option 2 – Do not Net R&P. Obtain separate forward covers for both R&P.

After 3 months - Convert £15,000 ₹ = 15,000 x 91 =	₹13,65,000
Invest it for 1m. Investment proceeds = 13,65,000 (1 + 0.06x1/12) =	₹13,71,825
Pay £20,000 payable at FR = 20,000 x 92 =	₹18,40,000
Net cost under option 2 = 18,40,000 – 13,71,825 =	₹4,68,175

- Hence, it is advisable to lag receivables and net the exposure as it is leading to lower cost.

II) MECHANICS OF LEADING

Generally discount is offered for early payment. Hence, in case of leading -

Gross receipt / payment (-) Discount

III) MECHANICS OF LAGGING

Lagging receivable -> Interest maybe received on FC balance.

Lagging payable -> Interest charged by supplier/lender for late payment. Net payment = Gross + Interest

3. Scenario 3 – ARTIFICIAL NETTING (MMO)

Problem – Sometimes only receivable or Payable is present. There is No counter exposure to Net.

Solution – **ARTIFICIALLY CREATE** opposite exposure to make netting possible.

Ex: You have ¥ receivable after 3 months. But no ¥ payable whatsoever.

Netting = Not possible ✗

Ans: Borrow today for 3m from Japan (in ¥). Convert this amount into ₹ today only.

After 3 months --> use ¥ receivable to pay off the ¥ borrowing. Hence, no forex exposure at all.

- Similarly, if you have ¥ payable, then invest today in ¥. Later use this investment to pay the payable.

II) IMPORTANT NOTES

1. Concept - If you have payable in FC, then artificially create receivable today by investing in FC.
   If you have receivable in FC, then artificially create payable today by borrowing in FC.
2. Period of investment or borrowing = Should be equal to period of receivable or payable.
3. How much to invest or borrow? = PV of receivable or borrowing.
4. Fancy name of Artificial Netting = 'Money Market operations (MMO)'
5. In ques, always calculate future value of amount paid or invested today.
6. More than 1 interest rate is given in ques -> Lower rate = Investment rate , Higher rate = Borrowing rate

III) MMO IN CASE OF EXPORTER

Ex: You have receivable £20,000 after 6 months. Illustrate how you can hedge this exposure if:

Spot rate – £1 = ₹90.

Interest rates in – India = 5% p.a. and UK = 2% p.a.

Ans: (Thought process -> Only receivable is there. So, artificially create a payable for Netting).

- Borrow PV of £20,000 today from UK = $\frac{20,000}{(1 + 0.02 \times 6/12)}$ = £19,802
- This borrowing will be later netted off with the £20,000 receivable.
- Convert £19,802 into ₹ at spot rate = 19,802 x 90 = ₹17,82,180
- Future value of ₹17,82,180 = 17,82,180 (1 + 0.06 x 6/12) = ₹18,35,645.4

IV) MMO IN CASE OF IMPORTER

Ex: You have $40,000 payable after 4 months. Illustrate how you can hedge this exposure if:

Spot rate – 1$ = ₹80.

Interest rates in – India = 6% p.a. and US = 3% p.a.

Ans: (Thought process -> Only payable is there. So, artificially create a receivable for Netting).

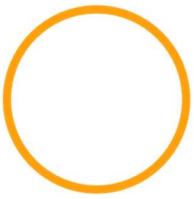
- Invest PV of $40,000 today in US = $\frac{40,000}{(1 + 0.03 \times 4/12)}$ = $39,604

- This investment will be later netted off with the $40,000 payable.

- This $39,604 will be borrowed today in ₹ = 39,604 x 80 = ₹31,68,320.

- After 6 months -> Repay borrowing = 31,68,320 (1 + 0.06 x 4/12) = ₹32,31,686.4

Hence, total cost under MMO = ₹32,31,686.4



PART D: Fate of forward contracts

1. Fate of forward contracts

Importer -> Buys forwards (i.e. Importer agrees to buy FC in future from bank).

Exporter -> Sells forwards (i.e. exporter agrees to sell FC in future to bank).

Different scenarios may arise after the contract is entered.

DELIVERY	CANCELLATION	EXTENSION
i) Early delivery (Technical)	i) Before date – Square off	i) Before due date – Square off
ii) Delivery on due date – Simply	ii) On due date – Square off	existing contract + Enter new
buy or sell FC at agreed rate.	iii) Late cancellation – Technical	ii) On due date – Square off
iii) Late delivery – Technical		existing contract + Enter new
		iii) Late extension – Technical

II) DELIVERY ON DUE DATE

Simply buy or sell FC at agreed rate (literally nothing special to be done).

Ex: Importer -> forward buy £5,000 at ₹92/£. Find his ₹ outflow if he requests bank to deliver £ on due date.

Ans: Outflow = £5,000 x 92 = ₹4,60,000.

III) CANCELLATION

1. To cancel -> One must **SQUARE OFF** the contract.

Squaring off a forward contract – Take opposite position to square off.

If earlier Bought forward -> Then sell forward to square off.

If earlier Sold forward -> Then Buy forward to square off.

2. Squaring off is done with contract of same maturity.

Ex: On 1 April, Importer bought a forward contract to buy $1L. Contract maturity = 30 June.

Later on 31 May, importer wants to cancel (square off) this contract. To do so, he must now sell a **FORWARD WITH SAME MATURITY** (i.e. 30 June). So, sell 1-month forward on 31 May to square off.

3. On Due date – Forward rate = Spot rate (as per principle of convergence).

IV) EXTENSION

1. A forward contract cannot be extended as such. If you want to extend, then
   1st Cancel (square off) existing contract. Then enter into a new contract of desired maturity.

V) CANCELLATION FEE

Bank may charge a fixed cancellation fee. If any such fee is given in ques, then customer must bear it.

VI) CRUX

1. Following 4 cases are almost same -
   a) Cancellation before due date
   b) Cancellation on due date
   c) Extension before due date
   d) Extension on due date
   All these cases include 'squaring off existing contract'. In extension, a new contract is also entered.

2. Early delivery

As per FEDAI* guidelines -> bank must deal with a customer even if customer shows up early.

* FEDAI = Foreign Exchange Dealers Association of India

Amount payable / receivable by customer under Early delivery

1.	Amount payable / receivable at contracted forward rate	xxx
2.	Swap loss Importer = Spot Buy & sell forward	xxx
	(or gain) Exporter = Spot Sell & Buy forward	xxx
3.	Interest cost (Note below) = (Outflow – Inflow) x Interest% x No. of days /365	xxx
	Net payable or receivable =	xxx

Understanding inflow & outflow – For exporter

Exporter showed up earlier and bank has to purchase FC from him at contracted rate.

But bank will not keep this FC purchased with itself. Rather it will sell it at prevailing Spot rate in IBM*.

Hence,

Bank outflow = FC purchased from exporter @ contracted rate.

Bank Inflow = FC sold in Inter-bank market (IBM) @ Spot rate.

Understanding inflow & outflow – For Importer

Importer showed up earlier and bank has to sell FC to him at contracted rate.

But bank itself has to buy this FC from IBM at Spot rate.

Bank outflow = FC purchased from IBM @ Spot rate.

Bank inflow = FC sold to importer @ Contracted rate.

Notes:

1. Swap gain (if any) or Interest cost gain will also be passed on to customer in case of early delivery.
2. Exchange margin is not applicable in case of Inter-bank market transactions.
3. When bank is selling in IBM -> Other dealer (Bank) is buying. Hence, Bid rate will be applicable.
   Similarly when Bank is buying from IBM -> Other dealer (Bank) is selling. Hence, Ask rate will be applicable.

3. Late Delivery / Cancellation / Extension

If customer does not show up on maturity date, then the contract shall be cancelled either on the date the customer comes or within 3 working days after the maturity date.

However, the customer must pay following charges.

☞ **GAIN IF ANY WILL NOT BE PASSED ON TO CUSTOMER IN THIS CASE.**

Amount payable / receivable by customer under Early delivery

1.	Cancel (square off) contract at SR prevailing on the date on which customer shows up	xxx
2.	Swap loss Importer = Spot Sell & Buy forward	xxx
	(or gain) Exporter = Spot Buy & Sell forward	xxx
3.	Interest cost (Note below) = (Outflow – Inflow) x Interest% x No. of days /365	xxx
	Net payable or receivable =	xxx

* Extension in this case – As discussed earlier, forward contract cannot be extended as such.
  Rather a new contract must be entered for new desired date.

PART E: Forex Decisions Credit, Hedge, Int. cash mgt

1. Forex Decisions – Avail credit or not?

Sometimes supplier gives the importer a credit period (say 60 days, 90 days etc.).

In such cases, importer has 2 options.

Option 1 – Avail the credit period and enter into a forward contract.

Option 2 – Borrow from the local bank today and pay the supplier today.

A discount is generally given by supplier for early payment.

Interest on loan from local bank is paid.

Cash balance (if any) should be subtracted from the loan amount.

2. Forex Decisions – Hedge or not?

Suppose you have a FC receivable or payable. Now, you can hedge this exposure or leave it unhedged.

In such cases, we'll calculate Expected loss or gain under both the scenarios.

i) Is hedging beneficial?

- Calculate amount at forward rate.
- Calculate amount at **ACTUAL** spot rate prevailing on the settlement date.

Compare the 2 and find if hedging was beneficial.

ii) Profit and loss under hedging

P&L (today) due to hedging = Amount at forward rate vs Amount at **EXPECTED SPOT RATE**

iii) Expected loss

Expected loss = Difference between amount paid (or received) at Expected SR and at current prevailing SR.

3. International Investment decision

Ex: let us say that Sweet Chilly ltd. (SCL) has offices at multiple locations – US, Germany, Australia etc.

The Head office is in US. It has some surplus funds (in $) which its wants to invest for 2 months.

Determine where funds should be invested.

Ans:	Calculate closing value of investment in $ at each location. The one with max. value will be chosen.
Step 1	Investment in FC (Germany & Australia) – 1st convert $ balance into FC at spot rate.
	At the end – Convert balance in foreign currency into $ using forward rate.
Step 2	Investment in US – Balance is already lying in $. So no hassles. Directly calculate closing investment value.
	Examiner Twist 1 – Surplus funds lying in US but are not in $. Be extra cautious in such case.
Ex	Surplus funds are lying in US in ₹. Then even while investing in US, first ₹ balance will be converted into
	$ at spot rate. (same procedure as above).
	Examiner Twist 2 – Stay alert regarding the currency in which closing investment is to be calculated.
	If specifically given in ques -> Then choose that currency.
	If nothing specific given in ques -> Chose currency in which surplus balance is currently lying.
4.	**International Borrowing decision**
	This is exactly opposite of international investment decision.
	In the above ex, say SCL wants to borrow funds in $. Again, it has 3 options – US, Germany and Australia.
Ans:	Calculate $ outflow under each location. It will borrow from the location which results in least $ outflow.
Step 1:	Borrowing in FC (Germany & Australia) – Calculate amount to be borrowed in FC using Spot rate.
	In the end – Convert balance in FC into $ using forward rate.
Step 2:	Borrowing in US – Borrow $ directly from US and calculate amount to be paid back in $.
5.	**International Cash management**
Ex:	MNC with office in London, India and Tokyo. Head office in India. Cash balance of each office is as below-
	London = Surplus £5 Lacs
	India = Surplus ₹300 Lacs
	Tokyo = Deficit ¥200 Lacs
	Two options
	OPTION 1 – INDEPENDENT CASH MANAGEMENT
Step 1:	London & India invests its surplus funds locally and Japan will borrow required ¥ locally from Japan.
Step 2:	Calculate closing value = convert all the balance in country's HC using forward rate.

OPTION 2 – POOLING METHOD

London, India & Japan will all pool their funds at Head office in India.

Step 1: Convert all the FC at spot rate in Home currency.

Step 2: Calculate Net surplus or deficit after pooling.

If Net surplus -> Invested at HC rate.

If Net deficit -> Borrowed from HC.

Step 3: Calculate closing value = Amount Invested (or borrowed) + Interest

Compare the closing value under both the alternatives and chose the more advantageous one.

When withholding tax is given

Effective interest rate on borrowing = $\frac{\text{Interest rate required by foreign bank}}{1 - \text{withholding tax rate}}$

Effective interest rate on investment = Interest paid by foreign bank x (1 – withholding tax)

Any other cost

Some other costs such as servicing fee etc. may be given in ques.

It will increase our borrowing cost (or decrease our investment value).

If Exchange rates are not given in ques

	Calculate the interest cost in foreign currency = Interest cost + servicing cost etc.	xxx
±	Premium (or discount) of foreign currency	xxx
	Net interest cost =	xxx

Ex: Cal. premium (or discount) when exchange rates are not given

Germany (€) = 5% p.a.

US ($) = 4% p.a.

Ans: As per IRPT -> $ premium (or Discount) = $\frac{1 + €\ Rf}{1 + \$Rf} - 1 = \frac{1.05}{1.04} - 1 = 0.96\%$

PART F: Other topics - Nostro-Vostro Forex exposure

1. Cash A/c and Exchange position A/c

I) CASH ACCOUNT (NOSTRO ACCOUNT)

This is just like your old school 'Cash book' account → Debit – when you actually purchase FC.

Credit – When you actually sale FC.

II) EXCHANGE POSITION ACCOUNT

This is an **'EXPOSURE'** account. → Long exposure = Positive (Add)

Short exposure = Negative (Subtract)

Ex: Bought $20,000 in cash market. Sold forward on $15,000.

Find balance in cash account and in exchange position account.

Ans:

Particulars	Cash A/c	Exchange position A/c
Bought $	20,000	20,000
Sold $ forward	-	(15,000)
Balance =	$20,000	$5,000

III) SOME ITEMS WORTH CONSIDERING

Particulars	Impact on Cash account	Impact on Exchange position A/C
Purchased spot FC	Add	Add
Sold Spot FC	Subtract	Subtract
Purchased forward on FC	✗	Add
Forward purchased cancelled	✗	Subtract
Sold forward on FC	✗	Subtract
Forward Sold cancelled	✗	Add
DD on FC issued but not yet paid	✗	Subtract
Draft on FC cancelled	✗	Add
Purchased DD / bill on FC	✗	Add
Purchased DD / bill cancelled	✗	Subtract
Cheque purchased but not credited	✗	Add

IV) BALANCE INTERPRETATION

Cash (Nostro) Account	Exchange position Account
Credit balance = Positive	Over-bought = Positive
Debit balance = Negative	Over-sold = Negative

V) MANAGING CLOSING BALANCE

Often in ques we are given the 'required' closing balance of cash account and Exchange position account.

In such cases -

Step 1: Achieve required closing balance of 'Cash A/c' by buying or selling spot.

(This buying or selling will also impact exchange position account)

Step 2: Achieve required closing balance of 'Exchange position A/c' by buying or selling forward.

VI) TT - TELEGRAPHIC TRANSFER

Telegraphic transfer is a method to buy or sell FC.

So, if Purchased TT -> Means bought FC spot

Sold TT -> Means sold FC spot

Purchased 3m forward TT -> Purchased forward contract and so on...

VII) NOSTRO, VORO & LORO ACCOUNTS

(These are just fancy Italian names)

Nostro – Our account with you

Vostro – Your account with us

Loro – Their account with you

WHAT DOES IT MEAN?

Ex: SBI has a bank account with JP Morgan Chase in US. All the $ buy and sell **SPOT** transactions of SBI happens through this account. So, this is simply a cash account of SBI maintained in $.

WHY SUCH FANCY NAME?

SBI communicating with JPMC -> Referring to its $ A/c -> Use term 'Nostro A/c' (our A/c with you)

JPMC communicating with SBI -> Referring to SBI's $ A/c -> Use term 'Vostro A/c' (your A/c with us)

PNB communicating with JPMC -> Referring to SBI's $ A/c -> Use term 'Loro A/c' (their A/c with you)

2. Forex exposure

I) TRANSACTION EXPOSURE

Transaction exposure = Profit / (loss) due to exchange rate fluctuations on transactions which were entered **BEFORE THE EXCHANGE RATE CHANGE**.

Txn. exposure = Net inflow / outflow at SR (-) Net inflow / outflow at settlement date

Ex: Purchased goods today worth $1000. Payment to be made in 3 months. Find transaction exposure if -

SR – 1$ = ₹79

Expected rate after 3 months – 1$ = ₹80

Ans:

₹ outflow at spot	= 1000 x 79 =	₹79,000
Expected ₹ outflow after 3 months	= 1000 x 80 =	₹80,000
	Transaction exposure =	₹1000

II) ECONOMIC or OPERATING EXPOSURE

It refers to the extent to which the economic value of a company can decline due to changes in exchange rate. It is the overall impact of exchange rate changes on the value of the firm.

P&L due to operating exposure = Profit at SR (-) Profit at changed rate at new demand

☞ % change in demand = – % change price x Price elasticity of demand

III) TRANSLATION EXPOSURE (Accounting exposure)

It refers to gains or losses caused by the translation of foreign currency assets and liabilities into the currency of the parent company for consolidation purposes.

Student's Space

Chapter 10B

Currency F&O

Chapter Index

PART A – Basics of Forex
PART B – Currency Options

---- Student's Space for Summary chart and notes ----

PART A: Basics of Forex

(as the name indicates, it is strongly advisable to first revise 'Futures' before this part.)

1. Currency Futures – Basics

I) IDENTIFYING FUTURES CURRENCY

Ex: Interpret following futures contract quotes -

a. 1 Ashok Leyland = ₹150

- It means futures contract on Ashok Leyland.
- Gain / loss will be in ₹ terms

b. 1 $ = ₹80. Contract size = $1000.

- It means futures contract on $.
- 1 Contract is for **1,000 $**
- Gain / loss will be in **RS. TERMS**.
- If 5 contracts entered, and gain = ₹2. Then total gain = 2 x 5 x 1000 = ₹10,000

c. 1 ₹ = 0.0125$. Contract size ₹50,000.

- It means futures contract on ₹
- 1 Contract is for **50,000 RS.**
- Gain / loss will be in **$ TERMS**.
- If 3 contracts entered and gain = $0.0004. Then total gain = 0.004 x 3 x 50,000 = $600.

Crux: Futures contract is on the L.H.S currency.

For ex – If 1₹ = 0.0125$, then it is futures contract of ₹ (in $ terms).

We will informally call the futures contract currency as **'FUTURES CURRENCY.'**

II) WHETHER TO LONG OR SHORT FUTURES?

First correctly identify the 'futures currency' using above logic.

If you want to buy 'Futures currency' in future -> Then Buy (long) futures.

If you want to sell 'Futures currency' in future -> Then Sell (short) futures.

(same normal futures logic).

III) **PRINCIPLE OF CONVERGENCE**

At maturity – Futures rate = Spot rate (for logic – Refer Derivatives Futures)

IV) **NUMBER OF CONTRACTS**

Number of contracts = Total exposure **IN FUTURES CURRENCY**
Contract size (or lot size)

2. When Exposure currency = Futures currency (1)

In this case future contract is directly given on the currency which we want to buy or sell in future.

Ex: $4,00,000 receivable after 3 months.

3-months futures quote – 1$ = ₹45.

Lot size = $1,000.

i) Analyse the action that should be taken today.

ii) Gain or loss on futures if Futures rate on maturity = ₹44.50.

iii) Net realization per $.

Ans: (Both futures currency and exposure are in same currency. Hurray!!! No worries.)

Whether to long or short futures?

We will receive $ after 3-months and will **SELL IT** to get ₹. Hence, sell (short) futures.

Number of contracts to short

Number of contracts = Total exposure in futures currency = 4,00,000 = 400 contracts.
Contract size (or lot size) 1,000

ii) Gain or loss

Sold futures at = ₹45/$

Bought futures at = ₹44.5/$

Gain / (loss) = ₹0.5/$

Total gain = ₹0.5 x 1000 x 400 = ₹2,00,000

iii) Net realisation per $

	Sale $4,00,000 at spot rate : $4,00,000 x 44.5	₹1,78,00,000
(+)	Gain on future square off :	₹2,00,000
	Total =	₹1,80,00,000

- Effective realization per $ = 1,80,00,000/4,00,000 = ₹45/$.

3. When Exposure currency ≠ futures currency (2a & b)

In this case, exposure will be in different currency and futures contract will on other currency.

In such cases, we'll have to take care of 2 things.

Ex: $20,000 receivable after 2 months. But futures contract is given on ₹.

2-months futures quote – ₹1 = $0.0125. Lot size = ₹50,000.

CARE 1

1st we need exposure in futures currency.

Convert exposure in futures currency **USING FUTURES RATE** = $20,000 / 0.0125 = ₹16,00,000.

$$\text{Number of contracts} = \frac{\text{Total exposure in futures currency}}{\text{Contract size (or lot size)}} = \frac{16,00,000}{50,000} = 32 \text{ contracts.}$$

CARE 2

Gain or loss on futures will be in $. This will affect our Net $ receipt.

For ex – If loss on futures = $700, then net $ received = $20,000 - $700 = $19,300.

Convert this net receipt (or payment) into HC at prevailing spot rate.

Ex: €2.8 Million receivable after 6 months.

6-months Futures contract is currently trading at €1.1943/£. Contract size = £62,500. Find

i) Number of contracts to be traded. Round off to nearest whole number.

ii) Net £ received after 6-months, if spot rate after 6-months turns out to be €1.1873/£.

Ans: (Here, exposure is in € but futures currency = £)

i) Thought process --> € is receivable. So, we will sell € after 6 months and buy £. So, buy £ futures.

Number of contracts to short

$$\text{Total exposure in futures currency} = \frac{€\ 2.8 \text{ Million}}{1.1943} = £23,44,470$$

$$\text{Number of contracts} = \frac{\text{Total exposure in FUTURES CURRENCY}}{\text{Contract size (or lot size)}} = \frac{23,44,470}{62,500} = 37 \text{ contracts (nearest whole number)}$$

ii) After 6-months, Gain/(Loss) on futures contracts

Buy futures = € 1.1943 / £

Sell futures = € 1.1873 / £

Gain/(loss) = (€0.0070) / £

Total loss = € 0.0070 x 37 x 62500 = € 16,187.5

-	Net £ realization after 6-months :		
	Receive € 2.8 Million	€ 28,00,000	
(-)	Loss on futures	€ 16,187.5	
=	Net € received	€ 27,83,812.5	
	Equivalent £ = 27,83,812.5 / 1.1873 =	£2.3447 Million	

4. Margin money in currency futures (3a & b)

- Remember – Margin money is just like a refundable security deposit. So, Initial margin paid is NOT cost as such. Only the interest cost incurred on Initial margin will be treated as cost.

Ex: $3,00,000 receivable after 3 months i.e. on 1 July.
July currency futures are trading at – 1₹ = $0.0151
Lot size of futures = ₹6,40,000. Initial margin required = ₹24,000. Interest rate in India is 8.5% p.a.
Find net realisation in ₹ if on 1 July the futures rate is $0.0147.

Ans: $ is receivable. So, we will sell $ after 3 months and buy ₹. So, buy ₹ futures.

- No. of contracts = 3,00,000/0.0151 / 6,40,000 = 31.04 i.e., 31 contracts

- Initial margin paid = 31 x 24,000 = ₹7,44,000
- Interest cost on initial margin = 7,44,000 x 8.5% x 3/12 = ₹15,810.

- Gain/(loss) on futures or Variation margin calculation

	Bought Futures :	$0.0151
	Sold Futures :	$0.0147
	Gain/(loss) =	($0.0004)
	Total Loss = $0.0004 x 31 x 6,40,000 =	$7,936.

Net realization under futures :

	Receive	$3,00,000
(-)	Loss on futures	($7,936)
=	Net $ receipt	$2,92,064
	Equivalent ₹ (Using SR = $0.0146/₹)	₹2,00,04,384
(-)	Interest on initial margin =	(15,810)
	Net ₹ receipt =	₹1,99,88,574

PART B: Currency Options

1. Currency options – Basics

I) BASIC RECALL

Call option = Right to BUY at strike price

Put option = Right to SELL at strike price

II) IDENTIFYING OPTIONS CURRENCY

(same as identifying futures currency)

Ex: Interpret following option contract quotes -

a. Call option on $ at strike = ₹80. Contract size = $1000.

- It means option contract on $ at strike price of ₹80.
- Call option means 'Right to Buy' i.e. we'll have right to buy $ at ₹80/$.
- 1 Contract is for **1,000 $**
- Premium will be paid in **RS.**

b. Put option on ₹ at strike price of 0.0125$. Contract size ₹50,000.

- It means option contract on ₹ at strike price of $0.0125.
- Put option means 'Right to Sell' i.e. we'll have right to sell ₹ at $0.0125.
- 1 Contract is for **50,000 RS.**
- Premium will be paid in **$ TERMS**.

Crux: Options contract is on the L.H.S currency.

We will informally call the options contract currency as **'OPTIONS CURRENCY.'**

II) WHETHER TO BUY CALL OPTION OR PUT OPTION.

First correctly identify the 'Options currency' using above logic.

If you want to buy 'Options currency' in future -> Then Buy Call option (Right to Buy).

If you want to sell 'Options currency' in future -> Then Buy Put option (Right to Sell).

III) OPTION PREMIUM IS COST

The premium paid today for purchasing option is a 'cost' for the buyer.

Also, since option premium is paid today (i.e. at the time of entering contract) so interest cost is also incurred on the option premium paid.

Total cost of option = Premium paid today + Interest cost on premium

IV) NUMBER OF CONTRACTS

Number of contracts = Total exposure **IN OPTIONS CURRENCY**

Contract size (or lot size)

V) UNHEDGED PORTION

Exposure left unhedged (due to option lot size) is usually hedged with forward contract.

Ex: $42,000 receivable. 1 option contract is for $5,000.

Buy 8 Put options contracts. Exposure covered via options = 8x5000 = $40,000.

For balance $2,000 enter forward contract.

VI) NET AMOUNT RECEIVED OR PAID IN CASE OF CURRENCY OPTIONS

	Amount received or paid under currency options	xxx
(+)	Option premium paid	xxx
(+)	Interest cost on option premium paid	xxx
(+)	Unhedged portion covered via forward contract	xxx
	Total amount received =	xxx

2. When Exposure currency = Options currency (5)

In this case option contract is directly given on the currency which we want to buy or sell in future.

Ex: Amount payable in 1 month = Cad $10,10,000

Call & put options on Cad $ are available with at a strike price of $0.94 and lot size = Cad $ 50,000.

Option premium – Call = 0.0102 $ Put = 0.0101 $

i) Determine whether you should buy call option or put option.

ii) Determine number of contracts to be bought.

iii) Total cost or total $ outflow if balance amount is purchased at $0.93 per Cad $.

Ans: i) Cad $ is payable after 1 month. So, we will have to buy Cad $. Hence, Buy call option cad $.

ii) Number of contracts = Total exposure in **OPTIONS CURRENCY** / Contract size (or lot size) = 10,10,000 / 50,000 = 20 contracts (rounded off)

- Option contract is entered for 20 x 50,000 = Cad $ 10,00,000.
- Balance Cad$ 10,000 will be purchased at forward rate of $0.93/Cad $.
- Option premium paid today = 10,00,000 x 0.0102 = $10,200

iii) Total cost or Total $ outflow

Cad $ purchased under options = 10,00,000 x 0.94 =	$9,40,000
Cad $ purchased under forward = 10,000 x 0.93 =	$9300
Option premium paid = $10,200 =	$10,200
Total cost =	$9,59,525.5

3. When Exposure currency ≠ Options currency (4)

Take care of 2 things:

1. Convert exposure into Options currency for the purpose of calculating number of contracts.
2. The premium paid in FC should be converted into HC at prevailing Spot rate.

Ex: ¥5,00,000 payable in 3 months. Currency option on ₹ is available with following details:

Strike Price	JY2.125
Call Option (June)	JY0.047
Put Option (June)	JY0.098

Currently, the prevailing spot rate is 1 ₹ = ¥1.9516 / 1.9711

Ans: Exposure in ¥. But currency option is not given on ¥. It is given on ₹.

Since ¥ is payable, so we'll need to purchase ¥. i.e. we'll sell ₹. Hence, buy put option on ₹.

ii) Exposure in options currency (in ₹) = 5,00,000 / 2.125 = ₹2,35,294

Put premium paid (in ¥) = ¥0.098 x 2,35,294 = ¥23,058.8

Put premium in ₹ today at SR = ¥23,058.8 / 1.9516 = ₹11,815

iii) Total ₹ outflow under options

At max. amt payable under put = 5,00,000 / 2.125 = ₹2,35,294

Put premium (in ₹) = ₹11,815

Total ₹ outflow = ₹2,47,109

II) CALCULATING UNHEDGED PORTION (7)

- When exposure currency = Options currency --> Total exposure (-) Amount covered via options
- When exposure currency ≠ Options currency --> Total exposure (-) Amount of options x Strike price

Ex: Payable $3,64,897 in 6-months. Currency options are available. Details are as under -

Strike price = $1.70/£ Lot size = £12,500

Call premium = $0.037 Put premium = $0.096

Spot rate = $1.5617 – 1.5673 6 month's forward rate = $1.5455 – 1.5609

Ans: Since $ is payable, so we'll need to purchase $ i.e. we'll sell £. Hence, buy put option on £.

ii) Exposure in options currency (in £) = $\frac{3,64,897 / 1.70}{1.70}$ = £214,645

Number of contracts = $\frac{\text{Total exposure in OPTIONS CURRENCY}}{\text{Contract size (or lot size)}} = \frac{214,645}{12,500}$ = 17 contracts (nearest whole number)

Exposure covered

£ covered under put option = 17 x 12,500 = £2,12,500

$ covered under put option = 1.7 x 2,12,500 = $3,61,250

$ to be covered under forward = 3,64,897 - 3,61,250 = $3,647

Premium paid

- Put premium paid (in $) = $0.096 x 212,500 = $20,400

Put premium in £ today at SR = $\frac{\$20,400}{1.5617}$ = £13,063

iii) Total £ outflow

At max. amt payable under put = $3,61,250 / 1.70 = £2,12,500

$ purchased under forward = $3,647 / 1.5455 = £2,360

Put premium (in £) = £13,063

Total £ outflow = £2,27,923

4. Different expected SR with probability given (6a & b)

An option is only exercised if it is leading to favourable outcome.

Calculate expected cost = Expected SR_1 x $Prob_1$ + Expected SR_2 x $Prob_2$ ...

Ex: Consider following options on $

a) Call option with strike = ₹76

It means right to buy $ at ₹76. Now of course we'll use this right if market price of $ > 76.

If prevailing market price = ₹74 only, then we'll directly buy from open market.

b) Put option with strike price = ₹75.

It means right to sell $ at ₹75. We'll use this right only if $ price < 75.

If $ is trading at > 75, say ₹78, then we'll directly sell $ in open market at 78.

Ex: Sun Ltd., an Indian company will need $5,00,000 in 90 days. Borrowing rate for 90-days in India = 6%.

A call option on $ that expires in 90 days has an exercise price of ₹74 and a premium of ₹0.10. Sun Ltd. has forecasted the spot rates for 90 days as below:

Future Rate	Probability
₹72.50	25%
₹73.00	50%
₹74.50	25%

Ans: Cost under Call option :

Expected SR	Call Payoff	Cost per $	Probability	Expected Cost
(1)	(2)	(3 = 1-2)	(4)	(5 = 3 x 4)
72.50	-	72.50	0.25	18.125
73	-	73	0.50	36.5
74.50	0.5	74	0.25	18.5
				73.125

	Gross Total Expected Cost = 73.125 x 5,00,000 =	₹3,65,62,500
(+)	Option premium paid = 5,00,000 x ₹0.10 =	₹50,000
(+)	Interest cost of premium = 50,000 x 6% =	₹3,000
	Total Expected cost =	₹3,66,15,500

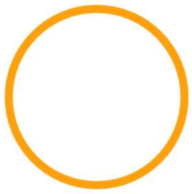
Chapter 11

IFM

Chapter Index

PART A – NPV of a foreign project
PART B – Discrete topics (GDR, MIRR, A-NPV etc.)

---- Student's Space for Summary chart and notes ----



PART A: NPV of a foreign project

1. NPV of a foreign project

Contemplating whether to invest in a foreign country or not.

This is just like regular capital budgeting decision + some foreign currency will be involved.

I) SHOULD A PROJECT BE ACCEPTED OR NOT?

Use NPV (Net Present Value). If NPV = Positive -> Accept.

NPV = Negative -> Reject

II) HOW TO CALCULATE NPV?

NPV = PVCI – PVCO

Cash Inflows = Project Cash flows, Subsidy, Sale of Fixed Assets at the end, release of WC.

Cash Outflows = Initial investment in Fixed Assets & WC, any other cash outflow.

Discount Rate = Weighted Average cost of capital (WACC)

III) CALCULATING FCFF (Free cash flows to Firm)

(Same as Corporate Valuation)

Step 1: Calculate NOPAT

	Sales		xxx
(-)	Operating Expenses (other than dep^{n}. & amortization)		xx
		EBIDTA =	xxx
(-)	Depreciation & Amortization		(xx)
		EBIT =	xxx
(-)	Tax		xxx
		NOPAT =	xxx

Important – We Do not subtract INTEREST while Calculating NOPAT.

Hence, tax is directly calculated on EBIT without subtracting interest.

If Net profit is directly given in ques -> ***NOPAT = NP + Interest (1 - tax)***

Step 2:	Calculate FCFF from NOPAT			
	NOPAT			xxx
(+)	Add back: Non cash expenses like Depreciation, amortization			xxx
(-)	Cash outflow: Capital expenditure		xxx	
	Increase in working capital		xxx	xxx
(+)	Cash inflow: Sale of capital asset (Net of tax)		xxx	
	Decrease in working capital		xxx	xxx
		FCFE =		xxx

While cal. FCFF we do not consider any amount received or paid to providers of Long Term Capital such as - Equity Shareholders, Debt/Loan, Preference Shareholders etc.

II) Different types of Costs (7,8)

1. Irrelevant or sunk cost – Ignore. No role in future decision making. Ex: R&D cost, product designing etc.
   Do not subtract while calculating FMP. If already subtracted, then add back.
2. Allocated fixed cost – Not to be subtracted. (Add back if already subtracted).
3. Additional fixed cost – It is subtracted while calculating FMP.
4. Opportunity cost – Subtract while calculating FMP.
   Ex: Machinery currently rented out. Rental income = ₹2 lacs per annum.
   Now it will be used in an internal project. ∴ Rental income forgone = Opportunity cost = ₹2 lacs p.a.

2. NPV - Home Currency or FC terms

I) HOME CURRENCY APPROACH (5)

Step 1: Convert all Cash Flows in HC terms.

- Generally, question will provide Inflation data or Interest rate of two currencies.
  Use -> Purchasing Power Parity Theory (when inflation is given)
  or Interest Rate Parity Theory (when interest rates are given)

Step 2: Calculate NPV using above CFs (Which are in HC terms).

☞ Discount Rate for NPV → HC discount rate.

II) FOREIGN CURRENCY APPROACH

Step 1: Calculate NPV in terms of FC only.

☞ Use FC discount rate for NPV.

Step 2: Then convert that NPV in HC terms using Spot rate.

3. Discount Rates

Discount rates differs by country.

Discount rate for a rail project in India ≠ Discount rate of similar project in US or UK etc.

Ex: A US Investor wants to establish a Theme Park in India. The investor already runs theme parks in US. Find required return from Indian project if his required return in US is 9%.

Risk-free rate in US = 3%

Risk-free rate in India = 5%

Ans:

METHOD 1 – SIMPLE ADDITION	METHOD 2 – MULTIPLICATION
R_F + Risk premium = Required Return	$(1 + r_F)(1 + R_P) = (1 + RR)$
3% + RP = 9%	$1.03 \times (1 + R_P) = 1.09$
RP = 6%	$R_P = 5.825\%$
Hence, Required Return in India = ₹R_F + RP	Hence, RR in India = $1.05 \times 1.05825 = 11.1165\%$
= 5 + 6 = 11%	This is known as **Risk-adjusted discount rate (RADR)**

Important - In this Chapter we will always use Multiplication Method.

(Note - 'Simple Addition' & 'Multiplication' are informal names. Do not use these names in exam.)

II) APPROPRIATE DISCOUNT RATE (2)

If discounting US Cash flows (i.e. in $) -> Use US RADR (9% in above example)

If discounting Indian Cash flows (i.e. in ₹) -> Use Indian RADR (11.1165% in above example)

4. Discount Rates – Twists in story

I) TWIST LEVEL 1 - WACC NOT GIVEN.

Discount Rate -> WACC = Ke.We + Kd.Wd

Where: Ke = cost of equity; We = Weight of equity

Kd = Cost of debt; Wd = Weight of debt

Ex: A Co. has 40% in its capital structure. Interest rate on debt is 10% Tax rate = 20%.

Risk-free rate = 6%. Market return is 14% and beta of company's equity is 1.4. Calculate its WACC.

Ans :

Ke = $R_F + (R_m - R_F) \times$ Beta = 6% + (14% - 6%) × 1.4 = 17.2%

Kd = Interest (1 – tax rate) = 10% (1 - 0.2) = 8%

WACC = Ke. We + Kd. Wd = 17.2 × 0.6 + 8 × 0.4 = 13.52%

II) TWIST LEVEL 2 – UNLEVERED BETA IS GIVEN.

Levered (Equity) Beta = $B_U \left[1 + \frac{D\ (1 - tax)}{E}\right]$

Ex: Let us say in above example, Equity Beta is not given. But unlevered Beta is given as 1.2.

Ans: Levered Beta (B_L) = $B_U \left[1 + \frac{D\ (1 - tax)}{E}\right]$ = $1.2\left[1 + \frac{0.4\ (1 - 0.2)}{0.6}\right]$ = B_L =1.84

or Equity Beta

* Ke = $R_F + (R_m - R_F) \times$ Beta = 6% + (14% – 6%) x 1.84 = 20.72%

* WACC = Ke. We + Kd. Wd = 20.72 x 0.6 + 8 x 0.4 = 15.632%

III) TWIST LEVEL 3 – USING PROXY FIRM TO CALCULATE EQUITY BETA.

Step 1: Beta of a similar public Company will be given. Use it to calculate Unlevered Beta (B_U) of the sector in which the company operates.

Step 2: Now we have B_U and hence can easily calculate Levered Beta (B_L) of the required company.

Ex: A Private Co. engaged in the manufacturing of tyres has debt to equity = 1:4. Tax rate = 20%.
A similar Public Company has Beta = 1.55. Its D/E ratio = 2.2:1 and applicable its tax rate is 30%.
Find cost of equity of private company if market return (R_m) = 12% and R_F = 3%.

Ans : Calculating Unlevered Beta using Proxy firm (i.e. Public Co.)

$B_L = B_U \left[1 + \frac{D\ (1 - tax)}{E}\right]$

$1.55 = B_U \left[1 + \frac{2.2\ (1 - 0.3)}{1}\right]$ → B_U = 0.61024

- Using B_U to calculate B_L

$B_L = B_U \left[1 + \frac{D\ (1 - tax)}{E}\right]$

$B_L = 0.61024\left[1 + \frac{1\ (1 - 0.2)}{4}\right]$ = 0.732288

Hence, Levered Beta or Equity Beta of Co. = 0.732288

Return of Pvt. Co. (As per CAPM) = $R_F + (R_m - R_F) \times$ Beta

= 3% + (12% - 3%) x 0.732288

= 9.59%

5. Inflation comes into picture (1)

(i) Real Cash Flows : Discount using Real discount rate.

(ii) Nominal Cash flows : Discount using Nominal discount rate.

If nothing is mentioned in question, then assume Cash Flows to be "Nominal CFs".

Relation b/w Real & Nominal rates -> (1 + real rate) (1 + Inflation) = (1 + Nominal rate)

Ex: Find NPV if the required return in Nominal terms is 12% p.a. Inflation rate 4% p.a.

Year	Real CF
0	(200)
1	108
2	120

Ans : Method 1 - Convert Real CFs to Nominal CFs.

Year	Real CFs	Nominal CFs
0	(200)	(200)
1	108	$108 \times (1.04)^1 = 112.32$
2	120	$120 \times (1.04)^2 = 129.792$

$$NPV = (200) + \frac{112.32}{1.12} + \frac{129.792}{1.12^2} = +3.755$$

Method 2 - Convert nominal rate to real rate and use real rate to directly discount real CFs.

(1 + real rate) (1 + Inflation Premium) = (1 + Nominal rate)

(1 + real rate) 1.04 = 1.12 => Real rate = 7.6923%

- $$NPV = (200) + \frac{108}{1.076923} + \frac{120}{(1.076923)^2} = +3.755$$

6. VERY IMPORTANT - Rule of Consistency

- Discount rate should always be consistent with the cash flows.

Real CFs -> Real discount rate Home Currency CFs -> HC discount rate

Nominal CFs -> Nominal discount rate Foreign Currency CFs -> FC discount rate

If only required return is given (& nothing else is mentioned) – Assume <u>Nominal HC rate</u>.

Ex: Interpret - A Sri Lankan investor wants to invest in Bangladesh. Required return = 15%.

This 15% means Investor's **HC NOMINAL** required return i.e. Sri Lankan Nominal return.

7. Handling Forex (6,8,9)

I) HOW TO SELECT RATES

Recall --->> Price tag rule of picking rates. (KE in-house name)

Ex : 1 Cad = 0.735$ - 0.738$ (Informally = Price tag of Cad)

1$ = $\frac{1}{0.738} - \frac{1}{0.735}$ Cad$ (Informally = Price tag of $)

- If you are buying or selling Cad → Just focus on 1st quote i.e. 'Price tag of Cad'.
- if you are buying or selling $ → Just focus on 2nd quote i.e. 'Price tag of $'.

(i) Sell $20,000.

Relevant equation → 1$ = $\frac{1}{0.738} - \frac{1}{0.735}$ Cad$

(Bid rate) (Ask rate)

Selling $, so Bid rate of bank applicable = $20{,}000 \times \frac{1}{0.738}$ = Cad 27,100 (Approx.)

(ii) Buy 15,000 Cad.

Relevant equation → 1 Cad = 0.735$ - 0.738$

(Bid rate) (Ask rate)

= 15,000 x 0.738 = $11,070

II) Purchasing Power Parity Theory (PPPT)

$$\text{Forward Rate}_{A/B} = \frac{SR\,(1 + \text{Inflation}_A)}{(1 + \text{Inflation}_B)}$$

III) Interest Rate Parity Theory (IRPT)

$$\text{Forward Rate}_{A/B} = \frac{SR\,(1 + \text{Interest rate}_A)}{(1 + \text{interest rate}_B)}$$

PART B: Discrete topics (GDR, MIRR, A-NPV etc.)

1. GDRs (3)

- Cost of GDR = $\frac{\text{Total next year dividend}}{\text{Net proceeds}}$ + Growth rate

Where: Net proceeds = GDR Issue price x (1 – floatation cost)

- GDR Issue price in HC (say ₹) = Market price per share x Number of shares in 1 GDR x (1 – discount)
- GDR Issue price in FC (Eg $, £) -> Simply convert issue price in HC to FC.
- Gross amount to be raised = Net funds required ÷ (1 – floatation cost)

Ex: Find the issue price of GDR in $ if current market price (CMP) of 1 share is ₹250.
Number of shares underlying 1 GDR = 2. GDR will be issued at 10% discount. 1 $ = ₹60.

Ans: Issue price per GDR in ₹ = 250 x 2 x (1 – 0.1) = ₹450
Issue price in $ = 450 x 1/60 = $7.5

Ex: Cost of above GDR if next year expected dividend per share = ₹20. Growth rate is expected to be 12% p.a.
2% floatation cost was incurred for issuing GDRs.

Ans: Net proceeds per GDR = 450 x (1 – 0.02) = ₹441
Cost of GDR = $\frac{2x20}{441}$ + 12% = 21.07%

2. MIRR (5)

Cash flows from a project will be re-invested at re-investment rate (will be given in ques).
All these cash flows will be ultimately withdrawn at the end of project life.
Such IRR is known Modified IRR (MIRR)

MIRR = Rate at which PVCI = PVCO.

Amount invested = $\frac{\text{FV of all the cash flows}}{(1 + \text{MIRR})^n}$

Ex: Amount invested today in project = ₹15.625 Lacs. Project's expected cash flows are as follows:

Year	CF
1	4.4789
2	6.5313
3	7.0924

Calculate MIRR if intermediate cash flows can be re-invested at 9% p.a.

Ans:

Year	CF	Value at year 3 end
1	4.4789	$4.4789 \times 1.09^2 = 5.3214$
2	6.5313	$6.5313 \times 1.09^1 = 7.119$
3	7.0924	$7.0924 \times 1.09^0 = 7.0924$
		19.533

MIRR -> Rate at which PVCO = PVCI

$$15.625 = \frac{19.533}{(1+IRR)^3}$$

$(1+IRR)^3 = 19.533 / 15.625$

$MIRR = (1.250112)^{1/3} - 1 = 7.725\%$

3. Adjusted NPV (11)

Step 1: Calculate NPV of the project as if it were all equity financed – This is known as Base NPV.

- Do not deduct tax while calculating cash flows p.a.
- Discount rate to be used = Cost of equity (Ke).

Step 2: Calculate NPV of debt financing.

- Cash inflow = Raising debt.
- Cash outflow = Interest payments **NET OF TAX** + Repayment of principal.
- Discount rate = Market interest rate of debt (without considering tax effect).

Step 3: Adjusted NPV (APV) = Base NPV + PV of Impact of Financing

Ex: You can raise $150 Lacs of debt at subsidized rate of 6% p.a. Market rate of such debt is 8% p.a. Calculate NPV of debt financing if tax rate is 30%. Term of debt = 15 years.

Ans: Cash inflow = $150L

Cash outflow p.a. **NET OF TAX** = $150 × 6% × (1 – 0.3) = $6.3L

Cash outflow at the end = $150L (repayment of principal)

PV of cash outflow = 6.3 × PVAF(8%, 15) + 150 × PVF(8%, 15) = $101.1717

NPV of debt financing = PVCI – PVCO = 150 – 101.1717 = $48.828 Lacs

Ex: Project Dhyan will provide EBIDTA of $33L p.a. for next 20 years. Initial investment = $250 Lacs.

Depreciation for first 10 years will be $25 Lacs p.a. and for last 10 years will be 0.

Tax rate is 30% p.a. Cost of equity is 12% p.a. Calculate the project NPV if -

Case 1 – The project the all equity financed.

Case 2 – Debt of $150L is raised at 6% p.a. for 15 years. Market interest on such debt is 8% p.a.

i.e. Calculate Adjusted NPV in this case.

Ans: Case 1 – Project is all equity financed

CF of first 10 years = EBITDA (1 – tax) + Tax savings on Depreciation

= 33 (1 – 0.3) + 25x0.3 = 30.6 Lacs p.a.

CF of next 10 years = EBIDTA (1 – tax)

= 33 (1 – 0.3) = 23.1 Lacs p.a.

PV of cash flows = 30.6 x PVAF(12%, 10) + 23.1 x PVAF(12%, 11-20)

= 172.89 + 42.0189 = $214.9089 Lacs

NPV of project = PVCI – PVCO = 214.9089 - 250 = – $35.091

The NPV is negative if the project is all equity financed.

So, it is not viable if the project is all equity financed.

Case 2 – If $150L is financed via subsidized debt

NPV of debt financing = $48.828 Lacs (already calculated in previous example).

Adjusted NPV of project = Base NPV (i.e. if project is all equity financed) + NPV of debt financing

= -35.091 + 48.828 = $13.737 Lacs

Adjusted NPV is positive. Hence project is viable if subsidized debt of $150 Lacs is raised.

Chapter 12

IRRM

Chapter Index

PART A – Forward Rate Agreement (FRA)
PART B – Interest Rate Guarantee
PART C – Interest Rate Swaps (IRS)
PART D – Currency Swaps
PART E – Interest Rate Futures (IRF)

---- Student's Space for Summary chart and notes ----

PART A: Forward Rate Agreement (FRA)

1. Forward Rate agreements (FRA)

We have forward contracts on stocks, Index etc. Similarly, there are forward contracts on Interest rates.

it is known as 'Forward rate agreement (FRA)'.

	FORWARD CONTRACT ON STOCKS	FRA ON INTEREST RATES
1.	Buy Forward = Betting that stock price will increase.	Buy FRA = Betting that interest rate will increase.
	Sell Forward = Downside betting.	Sell FRA = Downside betting (interest rates will fall)
2.	Ex: 3-months forward buy on a stock at ₹980.	Ex: 3-months FRA buy at 8%.
	I will gain if price at maturity rises above ₹980.	Win if interest rate at maturity > 8%.
	If ST = ₹995. Then gain = ₹15.	If rate after 3m is 10%, then gain = 2% (i.e. 10 - 8)
3.	For Total P&L -> Multiple with lot size.	For Total P&L -> Multiply with 'Notional amount'
	If lot = 1000, then total P&L = 15 x 1000 = 15,000.	If Notional = ₹50L, then total P&L = 50L x 2% = ₹1L

II) TENURE OF FRA

(Continuing with above ex) Let's say that interest rates after 3m are as follows: Then which rate to take?

Period	6 months	1 year	2 year	(& so on...)
Interest rate	7.6%	8.1%	8.4%	

Ans: It is decided at the time of entering into an FRA.

Ex: At the time of entering into FRA, it may be decided that 'after 3m, we will use 6m prevailing rate'

This is denoted by 3x9 FRA or 3/9 FRA or 3 by 9 FRA.

Ex: Interpret 6x15 FRA.

(Thought process → 6 = After 6 months and 15 -> 15 – 6 = 9 months i.e. interest rate of 9 months)

i.e. After 6 months, we will use prevailing 9 months rate to settle FRA.

III) WHICH RATE TO TAKE? LIBOR, MIBOR ETC.

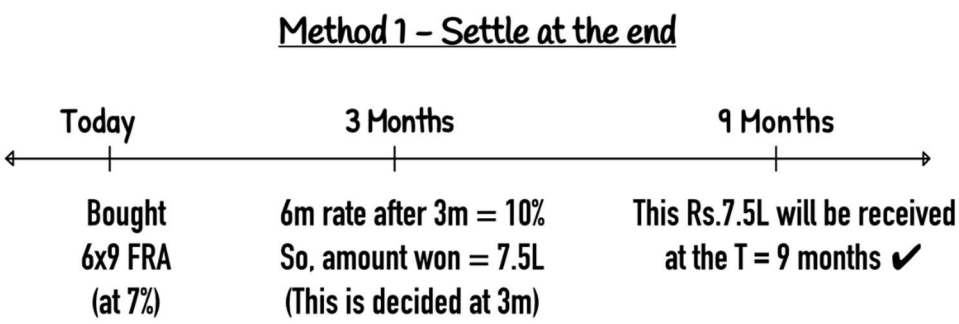
Ans: It will be specified in the contract.

2. Settlement of FRA

Ex: Mr. Pro bought a 3x9 FRA at 7% p.a. Notional amount = ₹500 Lacs. Show the settlement of FRA if 6 months interest rate after 3 months (I_T) turns out to be 10% p.a..

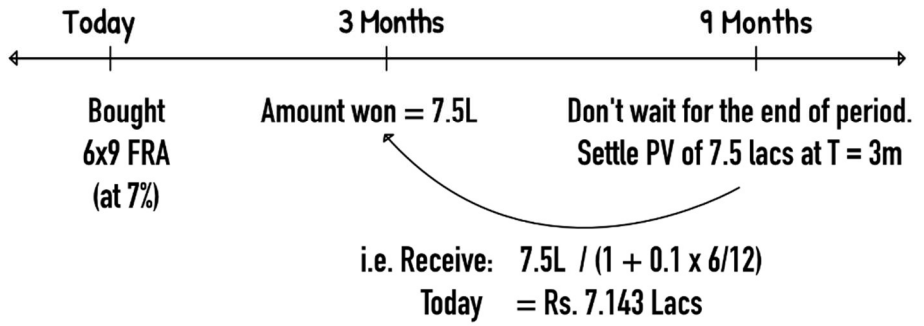
Ans: **METHOD 1: Settle at end**

Settlement the end of period = 500L x (10% - 7%) x 6/12 = ₹7.5 L



METHOD 2: Settle PV of Amount

Settle PV of Amount = $\frac{500L \times (10\% - 7\%) \times 6/12}{(1 + 0.1 \times 6/12)}$ = ₹7.143 L



I) SETTLEMENT – WHEN SETTLED AT END (1a&b)

For Long = Principal x (Reference rate – FRA rate) x months/12

For Short = Principal x (FRA rate – Reference rate) x months/12

II) SETTLEMENT – WHEN PV IS SETTLED (1c&d)

FOR LONG	FOR SHORT
$\frac{\text{Principal} \times (\text{Reference rate} - \text{FRA rate}) \times \text{months}}{(1 + \text{Reference rate} \times \text{months}/12)}$ 12	$\frac{\text{Principal} \times (\text{FRA rate} - \text{Reference rate}) \times \text{months}}{(1 + \text{Reference rate} \times \text{months}/12)}$ 12

III) **DISCOUNT RATE (FOR PV SETTLEMENT) =** Prevailing rate (i.e. reference rate)

IV) **WHICH METHOD TO FOLLOW IN EXAM?**

Case 1: Hedging (actual a borrower or investor wants to cover his position) → Method 1 – Settle at end

Case 2: In other ques (ex: Speculation) → Show both. 1st cal. amount to be settled at end. Then also cal. its PV.

3. FRA – Physical delivery

	BETTING	PHYSICAL DELIVERY
•	Believe interest rate will increase → Long FRA (F+)	Want to borrow in future → Long FRA (F+)
•	Believe interest rate will decrease → Short FRA (F-)	Want to invest in future → Short FRA (F-)

II) **NEVER EXCHANGE NOTIONAL**

The **NOTIONAL AMOUNT IS NEVER EXCHANGED** under FRA. Only amount won/lost is **NET SETTLED.**

Ex: Mr. A want to borrow ₹200 Lacs after 3 months for 6 months. There is another party, Mr. B who wants to invest ₹200 Lacs after 3 months for 6 months. They agree to enter into a 3x9 FRA at 8%.

Show the effect on each party if interest after 3 months turns out to be 6.5%.

Ans: There will be no exchange of principal even if the parties actually want to borrow or invest money.

Mr. A -> Borrow ₹200 Lacs at 6.5% (prevailing rate) from open market.

	Interest on loan = 200L x 6.5% x 6/12 =	₹6.5L
+	Payment under FRA = 200L x (8% - 6.5%) x 6/12 =	₹1.5L
	Total outflow:	₹8L

Effective interest cost of Mr. A = (8/200) x 12/6 = 8% p.a.

Mr. B -> Invest ₹200 Lacs at 6.5% (prevailing rate) in open market.

	Interest on investment = 200L x 6.5% x 6/12 =	₹6.5L
+	Receipt under FRA = 200L x (8% - 6.5%) x 6/12 =	₹1.5L
	Total inflow:	₹8L

Effective interest rate for Mr. B = (8/200) x 12/6 = 8% p.a.

Hence, effective interest rate for Mr. A and Mr. B is 8% p.a. = FRA rate.

☞ Informally, we can say that Interest rate gets 'Locked' once you enter into FRA.

4. Pricing FRA or Calculating Forward rate (2)

I) LOGICAL METHOD

Ex: Interest rates are follows:

Year	Interest rate
1	10%
2	10.5%

- Find 12x24 FRA rate (i.e. forward rate after 1 year for 1 year or Simply forward rate of year 2).

Ans: If you want to invest ₹100 for 2 years, then there are 2 ways:

Alternate 1 – Invest directly for 2 years @ 10.5% p.a.

Investment Value after 2 years = $100 \times (1.105)^2$ = ₹122.1025

Alternate 2 – Invest for 1 year @ 10% and enter into FRA for year 2.

Investment Value after 2 years = $100 \times 1.10 \times (1+FR)$

☞ Logically (& as per Principal of No arbitrage) – Investment Value under both the cases shall be same.

=> $100 \times 1.10 \times (1+FR) = 122.1025$

$$1 + FR = \frac{122.1025}{110}$$

$$FR = \frac{122.1025}{110} - 1$$

FR = 0.11 or 11%

Hence, Forward rate for year 2 shall be = 0.11 or 11%.

So, price (or rate) of 12x24 FRA = 11%.

II) DIRECT FORMULA METHOD

From above, we can say:

$$\text{Forward rate} = \left(\frac{\text{Longer effective yield}}{\text{Shorter effective yield}} - 1\right) \times \frac{12}{\text{Period of FRA}}$$

- Solving above example:

$$\text{Forward rate} = \left(\frac{1.105^2}{1.10^1} - 1\right) \times \frac{12}{12} = 0.11 \text{ or } 11\%$$

III) CALCULATING EFFECTIVE RATE

If period < 12 months → $(1 + \text{rate} \times \frac{\text{months}}{12})$

If period > 12 months → $(1 + \text{rate})^n$ (where n = number of compounding)

Ex: Rate = 12% p.a. Effective yield for:

- 3 years = $(1.12)^3 = 1.4049$
- 9-months = $1 + 0.12 \times 9/12 = 1.09$

IV) ARBITRAGE IF FRA RATE ≠ FAIR RATE (4)

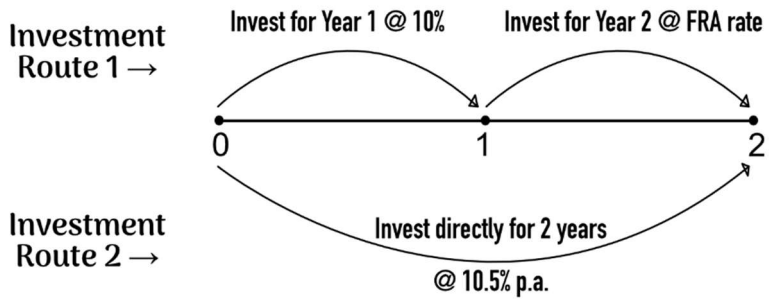
Ex: You want to invest for 2 years. Rates are as follows:

Year	Interest rate
1	10%
2	10.5%

A banker has quoted 12x24 FRA at 12%. Is arbitrage possible?

Ans: Forward rate = $\left(\frac{1.105^2}{1.10^1} - 1\right) \times \frac{12}{12} = 0.11$ or 11%

Therefore, the 12x24 FRA rate should be 11%. Since banker has quoted 12%, so arbitrage is possible.



LOGICAL THINKING OF ARBITRAGE:

For stocks – Buy low, Sell high
For FRA – Borrow low, Invest high

Invest (via route 1) -> Invest ₹100 for year 1 @ 10% p.a. and buy FRA at 12% p.a. for year 2,

Borrow (via other route, i.e. route 2) -> Borrow ₹100 @ 10.5% p.a. for 2 years.

After 2 years

	Investment proceeds: $100 \times 1.10 \times 1.12$ =	₹123.2
(-)	Repay loan proceeds: 100×1.105^2 =	(₹122.1025)
	Arbitrage profit =	₹1.0975

5. FRA – Other points

I) BID-ASK SPREAD

Sometimes FRA rate is given like -> Bid rate % - Ask rate %

Ex: If FRA given in ques is -> 8% - 8.5%

Then this means that 'Bank will buy FRA at 8% and will sell at 8.5%'.

In other words, 'Bank will borrow at 8% and will invest at 8.5%'.

Customer position -> Is always opposite of bank.

So, if customer wants to buy FRA, then Bank will sell FRA. Rate applicable = 8.5%.

II) PRESENTATION OF FRA QUOTE

Type 1 – 6x15 FRA or 6/15 FRA or 6 by 15 FRA

After 6 months, we will use prevailing 9 months (i.e. 15 – 6) rate to settle FRA.

Type 2 – 2v3 FRA

Reading style remains same. But 'v' represents years. So, this equation means:

After 2 years, we will use 1 year (i.e. 3 – 2) rate to settle FRA.

PART B: Interest Rate Gaurantee

1. Introduction

We have options on stocks. Similarly, we have options on Interest Rates. These are also known as 'Interest rate Guarantee (IRG)'.

	Stock Options	IRG. Interest rate options.
1.	Pay premium to buy option.	Pay premium today to buy option.
2.	Call Option (upside betting)	Cap option (Upside betting)
	If ST > Strike price → Exercise	If interest rate (I_T) > Strike price -> Exercise
	ST < strike price → Lapse	If I_T < Strike price -> Lapse
3.	Put Option (downside betting)	Floor option (downside betting)
	If ST < strike price → Exercise	If I_T < K -> Exercise
	ST > strike price → Lapse	If I_T > K -> Lapse
4.	Concept of lot size.	Concept of Notional amount.

NOTES:

Call option is also known as Cap option or Interest rate Cap.

Put option is also known as Floor option or Interest rate Floor.

II) ALTERNATIVE UNDERSTANDING

Cap option = Right to borrow notional amount at strike rate.

Floor option = Right to invest notional amount at strike rate.

☞ ***Interest rate options are always net settled. Principal i.e. notional is never exchanged.***

III) OPTION PAYOFF for Buyers (6,7,8)

- Under Call option = ***Max {Notional x (Reference rate - Cap rate) x months /12, 0}***
- Under Floor option = ***Max {Notional x (Floor rate - Reference rate) x months /12, 0}***

IV) PAYOFF FOR SELLER

Payoff of option seller = Opposite of option buyer.

V) CONCEPT OF RESET DATES

Let us say that A co. borrowed funds at floating interest rate for 3 years. The interest rate is reset every 6 months. Thus reset period here = 6 months. The dates on which rate is reset is known reset date.

VI) SINGLE PERIOD OPTIONS & MULTI-PERIOD OPTIONS

Single period option – Enters an option contract for only 1 period, say for next 6 months.

In such case, settlement will happen only once at the end of period.

Multi-period option – Enters an option contract for multiple periods. Say enters a contract for 2 years, Interest rate will reset after every 6 months. In such case, settlement happens at every reset date.

VII) OPTION PREMIUM (5a&b, 11)

- Generally paid at the time of entering into contract.
- While calculating Net payment or receipt under option -> Take Future value of premium paid.
- Sometimes in case of multi-period option, it may be decided to pay premium at every reset date.
- Further, sometimes amount of option premium that will be paid at every reset date is not directly given. Rather, lumpsum (PV) of all the option premium is given.

Ex: A lumpsum premium of £200,000 will be charged by the option seller. This premium will be paid in 4 equal instalments of 6 months each (at each reset date). Find the instalment amount if discount rate = 6% p.a.

Ans: Let the amount of instalment be 'I'.

PV of all the instalments = £2,00,000

I x PVAF (3%, 4) = 2,00,000

$$I = \frac{2,00,000}{PVAF\ (3\%, 4)} = £53,805$$

Hence, directly we can say -

Premium per period = Lumpsum period ÷ PVAF (r%, n)

VIII) COLLAR STRATEGY (10)

Concept – Option buyer pays premium and seller receives premium.

We want to hedge our risk – say floating rate loan payments. So, we want to buy cap option.

Problem – We do not want to pay any option premium.

Solution – Buy cap (premium outflow) and sell floor (premium inflow) such that -

Premium received = Premium paid → This strategy is known as 'Collar' strategy.

COLLAR STRATEGY FOR

Borrower – Buy cap, Sell floor

Investor – Sell cap, Buy floor

IX) IMP!! SLIPPERY POINT

Most of the times companies' borrowing rate is 'Libor + x%' or 'Mibor + x%' etc.

However, Option contract is almost always entered against Libor or Mibor only (& not Mibor + x%).

Ex: You bought cap option at 7% to hedge interest outflows on your floating rate loan of Libor + 2%.

Find Net payment if Libor on reset date turns out to be 5.6%.

Ans: Now interest rate for company = 5.6% + 2% = 7.6%.

However, payoff under option will '0'. Because cap is purchased at 7% strike against Libor.

And Libor rate is 5.6% only. So, no payoff under cap.

(A lot of students here accidentally compare option strike with Interest rate of co. – which is wrong).

PART C: Interest Rate Swaps (IRS)

1. Swaps

Swap means -> अदला बदली or 'Exchange'

Swaps basically helps you in **REVERSING** your position.

Very informal example – You have Ladoo but wants Jalebi. Your friend has Jalebi but wants Ladoo.

You can enter into a Swap -> Exchange your Ladoo with your friend's Jalebi.

Formal example – 'reversing floating rate to fixed rate' or 'fixed rate to floating rate' using swap.

I) INTEREST RATE SWAPS (IRS)

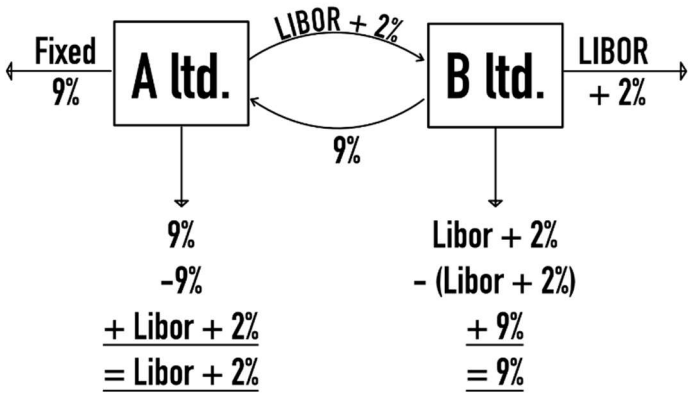
Ex: A ltd. -> Loan of ₹100 crores. Fixed rate = 9%. Period remaining = 5 years. Interest payable bi-annually.

B ltd. -> Loan of ₹100 crores. Floating rate = Libor + 2%. Period remaining = 5 years. Interest = bi-annually.

Now A ltd. wants to convert its fixed loan into a floating rate loan. B ltd. wants fixed rate loan.

Arrange an IRS which will allow both the parties to achieve its desired position.

Ans: Enter into an 5-year IRS against 6-months Libor.



Commentary:

a) Floating leg of swap

A ltd. will pay floating rate under the swap (Libor + 2%) -> This is known as 'floating leg' of swap.

b) Fixed leg of swap

B ltd. will pay fixed rate under swap (9%) -> This is known as 'fixed leg' of swap.

Rate of fixed leg of swap is also known as the **'PRICE OF THE SWAP'**. In this ex: Price of IRS = 9%.

c) Period of swap

Swaps have > 1 period. In above example, we will check '6-months Libor' after every 6-months.

Since this is a 5-year swap, so number of periods in this swap = 2 x 5 = 10 periods.

d) Notional amount of swap = ₹100 crores.

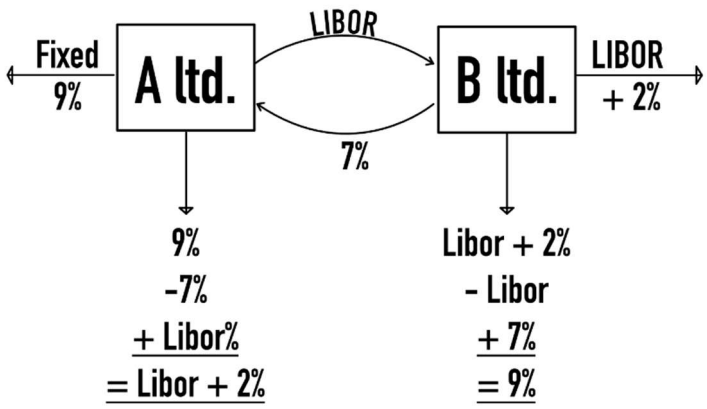
- Notional is never actually exchanged under IRS.
- Only used for the purpose of interest calculation.

e) IRS are always Net settled.

Ex: Let us say that payment under fixed leg = ₹4.5 lacs and payment under floating leg of a swap = ₹4 lacs.

Then it will be net settled. Fixed leg payer pay net ₹50,000 to floating leg payer.

☞ Since payment are always net settled, so I can re-write above swap as:



f) The net effective cost under swap is also known as **'ALL IN COST (AIC)'**

In above ex: All in Cost (AIC) of A ltd. = Libor + 2%

All in Cost (AIC) of B ltd. = 9%

☞ g) **PERIOD OF LIBOR**

Which Libor to take for the purpose of calculation?

If interest is paid every 6-months -> Take 6 months Libor

If interest is paid quarterly -> Take 3 months Libor (and so on...)

h) The above is a 'Plain vanilla swap' (i.e. where one leg is fixed and other leg is floating).

II) USING SWAP TO REDUCE BORROWING COST (16, 19, 21)

Ex: Shinewood Ltd (Sw ltd) can borrow at either fixed rate or at floating rate .

Fixed rate = 8.2%

Floating rate = Libor + 1.5%

Company wants to borrow at fixed rate only. An IRS against is available at a price of 6.5%.

Can it be used to gain any advantage?

Ans: Option 1 – Borrow directly at fixed rate. Effective Cost = 8.2%

Option 2 – Borrow at floating rate and enter into IRS against Libor.

	Floating rate payment	Libor + 1.5%
(-)	Receive Libor under IRS	(Libor)
(+)	Pay fixed 6.5% under IRS	6.5%
	Effective cost (or All in cost) under swap =	8%

Hence, option 2 should be preferred as it leads to lower cost.

2. Some Notes on Interest rate swaps (IRS)

I) DAY COUNT CONVENTION (12,13)

For fixed leg = 30/360

For floating leg = Actual/360

II) BID – ASK SPREAD

Ex: Swap price quoted by bank (i.e. Interest rate of fixed leg) → 7.2% - 7.35%

This means -> If bank has to pay fixed rate, then it will pay 7.2%

If bank has to receive floating rate, then it will receive 7.35% (customer shall 7.35%).

ANOTHER METHOD OF QUOTING SWAP RATES BY BANK

Ex: Swap price = Rf + 120/135 (This 120/135 are basis points)

Say if Rf = 6%, then swap quote = 6% + 1.2% - 6% + 1.35%

= 7.2% - 7.35%

3. Some other types of swaps

I) TOTAL RETURN SWAP (15)

Here total return of an asset is exchanged against the return of another asset / benchmark index etc.

Rest everything is same as IRS.

II) OVERNIGHT INDEX SWAP (OIS) (14a &b)

- This is also a type of Interest rate swap – for very short duration such as 1 week.
- Here, the overnight index rate (floating rate) is exchanged against a fixed rate.
- Imp! Floating rate under OIS is compounded daily. Whereas fixed leg rate is simple interest rate.

4. Swap valuation (22, 23)

Author note – Please revise following areas of 'Bonds' before proceeding with this section

i) Valuation of a floating rate bond (Value on reset date = Par value)

ii) Value of normal bond [Value = PVCI = Interest x PVAF(r%, n) + Principal x PVF(r%, n)]

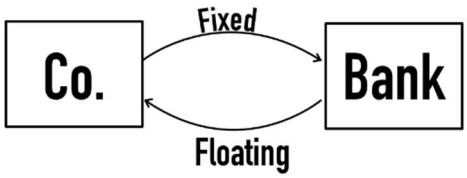
Imp! Do not get confused between the price of Swap and Value of swap!!!

Price of swap = Rate of fixed leg (simple)

Whereas - now we'll learn how to **VALUE** swap.

RECALL: VALUE OF ANY ASSET = PVCI

Ex: Consider a 5-year swap with yearly settlement.



	GENERAL INTERPRETATION	ALTERNATIVE INTERPRETATION
	Co. will pay fixed interest for next 5 years (PVCO)	Co. has issued fixed rate bond of 5 years.
	And	And
	Co. will receive floating interest for 5 years (PVCI).	Co. has invested in floating rate bond of 5 years.

☞ Value of swap for fixed payer (Co.) = PVCI – PVCO = Value of floating bond (V_{FL}) – Value of fixed bond (V_F)

☞ Value for fixed receiver (bank) = PVCI – PVCO = Value of fixed bond (V_F) – Value of floating bond (V_{FL})

5. Comparative Advantage Theory (CAT) (17, 18, 20)

I) CAT – BASIC UNDERSTANDING

Ex:	Fixed rate of borrowing	Floating rate of borrowing
A ltd.	12%	Libor + 5%
B ltd.	16%	Libor + 6.5%
Advantage to A ltd.	4%	1.5%

-> Advantage to A ltd. is not equal in fixed market and floating market.

If this advantage is Not equal -> Then we can use Interest rate swap (IRS) to our benefit.

-> A ltd. has lower interest cost in both fixed and floating market.

i.e. we can say that A ltd. has **ABSOLUTE ADVANTAGE** in both fixed and floating markets.

-> A ltd. has higher advantage in fixed market (4%) as compared to floating market (1.5% only).

i.e. A ltd. has 'Comparative advantage' in fixed market.

B ltd. has 'Comparative advantage' in floating market.

II) CAT – INTUITIVE UNDERSTANDING

A ltd. – Comparative Advantage in fixed market

A ltd – Lion in Fixed market

A ltd. – Dog in floating market

- A ltd. is a sher (Lion) in fixed market (because it has comparative advantage in fixed market).

If A ltd. wants to borrow at fixed rate -> Get the loan directly (on it own). शेर अकेला ही काफी ह |

- But A ltd. is a Dog when it comes to floating market.

If A ltd. wants to borrow at floating rate -> Then it will need someone else's help. (Using IRS)

किसी Floating market के शेर की मदद लेनी पड़ेगी |

B ltd. – Comparative Advantage in floating market

B ltd – Dog in Fixed market

So, it can use IRS to get better rate in fixed market.

B ltd. – Lion in floating market

So, it can borrow directly from floating Market (without anyone's help i.e. No IRS)

III) CAT – EXAMPLE

Ex:	Fixed rate of borrowing	Floating rate of borrowing
A ltd.	12%	Libor + 5%
B ltd.	16%	Libor + 6.5%
Advantage to A ltd.	4%	1.5%

Case A: A ltd. wants to borrow at fixed rate.

B ltd. wants to borrow at floating rate.

Should they enter into an IRS in this case?

Case B: A ltd. wants to borrow at floating rate.

B ltd. wants to borrow at fixed rate.

Should they enter into an IRS in this case? Benefit if any, will be shared equally by both the parties.

Ans: Case A: A ltd. has comparative advantage in fixed market and wants to borrow at fixed rate.

B ltd. has comparative advantage in floating market and wants to borrow at floating rate.

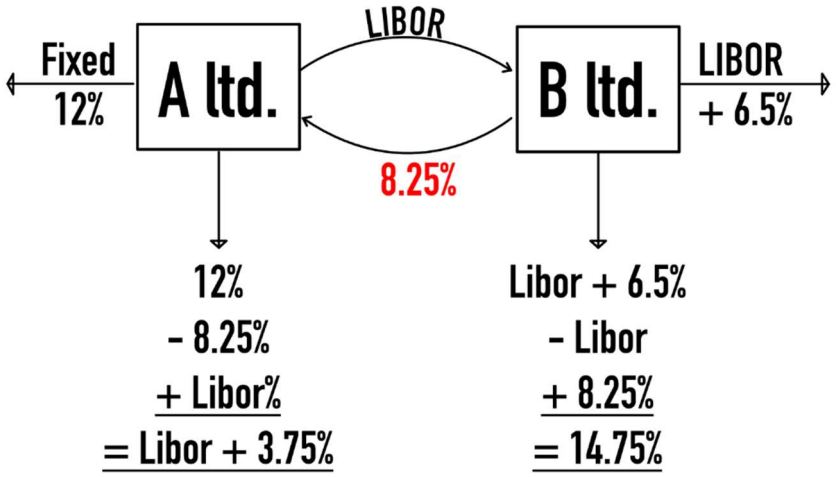
Hence, no need to IRS in such case.

Case B: 1st A ltd. should borrow at fixed rate and B ltd. should borrow at floating rate.

Then -> Enter into an IRS (to achieve the desired fixed / floating position)

Max savings if IRS is entered = Difference b/w advantage in 2 markets = 4% - 1.5% = 2.5%

Benefit per party = 2.5% / 2 = 1.25% (as per ques - benefit must be shared equally).



MOST IMP! – CALCULATION OF PRICE OF FRA

How is the Price of FRA (i.e. fixed leg rate) of 8.25% decided?

Step 1: Calculate effective rate (AIC) of any party under IRS

B's Effective rate under IRS = Fixed rate without IRS – Benefit of swap = 16% - 1.25% = 14.75%

Step 2: Back calculate FRA rate

Effective fixed interest rate of B under IRS = Libor + 6.5% - Libor + FRA rate

14.75% = 6.5% + FRA rate

FRA rate = 8.25%

IV) NOTES

1. The above example did not have any intermediary (like Bank). In case if intermediary is present, then it will also take away some share from the 'benefit of swap'. Let's say bank will charge 0.5% as commission for arranging swap.

   Then Total benefit under swap = (4% - 1.5%) – 0.5% = 2%

   This 2% benefit will be then shared between the two parties.

2. Above example is a way of solving FRA rate under CAT. Other alternatives are also possible.

PART D: Currency Swaps

1. Currency Swaps (Very similar to IRS) (28, 29,30)

IRS -> 1 party has comparative advantage in Fixed market

2nd party has comparative advantage in floating market.

Currency swap -> 1 party will have advantage in one currency say $.

2nd party will have advantage in other currency say ₹.

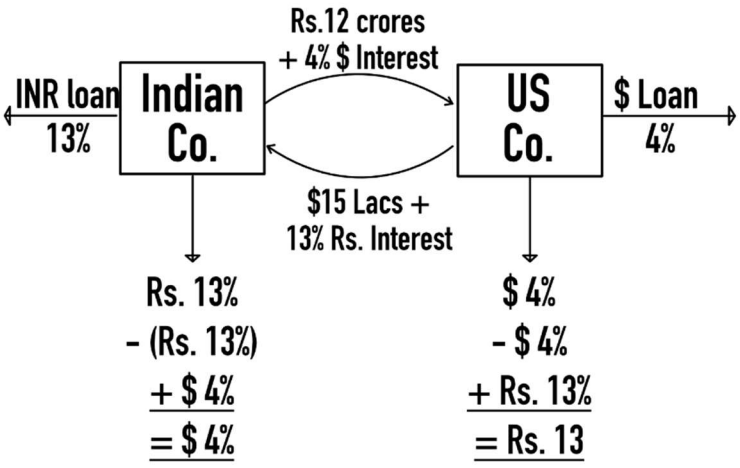
Imp!! – Principal amount (Notional) is actually exchanged in case of currency swap.

Ex: An Indian company wants to invest in US and requires $15 Lacs. On the other hand, a US company wants to invest in India and require ₹12 crores.

Interest rates are	$ borrowing	₹ borrowing
US co.	4%	14%
Indian co.	5%	13%

Can a swap be arranged to benefit both the parties? Current spot rate – 1$ = ₹80.

Ans: Approach to solve this ques is same as a CAT ques. (Only that principal will also be exchanged here).



- US co. will borrow $15 Lacs at 4% and Indian co. will borrow ₹12 crores at 13%.
- The principal will actually be exchanged at the prevailing spot rate.
- i.e. Indian co. will receive $15 Lacs and US co. will receive $15L x 80 = ₹12 crores.

PART E: Interest Rate Futures (IRF)

1. Interest rate futures (IRF)

Stock futures & stock forwards → Almost same.

But forward on interest rates (FRA) & Interest rate futures (IRF) → Very different.

I) UNDERSTANDING IRF QUOTE

IRF are quoted as → 100 – Interest rate

Ex: IRF quote if prevailing interest rate is 4.6% = 100 – 4.6 = 95.4

- If you expect interest rate increase -> IRF price will decrease -> Short futures.
- If you expect interest rate fall -> IRF price will increase -> Long futures.

There is INVERSE relation between IRF price and interest rate.

II) SETTLEMENT OF IRF

Settlement = (IRF sell rate – Buy rate)% x months/12 x Contract value x No. of contracts

Ex: 3-months IRF sold at 94.15. Each contract is for €50,000. Number of contracts shorted = 2000.

Calculate amount paid or received on IRF settlement if interest rate after 3-months turns out to be:

Case I – 4.5% pa. Case II – 6.5% p.a.

Case I: Interest rate = 4.5%. Price of FRA = 100 - 4.5 = 95.5

Settlement of FRA = (94.15 – 95.5)% x 50,000 x 2000 x 3/12 = -0.3375 million

Case II: Interest rate = 6.5%. FRA price = 100 - 6.5 = 93.5

Settlement amount = (94.15 – 93.5)% x 50,000 x 2000 x 3/12 = 0.1625 million

III) HEDGING USING IRF (24)

Borrower -> Afraid of interest rate increasing -> Short IRF

Investor -> Afraid of interest rate falling -> Long IRF

$$\text{No. of contracts} = \frac{\text{Exposure to be hedged}}{\text{Value of 1 lot}} \times \frac{\text{Period of borrowing/Investment}}{\text{Maturity of futures}}$$

If lot size is not given, then assume it to be 2000 bonds.

Ex: A co. intends to borrow €50 Million for 6 months after 3 months. It wants to hedge using IRF.

3-month €50,000 IRF contract maturing in a period of 3 months is quoted at 94.15.

i) Find number of IRF contracts to be traded.

ii) Calculate amount paid or received on IRF settlement if interest rate after 3-months turns out to be:

Case I – 4.5% pa. Case II – 6.5% p.a.

iii) Net interest cost in each of the above case.

Ans: i) Number of Contracts to be shorted

$$\text{No. of contracts} = \frac{\text{Exposure to be hedged}}{\text{Value of 1 lot}} \times \frac{\text{Period of borrowing/Investment}}{\text{Maturity of futures}}$$

$$\text{No. of contracts} = \frac{50 \text{ million}}{50{,}000} \times \frac{6}{3} = \text{Short 2000 contracts}$$

ii) Amount received / (paid) on Settlement of IRF

When rate is 4.5% = 50,000 (94.15 – 95.5)% × 2000 × 3/12 = -0.3375 million

When rate is 6.5% = 50,000 (94.15 – 93.5)% × 2000 × 3/12 = 0.1625 million

iii) Calculating Net Interest cost under IRF (€ million)

Particulars	Case I - 4.5% p.a.	Case II - 6.5% p.a.
• Interest on loan	1.125 50 × 4.5% × 6/12	1.625 50 × 6.5% × 6/12
(+) Paid under IRF	0.3375	(0.1625)
• Net Interest cost	1.4625	1.4625

∴ Interest cost incurred by Co. = (1.4625 / 50) × 12/6 = 5.85%

IV) Relation of IRF Price and Bond price

Interest rate	Bond price	IRF price
Increase	Fall	Fall
Decrease	Rise	Rise

There is DIRECT relation between bond price and IRF price

So, if I want to hedge my bond portfolio, then -

Long bond portfolio -> Short IRF Short bond portfolio -> Long IRF

2. Cheapest to Deliver (25)

IRF can be settled by (i) Net settlement (ii) Physical delivery

I) MECHANISM OF PHYSICAL DELIVERY

- Short must deliver bond to Long. Short can deliver any bond from a basket of deliverable bond.

Ex – Let us say that any of the following bonds can be delivered by the Short

Bond 1 -> Coupon 7%

Bond 3 -> Coupon 8%

Bond 2 -> Coupon 6.5% → Short will select Bond 3 as it will be cheapest.

But this facility is not favourable for long. So, a concept of conversion factor is introduced.

II) CONVERSION FACTOR

Amount paid by long will depend on the quality of bond delivered by Short.

i.e. Amount paid by long = Futures price (F) x Conversion factor (CF)

III) CHEAPEST TO DELIVER - CTD

CTD Bond = The bond that allows short to earn maximum profit or minimize loss.

2 ways to find CTD bond -

Method 1 - Calculate profit / (loss) under each bond delivery – and find CTD.

P&L of Short = Amount received (F x CF) – Price of bond

Method 2 - CTD = Spot rate of bond / Conversion factor

3. Calculation of mark to margin (27)

This concept is same as 'Stock futures'. Hence, not covered again.

Chapter 13

Corporate Valuation

Chapter Index

PART A – Valuation of a Company
PART B – EVA, MVA

---- Student's Space for Summary chart and notes ----

PART A: Valuation of a company

1. Chapter overview

 # INTRODUCTION – VARIOUS METHODS OF CORPORATE VALUATION

a)	Profit Capitalization Method	d)	Cash flow per (share) basis
b)	DCF Method (Value of Co = PVCI)	e)	Chop – Shop Method (theoretical)
c)	NAV Method	f)	Relative valuation

COMMON SHORT-FORMS:

FCFF – Free cash flows for Firm	FCFE – Free cash flows for equity
V_F or V_O – Value of entire Firm	V_E – Value of equity
K_O – Overall cost firm	K_E – Cost of equity
V_D – Value of debt	K_D – Cost of debt

2. Profit capitalization method (9a & b, 10)

Value under profit capitalization method = PV of FMP = $\frac{\text{Post-tax FMP}}{\text{Capitalization rate}}$

* FMP = Future maintainable profits

1) CALCULATION OF FMP

PRE-TAX	Current year profits or Average profits of past-years		xxx
Add:	Extra-Ordinary Expenses or losses / non-recurring expenses		xxx
	Any increase in future profits (ex. new product)s		xxx
	Any decrease in future expenses		xxx
Less:	Extra-Ordinary Incomes / Non-recurring income & gains		(xxx)
	Any increase in future expenses (ex. new product)		(xxx)
	Decrease in future income		(xxx)
		FMP before tax =	xxx
Less: Tax expected to be paid in future			(xxx)
		FMP after tax =	xxx

II) Different types of Costs

1. Irrelevant or sunk cost – Ignore. No role in future decision making. Ex: R&D cost, product designing etc.
   Do not subtract while calculating FMP. If already subtracted, then add back.
2. Allocated fixed cost – Not to be subtracted. (Add back if already subtracted).
3. Additional fixed cost – It is subtracted while calculating FMP.
4. Opportunity cost – Subtract while calculating FMP.
   Ex: Machinery currently rented out. Rental income = ₹2 lacs per annum.
   Now it will be used in an internal project. ∴ Rental income forgone = Opportunity cost = ₹2 lacs p.a.

3. Discounted Cash Flow Approach (1 to 8)

- Value of Co. as per DCF = PVCI. Two approaches --> FCFE approach & FCFF approach.

I) Free Cash Flows to Equity (FCFE) APPROACH

Directly calculate Value of Equity (V_E) = PV of FCFE.

Discount rate to be used = Cost of equity (K_E).

Calculating FCFE (Free cash flows to EQUITY)

Concept – Subtract all payments to every long-term capital provider such as debt, preference shares etc.

	Sales			xxx
(-)	Operating Expenses (other than dep^n. & amortization)			xx
			EBIDTA =	xxx
(-)	Depreciation & Amortization			(xx)
(-)	Interest			(xx)
			PBT =	xxx
(-)	Tax			xxx
			PAT =	xxx
(+)	Add back: Non cash expenses like Depreciation, amortization			xx
(-)	Cash outflow: Capex, Increase in Working capital	xxx		
	Payment of preference dividend	xxx		
	Repayment of debt or Preference capital	xxx		(xxx)
(+)	Cash inflow: Sale of capital asset (Net of tax)	xxx		
	Decrease in working capital	xxx		
	Amount raised via debt or pref. capital	xxx		xxx
			FCFE =	xxx

II) Free Cash Flows to Firm (FCFF) APPROACH

Calculate **VALUE OF FIRM** (V_F or V_0) -> PV of FCFF.

Discount rate to be used = Ko = Weighted average cost of capital.

Value of equity (V_E) = Value of Firm (V_o) – Value of Debt (V_D)

Calculating FCFF

Concept – Almost same as FCFE. But while Calculating FCFF we do not consider any amount received or paid to providers of Long term Capital such as debt / loan, preference shares etc.

	Sales			xxx
(-)	Operating Expenses (other than depⁿ. & amortization)			xx
			EBIDTA =	xxx
(-)	Depreciation & Amortization			(xx)
			EBIT =	xxx
(-)	Tax			xxx
			NOPAT =	xxx
(+)	Add back: Non cash expenses like Depreciation, amortization			xx
(-)	Cash outflow: Capital expenditure	xxx		
	Increase in working capital	xxx		xxx
(+)	Cash inflow: Sale of capital asset (Net of tax)	xxx		
	Decrease in working capital	xxx		xxx
			FCFE =	xxx

4. DCF – Notes

I) WEIGHTED AVERAGE COST OF CAPITAL (K_0) (17a & b)

2. Ko = Ke.We + Kd.Wd + Kp.Wp

Where: Ke = Cost of equity = Rf + (Rm – Rf).Beta

Kd = Cost of debt = Interest x (1 – tax)

Kp = Cost of preference share capital = Rate of preference dividend (if no other info given)

Order of preference -> 1. Market value weights

2. Book value weights (only if MV are not available).

Q: Should reserve & surplus be added while calculating weight of equity?

A: If using MV weights -> Directly take MV of equity. (no need to add R&S)

If using BV weights -> BV of equity = PUSC + R&S (i.e. R&S added while cal. BV)

II) SET-OFF IMPACT WHEN DEPRECIATION = CAPEX

Ex: Find cash flow if Net profit (NP) = ₹5L. Depreciation = ₹80,000 and capex = ₹80,000.

Ans:

NP =	5,00,000
(+) Depreciation =	80,000
(-) Capex =	(80,000)
Cash Flow =	5,00,000

Hence, when depreciation = capex, it offsets each other.

- NP = CFs (assuming no other items).

III) DEPRECIATION ALREADY INCLUDED IN COGS (OR OPERATING EXPENSES)

Don't subtract again while calculating taxable profits. But add back when calculating CFs.

Ex:

Sales =		₹50,000	
(-)	COGS (including Depreciation of ₹10,000)	₹30,000	→ No need to subtract depreciation again.
	Operating Profit =	₹20,000	(as ₹10,000 is already included in COGS)
	PAT = Operating profit x (1 – tax)	₹7,000	

But while calculating CFs -> Add back (as it is a non-cash expense) -> 7,000 + 10,000 = 17,000

IV) CALCULATING NOPAT FROM NP

Ex:

	EBIT	5,00,000
(-)	Interest	(1,00,000)
=	EBT	4,00,000
(-)	Tax @ 30%	1,20,000
=	Net profit	2,80,000

NOPAT = NP + Interest (1 - tax)

NOPAT = 2,80,000 + 1,00,000 (1 – 0.3) = ₹3,50,000

V) NOTES – Cash Flow

- Increase in CA -> Cash outflow — Increase in CL -> Cash inflow
  Decrease in CA -> Cash inflow — Decrease in CA -> Cash outflow

- If you encounter any new item in question (i.e. which is not included in above format):
  Use common sense, i.e. If Cash inflow -> Add, if that item leads to cash outflow -> Subtract.

5. Concept of Gross and Net investment

I) DEPRECIATION = FUND FOR INVESTMENT

Depreciation acts as a fund that can be used for purchasing new assets.

Ex:

		Depⁿ not charged	Depreciation charged	
	Revenue	5L	5L	
(-)	COGS	(2L)	(2L)	
	Operational Profit =	3L	3L	
(-)	Depreciation	Nil	(1L)	₹1L is automatically saved in business for future investment
	Net Profit =	3L	2L →	

-> (Continuing with above ex.) Let us say we want to invest ₹1.5 Lacs in fixed assets. (Gross Investment)
₹1L is already available in business (which is saved as depreciation).
New cash required = ₹1.5L – ₹1L = ₹50,000 (Net investment)

Net Investment (NI) = Gross Investment (GI) – Depreciation

This is required to be financed by Equity or debt etc.	Total amount Required	Amount available internally as depⁿ.

I) GROSS INVESTMENT (GI)

* Gross investment (GI) = Capex + Increase in working capital
- If Decrease in WC -> Subtract it from GI.
  Alternatively, details about CA/CL may be given. Adjust accordingly.
  (Ex: Increase in CA -> Add, Increase in CL -> Minus ...)

III) NI MAY BE FINANCED VIA DEBT OR EQUITY

Ex: (Continuing with above ex.) Evaluate the impact on FCFE if the Net investment of ₹50,000 is:

Case A – Financed wholly by Equity

Case B – Financed wholly by Debt

Case B – Financed 60% by equity and balance by via.

Ans:

	Particulars	A. 100% Equity	B. 100% debt	B. 60% Equity
	Net profit	2,00,000	2,00,000	2,00,000
(-)	Net investment	(50,000)	(50,000)	(50,000)
(+)	Amount raised via debt	-	50,000	20,000
	FCFE =	1,50,000	2,00,000	1,70,000

or directly,

FCFE = NP – Net investment of equity

IV) CAPITAL EMPLOYED CONCEPT (13a & b)

(Same as above, i.e. FCFE = NP – NI of equity. Just that here we are taking things on per share basis.)

Step 1: Calculate FCFE on per share basis

	EPS	xxx
(-)	Net investment per share x % of equity	(xxx)
	CF per basis for equity:	xxx

Step 2: Value of share = $\frac{CF_1}{Ke - g}$

6. NAV method (11)

Value as per NAV = $\frac{\text{Net assets}}{\text{No. of shares}} = \frac{\text{Total assets (-) External liabilities}}{\text{No. of shares}}$

1. Take Market Value (MV) of assets and liabilities. If MV is not available, then take Book value.
2. Debenture, preference shares & unpaid preference dividend are a part of external liability.
3. Contingent liability if any should also be subtracted.

7. Chop-Shop Method (14)

Calculate the "Fair capital required" for a business by using Industry average figures .

Ex: Industry average of capital to sales ratio = 0.4. Sales of a company = 10 Lacs. Find fair capital required.

Ans: $\frac{\text{Capital}}{\text{Sales}} = 0.4$ => $\frac{\text{Capital}}{10L} = 0.4$ => Capital = 0.4 x 10 = ₹4 lacs

II) STEPS TO SOLVE UNDER CHOP-SHOP

Under this method we will be given different ratios for each department / Business unit.

1. Calculate value of each department using different given ratios.
2. Final value of department = Average of all the different values
3. Final value of company = Sum Total of Value of all the departments

8. Relative Valuation or Comparables (15, 16)

Find average industry ratios using other companies' data (it will be given in ques)

Use these average ratios to calculate the market value of company.

Ex: Shiporbit ltd. have total sales of ₹10 crores.

There are two other companies in the same industry and with similar product-mix. Details are:

	Sales	Market value
Company A	20 crores	16 crores
Company B	30 crores	21 crores

Calculate market value of Shiporbit ltd. using comparables method. Use Market to Sales ratio.

Ans:

Particulars	Co. A	Co. B	Average
Market Value to sales ratio	16/20 = 0.8	21/30 = 0.7	(0.8 + 0.7)/2 = 0.75

For Shiporbit:

$0.75 = \frac{\text{Market value}}{\text{Sales}} = \frac{\text{Market Value}}{10 \text{ crores}}$

Market Value = ₹7.5 crores

9. Impact of new project on company's Value (20)

Value of co. (as per DCF) = PV of Net cash inflows

or in more refined terms, I can say ->

Value of co. = Net PV (NPV) of its projects

- So, when a new project with positive NPV is taken, then

New value of co. = NPV of existing projects + NPV of new project

Ex: Existing value of company = ₹100 crores.

A new project is undertaken by the co. PV of expected cash flows from new project = ₹15 crores.

PV of cash outflow = ₹5 crores. Find new value of co.

Ans: NPV of new project = 15 – 5 = ₹10 crores

New value of company = Existing value + NPV of new project

= 100 + 10 = ₹110 crores

2. Special case – Raising money via Equity

Every decision and project of co. involves some cash inflows and cash outflows.

However, there is 1 exception → Raising money via equity.

Amount raised **(NET OF FLOATATION COST)** = Cash inflows

But cash outflows = ₹0. Because when we raise money equity, then there is no liability of any cash outflow.

Hence, raising money via equity directly increase value of company.

New value of co. = Existing value + Amount raised via equity (Net of floatation cost)

10. Enterprise value (EV) / Total enterprise value (TEV) / Firm value

EV represents the Market value of the business.

- EV = MV of equity + MV of debt + MV of pref. shares + MV of minority (-) Cash & cash equivalents
- Core EV or Operating EV = Total EV (-) Non-operating assets

1) EV MULTIPLE

$$\text{EV Multiple} = \frac{\text{EV}}{\text{EBITDA}}$$

EBITDA = Net **OPERATING INCOME** from **CONTINUING OPERATIONS** (+) Tax (+) Interest (+) Depreciation

* Adjusted EBIDTA -> If past EBITDA is given in ques, then should be adjusted for any future changes such as – extraordinary income/expense etc. (just like we adjust future maintainable profits).

More on FMP adjustment in 'Corporate valuation' chapter.

SOME OTHER SIMILAR RATIOS

- Price / EBITDA ratio = $\frac{\text{Price per share}}{\text{EBITDA per share}}$

- EV / Sales multiple = $\frac{\text{EV}}{\text{Sales}}$

PART B: EVA, MVA

1. EVA – Economic Value Added (23 to 31)

EVA helps us in evaluating a company's financial performance.

Co. generates 'value' only if returns > cost of capital invested.

EVA = NOPAT – (WACC x Invested capital)

I) CONCEPT OF ECONOMIC ASSETS UNDER EVA

- Marketing exp, Patents, copywrites etc -> These are not expense but rather **ECONOMIC ASSETS.**
- Do not write off these expenses in P&L.
- These become part of 'Invested capital'.
- Depreciation is provided on these Economic assets. This depreciation is deducted from P&L.
- Depreciation to be provided on the basis of 'Economic life' of asset.

II) NON-CASH EXPENSES ARE NOT EXPENSES

Non-cash expenditure (other than depreciation & amortization) is not treated as expenditure by EVA.

So, add back any such non-cash expense given in ques. Ex: Provision for doubtful debt (PFDD).

III) NOPAT CALCULATION

EBIT (1 – tax)

(+) Any non-operating income (net of tax)

Ex: Interest received from marketable securities

(+) Non-cash expenditure (other than depreciation & amortization)

Ex: Any provision for doubtful debt **MADE DURING THE YEAR**

(+) Remaining value of any economic asset (which otherwise is fully written off)*

IV) WACC

WACC = Weighted average Cost of Capital = Ke.We + Kd.Wd + Kp.Wp

3.	**INVESTED CAPITAL**	(= CE + Some EVA adjustments)
	Capital employed (CE) as per Balance sheet (Note below)	xxx
(+)	Non-cash liabilities & provisions – Ex: Provision for doubtful debts	xxx
(+)	Market value / Economic value of assets not included in balance sheet – Ex: Patents	xxx
(-)	Market value of liabilities not included in balance sheet	(xxx)
(-)	Non-operating assets – Ex: Investment property	(xxx)
(-)	Assets without any economic value (unamortized floatation cost, P&L debit balance etc.)	(xxx)
	Invested capital =	xxx

IV) CAPITAL EMPLOYED

From assets side -> Total assets (-) Current liabilities, provisions etc.

From Liabilities side -> Equity Share capital + Reserve & surplus + Pref. Share capital + Long term debt

2. Market Value Added (MVA) (32, 33)

MVA = MV of Firm – Capital employed

or MVA = MV of equity – Book value of equity

3. Notes

1. EVA Dividend = $\frac{\text{EVA}}{\text{No. of shares}}$

2. Financial leverage of company = $\frac{\text{EBIT}}{\text{EBT}}$ or $\frac{\text{EBIT}}{\text{EBIT} - \text{Interest}}$

Chapter 14

M&A

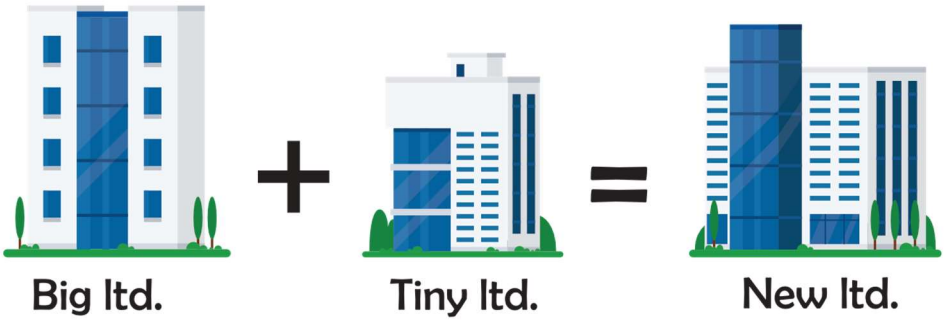
Chapter Index

PART A – Basics of M&A
PART B – Calculating SER
PART C – Tiny Topics

---- Student's Space for Summary chart and notes ----

PART A: Basics of M&A

1. Introduction



I) DIFFERENCE BETWEEN MERGER & ACQUISITION

Merger → Vodafone + Idea = Vodafone Idea

Acquisition = Facebook → WhatsApp = Facebook

II) WHY COMPANIES MERGE? (SYNERGY)

Merger often leads to benefit of synergy.

When companies merge, they can expect higher profits (due to synergy). This can be due to

a. Reduced operational costs.

b. Increase in revenue.

Note: General tone for examples in this chapter:

Big ltd will acquire Tiny ltd. The new entity will be called New ltd.

III) SYNERGY TYPE 1 – SYNERGY IN EARNINGS

i.e. Increase in earnings due to merger.

Ex: Earnings of Big ltd (E_{Big}) = ₹500. Earnings of Tiny ltd (E_{Tiny}) = ₹200. Increase in Earnings due merger = ₹ 100

New total earnings = 500 + 200 + 100 = 800

Ex: Earnings of Big ltd (E_{Big}) = ₹500. Earnings of Tiny ltd (E_{Tiny}) = ₹200. Increase in Earnings due to merger = 10%

New total earnings = 500 + 200 + (500 + 200)x10% = ₹770

IV) SYNERGY TYPE 2 – SYNERGY IN MARKET VALUE

i.e. Increase in Market value due to merger.

Ex: MV of Big ltd (E_{Big}) = ₹10,000. MV of Tiny ltd (E_{Tiny}) = ₹6,000. Increase in MV due to synergy benefits = ₹1500

New total MV = 10,000 + 6,000 + 1,500 = ₹17,500

Ex: MV of Big ltd (E_{Big}) = ₹10,000. MV of Tiny ltd (E_{Tiny}) = ₹6,000. Increase in MV due to synergy benefits = 20%

New total MV = 10,000 + 6,000 + (10000 + 6000)×20% = ₹19,200

2. Modes of Acquisition

I) CASH ACQUISITION

- Cash will be paid to SHs of Tiny ltd.
- No new shares are issued in this case.
- Amount of cash to be paid to the SHs of Tiny ltd will be given in question.
- ***Number of shares in New Ltd. = Number of shares in Big ltd.***

II) SHARE ACQUISITION

- Shares of New entity will be issued to SHs of Tiny ltd.
- New shares are issued in this case as per swap ratio (also known as share exchange ratio)
- Swap ratio (Share exchange ratio) - (a) Maybe given directly in question
  (b) We may need to calculate SER.
- $N_{New} = N_{Big} + N_{Tiny} \times SER$

Ex: Big ltd is planning to acquire Tiny ltd. The proposed swap ratio / Share exchange ratio (SER) is 0.5:1.

Number of shares in Big ltd. (N_{Big})= 20,000 and in Tiny ltd (N_{Tiny}) = 10,000.

Ans: This means that Big ltd. (acquirer) will issue 0.5 shares for every 1 share in Tiny ltd. (target).

Big ltd. will issue = 10,000 x 0.5 = 5,000 shares.

Total number of shares in new entity (N_{New}) = 20,000 + 5,000 = 25,000

or directly – $N_{New} = N_{Big} + N_{Tiny} \times SER$ = 20,000 + 10,000 x 0.5 = 25,000

3. Some Imp post-Merger figures

I) TOTAL EARNINGS OF NEW ENTITY (E_{NEW})

E_{new} = Earnings of Big (E_{Big}) + Earnings of Tiny (E_{Tiny}) + Synergy benefits

Ex: Earnings of Big ltd (E_{Big}) = ₹50L. Earnings of Tiny ltd (E_{Tiny}) = ₹20L.

Benefits of synergy i.e. increase in earnings due to merger = ₹10L. Find total earnings of New Ltd (E_{New}).

Ans: E_{new} = 50L + 20L + 10L = ₹80 lakhs

II) EPS OF NEW LTD (EPS_{NEW}) OR EPS OF MERGED ENTITY

$$EPS_{new} = \frac{\text{Total earnings after Merger}}{\text{Total number of shares after Merger}}$$

$$EPS_{new} = \frac{E_{Big} + E_{Tiny} + Synergy}{N_{Big} + N_{Tiny} \times SER}$$

Ex: Number of shares of Big ltd = 500, Earnings of Big ltd = 10,000

- Number of shares of Tiny ltd = 400, Earnings of Tiny ltd = 6,000
- Find EPS after Merger if SER = 0.5:1 & Synergy = 1500.

Ans: EPS after merger i.e. $EPS_{New} = \frac{10,000 + 6,000 + 1500}{500 + 400 \times 0.5}$ = ₹25 per share

III) MPS & Market Value (MV) – WHEN PE RATIO IS GIVEN

- $MPS_{New} = EPS_{New} \times PE_{New}$
  $MV_{new} = MPS_{New} \times N_{New}$

- If EPS_{New} is not directly given, then calculate it using above concepts.
- PE ratio of merged entity (a) If is given specifically -> Use that
  (b) If nothing specific is given -> Use existing PE ratio of Big ltd.

Ex: Find MPS & total MV of New ltd. if EPS of New ltd. is expected to be ₹30 and PE ratio of New ltd. = 12.

Total number of shares in merged entity = 20,000.

Ans: MPS_{New} = 30 x 12 = ₹360

Total MV = $MPS_{New} \times N_{New}$ = 360 x 20,000 = ₹72 Lacs

IV) MPS & MV – When MV of Big & Tiny are given (But PE Ratio Is Missing)

- $MV_{new} = MV_{Big} + MV_{Tiny}$ + Increase in MV due to synergy
- $MPS_{New} = \frac{\text{Total MV after merger}}{\text{Total Number of shares after merger}} = \frac{MV_{Big} + MV_{Tiny} + Synergy}{N_{Big} + N_{Tiny} \times SER}$

Ex: MV of Big ltd (MV_{Big}) = 50,000. MV of Tiny ltd (MV_{Tiny}) = 30,000. Synergy = 5,000. Find MV of New ltd (MV_{New}).

Ans: MV_{new} = 50,000 + 30,000 + 5,000 = 85,000

Ex: Calculate MPS_{new} if MV_{Big} = 40L, N_{Big} = 10,000. MV_{Tiny} = 15L, N_{Tiny} = 8,000. Synergy = 5L. SER = 0.625:1.

Ans: $MPS_{new} = \frac{40 \text{ lakhs} + 15 \text{ lakhs} + 5 \text{ lakhs}}{10{,}000 + 8000 \times 0.625} = 400$

NOTES:

1. Answers from different methods can differ.
2. If PE ratio is given in ques (or any hint related to PE ratio is given), then use $MV_{new} = MPS_{New} \times N_{New}$

V) EQUIVALENT MPS OF TINY LTD.

Equivalent MPS_{Tiny} = MPS_{New} x SER

Ex: MPS of new ltd = ₹60. SER = 0.6:1. Find equivalent MPS of Tiny ltd..

Ans: Equivalent MPS = 60 x 0.6 = ₹36

Understanding the above:

If I had 10 shares of Tiny ltd. After merger, I will receive 6 shares of New ltd. (as SER = 0.6:1).

MPS of New ltd = ₹60. My total value of shares in New ltd. = 6 x 60 = 360.

i.e. I got ₹360 worth of shares in New ltd. against my 10 shares in Tiny ltd.

or I can say my Equivalent MPS = 360/10 = ₹36

VI) EQUIVALENT EPS OF TINY LTD.

Equivalent MPS = MPS_{New} x SER

Ex: EPS of New ltd. = ₹15. SER = 0.4 : 1. Find Equivalent EPS.

Ans: Equivalent EPS = 15 x 0.4 = ₹6

PART B: Calculating SER

1. 3 Ways of calculating SER

I) ON THE BASIS OF – EPS, MPS, BVPS, NAV ETC.

SER = EPS of Tiny ÷ EPS of Big

Similarly, for MPS, BVPS, NAV etc. i.e. SER = $\frac{\text{MPS or BPVS or NAV of Tiny}}{\text{MPS or BVPS or NAV of Big}}$

Ex: EPS of Big ltd = ₹20. EPS of Tiny ltd = ₹10. What should be the SER?

Ans: SER = $\frac{10}{20} = \frac{1}{2} = 0.5:1$

II) ON THE BASIS OF – WEIGHTS

SER in this case = Weighted average of various SERs. Details will be given in ques.

Ex: Find SER if the weights of EPS, MPS & NAV are 30%, 50% & 20% respectively. Details are:

Particulars	Big ltd.	Tiny ltd.
EPS	20	5
MPS	800	500
NAV	600	300

Ans: Calculation of SER on the basis of:

- EPS = $\frac{EPS_{Tiny}}{EPS_{Big}} = \frac{5}{20} = 0.25:1$

- MPS = $\frac{MPS_{Tiny}}{MPS_{Big}} = \frac{500}{800} = 0.625:1$

- NAV = $\frac{NAV_{Tiny}}{NAV_{Big}} = \frac{300}{600} = 0.5:1$

SER = 0.25 × 30% + 0.625 × 50% + 0.5 × 20% = 0.4875:1

III) WEIGHTS IN CASE OF A 'BAD' RATIO

EPS, MPS, BVPS, NAV etc. -> These are all good ratios i.e. we want these to be High.

But sometimes a negative ratio may be given in ques such as Gross NPA ratio (GNPA).

We informally call it a bad ratio because we want GNPA to be less.

SER in such cases (of bad ratios) = $\frac{\text{Bad ratio of Big}}{\text{Bad ratio of Tiny}}$

Ex: GNPA of Bank A is 10% whereas GNPA of bank B is 40%. What should be SER based on GNPA?

Ans: SER = $\frac{\text{GNPA of Bank A}}{\text{GNPA of Bank B}} = \frac{10}{40} = 0.25:1$

2. 4 Special cases of calculating SER

Buyer ⟷ Seller

(Acquirer co. i.e. Big ltd.) DEAL (Target co. i.e. Tiny ltd.)

	Buyer (Acquirer Co. i.e. Big ltd.)	Seller (Target co. i.e. Tiny ltd.)
-	Has a **MAXIMUM** price in mind	Has a **MINIMUM** price in mind
-	i.e. is price se jada pay nhi karunga	i.e. ki is se kam to ek paisa bhi nhi lunga
-	Sometimes condition is put by Acquirer co. (Big ltd.)	Sometimes condition is put by Seller co. (Tiny ltd.)
-	Such conditions decide Maximum SER.	Such conditions decide Minimum SER.
-	(i.e. Big ltd. will not pay anything more than this)	(i.e. Tiny ltd. will not accept anything less than this)

SCENARIO 1: CONDITIONS PUT BY ACQUIRER CO. IT WILL DECIDE THE **MAXIMUM** NUMBER OF SHARES THAT ACQUIRER IS WILLING TO GIVE TO TARGET CO.

1) CONDITION TYPE 1 – SHs of Big ltd. does not want to sacrifice on their current EPS

$$EPS_{Big} = EPS_{New}$$

$$EPS_{Big} = \frac{E_{Big} + E_{Tiny} + Synergy}{N_{Big} + N_{Tiny} \times SER}$$

Ex: Total earnings of Big ltd. (E_{Big}) = 2500, Total earnings of Tiny ltd. (E_{Tiny}) = 500, Synergy benefits = 500

Number of Shares of Big ltd (N_{Big}) = 1000 shares, Number of Shares of Tiny ltd (N_{Tiny}) = 600 shares

Find the SER or Swap ratio is SHs of Big ltd. do not want to sacrifice on their current EPS.

Ans: $EPS_{Big} = 2500/1000 = 2.5$

-- $$EPS_{new} = \frac{E_{Big} + E_{Tiny} + Synergy}{N_{Big} + N_{Tiny} \times SER}$$

$$2.5 = \frac{2500 + 500 + 500}{1000 + 600 \times SER}$$

$1000 + 600 \times SER = 3500/2.5$

$SER = 0.6667 : 1$

II) CONDITION TYPE 2 – SHs of Big ltd. does not want to sacrifice on their current MPS

$MPS_{Big} = MPS_{New}$

$$MPS_{Big} = \frac{MV_{Big} + MV_{Tiny} + Synergy}{N_{Big} + N_{Tiny} \times SER}$$

Ex: MV of Big ltd (MV_{Big}) = 16,000 ; MV of Tiny ltd (MV_{Tiny}) = 5,000

Benefits of synergy i.e. increase in MV due to merger = 3,000

Number of Shares of Big ltd (N_{Big}) = 800 shares ; Number of Shares of Tiny ltd (N_{Tiny}) = 500 shares

-- Calculate the SER if SHs of Big ltd. do not want to sacrifice on their current MPS.

Ans: $MPS_{Big} = MPS_{New}$

$$\frac{16000}{800} = \frac{16,000 + 5000 + 3000}{800 + 500 \times SER}$$

$$20 = \frac{24000}{800 + 500 \times SER}$$

$800 + 500 \times SER = 24000/20$

$SER = 0.8:1$

SCENARIO 2: CONDITIONS PUT BY SELLER CO. IT WILL DECIDE THE **MINIMUM** NUMBER OF SHARES THAT TARGET CO. IS WILLING TO ACCEPT.

III) CONDITION TYPE 3 – SHs of Tiny ltd. does not want to sacrifice on their current EPS

Quite similar to condition type 1, but with one important difference.

We need **EQUIVALENT** EPS of Tiny ltd. in this case.

☞ EPS_{Tiny} = Equivalent EPS in Merged firm

$EPS_{Tiny} = EPS_{New} \times SER$

$$EPS_{Tiny} = \frac{E_{Big} + E_{Tiny} + Synergy}{N_{Big} + N_{Tiny} \times SER} \times SER$$

Ex: Cal. minimum SER that Tiny ltd. will accept if it does not want to sacrifice on their current EPS.

Earnings of Big ltd (E_{Big}) = ₹28,000 ; Earnings of Tiny ltd (E_{Tiny}) = ₹14,000 ; Benefits of synergy = ₹7,000

Number of Shares of Big ltd (N_{Big}) = 2000 shares ; Number of Shares of Tiny ltd (N_{Tiny}) = 1000 shares

Ans: EPS_{Tiny} = Equiavlent EPS of New ltd.

$$\frac{14000}{1000} = \frac{28000 + 14000 + 7000}{2000 + 1000 \times SER} \times SER$$

$$14 = \frac{4900 \times SER}{2000 + 1000 \times SER}$$

$$2000 + 1000 \times SER = \frac{49000 \times SER}{14}$$

SER = 0.8:1

IV) CONDITION TYPE 4 – SHs of Tiny ltd. does not want to sacrifice on their current MPS

Need EQUIVALENT MPS of Tiny ltd. in this case.

☞ MPS_{Tiny} = Equivalent MPS in Merged firm

$MPS_{Tiny} = MPS_{New} \times SER$

Note - Calculation of MPS_{New} is already before. Refer that section in case of any doubt.

PART C: Tiny Topics

1. Gain / loss due to Merger

	Equivalent EPS / MPS after merger	xxx
(-)	EPS / MPS before merger	(xxx)
	Gain / loss due to merger	xxx

Note: If ques asks to calculate gain or loss to SHs, then should we calculate it in EPS terms or in MPS terms?

☞ The answer will depend upon the framing of the ques. If ques is centric around EPS, then in EPS terms. or if ques is centric towards MPS, then calculate in MPS terms.

Ex 18: $Earnings_{Big}$ = 500, $Earnings_{Tiny}$ = 200, N_{Big} = 100, N_{Tiny} = 50. SER = 0.6:1. Synergy benefits = 80. Calculate gain or loss to the SHs of both the companies.

Ans: $EPS_{New} = \frac{500 + 200 + 80}{100 + 50 \times 0.6} = 6$

#	Calculating Gain or loss to SHs	Big ltd.	Tiny Ltd.
	Equivalent EPS / MPS after merger	6	6 x 0.6 = 3.6
(-)	EPS / MPS before merger	(5)	(4)
	Gain / (loss) due to merger	1	(0.4)

2. Cash Takeover / Leveraged Buyout

i) Source of cash = Borrowed funds

Deduct Interest (after tax) on such borrowed funds from the earnings of the merged entity.

ii) Source of cash = Business itself

The income lost (post tax) due to cash purchase (i.e. opportunity cost of cash) will be deducted from the earnings of the merged entity.

Ex: Earnings of Big ltd = 5000 and that of Tiny ltd is 3000. Big ltd is planning to acquire Tiny ltd. Consideration of ₹15000 will be paid in cash to Tiny ltd. Find the earnings of the merged entity if tax = 30%.

Case i) Cash is borrowed from a bank at an interest rate of 10%.

Case ii) Big ltd. already has surplus cash, which is current invested at 7%.

Ans: Case i) Funds are borrowed at 10%

Earnings of Big ltd.	5000
Earnings of Tiny ltd.	3000
Less: Post tax interest – 15000 x 10% x (1-0.3)	(1050)
Earnings of Merged Entity	6950

Case ii) Surplus Funds are invested at 7%

Earnings of Big ltd.	5000
Earnings of Tiny ltd.	3000
Less: Earnings lost – 15000 x 7% x (1-0.3)	(735)
Earnings of Merged Entity	7265

3. Percentage Holding in New Ltd.

Ex: Number of shares of Big ltd. = 20,000 ; Number of shares of Tiny ltd. = 10,000

SER = 0.5:1. Find percentage holding in new holding.

Ans: Number of shares issued to Tiny ltd = 10,000 x 0.5 = 5,000

Total number of shares of New ltd. = 20,000 + 5,000 = 25,000

Big ltd = 20,000/25,000 = 80%

Tiny ltd. = 5,000/25,000 = 20%

Using similar logic, you can also find percentage of promoter holding in New ltd.

4. Net or True cost of merger

Net Cost of merger = What is paid – What is received.

I) CASH TAKEOVER

Net Cost = Cash paid – MV of Tiny Ltd. received.

II) SHARE TAKEOVER

Net Cost = MV of merged co. given to Tiny ltd – MV of Tiny ltd received

5. When g or CFs changes under New Management

I) WHEN GROWTH RATE (g) CHANGES UNDER NEW MANAGEMENT

1. For calculating post-merger MV --> Use value based on new growth rate (like MPS of Tiny with new 'g')
2. For calculating benefits to SHs of Tiny ltd --> Use their old growth rate only.
3. This increase in value (due to increased growth rate under management) = Benefits of synergy

Ex: MV of Big ltd. = ₹3600.

MV of Tiny ltd. under old management (at current growth rate) = ₹480

MV of Tiny ltd. under new management (at increased growth rate) = ₹960

-> Hence, we will try to negotiate with Tiny ltd. at a minimum value of ₹480.

However, the maximum value that we may give to Tiny ltd. = ₹960.

-> Benefit of synergy = MV of New – (MV of Big + MV of Tiny)

= 3600 + 960 – (3600 + 480) = ₹480

II) NEGOTIATING

Max amount that Big can pay = PVCI of Total Benefits from Tiny

These **TOTAL BENEFITS** will also include benefits of synergy.

Min amount that Tiny can accept = PVCI of benefits that Tiny can earn 'on its own'

This does not include synergy benefits.

Note - Do not link the above with maximum SER concept of Part B.

Ex: Desi Halwai is a sweets shop. Future cash flows expectations from this shop are as follows -

Year	1	2	3	4
Cash flows	500	600	800	1000

After which it will grow at 6% p.a.

Received an offer from a Professional Halwai who is interested in buying this shop. As per the professional halwai, if he acquired this shop then he will be able to generate following cash flows -

Year	1	2	3	4
Cash flows	1000	1200	1400	2000

After which it will grow at 8% p.a.

If the required return from this sweets shop is 16%, find the -

i) Minimum value that Desi Halwai shall ask for selling the sweets shop.

ii) Maximum value that Professional Halwai will be willing to offer.

Ans: i) Min value = PVCI that Desi Halwai can earn

$$= \frac{500}{1.16} + \frac{600}{1.16^2} + \frac{800}{1.16^3} + \frac{1000}{1.16^4} + \frac{1000 \times 1.06}{0.16 - 0.06} \times \frac{1}{1.16^4} = ₹7800 \text{ approx.}$$

ii) Max. value = PVCI under new management (using growth rate under new management)

$$= \frac{1000}{1.16} + \frac{1200}{1.16^2} + \frac{1400}{1.16^3} + \frac{2000}{1.16^4} + \frac{2000 \times 1.08}{0.16 - 0.08} \times \frac{1}{1.16^4} = ₹18667 \text{ approx.}$$

6. Other points

I) FLOOR VALUE = MIN VALUE out of all the given values

Ex: BVPS = ₹5.25

Cash flow per share = ₹7.11

MPS = ₹4

Ans: Floor value = lowest of all = ₹4.

II) BONUS SHARES, STOCK SPLIT AND CONSOLIDATION OF SHARES

1. Bonus share --> Reserve & Surplus A/c Dr.
   To Equity Share capital A/c

   It results in capitalisation of R&S (as we can pay dividends out of R&S A/c but cannot redeem ESC A/c)

2. Stock Split --> Equity Share capital A/c (₹10) Dr.
   To Equity Share capital A/c (₹5)

3. Consolidation --> Equity Share capital A/c (₹5) Dr.
   To Equity Share capital A/c (₹10)

- These all are journal entries only.
- It does not impact the overall market capitalisation of the co..
- However, figures such as MPS, EPS, BVPS etc. are all impacted due to change in number of shares.
- Share exchange ratio will also be impacted.

III) **BANKING RATIOS**

Gross NPA ratio = $\frac{\text{Gross NPA}}{\text{Total advance given}}$

This ratio is commonly used in Banks.

Recall GNPA is a negative ratio. So, SER = GNPA of Big / GNPA of Tiny

CAR = Capital Adequacy ratio or CRAR = Capital Risk Weighted Assets ratio = $\frac{\text{Total Capital}}{\text{Total Risk weighted assets}}$

Student's Space

Student's Space