PAPER – 14

STRATEGIC FINANCIAL MANAGEMENT

[ILLUSTRATIONS]

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I really liked your classes, especially the practical linkages explained with amazing graphics. The full subject test serieshelped a lot in improving my writing speed and presentation skills.

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I took Accounting from IndigoLearn and the classes were really good. They emphasized on conceptual clarity over getting things done quickly, which is really vital to score good marks in practical papers. Other resources like Notes, Quizzes and Forum was beneficial too.

Dwarakesh

Thank you IndigoLearn team for the guidance and support throughout the past few months. I had great conceptual clarity in all the subjects and the revision classes by Suraj Sir were very helpful. Study planner and Free resources were very useful. Thank you Team IndigoLearn.

Yug Manoj Kumar Bhattad

I have cleared my CA Foundation examination with the total of 286. And this was not possible without the efforts and support of IndigoLearn. The way of teaching with utmost conceptual clarity is the best thing at Indigolearn.

Prakash Bhatt

Superb, one stop solution for All CA and Accountancy students they serve real Education at very very reasonable price

Naveen Kumar S

Good experience, unlimited views helped a lot in last one month preparation. Looking forward for

Bhagyasree Chougule

It was only because of Indigolearn that my concepts became very clear, and I was able to crack the exam. I wasn't 100% prepared I needed more practice but luckily I got through. I'm definitely choosing IndigoLearn for group 2 preparation. A big thanks!

Mohd Thayyab

Theoretical subjects made easier through story based examples and charts. Concept clarity 100%. Fully exam+practical oriented classes will help not only to retain the concepts during exams but for the longer duration.

Lalit Chetan Sanpal

Indigolearn has been fantastic and brilliant. Helped me alot in my preparations. I cleared both the groups in first attempt with your brilliant classes and notes. Thanks to all the faculties, coordinators, forum admins and everyone at Indigolearn. Really grateful. Will go for CA Finals at Indigolearn For sure. Thank you so much Indigolearn.

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Abishek M

I'd like to thank IndigoLearn for all the support they've provided me with. Modules were great. They were time saving and straight to the point. I extensively used the materials provided before exams, they were so helpful. Also I'd appreciate them for providing unlimited views as I kept looking into the maths modules till the end.

Munnur Nandini Sree

Accounting classes I have taken from IndigoLearn. Now I feel that it's a great choice that I have made (after seeing my result) because only in Accounting I got exemption. Thank you IndigoLearn.

Harshita G

Thank u so much IndigoLearn for your guidance. This is only possible because of u people.... For my finals also my journey will continue with IndigoLearn.

Bharathsha PS

I purchased Economics, IT, FM, EIS and Audit from Indigolearn. All your classes are superb and anyone can easily crack the CA exams. What makes u special is your classes help us to understand the concepts very well.Special thanks to the FM faculty, I studied only 2 chapters in economics,and still managed to score excemption in the 8th paper.

Nayi Mihir kumar

This platform is very helpful in all activity like mcq practise, notes, teaching activities, revisions and the forum interaction with all students which I like the most. If anybody want to clear their exams in first attempt then IndigoLearn is the best platform for them. My all regards to IndigoLearn. Thank you so much.

Rajalaxmi
CA Inter

Can't believe I cleared.Sathya Sir, Suraj Sir, Yogita Mam ... thanks to all my faculties. Basically an Eng student with zero accounts knowledge. Thanks IndigoLearn for making me clear in first attempt.

Priyanka Udeshi

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Naveen Kumar T

It been a great journey with indigo learn team. Thanks to all the facilities and forum friends who support me a lot.

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RISK MANAGEMENT (6Q)

1. Illustration

Neel holds ₹ 1 crore worth shares of XY ltd., whose market price standard deviation is 2% per day. Assume there are 252 days. Determine the maximum loss level over the period of 1 trading day and 10 trading days at 99% confidence level assuming:

- Share prices are distributed normally
- For 99% level the equivalent Z score from the normal table of cumulative area is 2.33

Solution :

Particulars	Amount (INR)
Value of Shares Held	1,00,00,000
Share Price Standard Deviation Per Day	2%
99% Probability Cumulative Area	2.33
Loss Over 1 Day	= 1,00,00,000 × 2.33 × 2% = 4,66,000
Loss over 10 Days	= 466,000 × $\sqrt{10}$ = 14,73,621.39

Note : *In order to calculate loss of any number of days, you multiply* ***Square Root*** *of number of days with Loss for 1 Day.*

2. Illustration

Following is the information about Mr. J's portfolio

Particulars	Prices
Investment in shares of ABC Ltd.	200 Lakhs
Investment in shares of XYZ Ltd.	200 Lakhs
Daily standard deviation of both shares	1%
Co-efficient of correlation between both shares	0.3

Determine the 10 days 99% Value at Risk (VAR) for Mr. J's portfolio. Given: The Z score from the normal table at 99% confidence level is 2.33 (Show your calculations upto four decimal points)

Solution :

Details	INR Lakhs	%	SD	SD in INR Lakhs
ABC Ltd	200	50%	1%	2
XYZ Ltd	200	50%	1%	2
Total Portfolio	400			
Correlation Coefficient			0.3	

Portfolio Variance (σ_P) = $\sqrt{W1^2\sigma1^2 + W2^2\sigma^2 + 2W1W2\sigma1\sigma2\rho}$

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Portfolio Variance	$= 2^2 + 2^2 + 2 \times 2 \times 2 \times 0.3$ $=10.40$	$=(1\% \times 50\%)^2 + (1\% \times 50\%)^2 + 2 \times 50\% \times 1\% \times 50\% \times 1\% \times 0.3$ $= 0.000065$
Portfolio Standard Deviation		$=\sqrt{0.0001}$ $= 0.0081$
Portfolio Standard Deviation in INR Lakhs	$=\sqrt{10.40}$ $=3.2249$	$= 0.0081 \times 400$ $= 3.2249$
Z Value at 99% Confidence Level	2.33	2.33
Number of Days	10	10
Value at Risk in INR Lakhs	$= 3.2249 \times 2.33 \times \sqrt{10}$ $= 23.7614$	$= 3.2249 \times 2.33 \times \sqrt{10}$ $= 23.7614$

3. Illustration

Suppose you hold ₹ 2 crore worth shares of X Ltd. whose market price standard deviation is 2% per day. Assuming 252 trading days a year, determine maximum loss level over the period of 1 trading day and 10 trading days with 99% confidence level.

Solution :

Details	**INR Lakhs**
Value of Shares of X Ltd	200
Standard Deviation	2%
Confidence Level 99%	2.33
VAR 1 Day	$= 200 \times 2\% \times 2.33$ $= 9.3200$
VAR 10 Days	$=$ VAR 1 Day $\times \sqrt{10}$ $= 9.3200 \times \sqrt{10}$ $= 29.4724$

4. Illustration

On Tuesday morning (before opening of the capital market) an investor, while going through his bank statement, has observed that an amount of ₹ 7 lakhs is lying in his bank account. This amount is available for use from Tuesday till Friday. The Bank requires a minimum balance of ₹1000 all the time. The investor desires to make a maximum possible investment where Value at Risk (VaR) should not exceed the balance lying in his bank account. The standard deviation of market price of the security is 1.5 per cent per day. The required confidence level is 99 per cent.

Given

Standard Normal Probabilities										
Z	0.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9998	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9923	.9925	.9929	.9931	.9932	.9934	.9936

You are required to determine the maximum possible investment.

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Solution :

Particulars	Amount
Current Balance	7,00,000
Minimum Balance	1,000
Utilisable Balance	= 7,00,000 – 1,000 = 6,99,000
Standard Deviation (SD)	1.5%
Confidence Level	99%
Z Score at 99%	2.3300
Assuming 1 Day VAR is INR 6,99,000	
VAR	**= SD × Portfolio × Z Score**
	6,99,000 = 1.5% × Portfolio × 2.33 Portfolio = 6,99,000/(2.33 × 1.5%) Portfolio = 2,00,00,000
Assuming 4 Day VAR is INR 6,99,000	
VAR	**= SD × Portfolio × Z Score × $\sqrt{4}$**
	6,99,000 = 1.5% × Portfolio × 2.33 × $\sqrt{4}$ Portfolio = 6,99,000/(2.33 × 1.5% × 2) Portfolio = 1,00,00,000
Maximum Investment for a Day is	INR 2 Crores
Maximum Investment for 4 Days is	INR 1 Crores

5. Illustration

Consider a portfolio of shares of P Ltd. and Q Ltd.

Particulars	Amount (₹)
P Ltd.	5 Crs
Q Ltd	12 Crs

The daily Standard deviation of the shares of P Ltd. is 0.5% and of Q Ltd. is 0.2%. The correlation co-efficient is 0.3. You are required to determine 1 week VAR at 99% confidence level for the portfolio (Assuming week is 5 trading days)

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Solution :

Details	INR Crores	Standard Deviation	Weights	SD in INR Crores
P Ltd	5	0.5%	=5/17 = 29.41%	= 5 × 0.5% = 0.0250
Q Ltd	12	0.2%	= 12/17 = 70.59%	= 12 × 0.2% = 0.0.240
Total	17			
Correlation		0.3		
5 Day VAR at 99%				
Portfolio Variance (σ_P): $\sqrt{W1^2\sigma1^2 + W2^2\sigma^2 + 2W1W2Cov1,2}$			Alternatively,	
	=(29.41% × 0.50%)^2 + (70.59% × 0.20%)^2 + 2 × 0.5% × 0.2% × 29.41% × 70.59% × 0.3 = 0.00000540		= 0.0250 ^2 + 0.0240 ^2 + (2 × 0.0250 × 0.0240 × 0.3) = 0.0016	
Portfolio SD	= $\sqrt{0.00000540}$ = 0.00232409		=$\sqrt{0.0016}$ = 0.0395	
Portfolio SD in INR Crores	= 0.00232409 × 17 = 0.0395			
Portfolio SD in INR	= 0.0395 × 1,00,00,000 = 3,95,094.93		= 0.0395 × 1,00,00,000 = 3,95,094.93	
5 Day VAR	= **3,95,094.93 × $\sqrt{5}$ × 2.33** = **20,58,459.73**		= **3,95,094.93 × $\sqrt{5}$ × 2.33** = **20,58,459.73**	

6. Illustration - May23

Mr. Bull is a rational risk taker. He takes his position in a single stock for 4 days a week. He does not take a position on Friday to avoid the weekend effect and takes position only for four days in a week i.e., Monday to Thursday. He transfers the amount on Monday morning and withdraws the balance on Friday morning. He desires to make a maximum investment where Value at Risk (VAR) should not exceed the balance lying in his bank account. The position by his manager, as per standing instructions, is taken on the free balance lying in the bank account in the morning on each Monday.

On Monday morning (before the opening of the capital market) he transferred an amount of 11 Crore to his bank account. A fixed deposit also matured on this Monday. The maturity amount of ₹63,42,560 was also credited to his account by the bank in the morning of the Monday. However, Mr. Bull received the intimation of the same in the evening. The bank needs a minimum balance of ₹1,000 all the time. The value of Z score, at the required confidence level of 99 percent is 2.33. The other information with respect to stocks X and Y, which are under consideration for this week, is as under:

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X		Y	
Return	**Probability**	**Return**	**Probability**
6	0.10	4	0.10
7	0.25	6	0.20
8	0.30	8	0.40
9	0.25	10	0.20
10	0.10	12	0.10

You are required to recommend a single stock, where maximum investment can be made and compute the amount of maximum investment.

Solution:

Expected Return $\bar{x}$ = $\sum P_i x_i$

VAR = $\sigma * \bar{z} * Portfolio\ Value$

For Security X:

x_i	P_i	$\bar{x} = x_i * P_i$	$x_i - \bar{x}$	$(x_i - \bar{x})^2$	$(x_i - \bar{x})^2 * P_i$
6	0.10	0.6	-2	4	0.4
7	0.25	1.75	-1	1	0.25
8	0.30	2.4	0	0	0
9	0.25	2.25	1	1	0.25
10	0.10	1	2	4	0.4
		8			**1.3**

σ^2 = 1.3

σ = $\sqrt{1.3}$ = **1.14018**

For Security Y:

y_i	P_i	$\bar{y} = y_i * P_i$	$y_i - \bar{y}$	$(y_i - \bar{y})^2 * P_i$	$(y_i - \bar{y})^2 * P_i$
4	0.10	0.4	-4	16	1.6
6	0.20	1.2	-2	4	0.8
8	0.40	3.2	0	0	0
10	0.20	2.0	2	4	0.8
12	0.10	1.2	4	16	1.6
		8			**4.8**

σ^2 = 4.8

σ = $\sqrt{4.8}$ = **2.1909**

Mr. Bull **should invest in security X** as it has same return i.e., 8% but at lower risk i.e., S.D of 1.1402%

Maximum Value of Investment

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Particulars	₹
Balance Available	11,00,00,000
Fixed Deposit Maturity	63,42,560
Total	11,63,42,560
Less: Minimum Balance	1000
Maximum Loss	**11,63,41,560**

Assuming, Investment is for 4 days and the Manager invests Fixed Deposit amount also despite Mr. Bull not being aware till Monday evening

VAR (maximum loss @99% confidence) = *Portfolio** $\sigma * z * \sqrt{t}$

$$11,63,41,560 = P * 1.1402\% * 2.33 * \sqrt{4}$$

$$P = \frac{11,63,41,560}{1.1402\% * 2.33 * 2}$$

$$P = ₹\ 2,18,96,15,857$$

The maximum investment is **₹ 218.96 Crores**.

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1. Illustration (SM)

Determine NPV of the project with the following information:

Initial Outlay of project	₹ 40,000
Annual revenues (Without inflation)	₹ 30,000
Annual costs excl depreciation (Without inflation)	₹ 10,000
Useful life	4 years
Salvage value	Nil
Tax Rate	50%
Cost of Capital (Including inflation premium of 10%)	12%

Solution:

Depreciation:

Initial Investment = 40,000

Life = 4 Years

Salvage Value = Nil

Depreciation per Annum = $\frac{40000}{4}$ = 10,000

Calculation of Profit After Tax:

Particulars	₹ without inflation
Revenue	30,000
Less: Cost	10,000
EBITDA	20,000
Less: Depreciation	10,000
EBIT/ PBT	10,000
Tax@ 50%	5,000
Profit After Tax (PAT)	5,000

Cash Flow After Tax = (Revenue – Cost- Depreciation) (1- Tax) + Depreciation

= 5,000+ 10,000 = **15,000**

OR

CFAT = (Revenue – Cost) (1-Tax)+ D*T

= (30,000-10,000) (1-50%)+ 10,000* 50% = **15,000** (without inflation)

k_c (incl. inflation) = 12%

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Method 1: Discounting Nominal Cash Flows

Year	Real Cash Flow	Inflation	Nominal Cash Flow	Discount Rate @12%	Present Value
1	15,000	=(1+10%)^1= 1.1	16,500	0.892	14,718.000
2	15,000	=(1+10%)^2= 1.21	18,150	0.797	14,465.550
3	15,000	=(1+10%)^3= 1.331	19,965	0.712	14,210.693
4	15,000	=(1+10%)^4= 1.4641	21,961.5	0.636	13,967.514
			76,576.5		**57,361.76**

PVCIF = ₹ 57,362
Initial Investment = ₹ 40,000
NPV = **₹ 17,362**

Method 2: Discounting Real Cash Flows with Real Rate

Real Discount Rate,
1+ Nominal Rate = (1+ Real Rate) (1+ Inflation Rate)
(1+ Real Rate) = $\frac{1+Nominal\ Rate}{1+Inflation\ Rate}$

Real Rate = $\frac{1+Nominal\ Rate}{1+Inflation\ Rate}$ -1

= $\frac{1+12\%}{1+10\%}$ -1

= 1.82%

Year	Real Cash Flow	PVF @ 1.82%
1	15,000	0.982
2	15,000	0.965
3	15,000	0.947
4	15,000	0.930
		3.824

PVCIF (real) = 15,000* 3.824
= ₹ 57,366
PVCOF (real) = ₹ 40,000
NPV = **₹ 17,366**

2. Illustration

XYZ Ltd. requires ₹ 8,00,000 for a unit.
Useful life of project - 4 years.
Salvage value - Nil.
Depreciation Charge ₹ 2,00,000 p.a.
Expected revenues & costs (excluding depreciation) ignoring inflation.

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Year	1	2	3	4
Revenues	₹ 6,00,000	₹ 7,00,000	₹ 8,00,000	₹ 8,00,000
Costs	₹ 3,00,000	₹ 4,00,000	₹ 4,00,000	₹ 4,00,000

Tax Rate 60% cost of capital 10% (including inflation premium).
Calculate NPV of the project if inflation rates for revenues & costs are as follows:

Year	Revenues	Costs
1	10%	12%
2	9%	10%
3	8%	9%
4	7%	8%

Solution:

Year	CF	PVF @10%	PVCF
1	2,49,600	0.909	2,26,909
2	2,58,600	0.826	2,13,719
3	3,19,514	0.751	2,40.055
4	3,31,331	0.683	2,26,303

PVCIF = 9,06,987
Cash Outflow = 8,00,000
NPV = ₹ 1,06,987

Working Notes

Cash Flow After Tax = (Revenue – Cost – Depreciation) (1– Tax) + Depreciation

Year	(1+i)	Revenue	R_N
1	(1.10)	6,00,000	6,60,000
2	(1.10) (1.09)	7,00,000	8,39,300
3	(1.10) (1.09) (1.08)	8,00,000	10,35936
4	(1.10) (1.09) (1.08) (1.07)	8,00,000	11,08,451.52
			36,43,687.52

Year	(1+i)	Cost	C_N
1	(1.12)	3,00,000	3,36,000
2	(1.12) (1.1)	4,00,000	4,92,800
3	(1.12) (1.1) (1.09)	4,00,000	5,37,152
4	(1.12) (1.1) (1.09) (1.08)	4,00,000	5,80,124.16
			19,46,076.61

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R_N	C_N	$(R_N - C_N)$	$A = (R_N - C_N) + DT$ $DT = 2,00,000 * 60\%$	PVF @10%	A *PVF
6,60,000	3,36,000	1,29,600	2,49,600	0.909	2,26,909
8,39,300	4,92,800	1,38,600	2,58,600	0.826	2,13,719
10,35936	5,37,152	1,99,514	3,19,514	0.751	2,40.055
11,08,451.52	5,80,124.16	2,11,331	3,31,331	0.683	2,26,303
					9,06,987

3. Illustration

A firm has projected the following cash flows from a project under evaluation:

Year	₹ lakhs
0	(70)
1	30
2	40
3	30

The above cash flows have been made at expected prices after recognizing inflation. The firm's cost of capital is 10%. The expected annual rate of inflation is 5%.

Show how the viability of the project is to be evaluated.

Solution:

Method 1: Cash Flow and Discount Rate is Nominal

Year	CF	PVF @ 15.5% (WN 1)	PVCF
0	(70)	1	(70)
1	30	0.865	25.97
2	40	0.749	29.98
3	30	0.649	19.47
		NPV	**5.42889 lakhs**

Project is viable as NPV Is positive.

Method 2: Cash Flow is converted to Real and Discount Rate is Real

Year	CF	Inflation Adjustment @5%	Real CF	PVF @10%	PVCF
0	(70)	1	(70)	1	(70)
1	30	0.952	28.57	0.909	25.97
2	40	0.907	36.28	0.826	29.98
3	30	0.8638	25.915	0.751	19.47
				NPV	**5.426 lakhs**

Project is viable as NPV Is **₹ 5.426 lakhs.**

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Working Notes:

1. Assuming given Discount rate is real, 10%. Inflation rate is 5%.
   Nominal Discount Rate,

   $(1+n) = (1+r)(1+i)$
   $(1+n) = (1+10\%)(1+5\%)$
   $(1+n) = 1.155$
   $n = 15.5\%$

2. Inflation is 5%, so all nominal cash flows are adjusted for inflation to convert them to real.

4. Illustration (SM)

Shashi Co. Ltd has projected the following cash flows from a project under evaluation:

Year	0	1	2	3
₹ (in lakhs)	(72)	30	40	30

The above cash flows have been made at expected prices after recognizing inflation. The firm's cost of capital is 10%. The expected annual rate of inflation is 5%. Show how the viability of the project is to be evaluated. PVF at 10% for 1 -3 years are 0.909, 0.826 and 0.751.

Solution:

Cash Flow is converted to Real and Discount Rate is Real

Year	CF	Inflation Adjustment @5%	Real CF	PVF @10%	PVCF
0	(72)	1	(72)	1	(72)
1	30	0.952	28.57	0.909	25.97
2	40	0.907	36.28	0.826	29.98
3	30	0.8638	25.915	0.751	19.47
					3.426 lakhs

5. Illustration

KLM Ltd. requires ₹ 15,00,000 for a new project. The useful life of the project is 3 years. Salvage value - NIL. Depreciation is ₹ 5,00,000 p.a. Given below are projected revenues and costs (excluding depreciation) ignoring inflation:

Year	1	2	3
Revenues in ₹	10,00,000	13,00,000	**14,00,000**
Costs in ₹	**5,00,000**	**6,00,000**	**6,50,000**

Applicable tax rate is 35%. Assume cost of capital to be 14% (after tax). The inflation rates for revenues and costs are as under:

Year	Revenues %	Costs %
1	9	10
2	8	9
3	6	7

PVF at 14%, for 3 years =0.877, 0.769 and 0.675 Show amount to the nearest rupee in calculations. You are

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required to calculate net present value of the project.

Solution:

Year	Rev R	Cost R	Inf R	Inf C	Inf Factor (Rev)	Inf Factor (Cost)
1	10	5	9%	10%	= 1.09	=1.1
2	13	6	8%	9%	=(1.09)(1.08) = 1.1772	(1.1)(1.09) =1.199
3	14	6.5	6%	7%	=(1.09)(1.08)(1.06) = 1.247	(1.1)(1.09)(1.07) = 1.283

Inflation Factor		Adjustment	
Revenue	Cost	Revenue	Cost
1.09	1.1	10.9	5.5
1.1772	1.199	15.303	7.194
1.247	1.283	17.458	8.3395

Cash Flow After Tax = (Revenue – Cost) (1– Tax) + Depreciation* Tax

Year	CFAT	PVF @ 14%	PVCF
1	5.26	0.877	4.613
2	7.02085	0.769	5.399
3	7.677	0.675	5.182

PVCIF = 15,19,400
Cash Outflow = 15,00,000
NPV = 19,400

Year	Revenue	Revenue Nominal	Cost	Cost Nominal	(R –C) Nominal
1	10,00,000	10,90,000	50,00,000	5,50,000	5,40,000
2	13,00,000	15,30,360	60,00,000	7,19,400	8,10,960
3	14,00,000	17,46,965	65,00,000	8,33,905	9,13,060

Cash Flow After Tax (Revenue – Cost)	*PV Factor	*(1-Tax)	+Depreciation* Tax	= CFAT
5,40,000	*0.877	*0.65	+ 1,75,000	= 4,61,302
8,10,960	*0.769	*0.65	+ 1,75,000	= 5,39,933
9,13,060	*0.675	*0.65	+ 1,75,000	= 5,18,730
			PVCIF	= 15,19,965.43
			Investment	= 15,00,000
			NPV	**= ₹ 19,965.43**

6. Illustration

Possible net cash flows of Projects A and B at the end of first year and their probabilities are given below. The discount rate is 10 per cent. For both the projects, initial investment is ₹ 10,000. Calculate the expected net present value for each project. State which project is preferable?

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Possible Event	Project A		Project B	
	Cash Flow (₹)	Probability	Cash Flow (₹)	Probability
A	8,000	0.10	24,000	0.10
B	10,000	0.20	20,000	0.15
C	12,000	0.40	16,000	0.50
D	14,000	0.20	12,000	0.15
E	16,000	0.10	8 ,000	0.10

Solution:

Project A

Probability	0.1	0.2	0.4	0.2	0.1
Cash Flow	8,000	10,000	12,000	14,000	16,000
Prob* CF	800	2,000	4,800	2,8000	1,600

Expected Value = 800+ 2,000+ 4,800+ 2,800+ 1,600 =12,000

PV of Project A (@10% discount rate) = $\frac{12,000}{1.1}$ = 10,909

NPV (A) = 10,909 – 10,000 = **₹ 909**

Project B

Probability	0.1	0.15	0.5	0.15	0.1
Cash Flow	24,000	20,000	16,000	12,000	8,000
Prob* CF	2,400	3,000	8,000	1,800	800

Expected Value = 2,400+ 3,000+ 8,000+ 1,800+ 800 =16,000

PV of Project B (@10% discount rate) = $\frac{16,000}{1.1}$ = 14,545

NPV (B) = 14,545 – 10,000 = **₹ 4,545**

NPV of Project B is greater than NPV of Project A, hence Project B should be preferred.

7. Illustration

Probabilities for net cash flows for 3 years of a project are as follows:

Year 1		Year 2		Year 3	
Cash Flow (₹)	Probability	Cash Flow (₹)	Probability	Cash Flow (₹)	Probability
2,000	0.1	2,000	0.2	2,000	0.3
4,000	0.2	4,000	0.3	4,000	0.4
6,000	0.3	6,000	0.4	6,000	0.2
8,000	0.4	8,000	0.1	8,000	0.1

Calculate the expected net present value of the project using 10 per cent discount rate if the Initial Investment of the project is ₹ 10,000.

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Solution:

Year 1			Year 2			Year 3		
Cf	P	Ex Val	Cf	P	Ex Val	Cf	P	Ex Val
2,000	0.1	200	2,000	0.2	400	2,000	0.3	600
4,000	0.2	800	4,000	0.3	1,200	4,000	0.4	1,600
6,000	0.3	1,800	6,000	0.4	2,400	6,000	0.2	1,200
8,000	0.4	3,200	8,000	0.1	800	8,000	0.1	800
		6,000			4,800			4,200

Year	**1**	**2**	**3**
A **Expected Value**	6,000	4,800	4,200
B **PVF @10%**	$\frac{1}{1.1^1}$	$\frac{1}{1.1^2}$	$\frac{1}{1.1^3}$
PV of Cash Inflow C= **A*B**	$\frac{6000}{1.1}$	$\frac{4800}{1.1^2}$	$\frac{4200}{1.1^3}$

PVCIF = 12,577
PVCOF = 10,000
NPV = 12,577– 10,000 = **₹ 2,577**

Expected NPV of the investment is **₹ 2,577**.

8. Illustration

Cyber Company is considering two mutually exclusive projects. The investment outlay of both the projects is ₹ 5,00,000 and each is expected to have a life of 5 years. Under three possible situations their annual cash flows and probabilities are as under:

		Cash Flow (₹)	
Situation	**Probabilities**	**Project A**	**Project B**
Good	0.3	6,00,000	**5,00,000**
Normal	0.4	4,00,000	**4,00,000**
Worse	0.3	2,00,000	**3,00,000**

Cost of Capital is 7%. Which project should be accepted and why?

Solution:

Project A

Expected Cash Flow = 0.3*6,00,000 + 0.4* 4,00,000 + 0.3*2,00,000
= ₹ 4,00,000 p.a for 5 yrs

PV of Cash Inflow for Project A for 5 yrs
= PVAF (7%, 5 yrs)
= 4.1

PVIF = 4.1* 4,00,000 = ₹ 16,40,000
PVOF = ₹ 5,00,000
NPV = **₹ 11,40,000**

Project B

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Expected Cash Flow = 0.3*5,00,000 + 0.4* 4,00,000 + 0.3*3,00,000
= ₹ 4,00,000 p.a for 5 yrs
Since Expected value of Cash Inflow
= **₹ 4,00,000**

NPV of Project B will also be ₹ 11,40,000. When Outflow =₹ 5,00,000, and k_c= 7%.

Project A

Variance = $\sum P_i(x-\bar{x})^2$

$\bar{x}$ = Expected Cash Flow

σ^2 = 0.3* (6,00,000- 4,00,000)^2 + 0.4* (4,00,000- 4,00,0000)^2 + 0.3(6,00,000- 4,00,000)^2

= 2.4

σ = 1.549 = **₹ 1,54,919**

Project B

σ^2 = 0.3* (5,00,000- 4,00,000)^2 + 0.4* (4,00,000- 4,00,0000)^2 + 0.3(3,00,000- 4,00,000)^2

= 0.6

σ = 0.775 = **₹ 77,459.67**

Since the S.D of cash flow of Project B is ₹ 77,459.67 and is much lower than the S.D of Cash Inflow of Project a which is ₹ 1,54,919, **Project B is less risky**. Even though they both have same NPV is ₹ 11,40,000, we choose Project B as it is less risky.

9. Illustration

Calculate Variance and Standard Deviation of Project A and Project B based on following:

Possible Event	Project A		Project B	
	Cash Flow (₹)	**Probability**	**Cash Flow (₹)**	Probability
A	8,000	0.10	24,000	0.10
B	10,000	0.20	20,000	0.15
C	12,000	0.40	16,000	0.50
D	14,000	0.20	12,000	0.15
E	**16,000**	**0.10**	**8,000**	**0.10**

Solution:

Variance, σ^2 = $\sum Pi\ (x-\bar{x})^2$

Project A

Cash Flows (Cf)	**Probability (Pi)**	$Pi * Cf$	**Variance Computation**
8,000	0.10	800	0.10 (8,000 – 12,000)^2
10,000	0.20	2,000	0.20 (10,000 – 12,000)^2

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12,000	0.40	4,800	0.40 (12,000 – 12,000)^2
14,000	0.20	2,800	0.20 (14,000 – 12,000)^2
16,000	0.10	1,600	0.10 (16,000 – 12,000)^2
		$\bar{x}$ = 12,000	**48,00,000**

σ^2 = **48,00,000**

σ = **₹ 2,190.89**

Project B

Cash Flows (Cf)	Probability (Pi)	$Pi * Cf$	Variance Computation
24,000	0.10	2,400	0.10 (24,000 – 16,000)^2
20,000	0.15	3,000	0.15 (20,000 – 16,000)^2
16,000	0.50	8,000	0.50 (16,000 – 16,000)^2
12,000	0.15	1,800	0.15 (12,000 – 16,000)^2
8,000	0.10	800	0.10 (8,000 – 16,000)^2
		$\bar{x}$ = 16,000	**1,76,00,000**

σ^2 = **1,76,00,000**

σ = **₹ 4,195.23**

10. Illustration

Calculate Coefficient of Variation of Project A and Project B based on the following information:

Possible Event	Project A		Project B	
	Cash Flow (₹)	Probability	Cash Flow (₹)	Probability
A	10000	0.10	26,000	0.10
B	12,000	0.20	22,000	0.15
C	14,000	0.40	18,000	0.50
D	16,000	0.20	14,000	0.15
E	**18,000**	**0.10**	**10,000**	**0.10**

Solution:

	Expected Cash Flow	σ	CV of ECF
Project A (WN 1)	14,000	2,190.89	0.1565
Project B (WN 2)	18,000	4,195.23	0.2331

Project A has lower Coefficient of Variation, hence from a risk perspective project A is chosen.

WORKING NOTES:

1. Expected Cash Flows of the project A

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Pi	Cash Flow	Pi * Cash flows	$\sigma^2 = \sum Pi\,(x-\bar{x})^2$
0.1	10,000	1,000	0.1 (10,000 – 14,000)^2
0.2	12,000	2,400	0.2 (12,000 – 14,000)^2
0.4	14,000	5,600	0.4 (14,000 – 14,000)^2
0.2	16,000	3,200	0.2 (16,000 – 14,000)^2
0.1	18,000	1,800	0.1 (18,000 – 14,000)^2
		14,000	**48,00,000**

σ^2 = **48,00,000**

σ = **2,190.89**

2. Expected Cash Flows of the project A

Pi	Cash Flow	Pi * Cash flows	$\sigma^2 = \sum Pi\,(x-\bar{x})^2$
0.1	26,000	2,600	0.1 (26,000 – 18,000)^2
0.15	22,000	3,300	0.15 (22,000 – 18,000)^2
0.5	18,000	9,000	0.5 (18,000 – 18,000)^2
0.15	14,000	2,100	0.15 (14,000 – 18,000)^2
0.1	10,000	1,000	0.1 (10,000 – 18,000)^2
		18,000	**1,76,00,000**

σ^2 = **1,76,00,000**

σ = **4,195.235**

11. Illustration

Skylark Airways is planning to acquire a light commercial aircraft for flying class clients at an investment of ₹ 50,00,000. The expected cash flow after tax for the next three years is as follows:

Year 1		Year 2		Year 3	
CFAT	**Probability**	**CFAT**	**Probability**	**CFAT**	Probability
14,00,000	0.1	15,00,000	0.1	18,00,000	0.2
18,00,000	0.2	20,00,000	0.3	25,00,000	0.5
25,00,000	0.4	32,00,000	0.4	35,00,000	0.2
40,00,000	**0.3**	**45,00,000**	**0.2**	**48,00,000**	**0.1**

The Company wishes to take into consideration all possible risk factors relating to airline operations. The company wants to know:

(i) The expected NPV of this venture assuming independent probability distribution with 6 per cent risk free rate of interest.

(ii) The possible deviation in the expected value.

(iii) How would standard deviation of the present value distribution help in Capital Budgeting decisions?

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Solution:

i) Expected NPV @ 6%

Year	0	1	2	3
Cash Flow (WN1)	(50)	27	29.3	27.9
PVF @6%	1	0.943	0.890	0.840
	(50)			74.97
NPV				**24.974**

ii) Variance and SD of Cash Flow

Year	1	2	3
σ^2	85.4	98.61	74.29
σ	9.2412	9.9302	8.619

iii) Expected Value of the Deviation

$$= \sqrt{\frac{85.4}{(1.06)^2} + \frac{98.61}{(1.06)^4} + \frac{74.29}{(1.06)^6}}$$

$$= \sqrt{206.4855}$$

= **₹ 14.3696 lakhs**

iv) Standard Deviation identifies risk in cash flows. Using this, coefficient of variation can be computed and per unit of cashflows, how much risk is taken can be measured and decision on capital budgeting can be taken.

Working Notes:

1.

Year 1			**Year 2**			**Year 3**		
CF	Pi	CF* Pi	CF	Pi	CF* Pi	CF	Pi	CF* Pi
14	0.1	1.4	15	0.1	1.5	18	0.2	3.6
18	0.2	3.6	20	0.3	6	25	0.5	12.5
25	0.4	10	32	0.4	12.8	35	0.2	7
40	0.3	12	45	0.2	9	48	0.1	4.8
		27			29.3			27.9

2. Standard Deviation and Variance

σ^2 = $\sum P_i(x-\bar{x})^2$

Year 1

0.1* $(14-27)^2$ = 16.9

0.2* $(18-27)^2$ = 16.2

0.4* $(25-27)^2$ = 1.6

0.3* $(40-27)^2$ = 50.7

σ^2 = 85.4

σ = 9.2412

Year 2

0.1* $(15-29.3)^2$ = 20.449

0.3* $(20-29.3)^2$ = 25.947

0.4* $(32-29.3)^2$ = 2.916

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0.2* $(45-29.3)^2$ = 49.298
σ^2 = 78.61
σ = 9.9302

Year 3
0.2* $(18-27.9)^2$ = 19.602
0.5* $(25-27.9)^2$ = 4.205
0.2* $(35-27.9)^2$ = 10.082
0.1* $(48-27.9)^2$ = 40.401
σ^2 = 74.29
σ = 8.619

12. Illustration

A company is considering Projects X and Y with following information:

Project	Expected NPV (₹)	Standard deviation
X	1,22,000	**90,000**
Y	**2,25,000**	**1,20,000**

(i) Which project will you recommend based on the above data?
(ii) Explain whether your opinion will change, if you use coefficient of variation as a measure of risk.
(iii) Which measure is more appropriate in this situation and why?

Solution:

i) Based on the given data, if risk is the sole criterion, Project X has lower risk i.e., S.D and it will be chosen.

However, if NPV were to be the criteria, Project Y which has higher NPV will be chosen.

ii) If Coefficient of variation is used then C.V will be as follows;

	X	Y
NPV	1,22,000	2,25,000
S.D	90,000	1,20,000
C.V = σ/ NPV	$\frac{90}{122}$	$\frac{120}{225}$
C.V	0.7377	0.533

Per unit of Expected NPV, **Project Y has lower risk** i.e., lower C.V of 0.533 and hence it will be chosen.

iii) Project Y is significantly better from both NPV and C.V perspectives and hence **Project Y should be recommended.**

iv) The most appropriate method would depend on an organisation's investment policy on the face of it considering NPV of Project Y which is 85% higher, **the NPV method would be the better method** to utilise in this scenario

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13. Illustration

KLM Ltd., is considering taking up one of the two projects-Project-K and Project-S. Both the projects having same life require equal investment of ₹ 80 lakhs each. Both are estimated to have almost the same yield. As the company is new to this type of business, the cash flow arising from the projects cannot be estimated with certainty. An attempt was therefore, made to use probability to analyse the pattern of cash flow from other projects during the first year of operations. This pattern is likely to continue during the life of these projects. The results of the analysis are as follows:

Project K		**Project S**	
Cash Flow (in ₹)	**Probability**	**Cash Flow (in ₹)**	Probability
11	0.10	09	**0.10**
13	0.20	13	**0.25**
15	0.40	17	**0.30**
17	0.20	21	**0.25**
19	**0.10**	**25**	**0.10**

Required:

(i) Calculate variance, standard deviation and co-efficient of variance for both the projects.

(ii) Which of the two projects is riskier?

Solution:

i)

Project K				Project S			
C.F	Pi	CF* Pi	$Pi\ (x-\bar{x})^2$	C.F	Pi	CF* Pi	$Pi\ (x-\bar{x})^2$
11	0.1	1.1	0.1 (11-15)^2	9	0.1	0.9	0.1 (9-17)^2
13	0.2	2.6	0.2 (13-15)^2	13	0.25	3.25	0.25 (13-17)^2
15	0.4	6.0	0.4 (15-15)^2	17	0.3	5.1	0.3 (17-17)^2
17	0.2	3.4	0.2 (17-15)^2	21	0.25	4.25	0.25 (21-17)^2
19	0.1	1.9	0.1 (19-15)^2	25	0.1	2.5	0.1(25-17)^2
	1.0	15.0	**4.8**		1.0	17	**20.8**

Project K

σ^2 = 4.8

σ = **2.1909**

Project S

σ^2 = 20.8

σ = **4.5607**

Coefficient of Variation

$= \frac{\sigma}{ENPV}$

K $= \frac{2.1909}{15}$ = **0.14606**

S $= \frac{4.5607}{17}$ = **0.26827**

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ii) **Project S is risky** considering per unit of Cash Flow, it has higher element of Standard Deviation. Also on an absolute basis, Project S has higher Standard Deviation.

14. Illustration

Project X and Project Y are under the evaluation of XY Co. The estimated cash flows and their probabilities are as below:

Project X : Investment (year 0) ₹ 70 lakhs

Probability weights	**0.30**	**0.40**	**0.30**
Years	**₹lakhs**	**₹lakhs**	₹lakhs
1	30	50	**65**
2	30	40	**55**
3	**30**	**40**	**45**

Project Y: Investment (year 0) ₹ 80 lakhs

Probability weighted	**Annual cash flows through life**
	₹lakhs
0.20	**40**
0.50	**45**
0.30	**50**

(i) Which project is better based on NPV, criterion with a discount rate of 10%?

(ii) Compute the standard deviation of the present value distribution and analyse the inherent risk of the projects.

Solution:

Assumption: Both projects X and Y have same time frame for Cash Inflows i.e., 3 years.

i) Expected Value of Cash flows across 3 years

Project X

Probability	**0.3**	**0.4**	**0.3**	**Expected CF**
Year 1	30	50	65	48.5
Year 2	30	40	55	41.5
Year 3	30	40	45	38.5

ECF $= \sum Pi * CF$

Year	**0**	**1**	**2**	**3**
Cash Flow	(70)	48.5	41.5	38.5
PVF @ 10%	1	0.909	0.826	0.757
PV	(70)	44.09	34.29	28.925
NPV				**₹ 37.314 Lakhs**

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Project Y

ECF (for each year) = 0.2*40 + 0.5*45 + 0.3*50
= 8+ 22.5+ 15 = **45.5 lakhs**

Year	0	1	2	3
Cash Flow	(80)	45.5	45.5	45.5
PVF @ 10%	1	0.909	0.826	0.757
PV	(80)	41.36	37.60	34.84
NPV				**₹ 33.15 Lakhs**

Project X is better on NPV criterion as it has higher NPV of ₹ 37.314 lakhs as compared to Project Y with NPV ₹ 33.15 lakhs

ii) Hillers Model,

σ^2 = $\sum_{i=0}^{n}(1+r)^{-2i}\sigma_i^2$

Variance: Project X

Year 1, σ^2 = $\sum P_i(x-\bar{x})^2$
= 0.3 (30-48.5)^2+ 0.4 (50-48.5)^2+ 0.3 (65-48.5)^2
= 185.25
σ = **13.6107**

Year 2, σ^2 = $\sum P_i(x-\bar{x})^2$
= 0.3 (30-41.5)^2+ 0.4 (40-41.5)^2+ 0.3 (55-41.5)^2
= 95.25
σ = **9.7596**

Year 3, σ^2 = $\sum P_i(x-\bar{x})^2$
= 0.3 (30-38.5)^2+ 0.4 (40-38.5)^2+ 0.3 (45-38.5)^2
= 35.25
σ = **5.93717**

Standard deviation of the expected Value/ Standard Deviation of the PV Distribution

σ^2 = $\sum_{i=0}^{n}(1+r)^{-2i}\sigma_i^2$

σ = $\sqrt{\frac{185.25}{(1.1)^2}+\frac{95.25}{(1.1)^4}+\frac{35.25}{(1.1)^6}}$
= $\sqrt{238.05}$
= **15.43**

Variance: Project Y

Year 1, σ^2 = $\sum P_i(x-\bar{x})^2$
= 0.2 (40-45.5)^2+ 0.5 (45-45.5)^2+ 0.3 (50-45.5)^2
= 12.25
σ = **3.5**

Standard deviation of the expected Value/ Standard Deviation of the PV Distribution

σ^2 = $\sum_{i=0}^{n}(1+r)^{-2i}\sigma_i^2$

σ = $\sqrt{\frac{12.25}{(1.1)^2}+\frac{12.25}{(1.1)^4}+\frac{12.25}{(1.1)^6}}$

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$= \sqrt{25.4056}$

= **5.04**

Project X has higher Standard Deviation about the Expected Value and hence **has the higher risk** than Project Y which has Standard Deviation of 5.04.

15. Illustration

Shivam Ltd. is considering two mutually exclusive projects, A and B. Project A costs ₹ 36,000 and project B ₹30,000. You have been given below the net present value probability distribution for each project.

Project A		Project B	
NPV estimates (₹)	**Probability**	**NPV estimates (₹)**	Probability
15,000	0.2	15,000	**0.1**
12,000	0.3	12,000	**0.4**
6,000	0.3	6,000	**0.4**
3,000	**0.2**	**3,000**	**0.1**

(i) Compute the expected net present values of projects A and B.
(ii) Compute the risk attached to each project i.e. standard deviation of each probability distribution.
(iii) Compute the profitability index of each project.
(iv) Which project do you recommend? State with reasons

Solution:

i)

A			B		
P_i	CF	P_i *CF	P_i	CF	P_i *CF
0.2	15,000	3,000	0.1	15,000	1,500
0.3	12,000	3,600	0.4	12,000	4,800
0.3	6,000	1,800	0.4	6,000	2,400
0.2	3,000	600	0.1	3,000	300
1.0		**9,000**			**9,000**

Expected NPV of Project A and B are ₹ 9,000 each.

ii) σ_A^2 = 0.2(15,000-9,000)^2 + 0.3(12,000-9,000)^2 +0.3(6,000-9,000)^2 +0.2(3,000-9,000)^2

= 19,80,00,000

σ = **4,449.72**

σ_B^2 = 0.1(15,000-9,000)^2 + 0.4(12,000-9,000)^2 +0.4(6,000-9,000)^2 +0.1(3,000-9,000)^2

= 14,40,00,000

σ = **3,794.73**

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iii) Profitability Index of each project

	A	B
NPV	9,000	9,000
Add: Outflow	36,000	30,000
Inflow	45,000	39,000

$$\text{Profitability Index} = \frac{Discounted\ Cash\ Inflow}{Intial\ Outflow}$$

$$A = \frac{45,000}{36,000} = \mathbf{1.25}$$

$$B = \frac{39,000}{30,000} = \mathbf{1.30}$$

iv) Project B has lower standard Deviation of Cash Flow at ₹ 3,794.73 for the same NPV of ₹ 9,000 and for a lower investment of ₹ 30,000 implying a higher Profitability Index of 1.3, hence **project B should be chosen**.

16. Illustration

An enterprise is investing ₹100 lakhs in a project. The risk-free rate of return is 7%. Risk premium expected by the Management is 7%. The life of the project is 5 years. Following are the cash flows that are estimated over the life of the project:

Year	Cash flows (₹ in lakhs)
1	25
2	60
3	75
4	80
5	65

Calculate Net Present Value of the project based on Risk free rate and also on the basis of Risks adjusted discount rate.

Solution:

R_f = 7%

RADR = R_f + Risk Premium

= **14%**

Year	Cash Flow	PVF @7%	PVF@14%	Discount @7%	Cash Flow @14%
1	25	0.9346	0.8772	23.265	21.93
2	60	0.8734	0.7695	52.404	46.17
3	75	0.8163	0.6750	61.2225	50.625
4	80	0.7629	0.5921	61.032	47.368
5	65	0.7130	0.5194	46.345	33.761
				244.3685	**199.854**

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Projected NPV	R_f Rate	RADR
PVCIF	244.3685	199.854
Less: PVCOF	(100)	(100)
NPV	**144.3685**	**99.54**

17. Illustration

If Investment proposal costs ₹ 45,00,000 and risk-free rate is 5%, calculate net present value under certainty equivalent technique:

Year	Expected cash flow (₹)	Certainty Equivalent coefficient
1	10,00,000	**0.90**
2	15,00,000	**0.85**
3	20,00,000	**0.82**
4	**25,00,000**	**0.78**

Solution:

Cash outflow for Year 0 is ₹ 45 Lakhs

Year	**0**	**1**	**2**	**3**	**4**
Cash Flow (in ₹ Lakhs)	(45)	10	15	20	25
PVF @5%	1	0.952	0.907	0.864	0.823
DCF		9.524	13.605	17.277	20.568
∝		0.90	0.85	0.82	0.78
DCF * ∝		8.5716	11.56425	14.16714	16.04304

PVCIF = 50.34603 Lakhs
Less: COF = 45 Lakhs
NPV = **₹ 5.34603 Lakhs**

18. Illustration

X Ltd. is considering its new project with the following details:

Sr. No.	Particulars	Figures
1	Initial capital cost	**₹ 400 Cr**
2	Annual unit sales	**5 Cr**
3	Selling price per unit	**₹ 100**
4	Variable cost per unit	**₹ 50**
5	Fixed costs per year	**₹ 50 Cr**
6	**Discount Rate**	**6%**

Required:
1. Calculate the NPV of the project.
2. Compute the impact on the project's NPV considering a 2.5 per cent adverse variance in each variable. Which variable is having maximum effect? Consider Life of the project as 3 years

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Solution:

1. Project NPV

Particulars	
Units Sold	5 Cr
Selling Price/ Unit	100
Variable Cost/ Unit	50
Contribution Per Unit	50
Total Contribution (D*A)	250 Cr
Less: Fixed Cost	50 Cr
Profit	200 Cr

Cash Flows

Year	0	1	2	3
Cash Flow	(400)	200	200	200
PVF @ 6%	1	0.943	0.8899	0.8396
PVCOF	(400)			
PVCIF	534.60			
NPV	**₹ 134.602 Cr**			

2. Impact on NPV for 2.5% adverse variance in each factor

Initial Investment	**400**	**410**	**400**	**400**	**400**	**400**	**400**
Units Sold	5 Cr	5 Cr	5 Cr	5 Cr	4.875 Cr	5 Cr	5 Cr
Selling Price/ Unit	100	100	97.5	100	100	100	100
Variable Cost/ Unit	50	50	50	51.25	50	50	50
Contribution / Unit	50	50	47.5	48.75	50	50	50
Total Contribution (D*A)	250 Cr	250 Cr	237.5 Cr	243.75 Cr	243.75 Cr	250 Cr	250 Cr
Less: Fixed Cost	50 Cr	50 Cr	50 Cr	50 Cr	50 Cr	51.25 Cr	50 Cr
Profit	200 Cr	200 Cr	187.5 Cr	193.75	193.75	198.75	200
Discount	6%	6%	6%	6%	6%	6%	6.15%
PVF	2.673	2.673	2.673	2.673	2.673	2.673	2.6656
PVIF	534.6	534.6	501.875	517.893	517.893	531.25	533.122
NPV	134.60	124.6	101.18	117.89	117.89	131.35	133.122
Sensitivity		7.43%	24.82%	12.41%	12.41%	2.48%	1.1%

Factors	**Sensitivity of 5% Adverse Change on NPV**
Investment	7.43%
Selling Price	24.82%
Units	12.41%
VC	12.41%
FC	2.48%
Discount Rate	1.1%

Selling Price variable has the maximum impact, and is the most sensitive factor.

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19. Illustration

XYZ Ltd. is considering a project "A" with an initial outlay of ₹ 14,00,000 and the possible three cash inflow attached with the project as follows:

Particulars	Year 1	Year 2	Year 3
Worst case	450	400	700
Most likely	550	450	800
Best case	**650**	**500**	**900**

Assuming the cost of capital as 9%, determine NPV in each scenario. If XYZ Ltd is certain about the most likely result in first two years but uncertain about the third year's cash flow, analyze what will be the NPV expecting worst scenario in the third year.

Solution:

Year	PVF	Cash Flows Worst	Most Likely	Best	Mix
0	1	(14)	(14)	(14)	(14)
1	0.9174	4.5	5.5	6.5	5.5
2	0.8417	4	4.5	5	4.5
3	0.7722	7	8	9	7

Scenario	1	2	3	4
PVCIF	12,90,044.5	15,01,089.94	17,12,135.40	14,23,871.59
PVCOF	(14,00,000)	(14,00,000)	(14,00,000)	(14,00,000)
NPV	**(1,09,955.5)**	**1,01,089.94**	**3,12,135.40**	**23,871.59**

Assuming cash inflows of most likely case in Year 1 and 2, and worst case in Year 3.

20. Illustration

Following are the estimates of the net cash flows and probability of a new project of M/s X Ltd.:

	Year	P = 0.3	P = 0.5	P = 0.2
Initial investment	0	4,00,000	4,00,000	4,00,000
Estimated net after tax cash inflows per year	1 to 5	1,00,000	1,10,000	1,20,000
Estimated salvage value (after tax)	**5**	**20,000**	**50,000**	**60,000**

Required rate of return from the project is 10%. Find:

(i) The expected NPV of the project.

(ii) The best case and the worst case NPVs.

(iii) The probability of occurrence of the worst case if the cash flows are perfectly dependent overtime and independent overtime.

(iv) Standard deviation and coefficient of variation, assuming that there are only three streams of cash flow, which are represented by each column of the table with the given probabilities.

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(v) Coefficient of variation of X Ltd. on its average project which is in the range of 0.95 to 1.0. If the coefficient of variation of the project is found to be less risky than average, 100 basis points are deducted from the Company's cost of Capital

Should the project be accepted by X Ltd?

Solution:

Initial Investment = ₹ 4,00,000
Cash Flows (Year 1–5)
(Expected)
0.3* 1,00,000
0.5* 1,10,000
0.2* 1,20,000 = ₹ 1,09,000
Salvage Value
0.3* 20,000
0.5* 50,000
0.2* 60,000 = ₹ 43,000

Present Value Factor @ 10% Cost of Capital

PVF_A (5,10%)	= 3.7908* 1,09,000	= ₹ 4,13,195.76
PVF (5,10%)	= 0.6209* 43,000	= ₹ 26,699.61
	Total	= **₹ 4,39,895.37**

i) Net Present Value = PV of Cash Inflows – PV of Cash Outflows
= 4,39,895.37– 4,00,000
= **₹ 39,895.37**

ii) NPV in best and worst cases

	Best Case	Worst Case
Per year Cash flow (a)	1,20,000	1,00,000
PVF_A (b)	3.7908	3.7908
A= **(a)* (b)**	**4,54,896**	**3,79,080**
Salvage Value (c)	60,000	20,000
PVF (Year 5) (d)	0.6209	0.6209
B= **(c)* (d)**	**37,254**	**12,418**
A+B	4,92,150	3,91,498
Less: Investment	4,00,000	4,00,000
NPV	**92,150**	**(8,502)**

iii) Cash flows perfectly Dependent Overtime
First year cash flows determine cash flow of all subsequent years, of which probability is provided 0.3.

Cash flows are Independent Overtime.
Probability of worst case in all 5 years,
= 0.3*0.3*0.3*0.3*0.3 = **0.00243**

iv) Computation of Most Likely NPV
= -4,00,000+1,10,000*3.7908 + 50,000*0.6209

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= 48,033

σ^2 = 0.3(-8,502-39,895)^2 + 0.5(48,033-39,895)^2 + 0.2(92,150-39,895)^2

= 1,28,19,11,409.4

σ = 35,803.79

Coefficient of Variation = $\frac{\sigma}{ENPV}$

= $\frac{35803.79}{39895}$ = 0.897

v) Because Coefficient of Variation is 0.897, which is less than 0.95, the cost of capital will be 100 bps lower than 10% i.e it will 9%. 9% is RADR.
ENPV of project at 9% Cost of Capital:

Year	PVF@ 9%	
Year 0	1	4,00,000 Investment
Year 1-5	3.889	1,09,000 Inflow
Year 5	0.6499	43,000 Salvage
	NPV	**₹ 51,919.03**

21. Illustration

XY Ltd. has under its consideration a project with an initial investment of ₹ 1,00,000. Three probable cash inflow scenarios with their probabilities of occurrence have been estimated as below:

Annual cash inflow (₹)	20,000	30,000	40,000
Probability	0.1	0.7	0.2

The project life is 5 years and the desired rate of return is 20%. The estimated terminal values for the project assets under the three probability alternatives, respectively, are ₹ 0, 20,000 and 30,000.
You are required to:
(i) Find the probable NPV;
(ii) Find the worst-case NPV and the best-case NPV; and
(iii) State the probability occurrence of the worst case, if the cash flows are perfectly positively correlated over time.

Solution:

i)

		S1		S2		S3		EV
Year	PVF @20%	Pi	CF	Pi	CF	Pi	CF	CF
0	1	0.1	(1)	0.7	(1)	0.2	(1)	(1)
1	0.833	0.1	0.2	0.7	0.3	0.2	0.4	0.31
2	0.694	0.1	0.2	0.7	0.3	0.2	0.4	0.31
3	0.579	0.1	0.2	0.7	0.3	0.2	0.4	0.31
4	0.482	0.1	0.2	0.7	0.3	0.2	0.4	0.31
5	0.402	0.1	0.2	0.7	0.3	0.2	0.4	0.31
5 (TV)	0.402	0.1	0	0.7	0.2	0.2	0.3	0.2
1-5	2.9906							

Expected Value for years 1-5

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= 2.9906* 0.31 lakhs = ₹ 0.927086 lakhs

Expected Value for Terminal Value

= 0.402 * 0.2 lakhs = ₹ 0.080375 lakhs

NPV = **₹ 746.151**

ii) Worst Case NPV = Annual Cash Inflow* PVFA (20%, 5 years) + TV* PVF – Investment

= 20,000*2.9906 + 0 – 1,00,000

= – **₹ 40,188**

Best Case NPV = 40,000*2.9906 + 30,000*0.4018 – 1,00,000

= **₹ 31,680.33**

iii) If cash flows are perfectly positively correlated over time, first year cash flow will determine the subsequent year cash flows. Probability of worst case in first year is 0.1 or **10%.** That will be the probability of worst-case scenario throughout.

22. Illustration

XYZ Ltd. is considering a project for which the following estimates are available:

	₹
Initial Cost of the project	**10,00,000**
Sales price/unit	**60**
Cost/unit	**40**
Sales volumes	
Year 1	**20000 units**
Year 2	**30000 units**
Year 3	**30000 units**

Discount rate is 10% p.a.

You are required to measure the sensitivity of the project in relation to each of the following parameters:

(a) Sales Price/unit
(b) Unit cost
(c) Sales volume
(d) Initial outlay and
(e) Project lifetime Taxation may be ignored.

Solution:

a) Project NPV for the given data

Year	**0**	**1**	**2**	**3**
Cash Flow (WN1)	- 10,00,000	4,00,000	6,00,000	6,00,000
PVF @10%	1	0.909	0.8264	0.7513
PVCIF	-10,00,000	3,63,636.36	4,95,867.76	4,50,788.8
NPV	-10,00,000			13,10,293
NPV	**3,10,293**			

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Method 1: Sensitivity, when Selling Price reduces by 10%

Year	0	1	2	3
Cash Flow (WN1)	- 10,00,000	2,80,000	4,20,000	4,20,000
PVF @10%	1	0.909	0.8264	0.7513
PVCIF	-10,00,000	2,54,545.45	3,47,107.44	3,15,552.22
NPV	-10,00,000			9,17,205.11
NPV	**-82,794.89**			

From a 10% reduction in selling price, the NPV fell by ₹ 3,93,087.89 to ₹ -82,794 from 3,10,293 i.e., a reduction of **126.68%**

Method 2: At what Standard Deviation Selling Price will NPV be zero.

Let S be the sale price,

$$\{\frac{(S-40)*20,000}{1.1}+\frac{(S-40)*30,000}{1.1^2}+\frac{(S-40)*30,000}{1.1^3}\} - 10,00,000 = 0$$

-36,20,586 +65,514.65 S = 0

S = 55.26

At price of ₹ 55.26, i.e., a reduction in Selling Price by ₹ 4.74, i.e., a **reduction of 7.89%** the NPV reduces by 100% to zero.

Change in Unit Cost:

Method 1: Unit Cost Increases by 10% from 40 to 44

Year	0	1	2	3
Cash Flow (WN 3)	-10,00,000	3,20,000	4,80,000	4,80,000
PV @10%	-10,00,000			10,48,234.41
NPV				**₹ 48,234.41**

Reduction in NPV = 3,10,293 - 48,234

= **₹ 2,62,058** = **84.45%**

For 10% increase in cost, the NPV reduces by 84.45%

Method 2: At what cost, NPV will be zero

Year	0	1	2	3
Cash Flow (WN 3)	-10,00,000	(60-c)*20,000	(60-c)*30,000	(60-c)*20,000
		1.1	1.21	1.31

29,30,879 - 65,514.6 C = 0

C = 44.736

If Cost increases by **11.84%** i.e., ₹ 4.736 from ₹ 40 to ₹ 44.736, the NPV will reduce by 100% to zero.

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Method 1: Reduction in Sales Volume by 10%

Year	0	1	2	3
C.F (WN 4)	= (10,00,000)	= 20* 18,000 = 3,60,000	=20* 27,000 = 5,40,000	=20*27,000 = 5,40,000

PV @ 10% = ₹ 1,79,263
Reduction from original NPV ₹ 3,10,293
= ₹ 1,31,029
= **42.22%**
10% reduction in volume, reduces NPV by 42.22%

Method 2: At what volume will NPV be zero.

Since volume reduction is common across all 3 yrs, the reduced NPV equation for NPV @ 0
- Outflow+ current Inflow (1-x) = D
- 10,00,000+ 13,10,293(1-x) = 3,10,293- 3,10,293
3,10,293 = 13,10,293 x
x = $\frac{310293}{1310293}$
x = **23.68%**

b) Method 1: 10% increase in Outlay (₹ 1,00,000)
₹ 1,00,000 increase in outlay, reduces NPV by ₹ 1,00,000 i.e., 10% for ₹ 3,10,293 to ₹ 2,10,293 i.e., a reduction of **32.2276%**

Method 2: Increase in Outflow to be zero
Current Outflow = ₹ 10,00,000
Current Inflow = ₹ 13,10,293
Increase in outflow for NPV to be zero, is increase of ₹ 3,10,293 i.e., **31.03%** for NPV to reduce by 100%.

c) Method 1: If project life time reduces by 10%, i.e., from 3years to 2.7 years, last year reduction from 1 year to 0.7 years or 8.4 months or 255.5 days

Year	0	1	2	3
CF	(10,00,000)	4,00,000	6,00,000	6,00,000
Period	1	1	1	0.7
PV @ 10%	(10,00,000)	11,75,056		
NPV	**1,75,056**			

Reduction for 3,10,293 to 1,75,056 = **43.58%**

Method 2: At what period will NPV be zero.
Amount received in years 1 and 2
= 4,00,000/1.1 + 6,00,000/1.21 = ₹ 8,59,504
Balance to be recovered in PV terms = 10,00,000 – 8,59,504 = 1,40,496
Amount to be recovered in FV terms = 1,40,496 X 1.331 = 1,87,000

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Total units manf per day = 30000 / 365 = 82.19 units | Profit per unit = ₹20 | Per day profit = 82.19 x 20 = ₹1643.84 | No of days of profit required = ₹1,87,000 / ₹1643.84 = 113.76 days. Unit has to operate for 114 days in Year 3. i.e a reduction of 251 days in Yr 3. So total period reduction = 251/1095 x 100 = 22.92 %

	Impact on NPV of a 10% Reduction	**Change required for NPV= 0**
Selling Price	126.68	7.89
Cost	84.45	11.84
Volume	42.22	23.68
Outlay	32.23	31.03
Time	43.58	22.92

Working Notes

1. Selling Price = ₹ 60/ unit Cost = ₹ 40/ unit Contribution = ₹ 20/ unit

Year 1 = 20,000 units, Cash flow = ₹ 4,00,000
Year 2 = 30,000 units, Cash flow = ₹ 6,00,000
Year 3 = 30,000 units, Cash flow = ₹ 6,00,000

2. Selling Price reduces by 10%
Selling Price = ₹ 54/ unit Cost = ₹ 40/ unit Contribution = ₹ 14/ unit

Year 1 = 20,000 units, Cash flow = ₹ 2,80,000
Year 2 = 30,000 units, Cash flow = ₹ 4,20,000
Year 3 = 30,000 units, Cash flow = ₹ 4,20,000

3. Unit Cost increase by 10%
Selling Price = ₹ 60 Cost = ₹ 40+ 10% = ₹ 44` Profit = ₹ 16

Year 1 = 20,000 units*16 Cash flow = ₹ 3,20,000
Year 2 = 30,000 units*16 Cash flow = ₹ 4,80,000
Year 3 = 30,000 units*16 Cash flow = ₹ 4,80,000

4. Reduction in Sales Volume

Year	Volume	%	Revised Volume
Year 1	20,000 units	10%	18,000
Year 2	30,000 units	10%	27,000
Year 3	30,000 units	10%	27,000

23. Illustration

From the following details relating to a project, analyze the sensitivity of the project to changes in initial project cost, annual cash inflow and cost of capital:

Initial Project Cost (₹)	1,20,000
Annual Cash Inflow (₹)	45,000

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Project Life (Years)	4
Cost of Capital	10%

To which of the three factors, the project is most sensitive? (Use annuity factors: for 10% 3.169 and 11% 3.103).

Solution:

Initial Cash Flow = (1,20,000)
Annual Cash Flow = 45,000
k_c = 10%
No. of Years = 4

NPV of the project at 10% k_c
= PVFAC (10%, 4years) * 45,000 – 1,20,000
= 3.169*45,000 -1,20,000
= 1,42,605 – 1,20,000
NPV = ₹ **22,605**

Sensitivity computation for a 10% adverse change

	Current	Initial COF	ACF	k_c
Initial Cash Outflow (A)	(1,20,000)	(1,32,000)	(1,20,000)	(1,20,000)
CFA (B)	45,000	45,000	40,500	45,000
Disc. Factor (C)	10%	10%	10%	11%
PVA	3.169	3.169	3.169	3.103
PVIF (D) = (B)*(C)	1,42,606	1,42,606	1,28,344.5	1,42,606
NPV (A)+(D)	22,605	10,605	8,344.5	19,635
% change in NPV	**0%**	**– 53.08%**	**– 63.08%**	**– 13.14%**

Based on the above, **cash inflow is the most sensitive factor** as 10% change in it leads to 63.08% change in the NPV.

24. Illustration

Red Ltd. is considering a project with the following Cash flows:

Years	Cost of Plant	Recurring Cost ₹	Savings
0	10,000		
1		4,000	**12,000**
2		**5,000**	**14,000**

The cost of capital is 9%. Measure the sensitivity of the project to changes in the levels of plant value, running cost and savings (considering each factor at a time) such that the NPV becomes zero. The P.V. factor at 9% are as under:

Year	Factor
0	1.000
1	0.917

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2 0.842

Which factor is the most sensitive to affect the acceptability of the project?

Solution:

Year	Outflow	Cost	Saving	PVF	PV
0	(10,000)			1	(10,000)
1		(4,000)	12,000	0.917	7,336
2		(5,000)	14,000	0.842	7,578
					4,914

If initial cash outflow/ investment increases to 14,914 from 10,000, i.e., an increase of 49.14%, NPV becomes zero.

Change in recurring cost such that total recurring cost increases by 4,914

Current PV of recurring cost = 4,000* 0.917 + 5,000*0.842

= **7,878**

4,914+ 7,8,78= 12,792

Let x be the change %

4000(1+x)*0.917+ 5000(1+x)*0.842

= 12,792

x = 12,792/7878 -1

= **62.37%**

i.e., **increase by 62.37%**

Reduction in saving by ₹ 4,914 to make NPV as zero

(12,000*0.917) (1-x) + (14,000*0.842) (1-x) = 22,792- 4,914

22,792 (1-x%) = 17,878

22,792 – 17,878 = 22,792 x

x = 4914/22,792

x = **21.56%**

Since the lowest required change for the NPV to become zero is in **savings**, that is the most Sensitive factor.

25. Illustration

The Easygoing Company Limited is considering a new project with initial investment, for a product "Survival". It is estimated that IRR of the project is 16% having an estimated life of 5 years.

The Financial Manager has studied that project with sensitivity analysis and informed that annual fixed cost sensitivity is 7.8416%, whereas cost of capital (discount rate) sensitivity is 60%.

Other information available are:

Profit Volume Ratio (P/V) is 70%, Variable cost ₹ 60/- per unit Annual Cash Flow ₹ 57,500/-

Ignore Depreciation on initial investment and impact of taxation.

Calculate

(i) Initial Investment of the Project

(ii) Net Present Value of the Project

(iii) Annual Fixed Cost

(iv) Estimated annual unit of sales

(v) Break Even Units

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Cumulative Discounting Factor for 5 years

8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%
3.993	3.890	3.791	3.696	3.605	3.517	3.433	3.352	3.274	3.199	3.127

Solution:

Given, IRR = -16%
Y = 5 years
FC Sensitivity = 7.8416%
k_c sensitivity = 60%
PV Ratio = 70%
Variable Cost = ₹ 60/ unit
Annual Cash Flow = ₹ 57,500

i) Initial Investment
Annual Cash Flow = ₹ 57,500
PVFA (5 yrs, 16%) = 3.274
PV of all Cash Inflows
(A) = PV of all Cash Outflows (B)
(A) = 57,500* 3.274
= ₹ 1,88,255
So, Initial Investment (B) = **₹ 1,88,255**

ii) k_e is <16% and sensitivity of k_c is 60%
At k_c of x, NPV = Y
At k_c of x(1+60%), NPV = 0 where IRR= 16%

So, x(1+60%) = 16%
x = 10%
So, k_c = 10%

At k_c of 10%, PVFA = 3.791
PVIF = 3.791* 57,500
= ₹ 2,17,982.5 (C)
PVOF = ₹ 1,88,255 (D)
NPV = **₹ 29,727.50** (C) -(D)

iii) Annual Fixed Cost
For a 7.8416% in Fixed Cost, the NPV becomes zero.
Let annual fixed cost be x
Then, PV of Annual Fixed Cost is 3.791x
If 3.791x increases by 7.8416%, then NPV of ₹ 29,727.50 becomes zero.
3.791x* 7.8416% = 29,727.50
Solving for x,
x *7.8416% = $\frac{29727.5}{3.791}$
x = ₹ 99,999.98 = **₹ 1,00,000 approx.**

iv) Estimated sale units

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Contribution (PV Ratio)= 70%
Variable Cost (%) = 1- Contribution%
= 1 –70% = 30%
Given, Variable Cost = ₹ 60
$\frac{60}{S.P}$ = 30%
Selling Price = ₹ 200
Annual Cash Flow = Contribution* Units –Fixed Cost
₹ 57,500 = 140*Units –1,00,000
Units Sold $=57{,}500 + \frac{1{,}00{,}000}{140}$ **=1,125 units**

v) Break Even Units
Break Even point at which,
Contribution = Fixed Cost

$$\frac{FixedCost}{Contribution\ per\ unit}$$

= Break Even Units
Contribution/unit*x–FC = 0
140 x = 1,00,000
x = $\frac{1{,}00{,}000}{140}$
x = 714.2857 units
Break Even Units = **715 units**

26. Illustration

Unnat Ltd. is considering investing ₹ 50,00,000 in a new machine. The expected life of machine is five years and has no scrap value. It is expected that 2,00,000 units will be produced and sold each year at a selling price of ₹ 30.00 per unit. It is expected that the variable costs to be ₹ 16.50 per unit and fixed costs to be ₹ 10,00,000 per year. The cost of capital of Unnat Ltd. is 12% and acceptable level of risk is 20%.
You are required to measure the sensitivity of the project's net present value to a change in the following project variables:
(a) sale price;
(b) sales volume;
(c) variable cost;
(d) On further investigation it is found that there is a significant chance that the expected sales volume of 2,00,000 units per year will not be achieved. The sales manager of Unnat Ltd. suggests that sales volumes could depend on expected economic states which could be assigned the following probabilities:

State of Economy	Annual Sales (in Units)	Prob.
Poor	1,75000	0·30
Normal	2,00,000	0·60
Good	**2,25,000**	**0·10**

Calculate expected net present value of the project and give your decision whether company should accept the project or not.

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Solution:

i) Project NPV @ 2,00,000 units sales volume

Annual Cash Inflow (WN) = ₹ 17,00,000

No. of Years = 5

k_c = 12%

PVFA (5 years, 12%) = 3.6047

NPV = PVCIF –PVCOF

= 17,00,000* 3.6047 – 50,00,000

= **₹ 11,28,119.54**

ii) Sensitivity of NPV for a 10% reduction in Selling Price

Annual Cash Flow when Selling Price reduces by 10%

(WN 2) = ₹ 11,00,000

PVFA (5 years, 12%) = 3.6047

NPV = PVCIF –PVCOF

= 11,00,000* 3.6047 – 50,00,000

= (₹ 10,34,830)

% change in NPV = $\frac{-10,34,830-11,28,120}{11,28,120}$

= **–191.73%**

iii) Sensitivity of NPV for a 10% reduction in Sales Volume

Annual Cash Flow when Selling Price reduces by 10%

(WN 2) = ₹ 14,30,000

PVFA (5 years, 12%) = 3.6047

NPV = PVCIF –PVCOF

= 14,30,000* 3.6047 – 50,00,000

= ₹ 1,54,721

% change in NPV = $\frac{11,28,120-1,54,721}{11,28,120}$

= **86.29%**

iv) Sensitivity of NPV for a 10% reduction in Variable Cost

Annual Cash Flow when Selling Price reduces by 10%

(WN 3) = ₹ 13,70,000

PVFA (5 years, 12%) = 3.6047

NPV = PVCIF –PVCOF

= 13,70,000* 3.6047 – 50,00,000

= (₹ 61,561)

% change in NPV = $\frac{-11,28,120-61,561}{11,28,120}$

= **- 105.46%**

v) Expected NPV of the Project

Selling Price = ₹ 30

Variable Cost = ₹ 16.5

Contribution = ₹ 13.5

Value = (1,75,000*0.3 + 2,00,000*0.6 + 2,25,000*0.1)

= 1,95,000

Total Contribution = 13.5* 1,95,000

= ₹ 26,32,500

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Less: Fixed Cost	= ₹ 10,00,000
Annual Profit	= ₹ 16,32,500
PVAF (5yr, 12%)	= 3.6047
PVCIF	= ₹ 58,84,673
Less: PVCOF	= ₹ 50,00,000
NPV	= **₹ 8,84,673**

vi) There is 30% probability that the economy is in poor state, when NPV will be ₹ 88,596 (WN 5) i.e., negative value and the company's risk tolerance level is 20% and therefore the company should not undertake this project.

Working Notes:

1.

Selling Price	= ₹ 30
Less: Variable Cost	= ₹ 16.5
Contribution	= ₹ 13.5
Units sold	= ₹ 2,00,000
Total Contribution	= 2,00,000* 13.5
	= ₹ 27,00,0000
Less: Fixed Cost	= ₹ 10,00,000
Profit	= ₹ 17,00,000

Since tax details are not give, no tax or tax benefit on depreciation are considered

2.

Selling Price	= ₹ 27
Less: Variable Cost	= ₹ 16.5
Contribution	= ₹ 10.5
Units sold	= ₹ 2,00,000
Total Contribution	= 2,00,000* 10.5
	= ₹ 21,00,0000
Less: Fixed Cost	= ₹ 10,00,000
Profit	= ₹ 11,00,000

3.

Selling Price	= ₹ 30
Less: Variable Cost	= ₹ 16.5
Contribution	= ₹ 13.5
Units sold	= ₹ 1,80,000
Total Contribution	= 1,80,000* 13.5
	= ₹ 24,30,0000
Less: Fixed Cost	= ₹ 10,00,000
Profit	= ₹ 14,30,000

4.

Selling Price	= ₹ 30
Less: Variable Cost	= ₹ 18.15
Contribution	= ₹ 11.85
Units sold	= ₹ 2,00,000
Total Contribution	= 2,00,000* 11.85
	= ₹ 23,70,0000
Less: Fixed Cost	= ₹ 10,00,000
Profit	= ₹ 13,70,000

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5. NPV in poor and good state

	Poor	Good
Contribution Per Unit	₹ 13.5	₹ 13.5
Units	1,75,000	2,25,000
Total Contribution	₹ 23,62,500	₹ 30,37,500
Less: Fixed Cost	₹ 10,00,000	₹ 10,00,000
Profit	₹ 13,62,500	₹ 20,37,500
PVFA (5y, 12%)	3.6047	3.6047
PVCIF	₹ 49,11,403.75	₹ 73,44,576
Less: PVCOF	₹ 50,00,000	₹ 50,00,000
NPV	(₹ 88,596)	₹ 23,44,576

27. Illustration

The Textile Manufacturing Company Ltd. is considering one of two mutually exclusive proposals, Projects M and N, which require cash outlays of ₹ 8,50,000 and ₹ 8,25,000 respectively. The certainty-equivalent (C.E) approach is used in incorporating risk in capital budgeting decisions. The current yield on government bonds is 6% and this is used as the risk-free rate. The expected net cash flows and their certainty equivalents are as follows:

	Project M		Project N	
Year-end	**Cash Flow ₹**	**C.E.**	**Cash Flow ₹**	C.E.
1	4,50,000	0.8	4,50,000	**0.9**
2	5,00,000	0.7	4,50,000	**0.8**
3	**5,00,000**	**0.5**	**5,00,000**	**0.7**

Present value factors of ₹ 1 discounted at 6% at the end of year 1, 2 and 3 are 0.943, 0.890 and 0.840 respectively. Required:

(i) Which project should be accepted?

(ii) If risk adjusted discount rate method is used, which project would be appraised with a higher rate and why?

Solution:

NPV of Project M

	Year	Cash Flow	C.E	CECF	PVF @6%	PVCF
Instalment	0	-8,50,000	1	-8,50,000	1	- 8,50,000
Annual CF	1	4,50,000	0.8	3,60,000	0.943	3,39,480
	2	5,00,000	0.7	3,50,000	0.890	3,11,500
	3	5,00,000	0.5	2,50,000	0.840	2,10,000
			2.0			**10,980**

NPV of Project N

	Year	Cash Flow	C.E	CECF	PVF @6%	PVCF
Instalment	0	-8,25,000	1	-8,25,000	1	-8,25,000
Annual CF	1	4,50,000	0.7	4,05,000	0.943	3,81,915

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	2	4,50,000	0.8	3,60,000	0.890	3,20,400
	3	5,00,000	0.7	3,50,000	0.840	2,94,000
			2.4			**1,71,315**

NPV on C.E basis = $\sum PV\ of\ Cfi * CEi$

i) Project N should be accepted as it has higher NPV.

ii) Project M has total C.E of 2.0/3 and Project N has C.E of 2.4/3. So, **Project M is more** uncertain as its C.E quotient is lower and hence is **riskier**, and will have higher discount rate/ Risk adjusted Discount Rate.

28. Illustration

Determine the risk adjusted net present value of the following projects:

	X	Y	Z
Net cash outlays (₹)	2,10,000	1,20,000	**1,00,000**
Project life	5 years	5 years	**5 years**
Annual Cash inflow (₹)	70,000	42,000	**30,000**
Coefficient of variation	**1.2**	**0.8**	**0.4**

The Company selects the risk-adjusted rate of discount on the basis of the coefficient of variation:

Coefficient of Variation	Risk-Adjusted Rate of Return	P.V. Factor 1 to 5 years @ Risk adjusted rate of discount
0.0	10%	**3.791**
0.4	12%	**3.605**
0.8	14%	**3.433**
1.2	16%	**3.274**
1.6	18%	**3.127**
2.0	22%	**2.864**
More than 2.0	**25%**	**2.689**

Solution:

	Cash Outflow	Annual Cash Inflow	Coeff. Of Var	Disc. Rate	PVFA	PVCIF	Risk Adjusted NPV
X	(2,10,000)	70,000	1.2	16%	3.274	2,29,180	19,180
Y	(1,20,000)	42,000	0.8	14%	3.433	1,44,186	24,186
Z	(1,00,000)	30,000	0.4	12%	3.605	1,08,150	8,150

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29. Illustration

New Projects Ltd. is evaluating 3 projects, P-I, P-II, P-III. Following information is available in respect of these projects:

	P-I	P-II	P-III
Cost	₹ 15,00,000	₹ 11,00,000	**₹ 19,00,000**
Inflows-Year 1	6,00,000	6,00,000	**4,00,000**
Year 2	6,00,000	4,00,000	**6,00,000**
Year 3	6,00,000	5,00,000	**8,00,000**
Year 4	6,00,000	2,00,000	**12,00,000**
Risk Index	**1.80**	**1.00**	**0.60**

The minimum required rate of return of the firm is 15% and applicable tax rate is 40%. The risk-free interest rate is 10%.

Required:
(i) Find out the risk-adjusted discount rate (RADR) for these projects.
(ii) Which project is the best?

Solution:

Assumption: Cash flows and Discount Rates are Post Tax and tax need not be adjusted.

i) PART 1: RADR

RADR= Risk free rate + Risk Index * (Expected Return – Risk free rate)

	P1	P2	P3
Rf	10	10	10
Risk Index	1.8	1.0	0.6
Expected Return	15	15	15
Risk Premium	(15 -10) =5	(15 -10) =5	(15 -10) =5
RADR	10+ (1.8*5) = 19%	10+(1*5) = 15%	10+(0.6*5) = 13%

ii) PART 2

NPV of Project 1

PVCOF = -15,00,000
PVCIF = PVF (19%,4y) * 6,00,000
= 2.6385* 6,00,000
= 15,83,151
NPV = 15,83,151 -15,00,000
= **₹ 83,151**

NPV of Project 2

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Year	Cash Flow	PVF @ 15%	PVCF
0	-11,00,000	1	- 11,00,000
1	6,00,000	0.8695	5,21,739
2	4,00,000	0.7561	3,02,457
3	5,00,000	0.6575	3,28,758
4	2,00,000	0.57175	1,14,350
			₹ 1,67,305

NPV of Project 3

Year	Cash Flow	PVF @ 13%	
0	-19,00,000	1	- 19,00,000
1	4,00,000	0.8849	3,53,982
2	6,00,000	0.7831	4,69,888
3	8,00,000	0.6930	5,54,440
4	12,00,000	0.6133	7,35,982
			₹ 2,14,292.91

P3 has higher NPV and hence it should be chosen.

30. Illustration

Jumble Consultancy Group has determined relative utilities of cash flows of two forthcoming projects of its client company as follows:

Cash Flow in ₹	-15000	-10000	-4000	0	15000	10000	5000	1000
Utilities	-100	-60	-3	0	40	30	20	10

The distribution of cash flows of project A and Project B are as follows:

Project A

Cash Flow (₹)	-15000	- 10000	15000	10000	5000
Probability	0.10	0.20	0.40	0.20	0.10
Project B					
Cash Flow (₹)	- 10000	-4000	15000	5000	10000
Probability	0.10	0.15	0.40	0.25	0.10

Which project should be selected and why ?

Solution:

	A				B		
Cash Flow	Pi	Utility	Pi* U	Cash Flow	Pi	Utility	Pi* U
-15,000	0.1	-100	-10	-10,000	0.1	-60	-6
-10,000	0.2	-60	-12	-4,000	0.15	-3	-0.45
15,000	0.4	40	16	15,000	0.4	40	16
10,000	0.2	30	6	5,000	0.25	20	5

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5,000	0.1	20	2	10,000	0.1	30	3
	1.0	-70	2		1.0	27	17.55

PW of Project A = -1,500 -2,000 +6,000 +2,000 +500
= 5,000

PW of Project B = -1,000 -600 +6,000 +1,250 +1,000
= 6,650

Evaluation

	A	**B**
Expected Cash Flow	5,000	6,650
Probability Weighted Utility Value	2	17.55

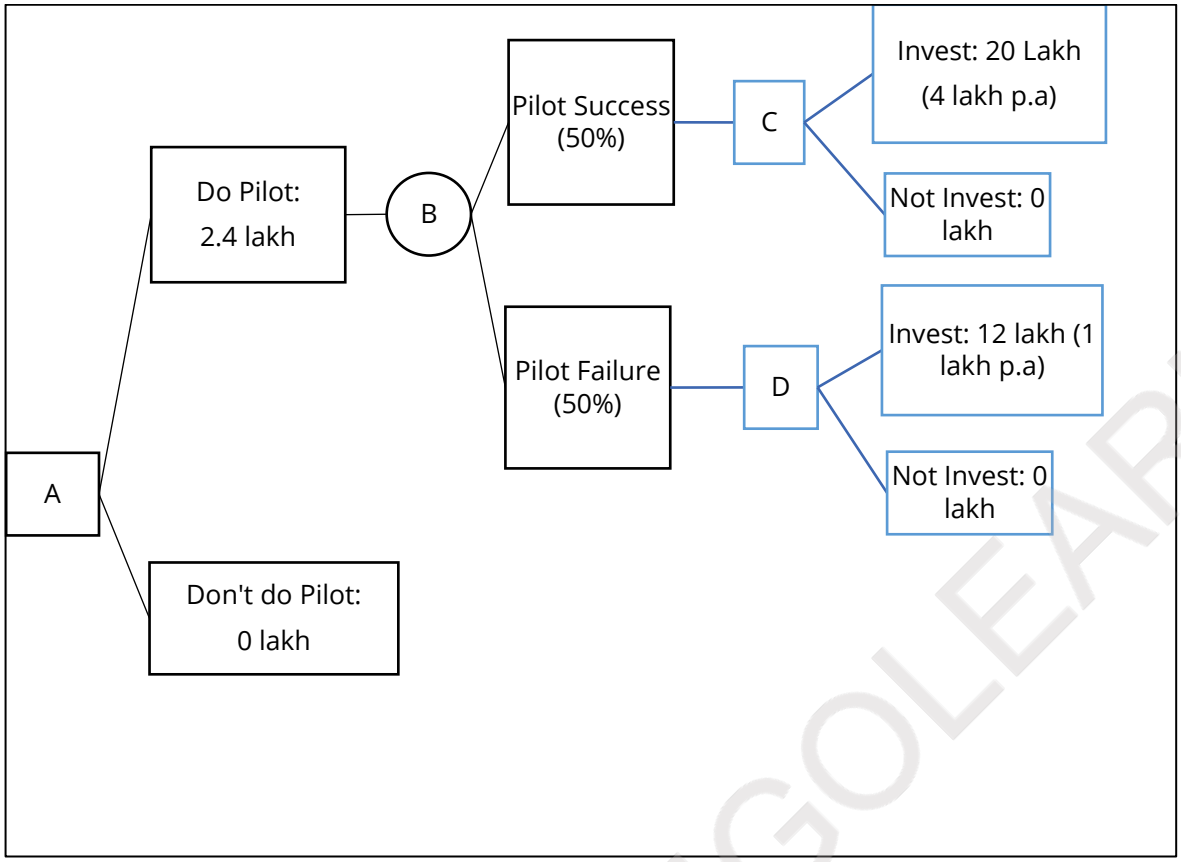
The company **should undertake Project B** given that its utility value and expected cash flow are higher than Project A.

31. Illustration

L & R Limited wishes to develop new virus-cleaner software. The cost of the pilot project would be ₹ 2,40,000. Presently, the chances of the product being successfully launched on a commercial scale are rated at 50%. In case it does succeed. L&R can invest a sum of ₹ 20 lacs to market the product. Such an effort can generate perpetually, an annual net after tax cash income of ₹ 4 lacs. Even if the commercial launch fails, they can make an investment of a smaller amount of ₹ 12 lacs with the hope of gaining perpetually a sum of ₹ 1 lac. Evaluate the proposal, adopting decision tree approach. The discount rate is 10%.

Solution:

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Value at Node C = ₹ 4,00,000 p.a till perpetuity

Value of ₹ 4,00,000 p.a till perpetuity (@10% discount rate) = $\frac{400000}{0.1}$
= ₹ 40,00,000
Less: Investment = ₹ 20,00,000
NPV = ₹ 20,00,000

Value of Node D = ₹ 1,00,000 p.a till perpetuity

Value of ₹ 1,00,000 p.a till perpetuity (@10% discount rate) = $\frac{100000}{0.1}$
= ₹ 10,00,000
Less: Investment = ₹ 12,00,000
NPV = -₹ 2,00,000

Value at Node B = Probability A* NPV (A) + Probability B* NPV (B)
= 0.5*20,00,000 + 0.5*0
= ₹ 10,00,000

Value at Node A = Invest ₹ 2,40,000 and get ₹ 10,00,000
NPV (When Pilot is done) = ₹ 7,60,000
NPV (No Pilot) = ₹ 0

The company **should go ahead with pilot as investment** of ₹ 2,40,000 will generate ₹ 10,00,000 that is NPV of ₹ 7,60,000

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32. Illustration

A firm has an investment proposal, requiring an outlay of ₹ 80,000. The investment proposal is expected to have two years economic life with no salvage value. In year 1, there is a 0.4 probability that cash inflow after tax will be ₹ 50,000 and 0.6 probability that cash inflow after tax will be ₹ 60,000. The probability assigned to cash inflow after tax for the year 2 is as follows:

The cash inflow year 1	₹ 50,000		₹ 60,000	
The cash inflow year 2	**Probability**		Probability	
	₹ 24,000	0.2	₹ 40,000	0.4
	₹ 32,000	0.3	₹ 50,000	0.5
	₹ 44,000	**0.5**	**₹ 60,000**	**0.1**

The firm uses a 10% discount rate for this type of investment. Required:

(i) Construct a decision tree for the proposed investment project and calculate the expected net present value (NPV).

(ii) What net present value will the project yield, if worst outcome is realized? What is the probability of occurrence of this NPV?

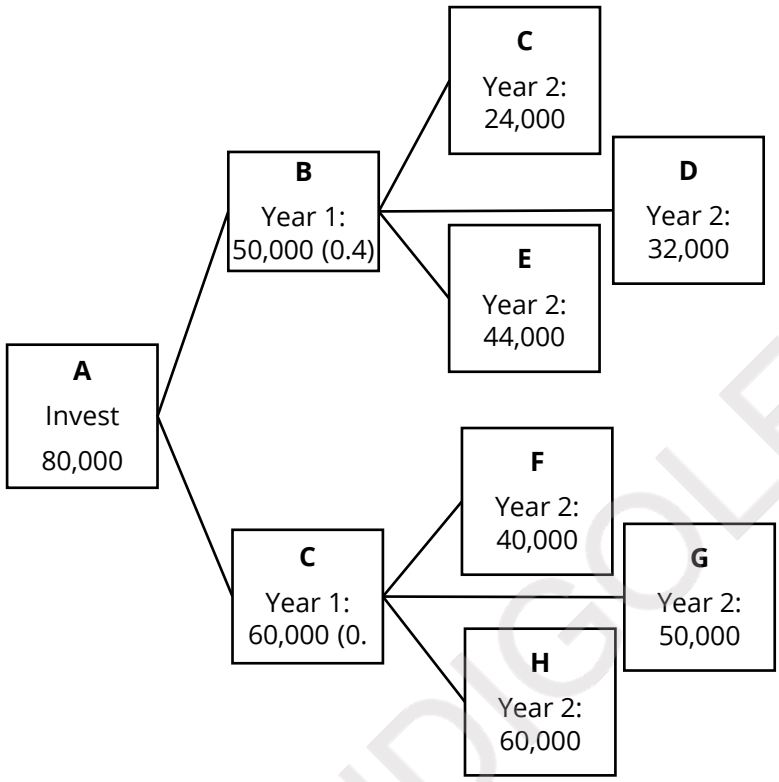
(iii) What will be the best outcome and the probability of that occurrence?

(iv) Will the project be accepted?

(Note: 10% discount factor 1 year 0.909; 2 year 0.826)

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Solution:



i) Expected Value

Part	Year 1 Cf* PV	Year 2 Cf*PV	- Invest	NPV (1)	Joint Probability (2)	(1)* (2)
1	= 50,000*0.909 = 45,450	= 24,000*0.826 = 19,824	- 80,000	-14,726	= 0.4*0.2 = 0.08	-1,178.08
2	45,450	= 32,000*0.826 = 26,432	- 80,000	-8,118	= 0.4*0.3 = 0.12	-974.16
3	45,450	= 44,000*0.826 = 36,344	- 80,000	1,794	= 0.4*0.5 = 0.2	358.8
4	= 60,000*0.909 = 54,540	= 40,000*0.826 = 33,040	- 80,000	7,580	= 0.6*0.4 =0.24	1,819.2
5	54,540	= 50,000*0.826 = 41,300	- 80,000	15,840	= 0.6*0.5 = 0.3	4,752
6	54,540	= 60,000*0.826 = 49,560	- 80,000	24,100	= 0.6*0.1 = 0.06	1,446

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						6,223.76

Expected Value = **₹ 6,223.76**

ii) If worst outcome is realised, the NPV will be –**₹ 14,726** and probability will be 0.08

iii) If best outcome is realised, the NPV will be –**₹ 24,100** and probability will be 0.06

iv) Yes, the project is accepted as the expected value of NPV is positive at **₹ 6,223.76.**

33. Illustration

A Company named Roby's cube decided to replace the existing Computer system of their organization. The original cost of the old system was ₹ 25,000 and it was installed 5 years ago. Current market value of old system is ₹ 5,000. Depreciation of the old system was charged with life of 10 years with Estimated Salvage value as Nil. Depreciation of the new system will be charged with life over 5 years. Present cost of the new system is ₹ 50,000. Estimated Salvage value of the new system is ₹ 1,000. Estimated cost savings with the new system is ₹ 5,000 per year. Increase in sales with new system is assumed at 10% per year based on original total sales of ₹ 1,00,000. Company follows straight line method of depreciation. The cost of capital of the company is 10% whereas tax rate is 30%. Evaluate the replacement decision.

Solution:

	Old System	**New System**
Original Cost	25,000	50,000
Original Life	10 years	5 years
Life Expected	5 years	0
Market Value (Today)	5,000	
Salvage Value (10 yrs)	0	1,000
Savings		5,000
Sales	1,00,000	
Increase In Sales		10,000 p.a
Depreciation	SLM	SLM
Kc	10%	10%
Tax	30%	30%

STEP 1:

Cash Outflow of New System + Cash Inflow of Old System

= -50,000 + 7,250 = **-42,750**

Calculation:

Book Value of Old System

Depreciation = $\frac{25,000-0}{10}$ = ₹ 2,500

Life Exhausted = 5 years

Depreciation for 5 years = 5* 2500

= 12,500

Current Book Value = 25,000- 12,500 = ₹ 12,500

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Cash Inflow from Old System

i) Market Value = ₹ 5,000

ii) Tax Benefit on Loss = (Book Value – Market Value) * Tax Rate

= (12,500–5,000)*30% = ₹ 2,250

Cash Inflow = 5,000+ 2,250 = 7,250

Cash Outflow from New System

= – 50,000

STEP 2:

Changes in Annual Cash Flows

= **(Change in Sales+ Change in Savings) (1–t) + (Change in Depreciation)*t**

= (15,000) *(1-30%) + 7,300*30%

= 10,500+ 2,190 = **₹ 12,690**

Calculation:

i) Increase in Sales = ₹ 1,00,000* 10% = ₹ 10,000

ii) Savings = ₹ 5,000

iii) Change in Depreciation

= New depreciation – Old Depreciation

= 9,800 – 2,500 = 7,300

New depreciation = (Original cost – Salvage Value)/Life

= 50000-1000/5 = 9,800

STEP 3:

PV of Annual Cash Flow @10% for 5 Years

= (12,690* 3.790786) + (1000*0.62092)

= 48,105.08 + 620.92 = **₹ 48,726**

STEP 4:

PV of Cash Inflow+ PV of Cash Outflow

= 48,726– 42,750 = **₹ 5,976**

STEP 5:

Since NPV>0, the replacement **decision is correct**.

34. Illustration

X Ltd. is a taxi operator. Each taxi cost to company ₹ 4,00,000 and has a useful life of 3 years. The taxi's operating cost for each of 3 years and salvage value at the end of year is as follow s:

	Year 1	Year 2	Year 3
Operating Cost	₹ 1,80,000	₹ 2,10,000	**₹ 2,38,000**
Resale Value	**₹ 2,80,000**	**₹ 2,30,000**	**₹ 1,68,000**

You are required to determine the optimal replacement period of taxi if cost of capital of X Ltd. is 10%.

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Solution:

EAC at the end of Year 1

Period	0	1
Cash Flow	(4,00,000)	(1,80,000)+ 2,80,000 = 1,00,000
PVF	1	0.909
PVCF	(4,00,000)	90,909.09
PVCF		(3,09,090.9)
EAC	$\frac{3,09,090.9}{0.909}$	= **3,40,034**

EAC at the end of Year 2

Period	0	1	2
Cash Flow	(4,00,000)	(1,80,000)	(2,10,000)+ 2,30,000 = 20,000
PVF	1	0.909	0.826
PVCF	(4,00,000)	1,63,636	16,528.92
PVCF		(5,47,107.08)	
EAC	$\frac{5,47,107.08}{1.7353}$	= **3,15,237.89**	

EAC at the end of Year 3

Period	0	1	2	3
Cash Flow	(4,00,000)	(1,80,000)	(2,10,000)	(70,000)
PVF	1	0.909	0.826	0.7513
PVCF	(4,00,000)	(1,63,636.36)	(1,73,553.72)	(52,592.04)
PVCF		(7,89,782.12)		
EAC	$\frac{7,89,782.12}{2.48685}$	= **3,17,583**		

The optimum replacement period is at the end of two years because EAC is less at the end of year 2

35. Illustration

Company X is forced to choose between two machines A and B. The two machines are designed differently but have identical capacity and do exactly the same job. Machine A costs
₹ 1,50,000 and will last for 3 years. It costs ₹ 40,000 per year to run. Machine B is an 'economy' model costing only ₹ 1,00,000, but will last only for 2 years, and costs ₹ 60,000 per year to run. These are real cash flows. The costs are forecasted in rupees of constant purchasing power. Ignore tax. Opportunity cost of capital is 10 per cent. Which machine company X should buy?

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Solution:

Machine	A	B
Cost	1,50,000	1,00,000
Annual Maintenance (p.y)	40,000	60,000
Life	3	2
Cost of Capital	10%	10%

Machine	A	B
Cost	1,50,000	1,00,000
PVAF	2.48685	1.7355
PV of Maintenance Cost	2.4865* 40,000 = (99,474.08)	1.7355* 60,000 = (1,04,132.23)
Total PV of all Cash Flows (PVCF)	(2,49,474.08)	(2,04,132.23)
EAC= $\frac{PVCF}{PVAF}$	1,00,331.42	1,17,621.56

Since **EAC of Machine A is lower**, X Ltd. Is advised to go with it.

36. Illustration

Company Y is operating an elderly machine that is expected to produce a net cash inflow of ₹ 40,000 in the coming year and ₹ 40,000 next year. The current salvage value is ₹ 80,000 and next year's value is ₹ 70,000. The machine can be replaced now with a new machine, which costs ₹ 1,50,000, but is much more efficient and will provide a cash inflow of ₹ 80,000 a year for 3 years. Company Y wants to know whether it should replace the equipment now or wait a year with the clear understanding that the new machine is the best of the available alternatives and that it in turn be replaced at the optimal point. Ignore tax. Take opportunity cost of capital as 10 per cent. Advise with reasons.

Solution:

	Year	Old Machine	New Machine
Cash Inflow	Year 1	40,000	80,000
	Year 2	40,000	80,000
	Year 3		80,000
Salvage Value	Year 0	80,000	
	Year 1	70,000	
Cash Outflow	Year 0		(1,50,000)

Alternative 1: Replace Now

Salvage Value of
Old Machine = 80,000
Cost of New Machine = (1,50,000)
Cash Flow of Year 0 = (70,000)
Cash Flows Year (1-3) = 80,000 * 2.48685 (PVAF- 3,10%)

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= 1,98,948

PVCF = (70,000) + 1,98,948

= **1,28,948**

Alternative 2: Replace after a Year

	Year	Cash Flow	PVF	PVCF
Cash Inflow Old	1	40,000	0.909	36,364
Salvage Old	1	70,000	0.909	63,636
Expense New	1	(1,50,000)	0.909	(1,36,364)
			(A)	**(36,364)**
Year 2-4 Cash flows from New Machine	2-4	80,000	2.260	**(B)**1,80,862

PV at Year 0 for New Machine (cash Inflows) = 1,80,862 **(B)**

NPV as on day 0 for Replacement After Year 1 = **(A) + (B)**

= 1,80,862- 36,364 = **₹ 1,44,498**

Hence it is better to **replace after Year 1** as NPV is higher.

37. Illustration

Trouble Free Solutions (TFS) is an authorized service center of a reputed domestic air conditioner manufacturing company. All complaints/service-related matters of Air conditioner are attended by this service center. The service center employs many mechanics, each of whom is provided with a motorbike to attend to the complaints. Each mechanic travels approximately 40000 kms per annum. TFS decides to continue its present policy of always buying a new bike for its mechanics but wonders whether the present policy of replacing the bike every three years is optimal or not. It is believed that as new models are entering into the market on a yearly basis, it wishes to consider whether a replacement of either one year or two years would be a better option than present three-year period. The fleet of bikes is due for replacement shortly soon.

The purchase price of the latest model bike is ₹ 55,000. Resale value of used bike at current prices in market is as follows:

Period	₹
1 Year old	**35,000**
2-Year-old	**21,000**
3-Year-old	**9,000**

Running and Maintenance expenses (excluding depreciation) are as follows:

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Year	Road Taxes Insurance etc. (₹)	Petrol Repair Maintenance etc. (₹)
1	3,000	30,000
2	3,000	35,000
3	3,000	43,000

Using opportunity cost of capital as 10% you are required to determine optimal replacement period of bike.

Solution:

Cost of running a bike for years 1,2,3 and salvage value.

Year	Total Expenses	Salvage Value	PVF @ 10%	Cash Flow	PVCF
1	33,000	35,000	0.909	2,000	1,818
2	38,000	21,000	0.8264	(17,000)	(14,049)
3	46,000	9,000	0.7513	(37,000)	(27,798.1)

NPV of Cumulative Cash Flows for the bike

Year	PV of Previous Year Expenses	PV of CY	Cumulative NPV
1	0	1,818	(1,818)
2	(33,000) * 0.909	(14,049)	(44,046)
3	(33,000) * 0.909 (38,000)* 0.8264	(27,798)	(89,198)

Expenses for a new Bike + Cumulative Costs

Year	PV of Previous Year Expenses	Cumulative Cash Flows NPV	Cumulative Cost PV
1	-55,000	(1,818)	53,182
2	-55,000	(44,046)	99,046
3	-55,000	(89,198)	1,44,198

EAC of Cumulative Cost

Year	Cumulative Cost PV	Cumulative Cash Flows NPV	EAC
1	53,182	0.909	58,506
2	99,046	1.7354	57,074
3	1,44,198	2.4867	57,987

As the EAC is lowest for replacement after year 2, it is advised to **replace after year 2.**

38. Illustration

A machine used on a production line must be replaced at least every four years. Costs incurred to run the machine according to its age are:

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Age of the Machine (years)

	0	1	2	3	4
Purchase price (in ₹)	60,000				
Maintenance (in ₹)		16,000	18,000	20,000	**20,000**
Repair (in ₹)		0	4,000	8,000	**16,000**
Scrap Value (in ₹)		32,000	24,000	16,000	**8,000**

Future replacement will be with identical machine with same cost. Revenue is unaffected by the age of the machine. Ignoring inflation and tax, determine the optimum replacement cycle. PV factors of the cost of capital of 15% for the respective four years are 0.8696, 0.7561, 0.6575 and 0.5718.

Solution:

Replacement Cycle:

Repl. Cycle Years		**1**		**2**	
Year	**PVF 15%**	**CF**	**PVCF**	**CF**	**PVCF**
0	1	-60,000	-60,000	-60,000	-60,000
1	0.896	16,000	13,913.6	-16,000	-13,913.6
2	0.7561			2,000	1,512.2
3	0.6575				
4	0.5718				
			-46,086.4		**-72,401**

Repl. Cycle Years		**3**		**4**	
Year	**PVF 15%**	**CF**	**PVCF**	**CF**	**PVCF**
0	1	-60,000	-60,000	-60,000	-60,000
1	0.896	-16,000	-13,913.6	-16,000	-13,913.6
2	0.7561	-22,000	-16,634.2	-22,000	-16,634.2
3	0.6575	-12,000	-7,890	-28,000	-18,410
4	0.5718			-28,000	-16,010.4
			-98,437.8		**-1,24,968.2**

Optimum Replacement Cycle:

$$EAC = \frac{CumCF}{PVAF}$$

Replacement Period	**Cum. PV of CF (1)**	**PVAF (2)**	**(1)/ (2)**
1	-46,086.4	0.896	52,997
2	-72,401	1.6257	44,535
3	-98,437.8	2.2832	43,113.96
4	-1,24,968.2	2.855	43,771.7

The optimum replacement cycle is **after 3 years.** When EAC is lowest at ₹ 43,113.96.

Working Notes:

1. Replacement at the end of Year 1:

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Year	0	1
Cash Flows:		
Purchase	-60,000	
Maintenance		-16,000
Repairs		0
Scrap		32,000
	-60,000	16,000

2. Replacement at the end of Year 2:

Year	0	1	2
Cash Flows:			
Purchase	-60,000		
Maintenance		-16,000	-18,000
Repairs			-4,000
Scrap			24,000
	-60,000	-16,000	2,000

3. Replacement at the end of Year 3:

Year	0	1	2	3
Cash Flows:				
Purchase	-60,000			
Maintenance		-16,000	-18,000	-20,000
Repairs			-4,000	-8,000
Scrap				16,000
	-60,000	16,000	-22,000	-12,000

4. Replacement at the end of Year 4:

Year	0	1	2	3	4
Cash Flows:					
Purchase	-60,000				
Maintenance		-16,000	-18,000	-20,000	-20,000
Repairs			-4,000	-8,000	-16,000
Scrap					8,000
	-60,000	**16,000**	**-22,000**	**-28,000**	**-28,000**

39. Illustration

A company has an old machine having book value zero – which can be sold for ₹ 50,000. The company is thinking to choose one from following two alternatives:

(i) To incur additional cost of ₹ 10,00,000 to upgrade the old existing machine.

(ii) To replace old machine with a new machine costing ₹ 20,00,000 plus installation cost ₹ 50,000.

Both above proposals envisage useful life to be five years with salvage value to be nil. The expected after-tax profits for the above three alternatives are as under:

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Year	Old existing Machine (₹)	Upgraded Machine (₹)	New Machine (₹)
1	5,00,000	5,50,000	**6,00,000**
2	5,40,000	5,90,000	**6,40,000**
3	5,80,000	6,10,000	**6,90,000**
4	6,20,000	6,50,000	**7,40,000**
5	6,60,000	7,00,000	**8,00,000**

The tax rate is 40 per cent. The company follows straight line method of depreciation. Assume cost of capital to be 15 per cent.
P.V.F. of 15%, 5 = 0.870, 0.756, 0.658, 0.572 and 0.497. You are required to advise the company as to which alternative is to be adopted.

Solution:

i) Upgraded Machine

Year	0	1	2	3	4	5
PAT		5,50,000	5,90,000	6,10,000	6,50,000	7,00,000
Add: Depreciation		2,00,000	2,00,000	2,00,000	2,00,000	2,00,000
CFAT		7,50,000	7,90,000	8,10,000	8,50,000	9,00,000
Investment	-10,00,000					

PV Factor	Cash Flows	PV of Cash Flows
1	-10,00,000	-10,00,000
0.87	7,50,000	6,52,500
0.756	7,90,000	5,97,240
0.658	8,10,000	5,32,980
0.572	8,50,000	4,86,200
0.497	9,00,000	4,47,300
	NPV	**17,16,220**

Depreciation:
No Salvage of Old Machine
Upgradation Cost = 10,00,000
Depreciation = $\frac{10,00,000}{5}$ = 2,00,000

ii) Replacement:

Year	0	1	2	3	4	5
PAT		6,00,000	6,40,000	6,90,000	7,40,000	8,00,000
Scrap (After Tax)	30,000					
Add: Depreciation		4,10,000	4,10,000	4,10,000	4,10,000	4,10,000
CFAT		10,10,000	10,50,000	11,00,000	11,50,000	12,10,000
Investment	-20,50,000					

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PV Factor	Cash Flows	PV of Cash Flows
1	-20,20,000	-20,20,000
0.87	10,10,000	8,78,700
0.756	10,50,000	7,93,800
0.658	11,00,000	7,23,800
0.572	11,50,000	6,57,800
0.497	12,10,000	6,01,370
	NPV	**16,35,470**

Replacement Scrap Value = 50,000
Less: Tax = (20,000)
Net Scrap = 30,000

Cost of New = 20,50,000
Depreciable Life = 5 years
Depreciation = 4,10,000

iii) PAT of Old Machine:

Year	0	1	2	3	4	5
PAT	0	5,00,000	5,40,000	5,80,000	6,20,000	6,60,000
PVF	1	0.87	0.756	0.658	0.572	0.497
PVCF	0	4,35,000	4,08,240	3,81,640	3,54,640	3,28,020
NPV	**19,07,540**					

Continuing with old machine is most preferred as it gives the highest NPV of **₹19,07,540.**

40. Illustration

A & Co. is contemplating whether to replace an existing machine or to spend money on overhauling it. A & Co. currently pays no taxes. The replacement machine costs ₹ 90,000 now and requires maintenance of ₹ 10,000 at the end of every year for eight years. At the end of eight years it would have a salvage value of ₹ 20,000 and would be sold. The existing machine requires increasing amounts of maintenance each year and its salvage value falls each year as follows:

Year	Maintenance (₹)	Salvage (₹)
Present	0	**40,000**
1	10,000	**25,000**
2	20,000	**15,000**
3	30,000	**10,000**
4	40,000	**0**

The opportunity cost of capital for A & Co. is 15%. Required:
When should the company replace the machine?
(Notes: Present value of an annuity of Re. 1 per period for 8 years at interest rate of 15% : 4.4873; present value of Re. 1 to be received after 8 years at interest rate of 15% : 0.3269).

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Solution:

Year	0	1–8	8
Cash Flow	-90,000 Investment	-10,000 Maintenance	20,000 Salvage Value
PV Factor	1	4.4873	0.3269
Present Value	-90,000	-44,873	6538

Net Present Value = -1,28,335 (excluding old machine scrap)

Equivalent Annual Cost = $-\frac{1,28,335}{4.4873}$ = - 28,599.6 = -28,600

Case: Machine Replaced in Year 0		PVF	PVCF
Cash Flow	40,000	1	40,000
EAC of New Machine	(28,600)	1	(28,600)
			11,400

Case: Machine Replaced in Year 1		PVF	PVCF
Cash Flow	25,000	0.8695	
	(10,000)	0.8695	
	(28,600)	0.8695	
	(13,600)	0.8695	**(11,825.2)**

Case: Machine Replaced in Year 2

Year	Cash Flow	PVF	PVCF
1	(10,000)	0.8695	(8,695)
2	(20,000)	0.7561	
2	15,000	0.7561	(25,405)
2	(28,600)	0.7561	
			(34,100)

Case: Machine Replaced in Year 3

Year	Cash Flow	PVF	PVCF
1	(10,000)	0.8695	(8,695)
2	(20,000)	0.7561	(15,122)
3	(30,000)	0.6575	(19,725)
3	10,000	0.6575	6,575
3	(28,600)	0.6575	(18,804.5)
			(55,771.5)

Case: Machine Replaced in Year 4

Year	Cash Flow	PVF	PVCF
1	(10,000)	0.8695	(8,695)
2	(20,000)	0.7561	(15,122)
3	(30,000)	0.6575	(19,725)
4	(40,000)	0.5717	(22,868)
4	(28,600)	0.5717	(16,350.62)
			(82,760.62)

It is better to **replace in year 1** itself as NPV of replacement cost is the least

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SECURITY ANALYSIS (6Q)

1. Illustration

Closing values of BSE Sensex from 6th to 17th day of the month of January of the year 2020 were as follows.

Days	Date	Day	Sensex
1	6	Thursday	14522
2	7	Friday	14925
3	8	Saturday	No trading
4	9	Sunday	No Trading
5	10	Monday	15222
6	11	Tuesday	16000
7	12	Wednesday	16400
8	13	Thursday	17000
9	14	Friday	No Trading
10	15	Saturday	No Trading
11	16	Sunday	No Trading
12	17	Monday	18000

Calculate EMA of Nifty during the above period. The previous day EMA of Sensex can be assumed as 15,000. The Value of exponent for 31 days EMA is 0.062

Solution :

Day	Sensex	Pt	EMA of Previous Day	Exponent (2/n+1)	EMA for the Day
6	14522	14522	15000	0.062	(14522*0.062) + (1-0.062) × 15000 = **14,970**
7	14925	14925	14970	0.062	(14925*0.062) + (1-0.062) × 14970 = **14,968**
10	15222	15222	14968	0.062	(15222*0.062) + (1- 0.062) × 14968 = **14,983**
11	16000	16000	14,983	0.062	(16000*0.062) + (1- 0.062) × 14,983 = **15,046**
12	16400	16400	15,046	0.062	(16,400*0.062) + (1- 0.062) × 15,046 = **15,130**
13	17000	17000	15,130	0.062	(17000*0.062) + (1- 0.062) × 15,130 = **15,246**
17	18000	18000	15,246	0.062	(18000*0.062) + (1- 0.062) × 15,246 = **15,417**

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2. Illustration

Closing values of TCS for the month of January and August 2021 were as follows.

Date	Close Price	Date	Close Price
30-Aug-21	3,701.40	29-Jan-21	3,112.90
27-Aug-21	3,720.15	28-Jan-21	3,199.45
26-Aug-21	3,671.05	27-Jan-21	3,261.05
25-Aug-21	3,659.50	25-Jan-21	3,290.20
24-Aug-21	3,612.20	22-Jan-21	3,303.40
23-Aug-21	3,635.85	21-Jan-21	3,274.80
20-Aug-21	3,557.45	20-Jan-21	3,308.20
18-Aug-21	3,558.50	19-Jan-21	3,265.15
17-Aug-21	3,552.40	18-Jan-21	3,220.80
16-Aug-21	3,471.75	15-Jan-21	3,233.60
13-Aug-21	3,461.90	14-Jan-21	3,250.15
12-Aug-21	3,353.95	13-Jan-21	3,158.80
11-Aug-21	3,340.55	12-Jan-21	3,172.85
10-Aug-21	3,333.25	11-Jan-21	3,175.05
09-Aug-21	3,322.40	08-Jan-21	3,120.35
06-Aug-21	3,310.15	07-Jan-21	3,032.70
05-Aug-21	3,285.15	06-Jan-21	3,052.95
04-Aug-21	3,273.45	05-Jan-21	3,092.30
03-Aug-21	3,284.15	04-Jan-21	3,039.25
02-Aug-21	3,217.90	01-Jan-21	2,928.20

You are required:

To test the Weak Form of Market Efficiency using Auto-Correlation test, assuming the time lag is 211 days.

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Solution :

Date	Close Price	X (Change from Previous Day)	X mean	X – X Mean	(X-X Mean)^2
30-Aug-21	3,701.40	(18.75)	25.45	=(18.75)-25.45 = (44.20)	1,953.41
27-Aug-21	3,720.15	49.10	25.45	23.65	559.45
26-Aug-21	3,671.05	11.55	25.45	(13.90)	193.14
25-Aug-21	3,659.50	47.30	25.45	21.85	477.54
24-Aug-21	3,612.20	(23.65)	25.45	(49.10)	2,410.55
23-Aug-21	3,635.85	78.40	25.45	52.95	2,803.98
20-Aug-21	3,557.45	(1.05)	25.45	(26.50)	702.11
18-Aug-21	3,558.50	6.10	25.45	(19.35)	374.32
17-Aug-21	3,552.40	80.65	25.45	55.20	3,047.33
16-Aug-21	3,471.75	9.85	25.45	(15.60)	243.28
13-Aug-21	3,461.90	107.95	25.45	82.50	6,806.68
12-Aug-21	3,353.95	13.40	25.45	(12.05)	145.14
11-Aug-21	3,340.55	7.30	25.45	(18.15)	329.33
10-Aug-21	3,333.25	10.85	25.45	(14.60)	213.08
09-Aug-21	3,322.40	12.25	25.45	(13.20)	174.17
06-Aug-21	3,310.15	25	25.45	(0.45)	0.2
05-Aug-21	3,285.15	11.70	25.45	(13.75)	188.99
04-Aug-21	3,273.45	(10.70)	25.45	(36.15)	1,306.63
03-Aug-21	3,284.15	66.25	25.45	40.80	1,664.85
02-Aug-21	3,217.90				

N			19
Average/Mean	25.45		
Sum			23,594.18
Variance			=23,594.18/19 = 1,241.80
Standard Deviation			$= \sqrt{1241.80}$ = **35.24**

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Date	Close Price	X (Change from Prev Day)	X mean	X – X Mean	(X-X Mean)^2	(x-X mean) (y-Y mean)
29-Jan-21	3,112.90	(86.55)	9.72	(96.27	9268.12	4254.93
28-Jan-21	3,199.45	(61.60)	9.72	(71.32)	5,086.69	(1686.93)
27-Jan-21	3,261.05	(29.15)	9.72	(38.87)	1510.96	540.21
25-Jan-21	3,290.20	(13.20)	9.72	(22.92)	525.37	(500.89)
22-Jan-21	3,303.40	28.60	9.72	18.88	356.41	(926.91)
21-Jan-21	3,274.80	(33.40)	9.72	(43.12)	1,859.43	(2283.37)
20-Jan-21	3,308.20	43.05	9.72	33.33	1,110.82	(883.13)
19-Jan-21	3,265.15	44.35	9.72	34.63	1,199.16	(669.98)
18-Jan-21	3,220.80	(12.80)	9.72	(22.52)	507.2	(1243.22)
15-Jan-21	3,233.60	(16.55)	9.72	(26.27)	690.17	409.76
14-Jan-21	3,250.15	91.35	9.72	81.63	6,663.29	6,734.60
13-Jan-21	3,158.80	(14.05)	9.72	(23.77)	565.06	286.38
12-Jan-21	3,172.85	(2.20)	9.72	(11.92)	142.11	216.34
11-Jan-21	3,175.05	54.70	9.72	44.98	2,023.11	(656.57)
08-Jan-21	3,120.35	87.65	9.72	77.93	6,072.92	(1028.46)
07-Jan-21	3,032.70	(20.25)	9.72	(29.97)	898.26	13.41
06-Jan-21	3,052.95	(39.35)	9.72	(49.07)	2,407.97	674.60
05-Jan-21	3,092.30	53.05	9.72	43.33	1,877.40	(1566.23)
04-Jan-21	3,039.25	111.05	9.72	101.33	10,267.56	4,134.49
01-Jan-21	2,928.20					
N		19				
Average / Mean		9.72				
Sum					53,032.00	
Variance					=53,032/19 = 2,791.16	
Standard Deviation					=$\sqrt{2791.16}$ = **52.83**	
Sum of (x – X Mean) (y-Y Mean)						**=5,819.018**
Covariance						= **5,819.018/19** Sum of (x-X Mean) (y-Y Mean)/N = **306.26**
Correlation						= Cov (X,Y)/ $SD_x \times SD_y$ **=306.26/(35.24 × 52.83)** = **16.45%**

Alternatively, students can take percentage change instead of absolute price changes.

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3. Illustration

Mr. X is of the opinion that market has recently shown the Weak Form of Market Efficiency. In order to test the validity of his impression he has collected the following data relating to the movement of the SENSEX for the last 20 days.

Days	Open	High	Low	Close
1	33470.94	33513.79	33438.03	33453.99
2	33453.64	33478.11	33427.82	33434.83
3	33414.06	33440.29	33397.65	33431.93
4	33434.94	33446.18	33377.78	33383.41
5	33372.92	33380.27	33352.12	33370.93
6	33375.85	33389.49	33331.42	33340.75
7	33340.89	33340.89	33310.95	33330.98
8	33326.84	33340.91	33306.17	33335.08
9	33307.16	33328.22	33296.43	33301.97
10	33298.64	33318.60	33254.28	33259.03
11	33260.04	33228.85	33241.66	33251.53
12	33255.92	33289.46	33249.46	33285.89
13	33288.86	33535.67	33255.98	33329.28
14	33335.00	33346.21	33276.72	33284.17
15	33293.83	33310.86	33278.54	33298.78
16	33300.02	33337.79	33300.02	33325.38
17	33323.36	33356.34	33322.44	33329.95
18	33322.81	33345.98	33317.44	33319.67
19	33317.51	33321.18	33294.19	33302.32
20	33290.86	33324.96	33279.62	33319.61

You are required to test the Weak Form of Market Efficiency using Auto-Correlation test, taking time lag of 10 days

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Solution :

Day	Sensex	Price Change from Previous Day (X)
1	33453.99	
2	33434.83	(19.16)
3	33431.93	(2.84)
4	33383.41	(48.58)
5	33370.93	(12.48)
6	33340.75	(30.18)
7	33330.98	(9.82)
8	33335.08	4.15
9	33301.97	(33.11)
10	33259.03	(42.94)
11	33251.53	(21.66)
12	33285.89	34.36
13	33329.28	43.39
14	33284.17	(45.11)
15	33298.78	14.61
16	33325.38	26.60
17	33329.95	4.57
18	33319.67	(10.28)
19	33302.32	(17.35)
20	33319.61	17.29

Day	Sensex	Price change	Day	Sensex	Price change
		X			Y
1	33,453.99		11	33251.53	
2	33,434.83	(19.16)	12	33285.89	34.36
3	33,431.99	(2.84)	13	33329.28	43.39
4	33,383.41	(48.58)	14	33284.17	(45.11)
5	33,370.93	(12.48)	15	33298.78	14.61
6	33,340.75	(30.18)	16	33325.38	26.60
7	33,330.93	(9.82)	17	33329.95	4.57
8	33,335.08	4.15	18	33319.67	(10.28)
9	33,301.97	(33.11)	19	33302.32	(17.35)
10	33,259.03	(42.94)	20	33319.61	17.29
	X mean	(21.66)			7.56

Days	x - x mean	x - x mean	y - y mean	y - y mean
1	-19.16 - -21.66	2.50	34.36 - 7.56	26.80
2	-2.84 - -21.66	18.82	43.39 - 7.56	35.83
3	-48.58 - -21.66	(26.92)	-45.11 - 7.56	- 52.67
4	-12.48 - -21.66	9.18	14.61 - 7.56	7.05
5	-30.18 - -21.66	(8.52)	26.6 - 7.56	19.04
6	-9.82 - -21.66	11.84	4.57 - 7.56	- 2.99
7	4.15 - -21.66	25.81	-10.28 - 7.56	- 17.84
8	-33.11 - -21.66	(11.45)	-17.35 - 7.56	- 24.91
9	-42.94 - -21.66	(21.28)	17.29 - 7.56	9.73

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	X – X mean	(X – X mean)^2	Y – Y Mean	(Y – Y Mean)^2	(X – X Mean) (Y – Y Mean)
1	2.5	6.26	26.80	718	67.05
2	18.82	354.28	35.83	1,283.47	674.32
3	(26.92)	724.57	(52.67)	2,774.60	1417.88
4	9.18	84.31	7.05	49.64	64.69
5	(8.52)	72.55	(19.04)	362.35	(162.14)
6	11.84	140.24	(2.99)	8.97	(35.46)
7	25.81	666.27	(17.84)	318.42	(460.60)
8	(11.45)	131.05	(24.91)	620.73	285.22
9	(21.28)	452.74	9.73	94.59	(206.94)
Sum		**2,632.27**		**6,230.77**	**1644.01**
Variance		**=2632.27/9 =292.47**		**=6230.77/9 =692.31**	
SD		**=$\sqrt{292.47}$ =17.10**		**=$\sqrt{692.31}$ =26.31**	

Co- Variance = Sum of (X – X Mean) × (Y – Y Mean)/n
= 1,644.01/9
= **182.67**
Correlation = Cov (X,Y)/ $SD_x \times SD_y$
=182.67/(17.10 × 26.31)
= **40.59%**
Given that correlation is 40.59%, the market exhibits weak form of efficiency, it is not all efficient.

4. Illustration

The closing value of a Stock Market Index for the month of October 2007 is given below

Date Closing	**Index**
1.10.07	2800
3.10.07	2780
4.10.07	2795
5.10.07	2830
8.10.07	2760
9.10.07	2790
10.10.07	2880
11.10.07	2960
12.10.07	2990
15.10.07	3200
16.10.07	3300
17.10.07	3450
19.10.07	3360
22.10.07	3290
23.10.07	3360
24.10.07	3340
25.10.07	3290
29.10.07	3240

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30.10.07	3140
31.10.07	3260

You are required to test the weak form of efficient market hypothesis by applying the run test at 5% and 10% level of significance.
Value of t at 5% is 2.101 at 18 degrees of freedom
Value of t at 10% is 1.734 at 18 degrees of freedom.

Solution :

Date	Index Value		Run
1-Oct-07	2800		
03-Oct-07	2780	-	1
04-Oct-07	2795	+	2
05-Oct-07	2830	+	
08-Oct-07	2760	-	3
09-Oct-07	2790	+	4
10-Oct-07	2880	+	
11-Oct-07	2960	+	
12-Oct-07	2990	+	
15-Oct-07	3200	+	
16-Oct-07	3300	+	
17-Oct-07	3450	+	
19-Oct-07	3360	-	5
22-Oct-07	3290	-	
23-Oct-07	3360	+	6
24-Oct-07	3340	-	7
25-Oct-07	3290	-	
29-Oct-07	3240	-	
30-Oct-07	3140	-	
31-Oct-07	3260	+	8

Number of Sign Changes	19
+	11
-	8
Runs	8

	t	Degree of Freedom = Number of Sign Changes – 1	
5%	2.101	18	
10%	1.734	18	

Mean = 2n1n2/(n1+n2) + 1
= (2 × 11 × 8)/(11+8) + 1
= 10.2632

Standard Deviation $\sigma = \frac{\sqrt{2n1n2(2n1n2 - n1 - n2)}}{\sqrt{n1 + n2)\text{^}2(n1 + n2 - 1))}}$

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	= $\sigma = \frac{\sqrt{2 \times 11 \times 8\,(2 \times 11 \times 8 - 11 - 8)}}{\sqrt{11+8)\text{^}2(11+8-1))}}$ $= \frac{\sqrt{176\,(157)}}{\sqrt{361)(18))}}$ = 2.06213

Particulars	5%	10%
t	2.10	1.734
Mean	10.26	10.26
SD	2.06	2.06
R (Number of runs)	8	8
Mean + t × SD	=10.26+ (2.10 × 2.06) = 14.60	=10.26+ (1.734 × 2.06) = 13.84
Mean – t × SD	=10.26 - (2.10 × 2.06) = 5.93	=10.26 - (1.734 × 2.06) = 6.69
R	8	8

As the number of runs lies between the 1 SD Value from mean at t Levels of 5% & 10% , the market exhibits weak form of efficiency.

5. Illustration

The closing value of TCS stock for the month of August 2021 is given below

Date	Close Price
02-Aug-21	3,217.90
03-Aug-21	3,284.15
04-Aug-21	3,273.45
05-Aug-21	3,285.15
06-Aug-21	3,310.15
09-Aug-21	3,322.40
10-Aug-21	3,333.25
11-Aug-21	3,340.55
12-Aug-21	3,353.95
13-Aug-21	3,461.90
16-Aug-21	3,471.75
17-Aug-21	3,552.40
18-Aug-21	3,558.50
20-Aug-21	3,557.45
23-Aug-21	3,635.85
24-Aug-21	3,612.20
25-Aug-21	3,659.50
26-Aug-21	3,671.05

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27-Aug-21	3,720.15
30-Aug-21	**3,701.40**

You are required to test the weak form of efficient market hypothesis by applying the run test at 5% and 10% level of significance.

Solution :

Date	Close Price	Sign Changes	Runs
02-Aug-21	3,217.90		
03-Aug-21	3,284.15	+	1
04-Aug-21	3,273.45	-	2
05-Aug-21	3,285.15	+	3
06-Aug-21	3,310.15	+	
09-Aug-21	3,322.40	+	
10-Aug-21	3,333.25	+	
11-Aug-21	3,340.55	+	
12-Aug-21	3,353.95	+	
13-Aug-21	3,461.90	+	
16-Aug-21	3,471.75	+	
17-Aug-21	3,552.40	+	
18-Aug-21	3,558.50	+	
20-Aug-21	3,557.45	-	4
23-Aug-21	3,635.85	+	5
24-Aug-21	3,612.20	-	6
25-Aug-21	3,659.50	+	7
26-Aug-21	3,671.05	+	
27-Aug-21	3,720.15	+	
30-Aug-21	3,701.40	-	8

Number of Sign Changes	**19**
+	15
-	4
Runs	8

	T	**Degree of Freedom = Number of Sign Changes – 1**	
5%	2.101	18	
10%	1.734	18	

Mean $= 2n_1n_2/(n_1+n_2) + 1$

$= (2 \times 15 \times 4)/(15+4) + 1$

$= 7.32$

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Standard Deviation	$\sigma = \frac{\sqrt{2n1n2(2n1n2 - n1 - n2)}}{\sqrt{n1 + n2)\text{^}2(n1 + n2 - 1))}}$ $\sigma = \frac{\sqrt{2 \times 15 \times 4\,(2 \times 15 \times 4 - 15 - 4)}}{\sqrt{15 + 4)\text{^}2(15 + 4 - 1))}}$ $= \frac{\sqrt{120\,(101)}}{\sqrt{361)(18))}}$ = 1.37

Particulars	**5%**	**10%**
t	2.10	1.734
Mean	7.32	7.32
SD	1.37	1.37
R (Number of runs)	8	8
Mean + t × SD	**=7.32+ (2.10 × 1.37) = 10.1851**	**=7.32+ (1.734 × 1.37) = 9.6840**
Mean – t × SD	**=7.32 - (2.10 × 1.37) = 4.44652**	**=7.32+ (1.734 × 1.37) = 4.94754**

Under both 5% and 10% levels of Significance the number of runs I.e., 8 lies within the confidence interval , Hence, the market exhibits atleast a weak form of efficiency.

6. Illustration (May'24 RTP)

You are a financial analyst at a prominent investment firm and have been tasked with empirically verifying the weak form of Efficient Market Hypothesis (EMH) Theory for the XYZ Stock Index, a collection of diverse stocks. You decided to conduct three different tests to assess whether the stock market follows the principles of the weak form of EMH.

Test 1
For the past five years, you collected daily price changes of the stocks in the XYZ Stock Index. You calculated correlation coefficients for different lag periods and analyzed whether past price changes exhibit any significant correlation with future price changes. You considered price changes to be serially independent. The results indicated that most auto correlation coefficients are close to zero and statistically insignificant, suggesting those past price changes do not predict future price changes.

Test 2
You further investigated the randomness of price changes in the XYZ Stock Index. Analyzing the sequence of daily price changes, you count the number of runs where price changes are consistently positive or negative. Upon comparing the observed number of runs with the expected number based on randomness, you find that they align closely, supporting the idea that price changes follow a random pattern.

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Test 3
To examine the efficacy of trading strategies based on historical price trends, you implemented a simple trading rule for the XYZ Stock Index. The rule involves buying when the price crosses a moving average of 5% threshold and selling when it crosses another 7% threshold. Over a period of testing, you computed the returns generated by the trading strategy. The results revealed that the returns are not consistently better than random chance, implying that past price trends do not reliably predict future price movements.

Conclusion:
After conducting the three tests the evidence supports the weak form of Efficient Market Theory for the XYZ Stock Index you concluded that past price trends do not reliably predict future price movements.

Based on the above information answer the following questions:

I. Test 1 is ……

(a) **Serial Correlation test**
(b) Filter Rules test
(c) Run test
(d) Variance Ratio test

II. Test 2 is ……

(a) Serial Correlation test
(b) Filter Rules test
(c) **Run test**
(d) Variance Ratio test

III. Test 3 is ……
(a) Serial Correlation test
(b) **Filter Rules test**
(c) Run test
(d) Variance Ratio test.

IV. The Filter Rule Test should not be applied for buy and hold strategy if…….

(a) the behavior of stock price changes is predictable.
(b) the behavior of stock price changes is dependent on past trends.
(c) the behavior of stock price changes is correlated.
(d) **the behavior of stock price changes is random.**
If Stock prices are random then filter rules will not work.

V. Results of your studies support the……

(a) Semi-strong EMH Theory
(b) Strong EMH Theory
(c) **Random Walk Theory**
(d) Markowitz Theory

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SECURITY VALUATION – EQUITIES (46Q)

1. Illustration

A company has a book value per share of Rs. 137.80. Its return on equity is 15% and it follows a policy of retaining 60% of its earnings. If the Opportunity Cost of Capital is 18%, compute the price of the share today using both Dividend Growth Model and Walter's Model.

Solution 1:

Given:

Book value per share = 137.80
ROE = 15%
Retention Ratio = 60%
Payout Ratio (p) = 1-60% = 40%
Opportunity Cost (K_e) = 18%

Dividend Growth Model:

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

g = b x r = Retention x Return on equity

D = *EPS (1-b) = EPS x p*

Where, EPS = $\frac{PAT}{Share\ Count}$ & ROE = $\frac{PAT}{Equity} = \frac{EPS}{BVPS}$

i.e; 15% = $\frac{EPS}{137.80}$ = **₹20.67 per share**

Assumed that Data of ROE & BVPS is past data and hence EPS is for the year 0.

$E_0 = 20.67$
P = 40%
$D_0 = 20.67 * 40\% = 8.268$
G = b x r = 60% x 15% = 9%
$D_1 = D_0(1 + g)$ = 8.268(1 + 9%) = 9.01212

$$\boldsymbol{P_0 = \frac{9.01212}{15\% - 9\%} = 100.135}$$

Walter's Model:

$P_0 = \frac{D + (E - D) * \frac{r}{K_e}}{K_e}$

$= \frac{8.268 + (20.67 - 8.268) * \frac{15\%}{18\%}}{18\%}$ = **₹ 103.35**

Where,
P_0 = Price per share
D_0 = Dividend per Share for the just concluded year
E = Earnings per share
r = Return on equity
K_e – Cost of Equity

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2. Illustration

ABC Limited's shares are currently selling at Rs. 13 per share. There are 10,00,000 shares outstanding. The firm is planning to raise Rs. 20 lakhs to Finance a new project.

Required:

- What are the ex-right price of shares and the value of a right, if
  - The firm offers one right share for every two shares held.
  - The firm offers one right share for every four shares held.
- How does the shareholders' wealth (holding 100 shares) change from (i) to (ii)? How does right issue increase shareholders' wealth?

Solution 2

Given

Company Name : ABC Ltd.
Current Market price of equity Share is ₹13
Existing share count 10,00,000
New Project = ₹20,00,000

(i) 1 Right share for 2 shares held

∴ No. of rights shares issued = 10,00,000/2 = 5,00,000 shares
Hence, Project of ₹20,00,000 will be financed by issuing 5,00,000 shares

Price per right share = $\frac{Money\ raised}{No.of\ shares\ issued}$ = $\frac{₹20,00,000}{5,00,000}$ = ₹4 per share

So, Ex Right Price of share = $\frac{N_0P_0+S}{N_0+N_1}$ = $\frac{(10,00,000*13)+20,00,000}{10,00,000+5,00,000}$ = ₹10 per share

N = Number of existing equity shares
P_0 = Price of Share Pre-Right Issue
S = Subscription amount raised from Right Issue
N_1 = No. of new shares offered

Value of Right = ₹10 per share - ₹4 per share = ₹6 per share

Value of Right on per share basis = $\frac{₹10-₹4}{2}$ = ₹3

(ii) 1 Right share for 4 shares held

Total Existing share count 10,00,000
∴ No. of rights shares issued = 10,00,000/4 = 2,50,000 shares

Price per right share = $\frac{Money\ raised}{No.of\ shares\ issued}$ = $\frac{₹20,00,000}{2,50,000}$ = ₹8 per share

Ex Right Price of share = $\frac{N_0P_0+S}{N_0+N_1}$ = $\frac{(10,00,000*13)+20,00,000}{10,00,000+2,50,000}$ = ₹12 per share

Value of Right = ₹12 per share - ₹8 per share = ₹4per share

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Value of Right on per share basis = $\frac{₹12-₹8}{4}$ = **₹1**

Shareholder's wealth pre issue =

Shares held	**100**
CMP	₹13
Total shareholder's wealth	**₹1300**

Shareholder's wealth in (i)

Shares held	**100**
New right shares	50
Total shares	**150**
Ex right price	₹10
Total Value of shareholding	₹1500
Less: Subscription amt paid (Price per right share * No. of shares subscribed)	₹200 i.e (50*4)
Shareholder's wealth	**₹1300**

Shareholder's wealth in (ii)

Shares held	**100**
New right shares	25
Total shares	**125**
Ex right price	₹12
Total Value of shareholding	₹1500
Less: Subscription amt paid (Price per right share * No. of shares subscribed)	₹200 (25*8)
Shareholder's wealth	**₹1300**

Conclusion: There is no change in shareholder's wealth due to rights issue in both the scenarios.

3. Illustration

MNP Ltd. has declared and paid annual dividend of Rs. 4 per share. It is expected to grow @ 20% for the next two years and 10% thereafter. The required rate of return of equity investors is 15%. Compute the current price at which equity shares should sell.

Note: Present Value Interest Factor (PVIF) @ 15%:

- For year 1 = 0.8696.
- For year 2 = 0.7561

Solution 3

Given,

D_0 = **4**

$D_1 = D_0$ **(1+g) = 4 x 1.2 = 4.8**

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D_2 = D_1 (1+g)= 4 × $(1.2)^2$ = 5.76

D_3 = D_2 (1+g) = 5.76 × 1.10 = 6.336

K_e = 15%

Yr	1	2	2
P_0	4.8	5.76	126.72
PVIF	0.8696	0.7561	0.7561

∴ P_0 = 4.17408 + 100.168 = ₹104.34

4) Illustration

X Limited, just declared a dividend of Rs. 14.00 per share. Mr. B is planning to purchase the share of X Limited, anticipating increase in growth rate from 8% to 9%, which will continue for three years. He also expects the market price of this share to be Rs. 360.00 after three years.

You are required to determine:

i. The maximum amount Mr. B should pay for shares if he requires a rate of return of 13% per annum.
ii. The maximum price Mr. B will be willing to pay for share, if he is of the opinion that the 9% growth can be maintained indefinitely and require 13% rate of return per annum.
iii. The price of share at the end of three years, if 9% growth rate is achieved and assuming other conditions remaining same as in (ii) above.

Calculate rupee amount up to two decimal points.

	Year 1	Year 2	Year 3
FVIF @ 9%	1.090	1.188	1.295
FVIF @ 13%	1.130	1.277	1.443
PVIF @ 13%	0.885	0.783	0.693

Solution 4

(i) Expected dividend for next 3 years.

Year 1 (D_1) 14.00 (1.09) = 15.26
Year 2 (D_2) 14.00 (1.09)2 = 16.63
Year 3 (D_3) 14.00 (1.09)3 = 18.13

Required rate of return = 13% (K_e)

Market price of share after 3 years = (P_3)= 360

The present value of share

$$P_0 = \frac{D_1}{1+K_e} + \frac{D_2}{(1+K_e)^2} + \frac{D_3}{(1+K_e)^3} + \frac{P_3}{(1+K_e)^3}$$

$$= \frac{15.26}{(1+0.13)} + \frac{16.63}{(1+0.13)^2} + \frac{18.13}{(1+0.13)^3} + \frac{360}{(1+0.13)^3}$$

P_0 = 15.26(0.885) + 16.63(0.783) +18.13(0.693)+360(0.693)

= 13.50 + 13.02 + 12.56 + 249.48

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P_0 = **288.56**

(ii) If growth rate 9% is achieved for indefinite period, then maximum price of share
should Mr.B willing be to pay is

$P_0 = \frac{D_1}{K_e - g} = \frac{15.26}{0.13-0.09}$ = **₹381.50**

(iii) Assuming that conditions mentioned above remain same, the price expected after 3
years will be:

$P_3 = \frac{D_4}{K_e - g} = \frac{D_3(1.09)}{0.13-0.09} = \frac{18.13 \times 1.09}{0.04}$ = ₹494

5) Illustration

On the basis of the following information:

Current dividend (D_0) **Rs. 2.50**

Discount Rate (k)	10.5%
Growth Rate	2%

i.Calculate the present value of stock of ABC Ltd.
ii.Is its stock overvalued if stock price is Rs.35, K_e = 9% and EPS = Rs. 2.25? Show detailed calculation. Using PE Multiple Approach and Earning Growth Model.

Solution 5

(i) Present Value of the stock of ABC Ltd.is:

$P_0 = \frac{D_1}{K_e - g} = \frac{D_0(1+g)}{0.105-0.02} = \frac{2.5*1.02}{0.085}$ = ₹30/-

(ii) Value of stock under the PE Multiple Approach

Particulars	**Value**
Actual Stock Price	₹35.00
EPS	₹2.25
PE Multiple (1/Return on Equity(K_e)= 1/9%	11.11
Market Price per Share	₹25

Since, Actual Stock Price is higher, hence it is overvalued
Alternatively,

PE Multiple based on P_0 as per Earnings growth model is ₹32.78/2.25 = 14.57
PE Multiple as implied by the market = ₹35/2.25 = 15.55
So, the stock is overvalued

(iii) Value of the Stock under the Earnings Growth Model

Particulars	Value

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Actual Stock Price	₹35
Return on equity	9%
EPS	2.25
Growth Rate	2%
Market Price per Share [EPS ×(1+g)]/(Ke – g)] = 2.25 × 1.02/0.07	₹32.79

Since, Actual Stock Price is higher, hence it is overvalued

6) Illustration

Piyush Loonker and Associates presently pay a dividend of Rs. 1.00 per share and has a share price of Rs. 20.00.

i. If this dividend were expected to grow at a rate of 12% per annum forever, what is the firm's expected or required return on equity using a dividend-discount model approach?

ii. Instead of this situation in part (i), suppose that the dividends were expected to grow at a rate of 20% per annum for 5 years and 10% per year thereafter. Now what is the firm's expected, or required, return on equity?

Solution 6

(i) Firm's Expected or Required Return on Equity (Using a dividend discount model approach)

According to Dividend discount model approach the firm's expected or required return on equity is computed as follows:

$P_0 = \frac{D_1}{K_e - g}$ *or* $K_e = \frac{D_1}{P_0} + g$

Where,

K_e= Cost of equity share capital or (Firm's expected or required return on equity share capital)

D_1= Expected dividend at the end of year 1

P_0= Current market price of the share.

g = Expected growth rate of dividend.

Now, $D_1 = D_0$ (1 + g) or 1 (1 + 0.12) or 1.12, P0 = 20 and g = 12% per annum

Therefore, $K_e = \frac{₹1.12}{₹20}$ + 12% = 17.6%

(ii) Firm's Expected or Required Return on Equity

(If dividends were expected to grow at a rate of 20% per annum for 5 years and 10% per year thereafter) i.e. $P_0 = 20 \quad g_1 = 20\% \quad g_2 = 10\% \; D_0 = 1 \quad K_e = ?$

Assume $K_e = 18\%$ and see if it leads us to $P_0 = 20$

Year	Growth	Dividend	Dividend(₹)	PVF@18%	PV
0	-	1			
1	20%	(1.2)	1.2	0.847	1.0164

2	20%	$(1.2)^2$	1.44	0.718	1.03392
3	20%	$(1.2)^3$	1.728	0.609	1.0505
4	20%	$(1.2)^4$	2.074	0.516	1.0701
5	20%	$(1.2)^5$	2.488	0.437	1.087256
					Σ= 5.258
6	10%	$(1.2^5)(1.1)$	2.737		

$P_0 = \frac{D_1}{1+K_e} + \frac{D_2}{(1+K_e)^2} + \frac{D_3}{(1+K_e)^3} + \frac{D_4}{(1+K_e)^4} + \frac{D_5}{(1+K_e)^5} + \frac{P_5}{(1+K_e)^5}$

$P_5 = \frac{D_6}{K_e - g} = \frac{2.737}{18\% - 10\%}$ = **₹34.2125**

$P_0 = 5.258 + \text{PV of } 34.2125$ = 5.258 + 0.437(34.2125) = **₹20.209**

Computation using $K_e = 19\%$, g = 10%

Year	Dividend(₹)	PVF@19%	PV
1	1.2	0.840	1.008
2	1.44	0.706	1.01664
3	1.728	0.593	1.0247
4	2.074	0.499	1.0349
5	2.488	0.419	1.0424
			Σ= 5.127
6	2.737		

P_0 = 5.127 + $\frac{P_5}{(1+K_e)^5}$

$P_5 = \frac{D_6}{K_e - g} = \frac{2.737}{19\% - 10\%}$ = ₹30.411

$P_0 = 5.127 + PV\ of\ 30.411$ = 5.127 + 0.419(30.411) = **₹17.869**

Since the present value of dividend stream is more than required it indicates that K_e is greater than 18%.

	A	B	C	(B-C)	(A-B)
P_0	20	20.209	17.869	2.34	0.209
K_e	?	18%	19%	1%	? (1%*0.209//2.34)= 0.089%

K_e = 18% + 0.089% = **18.089%**

Alternatively,

$K_e = LR + \frac{NPV\ at\ LR - NPV\ Required}{NPV\ at\ LR - NPV\ at\ HR} \times \Delta r$

Where,

LR = Lower Rate

NPV at LR = Present value of share at LR

NPV at HR = Present value of share at Higher Rate

Δr = Difference in rates

K_e = 18% + $\frac{(₹20.209 - ₹20)}{₹20.209 - ₹17.869} \times 1\%$ = **18.089%**

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7) Illustration

ABC Ltd. has been maintaining a growth rate of 10 percent in dividends. The company has paid dividend @ Rs. 3 per share. The rate of return on market portfolio is 12 percent and the risk-free rate of return in the market has been observed as 8 percent. The Beta co-efficient of company's share is 1.5.

You are required to calculate the expected rate of return on company's shares as per CAPM model and equilibrium price per share by dividend growth model.

Solution 7

CAPM formula for calculation of Expected Rate of Return is :

ER = R_f + β (R_m – R_f) = 8 + 1.5 (12 – 8) = 8 + 1.5 (4)

= 8 + 6

=14% or 0.14

Applying Dividend Growth Model for the calculation of per share equilibrium price:

ER = $K_e = \frac{D_1}{P_0} + g$

0.14 = $\frac{3(1.10)}{P_0}$ + 0.10

0.04P_0 = 3.30

P_0= **₹82.50**

∴ Per share equilibrium price will be 82.50

8) Illustration

A Company pays a dividend of Rs. 2.00 per share with a growth rate of 7%. The risk-free rate is 9% and the market rate of return is 13%. The Company has a beta factor of 1.50. However, due to a decision of the Finance Manager, beta is likely to increase to 1.75. Find out the present as well as the likely value of the share after the decision.

Solution 8

In order to find out the value of a share with constant growth model, the value of K_e should be ascertained with the help of 'CAPM' model as follows:

$K_e = R_f$ + β (R_m – R_f)

Where, K_e = Cost of equity R_f = Risk free rate of return β = Portfolio Beta i.e. market sensitivity index K_m = Expected return on market portfolio

By substituting the figures,

K_e = 0.09 + 1.5 (0.13 – 0.09) = 0.15 or 15% and the value of the share as per constant growth model is –

P_0 = $\frac{D_1}{K_e - g}$ = $\frac{2(1.07)}{0.15 - 0.07}$ = **₹26.75**

However, if the decision of finance manager is implemented, the beta (β) factor is likely to increase to 1.75 therefore,

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$K_e = R_f + \beta\ (R_m - R_f)$
= 0.09 + 1.75 (0.13 – 0.09) = 0.16 or 16%

The value of share is $P_0 = \frac{D_1}{K_e - g} = \frac{2(1.07)}{0.16 - 0.07}$ = **₹23.78**

∴ At β of 1.5, price is ₹26.75 & as β increases to 1.75 price falls to ₹23.77

9) Illustration
Shares of Voyage Ltd. are being quoted at a price-earnings ratio of 8 times. The company retains Rs. 5 per share which is 45% of its Earning Per Share.

You are required to compute

- The cost of equity to the company if the market expects a growth rate of 15% p.a.
    - If the anticipated growth rate is 16% per annum, calculate cost of capital with same market price.
    - If the company's cost of capital is 20% p.a. & the anticipated growth rate is 19% p.a., calculate the market price per share.
- At anticipated growth rate in (ii), and cost of capital calculated above, compute indicative market price

Solution 9
Given,
PE = 8 times
Retained earnings = 5

45% of EPS = b
b x EPS = 5
45% x EPS = 5

∴ EPS = ₹11.11

(i) K_e =? if g= 15% where, $\frac{MPS}{EPS} = PE\ Ratio$

so, $\frac{MPS}{11.11}$ = 8 then, MPS = ₹88.88

MP = $\frac{D_1}{K_e - g}$

D_1 = EPS x P = EPS(1-b) = 11.11(1 - 45%) = **6.11**

88.88 = $\frac{6.11}{K_e - 15\%}$

K_e= 15% + 6.87% = 21.87%

(ii) if g = 16% then, $K_e = ?$

88.88 = $\frac{6.11}{K_e - 16\%}$ so, K_e = 22.87%

(iii) K_e = 20% & g=19% MP = $\frac{D_1}{K_e - g} = \frac{6.11}{20\% - 19\%}$ = **₹611 per share**

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(iv) MP @ 16%=g & K_e=22.87% MP = $\frac{D_1}{K_e - g}$

$\frac{6.11}{20\% - 16\%}$= **₹88.93 per share**

10) Illustration

Capital structure of Sun Ltd., as at 31.3.2003 was as under:

	(Rs. In Lakhs)
Equity share capital	80
8% Preference share capital	40
12% Debentures	64
Reserves	32

Sun Ltd. earns a profit of Rs. 32 lakhs annually on an average before deduction of income-tax, which works out to 35%, and interest on debentures.

Normal return on equity shares of companies similarly placed is 9.6% provided:

a. Profit after tax covers fixed interest and fixed dividends at least 3 times.
b. Capital gearing ratio is 0.75
c. Yield on share is calculated at 50% of profits distributed and at 5% on undistributed profits

Sun Ltd. has been regularly paying equity dividend of 8%.

Compute the value per equity share of the company assuming:

i.1% for every one time of difference for Interest and Fixed Dividend Coverage.

ii.2% for every one time of difference for Capital Gearing Ratio.

Solution 10

Working note 1: Calculation of Profit after tax (PAT)

Profit before interest and tax (PBIT)	32,00,000
Less: Debenture interest (64,00,000 × 12/100)	7,68,000
Profit before tax (PBT)	24,32,000
Less: Tax @ 35%	8,51,200
PAT Profit after tax (PAT)	**15,80,800**
Less: Preference Dividend(40,00,000 × 8/100)	3,20,000
Equity Dividend (80,00,000 × 8/100)	6,40,000
Retained Earnings (Undistributed Profit)	**6,20,800**

(i) Calculation of Interest and Fixed Dividend Coverage

$\frac{\text{PAT}}{\text{Debenture interest} + \text{Preference dividend}} = \frac{15,80,800}{7,68,000 + 3,20,000} = 1.453$

(ii) Capital Gearing Ratio

$= \frac{Fixed\ interest\ bearing\ funds}{Equity\ shareholders\ \ funds}$

$= \frac{Preference\ Share\ Capital + Debentures}{Equity\ Share\ Capital + Reserves}$

$= \frac{40,00,000+64,00,000}{80,00,000 + 32,00,000} = 0.93$

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(iii) Calculation of Yield on Equity Shares: Yield on equity shares is calculated at 50% of profits distributed and 5% on undistributed profits:

50% on distributed profits (6,40,000 × 50/100)	3,20,000
5% on undistributed profits (6,20,800 × 5/100)	31,040
Yield on equity shares	3,51,040

Yield on equity shares % = $\frac{\text{Yield on shares}}{\text{Equity share capital}}$ *100 = $\frac{3,51.040}{80,00,000}$ *100 = **4.388%**

(iv) Calculation of Expected Yield on Equity shares (a) Interest and fixed dividend coverage of Sun Ltd. is 2.16 times but the industry average is 3 times. Therefore, risk premium is added to Sun Ltd. Shares @ 1% for every 1 time of difference.

Risk Premium = 3.00 – 1.453 (1%) = (1%) = **1.547%**

(b) Capital Gearing ratio of Sun Ltd. is 0.93 but the industry average is 0.75 times. Therefore, risk premium is added to Sun Ltd. shares @ 2% for every 1 time of difference.

Risk Premium = (0.75 – 0.93) (2%) = 0.18 (2%) = **0.36%**

Particulars	**%**
Normal return expected	9.60
Add: Risk premium for low interest and fixed dividend coverage	1.547
Add: Risk premium for high interest gearing ratio	0.36
	11.507%

Value of Equity Share

Actual yield Expected yield × Paid-up value of share = 4.39/11.507 × 100 = **₹38.15**

Note: Alternate solution as per ICAI

Consider PAT as computed above

(i) Calculation of Interest and Fixed Dividend Coverage

$\frac{\text{PAT+ Debenture interest}}{\text{Debenture interest+ Preference dividend}} = \frac{15,80,800+ 7,68,000}{7,68,000 + 3,20,000}$ = **2.16**

(ii) Capital Gearing Ratio

= $\frac{Fixed\ interest\ bearing\ funds}{Equity\ shareholders\ funds}$

= $\frac{Preference\ Share\ Capital + Debentures}{Equity\ Share\ Capital + Reserves}$

= $\frac{40,00,000+64,00,000}{80,00,000 + 32,00,000}$ = **0.93**

(iii) Calculation of Yield on Equity Shares: Yield on equity shares is calculated at 50% of profits distributed and 5% on undistributed profits:

Particulars	**Amount(₹)**
50% on distributed profits (6,40,000 × 50/100)	3,20,000
5% on undistributed profits (6,20,800 × 5/100)	(+)31,040
Yield on equity shares	3,51,040

Yield on equity shares % = $\frac{\text{Yield on shares}}{\text{Equity share capital}}$ *100 = $\frac{3,51.040}{80,00,000}$ *100 = **4.388% or 4.39%**

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(iv) Calculation of Expected Yield on Equity shares (a) Interest and fixed dividend coverage of Sun Ltd. is 2.16 times but the industry average is 3 `s. Therefore, risk premium is added to Sun Ltd. Shares @ 1% for every 1 time of difference.

Risk Premium = 3.00 – 2.16 (1%) = (1%) = **0.84%**
Capital Gearing ratio of Sun Ltd. is 0.93 but the industry average is 0.75 times. Therefore, risk premium is added to Sun Ltd. shares @ 2% for every 1 time of difference.
Risk Premium = (0.75 – 0.93) (2%) = 0.18 (2%) = **0.36%**

Particulars	%
Normal return expected	9.60
Add: Risk premium for low interest and fixed dividend coverage	0.84
Add: Risk premium for high interest gearing ratio	0.36
	10.80%

Value of Equity Share
Actual yield Expected yield × Paid-up value of share = 4.39/10.80 × 100 = **₹40.65**

11) Illustration

Following Financial data are available for PQR Ltd. for the year 2008:

	(Rs. In Lakhs)
8% debentures	125
10% bonds (2007)	50
Equity shares (Rs. 10 each)	100
Reserves and Surplus	300
Total Assets	600
Assets Turnovers ratio	1.1
Effective interest rate	8%
Effective tax rate	40%
Operating margin	10%
Dividend payout ratio	16.67%
Current market Price of Share	Rs. 14
Required rate of return of investors	15%

You are required to:
i. Draw income statement for the year
ii. Calculate its sustainable growth rate of earnings
iii. Calculate the fair price of the Company's share using dividend discount model, and
iv. What is your opinion on investment in the company's share at current price?

Solution 11
Working Note 1:

Asset turnover ratio	**1.1**
Total Assets	600 lakhs
Turnover (600 lakhs × 1.1)	660 lakhs
Effective interest rate	8%
Liabilities (125 lakhs + 50 lakhs)	175 lakhs
Interest	= 175 lakhs × 0.08 = 14 lakh

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Working Note 2:

Operating Margin = 10% i.e. $\frac{Operating\ Profit}{Turnover} = 10\%$

$\frac{Operating\ Profit}{660\ lakhs} = 10\%$

So, EBIT/Operating profit = 660 lakhs x 10% = 66 lakhs

(i) **Income statement**

Particulars	(₹ Lakhs)
Sale	660
EBIT	66
(-) Interest	14
= EBT	52
(-) Tax @ 40%	20.80
= EAT	31.20
Dividend @ 16.67%	5.20
Retained Earnings	**26**

(ii) Computation of Growth rate: **g = b x r**

$r = \frac{PAT}{Net\ Worth} = \frac{31.20}{ESC+Reserves} = \frac{31.20}{100+300} = 7.8\%$

b = 1 – payout ratio = 1 – 16.67%= 83.35%

g = 83.33% x 7.8% = **6.5%**

(iii) Calculation of fair price of share using dividend discount model

$P_0 = \frac{D_1}{K_e - g} = \frac{D_0(1+g)}{0.15-0.065} = \frac{0.52*1.065}{0.085}$ = **₹6.52/-**

Where, g= 6.5% , k = 15%

No. of shares = 100 lakhs/₹10 = 10 lakhs & $D_0 = \frac{₹5.2\ lakhs}{10\ lakhs}$ = **₹0.52**

(iv) DDM Price = ₹6.52 and CMP = ₹14
Since the current market price of share is 14, the share is **overvalued**. Hence the investor should not invest in the company.

12) Illustration

M/s X Ltd. has paid a dividend of Rs. 2.50 per share on a face value of Rs. 10 in the financial year ending on 31st March 2009. The details are as follows:

Current market price of share	Rs. 60

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Growth rate of earnings and dividends	10%
Beta of share	0.75
Average market return	15%
Risk free rate of return	9%

Calculate the intrinsic value of the share

Solution 12

Intrinsic value $D_0 = \frac{D_1}{K_e - g}$ & ER = R_f + β (R_m – R_f)

Where,

R_f = Risk Free Rate β = Beta of Security R_m = Market Return

ER (K_e) = 9% + 0.75 (15% - 9%) = **13.5%**

$\therefore P_0 = \frac{2.5*1.1}{0.135-0.10}$ = **₹78.57**

13) Illustration

Mr. A is thinking of buying shares at Rs. 500 each having face value of Rs. 100. He is expecting a bonus at the ratio of 1: 5 during the fourth year. Annual expected dividend is 20% and the same rate is expected to be maintained on the expanded capital base.

He intends to sell the shares at the end of seventh year at an expected price of Rs. 900 each. Incidental expenses for purchase and sale of shares are estimated to be 5% of the market price. He expects a minimum return of 12% per annum.

Should Mr. A buy the share. If so, what maximum price should he pay for each share? Assume no tax on dividend income and capital gain.

Solution 13

Year	Bonus	Dividend/Cash flow	PVF (12%)	Present Value
0	1	-525 (500 + 5%)	1	-525
		Total Outflow		**Σ = -525**
1	1	₹20	0.893	17.86
2	1	₹20	0.797	15.94
3	1	₹20	0.712	14.24
4	1.2	₹24	0.636	15.264
5	1.2	₹24	0.567	13.608
6	1.2	₹24	0.507	12.168
7	1.2	₹24	0.452	10.848
7	1.2	900 x 1.2 x 95% = 1026	0.452	463.752
		Total Inflow		**Σ** =563.68
		Net gain (Outflow – Inflow)		**38.68**

Since Mr. A is gaining 38.68 per share, he should buy the share.

Maximum price Mr. A should be ready to pay is 563.68 which will include incidental expenses. So the maximum price should be 563.68 x 100/105 = **536.84 (purchase price before expense)**

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***Assumptions :**

1. Mr.A purchases only 1 share
2 Bonus of 1:5 is pre-dividend i.e. dividend is paid on bonus shares also
3 Bonus share 1:5 for every share will get 0.2 shares as bonus. So, revised shares is 1.2
4. Revised dividend in Yr 4 is Rev shares x FV x Dividend % = 1.2 x 100 x 20% =₹24

14) Illustration

SAM Ltd. has just paid a dividend of Rs. 2 per share and it is expected to grow @ 6% p.a. After paying dividend, the Board declared to take up a project by retaining the next three annual dividends. It is expected that this project is of same risk as the existing projects. The results of this project will start coming from the 4th year onward from now. The dividends will then be Rs. 2.50 per share and will grow @ 7% p.a.

An investor has 1,000 shares in SAM Ltd. and wants a receipt of at least Rs. 2,000 p.a. from this investment.

Show that the market value of the share is affected by the decision of the Board. Also show as to how the investor can maintain his target receipt from the investment for first 3 years and improved income, thereafter, given that the cost of capital of the firm is 8%.

Solution 14

Given, $D_0 = 2$ $D_1 - D_3 = 0$ $D_4 = 2.5$

$g_1 = 6\%$ $g_2 = 7\%$ from D_4 $K_e = 8\%$

(i) Market Value of share is affected by the board's decision Yes or No?

Scenario 1 : Project not undertaken

$P_0 = \frac{D_1}{K_e - g} = \frac{2(1+6\%)}{8\% - 6\%}$ = **₹106**

Scenario 2 : Price at end of $P_3 = \frac{D_4}{K_e - g_2} = \frac{2.5}{8\% - 7\%}$ = **₹250**

$P_0 = \frac{P_3}{(1.08)^3} = \frac{250}{1.257}$ = **₹198.46**

Yes, because of the project the share price will go up.

(ii) Investor holds 1000 shares – Year wise price of the share

Year	FVF@8%	Price(₹)
0	1	198.46
1	1.08	214.33 (1.08 x 198.46)
2	1.166	231.48
3	1.259	250.00

No. Of shares to be sold to get ₹2000 each year

Year	**Cash required**	**Share price per share**	**Shares he can sell**
1	₹2000	214.33	2000/214.33 = 9.33 i.e. 10 shares
2	₹2000	231.48	2000/231.48 = 8.64 i.e. 9 shares
3	₹2000	250	8 shares

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Total shares sold	**Σ = 27 shares**

Shares left = 1000 – 27 = 973 shares
So, the dividend on 973 shares in Yr 4 = 973 x 2.5 = ₹2432.5
The share holder needs to sell 27 shares in 3 yrs to get minimum of ₹2000 p.a and In those 3 years balance shares will be earning dividend greater than ₹2000 thereafter.

15) Illustration

XYZ Ltd. paid a dividend of Rs. 2 for the current year. The dividend is expected to grow at 40% for the next 5 years and at 15% per annum thereafter. The return on 182 days T-bills is 11% per annum and the market return is expected to be around 18% with a variance of 24%.

The co-variance of XYZ's return with that of the market is 30%. You are required to calculate the required rate of return and intrinsic value of the stock.

Solution 15

Given,

D_0 = 2 g_1–g_5 = 40% thereafter g =15% R_f = 11% R_m = 18% Covariance = 30% Variance =24%

β =? K_e = ? P_0 = ?

β = $\frac{\text{Covariance of Market Return and Security Return}}{\text{Variance of Market Return}} = \frac{30\%}{24\%}$ = 1.25 &

$K_e = R_f + \beta (R_m - R_f)$ = 11% + 1.25 (18% - 11%) = **19.75%**

Intrinsic value of the stock = $P_0 = \frac{D_1}{1+K_e} + \frac{D_2}{(1+K_e)^2} + \frac{D_3}{(1+K_e)^3} + \frac{D_4}{(1+K_e)^4} + \frac{D_5}{(1+K_e)^5} + \frac{P_5}{(1+K_e)^5}$

Year	D(1+g)	Dividend	PVIF@19.75%	PFCF
1	2(1.4)	2.8	0.835	2.338
2	$2(1.4)^2$	3.92	0.697	2.732
3	$2(1.4)^3$	5.488	0.582	3.194
4	$2(1.4)^4$	7.638	0.486	3.712
5	$2(1.4)^5$	10.76	0.406	4.368
5		*260.505	0.406	105.76
				₹122.129

$* P_5 = \frac{D_6}{K_e - g} = \frac{10.76(1+0.15)}{19.75\% - 15\%}$ = ₹260.505

16) Illustration

Rahul Ltd. has surplus cash of Rs. 100 lakhs and wants to distribute 27% of it to the shareholders. The company decides to buy back shares. The Finance Manager of the company estimates that its share price after re-purchase is likely to be 10% above the buyback price-if the buyback route is taken. The number of shares outstanding at present is 10 lakhs and the current EPS is Rs. 3.

You are required to determine:

- The price at which the shares can be re-purchased if the market capitalization of the company should be Rs. 210 lakhs after buyback,
- The number of shares that can be re-purchased, and
- The impact of share re-purchase on the EPS, assuming that net income is the same.

Solution 16

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(i) Given,
Surplus Cash = 100 lakhs
Buy back value ₹27 lakhs
Let Buy back price = P
Post buy back price = 1.1P
Current shares = 10 lakhs
Shares re-purchased = $\frac{₹27 lakhs}{P}$
Outstanding shares post buy back = 10 lakhs - $\frac{₹27 lakhs}{P}$
Market capitalisation = 210 lakhs
Market capitalisation = O/S share x price per share
₹210 lakhs = (10 lakhs - $\frac{₹27 lakhs}{P}$) x 1.1P
₹210 lakhs = $\frac{(₹10 \text{ lakhs} P - ₹27 \text{ lakhs})}{P}$ x 1.1P
On solving the above equation we get,
P = ₹21.79
(ii) No. of shares re-purchased = $\frac{₹27 \ lakhs}{₹21.79}$ = 123910 shares
Current EPS = ₹3
Current shares 10 lakhs ∴Net profit = ₹3 x 10 lakhs = ₹30 lakhs
Share count after buy back = 10,00,000 - 1,23,910 = **8,76,090**
Revised EPS = ₹30,00,000/8,76,090 = **₹3.424**
If Net Income is same EPS will go up from ₹3 to ₹3.424.

17) Illustration

Goldi locks Ltd was started a year back with equity capital of Rs. 40 lakhs. The other details are as under:

Earnings of the company	Rs. 4,00,000
Price Earnings ratio	12.5
Dividend paid	Rs. 3,20,000
Number of Shares	40,000

Find the current market price of the share. Use Walter's Model.
Find whether the company's D/ P ratio is optimal, use Walter's formula

Solution 17
Given
PAT = ₹4,00,000
PE Ratio = 12.5
Dividend = ₹3,20,000
No. Of shares = 40,000
Equity Capital = ₹40,00,000
Walter's model P_0 = $\frac{D+(E-D)*\frac{r}{Ke}}{Ke}$

DPS = Dividend/Shares = ₹3,20,000/40,000 = ₹8

EPS = PAT/No. of shares = ₹4,00,000/40,000 = ₹10 per share
For investment of ₹40,00,000 PAT = ₹4,00,000. ∴ Return(r) = 10%

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PE = $\frac{MPS}{EPS}$ or $\frac{EPS}{MPS} = \frac{1}{PE}$ i.e $K_e = \frac{1}{PE} = \frac{1}{12.5}$ = 8%

Price as per Walter's model = $\frac{₹8+(10-8)*\frac{10\%}{8\%}}{8\%}$ = **₹131.5**

r Vs. Ke	Company Phase	Correlation (DPS, MPS)	Optimum Dividend Payout Ratio
r > Ke	Growth	Negative	Zero
r = Ke	Constant / Stable	Zero	Any Ratio
r < Ke	Decline	Positive	100%

Given that r @ 10% is > Ke @ 8%, it is advisable that Goldi locks Ltd. **NOT PAY** any dividend at all &instead invest all the money / profits in the business, as the business is generating a return higher than the expected shareholder return

18) Illustration

X Ltd. earns Rs. 6 per share having capitalization rate of 10% and return on investment of 20%. According to Walter's model, what should be the price of the share at 25 percent dividend pay-out.

Solution 18

Given,

EPS = ₹6 Capitalisation rate(K_e) = 10% ROI(r) = 20%

Pay out ratio = 25% ∴ 6 x 25% = ₹1.5

As per Walter's Model = $P_0 = \frac{D+(E-D)*\frac{r}{Ke}}{Ke} = \frac{₹1.5+(6-1.5)*\frac{20\%}{10\%}}{10\%}$ = **₹105**

19) Illustration

The following information is collected from the annual reports of J Ltd:

Profit before tax	Rs. 2.5 crore
Tax rate	40%
Retention ratio	40%
Number of outstanding shares	50,00,000
Equity capitalization rate	12%
Rate of return on investment	15%

What should be the market price per share according to Gordon's model of dividend policy?

Solution 19

From annual return of J Ltd given,

PBT = ₹2.5 crore PAT = ₹2.5(1 - 40%) = ₹1.5 crore

T = 40% b = 40% No. of shares O/S = ₹50 lakhs K_e = 12%

r =15%

Market price as per Gordon's growth model

EPS = PAT/No. of shares = ₹1.5cr/50lakh = **₹3 per share**

EPS_1 = EPS(1+g) = 3(1+6%) = **₹3.18**

g =br = 40% x 15% = **6%**

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Therefore, $P_0 = \frac{D_1}{K_e - g} = \frac{EPS_1(1-b)}{K_e - g} = \frac{₹3.18(1-40\%)}{12\% - 6\%}$ = **₹31.8**

20) Illustration

The following information is given for QB Ltd.

Earnings per Share	Rs. 12
Dividend per share	Rs. 3
Cost of Capital	18%
IRR on investment	22%

Calculate market price per share using

i.Gordon's Formula

ii.Walter's Formula

Solution 20

Earnings per Share	₹ 12
Dividend per share	₹ 3
Cost of Capital(K_e)	18%
IRR on investment	22%
g = br where b = $\frac{(12-3)}{12}$ = 75% and r = 22% So, 75% x 22% = 16.5%	16.5%

(i)Gordon's formula = $P_0 = \frac{D_1}{K_e - g} = \frac{D_0(1+g)}{K_e - g} = \frac{3(1+16.5\%)}{18\% - 16.5\%}$ = **₹233**

(ii) Walter's formula : $P_0 = \frac{D + (E-D)*\frac{r}{K_e}}{K_e} = \frac{3 + (12-3)*\frac{22\%}{18\%}}{18\%}$ = **₹77.77**

21) Illustration

A share of Tension free Economy Ltd. is currently quoted at a price earnings ratio of 7.5 times. The retained earning being 37.5% is Rs. 3 per share.

Calculate

- The company's cost of equity if investor's expected rate of return is 12%
- Market price of share, if anticipated growth rate is 13% per annum with same cost of capital.
- Market price per share, if company's cost of capital is 18% and anticipated growth rate is 15% per annum, assuming other conditions remaining the same.

Solution 21

Particulars	Computation	Value
PE Ratio	given	7.5
Retention ratio (b)	given	37.5%
r	given	12%
EPS	3/37.5% * 100% EPS: 100%, ? RE: 37.5%, ₹3	8
Payout ratio(p)	(1-37.5%)	62.5%
g = br	37.5% x 12%	4.5%

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PE	given	7.5
Price(MPS)	PE X EPS = 7.5 X 8	₹60

$P_0 = \frac{D_1}{K_e - g} = \frac{D_0(1+g)}{K_e - g}$

₹60 = $\frac{5(1+4.5\%)}{K_e - 4.5\%}$

K_e - 4.5% = $\frac{5.225}{60}$

K_e = **13.21%**

(ii) P_0 = ? if, g = 13% K_e = 13.21%

$P_0 = \frac{D_1}{K_e - g} = \frac{D_0(1+g)}{K_e - g} = \frac{5(1+13\%)}{13.21\% - 13\%}$ = **₹2690.5**

(iii) g = 15% K_e = 18% D_0 = ₹5

$P_0 = \frac{D_1}{K_e - g} = \frac{5(1+15\%)}{18\% - 15\%}$ = **₹191.7**

22) Illustration

A firm had been paid dividend at Rs. 2 per share last year. The estimated growth of the dividends from the company is estimated to be 5% p.a. Determine the estimated market price of the equity share if the estimated growth rate of dividends

- Rises to 8%, and
- Falls to 3%.

Also find out the present market price of the share, given that the required rate of return of the equity investors is 15.5%.

Solution 22

Given,

D_0 = 2	g = 5%	g_A =8%	g_B =3%	K_e=15.5%

Case 1 Market price = ? when g= 5%,

$P_0 = \frac{D_1}{K_e - g} = \frac{D_0(1+g)}{K_e - g} = \frac{2(1+5\%)}{15.5\% - 5\%}$ = **₹20**

Case 2 Market price = ? when g= 8%

$P_0 = \frac{D_1}{K_e - g} = \frac{D_0(1+g)}{K_e - g} = \frac{2(1+8\%)}{15.5\% - 8\%}$ = **₹28.8**

Case 2 Market price = ? when g= 3%

$P_0 = \frac{D_1}{K_e - g} = \frac{D_0(1+g)}{K_e - g} = \frac{2(1+3\%)}{15.5\% - 3\%}$ = **₹16.48**

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23) Illustration

Shares of Voyage Ltd. are being quoted at a price-earnings ratio of 8 times. The company retains 50% of its earnings which are Rs. 10 per share.
You are required to compute

- The cost of equity to the company if the market expects a growth rate of 15% per annum.
    - If the anticipated growth rate is 16% per annum, calculate the indicative market price with the same cost of capital.
    - If the company's cost of capital is 20% p.a. & the anticipated growth rate is 18% p.a., calculate the market price per share.

Solution 23

Given,

P/E Ratio	**8 times**
EPS	**₹10**
∴MPS	**₹80 (EPS x PE)(8 x 10)**
Retention ratio(b)	**50%**
Payout ratio(p)	**50%**

Case 1

K_e = ? when g = 15% and D_0 = 10 x 50% = ₹5

$P_0 = \frac{D_1}{K_e - g} = \frac{D_0(1+g)}{K_e - g}$

₹80 = $\frac{5(1+15\%)}{K_e - 15\%}$

$\therefore K_e = \frac{5.75}{80}$ + 15% = **22.1875%**

Case 2

P_0 = ? K_e = 22.1875% g = 16%

$P_0 = \frac{D_1}{K_e - g} = \frac{D_0(1+g)}{K_e - g} = \frac{5(1+16\%)}{22.1875\% - 16\%}$ = **₹93.74**

Case 3

P_0 = ? K_e = 20% g = 18%

$P_0 = \frac{D_1}{K_e - g} = \frac{D_0(1+g)}{K_e - g} = \frac{5(1+18\%)}{20\% - 18\%}$ = **₹295**

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24) Illustration

In December 2011 AB Co's share was sold for Rs. 146 per share. A long-term earnings growth rate of 7.5% is anticipated. AB Co. is expected to pay dividend of Rs. 3.36 per share.
What rate of return an investor can expect to earn assuming that dividends are expected to grow along with earnings at 7.5% per year in perpetuity?
It is expected that AB Co. will earn 10% on book Equity and shall retain 60% of earnings. In this case, whether there would be any change in growth rate and cost of Equity?

Solution 24

Given,

Method 1

(i) P_0 = 146 g = 7.5% K_e = ? D_1 = 3.36

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

$146 = \frac{3.36}{K_e - 7.5\%}$

$K_e = \frac{3.36}{146} + 7.5\% = 2.30\% + 7.5\% =$ **9.8%**

(ii) r = 10% b = retention ratio = 60% so, g = br = 60% x 10% = **6%**

Hence the growth rate will change to 6% from 7.5%.

Now for old data , $D_1 = D_0(1+g)$

So, $3.36 = D_0(1+7.5\%)$

$\boldsymbol{D_0} = \frac{3.36}{1.075} =$ **3.126**

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

$146 = \frac{3.126(1+6\%)}{K_e - 6\%}$

$K_e = \frac{3.314}{146} + 6\% = 2.27\% + 6\% =$ **8.27%**

Method 2

g = 7.5% means, br = 7.5%

So, b x 10% = 7.5% hence b = 75% then, p =25%

It is assumed that ROE remains same and retention ratio changes

Then, dividend being ₹3.36 is 25% so, EPS = $\frac{3.36}{25\%}$ = **₹13.44**

(ii) EPS = 13.44 & b = 60% so, Payout = 40% then, D_1 **= 13.44 x 40% = ₹5.376**

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

$146 = \frac{5.376}{K_e - 6\%}$

$\boldsymbol{K_e} = \frac{5.376}{146} + 6\% = 3.68\% + 6\% =$ **9.68%**

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25) Illustration

A company has an EPS of Rs. 2.5 for the last year and the DPS of Rs. 1. The earnings is expected to grow at 2% a year in long run. Currently it is trading at 7 times its earnings. If the required rate of return is 14%, compute the following.
An estimate of the PE Ratio using Gordon growth model.
The long-term growth rate implied by the current PE Ratio.

Solution 25

EPS=2.5	DPS_0=1	g = 2%	PE = 7 times	K_e=14%

MPS = PE x EPS = 7 x 2.5 = ₹17.5

(i) PE = ? by using **Gordon Growth Model** to find P_0

MPS(P_0)= $\frac{D_1}{K_e-g}$ = $\frac{1(1+2\%)}{14\%-2\%}$ = ₹8.5

So, PE = $\frac{\text{MPS}}{\text{EPS}}$ = $\frac{₹8.5}{₹2.5}$ = 3.4

(ii) Current PE = 7

Current price = PE x EPS = 7 x 2.5 = 17.5

P_0 = $\frac{D_0(1+g)}{K_e-g}$

17.5 = $\frac{1(1+g)}{14\%-g}$

So, 17.5(14 - g) = 1(1 + g)
17.5 x 14 – 17g = 1+g
2.45 – 1 = 17.5g +g

g = $\frac{1.45}{18.5}$ = **7.84% is the long term growth rate for the current PE ratio**

26) Illustration

Rahim Enterprises is a manufacturer and exporter of woollen garments to European countries. Their business is expanding day by day and in the previous financial year the company has registered a 25% growth in export business. The company is in the process of considering a new investment project. It is an all equity financed company with 10,00,000 equity shares of face value of Rs. 50 per share. The current issue price of this share is Rs. 125 ex-divided. Annual earning is Rs. 25 per share and in the absence of new investments will remain constant in perpetuity. All earnings are distributed at present. A new investment is available which will cost Rs. 1,75,00,000 in one year's time and will produce annual cash inflows thereafter of Rs. 50,00,000. Analyse the effect of the new project on dividend payments and the share price.

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Solution 26

Rahim Enterprises

Equity share count = 10 lakh share
FV = ₹50
MPS = ₹125 ex-dividend
EPS = 25

Since all earnings have been paid, DPS = EPS =₹25

New investment = ₹1.75 Cr

Cash flow from investment = ₹50 lakh

If new project is undertaken then total amount invested is 1.75 Cr
PAT = Dividend = 25 per share x 10 lakh shares = ₹2.5 Cr

Next year out of ₹2.5 Cr, ₹1.75 Cr will be invested. So, dividend for Yr 1 will be
2.5Cr – 1.75Cr = 0.75 Cr
i.e. ₹7.5/- per share which will be compared to 25 per share in Yr 0

From Yr 2 dividend will increase to ₹3 Cr i.e. ₹2.5 Cr from existing business and ₹50 lakhs from new investments.

So, Dividend will increase to ₹3 Cr/10 lakh = ₹30 per share.

Analysis (for classroom purpose)

Year	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4
Earlier	25	↓ 25	↑ 25	↑ 25	↑ 25
Now	25	7.5	30	30	30

So if the company goes through with the project, next year dividend will fall to 7.5 but will increase to ₹30 from the year after.

(ii) Impact on share price

$P_0 = \frac{D_1}{K_e - g}$ where K_e can be determined using existing data considering there is no growth (g= 0)

$125 = \frac{25}{K_e - 0}$ So, $K_e = \frac{25}{125}$ = 20%

Now using two stage dividend discount model

$P_0 = \frac{D_1}{1+K_e} + \frac{P_1}{1+K_e}$

Where, $P_1 = \frac{D_2}{K_e - g} = \frac{30}{20\%}$ = ₹150

So, $P_0 = \frac{7.5}{1+20\%} + \frac{150}{1+20\%} = \frac{157.5}{1.2}$ = **₹131.25**

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27) Illustration

A company had paid a dividend of Rs. 2.50 per share last year and its required rate of return for equity investors is 20%. What will be the market price of the share at the end of the year, if?
There is no growth in dividend?

Dividend grows at constant rate of 5% per annum in perpetuity.
Constant dividend for first five years and then grows at constant rate of 5% per annum in perpetuity?
Constant dividend for first five years and then shares is sold at the price of Rs. 20.

Solution 27

Given,

D_0 = 2.5 K_e = 20%

Part 1: Where there is no growth in dividend

$P_0 = \frac{D_1}{K_e - g}$ since g=0 $P_0 = \frac{D}{K_e} = \frac{2.5}{20\%}$ = **₹12.5**

Part 2 : g=5% then,

$P_0 = \frac{D_1}{K_e - g}$ where, $P_0 = \frac{D_0(1+g)}{K_e - g}$

then, $\frac{2.5(1+5\%)}{20\% - 5\%} = \frac{2.625}{15\%}$ = **₹17.5**

Part 3 : $D_1 - D_5$ = constant $D_6 = D_5(1 + 5\%)$ g_6 = 5%
$g_6 - g_\infty$ = 5%

That can be tabulated as,

Yr	0	1	2	3	4	5	6
Dividend	2.5	2.5	2.5	2.5	2.5	2.5	2.625
growth	-	-	-	-	-	-	5%
K_e = 20% so, PV factor is	1	0.833	0.694	0.578	0.482	0.402	

So, the PVAF for 5 yrs @20% = 2.989 (0.833 + 0.694 + 0.578 + 0.482 + 0.402)

$D_6 = D_5(1 + 5\%)$ = 2.5(1+ 5%) = **2.625** so, $P_5 = \frac{D_6}{K_e - g} = \frac{2.625}{20\% - 5\%}$ = ₹17.5

P_0 = PVAF (5,20%) + $\frac{P_5}{(1+20\%)^5}$

= 2.989 x (2.5) + 17.5 x 0.402

= 7.473 + 7.035 = **14.508**

Part 4 : when, $D_1 - D_5$ = constant and P_5 = 20

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P_0 = PVAF(5,20%) + $\frac{P_5}{(1+20\%)^5}$

= 2.989 x (2.5) + 20 x 0.402

= **₹15.513**

28) Illustration

An investor is considering purchasing the equity shares of LX Ltd., whose current market price is Rs. 150. The company is proposing a dividend of Rs. 6 for the next year. LX is expected to grow at 18% per annum for the next four years. The growth will decline linearly to 14% per annum after first four years. Thereafter, it will stabilise at 14% per annum infinitely. The required rate of return is 18% per annum.
You are required to determine:

i. The intrinsic value of one share
ii. Whether it is worth to purchase the share at this price

t	1	2	3	4	5	6	7	8
PVIF (18,t)	0.847	0.718	0.609	0.516	0.437	0.370	0.314	0.266

Solution 28

MPS =₹150	D_1 = ₹6	$g_1 - g_4$ = 18%	$g_5 - g_8$ =17%/16%/15%/14%	g_9 - g_∞= 14%	K_e = 18%

Year	Growth rate	Computation	Dividend	PVIF @ 18%	PV
1	18%	-	6	0.847	5.082
2	18%	6(1.18)	7.08	0.718	5.084
3	18%	$6(1.8)^2$	8.35	0.609	5.085
4	18%	$6(1.8)^3$	9.86	0.516	5.088
5	17%	9.86(1.17)	11.53	0.437	5.005
6	16%	11.53(1.16)	13.38	0.370	4.95
7	15%	13.38(1.15)	15.39	0.314	4.83
8	14%	15.39(1.14)	17.54	0.266	4.66
Present value of explicit factor					**Σ = 39.79**
9	14%	17.54(1.14)	20		

$P_8 = \frac{D_9}{K_e - g} = \frac{20}{18\% - 14\%}$ = ₹500

PV of P_8 = ₹500 x 0.266 = **₹133**

So, the total value of cash inflow = ₹39.79 + ₹133 = **₹172.79**
Intrinsic Value = 172.79 and investor should buy shares of LX Ltd as MPS (₹150) is less than the intrinsic value.
Alternatively,
Explicit factor (discounting for 7 years) = **35.13** (5.082 + 5.084 + 5.085 + 5.088 + 5.005 + 4.95 + 4.83)

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Terminal value of P_7 = $\frac{D_8}{K_e - g} = \frac{17.54}{18\% - 14\%}$ = ₹438.5

PV(7th yr @18%) of ₹438.5 is 0.314 x 438.5 = ₹137.69

So, the total value of cash inflow = Explicit factor + Terminal value of P_7
= ₹35.13 + ₹137.69
= **₹172.81**

Intrinsic Value = 172.81 and investor should buy shares of LX Ltd as MPS (₹150) is less than the intrinsic value.

29) Illustration

X Ltd. is a Shoes manufacturing company. It is all equity financed and has a paid up Capital of Rs. 10,00,000 (Rs. 10 per share) X Ltd. has hired Swastika consultants to analyse the future earnings. The report of Swastika consultants states as follows:

i. The earnings and dividend will grow at 25% for the next two years.
ii. Earnings are likely to grow at the rate of 10% from 3rd year and onwards.
iii. Further, if there is reduction in earnings growth, dividend pay-out ratio will increase to 50%.

The other data related to the company are as follows:

Year	EPS (Rs.)	Net Dividend per share (Rs.)	Share Price (Rs.)
2010	6.30	2.52	63.00
2011	7.00	2.80	46.00
2012	7.70	3.08	63.75
2013	8.40	3.36	68.75
2014	9.60	3.84	93.00

You may assume that the tax rate is 30% (not expected to change in future) and post-tax cost of capital is 15%.

By using the Dividend Valuation Model, calculate

i. Expected Market Price per share
ii. P/E Ratio.

Solution 29

(i) Assuming we're on 1/1/2015 & EPS AD DPS AND Growth rate is from this date.

Year	g	EPS Computation	EPS	DPS computation	DPS
2014			9.6		
2015	25%	9.6(1.25)	12	3.84 x 1.25	4.8
2016	25%	12(1.25)	15	4.8 x 1.25	6
2017	10%	15(1.10)	16.5	16.5 x 50%	8.25
2018	10%	16.5(1.10)	18.15	18.15 x 50%	9.075

$P_0 = \frac{D_1}{1+K_e} + \frac{D_2}{(1+K_e)^2} + \frac{D_3}{(1+K_e)^3} + \frac{P_3}{(1+K_e)^3}$ & $P_3 = \frac{D_4}{K_e - g}$

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Year	Dividend	PVF @ 15%	PV of dividend
1	4.8	0.8696	4.17408
2	6	0.7561	4.5366
3	8.25	0.6575	5.4243
Present value of explicit factor			**Σ = 14.13498**
4	9.075	0.5717	

$P_3 = \frac{D_4}{K_e - g} = \frac{9.075}{15\% - 10\%}$ = **₹181.5**

P_0 = **14.13498 + PV of** P_3 = **14.13498 + 0.6575 x 181.5 = ₹133.47**

(ii) PE = $\frac{MPS}{EPS}$

	Forward	Trailing
Market price(MPS₹)	133.47	133.47
EPS(₹)	12	9.6
PE Ratio	11.12	13.90

30) Illustration

AMKO Limited has issued 75,000 equity shares of Rs. 10 each. The current market price per share is Rs. 36. The company has a plan to make a rights issue of one new equity share at a price of Rs. 24 for every four shares held.

You are required to:
Calculate the theoretical post-rights price per share.
Calculate the theoretical value of the right alone

Solution 30

Share capital = 75000 units of ₹10 each	CMP/MPS = ₹36	Rights issue price = ₹24	Rights issue = 1:4

Theoretical Ex- Right Price (TERP)

Issue size is 1 for 4 held. So, total shares issued = $\frac{75000}{4}$ * 1 = 18750

TERP = $\frac{nP_0 + S}{n + n_1} = \frac{75000 * 36 + 18750 * 24}{75000 + 18750}$ = **₹33.6**

Where,

n = No. of existing equity shares
P_0 = Price of Share Pre-Right Issue
S = Subscription amount raised from Right Issue
n_1 = No. of new shares offered

Now, Theoretical value of the right = ₹33.6 – ₹24 = ₹9.6 (is for 4 right shares)
Value of the right per existing share = ₹9.6/4 = **₹2.4**

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31) Illustration

AB Limited's shares are currently selling at Rs. 130 per share. There are 10,00,000 shares outstanding. The firm is planning to raise Rs. 2 crores to finance new project.
Required

- What is the ex-right price of shares and value of a right, if.
  - The firm offers one right share for every two shares held.
  - The firm offers one right share for every four shares held.

Solution 31

Share capital = 10 lakhs	CMP/MPS = ₹130	New project = ₹2 Crores
Scenario	**1**	**2**
Rights issue	1:2	1:4
Project Value	2 Cr	2 Cr
Existing share count	10 lakhs	10 lakhs
No. of rights shares	10lakhs x 1/2= 5lakhs	10 lakhs x 1/4 = 2.5 lakhs
Price per share	₹2Cr/5lakhs = ₹40	₹2 Cr/2.5lakhs = ₹80
CMP	₹130	₹130
TERP	$\frac{10lacs*130+5lacs*40}{10lacs+5lacs}$ = ₹100	$\frac{10lacs*130+2.5lacs*40}{10lacs+2.5lacs}$ = ₹120
Theoretical value of the right	₹100 – ₹40 = ₹60	₹120 – ₹80 = ₹40
Shares held	2	4
Value per share	₹60/2 = 30	₹40/4 = ₹10

32) Illustration

Pregya Ltd has issued 75000 equity shares of Rs. 10 each. Current market price is Rs. 24. Company has a plan to make rights issue of one equity share at a price of Rs. 16 for every 4 shares held.
You are required to calculate

- Theoretical post right price per share
- Calculate value of the right
- Show the effect of rights on the wealth of the shareholder who has 1000 shares assuming he sells the entire rights and show the effect of same holder if same shareholder does not take any action and ignores the issue.

Solution 32

Given,

Share count 75000	FV = ₹10	CMP = ₹24	Rights issue = 1:4	Rights price = ₹16

Total rights shares issued = 75000 x $\frac{1}{4}$ = 18750

(i) Theoretical Ex Right Price = $\frac{75000*24+18750*16}{75000+18750} = \frac{21,00,000}{93750}$ = ₹22.40

(ii) Value of right = ₹22.4 - ₹16 = ₹6.4
Value per share held by existing shareholder = 6.4/4 = ₹1.6

(iii) Impact on shareholder

Value before rights issue = 24 x 1000 = 24000

Value after rights issue = 1000 x 22.4 = 22400

For 1000 shares he gets 250 rights.
Value realised on sale of rights shares = 250 x 6.4 = ₹1600

Post rights wealth = 22400 + 1600 = 24000
Pre rights wealth = 24000

Hence there is no change

(iv) If shareholder does not sell, he loses ₹1600 is the form of loss on rights unsold.

33) Illustration

Telbel Ltd. is considering undertaking a major expansion an immediate cash outlay of Rs. 150 crores. The Board of Director of company are expecting to generate an additional profit of Rs. 15.30 crore after a period of one year. Further, it is expected that this additional profit shall grow at the rate of 4% for indefinite period in future.

Presently, Telbel Ltd. is completely equity financed and has 50 crore shares of Rs. 10 each. The current market price of each share is Rs. 22.60 (cum dividend). The company has paid a dividend of Rs. 1.40 per share in last year. For the last few years dividend is increasing at a compound rate of 6% p.a. and it is expected to be continued in future also. This growth rate shall not be affected by expansion project in any way.

Board of Directors are considering following ways of financing the possible expansion:
(1) A right issue on ratio of 1:5 at price of Rs. 15 per share.
(2) A public issue of shares.

In both cases the dividend shall become payable after one year.
You as a Financial Consultant required to:
Determine whether it is worthwhile to undertake the project or not.
Calculate ex-dividend market price of share if complete expansion is financed from the right issue.
Calculate the number of new equity shares to be issued and at what price assuming that new shareholders do not suffer any loss after subscribing new shares.
Calculate the total benefit from expansion to existing shareholders under each of two financing option.

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Solution 33

Given,

Project outflow = 150 Cr	g = 4% till ∞	$Profit_1$(inflow)=15.3 Cr	Current share capital is 50 Cr shares @₹10 each	CMP = 22.6 cum dividend	g rate of dividend= 6% & $D_{\square}$=1.4

To find out project value till perpetuity and thereafter to find NPV K_e is required.

$P_0 = \frac{D_1}{K_e - g}$ where, P_0 (Ex-dividend) = 22.6 – 1.4 = ₹21.2

$21.2 = \frac{1.4(1.06)}{K_e - 6\%}$

$K_e - 6\% = \frac{1.484}{21.2}$

K_e = 13%

Using K_e = 13% , g=4%and Cash inflow = 15.3Cr PV of future cashflows from the new project are computed as

PV of inflow = $\frac{15.3}{13\%-4\%}$ = ₹170 Cr

PV of outflow = ₹150 Cr

So, NPV = ₹170Cr – ₹150 Cr = ₹20 Cr

(ii)

Rights issue size = 150Cr	Price per share = 15	Issue terms = 1:5	New shares issued = ₹50Cr/5 = 10Cr

TERP = $\frac{nP_0 + S}{n + n_1} + \frac{NPV\ from\ the\ project}{60} = \frac{50Cr * 21.2 + 10Cr * 15}{50Cr + 10Cr} + \frac{20Cr}{60Cr}$ = ₹20.5

The NPV of the project should also be included in the value of the share.

(iii) Let the number of new equity share = m

New issue price = p

M x p = ₹150 So, P = $\frac{150}{M}$

Post issue price = $\frac{nP_0 + S}{n + n_1} = \frac{(m * p) + 20Cr + (21.2 * 50)}{50+m}$

P = $\frac{(m * p) + 20Cr + (21.2 * 50)}{50+m}$

$\frac{150}{M} = \frac{(150Cr + 20Cr + 1060)}{50+m}$

$150(50 + m) = (150Cr + 20Cr + 1060)m$

7500 = 1230m – 150m

M = 7500/1080 = 6.944 Put M=6.944 in P = $\frac{150}{M}$

Then, P = $\frac{150}{6.944}$ = ₹21.60

Existing shareholders = 21.2 – 21.6 = 0.4

Value = 0.4 x 50 = ₹20Cr

(iv) (a) Rights issue

(Amt. in Cr)

	Pre Rights Issue	Post Rights Issue
Share Count	50	60 (50 + 10)
Price(Ex-dividend)	21.2	20.5
Value	1060	1230
Add : Subscription Amt	150	

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	1210	**1230**
Net gain in case of rights issue is ₹20Cr		

(b) In case of Public Issue

	Pre	**Post**
Shares	50	50
Price	21.2	21.6
	1060	**1080**
Net gain in case of public issue is ₹20Cr		

34) Illustration

X is evaluating PQR Co., which has been growing at the annual rate of 15% for the last 5 years. Here is her forecast of the company's future dividend growth trend.

2022	13.5%
2023	12%
2024	10.5%
2025	9.0%
2026	7.5%
2027	6%
Till perpetuity	6%

After considerable study, she has decided to use the following information in her valuation (as of the end of 2021):

- Beta: 1.2.
- 2021 dividend: ₹5.
- The risk-free rate: 4%.
- Expected equity premium: 6%.

What is the value of the PQR stock?

Solution 34

Beta: 1.2	D_0: ₹5	$R_f = 4\%$	$R_p = 6\%$

H Model formula

$\mathbf{P_0} = \frac{D_0(1+g_c)}{K_e - g_c} + \frac{D_0\left(\frac{1}{2}*2H\right)(g_h - g_c)}{K_e - g_c}$ where,

g_h= Highest growth g_c = constant growth 2H = 6yrs (2021 to 2027)

$K_e = R_f + \beta\ (R_m - R_f)$ = 4% + 1.2(6%) = 11.2%

So, $P_0 = \frac{5(1+6\%)}{11.2\%-6\%} + \frac{5\left(\frac{1}{2}*6\right)(15\%-6\%)}{11.2\%-6\%} = \frac{5.3+1.35}{5.2\%}$ = **₹127.88**

35) Illustration

The management of T Ltd, an internationally diversified conglomerate, believes that the recent strong performance of its wholly owned medical supply subsidiary, S Ltd, has gone unnoticed. To realize S Ltd' s full value, T Ltd has announced that it will List S Ltd.

Data for 2021 & 2022 is given below

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Income Statement Rs.cr	2021	2022
Revenue	474	598
Depreciation	20	23
Other Operating costs	368	460
Income before taxes	86	115
Taxes	26	35
Net Income	60	80
Dividends	18	24
EPS	Rs. 0.714	Rs. 0.952
Dividends per share	Rs. 0.214	Rs. 0.286
Common Shares Outstanding	84	84

Balance Sheet – Rs. Cr	2021	2022
Current Assets (Includes Rs. 5 Cr. cash in 2021 and 2022)	201	326
Net property, plant, and equipment	474	489
Total Assets	675	815
Current Liabilities (all non-interest-bearing)	57	141
Long Term Debt	0	0
Shareholder's Equity	618	674
Total Liabilities and equity	675	815
Capital Expenditures	34	38

A. Calculate the amount of FCFE per share for 2022 by using the data from Exhibit.
B. Calculate the current value of a share of S Ltd. based on the two - stage FCFE model.
For the next three years, growth rate is 10% and after 3 years at 5% in perpetuity.
Cost of Equity is 11%.

Solution 35

FCFF = EBIT (1 – Tax) + Depreciation -/+ Capital Expenditure / Assets Disposed off +/- Change in Working capital

FCFE = FCFF - Interest (1 – Tax rate) - Debt / Preference Shares repaid / redeemed + New Debt / Preference shares Issued - Preference Dividend

So,

	2021	2022
PBIT	86	115
Int	-	-
PBT	86	115
Tax	26	35
PAT	60	80

EBIT(1 – t) = PAT
Int = 0 & Not accrued taxes & No adj.
Now, FCFF

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	2021	2022
PAT	60	80
(+) DEP	20	23
(-) CAPEX*	(34)	(38)
(-) Inc in WC	-	(41)
FCFF	6	24

*WN :1 Increase in working capital

	2021	2022
Assets excluding cash	201	326
(-) Cash	(5)	(5)
	196	**321**
Current Liabilities	57	141
	139	180
Increase in working capital	**41 (180-139)**	

FCFE = FCFF - Interest (1 – Tax rate) - Debt /Preference Shares repaid / redeemed + New Debt / Preference shares Issued - Preference Dividend

FCFE = FCFF – 0

FCFE = 24Cr – 0 = 24Cr

O/S shares = 84Cr
FCFE/Share = 0.2857/share

(ii)

$g_1 - g_3$ = **10%**	g_4 - g_∞= 5%	K_e = 11%

Two stage FCFE Model

Stage 1

FCFE 0.2857

Year	Growth	Computation	FCFE Value
2022			0.2857
2023	10%	0.2857(1.10)	0.3143
2024	10%	0.3143(1.10)	0.3457
2025	10%	0.3457(1.10)	0.3803
2026	5%	0.3803 (1.05)	0.3993

P_0 = Explicit period value + perpetuity value

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Year	Cashflow	PVF@11%	PVCF
1	0.3143	0.9009	0.2831
2	0.3457	0.8116	0.2806
3	0.3803	0.7312	0.2780
			∑ = 0.8417
4	0.3803(1.05) = 0.3993		

Stage 2

Perpetuity Value : $\frac{P_3}{(1+K_e)^3}$

$P_3 = \frac{FCFE_4}{K_e - g} = \frac{0.3993}{11\% - 5\%}$ = ₹6.6547

PV of P_3 = 6.6547 x 0.7312 = ₹4.8659

Now, P_0 = **Explicit period value + perpetuity value**

P_0 = 0.8417 + 4.8659 = **₹5.7076 per share**

36) Illustration

Mr. AF is analysing the financial statements of SD Limited. He has a 2007 income statement and balance sheet, as well as 2008 income statement, balance sheet, and cash flow from operations forecasts (as shown in the tables below). Assume there will be no sales of long-term assets in 2008. Calculate forecasted free cash flow to the firm (FCFF) and free cash flow to equity (FCFE) for 2008

Income Statement — In Crores

	2008 (Forecast)	2007 (Actual)
Sales	300	250
Cost of Goods Sold	120	100
Gross Profit	180	150
SG & A	35	30
Depreciation	50	40
EBIT	95	80
Interest Expense	15	10
Pre-Tax Earnings	80	70
Taxes (at 30%)	24	21
Net income	56	49

Balance Sheet — In Crores

	2008 (Forecast)	2007 (Actual)
Cash	10	5
Accounts Receivable	30	15
Inventory	40	30
Current Assets	80	50

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Gross property, plant, and equipment	400	300
Accumulated Depreciation	(190)	(140)
Total Assets	**290**	**210**
Accounts payable	20	20
Short term Debt	20	10
Current Liabilities	40	30
Long term Debt	114	100
Common stock	50	50
Retained Earnings	86	30
Total Liabilities and Owner's Equity	**290**	**210**

SD Ltd Cash Flow from Operations Forecast for 2008

Net Income	56
Add: Depreciation	50
Less: Investment in working capital	25
Cash Flow from operations	81

Solution 36

FCFF = EBIT (1 – Tax) + Depreciation -/+ Capital Expenditure / Assets Disposed off +/- Change in Working capital

= **95(1-30%)+50-100*-25****

= **66.5 – 75**

FCFF = (8.5) – negative cashflow

FCFE = FCFF – Int(1 – tax) – Debt Paid + Debt raised

FCFE = -8.5 – 15(1 – 0.3) + Net borrowing***

= -8.5 -10.5 +24 = **5**

FCFE = 5

*WN 1

Capex = GFA (2008) – GFA (2007) = 400-300 = **100Cr**

**WN 2

Working capital investment

	2008	2007
Current Asset	80	50
(-) Cash	10	5
Current asset excluding cash	**70**	**45**
Current Liabilities	40	30
(-) Short term debt	20	10
Current liabilities excluding short term debt	**20**	**20**
Net working capital	**50**	**25**

Increase in working capital

25

***WN 3 : Net borrowing

	2008	**2007**

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Short term loan	20	10
Long term Loan	114	100
	134	110
Increase in net borrowing 24		

EBITDA

FCFF = EBITDA(1-tax) + Dep x tax – WC – Capex
= 145(1-0.3) + 50(0.30) – 25 – 100
= 101.5 – 110
FCFF = (8.5)

CFO

CFO = NI + Dep- Inc in WC +Int Exp
CFO = 56 +50 -25+15= 96
FCFF = CFO - Int(tax) – Capex
= 96- 15(0.30) - 100
FCFF = (8.5)

PAT based approach

FCFF = PAT + Dep - Inc in WC – Capex + Int(1 – tax)
= 56 + 50 -25 – 100 + 15(0.7)
= -19 + 10.5
FCFF = -8.5

37) Illustration

Calculate the value of share from the following information:

Profit after tax of the company	Rs. 290 crores
Equity capital of company	Rs. 1,300 crores
Par value of share	Rs. 40 each
Debt ratio of company (Debt/ Debt + Equity)	27%
Long run growth rate of the company	8%
Beta 0.1; risk free interest rate	8.7%
Market returns	10.3%
Capital expenditure per share	Rs. 47
Depreciation per share	Rs. 39
Change in Working capital	Rs. 3.45 per share

Solution 37

Given,

PAT	₹290Cr
Equity Capital	₹1300Cr
FV per share	40
Debt : Equity	27%
g	8%
β	0.1
R_f	8.7%

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R_m	10.3%
Capital expenditure per share	₹47
Depreciation per share	₹39
Change in WC per share	₹3.45

$K_e = R_f + \beta (R_m - R_f)$
$= 8.7\% + 0.1(10.3\% - 8.7\%)$
$\boldsymbol{K_e}$ **= 8.86%**

FCFE = FCFF – Int(1 – tax) + Net borrowing + Net pref raised – Pref dividend

FCFF = PAT + Dep - Inc in WC – Capex + Int(1 – tax)

So, FCFE = PAT – WC – Capex + Dep + Net Borrowing

= PAT – WC (1 - Debt rate) – (1 – Debt rate)(Capex – Dep)

=*8.92 – (1 - 0.27)(3.45) – (1 - 0.27)(47 - 39) = 8.92 – 8.36 = 0.56

FCFE = ₹0.56

*[Instead of net borrowing multiply with 1-debt rate]

*PAT per share

Share count = 1300/40 = 32.5

PAT per share = 290/32.5 = **8.92**

Now, Value per share is

$FCFE_1 = FCFE_0$ (1+g) = 0.56 (1+8%) = 0.605

$\boldsymbol{P_0} = \frac{\boldsymbol{FCFE_1}}{\boldsymbol{K_e - g}} = \frac{\boldsymbol{0.605}}{\boldsymbol{8.86\% - 8\%}}$ **= ₹70.35**

38) Illustration

Mr. SV has gathered the following data for CSI Ltd.

Recent Share Price	Rs. 31.25
Shares Outstanding	30 Lakhs
Market Value of Debt	115 Lakhs
Cash and Marketable Securities	47.6 Lakhs
Investments	247 Lakhs
Net Income	119.4 Lakhs
Interest Expense	5.8 Lakhs
Depreciation	6.9 lakhs
Amortization	2.3 Lakhs
Taxes	85.9 Lakhs

Based on these, compute EV, EV/EBITDA, Market Cap

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Solution 38

Computation of EV, EV/EBITDA, Market Cap

Particulars	Computation	Value
Share Price		₹31.25
Shares O/S		30 Lakhs
Market Capitalisation	MP x shares O/S =31.25 x 30lakhs	₹9.375Cr
EV	Market cap + Debt – Cash –Invst = 9.375 + 1.15 – 0.476 – 2.47	₹7.579Cr
EBITDA	PAT +Tax + Dep +Int = 1.194Cr + 0.859Cr + 0.023Cr + 0.069Cr + 0.058Cr	₹2.203Cr
EV/EBITDA	₹7.579/₹2.203	**3.44 times**

39) Illustration

An investor is considering purchasing the equity shares of LX Ltd., whose current market price (CMP) is Rs. 112. The company is proposing a dividend of Rs. 4 for the next year. LX Ltd. is expected to grow @ 20 per cent per annum for the next four years. The growth will decline linearly to 16 per cent per annum after first four years. Thereafter, it will stabilize at 16 per cent per annum infinitely. The investor requires a return of 20 per cent per annum

You are required

To calculate the intrinsic value of the share of LX Ltd.

Whether it is worth to purchase the share at this price.

Period	1	2	3	4	5	6	7
PVIF(20%, n)	0.833	0.694	0.579	0.482	0.402	0.335	0.279

Solution 39

CMP = 112

Yr	Computation	Cash flow	PVF@20%	Present Value
D_0	$\frac{4}{1.2}$	3.33	1	
D_1	3.33(1.2)	4	0.833	3.332
D_2	4(1.2)	4.8	0.694	3.331
D_3	4.8(1.2)	5.76	0.579	3.335
D_4	5.76(1.2)	6.912	0.482	3.331
D_5	6.912(1.19)	8.225	0.402	3.306
D_6	8.225(1.18)	9.706	0.335	3.251
D_7	9.706(1.17)	11.356	0.279	3.168
Explicit period value				**Σ = 23.056**
D_8	11.356(1.16)	13.173		

P_0 = **Explicit period value + perpetuity value**

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Explicit period value = Sum of PV of D_1 *to* D_7 = 23.056

Perpetuity value = $\frac{P_7}{(1+K_e)^7}$

P_7 = $\frac{D_8}{K_e - g}$= $\frac{13.173}{20\%-16\%}$ = ₹329.325 ,

PV of 329.325 = 329.325 x 0.279 = ₹91.88

P_0 = 23.056 + 91.88 = ₹114.93

Hence the intrinsic value is 114.93. Since the CMP is ₹112, the investor may buy.

40) Illustration (Jul 21)

SK Ltd. has a surplus cash of ₹150 lakhs and wants to distribute 30% of it to the shareholders. The company decided to buy-back shares.
The company estimates that its share price after the buy-back is likely to be 15% above the buy-back price. The number of shares outstanding at present is 15 lakhs and the current EPS is ₹4.

You are required to determine:
The price at which the shares can be bought-back, if the market capitalization of the company should be ₹400 lakhs after buy back.
The number of shares that can be bought-back, and
The impact of this buy-back on the EPS, assuming that the net income remains the same.

Solution 40

(i) Let P be the buyback price decided by SK Ltd.

Market Capitalisation after Buyback

1.15P (Original Shares – Shares Bought Back)

400 Lakhs = 1.15P[15lakhs - $\frac{30\% \text{ of } 150 \text{ lakhs}}{\text{P}}$

400 Lakhs = 17.25lakhs x P - 45 lakhs $\times$ 1.15 = 17.25 lakhs P – 51.75 lakhs

Again, 400 Lakhs = 17.25 lakhs P – 51.75 lakhs

or 17.25 lakhs P = 400 lakhs + 51.75 lakhs

or P = $\frac{451.75}{17.25}$ = 26.19

(ii) Number of Shares to be Bought Back :$\frac{45 \text{ lakh}}{26.19}$ = 1.718 lakhs (approx.) or 171821 share

(iii) Impact of Buy Back on the EPS:

No. of equity shares after buy back :- 15 lakhs – 1.718 lakhs = 13.282 lakhs or 15,00,000 – 1,71,821 = 13,28,179 shares

$\therefore$ EPS = $\frac{4 \text{ x } 15 \text{ lakhs}}{13.282 \text{ lakhs}} \times$ = 4.52 or $\frac{4 \text{ x } 15 \text{ lakhs}}{13,28,179}$ = 4.52

Thus, EPS of SK Ltd., increases to 4.52 or increases by 0.52 (4.52 - 4.00)

41) Illustration (RTP May 21)

ABC Limited, just declared a dividend of ₹28.00 per share. Mr. A is planning to purchase the share of ABC Limited, anticipating increase in growth rate from 8% to 9%, which will continue for three years. He also expects the market price of this share to be ₹720.00 after three years.

You are required to determine:

- the maximum amount Mr. A should pay for shares, if he requires a rate of return of 13% per annum.
- the maximum price Mr. A will be willing to pay for share, if he is of the opinion that the 9% growth can be maintained indefinitely and require 13% rate of return per annum.
- the price of share at the end of three years, if 9% growth rate is achieved and assuming other conditions remaining same as in (ii) above. [RTP May 21]

Note : Calculate rupee amount up to two decimal points and use PVF upto 3 decimal points.

Solution 41

(i) Expected dividend for next 3 years.

Year 1 (D_1) 28.00 (1.09) = ₹30.52
Year 2 (D_2) 28.00 $(1.09)^2$ = ₹ 33.27
Year 3 (D_3) 28.00 $(1.09)^3$ = ₹36.26

Required rate of return = 13% (Ke)

Market price of share after 3 years = (P_3) = ₹720

The present value of share

$P_0 = \frac{D_1}{1+K_e} + \frac{D_2}{(1+K_e)^2} + \frac{D_3}{(1+K_e)^3} + \frac{P_3}{(1+K_e)^3}$

$= \frac{30.52}{(1+0.13)} + \frac{33.27}{(1+0.13)^2} + \frac{36.26}{(1+0.13)^3} + \frac{720}{(1+0.13)^3}$

P_0 = 30.52(0.885) + 33.27(0.783) +36.26(0.693) +720(0.693)

$\boldsymbol{P_0}$ = **₹577.15**

(ii) If growth rate 9% is achieved for indefinite period, then maximum price of share should Mr. A willing be to pay is

$P_0 = \frac{D_1}{K_e - g} = \frac{30.52}{0.13-0.09}$ = **₹763**

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(iii) Assuming that conditions mentioned above remain same, the price expected after 3 years will be:

$$P_3 = \frac{D_4}{K_e - g} = \frac{D_3(1+9\%)}{0.13-0.09} = \frac{36.26(1.09)}{0.13-0.09} = \textbf{₹988}$$

42) Illustration (RTP May 21)

KLM Limited has issued 90,000 equity shares of ₹10 each. KLM Limited's shares are currently selling at ₹72. The company has a plan to make a rights issue of one new equity share at a price of ₹48 for every four shares held.

You are required to:

- Calculate the theoretical post-rights price per share and analyse the change
- Calculate the theoretical value of the right alone.

Suppose Mr. A who is holding 100 shares in KLM Ltd. is not interested in subscribing to the right issue, then advice what should he do.

Solution 42

(i) Calculation of theoretical Post-rights (ex-right) price per share

Ex Right Price of share = $\frac{N_0P_0 + S}{N_0 + N_1} = \frac{72 \times 4 + 48 \times 1}{4+1}$ = **₹67.20**

Thus, post right issue the price of share has reduced by 4.80 per share

(ii) Calculation of theoretical value of the rights alone:

= Ex-right price – Cost of rights share
= 67.20 – 48 = 19.20
= **₹4.80**

(iii) If Mr. A is not interested in subscribing to the right issue, he can renounce his right eligibility @ 19.20 per right and can earn a gain of 480.

43) Illustration (Jan 21)

M/s. B Ltd. has declared dividend of ₹2.50 per share on the EPS of ₹7. Earnings of the company are expected to grow at the rate of 10% for the next 3 years and to be stabilized at 3% thereafter. The pay-out ratio is expected to remain at the same level during 3 years and then will increase to 60%. If required rate of return is 16% calculate:

i. The current price of the share.
ii. The expected price of share of B Ltd. At the end of 3rd year.

Following table may be used for calculations.

Present Values	t_1	t_2	t_3	t_4	t_5
$PVIF_{0.16,\ t}$	0.862	0.743	0.641	0.553	0.477

Solution 43

Working Notes:

Period	EPS	Dividend
1	7.70	2.750
2	8.47	3.025
3	9.317	3.327
4th onwards	9.60	5.76

(i) **Current price of the Share**

= PV of Dividends upto 3 Years + PV of Expected price of share of at the end of 3rd year

Expected price of share of B Ltd. at the end of 3rd year = $\frac{5.76}{0.16 - 0.03}$ = **₹44.31**

Accordingly, Current Market Price of Share shall be:

= 2.750 x 0.862 + 3.025 x 0.743 + 3.327 x 0.641 + 44.31 x 0.641
= 2.371 + 2.248 + 2.133 + 28.403 = **35.155** say **35.16**

(ii) **Expected price of share of B Ltd. at the end of 3rd year**

= $\frac{5.76}{0.16 - 0.03}$ = **₹44.31**

44) Illustration (May 22 RTP)

Mr. A is holding 1000 shares of face value of ₹ 100 each of M/s. ABC Ltd. He wants to hold these shares for long term and has no intention to sell.
On 1st January 2020, M/s XYZ Ltd. has made short sales of M/s. ABC Ltd.'s shares and approached Mr. A to lend his shares under Stock Lending Scheme with following terms:

1. Shares to be borrowed for 3 months from 01-01-2020 to 31-03-2020
2. Lending Charges/Fees of 1% to be paid every month on the closing price of the stock quoted in Stock Exchange and
3. Bank Guarantee will be provided as collateral for the value as on 01-01-2020.

Other Information:

a. Cost of Bank Guarantee is 8% per annum,
b. On 29-02-2020, M/s. ABC Ltd., declared dividend of 25%
c. M/s ABC Ltd.'s share quoted in Stock Exchange on various dates are as follows:

Date	Share Price in Scenario -1 Bullish	Share Price in Scenario -2 Bullish
01-01-2020	1000	1000
31-01-2020	1020	980
29-02-2020	1040	960
31-03-2020	1050	940

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You are required to find out:

i. Earning of Mr. A through Stock Lending Scheme in both the scenarios

ii. Total Earnings of Mr. A during 01-01-2020 to 31-03-2020 in both the scenarios

iii. What is the Profit or loss to M/s. XYZ by shorting the shares using through Stock Lending Scheme in both the scenarios?

Solution 44

Earnings of Mr. A through stock lending scheme

		Scenario 1	Scenario 2
(i)	Lending fee		
	31-01-20 1020 x 1% and 980 x 1%	10.20	9.80
	29-02-20 1040 x 1% and 960 x 1%	10.40	9.60
	31-03-20 1050 x 1% and 940 x 1%	10.50	9.40
	Earnings from lending per Share (A)	**31.10**	**28.80**
	Total No. of Shares	1000	1000
	Total Earning from Lending	**31,100**	**28,800**
(ii)	Dividend income per Share (B)	25.00	25.00
	Total earnings per share (A) + (B)	56.10	53.80
	Total No. of Shares	1000	1000
	Total Earning	**56,100**	**53,800**
(iii)	Gain on shorting the shares (1,050 - 1,000) and (1,000 - 940)	(50.00)	60.00
	Lending fees paid	(31.10)	(28.80)
	Bank guarantee charges @ 8%	(20.00)	(20.00)
	Dividend Exp (If paid before March 31st)	(25.00)	(25.00)
	Gain Per Share	**(126.10)**	**(13.80)**
	Total No. of Shares	1000	1000
	Total Gain on shorting the shares	(1,26,100)	(13,800)

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45) Illustration (Nov'22)

Mr. X has submitted the following data:

Particulars	(₹) in Lakhs
Total Assets	**250**
Total Liabilities	**220**
Net Income	**12**
Dividend Paid	**4.5**
Sales	**100**

Mr. X wants to know to what extent sales can be increased without going for additional borrowings by using the Sustainable Growth Rate (SGR) concept?

Solution:

SGR = $ROE * Retention\ Rate$
= $r * b$

b = $1 - d$
d = Dividend payout rate

Given,

Total Assets = 250 lakhs
Total Liability = 220 Lakhs
Equity = 30 lakhs
Net Income = 12lakhs
ROE = $12/30$ = 40%

Dividend Paid = 4.5 lakhs
Retained Earnings = 12- 4.5 = 7.5 lakhs

Retained Earnings % = $7.5/12$ = 62.5%

SGR (g) = b* r
= 62.5%* 40% = **25%**

Sales (Original) = 100 lakhs
g = 25%
Revised Sales = 100(1+25%) = **125 Lakhs**

46) Illustration (May'23)

An investor is considering purchasing equity shares of Alpha Ltd., whose current Market price in May 2023 is 172.45. The company is proposing a dividend of 6 for the year ending 31st March 2024. Alpha Ltd. is expected to grow @ 20 percent per annum for the next four years. Thereafter, the growth, over the next three years, will decline linearly by 100 basis points per annum. Thereafter, it will stabilize at a certain growth rate per annum infinitely. The required rate of return for the investor is 20%.

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Dividend value is to be taken in 2 decimal points only. You are required:

(i) To calculate the stable growth rate of Alpha Ltd. after the end of 7 years.

(ii) To advise whether it is worth purchasing the share at this price if the investor has a stable target growth rate of 15% per annum.

Period	1	2	3	4	5	6	7
PVIF (20%, n)	0.8333	0.6944	0.5787	0.4823	0.4019	0.3349	0.2791

Solution:

Assuming growth rate of 20% from D_0 – D_4 i.e., 4 years and D_5 - D_7 @ 19% ,18% and 17%.

D_1 = 6

D_2 = 6*1.2 = 7.2

D_3 = 6* $(1.2)^2$ = 8.64

D_4 = 6* $(1.2)^3$ = 10.37

D_5 = 6* $(1.2)^3$ *1.19 = 12.34

D_6 = 6* $(1.2)^3$ *1.19 * 1.18 = 14.56

D_7 = 6* $(1.2)^3$ *1.19 * 1.18 * 1.17 = 17.03

Present Value of Dividends

	Dividend	PVF @ 20%	PV of Dividend
D_1	6	0.833	5
D_2	7.2	0.6944	5
D_3	8.64	0.5782	5
D_4	10.37	0.5823	5
D_5	12.34	0.4019	4.96
D_6	14.56	0.3349	4.88
D_7	17.03	0.2791	4.75
			34.59

P_0 = PV of Dividend for Explicit Period + PV of Dividend till Infinity

172.45 = 34.59 + PV of Dividend till Infinity

PV of D till Infinity

= 172.45 – 34.59

= 137.86

PV of D_8 – D_∞

D_7 = 17.03

k_e = 20%

D_8 = D_7 (1+g)

P_7 = $\frac{D_8}{ke-g}$ = $\frac{D_7\,(1+g)}{ke-g}$ = $\frac{17.03\,(1+g)}{0.2-g}$ **(1)**

P_7 = $\frac{PV\ of\ P_7}{PVF}$ = $\frac{137.86}{0.2791}$ = 493.95 **(2)**

Equating **(1)** and **(2)** ;

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$\frac{17.03\ (1+g)}{0.2-g}$ = 493.95

$17.03\ (1+g)$ = $98.79 - 493.95g$

$17.03 - 98.79$ = $-17.03\ g - 493.95\ g$

g = $\frac{81.76}{510.98}$ = **16%**

i) Stable growth rate of Alpha Ltd. After 7 years is **16%.**

ii) If target Growth rate is 15% it is **advisable to purchase** this stock as it has a higher stable growth.

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SECURITY VALUATION – BONDS (55Q)

1) Illustration

The following data are available for a bond:

- Face Value ₹10,000 to be redeemed at par on maturity
- Coupon rate 8.5 % p.a.
- Years to Maturity 5 years
- Yield to Maturity (YTM) 10%

You are required to calculate:

(i) Current market price of the Bond
(ii) Macaulay's Duration
(iii) Volatility of the Bond
(iv) Convexity of Bond
(v) Expected market price if there is decrease in YTM by 200 basis points
  a. By Macaulay's Duration based estimate
  b. By Intrinsic Value Method

Years	1	2	3	4	5
PVIF (10%, n)	0.909	0.826	0.751	0.683	0.621
PVIF (8%, n)	0.926	0.857	0.794	0.735	0.681

Solution 1

(a) (i) **Current Market Price of Bond**

$$P_0 = \sum_{t=1}^{n} \frac{C}{(1+y)^t} + \frac{M}{(1+y)^n}$$

= 850 (PVIAF 10%, 5) + 10,000 (PVIF 10%, 5)
= 850 (3.79) + 10,000 (0.621) = 3,221.50 + 6,210 = **₹9,431.5**

(ii) **Macaulay's Duration**

Year	Cash flow (b)	PVF@ 10% (c)	Present Value (b) * (c) = (d)	Proportion of bond value (e)	Proportion of bond value x time (years) (e) *(a) = f
1	850	0.909	772.65	0.082	0.082
2	850	0.826	702.10	0.074	0.148
3	850	0.751	638.35	0.068	0.204
4	850	0.683	580.55	0.062	0.248
5	10,000 + 850	0.621	6737.85	0.714	3.57
			9431.50	1.000	**4.252**

Duration of the bond = **4.252 years**

Alternatively,

$$\sum_{t=1}^{n} \frac{t*c}{(1+i)^t} + \frac{n*M}{(1+i)^n}$$

Part -1

$\frac{1*850}{(1+0.10)} + \frac{2*850}{(1+0.10)^2} + \frac{3*850}{(1+0.10)^3} + \frac{4*850}{(1+0.10)^3} + \frac{5*850}{(1+0.10)^5}$

= 1*850(0.909) + 2*850(0.826) + 3*850(0.751) + 4*850(0.683) + 5*850(0.621) = **9053.35**

Part-2

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$\frac{5*10,000}{(1+0.10)^5}$ = **31,050**

Macaulay's Duration = $\frac{9053.35+31050}{9431.50}$ = **4.252 years**

(iii) **Volatility of Bond**

Volatility of Bonds = Modified Duration = $\frac{\text{Duration}}{(1+y)}$ = $\frac{4.252}{1.10}$ = 3.865

(iv) Convexity of Bond

$C^* \times (\Delta y)^2 \times 100$

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

Year	Cash flow	PVF@ 8%	Present Value	PVF@ 12%	Present Value
1	850	0.926	787.10	0.082	758.20
2	850	0.857	728.45	0.074	677.45
3	850	0.794	674.90	0.068	605.20
4	850	0.735	624.75	0.062	540.60
5	10,000 + 850	0.681	7388.85	0.714	6151.95
			10204.05		**8733.40**

$C^* = \frac{10,204.05 + 8,733.40 - 2 \times 9,431.50}{2 \times 9,431.50 \times (0.02)^2} = \frac{74.45}{7.5452}$ = 9.867

So, $C^* \times (\Delta y)^2 \times 100$ = 9.867 x $(0.02)^2$ x 100 = **0.395%**

(v) The expected market price if decrease in YTM by 200 basis points

(A) By Macaulay's duration-based estimate

9431.50 x 2 (3.865/100) = ₹729.05

Hence expected market price is 9431.50 + 729.05 = **10,160.55**

Hence, the market price will increase.

(B) By Intrinsic Value method

Intrinsic Value at YTM of 10%	₹9,431.50
Intrinsic Value at YTM of 8%	₹10,204.05
Price increased by	₹772.55

Hence, expected market price is ₹10,204.05

2) Illustration

The following data are available for three bonds A, B and C. These bonds are used by a bond portfolio manager to fund an outflow scheduled in 6 years.

Current yield is 9%. All bonds have face value of ₹100 each and will be redeemed at par. Interest is payable annually.

Bond	Maturity (years)	Coupon rate
A	10	10%
B	8	11%
C	5	9%

(i) Calculate the duration of each bond.

(ii) The bond portfolio manager has been asked to keep 45% of the portfolio money in Bond A. Calculate the percentage amount to be invested in bonds B and C that need to be purchased to immunise the portfolio.

(iii) After the portfolio has been formulated, an interest rate change occurs, increasing the yield to 11%. The new duration of these bonds are: Bond A = 7.15 Years, Bond B = 6.03 Years and Bond C = 4.27 years.

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Is the portfolio still immunized? Why or why not?

(iv) Determine the new percentage of B and C bonds that are needed to immunize the portfolio. Bond A remaining at 45% of the portfolio.

Solution 2

(i) Macaulay's Duration

$$\sum_{t=1}^{n} \frac{t * c}{(1+i)^t} + \frac{n * M}{(1+i)^n}$$

Bond A

Year (a)	Cash flow (b)	PVF@9% (c)	Present Value(a*b*c)
1	10	0.917	**9.17**
2	10	0.842	16.83
3	10	0.772	23.17
4	10	0.708	28.34
5	10	0.650	32.50
6	10	0.596	35.78
7	10	0.547	38.29
8	10	0.502	40.15
9	10	0.460	41.44
10	**10+100**	0.422	464.65
			Σ = 730.32

PVAF = 6.417 * 10 = 64.17
+ 0.422*100 =42.24
106.41

So, D = $\frac{730.32}{106.41}$ = 6.86 Years

Bond B

Year (a)	Cash flow (b)	PVF@9% (c)	Present Value(a*b*c)
1	**11**	0.917	10.08
2	**11**	0.842	18.52
3	**11**	0.772	25.48
4	**11**	0.708	31.15
5	**11**	0.650	35.75
6	**11**	0.596	39.33
7	**11**	0.547	42.12
8	**111**	0.502	445.776
			648.2

PVAF = 5.53* 11 = 50.2
+ 0.502*100 =60.88
111.08

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So, D = $\frac{648.2}{111.08}$ = **5.835Years**

Bond C

Year (a)	Cash flow (b)	PVF@9% (c)	Present Value (a*b*c)
1	9	0.917	8.253
2	9	0.842	15.156
3	9	0.772	20.084
4	9	0.708	25.49
5	**109**	0.650	354.25
			423.991

PVAF = 3.88* 9 = 35
+ 0.55*100 = 65
100

So, D = $\frac{423.991}{100}$ = **4.24 Years**

(ii) Now if,

Bond	Duration	Weight
A	6.86 Years	45%
B	5.84 Years	b
C	4.24 Years	55% - b

Target duration = 6 Years
6.86 x 0.45 + 5.83 x b + 4.24(0.55 – b) = 6
3.087 + 5.83b + 2.332 – 4.24b = 6
5.419 + 1.59b = 6
1.59b = 6 – 5.419
b = 0.581/1.59 = 36.54%
Then, 55% - 36.54% = **18.46%**

(iii)

Bond	Duration	Weight	Duration * Weight
A	7.15 Years	45%	3.218
B	6.03 Years	36.54 %	2.203
C	4.27 Years	18.46%	0.788
			6.209

Duration of the portfolio has increased as the duration of the individual bonds has increased. Hence the portfolio is not immunized as the portfolio duration is 6.2 vs maturity of 6 years

(iv)

Bond	Duration	Weight	Weighted duration
A	7.15 Years	45%	3.2175
B	6.03 Years	b	6.03b
C	4.27 Years	55% - b	2.35 - 4.27b
			Σ = 5.566 + 1.76b

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5.566 + 1.76b = 6 years
1.76b = 6 - 5.566
b = 0.434/1.76 = **24.66%**
c = 55% - b = 55% - 24.66% = **30.34%**
So, **A = 45% B = 24.66% C = 30.34%**

3) Illustration

A convertible bond with a face value of ₹1,000 is issued at ₹1,350 with a coupon rate of 10.5%. The conversion rate is 14 shares per bond. The current market price of bond and share is ₹1,475 and ₹80 respectively. What is the premium over conversion value?

Solution 3

Given, FV =₹1000 Issue price = ₹1350 coupon rate = 10.5%
Conversion rate is 14 shares per bond. Market price of share ₹80
Conversion Value = 14 x 80 = ₹1120
Market price of bond = ₹1475
Premium over Conversion Value (1475- 1120) = 355/1120 x 100 = **31.7%**

4) Illustration

Nominal value of 10% bonds issued by a company is ₹100. The bonds are redeemable at ₹110 at the end of year 5.
Determine the value of the bond if required yield is
(i) 5%
(ii) 5.1%
(iii) 10% and
(iv) 10.1%

Solution 4

Case (i) Required yield rate = 5%

Year	Cash flow	DF (5%)	Present Value ₹
1-5	10	4.3295	43.295
5	100+10	0.7835	86.185
	Value of bond		**129.48**

Case (ii) Required yield rate = 5.1%

Year	Cash flow	DF (5.1%)	Present Value ₹
1-5	10	4.3175	43.175
5	100+10	0.7798	85.778
	Value of bond		**128.953**

Case (iii) Required yield rate = 10%

Year	Cash flow	DF (10%)	Present Value ₹
1-5	10	3.7908	37.908
5	100+10	0.6209	68.299
	Value of bond		**106.207**

Case (iv) Required yield rate = 10.1%

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Year	Cash flow	DF (10.1%)	Present Value ₹
1-5	10	3.7811	37.811
5	100+10	0.6181	67.991
	Value of bond		**105.802**

5) Illustration

An investor is considering the purchase of the following Bond:

Face value	₹100
Coupon rate	11%
Maturity	3 years

(i) If he wants a yield of 13%, what is the maximum price, he should be ready to pay for?

(ii) If the Bond is selling for ₹97.60, what would be his yield?

Solution 5

Given, Face value = ₹100 Coupon rate = 11% Maturity = 3 years

(i) Calculation of Maximum price

= ₹11 × PVIFA (13%,3) + ₹100 × PVIF (13%,3)

= ₹11 × 2.361 + ₹100 × 0.693 = ₹25.97 + ₹69.30 = ₹95.27

(ii) Calculation of yield

At 12% the value = ₹11 × PVIFA (12%,3) + 100 × PVIF (12%,3)

= ₹11×2.402 + ₹100×0.712 = ₹26.42 + ₹71.20 = ₹97.62

It the bond is selling at ₹97.60 which is more than the fair value, the YTM of the bond would be less than 13%. This value is almost equal to the amount price of ₹97.60. Therefore, the YTM of the bond would be 12%.

Alternatively,

$$YTM = \frac{11+\frac{(100-97.60)}{3}}{\frac{(100+97.60)}{2}} = 0.1194 \text{ or } 11.94\% \text{ say } 12\%$$

6) Illustration

Calculate Market Price of:

(i) 10% Government of India security currently quoted at ₹110, but yield is expected to go up by 1%.

(ii) A bond with 7.5% coupon interest, Face Value ₹10,000 & term to maturity of 2 years, presently yielding 6%. Interest payable half yearly.

Solution 6

(i) Current yield = (Coupon Interest / Market Price) x 100

(10/110) x 100 = 9.09%

If current yield go up by 1% i.e. 10.09 the market price would be

10.09 = 10 / Market Price x 100

Market Price = ₹99.11

(ii) Market Price of Bond = P.V. of Interest + P.V. of Principal

= ₹1,394 + ₹8,885 = **₹10,279**

7) Illustration

(7a) There is a 9% 5-year bond issue in the market. The issue price is Rs. 90 and the redemption price Rs. 105. For an investor with marginal income tax rate of 30% and capital gains tax rate of 10% (assuming no indexation), what is the post-tax yield to maturity? [MTP Sep 15 (5 marks)]

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Solution 7a

Coupon = 9% Maturity = 5yrs Issue price = ₹90 Redemption Price = ₹105 Tax rate = 30% /10%

Year	Cash flow	Post tax cash flow	PVF@9%	PVCF	PVF@10%	PVCF
0	-90	-90	1	-90	1	-90
1	9	6.3	0.917	5.7711	0.909	5.727
2	9	6.3	0.842	5.3046	0.826	5.204
3	9	6.3	0.772	4.8636	0.751	4.731
4	9	6.3	0.708	4.4604	0.683	4.303
5	105 + 9	**109.8**	0.650	71.37	0.621	68.186
				+ 1.7697		**- 1.8495**

Assumption

Face Value = ₹100 Issue Price = ₹90 Discount on issue ₹10 Premium on redemption ₹5 Redemption price 105 Annual Coupon 9% on ₹100

Working Note

Post tax cash flow Yr 1-4

Coupon = ₹9 Tax rate 30% Post tax cash flow = 9 x 70% = ₹6.3

On redemption value : Issue price – Redemption value = 90-105 = 15

₹15 is capital gain net off tax@10% which is ₹1.5

On Coupon ₹9 less tax @30% Net Cash flow = 6.3

Cash flow in Yr 5 for principal value = 105 less tax 1.5 = 103.5

Total Cash flow post tax Yr 5 = 103.5 + 6.3 = **₹109.8**

Using Interpolation,

$9\% + \frac{1.7696}{1.7696-(-1.8495)} \times (10\% - 9\%) = 9\% + 0.49 =$ **9.49%**

(7b) If the market price of the bond is ₹95; years to maturity = 6 yrs: coupon rate = 13% p.a. (paid annually) and issue price is ₹100. What is the yield to maturity? [MTP Feb 14 (5 Marks)]

Solution 7b

Present Value of Cashflow @14%

PV = 13PVIF(14% , 6yrs) + 100PVF(14% , 6TH yr)

= 3.888 x 13 + 0.455 x 100 = 50.55 + 45.55 = 96.10

Market Price is 95

SO, NPV = 96.10 – 95 = +1.10

Present Value of Cashflow @15%

PV = 13PVIF(1% , 6yrs) + 100PVF(15% , 6TH yr)

13 x 3.7844 + 100 x 0.4323 = 49.498 + 43.23 = 92.43

NPV = 92.43 – 95 = - 2.57

Using Interpolation,

$14\% + \frac{1.10}{1.10-(-2.57)} \times (15\% - 14\%) = 14\% + 0.299 =$ **14.30%**

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8) Illustration

M/s Agfa Industries is planning to issue a debenture series on the following terms:

Face value	₹100
Term of maturity	10 years
Yearly coupon rate	
Years	
1 – 4	9%
5 – 8	10%
9 – 10	14%

The current market rate on similar debentures is 15% p.a. The Company proposes to price the issue in such a manner that it can yield 16% compounded rate of return to the investors. The Company also proposes to redeem the debentures at 5% premium on maturity. Determine the issue price of the debentures. [RTP May 20]

Solution 8

The issue price of the debentures will be the sum of present value of interest payments during 10 years of its maturity and present value of redemption value of debenture.

Years	Cash out flow (₹)	PVIF @ 16%	PV
1	**9**	0.862	7.758
2	**9**	0.743	6.687
3	**9**	0.641	5.769
4	**9**	0.552	4.968
5	**10**	0.476	4.76
6	**10**	0.410	4.10
7	**10**	0.354	3.54
8	**10**	0.305	3.05
9	**14**	0.263	3.682
10	**14 + 105 = 119**	0.227	3.178 + 23.835
			71.327

Thus the debentures should be priced at ₹71.327

9) Illustration

Based on the credit rating of bonds, Mr. Z has decided to apply the following discount rates for valuing bonds:

Credit Rating	Discount Rate
AAA	364 day T bill rate + 3% spread
AA	AAA + 2% spread
A	AAA + 3% spread

He is considering to invest in AA rated, ₹1,000 face value bond currently selling at ₹1,025.86. The bond has five years to maturity and the coupon rate on the bond is 15% p.a. payable annually. The next interest payment is due one year from today and the bond is redeemable at par. (Assume the 364 day T-bill rate to be 9%).

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You are required to calculate the intrinsic value of the bond for Mr. Z. Should he invest in the bond? Also calculate the current yield and the Yield to Maturity (YTM) of the bond. [RTP May 19, Nov 11]

Solution 9

The appropriate discount rate for valuing the bond for Mr. Z is:
R = 9% + 3% + 2% = 14%

Year	CF	PVIF 14% PV (CF)	PV (CF)
1	150	0.877	131.55
2	150	0.769	115.35
3	150	0.675	101.25
4	150	0.592	88.80
5	1150	0.519	596.85
			$P_0 = 1033.80$

Since, the current market value is less than the intrinsic value; Mr. Z should buy the bond.
Current yield = Annual Interest / Price = 150 / 1025.86 = **14.62%**
The YTM of the bond is calculated as follows:
@15%
P = 150 × $PVIFA_{15\%,4}$ + 1150 × $PVIF_{15\%\,5}$
= = 150 × 2.855 + 1150 × 0.497 = 428.25 + 571.55 = 999.80
@14%
As found in sub part (a) P0 = 1033.80
By interpolation we get,
= 14% + $\frac{7\,94}{7\,94-(-\,26.06)}$× 15 -% 14%) = 14% + $\frac{7.94}{34}$%
YTM = 14.23%

10)Illustration

On 31st March, 2013, the following information about Bonds is available:

Name of Security	Face Value ₹	Maturity Date	Coupon Rate	Coupon Date(s)
Zero coupon	10,000	31st March, 2023	N.A.	N.A.
T-Bill	1,00,000	20th June, 2013	N.A.	N.A.
10.71% GOI 2023	100	31st March, 2023	10.71	31st March
10% GOI 2018	100	31st March, 2018	10.00	31st March & 30th September

Calculate:
(i) If 10 years yield is 7.5% p.a. what price the Zero Coupon Bond would fetch on 31st March, 2013?
(ii) What will be the annualized yield if the T-Bill is traded @ 98500?
(iii) If 10.71% GOI 2023 Bond having yield to maturity is 8%, what price would it fetch on April 1, 2013 (after coupon payment on 31st March)?
(iv) If 10% GOI 2018 Bond having yield to maturity is 8%, what price would it fetch on April 1, 2013 (after coupon payment on 31st March)? [MTP Aug 17 (8 marks), May 15 (8 marks)]

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Solution 10

(i) Rate used for discounting shall be yield. Accordingly ZCB shall fetch:
$\frac{10000}{(1.075)^{10}}$ = 4852
(ii) The day count basis is actual number days / 365. Accordingly annualized yield shall be :
Yield = $\frac{\text{FV}-\text{Price}}{\text{Price}} * \frac{365}{\text{No.of days}} = \frac{100000-98500}{98500} * \frac{365}{81}$ = 6.86%
(iii) Price GOI 2023 would fetch
= ₹10.71 PVAF (8%, 10) + ₹100 PVF (8%, 10)
= ₹10.71 x 6.71 + ₹100 x 0.4632
= ₹71.86 + ₹46.32 = ₹118.18
(iv) Price GOI 2018 Bond would fetch:
= ₹5 PVAF(4%, 10) + ₹100 PVF (4%, 10)
= ₹5 x 8.11 + ₹100 x 0.6756
= 40.55 + 67.56 = **108.11**

11)Illustration

Pet feed plc has outstanding, a high yield Bond with following features:

Face Value	£ 10,000
Coupon	10%
Maturity Period	6 Years
Special Feature	Company can extend the life of Bond to 12 years

Presently the interest rate on equivalent Bond is 8%.
(a) If an investor expects that interest will be 8%, six years from now then how much he should pay for this bond now.
(b) Now suppose, on the basis of that expectation, he invests in the Bond, but interest rate turns out to be 12%, six years from now, then what will be his potential loss/ gain if company extends the life of bond by another 6 years.
[RTP Nov 18 (O)]

Solution 11

(a) If the current interest rate is 8%, the company will not extent the duration of Bond and the maximum amount the investor would ready to pay will be:
= £1,000 PVIAF (8%, 6) + £10,000 PVIF (8%, 6)
= £1,000 x 4.623 + £10,000 x 0.630
= £4,623 + £ 6,300
= £ 10,923
(b) If the current interest rate is 12%, the company will extent the duration of Bond. After six years the value of Bond will be
= £1,000 PVIAF (12%, 6) + £10,000 PVIF (12%, 6)
= £1,000 x 4.111 + £10,000 x 0.507
= £4,111 + £5,070
= £9,181
Thus, potential loss will be £9,181 - £10,923 = £1,742

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12)Illustration

XYZ Ltd.'s bond (Face Value of Rs. 1,000) with 4 years maturity is currently trading at Rs. 900 carrying a coupon rate of 15%. Assuming that the reinvestment rate is 16%, you are required to calculate Realized Yield to Maturity of the Bond. [MTP Apr 18 (O)]

Solution 12

We shall compute y* (Realized Yield to Maturity) by using following equation:
PV $(1 + y^*)^4$ = Future Value of Benefits and Future Value of Benefits shall be computed as follows:

	0	1	2	3	4
Investment (Rs.)	900				
Annual Interest (Rs.)		**150**	**150**	**150**	**150**
Compound Factor @ 16%		**1.56**	**1.35**	**1.16**	**1.00**
Future Value of Intermediate Cash Flows (Rs.)		234.00	202.50	174.00	150
Maturity Value (Rs.)					1000.00
	900	234.00	202.50	174.00	1150.00
Total of Future Benefits					**1760.50**

Accordingly,
900 $(1 + y^*)^4$ = 1760.50
$(1 + y^*)^4$= 1760.50/900
$(1 + y^*)^4$= 1.956
(1+y*) = $(1.183)^{1/4}$
y* = 0.183 say 18.30%

13)Illustration

The following data are available for a bond

Face value	₹1,000
Coupon Rate	16%
Years to Maturity	6
Redemption value	₹1,000
Yield to maturity	17%

Calculate the duration and volatility of this bond? Calculate the expected market price if increase in required yield is by 75 basis points. [RTP May 16]

Solution 13

To calculate the duration first we shall calculate Market price of bond as follows:
160 (PVIFA 17%,6) + 1,000 (PVIF 17%,6)
= 160 (3.589) + 1,000 (0.390)
= 574.24 + 390
= 964.24

1. Duration

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Year	Cash flow	P.V. @ 17%		Proportion of bond value	Proportion of bond value x time (years)
1	**160**	0.855	136.80	0.142	**0.142**
2	**160**	0.731	116.96	0.121	**0.242**
3	**160**	0.624	99.84	0.103	**0.309**
4	**160**	0.534	85.44	0.089	**0.356**
5	**160**	0.456	72.96	0.076	**0.38**
6	**1160**	0.390	452.40	0.469	**2.814**
			964.40	**1.000**	**4.243**

Duration of the Bond is 4.243 years

2. Volatility

Volatility of the bonds= Modified Duration = $\frac{\text{Macaulay Duration}}{(1+\text{YTM})} = \frac{4.243}{1.17} = 3.63$

Change yield = 0.75%

Change in price = - Modified Duration x 0.75% x Price

Change in Price = -3.63 X 0.75% X 964.40 = -26.255

Revised price = 964.4 -26.244 = 938.14421

14)Illustration

The following data is available for a bond:

Face value	₹1,000
Coupon rate	11%
Years to Maturity	6
Redemption Value	₹1,000
Yield to Maturity	15%

(Round-off your answers to 3 decimals)

Calculate the following in respect of the bond:

(i) Current Market Price
(ii) Duration of the Bond
(iii) Volatility of the Bond
(iv) Expected market price if increase in required yield is by 100 basis points
(v) Expected market price if decrease in required yield is by 75 basis points

[MTP Apr 19, RTP May 18 (O), Nov 15]

Solution 14

(i) & (ii)Calculation of Market price & Duration

Year	**Cash flow**	**P.V. @ 15%**	**PVCF**	**Proportion of bond value**	**Proportion of bond value x time (years)**
1	110	0.870	95.70	0.113	0.113
2	110	0.756	83.16	0.098	0.196
3	110	0.658	72.38	0.085	0.255
4	110	0.572	62.92	0.074	0.296
5	110	0.497	54.67	0.064	0.320

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6	1110	0.432	479.52	0.565	3.39
			MP -> 848.293	**1.000**	**4.575**

Duration of the Bond is 4.575 years

2. Volatility

Volatility of the bonds = $\frac{\text{Duration}}{(1+\text{YTM})} = \frac{4.575}{1.15}$ = 3.979

(iv) The expected market price if increase in required yield is by 100 basis points

₹848.293 × - 1.00 (3.979/100) = - ₹33.750

Hence expected market price is ₹848.293 – ₹33.750 = ₹814.543

Hence, the market price will decrease

(v) The expected market price if decrease in required yield is by 75 basis points.

₹848.293 × **-(**-0.75 (3.974/100)) = ₹25.315

Hence expected market price is ₹848.293 + ₹25.315 = ₹873.608

Hence, the market price will increase.

15)Illustration

Mr. A will need ₹1,00,000 after two years for which he wants to make one time necessary investment now. He has a choice of two types of bonds. Their details are as below:

	Bond X	**Bond Y**
Face value	₹1,000	₹1,000
Coupon	7% payable annually	8%payable annually
Years to maturity	1	4
Current price	₹972.73	₹936.52
Current yield	10%	10%

Advice Mr. A whether he should invest all his money in one type of bond or he should buy both the bonds and, if so, in which quantity? Assume that there will not be any call risk or default risk.

Solution 15

Duration of Bond X

Year	**Cash flow**	**P.V. @ 10%**		**Proportion of bond value**	**Proportion of bond value x time (years)**
1	1070	0.909	972.63	1.000	1.000

Duration of the Bond is **1 year**

Duration of Bond Y

Year	**Cash flow**	**P.V. @ 10%**		**Proportion of bond value**	**Proportion of bond value x time (years)**
1	**80**	0.909	**72.72**	**0.077**	**0.077**
2	**80**	0.826	**66.08**	**0.071**	**0.142**
3	**80**	0.751	**60.08**	**0.064**	**0.192**
4	**1080**	0.683	**737.64**	**0.788**	**3.152**
			936.52	**1.000**	**3.563**

Duration of the Bond is **3.563 years**

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Let x_1 be the investment in Bond X and therefore investment in Bond Y shall be (1 - x_1). Since the required duration is 2 years the proportion of investment in each of these two securities shall be computed as follows:

2 = x_1 + (1 - x_1) 3.563

x_1 = **0.61**

Amount of investment

Bond X	**Bond Y**
PV of ₹1,00,000 for 2 years @ 10% x 61% **= ₹1,00,000 (0.826) x 61%** **= ₹50,386** **No. of Bonds to be purchased** **= ₹50,386/₹972.63 = 51.80 i.e. approx. 52 bonds**	PV of ₹1,00,000 for 2 years @ 10% x 39% = ₹1,00,000 (0.826) x 39% = ₹32,214 No. of Bonds to be purchased = ₹32,214/₹936.52 = 34.40 i.e. approx. 34 bonds

Note: The investor has to keep the money invested for two years. Therefore, the investor can invest in both the bonds with the assumption that Bond X will be reinvested for another one year on same returns.

Further, in the above computation, Modified Duration can also be used instead of Duration.

16)Illustration

Mr. A is planning for making investment in bonds of one of the two companies X Ltd. and Y Ltd. The detail of these bonds is as follows:

Company	Face Value	Coupon Rate	Maturity Period
X Ltd.	₹10,000	6%	5 Years
Y Ltd.	₹10,000	4%	5 Years

The current market price of X Ltd.'s bond is ₹10,796.80 and both bonds have same Yield To Maturity (YTM). Since Mr. A considers duration of bonds as the basis of decision making, you are required to calculate the duration of each bond and give your decision. [RTP May 14]

Solution 16

To calculate duration of bond we need YTM, which shall be calculated as follows

Let us try NPV @ 5%

$\frac{600}{(1+0.05)} + \frac{600}{(1+0.05)^2} + \frac{600}{(1+0.05)^3} + \frac{600}{(1+0.05)^4} + \frac{10600}{(1+0.05)^5}$ -10796.80

=₹571.43 +₹544.22 +₹518.30 +₹493.62 +₹8,305.38 -₹10,796.80 = - ₹363.85

Let us now try NPV @ 4%

$\frac{600}{(1+0.04)} + \frac{600}{(1+0.04)^2} + \frac{600}{(1+0.04)^3} + \frac{600}{(1+0.04)^4} + \frac{10600}{(1+0.04)^5}$ -10796.80

=₹576.92 + ₹554.73 + ₹533.40 + ₹512.88 + ₹8,712.43 - ₹10,796.80 = ₹93.56

Let us now interpolation formula

= 4% + $\frac{93.56}{93.56 - (-363.85)}$ x (5% - 4%) = 4% + $\frac{93.56}{457.41}$ = **4.20%**

Duration of X Ltd.'s Bond

Year	Cash flow	P.V. @ 4.2%		Proportion of bond value	Proportion of bond value x time (years)
1	600	0.9597	575.82	0.0533	0.0533
2	600	0.9210	552.60	0.0512	0.1024
3	600	0.8839	530.34	0.0491	0.1473
4	600	0.8483	508.98	0.0472	0.1888
5	10600	0.8141	8,629.46	0.799	3.9960
			10797.20	**1.000**	**4.4878**

Duration of the Bond is 4.4878 years say **4.49 years**

Duration of Y Ltd.'s Bond

Year	Cash flow	P.V. @ 4.2%		Proportion of bond value	Proportion of bond value x time (years)
1	400	0.9597	383.88	0.0387	0.0387
2	400	0.9210	368.40	0.0372	0.0744
3	400	0.8839	353.56	0.0357	0.1071
4	400	0.8483	339.32	0.0342	0.1368
5	10400	0.8141	8,466.64	0.8542	4.2710
			9911.80	**1.000**	**4.6280**

Duration of the Bond is 4.6280 years say **4.63 years**.

Decision: Since the duration of Bond of Y Ltd. is higher hence it should be preferred. However, difference between the duration of bond is not much higher and with higher coupon. rate of X Ltd.'s bond, Mr. A should go for X Ltd.'s bond.

17)Illustration

XL Ispat Ltd. has made an issue of 14 per cent non-convertible debentures on January 1, 2007. These debentures have a face value of ₹100 and is currently traded in the market at a price of ₹90. Interest on these NCDs will be paid through post-dated cheques dated June 30 and December 31. Interest payments for the first 3 years will be paid in advance through post-dated cheques while for the last 2 years post-dated cheques will be issued at the third year. The bond is redeemable at par on December 31, 2011 at the end of 5 years.

Required :

(i) Estimate the current yield and YTM of the bond.

(ii) Calculate the duration of the NCD.

(iii) Assuming that intermediate coupon payments are, not available for reinvestment, calculate the realised yield on the NCD. [RTP May 18]

Solution 17

(i) Current yield = $\frac{7}{90} * \frac{12}{6}$ = 0.1555 or 15.55%

YTM can be determined from the following equation

7 × PVIFA (YTM, 10) + 100 × PVIF (YTM, 10) = 90

Let us discount the cash flows using two discount rates 7.50% and 9% as follows:

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Year	Cash Flows	PVF@7.50%	PV	PVF@9%	PV
0	-90	1	-90	1	-90
1	7	0.930	6.51	0.917	6.419
2	7	0.865	6.055	0.842	5.894
3	7	0.805	5.635	0.772	5.404
45	7	0.749	5.243	0.708	4.956
5	7	0.697	4.879	0.650	4.550
6	7	0.648	4.536	0.596	4.172
7	7	0.603	4.221	0.547	3.829
8	7	0.561	3.927	0.502	3.514
9	7	0.522	3.654	0.460	3.220
10	107	0.485	51.90	0.422	45.154
			6.560		**-2.888**

Now we use interpolation formula

= 7.5% + $\frac{6.560}{6.560-(-2.888)}$ × (9 - 7.5%) = 7.5% + $\frac{6.560}{9.448}$ x 1.5% = 8.54%

(ii) The duration can be calculated as follows:

Year	Cash flow	P.V. @ 8.54%	PV	Proportion of bond value	Proportion of bond value x time (years)
1	7	0.921	6.447	0.0717	0.0717
2	7	0.849	5.943	0.0661	0.1322
3	7	0.782	5.474	0.0608	0.1824
4	7	0.721	5.047	0.0561	0.2244
5	7	0.664	4.648	0.0517	0.2585
6	7	0.612	4.284	0.0476	0.2856
7	7	0.563	3.941	0.0438	0.3066
8	7	0.519	3.633	0.0404	0.3232
9	7	0.478	3.346	0.0372	0.3348
10	107	0.441	47.187	0.5246	5.2460
			89.95		**7.3654**

Duration = 7.3654 half years i.e. **3.683 years.**

(iii) Realized Yield can be calculated as follows:

$\frac{(7*10)+100}{1+R^{10}}$ = 90

$1 + R^{10} = \frac{170}{90}$

$R = \left(\frac{170}{90}\right)^{1/10} - 1$

$= (1.888)^{1/10} - 1$

= 1.065 – 1 = 0.065 or 6.50% for half yearly

Steps to compute n^{th}root of a number:

- Write the number on your calculator – Say 1.888
- Press the square root button 12 times
- Subtract 1
- Divide by n where n is the nth root.= i.e 10 or multiply with 1/10
- Add 1
- Press "multiply button and then equal to button" 12 times

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18) Illustration

Find the current market price of a bond having face value ₹1,00,000 redeemable after 6 year maturity with YTM at 16% payable annually and duration 4.3202 years. Given $1.16^6 = 2.4364$

Solution 18

Duration = 4.3202 yrs YTM = 16% FV = 1,00,000 Maturity = 6 years

Duration = $\frac{1+y}{y} - \frac{(1+y)+t(c-y)}{c[(1+y))^t-1]+y}$

$4.3202 = \frac{1.16}{0.16} - \frac{(1.16)+6(C-0.16)}{C[(1.16)^6-1]+0.16}$

$4.3202 = 7.25 - \frac{1.16+6C-0.96}{C[2.4364-1]+0.16}$

$-4.3203 + 7.25 = \frac{0.2+6C}{0.16+1.4364C}$

$2.9298(0.16 + 1.4364C) = 0.2 + 6C$

$0.2688 = 1.7917C$

C = 0.2688/1.7917 = 0.15 or 15%

Coupon rate = 15%

Price when C = 15% FV = 100000 Y = 16% T = 6yrs

P_0 = 15000 PVAF (16%, 6) + 100000 PVF (16%, 10th yr)

= 3.6847 x 15000 + 0.41055 x 100000 = **₹96315.03**

19)Illustration

John inherited the following securities on his uncle's death:

Types of Security	Nos.	Annual Coupon %	Maturity Years	Yield %
Bond A (₹1,000)	10	9	3	12
Bond B (₹1,000)	10	10	5	12
Preference shares C (₹100)	100	11	*	13*
Preference shares D (₹100)	100	12	*	13*

* likelihood of being called at a premium over par.

Compute the current value of his uncle's portfolio. Applicable tax rate is 20% dividend is tax free. [MTP Oct 14]

Solution 19

Computation of current value of John's portfolio

10 Nos. Bond A, Rs. 1,000 par value, 9% Bonds maturity 3 years:

Current value of interest on bond A **1-3 years: Rs. 900(1-0.20) × Cumulative P.V. @ 12% (1-3years)** **= Rs. 720 × 2.402**	₹1,729
Add: Current value of amount received on maturity of Bond A **End of 3rd year: Rs. 1,000 × 10 × P.V. @ 12% (3rd year)** **= Rs. 10,000 × 0.712**	₹7,120
	₹8,849

(ii) 10 Nos. Bond B, Rs. 1,000 par value, 10% Bonds maturity 5 years:

Current value of interest on bond B **1-5 years: Rs. 1,000(1-0.20) × Cumulative P.V. @ 12% (1-5 years)** **= Rs. 800 × 3.605**	₹2,884

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Add: Current value of amount received on maturity of Bond B End of 5th year: Rs. 1,000 × 10 × P.V. @ 12% (5th year) = Rs. 10,000 × 0.567	₹5,670
	₹8,554

(iii) 100 Preference shares C, Rs. 100 par value, 11% coupon

$\frac{\mathbf{11\% \times 100\ Nos. \times\ Rs. 100}}{\mathbf{13\%}}$	**8462**

(iv) 100 Preference shares D, Rs. 100 par value, 12% coupon

$\frac{\mathbf{12\% \times 100\ Nos. \times\ Rs. 100}}{\mathbf{13\%}}$	**9231**

Total Current value of his portfolio [(i) + (ii) + (iii) + (iv)] **Rs. 35,096**

20)Illustration

MP Ltd. issued a new series of bonds on January 1, 2010. The bonds were sold at par (₹1,000), having a coupon rate 10% p.a. and mature on 31st December, 2025. Coupon payments are made semiannually on June 30th and December 31st each year. Assume that you purchased an outstanding MP Ltd. bond on 1st March, 2018 when the going interest rate was 12%.

Required:

(i) What was the YTM of MP Ltd. bonds as on January 1, 2010?

(ii) What amount you should pay to complete the transaction? Of that amount how much should be accrued interest and how much would represent bonds basic value.

Solution 20

(i) As the issue @ 10% coupon is at par the YTM is also 10% p.a

(ii) Date of purchase 1/3/2018

Semi-Annual Coupon dates = 30th June and 31st December

On 1/03/2018 Price includes 2 months accrued interest

$P_0 = 50.PVAF_{(6\%,15\ Periods)} + 1000.PVIF_{(6\%,15th\ Period)}$ = 50 x 9.7122 + 1000 x 0.41727 = **902.88**

Two Adjustments

(i) PV of Bond by 4 months @ 12% p.a

(ii) Adjust the interest for 4 months

Price on 30th June before coupon is 902.88 + 50 = ₹952.88

Now, if price on 30th June 2018 is 952.88 then, what is the price on 1/03/2018?

i.e. 952.88 x $PVAF_{(6\%,4months)}$

= 952.88 x $\frac{1}{(1.06)^{4/6}} = \frac{952.88}{(1.06)^{2/3}} = \frac{952.88}{1.0396}$ = **₹916.57 is dirty price as on 1/03/2018**

Clean Price = Dirty Price – Interest Accrued

Interest Accrued = 1000 x $\frac{10\%}{2}$ x $\frac{2}{6}$ = 50 x $\frac{1}{3}$ = ₹16.67 (2m = 31/12 to 1/3)

Clean Price = 916.57 – 16.67 = **₹899.90**

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21)Illustration

Tiger Ltd. is presently working with an Earning Before Interest and Taxes (EBIT) of ₹ 90 lakhs. Its present borrowings are as follows:

	₹ in lakhs
12% term loan	300
Working capital borrowings:	
From Bank at 15%	200
Public Deposit at 11%	100

The sales of the company are growing and to support this, the company proposes to obtain additional borrowing of ₹ 100 lakhs expected to cost 16%. The increase in EBIT is expected to be 15%.
Calculate the change in interest coverage ratio after the additional borrowing is effected and comment on the arrangement made.

Solution 21

Existing EBIT = ₹90 lakhs

Computation of Interest

Borrowing	Amount (₹ in lakhs)	Interest(%)	Interest(₹ in lakhs)
12% term loan	300	12%	36
From Bank at 15%	200	15%	30
Public Deposit at 11%	100	11%	11
			77

Interest Coverage Ratio = $\frac{90}{77}$ = **1.1688**

Revised Interest Coverage Ratio

	(₹ in lakhs)
Revised EB IT 90 x 1.15	103.5
Existing Interest Cost	77
New Interest Cost	16
Revised Interest Expense	**93 (77 + 16)**

Interest Coverage Ratio = $\frac{103.5}{93}$ = **1.1129**

Therefore, the interest coverage has dropped from 1.1688 to 1.1129 and hence the new borrowing cost is not recommended.

22)Illustration

Saranam Ltd. has issued convertible debentures with coupon rate 12%. Each debenture has an option to convert to 20 equity shares at any time until the date of maturity. Debentures will be redeemed at ₹ 100 on maturity of 5 years. An investor generally requires a rate of return of 8% p.a. on a 5-year security. As an investor when will you exercise conversion for given market prices of the equity share of (i) ₹ 4, (ii) ₹ 5 and (iii) ₹ 6.

Cumulative PV factor for 8% for 5 years : 3.993

PV factor for 8% for year 5 : 0.681

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Solution 22

If Debentures are not converted its value is as under: -

	PVF @8%	PV₹
Interest - ₹12 for 5 years	3.993	47.916
Redemption - ₹100 in 5th year	0.681	68.100
		116.016

Value of equity shares:-

Market Price	No.	Total
4	20	80
5	20	100
6	20	120

Hence, unless the market price is ₹6 conversion should not be exercised.

23)Illustration

The data given below relates to a convertible bond :

Face value	₹ 250
Coupon rate	12%
No. of shares per bond	20
Market price of share	₹ 12
Straight value of bond	₹ 235
Market price of convertible bond	₹ 265

Calculate:

(i) Stock value of bond
(ii) The percentage of downside risk
(iii) The conversion premium
(iv) The conversion parity price of the stock

Solution 23

(i) Stock value or conversion value of bond

12 × 20 = ₹240

(ii) Percentage of the downside risk

$\frac{265-235}{235}$ = **12.77%** or $\frac{265-235}{265}$ = **11.32%**

This ratio gives the percentage price decline experienced by the bond if the stock becomes worthless.

(iii) Conversion Premium

$\frac{\text{Market Price Conversion Value}}{\text{Conversion Value}}$ × 100 = $\frac{265-240}{240}$ = **10.42%**

(iv) Conversion Parity Price

$\frac{\text{Bond Price}}{\text{No.of shares on Conversion}}$ = $\frac{265}{20}$ = ₹13.25

This indicates that if the price of shares rises to ₹13.25 from ₹12 the investor will neither gain nor lose on buying the bond and exercising it. Observe that ₹1.25 (₹13.25 – ₹12.00) is 10.42% of ₹12, the Conversion Premium.

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24) Illustration

ABC Ltd. has ₹300 million, 12 per cent bonds outstanding with six years remaining to maturity. Since interest rates are falling, ABC Ltd. is contemplating of refunding these bonds with a ₹300 million issue of 6 year bonds carrying a coupon rate of 10 per cent.

Issue cost of the new bond will be ₹6 million and the call premium is 4 per cent. ₹9 million being the unamortized portion of issue cost of old bonds can be written off no sooner the old bonds are called off. Marginal tax rate of ABC Ltd. is 30 per cent.

You are required to analyse the bond refunding decision. [RTP - May 20 (Old), May 14, Nov 11; MTP Mar 18 (Old); Jun 09 exam ICAI SM]

Solution 24

(i) Calculation of initial outlay:-

	₹(million)
a. Face value	**300**
Add:-Call premium	**12**
Cost of calling old bonds	**312**
b. Gross proceed of new issue	**300**
Less: Issue costs	**6**
Net proceeds of new issue	**294**
c. Tax savings on call premium	
and unamortized cost 0.30 (12 + 9)	6.3
∴ Initial outlay = ₹312 million – ₹294 million – ₹6.3 million = ₹11.7 million	

(ii) Calculation of net present value of refunding the bond:-

	₹(million)
Saving in annual interest expenses [300 x (0.12 – 0.10)]	6.00
Less:- Tax saving on interest and amortization [0.30 x [6 + (9-6)/6]	(1.95)
Annual net cash saving	**4.05**
PVIFA (7%, 6 years)	4.766
∴Present value of net annual cash saving	19.30 million
Less:- Initial outlay	(11.70) million
Net present value of refunding the bond	₹7.60 million

Decision: The bonds should be refunded

25) Illustration

A Ltd. has issued convertible bonds, which carries a coupon rate of 14%. Each bond is convertible into 20 equity shares of the company A Ltd. The prevailing interest rate for similar credit rating bond is 8%. The convertible bond has 5 years maturity. It is redeemable at par at ₹100. The relevant present value table is as follows.

Present values	t_1	t_2	t_3	t_4	t_5
$PVIF_{0.14, t}$	0.877	0.769	0.675	0.592	0.519

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$PVIF_{0.08, t}$	0.926	0.857	0.794	0.735	0.681

You are required to estimate:

(Calculations be made upto 3 decimal places)

(i) current market price of the bond, assuming it being equal to its fundamental value,

(ii) minimum market price of equity share at which bond holder should exercise conversion option; and

(iii) duration of the bond [Nov 16 exam, MTP Oct 19, RTP May 19 (O)]

Solution 25

(i) **Current Market Price of Bond**

Year	Cashflow	PVF@8%	PV
1	14	0.926	12.964
2	14	0.857	11.998
3	14	0.794	11.116
4	14	0.735	10.290
5	114	0.681	77.634
		∑ PV (CF) i.e. P_0 =	**124.002**

(ii) **Minimum Market Price of Equity Shares at which Bondholder should exercise conversion option:**

$\frac{124.00}{20}$ = ₹6.20

(iii) **Duration of the Bond**

Year	Cash flow	PVF@ 8%		Proportion of bond value	Proportion of bond value x time (years)
1	14	0.926	12.964	0.105	0.105
2	14	0.857	11.998	0.097	0.194
3	14	0.794	11.116	0.089	0.267
4	14	0.735	10.290	0.083	0.332
5	114	0.681	77.634	0.626	3.130
			124.002	**1.000**	**4.028**

Duration of the bond is 4.028

26) Illustration

Sabanam Ltd. has issued convertible debentures with coupon rate 11%. Each debenture has an option to convert to 16 equity shares at any time until the date of maturity. Debentures will be redeemed at ₹100 on maturity of 5 years. An investor generally requires a rate of return of 8% p.a. on a 5-year security. As an advisor, when will you advise the investor to exercise conversion for given market prices of the equity share of (i) ₹5, (ii) ₹6 and (iii) ₹7.10

Cumulative PV factor for 8% for 5 years: 3.993

PV factor for 8% for year 5: 0.681

[May 18 (6 marks)]

Solution 26

If Debentures are not converted its value is as under: -

	PVF @ 8 %	₹PV
Interest - ₹11 for 5 years	3.993	43.923

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Redemption - ₹100 in 5th year	0.681	68.100
		112.023

Value of equity shares:-

Market Price	No.	Total
₹5	16	80
₹6	16	96
₹7	16	113.60

Recommendation

Market Price	Recommendation	Reason
₹5	Don't Covert	Current Market Price < Break Even Price
₹6	Don't Covert	Current Market Price < Break Even Price
₹7.10	Convert	Current Market Price > Break Even Price

Hence, unless the market price is (113.60/16) ₹7.10 conversion should not be exercised.

27)Illustration

Suppose Mr. A is offered a 10% Convertible Bond (par value ₹1,000) which either can be redeemed after 4 years at a premium of 5% or get converted into 25 equity shares currently trading at ₹33.50 and expected to grow by 5% each year. You are required to determine the minimum price Mr. A shall be ready to pay for bond if his expected rate of return is 11%.

Solution 27

Bond Face Value = ₹1000 Maturity = 4yrs Redemption premium = 5% Redemption price = 1050

Coupon 10% Market rate = 11%

Equity shares offered = 25 CMP = 33.5 Growth = 5%p.a

(i) Intrinsic Value of Bond assuming no immediate conversion

P_0= 100 PVAF (11%, 4) + 1050 PVF (11%, 4th yr)

= 3.1024 x100 + 0.6587 x 1050

= 310.245 + 691.635

$\boldsymbol{P_0}$ = **₹1001.88**

If Bond is converted to shares immediately then, value of resulted shares

F.V of shares = 25 x 33.5 x $(1.05)^4$ = 1017.99

PV of share = 1017.99 x 0.6587 = 670.54

Combined Present value of conversion option = ₹310.245 + ₹670.54 = **₹980.785**

Redemption Option is best and Conversion Option can be opted only if the PV of conversion option is > ₹1001.88

28) Illustration

XYZ company has current earnings of ₹3 per share with 5,00,000 shares outstanding. The company plans to issue 40,000, 7% convertible preference shares of ₹50 each at par. The preference shares are convertible into 2 shares for each preference shares held. The equity share has a current market price of ₹21 per share.

(i) What is preference share's conversion value?

(ii) What is conversion premium?

(iii) Assuming that total earnings remain the same, calculate the effect of the issue on the basic earning per share (a) before conversion (b) after conversion.
(iv) If profits after tax increases by ₹1 million what will be the basic EPS (a) before conversion and (b) on a fully diluted basis? [May 17 (8 marks)]

Solution 28

CMP of Equity share = ₹21
Convertible preference share issue price = ₹50
Equity share count = 500000
7% Preference shares to be issued = 40000
Conversion ratio 2:1
(i) Conversion Value = No. of equity shares/Pref shares x Market premium per equity share = 2 x 21 = ₹42
(ii) Conversion premium = FV/Issue price of pref share – Conversion price = 50 - 42 = ₹8
Conversion premium = 8/42 = 19.05%
(iii) Earning = EPS x Share Count = 3 x 5, 00,000 = 15, 00,000
Preference dividend = 7% x 40000 x 50 = 1, 40,000
Earnings available for equity shareholders = 13, 60,000 (15, 00,000 – 1, 40,000)
EPS = 13,60,000/5,00,000 = ₹2.72
After Conversion
PAT ₹15, 00,000
Existing equity 5, 00,000
Preference converted into equity = 40,000 x 2 = 80,000
Total share = 5, 80,000
EPS = ₹15, 00,000/5,80,000 = **₹2.586**
(iv) Assuming PAT goes up by ₹10, 00,000
Revised PAT = ₹25, 00,000
Preference dividend = 1, 40,000
Earnings available for equity shareholders = ₹23, 60,000
Share count = 5, 00,000
EPS = 4.72
Diluted EPS or EPS after conversion
PAT = ₹25, 00,000
Old equity shares = 5, 00,000
New equity shares = 80,000
Total share count = 5, 80,000
EPS = ₹25,00,000/5,80,000 = **₹4.310**

29)Illustration

The following data is related to 8.5% Fully Convertible (into Equity shares) Debentures issued by JAC Ltd. at ₹1000.

Market Price of Debenture	₹900
Conversion Ratio	30
Straight Value of Debenture	₹700
Market Price of Equity share on the date of Conversion	₹25
Expected Dividend Per Share	1

You are required to calculate:
(a) Conversion Value of Debenture

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(b) Market Conversion Price
(c) Conversion Premium per share
(d) Ratio of Conversion Premium
(e) Premium over Straight Value of Debenture
(f) Favourable income differential per share
(g) Premium pay back period [May 18 (Old); RTP Nov 16 & May 15]

Solution 29

(a) Conversion Value of Debenture

= Market Price of one Equity Share X Conversion Ratio

= ₹30 X 25 = **₹750**

(b) Market Conversion Price

$\frac{\text{Market Price of Convertible Debenture}}{\text{Conversion Ratio}} = \frac{900}{30} =$ **30**

(c) Conversion Premium per share

Market Conversion Price – Market Price of Equity Share

= ₹30 – ₹25 = **₹5**

(d) Ratio of Conversion Premium

$\frac{\text{Conversion premium per share}}{\text{Market Price of Equity Share}} = \frac{5}{25} \times 100 =$ **20%**

(e) Premium over Straight Value of Debenture

$\frac{\text{Market Price of Convertible Bond}}{\text{Straight Value of Bond}} - 1 = \frac{900}{700} - 1 =$ **28.57%**

(f) Favorable income differential per share

$\frac{\text{Coupon Interest from Debenture} - \text{Conversion Ratio Dividend Per Share}}{\text{Conversion Ratio}} = \frac{85-30}{30} =$ **₹ 1.833**

(g) Premium pay back period

$\frac{\text{Conversion premium per share}}{\text{Favourable Income Differntial Per Share}} = \frac{5}{1.833} =$ **2.73 years**

30) Illustration

Pineapple Ltd has issued fully convertible 12 percent debentures of ₹5,000 face value, convertible into 10 equity shares. The current market price of the debentures is ₹5,400. The present market price of equity shares is ₹430.

Calculate: (i) the conversion percentage premium, and (ii) the conversion value

Solution 30

(i) Conversion % premium = $\frac{5400-4300}{4300}$ = **25.58%**

(ii) Conversion Value =No. of shares x Market price per share = 10 x 430 = **4300**

31)Illustration

GHI Ltd., AAA rated company has issued, fully convertible bonds on the following terms, a year ago:

Face value of bond	₹1000
Coupon (interest rate)	8.5%
Time to Maturity (remaining)	3 years
Interest Payment	Annual, at the end of year
Principal Repayment	At the end of bond maturity
Conversion ratio (Number of shares per bond)	25
Current market price per share	₹45
Market price of convertible bond	₹1175

AAA rated company can issue plain vanilla bonds without conversion option at an interest rate of 9.5%.

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Required: Calculate as of today:

(i) Straight Value of bond
(ii) Conversion Value of the bond
(iii) Conversion Premium
(iv) Percentage of downside risk
(v) Conversion Parity Price [May 14 (8 marks), MTP Aug 18, RTP May 17]
PVIF @9.5% (Yr 1 – 0.9132, Yr 2 – 0.8340, Yr 3 – 0.7617)

Solution 31

(i) Straight Value of Bond

Rs. 85 x 0.9132 + Rs. 85 x 0.8340 + Rs. 1085 x 0.7617 = **Rs. 974.96**

(ii) Conversion Value

Conversion Ratio x Market Price of Equity Share

= Rs. 45 x 25 = **₹1,125**

(iii) Conversion Premium

Conversion Premium = Market Conversion Price - Market Price of Equity Share

= $\frac{Rs.1,175}{25}$ - 45 = 2

or = Rs. 1,175 - Rs. 45 x 25 = **₹ 50**

Or $\frac{Rs.1,175 - Rs.1,125}{1125}$ = **4.44%**

(iv) Percentage of Downside Risk

= $\frac{Rs.1,175 - Rs.974.96}{Rs.974.96}$ x 100 = **20.52%** or = $\frac{Rs.1,175 - Rs.974.96}{Rs.1175}$ = **17.02%**

(v) Conversion Parity Price

$\frac{\text{Bond Price}}{\text{No.of Share on Conversion}}$ = $\frac{Rs.1,175}{25}$ = **₹47**

32)Illustration

A hypothetical company ABC Ltd. issued a 10% Debenture (Face Value of ₹ 1000) of the duration of 10 years is currently trading at ₹ 850 per debenture. The bond is convertible into 50 equity shares being currently quoted at ₹ 17 per share.

If yield on equivalent comparable bond is 11.80%, then calculate the spread of yield of the above bond from this comparable bond.

The relevant present value table is as follows:

Present Values	t_1	t_2	t_3	t_4	t_5	t_6	t_7	t_8	t_9	t_{10}
$PVIF_{0.11, t}$	0.901	0.812	0.731	0.659	0.593	0.535	0.482	0.434	0.391	0.352
$PVIF_{0.13, t}$	0.885	0.783	0.693	0.613	0.543	0.480	0.425	0.376	0.333	0.295

iii. [RTP Nov 19 (O); MTP – Apr 19, Mar 19, Mar 18]

Solution 32

Conversion Price = ₹50 x 17 = ₹850

Intrinsic Value = ₹850

Accordingly the yield (r) on the bond shall be :

₹850 = ₹100 PVAF (r, 10) + ₹1000 PVF (r, 10)

Let us discount the cash flows by 11%

850 = 100 PVAF (11%, 10) + 1000 PVF (11%, 10)

850 = 100 x 5.890 + 1000 x 0.352 = 91

Now let us discount the cash flows by 13%

850 = 100 PVAF (13%, 10) + 1000 PVF (13%, 10)

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850 = 100 x 5.426 + 1000 x 0.295 = -12.40

Accordingly, IRR

$11\% + \frac{90.90}{90.90-(-12.40)} \times (13\% - 11\%)$

$11\% + \frac{90.90}{103.30} \times (13\% - 11\%)$

=12.76%

The spread from comparable bond = 12.76% - 11.80% = **0.96%**

33) Illustration

M/s. Earth Limited has 11% bond worth of ₹2 crores outstanding with 10 years remaining to maturity. The company is contemplating the issue of a ₹2 crores 10-year bond carrying the coupon rate of 9% and use the proceeds to liquidate the old bonds.

The unamortized portion of issue cost on the old bonds is ₹3 lakhs which can be written off no sooner the old bonds are called. The company is paying 30% tax and its after-tax cost of debt is 7%. Should Earth Limited liquidate the old bonds?

You may assume that the issue cost of the new bonds will be ₹2.5 lakhs and the call premium is 5%. [May 13 (6 marks)]

Solution 33

1.Calculation of initial outlay:-	₹ (lakhs)
a. Face value	200
Add:-Call premium	10
Cost of calling old bonds	**210**
b. Gross proceed of new issue	200
Less: Issue costs	2.50
Net proceeds of new issue	197.50
c. Tax savings on call premium	
and unamortized cost 0.30 (10 + 3)	₹3.90 lakhs

∴ Initial outlay = ₹210 lakhs – ₹197.50 lakhs – ₹3.90 lakhs = ₹8.60 lakhs

2. Calculation of net present value of refunding the bond

Saving in annual interest expenses	**₹(lakhs)**
[₹200 x (0.11 – 0.09)]	4.000
Less:-Tax saving on interest and amortization 0.30 x [4+(3-2.5)/10]	1.215
Annual net cash saving	**2.785**
PVIFA (7%, 10 years)	7.024
∴Present value of net annual cash saving	₹19.56 lakhs
Less:- Initial outlay	₹8.60 lakhs
Net present value of refunding the bond	₹10.96 lakhs

Decision: The bonds should be refunded

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34) Illustration

Tangent Ltd. is considering calling ₹3 crores of 30 years, ₹1,000 bond issued 5 years ago with a coupon interest rate of 14 per cent. The bonds have a call price of ₹1,150 and had initially collected proceeds of ₹2.91 crores since a discount of ₹30 per bond was offered. The initial floating cost was ₹3,90,000. The Company intends to sell ₹3 crores of 12 per cent coupon rate, 25 years bonds to raise funds for retiring the old bonds. It proposes to sell the new bonds at their par value of ₹1,000. The estimated floatation cost is ₹4,25,000. The company is paying 40% tax and its after tax cost of debt is 8 per cent. As the new bonds must first be sold and then their proceeds to be used to retire the old bonds, the company expects a two month period of overlapping interest during which interest must be paid on both the old and the new bonds. You are required to evaluate the bond retiring decision. [Nov 18 (8 marks)]. [PVIFA 8%, 25 = 10.675]

Solution 34

(a) NPV for bond refunding

	₹
PV of annual cash flow savings (W.N. 2)	
(3,49,600 x PVIFA 8%,25) i.e. 10.675	37,31,980
Less: Initial investment (W.N. 1)	31,15,000
NPV	**6,16,980**

Recommendation: Refunding of bonds is recommended as NPV is positive.

Working Notes:

(1) Initial investment:

(a) Call premium Before tax (1,150 – 1,000) x 30,000		**45,00,000**
Less tax @ 40%	18,00,000	
After tax cost of call premium		**27,00,000**
(b) Floatation cost		4,25,000
(c) Overlapping interest Before tax (0.14 × 3 crores)× 2/12	7,00,000	
Less tax @ 40%	2,80,000	4,20,000
(d) Tax saving on unamortised discount on old bond (25/30 × 9,00,000 x (0.4)		(3,00,000)
(e) Tax savings from unamortised floatation		
Cost of old bond (25/30 x 3,90,000 x 0.4)		(1,30,000)
		31,15,000
(2) Annual cash flow savings:		
(a) Old bond		
(i) Interest cost (0.14 x 3 crores)	42,00,000	
Less tax @ 40%	16,80,000	25,20,000
(ii) Tax savings from amortisation of discount (9,00,000/30 × 0.4)		(12,000)
(iii) Tax savings from amortisation of floatation cost (3,90,000/30 × 0.4)		(5,200)

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Annual after tax cost payment under old Bond (A)		**25,02,800**

(b) New bond

(i) Interest cost before tax (0.12 × 3 crores)	**36,00,000**
Less tax @ 40%	14,40,000
After tax interest	**21,60,000**
(ii) Tax savings from amortisation of floatation cost (0.4 x 4,25,000/25)	(6,800)
Annual after tax payment under new Bond (B)	**21,53,200**
Annual Cash Flow Saving (A) – (B)	**3,49,600**

35) Illustration

The HLL has Rs. 8.00 crore of 10% mortgage bonds outstanding under an indenture. The indenture allows additional bonds to be issued as long as all of the following conditions are met:

(1) Pre- tax interest coverage i.e., (Income before tax + Bond Interest) / Bond Interest remains greater than 4.

(2) Net depreciated value of mortgage assets remains twice the amount of the mortgage debt.

(3) Debt-to-equity ratio remains below 0.50.

The HLL has net income after taxes of Rs. 2 crores and a 40% tax-rate, Rs. 40 crores in equity and Rs. 30 crores in depreciated assets, covered by the mortgage.

Assuming that 50% of the proceeds of a new issue would be added to the base of mortgaged assets and that the company has no Sinking Fund payments until next year, how much more 10% debt could be sold under each of the three conditions? Which protective covenant is binding? [MTP Oct 17 (8 marks)]

Solution 35

Let x be the crores of Rupees of new 10% debt which would be sold under each of the three given conditions. Now, the value of x under each of the three conditions is as follows:

1. Pre-tax interest coverage $\frac{\text{Income before tax+bond interest}}{\text{Bond Interest}}$ remains greater than 4.

$\frac{\frac{₹2\text{crores}}{(1-0.4)}+8\text{crores}*0.1+x*0.1}{8\text{crores}*0.1)+(x*0.1)} = 4$

Or $\frac{3\,33.0\text{ crores} + 0.80\text{ crores} + 10x}{(80\text{ crores} + 0.10x)} = 4$

Or Rs. 4.13 crores + 0.10x = 4 (Rs. 0.80 crores + Rs. 0.10x)

Or Rs. 4.13 crores + 0.10x = Rs. 3.2 crores + Rs. 0.40x

Or Rs. 0.30 x = 0.93

Or x = Rs. 0.93/0.30

Or x = Rs. 3.10 crores

Additional mortgage required shall be a maximum of Rs. 3.10 crores.

2. Net depreciated value of mortgage assets remains twice the amount of mortgage debt

(Assuming that 50% of the proceeds of new issue would be added to the base of mortgaged assets)

i.e $\frac{₹30\text{ crores}+0.5x}{₹8\text{crores}+x} = 2$

or Rs. 30 crores + 0.5x = 2 (Rs. 8 crores + x)

or Rs. 1.5x = Rs. 14 crores

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or **x = 9.33 crores**

Additional mortgage required to satisfy condition No. 2 is Rs. 9.33 crores

3. Debt to equity ratio remains below 5

i.e $\frac{₹8 \text{ crores}+x}{₹40 \text{ crores}}$ = 0.5

or Rs. 8 crores + x = Rs. 20 crores

or x = Rs. 12 crores

Since all the conditions are to be met, the least i.e. Rs. 3.10 crores (as per condition – 1) can be borrowed by issuing additional bonds.

Thus, binding conditions are met and it limits the amount of new debt to 3.10 crore.

36) Illustration

ABC Ltd. issued 9%, 5-year bonds of ₹ 1,000/- each having a maturity of 3 years. The present rate of interest is 12% for one year tenure. It is expected that Forward rate of interest for one year tenure is going to fall by 75 basis points and further by 50 basis points for every next year in further for the same tenure. This bond has a beta value of 1.02 and is more popular in the market due to less credit risk.

Calculate

(i) Intrinsic value of bond

(ii) Expected price of bond in the market [Nov 18, Nov 13 exam]

Solution 36

(i) Intrinsic value of Bond

PV of Interest + PV of Maturity Value of Bond

Forward rate of interests:

1 st Year	12%
2nd year	11.25%
3rd Year	10.75%

PV of interest = $\frac{₹80}{(1\ 0.12)} + \frac{₹80}{(1\ 0.12)(1\ 0.1125)} + \frac{₹80}{(1\ 0.12)(1\ 0.1125)(1\ 0.1075)}$ = 193.61

PV of Maturity Value of Bond = $\frac{₹1000}{(1+\ 0.12)(1+\ 0.1125)(1+\ 0.1075)}$ = ₹724.67

Intrinsic value of Bond = ₹193.61 + ₹724.67 = ₹918.28

(ii) Expected Price = Intrinsic Value x Beta Value

= ₹918.28 x 1.02 = ₹**936.65**

37) Illustration

Consider the following data for Government securities:

Face Value	Coupon Rate (%)	Maturity (years)	Current Price	Yield to Maturity (%)
10,000	12.40	1	9,987	12.546
10,000	12.75	2	9,937	13.128
10,000	13.50	3	10,035	13.351
10,000	13.50	4	9,971	13.599
10,000	13.75	5	9,948	13.901

Calculate forward rates for year 1 to 5.

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Solution 37

F_1

$F_1 = S_1 = \mathbf{12.546\%}$

F_2

2 Year Maturity Bond

Year	1	2
Cash flow	1275	11275
PVF	1.13128	$(1.13128)^2$
PVF	0.88396	0.7814
Present Value	1127.049	8810.285
	9937	

$$9937 = \frac{1275}{1+12.546\%} + \frac{11275}{(1.12546)(1+F_2)}$$

$$9937 = 1132.87 + \frac{10018.126}{(1+F_2)}$$

$$8804.13 = \frac{10018.126}{(1+F_2)}$$

$$(1+F_2) = 1.13789$$

$$F_2 = \mathbf{13.789\%}$$

F_3

$$10035 = \frac{1350}{1.12546} + \frac{1350}{(1.13789)(1.12546)} + \frac{11350}{(1.13789)(1.12546)(1+F_3)}$$

$$10035 = 1350 \times 0.88853 + 1350 \times 0.78085 + \frac{11350 \times 0.78085}{1+F_3}$$

$$10035 = 2253.668 + \frac{8862.6475}{1+F3}$$

$$1 + F_3 = 1.13896$$

$$F_3 = \mathbf{13.896\%}$$

F_4

$$9971 = 1350 \times 0.88853 + 1350 \times 0.78085 + 1350 \times 0.68558 + 11350 \times \frac{0.68558}{1+F_4}$$

$$9971 = 3179.196 + \frac{7781.333}{1+F_4}$$

$$1 + F_4 = 1.14569$$

$$F_4 = \mathbf{14.569\%}$$

F_5

$$9948 = 1375 \times 0.88853 + 1375 \times 0.78085 + 1375 \times 0.68558 + 1375 \times 0.5984 + 11375 \times \frac{0.5984}{1+F_5}$$

$$9948 = 4060.87 + \frac{6806.8}{1+F_5}$$

$$1 + F_5 = \frac{6806.8}{5887.13}$$

$$F_5 = \mathbf{15.622\%}$$

38) Illustration

RBI sold a 91-day T-bill of face value of ₹100 at an yield of 6%. What was the issue price?

Solution 38

Let the issue price be X

By the terms of the issue of the T-bills:

$$6\% = \frac{100-x}{x} \times \frac{365}{91} \times 100$$

$$\frac{6*91*x}{36500} = 100 - x$$

$$0.01496\,x = 100 - x$$

$$x = \frac{100}{1.01496} = \mathbf{₹98.53}$$

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39) Illustration

Wonderland Limited has excess cash of ₹20 lakhs, which it wants to invest in short term marketable securities. Expenses relating to investment will be ₹50,000.

The securities invested will have an annual yield of 9%.

The company seeks your advice

(i) as to the period of investment so as to earn a pre-tax income of 5%. (discuss)

(ii) the minimum period for the company to breakeven its investment expenditure overtime value of money.

Solution 39

(i) Pre-tax Income required on investment of ₹20,00,000

Let the period of Investment be 'P' and return required on investment ₹1,00,000 (₹20, 00,000 x 5%)

Accordingly,

(₹20, 00,000 x $\frac{9}{100}$ x $\frac{P}{12}$) - ₹50,000 = ₹1, 00,000

P = 10 months

(ii) Break-Even its investment expenditure

(₹20, 00,000 x $\frac{9}{100}$ x $\frac{P}{12}$) - ₹50,000 = 0

P = 3.33 months

40) Illustration

Z Co. Ltd. issued commercial paper worth ₹10 crores as per following details:

Date of issue:	16th January, 2019
Date of maturity:	17th April, 2019
No. of days:	91
Interest rate:	12.04% p.a

What was the net amount received by the company on issue of CP? (Charges of intermediary may be ignored)

Solution 40

The company had issued commercial paper worth ₹10 crores

No. of days Involves = 91 days

Interest rate applicable = 12.04 % p.a.

Interest for 91 days = 12.04% × $\frac{91\text{Days}}{365\text{Days}}$ = 3.00175%

= or ₹10 cr x $\frac{3.00175}{100+3.00175}$ = ₹29, 14,274

= or ₹29.14274 Lakhs

∴ Net amount received at the time of issue:- ₹10.00 Crores – ₹0.2914274 Cr = **₹9.7085726 Cr**

Alternatively, it can also be computed as follows:

Price = $\frac{₹10\ crores}{\left(1+12.04\% \times \frac{91 days}{365 days}\right)}$ = **₹9.7085726 Cr**

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41) Illustration

Bank A enter into a Repo for 14 days with Bank B in 10% Government of India Bonds 2028 @ 5.65% for ₹ 8 crore. Assuming that clean price (the price that does not have accrued interest) be ₹ 99.42 and initial Margin be 2% and days of accrued interest be 262 days. You are required to determine

(i) Dirty Price

(ii) Repayment at maturity. (consider 360 days in a year)

Solution 41

(i) Dirty Price

= Clean Price + Interest Accrued

= $99.42 + 100 \times \frac{10}{100} \times \frac{262}{360} = 106.70$

(ii) First Leg (Start Proceed)

= Nominal Value $\times \frac{\text{DirtyPrice}}{100} \times \frac{100-\text{Initial Margin}}{100}$

= ₹8,00,00,000 $\times \frac{106.70}{100} \times \frac{100-2}{100}$ = ₹8,36,52,800

Second Leg (Repayment at Maturity) = Start Proceed x (1 + Repo Rate $\times \frac{\text{No.of days}}{360}$)

= ₹8,36,52,800 x (1 + 0.0565 $\times \frac{14}{360}$) = ₹8,38,36,604

42) Illustration

The Bank BK enters into a Repo for 9 days with Bank NE in 6% Government bonds 2022 for an amount of 2 crore. The other relevant details are as follows:

First Leg Payment (Start Proceeds)	2,00,06,750
Second Leg Payment (Repayment Proceeds)	2,00,31,759
Initial Margin	1.25%
Days of accrued interest	240

Assume 360 days in a year. You are required to calculate:

(i) Repo Rate

(ii) Dirty Price and

(iii) Clean Price

Solution 42

(i) Repo Rate :

Particulars	Amt(₹)
Loan	20006750
Repayment	20031759
Difference(Interest)	25009

Interest = Loan x Repo rate $\times \frac{Days}{360}$

$25009 = 20006750 \times r\% \times \frac{9}{360}$

$25009 \times 40 = 20006750 \times r\%$

r% = 5.0001 = 5%

(ii) Dirty Price

Loan = Security given – Margin

=- 1.25%

If Security is 100 then loan is 98.75% of security given.

20006750 = 98.75% of security

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Security sold = 20006750/98.75% = ₹20260000
Face Value = ₹ 2,00,00,000
Market Value = ₹ 2,02,60,000
Dirty Price using Face Value of bond ₹100
If Face Value ₹100 is worth ₹20000000 Then, How much Dirty Price is worth ₹20260000?
So, $\frac{2,02,60,000}{2,00,00,000}$ x 100 = **₹101.3**
(iii) Clean Price = DP – Accrued Interest = 101.3 – $\left(100 * 6\% * \frac{240}{360}\right)$ = 101.3 – 4 = **₹97.3**

43) Illustration

The data given below relates to convertible bond of Hi -Fi Ltd.:

Face value	2,500
No. of shares per bond	20
Coupon rate	12%
Market price per share	120
Market price of convertible bond	2,650
Straight Value of the bond	2,350

You are required to calculate the following:

(i) Conversion value of bond
(ii) The percentage of downside risk
(iii) The conversion premium
(iv) Conversion parity price of the stock and also interpret the results. [July 21 (8 marks)]

Solution 43

(i) Stock value or conversion value of bond
120 × 20 = ₹2,400
(ii) Percentage of the downside risk
$= \frac{\text{Market Price – Straight Value}}{\text{Market Price}} = \frac{2650 - 2350}{2650}$ = 0.1132 or 11.32%
This ratio gives the percentage price decline experienced by the bond if the stock becomes worthless.
(iii) Conversion Premium
$\frac{\text{Market Price} - \text{ConversionValue}}{\text{ConversionValue}}$ x 100 = $\frac{2650-2400}{2400}$ = **10.42**
(iv) Conversion Parity Price
$\frac{\text{Bond Price}}{\text{No.of Shares on Conversion}} = \frac{2650}{20}$ = **₹132.50**
This indicates that if the price of shares rises to ₹132.50 from ₹120 the investor will neither gain nor lose on buying the bond and exercising it. Observe that ₹12.50 (₹132.50 – ₹120.00) is 10.42% of ₹120, the Conversion Premium.

44) Illustration

Today being 1st January 2019, Ram is considering to purchase an outstanding Corporate Bond having a face value of ₹1,000 that was issued on 1st January 2008 which has 9.5% Annual Coupon and 20 years of original maturity (i.e. maturing on 31st December 2027). Since the bond was issued, the interest rates have been on downside and it is now selling at a premium of ₹125.75 per bond.

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Determine the prevailing interest on the similar type of Bonds if it is held till the maturity which shall be at Par. [RTP Nov 20]

Solution 44

To determine the prevailing rate of interest for the similar type of Bonds we shall compute the YTM of this Bond using IRR method as follows:
M = ₹1000
Interest = ₹95 (0.095 x ₹1000)
n = 9 years
V_0 = ₹1125.75 (₹1,000 + ₹125.75)
YTM can be determined from the following equation
₹95 × PVIFA (YTM, 9) + ₹1000 × PVIF (YTM, 9) = ₹1125.75
Let us discount the cash flows using two discount rates 8% and 10% as follows:

Year	Cash Flows	PVF@6%	PV@6%	PVF@8%	PV@8%
0	-1125.75	1	-1125.75	1	-1125.75
1	95	0.943	89.59	0.926	87.97
2	95	0.890	84.55	0.857	81.42
3	95	0.840	79.80	0.794	75.43
4	95	0.792	75.24	0.735	69.83
5	95	0.747	70.97	0.681	64.70
6	95	0.705	66.98	0.630	59.85
7	95	0.665	63.18	0.583	55.39
8	95	0.627	59.57	0.540	51.30
9	1095	0.592	648.24	0.500	547.50
			112.37		**-32.36**

Now we use interpolation formula
= 6% + $\frac{112.37}{112.37-(-32.36)}$ × (8% - 6%) = 6% + 1.553% = **7.55%**

45) Illustration

The following data is available for NNTC bond:

Face value	₹1000
Coupon rate	7.50%
Market price per share	8 years
Market price of convertible bond	₹1000
YTM	8%

Calculate:
(i) The current market price, duration, and volatility of the bond.
(ii) The expected market price if the decrease in required yield by 50 bps. [RTP Nov 20]

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Solution 45

(i) Current Market Price of Bond shall be computed as follows:

Year	Cash Flows	PVF@ 8%	PV@8%
1	75	0.926	69.45
2	75	0.857	64.28
3	75	0.794	59.55
4	75	0.735	55.13
5	75	0.681	51.08
6	75	0.630	47.25
7	75	0.583	43.73
8	1075	0.540	580.50
			970.97

Thus, the current market price of the Bond shall be ₹970.97.

Alternatively, using the Short-cut method the Market Price of Bond can also be computed as follows:

$$\frac{\text{Interest} + (\text{Discount/Premium})/\text{ Years to maturity}}{(\text{Face Value} + \text{market Value})/2}$$

Let market price be X

$0.08 = \frac{75 + (1000-X)/8}{(1000+X)/2}$

Thus, Value of X i.e. the price of Bond shall be ₹969.70

For the duration of the bond, we have to see the future cash flow and discount them as follows:

Year	CF	PV@8%	Discounted CF	Proportion	Prop*Time(years)
1	75	0.926	69.45	0.071	0.071
2	75	0.857	64.28	0.066	0.132
3	75	0.794	59.55	0.061	0.183
4	75	0.735	55.13	0.057	0.228
5	75	0.681	51.08	0.053	0.265
6	75	0.630	47.25	0.049	0.294
7	75	0.583	43.73	0.045	0.315
8	1075	0.540	580.50	0.598	4.784
		Total	**970.97**	1.000	**6.272**

Volatility of the bond = Duration / (1+ Yield) = 6.272/1.08 = 5.81

If there is decrease in required yield by 50 bps the expected market price of the Bond shall be increased by: ₹970.97 × - 0.50 (-5.81/100) = ₹28.21

Hence expected market price is ₹970.97 + ₹28.21 = ₹999.18

As yield approaches coupon, market price will equal redemption value.

Alternatively, this portion using Bond Price as per Short-cut method can also be computed as follows:

0.50 (5.81/100) = ₹28.17×= ₹969.70

Then, the market price will be = ₹969.70 + ₹28.17 = **₹997.87**

Duration can also be computed as : $\frac{1+y}{y} - \frac{(1+y)+t(c-y)}{c[(1+y))^t-1]+y} = \frac{1.08}{0.08} - \frac{(1.08)+8(0.075-0.08)}{0.075[(1.108)^8-1]+0.08}$

$= 13.5 - \frac{1.08+8(-0.005)}{0.075(1.85-1)+0.08} = 13.5 - \frac{1.08-0.04}{0.075*0.85+0.08}$

$= 13.5 - \frac{1.04}{0.14375} = 13.5 - 7.235 =$ **6.72 years**

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46) Illustration

Following are the yields on Zero Coupon Bonds (ZCB) having a face value of ₹ 1,000.

Maturity (Years)	Yield to Maturity (YTM)
1	10%
2	11%
3	12%

Assume that the term structure of interest rate will remain the same.

You are required to

(i) Calculate the implied one year forward rates

(ii) Expected Yield to Maturity and prices of one year and two-year Zero Coupon Bonds at the end of the first year.

Solution 46

(i) Implied 1 year forward rates

Rate for Yr 1 is YTM for Yr 1 = 10%

Maturity (Years)	Yield to Maturity (YTM)	Froward rate
1	10%	10%
2	11%	?
3	12%	?

In ZCB, there is no coupon cashflow.

P_0 = PVF $1000_{(1,10\%)}$ = $\frac{1000}{1.10}$ = 909.09

P_0= PVF $1000_{(2,11\%)}$ = 811.62

P_0 = PVF$1000_{(3,12\%)}$ = 711.78

811.62 = $\frac{1000}{1.10}$ X $\frac{1}{(1+F_2)}$

1 + F_2 = $\frac{1000}{811.62 \times 1.10}$

1+ F_2 =1.120094

$\boldsymbol{F_2}$ = **12.01%**

Now to find F_3

711.78 = $\frac{1000}{(1.10)(1.1201)(1+F_3)}$

1 + F_3 = $\frac{1000}{711.78 * 1.1 * 1.1201}$

1 + F_3= $\frac{1000}{1.1403}$

$\boldsymbol{F_3}$= **14.03%**

(ii) **Price of one year bond at end of Yr 1**

P_0 = $\frac{1000}{1.1201}$

P_0 = ₹892.78 YTM = 12.01%

Then **price of two year bond** at the end of year 1 shall be:

P_0 = $\frac{1000}{1.1201 * 1.1403}$ = **₹782.93**

YTM of two year bond after year 1 when P_0 = 782.93 is computed as :

P_0 = $\frac{1000}{(1+y)^2}$

$(1+y)^2$= 1000/782.93

$(1+y)^2$ = 1.27725 , So, 1 + y = $\sqrt{1.27725}$

1 + y = 1.1302

y= 13.02%

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47) Illustration

Following is the information for the free options bond:

Face value of the bond	₹1,000
Coupon rate	7%
Terms of Maturity	7 years
Yield to Maturity	8%

You are required to calculate:

(i) Market price of the bound and duration

(ii) If there is an increase in yield by 35 basis points, what would be the price of bond? [Jan 21 (O), 5 marks]

Present Values	t_1	t_2	t_3	t_4	t_5	t_6	t_7
$PVIF_{0.07, t}$	0.935	0.874	0.817	0.764	0.714	0.667	0.623
$PVIF_{0.08, t}$	0.926	0.857	0.794	0.735	0.681	0.631	0.584

Solution 47

(i) (1) Market price and duration of Bond

= 70 (PVIAF 8%,7) + 1,000 (PVIF 8%,7)

= 70 (5.208) + 1,000 (0.584) = 364.56 + 584.00 = 948.56

(2) Duration of Bond

Period	Cash flows	PVF@8%	PV (₹)	Proportion	Proportion *Time
1	70	0.926	64.82	0.0683	0.0683
2	70	0.857	59.99	0.0632	0.1264
3	70	0.794	55.58	0.0586	0.1758
4	70	0.735	51.45	0.0542	0.2168
5	70	0.681	47.67	0.0503	0.2515
6	70	0.631	44.17	0.0466	0.2796
7	1,070	0.584	624.88	0.6588	4.6116
			948.56		**5.73**

Duration of the Bond is 5.73 years

(ii) Price of Bond if increase in yield by 35 basis points

Period	Cashflow (₹)	PVF@8.35%	PV (₹)
1	70	0.923	64.61
2	70	0.852	59.64
3	70	0.786	55.02
4	70	0.726	50.82
5	70	0.670	46.90
6	70	0.618	43.26
7	1,070	0.570	609.90
			930.15

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Alternatively, if the same increase in yield is linked with duration as computed in sub part (i), then answer will be computed as follows:

Volatility of Bond = $\frac{\text{Duration}}{1+\text{YTM}}$ = $\frac{5.73}{1+0.08}$ = 5.306

The expected market price if increase in yield is by 35 basis points. : p = - M.D x Δy x P

= ₹948.56 x 0.35 (5.306/100) = **₹17.62**

Hence expected market price is ₹948.56 – ₹17.62 = **₹930.94**

Hence, the market price will decrease.

48) Illustration

Bank A enters into a Repo for 21 days with Bank B in 8% Government of India Bonds 2020 @ 6.10% for ₹5 crore. Assuming that clean price is ₹97.30 and initial margin is 1.50% and days of accrued interest are 240 days (assume 360 days in a year).

Compute:

(i) The dirty price

(ii) The repayment at maturity [Jan 21 (O), 5 Marks]

Solution 48

(i) Dirty Price = Clean Price + Interest Accrued

= 97.30 + 100 x 8% x $\frac{240}{360}$ = **₹102.63**

(ii) First Leg (Start Proceed)

= Nominal Value x $\frac{\text{Dirty Price}}{100}$ x $\frac{100-\text{Initial Margin}}{100}$

= ₹5,00,00,000 x $\frac{102.63}{100}$ x $\frac{100-1.50}{100}$ = **₹5,05,45,275**

Second Leg (Repayment at Maturity) = Start Proceed x (1 + Repo Rate x $\frac{\text{No.of days}}{360}$)

= ₹5,05,45,275 x (1 + 0.0610 x $\frac{21}{360}$) = **₹5,07,25,132**

OR, ₹5,05,45,275 x 6.1% x $\frac{21}{360}$ = 1,79,856.94

Hence, Re purchase price = S.P + Repo Interest = 5,05,45,275 + 1,79,856.94 = **₹5,07,25,132**

49) Illustration

A bond is currently trading for 98.722 per 100 of par value. If the bond's yield to-maturity (YTM) rises by 10 basis points, the bond's full price is expected to fall to 98.669. If the bond's YTM decreases by 10 basis points, the bond's full price is expected to increase to 98.782. The bond's approximate convexity is closest to:

A. 35.453

B. 70.906

C. 1,144.628

Solution 49

Δy = 10bps = 1% = 0.001 V_0= 98.722

Y_- V_+ 98.782 : for Y_- 10bps

Y_+ V_- 98.669 : for Y_+ 10bps

Approximate convexity = $\frac{V_+ + V_- - 2V_0}{2\,x\,V_0(\Delta y)^2}$ = $\frac{98.782+98.669-2\times 98.722}{2\,x\,(0.001)^2\times 98.722}$ = $\frac{0.007}{0.000098722\ X\ 2}$ = **35.453**

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50) Illustration

A bond has an annual modified duration of 7.020 and annual convexity of 65.180. If the bond's yield-to-maturity decreases by 25 basis points, the expected percentage price change is closest to:

A. 1.73%
B. 1.76%
C. 1.80%

Solution 50

Given, MD = 7.02 Convexity = 65.18↓ YTM = 25 bps = 0.25% = 0.0025

So, determine actual change in price **in terms of ₹** , the formula is :

Δprice = - MD x Δy x P_0 + $(\Delta y)^2$ x Conv x P_0

And to determine actual change in **price in terms of %** , the formula is :

Δprice % = - MD x Δy + $(\Delta y)^2$ x Conv

= -7.020 x – 0.0025 + $(0.0025)^2$ x 65.180

= 0.01755 + 0.000404 = 0.01795

= **1.795% or 1.8%**

51) Illustration

A bond has an annual modified duration of 7.140 and annual convexity of 66.200. The bond's yield-to-maturity is expected to increase by 50 basis points.

The expected percentage price change is closest to:

A. -3.40%
B. -3.49%
C. -3.57%

Solution 51

Δprice% = - MD x Δy + $(\Delta y)^2$ x Conv = -7.14 x 0.005 + $(0.005)^2$ x 66.2

= -0.0357 + 0.001655

= -0.034045

%change in price = - 3.405% **or -3.40%**

52) Illustration

Based on the following data, estimate the Net Asset Value (NAV) 1st July 2016 on per unit basis of a Debt Fund:

Name of Security	Face Value (₹)	Purchase Price (₹)	Maturity Date	No. of Securities	Coupon Date(s)	Duration of Bonds
10.71% GOI 2028	100	104.78	31st March, 2028	100000	31st March	7.3494
10% GOI 2023	100	100.00	31st March 2023	50000	31st March & 30th Sep	5.086
9.5% GOI 2021	100	97.93	31st Dec 2021	40000	30th June & 31st Dec	4.3949
8.5% SGL 2025	100	91.36	30th June 2025	20000	30th June	6.5205

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Number of Units (₹ 10 face value each): 100000
All securities were purchased at a time when applicable Yield to Maturity (YTM) was 10%. On NAV date, the required yield increased by 75 basis point and Cash in hand and accrued expenses were ₹ 6,72,800 and ₹ 2,37,400 respectively.

Solution 52

Computation of Change in price of the bond

Name of Security	Purchase Price (₹) (A)	No. of Securities (B)	Value of the bond P = (A * B)	Duration of Bonds (C)	Modified Duration(M.D) = (C)/1.1 or 1.05	Δ Bond Δp = - Δy × M.D × P
10.71% GOI 2028 (Annual coupon)	104.78	100000	10478000	7.3494	6.6813	- 525048 (10478000 x 6.6813 x 0.75%) Or $\left(\frac{10478000 \times 7.3494}{1.1}\right) 0.7$
10% GOI 2023 (Semi-annual coupon)	100.00	50000	5000000	5.086	4.8438	- 181643 (5000000 x 5.086 x 0.75%) Or $\left(\frac{5000000 \times 5.086}{1.05}\right) 0.75$
9.5% GOI 2021 (Semi-annual coupon)	97.93	40000	3917200	4.3949	4.1856	- 122969 (3917200 x 4.3949x 0.75%) Or $\left(\frac{3917200 \times 4.3949}{1.05}\right) 0.75$
8.5% SGL 2025 (Annual coupon)	91.36	20000	1827200	6.5205	5.9277	- 81234 (1827200 x 6.5205 x 0.75%) Or $\left(\frac{1827200 \times 6.5205}{1.1}\right) 0.75$
			∑=2122240 0			

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Computation of Expected Market Price

Name of Security	Value of the bond (P)	Δ in price	Expected Market Price P - Δp
10.71% GOI 2028 (Annual coupon)	10478000	- 525048	9952952 (10478000 – 525048)
10% GOI 2023 (Semi-annual coupon)	5000000	- 181643	4818357 (5000000 – 181643)
9.5% GOI 2021 (Semi-annual coupon)	3917200	- 122969	3794231 (3917200 – 122969)
8.5% SGL 2025 (Annual coupon)	1827200	- 81234	1745966 (1827200 – 81234)
	Σ = 21222400	**Σ = - 910894**	**Σ = 20311506**

Computation of NAV per unit

Particulars	Amount(₹)
Closing Value of the bond	20311506
Add : Cash in hand	672800
Less : Accrued Expenses	(237400)
Add :Interest Accrued (WN : 1)	392750
Value of net assets	21139656
Total units	100000
NAV/No. of units	211.3965

Working Note 1: Computation of Interest Accrued

Name of Security	Computation	Interest Accrued(₹)
10.71% GOI 2028 (Annual coupon)	100 x 100000 x 10.71% x3/12	267750
10% GOI 2023 (Semi-annual coupon)	100 x 50000 x 5% x 3/6	125000
		Σ = 392750

53) Illustration

Following is the information for the options free bond

Face value of the bond	**₹ 1,000**
Coupon rate	**7%**
Terms of Maturity	**7 years**
Yield to Maturity	**8%**

You are required to calculate:

i. Market price of the bond and duration.

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ii. If there is an increase in yield by 35 basis points, what would be the price of bond?

Present Value	t_1	t_2	t_3	t_4	t_5	t_6	t_7
PVIF0.07,t	0.935	0.874	0.817	0.764	0.714	0.667	0.623
PVIF0.08,t	0.926	0.857	0.794	0.735	0.681	0.631	0.584

Solution 53

(i) (1) Market price and duration of Bond
= 70 (PVIAF 8%,7) + 1,000 (PVIF 8%,7)
= 70 (5.208) + 1,000 (0.584) = 364.56 + 584.00 = **₹948.56**

(2) Duration of Bond

Period (A)	Cash flow (₹) (B)	PVF@ 8% (C)	PV (₹) (D) = (B) × (C)	(E) = (A) × (D)
1	70	0.926	64.82	64.82
2	70	0.857	59.99	119.98
3	70	0.794	55.58	166.74
4	70	0.735	51.45	205.80
5	70	0.681	47.67	238.35
6	70	0.631	44.17	265.02
7	1,070	0.584	624.88	4374.16
			948.56	**5434.87**

Duration of the Bond is 5434.87/948.56 = 5.73 years

(ii) Price of Bond if increase in yield by 35 basis points

Year (A)	Cash flow (₹) (B)	PVF@ 8% (C)	PV (₹) (D) = (B) × (C)
1	70	0.923	64.61
2	70	0.852	59.64
3	70	0.786	55.02
4	70	0.726	50.82
5	70	0.670	46.90
6	70	0.618	43.26
7	1,070	0.570	609.90
			930.15

Alternatively, if the same increase in yield is linked with duration as computed in sub part (i), then answer will be computed as follows:
Volatility of Bond = $\frac{\text{Duration}}{1+\text{YTM}} = \frac{5.73}{1+0.08}$ = 5.306
The expected market price if increase in yield is by 35 basis points. : $\Delta p = -\Delta y \times M.D \times P$
0.35% x 5.306 x 948.56 = **₹17.62**
Hence expected market price is ₹948.56 – ₹17.62 = **₹930.94**
Hence, the market price will decrease with increase in the yield.

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54) Illustration

Mr. X wants to invest ₹ 1,00,000 in the 7 years 8% bonds in the market (Face Value ₹100) which were issued 2 years ago.

(i) You are requested to advise him what is the maximum price for bonds to be paid in the following scenarios:

(1) If Mr. X is expecting minimum 9% return on the bonds
(2) If Mr. X is expecting minimum 7% return on the bonds
(3) If the present rate of similar bonds issued is 8.25%
(4) If the present rate of similar bonds issued is 7.75%

(ii) If the bonds are available at par and 1% is the transaction cost, what is the effective yield?

(iii) Find the number of days required to breakeven transaction cost if the bonds are available at par and 2% is the transaction cost.

Solution

Assumption: Bonds are annual coupon only
Balance period = 5 years

(i) Maximum price for bonds to be paid

1) Price of Bond if Minimum return is 9%

Coupon Payment = 100* 8% = 8
Principal = 100
Discount = 9%
Bond Price $= \frac{8}{1.09^1} + \frac{8}{1.09^2} + \frac{8}{1.09^3} + \frac{8}{1.09^4} + \frac{108}{1.09^5}$
(Alternatively) =100* PVIF (9%,5th year) + 8* PVAF (9%, 5 years)
= **₹ 96.1072**

2) Price of Bond if Minimum return is 7%

Coupon Payment = 100* 8% = 8
Principal = 100
Discount = 7%
Bond Price $= \frac{8}{1.07^1} + \frac{8}{1.07^2} + \frac{8}{1.07^3} + \frac{8}{1.07^4} + \frac{108}{1.07^5}$
(Alternatively) = 100* PVIF (7%,5th year) + 8* PVAF (7%, 5 years)
= 100* 0.7129 + 8* 4.1002
= **₹ 96.1072**

3) Price of Bond if present rate on similar Bonds is 8.25%

P_0 = 100* PVIF (8.25%,5th year) + 8* PVAF (8.25%, 5 years)
= 100* 0.6727 + 8* 3.9665
= **₹ 99.002**

4) Price of Bond if present rate on similar Bonds is 7.75%

P_0 = 100* PVIF (7.75%,5th year) + 8* PVAF (7.75%, 5 years)
= 100* 0.6885 + 8* 4.0191

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= ₹ 101.0032

(ii) Effective Yield

P_0 = 100
Coupon = ₹ 8
Face Value = 100
Transaction Cost = 1%
Market Rate = 8%
Yield = 8%
Investment = 100 (1+ 1%) = ₹ 101
Of ₹ 101 invested, ₹ 1 goes to the transaction cost and the remaining to the Bond.

Effective Yield = $\frac{Coupon}{Investment}$ = $\frac{8}{101}$ = **7.92%**

(i) Number of days required to breakeven transaction cost

P_0 = 100
Coupon = ₹ 8
Face Value = 100
Transaction Cost = 2%

Coupon = ₹ 8
Face Value = 100
Transaction Cost = 2%* 100 = ₹ 2
No. of Days = $\frac{8*365}{2}$ = **91.25 days**
For a bond with annual coupon of ₹ 8, it will take 91.25 days to breakeven transaction cost, assuming 365 days in the year.

55) Illustration

An investor, in the beginning of 2022, purchased substantial number of 8-year 7.50% ₹ 1000 bond with 5 % premium on maturity at a required Yield to Maturity (YTM) of 8.50 %. However, due to the continuing war in Europe, inflation is running very high in the economies of the countries. The yield on the bonds is decreasing. The risk averse investor wants to protect himself from further loss and decides to sell the bonds in 2023. He has got a proposal from another investor who is willing to purchase these bonds by shelling out a maximum amount of ₹ 797.50 per bond.

Investor follows intrinsic value method for valuation of the Bonds. You are required to determine.

The Market price, Duration and Volatility of the bond.

Will it be the right decision of the new investor if he is looking for Required Yield to Maturity (YTM) as 12% p.a.?

Period	1	2	3	4	5	6	7
PVIF(8.50%,n)	0.9217	0.8495	0.7829	0.7216	0.6650	0.6129	0.5649

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Solution

Market Price

Tenure	= 8 years
Time of Purchase	= 2022
Face Value	= 10,000
Coupon %	= 7.5%
Premium on redemption	= 5%
Regular YTM	= 8.5%
Proposed Selling Price	= ₹ 797.5

Bond price at the time of investment

P_0 = 1050* PVIF (8.5%,8th year) + 75* PVAF (8.5%, 8 years)

= 1050* 0.5649 + 75* 5.1185

= **977.0325**

Assuming the 8- year bond was purchased at balance maturity of 7 years.

Duration = $\sum CF * PV * T$

Year	Cash Flow	PV		$\sum CF * PV * T$
1	75	0.9127		69.1275
2	75	0.8495		127.425
3	75	0.7829		176.1525
4	75	0.7216		216.48
5	75	0.6650		249.375
6	75	0.6129		275.805
7	1125	0.5649		4448.5875
				5562.9525

Duration in Years = $5562.9525/977.0325$ = **5.6937 years**

Volatility = $\frac{Duration}{1+YTM}$

= $\frac{5.6934}{1+8.5\%}$ = **5.2777**

Price of Bond in 2023 i.e., at balance maturity of 6 years.

P_{2023} = 1050* PVIF (12%,6th year) + 75* PVAF (12%, 6 years)

= 1050* 0.50663 + 75* 4.1114

= **₹ 840.3170**

For new investor, intrinsic value is ₹ 840.3170 but he/she is acquiring at ₹ 797.50, hence it is a great deal, but for an existing investor it is a bad deal.

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PORTFOLIO MANAGEMENT (90Q)

Examples

Example 1

The probability distribution of possible returns from an investment in shares is given. Compute expected return and the risk of the investment.

Possible returns (in %) x_i	Probability of occurrence P_i
20	0.20
30	0.20
50	0.40
60	0.10
70	0.10

Solution:

x_i	P_i	x_iP_i	$x-\bar{x}$	$(x-\bar{x})^2$	$(x-\bar{x})^2*P_i$
20	0.20	4	-23	529	105.8
30	0.20	6	-13	169	33.8
50	0.40	20	7	49	19.6
60	0.10	6	17	289	28.9
70	0.10	7	27	729	72.9
230	**1.0**	**43**			**261**

$E(R)$ = $\sum_{i=1}^{n} P_i x_i$ = **43%**

Variance = $\sum(x-\bar{x})^2 * P_i$ = 261

Standard Deviation = $\sqrt{variance}$ = **16.16%**

Example 2

From the given data, compute covariance and correlation:

Day	ICICI Bank (X)	HDFC Bank (Y)
1	10 %	11%
2	8%	7%
3	14%	3%
4	-3%	-7%
5	-1%	0%

Solution:

Day	x	$x-\bar{x}$	$(x-\bar{x})^2$	y	$y-\bar{y}$	$(y-\bar{y})^2$	$(x-\bar{x})(y-\bar{y})$
1	10%	4.4	19.36	11%	8.2	67.24	36.08
2	8%	2.4	5.76	7%	4.2	17.64	10.08
3	14%	8.4	70.56	3%	0.2	0.04	1.68
4	-3%	-8.6	73.96	-7%	-9.8	96.04	84.28
5	-1%	-6.6	43.56	0%	-2.8	7.84	18.48
Total	**28%**		**213.2**	**14%**		**188.8**	**150.6**
Mean	5.6%			2.8%			

Variance = $\frac{\sum(x-\bar{x})^2}{n} = \frac{213.2}{5}$ = 42.64

S. D = $\sqrt{variance} = \sqrt{42.63}$ = **6.53**

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Variance = $\frac{\sum(y-\bar{y})^2}{n} = \frac{188.8}{5}$ = 37.76

S. D = $\sqrt{variance} = \sqrt{37.76}$ = **6.15**

cov_{xy} = $\frac{\sum(x-\bar{x})(y-\bar{y})}{n} = \frac{150.6}{5}$ = **30.12**

Correlation Coefficient, $r = \frac{cov_{xy}}{\sigma_x \sigma_y} = \frac{30.12}{6.53*6.15}$ = **0.75**

Example 3

From the given data, compute Beta (β) using all four formulae:

Day	ICICI Bank (i or y)	NIFTY (m or x)
1	10 %	11%
2	8%	7%
3	14%	3%
4	-3%	-7%
5	-1%	0%

Solution:

x	y	$(x-\bar{x})$	$(y-\bar{y})$	$(x-\bar{x})(y-\bar{y})$	xy	y^2
11	10	8.2	4.4	36.08	110	100
7	8	4.2	2.4	10.08	56	64
3	14	0.2	8.4	1.68	42	196
-7	-3	-9.8	-8.6	84.28	21	9
0	-1	-2.8	-6.6	18.48	0	1
14	**28**			**150.6**	**229**	**370**

$\bar{x}$ = $\frac{\sum x}{n} = \frac{28}{5}$ = 5.6

$\bar{y}$ = $\frac{\sum y}{n} = \frac{14}{5}$ = 2.8

σ_x = $\sqrt{\frac{\sum(x-\bar{x})^2}{n}} = \sqrt{\frac{213.2}{5}}$ = 6.15

σ_x^2 = 37.76

σ_y = $\sqrt{\frac{\sum(y-\bar{y})^2}{n}} = \sqrt{\frac{188.8}{5}}$ = 6.53

σ_y^2 = 42.64

Equation 1:

$\boldsymbol{\beta}$ = $\frac{cov_{xy}}{\sigma_x^2}$

cov_{xy} = $\frac{\sum(x-\bar{x})(y-\bar{y})}{n} = \frac{150.6}{5}$ = 30.12

β = $\frac{30.12}{37.76}$ = **0.7976**

Equation 2:

$\boldsymbol{\beta}$ = $\frac{r_{xy}\sigma_y}{\sigma_x}$

r_{xy} = $\frac{cov_{xy}}{\sigma_x \sigma_y} = \frac{30.12}{6.53*5.15}$ = 0.75

β = $\frac{0.75*6.53}{6.15}$ = **0.7963**

Equation 3:

$\boldsymbol{\beta}$ = $\frac{n\sum xy - \sum x \sum y}{n\sum x^2 - (\sum x)^2} = \frac{5*229-28*14}{5*228-14^2} = \frac{1145-392}{1140-196}$ = **0.79767**

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Equation 4:

β $= \frac{\sum xy - n\bar{x}\bar{y}}{\sum x^2 - n(\bar{x})^2} = \frac{229 - 5*5.6*2.8}{228 - 2.8^2} = \frac{229 - 78.4}{228 - 39.2} =$ **0.79767**

Example 4

Compute portfolio risk for the portfolio consisting of ICICI Bank and HDFC Bank securities. The expected returns of both the securities are given as below:

Day	ICICI Bank (X)	HDFC Bank (Y)
1	10 %	11%
2	8%	7%
3	14%	3%
4	-3%	-7%
5	-1%	0%

Compute the portfolio risk when correlation is 0.75

(i) Securities are held in the ratio 1:1

(ii) Securities are held in the ratio 3:7

Solution:

	ICICI Bank	HDFC Bank
	10%	11%
	8%	7%
	14%	3%
	-3%	-7%
	-1%	0%
Total	**28**	**14**
Average	**5.6**	**2.8**
S. D	**6.52993**	**6.14492**

Portfolio @ 50:50 ratio of x and y

Return = 0.5*5.6% + 0.5*2.8% = 4.2%

Risk, σ_p^2 $= \sigma_1^2 * w_1^2 + \sigma_2^2 * w_2^2 + 2 * \sigma_1 \sigma_2 w_1 w_2 r$

$= 6.53^2 * 0.5^2 + 6.15^2 * 0.5^2 + 2 * 30.12 * 0.5 * 0.5$

= 10.66+ 9.46+ 15.06 = **35.18**

σ_p = **5.93**

Portfolio @ 30:70 ratio of x and y

Return = 0.3*5.6% + 0.7*2.8% = 3.64%

Risk, σ_p^2 $= \sigma_1^2 * w_1^2 + \sigma_2^2 * w_2^2 + 2 * \sigma_1 \sigma_2 w_1 w_2 r$

$= 6.53^2 * 0.3^2 + 6.15^2 * 0.7^2 + 2 * 30.12 * 0.3 * 0.7$

= 3.84+ 18.38+ 12.65 = **34.87**

σ_p = **5.90**

Example 5

Compute portfolio risk for a portfolio with three securities based on the following information

Security	Weight	Standard Deviation (σ)
X	0.2	10%
Y	0.3	11%
Z	0.5	16%

The correlation for securities in relation to another security is as follows:

x & y	y & z	x & z

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Correlation - 'r'	0.2	0.4	-0.1

Solution:

Return = $\sum_{i=1}^{n} w_i r_i$ = 10%* 50% + 5%* 10% + 6%* 40% = **7.9%**

Variance Covariance Matrix

	x 0.2	y 0.3	z 0.5
x 0.2	0.2*0.2*1*10*10	0.2*0.3*0.2*10*11	0.2*0.5*-0.1*10* 16
y 0.3	0.3*0.2*0.2*11*10	0.3*0.3*1*11*11	0.5*0.3*11*16*0.4
z 0.5	0.2*0.5*-0.1*16*10	0.3*0.5*0.4*16*11	0.5*0.5*1*16*16

σ_p^2 = 99.45

σ_p = **9.972**

Example 6

Compute portfolio risk for a portfolio with three securities in the portfolio (weights of A, B and C in the portfolio are 0.2, 0.3 and 0.5 respectively) based on the following information;

	Security A	**Security B**	**Security C**
Return	15	20	12
SD	20	25	16

The correlation for securities in relation to another security is as follows:

	AB	**BC**	**AC**
Correlation - 'r'	0.2	0.3	0.5

Solution:

Refer the Excel Sheet provided.

Illustrations

1. Illustration

A company's beta is 1.40. The market return is 14% and the risk-free rate is 10%.

(i) What is the expected return of the company's stock based on CAPM.

(ii)If the risk premium on the market goes up by 2.50% points, what would be the revised expected return on this stock?

Solution:

β = 1.4

R_m = 14%

R_f = 10%

(i) $E(R)$ = $R_f + \beta (R_m - R_f)$ = 10% + 1.4(14%-10%) = 10% + 5.6%

$\boldsymbol{E(R)}$ = **15.6%**

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(ii) $E\ (R)$ when Market Risk Premium $(R_m - R_f)$goes up by 2.5%

Market Risk Premium

$(R_m - R_f)$ = 4% + 2.5% = 6.5%

$E\ (R)$ = 10% + 1.4(6.5%) = 10% + 9.1% = **19.1%**

2. Illustration

The risk premium for the market is 10%.

Assuming Beta values of Security K are 0, 0.25, 0.42, 1.00 and 1.67.

Compute the risk premium on Security K.

Solution:

Market Risk Premium,

$(R_m - R_f)$ = 10%

$\beta\ (R_m - R_f)$ = Risk Premium on Security

B value of Security (k) (a)	Market Risk Premium (b)	Security Risk Premium (a)*(b)
0	10%	**0**
0.25	10%	**2.5%**
0.42	10%	**4.2%**
1.00	10%	**10%**
1.67	10%	**16.7%**

3. Illustration

Treasury Bills give a return of 5%. Market Return is 13%

(i) What is the market risk premium

(ii) Compute the Beta Value and required returns for the following combination of investments.

Treasury Bill	**100**	**70**	**30**	**0**
Market	0	30	70	100

Solution:

Rm = 13%

Rf = 5%

(i) $(R_m - R_f)$ = 13% - 5% = **8%**

(ii)

Market Portfolio	Risk-Free TB	R_m	R_f	β_m	β_p	Return of Portfolio
0%	100%	13%	5%	1	**0**	**5%**
30%	70%	13%	5%	1	**0.3**	**7.4%**
70%	30%	13%	5%	1	**0.7**	**10.6%**
100%	0%	13%	5%	1	**1**	**13%**

a) β of Portfolio

β_p = $\sum_{i=1}^{n} w_i \beta_i$

Beta of Market = 1

Beta of R_f = 0 (no risk)

Weight of Market * β + Weight of Risk-Free TB *β = β_p

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0* 1	100* 0	**0**
30* 1	70* 0	**0.3**
70* 1	30* 0	**0.7**
100* 1	0* 0	**1**

b) Return of Portfolio

R_p = $\sum_{i=1}^{n} w_i R_i$

Weight of Market * Return + Weight of Risk-Free TB *Return = R_p

0* 13%	100* 5%	**5%**
30* 13%	70* 5%	**7.4%**
70* 13%	30* 5%	**10.6%**
100* 13%	0* 5%	**13%**

Alternate Formula

R_p = R_f + β (Market Risk Premium)

4. Illustration

Pearl Ltd. expects that considering the current market prices, the equity shareholders as per Moderate Approach, should get a return of at least 15.50% while the current return on the market is 12%.
RBI has closed the latest auction for ₹ 2500 crores of 182-day Treasury bills for the lowest bid of 4.3% although there were bidders at a higher rate of 4.6% also for lots of less than ₹ 10 crores. What is Pearl Ltd.'s Beta?

Solution:

$E(R)$ = 15.5%

R_m = 12%

R_{f1} = 4.3%

R_{f2} = 4.6% (<10 crores)

$R_{f\,avg}$ = 4.45%

$E(R) = R_f + \beta (R_m - R_f)$

15.5% = 4.45% + β (12%-4.45%)

15.5% = 4.45% + β (7.55%)

11.05% = β (7.55%)

β = **1.4636**

(Given two risk free rates, we have assumed their average in computing the beta of Pearl Ltd.)

5. Illustration

The following information is available with respect of Jaykay Ltd.

Year	Jay Kay Limited		Market		Return on Govt. Bonds
	Average Share Price (₹)	**DPS (₹)**	**Average Index**	**Dividend Yield (%)**	
2002	242	20	1812	4	6
2003	279	25	1950	5	5
2004	305	30	2258	6	4

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2005	322	35	2220	7	5

Compute Beta Value of the company as at the end of 2005. What is your observation?

Solution:

$E(R)$ of stock $= \frac{\text{dividend}}{\text{opening value}} + \frac{\text{capital gain}}{\text{opening value}}$

	Op Stk Price	Closing Stk Price	Increase	Stk Return = (Cl - OP)/ OP	Dividend	Div / OP	Total Return (Stk + Div Yld)
2002-03	242	279	37	15.29%	25.00	10.33%	25.62%
2003-04	279	305	26	9.32%	30.00	10.75%	20.07%
2004-05	305	322	17	5.57%	35.00	11.48%	17.05%

	Opening Index Value	Closing Index Value	Increase	Index Return = (Cl - OP)/ OP	Div Yield	Total Return Index + Div
2009-10	1812	1950	138	7.62%	5%	12.62%
2010-11	1950	2258	308	15.79%	6.00%	21.79%
2011-12	2258	2220	-38	-1.68%	7.00%	5.32%

Average Return on Treasury Bond, $= \frac{6\% + 5\% + 4\% + 5\%}{4}$

R_f = 5%

Beta = $Covariance\ (x, y)$ / $Variance\ Y$

Beta = $\sum(x - \bar{x})\ (y - \bar{y})$ /n / $\sum(y - \bar{y})^{\ 2}$ / n

	X - Stock Return	Y - Market Return	x-x mean (A)	y- y mean (B)	AB	B^2
2002-03	25.62	12.62	4.71	-0.63	-2.95	0.39
2003-04	20.07	21.79	-0.84	8.55	-7.20	73.14
2004-05	17.05	5.32	-3.86	-7.93	30.63	62.81
Total	**62.74**	**39.73**			**20.48**	**136.35**
Average	20.91	13.24				

Beta = (20.458/136.38) = 0.15

Expected Return across years based on Beta

CAPM Return	Actual Return	Action
5% + 0.15 (12.62%-5%)= 6.14%	25.62%	Buy
5% + 0.15 (21.8%-5%)= 7.52%	20.07%	Buy
5% + 0.15 (5.32%-5%)= 5.05%	17.05%	Buy

In all 3 years CAPM based Expected return is lower than actual return

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6. Illustration

Information related to an investment is as follows:

- Risk free rate 10%
- Market Return 15%
- Beta 1.2

(i) What would be the return from this investment?

(ii) If the projected return is 18%, is the investment rightly valued?

(iii) What is your strategy?

Solution:

(i) $E(R)$ $= R_f + \beta\,(R_m - R_f)$ = 10%+ 1.2 (15%-10%)
= 10%+ 1.2* 5 = **16% (CAPM)**

(ii) CAPM = 16%
Projected return = 18%
Project is **undervalued**

(iii) If projected return is 18%, **invest in the project** because return is greater than what is expected based on CAPM.

7. Illustration

The expected returns and Beta of three stocks are given below

Stock	A	B	C
Expected Return (%)	18	11	15
Beta Factor	1.7	0.6	1.2

If the risk-free rate is 9% and the expected rate of return on the market portfolio is 14% which of the above stocks are over, under or correctly valued in the market? What shall be the strategy?

Solution:

Stock	CAPM Return $= R_f + \beta(R_m - R_f)$	Return	Expected Return	Value and Action
A	9%+ 1.7 (14%-9%)	17.5%	<18%	**Undervalued Buy**
B	9%+ 0.6 (14%-9%)	12%	>11%	**Overvalued Sell**
C	9%+ 1.2 (14%-9%)	15%	=15%	**Rightly Valued Hold**

8. Illustration

A stock costing ₹ 120 pays no dividends. The possible prices that the stock might sell for at the end of the year with the respective probabilities are:

Price	Probability
115	0.1
120	0.1
125	0.2
130	0.3
135	0.2
140	0.1

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Required:

(i) Calculate the expected return.

(ii) Calculate the Standard deviation of returns.

Solution:

(i) Expected Return

Year End price	Cost (a)	Absolute Return (b)	Return % = [(b)/(a)] *100
115	120	-5	- 4.16
120	120	0	0
125	120	5	4.16%
130	120	10	8.33%
135	120	15	12.5%
140	120	20	16.67%

$E(R)$ $= \sum Probability * Return$

= 0.1* (-4.16%) +0.1*0% + 0.2*4.16% + 0.3*8.33% + 0.2*12.5% + 0.1*16.67%

= **7.082**

(ii)

Scenario	Probability P_i	Return, x	$(x-\bar{x})$	$(x-\bar{x})^2$	$(x-\bar{x})^2 * P_i$
1	0.1	- 4.16	- 11.242	126.38	12.638
2	0.1	0	- 7.082	50.15	5.015
3	0.2	4.16%	- 2.922	8.538	1.707
4	0.3	8.33%	1.248	1.5575	0.467
5	0.2	12.5%	5.418	29.354	5.87
6	0.1	16.67%	9.588	91.93	9.192
					34.892

$\bar{x}$ = 7.082

Variance = 34.892

SD $= \sqrt{variance}$ = **5.907**

9. Illustration

Following information is available in respect of expected dividend, market price and market condition after one year.

Market condition	Probability	Market Price	Dividend per share
		₹	₹
Good	0.25	115	9
Normal	0.50	107	5
Bad	0.25	97	3

The existing market price of an equity share is Rs. 106 (F.V. ₹ 1), which is cum 10% bonus debenture of ₹ 6 each, per share. M/s. X Finance Company Ltd. had offered the buy-back of debentures at face value.

Find out the expected return and variability of returns of the equity shares if buyback offer is accepted by the investor.

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And also advise-Whether to accept buy-back offer?

Solution:

Current M. P = 106
Net Price = 100 (post buy back)
Face Value = 6 (when buyback is accepted)

Condition	P_i	Return	Market Price Post Buyback	Future Price	Dividend
Good	0.25	100	100	115	**9**
Normal	0.5	100	100	107	**5**
Bad	0.25	100	100	97	**3**

Absolute Return Computation	Expected Return (Absolute*Probability)
115+9-100 = 24	24* 0.25 = 6%
107+5-100 =10	12* 0.5 = 6%
97+3-100 =0	0* 0.25 = 0%

$E\ (R)$ = $\sum_{i=1}^{n} w_i \mathrm{R}_i$ = 6+ 6+ 0
$\bar{x}$ = 12%
σ_p^2 = $\sum_{i=1}^{n} (x - \bar{x})^2 \mathrm{w}_i$
= (24%- 12%)^2 * 0.25 + (12%- 12%)^2* 0.5 + (0%- 12%)^2* 0.25
= 144* 0.25 + 144*0.25 = **72**
σ_p = $\sqrt{\sum_{i=1}^{n} (x - \bar{x})^2 \mathrm{w}_i}$ = $\sqrt{72}$ = **8.48%**
Return (Debt) = 10%
$E\ (R)$ Equity = 12%

Depending on investor's risk preference, he or she may choose to sell the debenture back or hold on to it, as its return is slightly lower than that of equity shares.

10. Illustration

Mr. A is interested to invest ₹ 1,00,000 in the securities market. He selected two securities B and D for this purpose. The risk return profile of these securities are as follows:

Security	Risk (SD)	Expected Return (ER)
B	10%	12%
D	18%	20%

Co-efficient of correlation between B and D is 0.15.
You are required to calculate the portfolio return of the following portfolios of B and D to be considered by A for his investment.
(i) 100 percent investment in B only;
(ii) 50 percent of the fund in B and the rest 50 percent in D;
(iii) 75 percent of the fund in B and the rest 25 percent in D; and
(iv) 100 percent investment in D only.
Also indicate that which portfolio is best for him from risk as well as return point of view?

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Solution:

	R	σ
B	12%	10%
D	20%	18%

r = 0.15

Portfolio B:D	Expected Return	Risk Computation	Risk
100:0	12 %	Only B B's σ	10%
50:50	16%	WN 2	10.93%
75:25	14%	WN 4	9.307%
100:0	20%	Only D D's σ	18%

(i) CASE 2

$E(R)$ = $\sum_{i=1}^{n} w_i R_i$

$E(R)$ = 12%* 0.5 + 20% * 0.5 = **16%**

(ii) σ_p^2 = $\sigma_B^2 * w_B^2 + \sigma_D^2 * w_D^2 + 2 * \sigma_B \sigma_D w_B w_D r$

= $10^2 0.5^2 + 18^2 0.5^2 + 2 * 10 * 18 * 0.5 * 0.5 * 0.15$

= 25+ 81+ 13.5 = 119.5

σ_p = $\sqrt{119.5}$ = **10.93**

(iii) CASE 3

$E(R)$ when ratio is 75:25

= $0.75 * 12\% + 0.25 * 20\%$ = 9% + 5% = **14%**

(iv) CASE 3

σ_p^2 = $\sigma_B^2 w_B^2 + \sigma_D^2 w_D^2 + 2\sigma_B \sigma_D w_B w_D r$

= $0.75^2 10^2 + 0.25^2 18^2 + 2 * 10 * 18 * 0.75 * 0.25 * 0.15$

= 56.25+ 20.25+ 10.125 = **86.625**

σ_p = $\sqrt{86.625}$ = **9.307**

Purely from risk perspective Portfolio 3 has lowest risk and very low return, and from return perspective Portfolio 4 is the best but with high risk. However, considering the need for diversification we would recommend Portfolio 2 over 3 as it gives better return for marginal increase in risk.

11. Illustration

Consider the following information on two stocks, A and B:

Year	Return on A (%)	Return on B (%)
2006	10	12
2007	16	18

You are required to determine:

(i) The expected return on a portfolio containing A and B in the proportion of 40% and 60% respectively.

(ii) The Standard Deviation of return from each of the two stocks.

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(iii) The covariance of returns from the two stocks.
(iv) Correlation coefficient between the returns of the two stocks.
(v) The risk of a portfolio containing A and B in the proportion of 40% and 60%.

Solution:

(i) $E(R)$ when A: B = 40:60

$E(R)$ of A = $\frac{10+16}{2}$ =13%

$E(R)$ of B = $\frac{12+18}{2}$ =15%

$E(R)_p$ = 13*0.4 + 15*0.6 = 5.2+ 9 = **14.2%**

(ii) σ of each of the stocks

For A:

σ_A^2 = $\sum_{i=1}^{n} \frac{(x-\bar{x})^2}{n}$ = $\frac{(10-13)^2+(16-13)^2}{2}$ = 9

σ_A = $\sqrt{9}$ = **3**

For B:

σ_B^2 = $\frac{(12-15)^2+(18-15)^2}{2}$ = 9

σ_B = $\sqrt{9}$ = **3**

(iii) Covariance = $\sum \frac{(x-\bar{x})(y-\bar{y})}{n}$ = $\frac{(10-13)(12-15)+(16-13)(18-15)}{2}$

= $\frac{9+9}{2}$ = **9**

(iv) Correlation

$r\sigma_A\sigma_B$ = cor_{AB}

r* 3* 3 = 9

$\boldsymbol{r}$ = **1**

(v) σ_p^2 = $\sigma_A^2 w_A^2 + \sigma_B^2 w_B^2 + 2\sigma_A\sigma_B w_A w_B r$

= 9 *0.4^2 + 9* 0.6^2 + 2* 3* 3* 0.4* 0.6* 1 = 9

σ_p = $\sqrt{9}$ = **3**

12. Illustration

Following is the data regarding six securities:

	A	B	C	D	E	F
Return (%)	8	8	12	4	9	8
Risk (Standard deviation)	4	5	12	4	5	6

(i) Assuming three will have to be selected, state which ones will be picked.
(ii) Assuming perfect correlation, show whether it is preferable to invest 75% in A and 25% in C or to invest 100% in E

Solution:

(i) Given that A has better return than D for the same risk, A is chosen.
Also, A is better compared to B and F.
E is better than F.
Here the stocks A, E are chosen and B, D and F are not chosen.
C is chosen for highest return despite highest risk.

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(ii) Portfolio 1, A:C = 75:25

Portfolio 2, E = 100%

Return (P1) = 0.75* 0.8 + 0.25* 12 = 6+ 3 = 9%

σ_p^2 = $\sigma_A^2 * w_A^2 + \sigma_C^2 * w_C^2 + 2 * \sigma_A \sigma_C w_A w_C r$

= $4^2 0.75^2 + 12^2 0.25^2 + 4 * 12 * 0.75 * 0.25 * 1$

= 9+9+18 = 36

σ_p = $\sqrt{36}$ = **6**

Comparing	A and C	E
R	9	9
σ_p	6	5

It is better to invest in E as one gets same return for lower risk.

13. Illustration

The historical rates of return of two securities over the past ten years are given.
Calculate the Covariance and the Correlation coefficient of the two securities:

Years:	1	2	3	4	5	6	7	8	9	10
Security 1: (Return %)	12	8	7	14	16	15	18	20	16	22
Security 2: (Return %)	20	22	24	18	15	20	24	25	22	20

Solution:

x	y	$(x-\bar{x})$	$(y-\bar{y})$	$(x-\bar{x})^2$	$(y-\bar{y})^2$	$(x-\bar{x})(y-\bar{y})$
12	20	-2.8	-1	7.84	1	2.8
8	22	-6.8	1	46.24	1	-6.8
7	24	-7.8	3	60.84	9	-23.4
14	18	-0.8	-3	0.64	9	2.4
16	15	1.2	-6	1.44	36	-7.2
15	20	0.2	-1	0.04	1	-0.2
18	24	3.2	3	10.24	9	9.6
20	25	5.2	4	27.04	16	20.8
16	22	1.2	1	1.44	1	1.2
22	20	7.2	-1	51.84	1	-7.2
148	**210**			**-207.6**	**84**	**-8**

$\bar{x}$ = $\frac{148}{10}$ =14.8

$\bar{y}$ = $\frac{210}{10}$ = 21

σ_X = $\sqrt{\frac{(x-\bar{x})^2}{n}}$ = $\sqrt{\frac{207.6}{10}}$ = 4.556

σ_Y = $\sqrt{\frac{(y-\bar{y})^2}{n}}$ = $\sqrt{\frac{84}{10}}$ = 2.898

Covariance = $\frac{\sum(x-\bar{x})(y-\bar{y})}{n}$ = - $\frac{8}{10}$ = **- 0.8**

r = $\frac{cov_{xy}}{\sigma_x \sigma_y}$ = - $\frac{0.8}{4.556*2.898}$ = **0.0606**

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14. Illustration

An investor has decided to invest to invest ₹ 1,00,000 in the shares of two companies, namely, ABC and XYZ. The projections of returns from the shares of the two companies along with their probabilities are as follows:

Probability	XYZ (%)	ABC (%)
0.20	16	12
0.25	10	14
0.25	28	-7
0.30	-2	28

You are required to

(i) Comment on return and risk of investment in individual shares.

(ii) Compare the risk and return of these two shares with a Portfolio of these shares in equal proportions.

(iii) Find out the proportion of each of the above shares to formulate a minimum risk portfolio.

Solution:

For ABC

p_i	r_i	$p_i r_i$	$(x-\bar{x})$	$(x-\bar{x})^2$	$(x-\bar{x})^2 p_i$
0.2	12	2.4	-0.55	0.3025	0.0605
0.25	14	3.5	1.45	2.1025	0.52563
0.25	-7	-1.75	-19.55	382.2	95.5506
0.3	28	8.4	15.45	238.7	71.6108
		12.55		623.31	**167.7475**

σ^2_{ABC} = 167.7475

σ_{ABC} = $\sqrt{167.7475}$ = 12.9517

For XYZ

p_i	r_i	$p_i r_i$	$(x-\bar{x})$	$(x-\bar{x})^2$	$(x-\bar{x})^2 p_i$
0.2	16	3.2	3.9	15.21	3.042
0.25	10	2.5	-2.1	4.41	1.1025
0.25	28	7	15.9	252.81	63.2025
0.3	-2	-0.6	-14.1	198.81	59.643
		12.1		471.24	**126.99**

σ^2_{XYZ} = 126.99

σ_{XYZ} = $\sqrt{126.99}$ = 11.269

(i) XYZ has a better risk return portfolio.

(ii) σ_p^2 = $\sigma_A^2 w_B^2 + \sigma_A^2 w_B^2 + 2 * \sigma_A \sigma_B w_A w_B r$

w_A = w_B

$r\sigma_A\sigma_B$ = $\frac{cov_{AB}}{\sigma_A \sigma_B}$

cov_{AB} = $\frac{\sum(x-\bar{x})(y-\bar{y})}{n}$

$x-\bar{x}$	$y-\bar{y}$	$(x-\bar{x})(y-\bar{y})$	p_i	$(x-\bar{x})(y-\bar{y})p_i$
-0.55	3.9	-2.145	0.2	-0.429

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1.45	-2.1	-3.045	0.25	-0.761
-19.55	15.9	-310.845	0.25	-77.71
15.45	-14.1	-217.845	0.3	-65.35
		-533.880		**-144.255**

r = $-\frac{144.255}{12.952*11.269}$ = 0.9883

σ_p^2 = $(12.952)^2$ * $(0.5)^2$ + $(11.269)^2$ * $(0.5)^2$ + 2* -144.255 * 0.5* 0.5*0.9883 =

= 1.54042

σ_p = 1.2411

$E(R)$ = 0.5* 12.55 + 0.5*12.1 = **12.33%**

The shares have negative correlation and hence the 50:50 portfolio has very low risk/ variance but at almost same return.

(iii) Minimum Risk Portfolio

W_{ABC} at minimum variance, = $\frac{\sigma_B^2 - r\sigma_A\sigma_B}{\sigma_A^2+\sigma_B^2-2r\sigma_A\sigma_B}$

= $\frac{11.269^2-(-144.255)}{11.269^2+12.952^2-2*(-144.255)}$ = $\frac{271.51}{583.254}$ = 0.465

W_{XYZ} = 1-W_{ABC} = 1- 0.465 = 0.535

The minimum risk portfolio will have ABC and XYZ in the proportion 46.5% and 53.5%

$E(R)$ = 12.55* 0.465 + 0.535* 12.1 = 12.30925

σ_p^2 = 126.99* $(0.535)^2$+ 167.754* $(0.465)^2$ + 2(-144.25) *0.535* 0.465

= **0.848**

σ_p = **0.9213**

15. Illustration

The following information are available with respect of Krishna Ltd.

Year	ishna Ltd.Average share price (Rs.)	Dividendper Share (Rs.)	Average Market Index	Dividend Yield	**Return on Govt. bonds**
2012	245	20	2013	4%	**7%**
2013	253	22	2130	5%	**6%**
2014	310	25	2350	6%	**6%**
2015	330	30	2580	7%	**6%**

Compute Beta Value of the Krishna Ltd. at the end of 2015 and state your observation.

Solution:

Period	Equity Return	Market Return	R_f
2012-13	12.25%	10.81%	6%
2013-14	32.41%	16.33%	6%
2014-15	16.13%	16.79%	6%

	$\frac{D}{P_0}+\frac{P_1-P_0}{P_0}$	**Equity Return**
2012-13	(22+253-245)/245	12.25%
2013-14	(25+310-253)/253	32.41%
2014-15	(30+330-310)/310	16.13%

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	Market Return		Dividend
2012-13	(2130-2013)/2013	5.8%	5%
2013-14	(2350-2130)/2130	10.33%	6%
2014-15	(2580-2350)/2350	9.79%	7%

	x	y	$x-\bar{x}$	$y-\bar{y}$	$(x-\bar{x})(y-\bar{y})$
2012-13	10.81%	12.25%	-3.83%	-8.01%	30.68
2013-14	16.33%	32.41%	1.69%	12.15%	20.5335
2014-15	16.79%	16.13%	2.15%	-4.13%	-8.8795
	43.93%	**60.79%**			**42.33**

$\bar{x}$ = 14.64%

$\bar{y}$ = 20.26%

(cov_{xy}) = $\frac{\sum(x-\bar{x})(y-\bar{y})}{n}$ = $\frac{42.3323}{3}$ = 14.11076

Market Variance = $\frac{\sum(x-\bar{x})^2}{n}$ = $\frac{22.1475}{3}$ = 7.3825

β = $\frac{\sigma_{xyz,m}}{var_m}$ = $\frac{14.11076}{7.3825}$ = 1.911

$E(R)$ = $R_f + \beta\,(R_m - R_f)$

Period		$E(R)$	Actual Return
2012-13	6%+ 1.911(10.81-6)	15.20%	12.25%
2013-14	6%+ 1.911(16.33-6)	27.54%	32.41%
2014-15	6%+ 1.911(16.79-6)	26.62%	16.13%

In period 2012-13 and 2014-15, Actual Return< Expected Return – Stock is a sell in this period
Whereas, in 2013-14 Actual Return> Expected Return – Stock is a buy in this period

16. Illustration

The distribution of return of security 'F' and the market portfolio 'P' is given below:

Probability	Return (%)	
	F	**P**
0.30	30	-10
0.40	20	20
0.30	0	30

You are required to calculate the expected return of security 'F' and the market portfolio 'P', the covariance between the market portfolio and security and beta for the security.

Solution:

Probability	**Stock return**	**Market return**	$(F-\bar{F})$	$(P-\bar{P})$	$(F-\bar{F})(P-\bar{P})$	$(P-\bar{P})^2$
0.3	30	-10	13	-24	-312	576
0.4	20	20	3	6	18	36
0.3	0	30	-17	16	-272	256

$E(R)$ = $\sum P_i R_i$

$E(R)$ of Stock F,

$\bar{F}$ = 0.3* 30+ 0.4* 20 + 0.3* 0 = **17%**

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$E(R)$ of Stock P

$\bar{P}$ = 0.3* -10+ 0.4* 20 + 0.3* 30 = **14**

Covariance = $\sum(F-\bar{F})(P-\bar{P}) * P_i$

= 0.3* -312 + 0.4* 18 + 0.3* -272 = -168

Variance of Market Portfolio P = 576* 0.3 + 36* 0.4+ 256* 0.3 = **264**

β = $\frac{\sigma_{FP}}{\sigma_P^2}$ = - $\frac{168}{264}$ = **- 0.64**

17. Illustration

Given below is information of market rates of Returns and Data from two Companies A and B:

	Year 2007	Year 2008	Year 2009
Market (%)	12.0	11.0	9.0
Company A (%)	13.0	11.5	9.8
Company B (%)	11.0	10.5	9.5

You are required to determine the beta coefficients of the Shares of Company A and Company B.

Solution:

Year	Market Return	$(R_M - \overline{R_M})$	$(R_M - \overline{R_M})^2$
2007	12	1.33	1.7689
2008	11	0.33	0.1089
2009	9	-1.67	2.7889
	32		**4.667**

$\bar{R}_M$ = $\frac{32}{3}$ = 10.671

Variance of Market,

σ_M^2 = $\sqrt{\frac{(R_M-\bar{R}_M)^2}{n}}$ = $\frac{4.667}{3}$ = 1.556%

Year	R_A	$(R_A - \overline{R_A})$	$(R_M - \overline{R_M})$	$(R_A - \overline{R_A})(R_M - \overline{R_M})$
2007	13	1.57	1.33	2.0881
2008	11.5	0.07	0.33	0.0231
2009	9.8	-1.63	-1.67	2.7221
	34.3			**4.8323**

$\overline{R_A}$ = 11.43

cov_A = $\frac{4.833}{3}$ = 1.6111

β_A = $\frac{\sigma_{AM}}{\sigma_M^2}$ = $\frac{1.611}{1.556}$ = 1.036

Year	R_B	$(R_B - \overline{R_B})$	$(R_M - \overline{R_M})$	$(R_B - \overline{R_B})(R_M - \overline{R_M})$
2007	11	0.67	1.33	0.8911
2008	10.5	0.17	0.33	0.0561
2009	9.5	-0.83	-1.67	1.3861
	31			**2.3333**

$\overline{R_B}$ = 10.3

cov_B = $\frac{2.333}{3}$ = 0.7776

β_B = $\frac{\sigma_{AM}}{\sigma_M^2}$ = $\frac{0.7776}{1.556}$ = **0.50**

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18. Illustration

Mr. Tempest has the following portfolio of four shares:

Name	Beta	Investment (Lakhs)
Oxy Rin Ltd.	0.45	0.80
Boxed Ltd.	0.35	1.50
Square Ltd.	1.15	2.25
Ellipse Ltd.	**1.85**	**4.50**

The risk-free rate of return is 7% and the market rate of return is 14%. Required.

(i) Determine the portfolio return.

(ii) Calculate the portfolio Beta.

Solution:

R_f = 7%

R_m = 14%

MRP = $(R_m - R_f)$ = 14%- 7% = 7%

Total Investment = 9.05 Lakh

Stock	β	$E\ (R)$	$= R_f + \beta\ (R_m - R_f)$	$E\ (R)$
Oxy Rin Ltd	0.45		7+ 0.45*7	10.15
Boxed Ltd.	0.35		7+ 0.35*7	9.45
Square Ltd	1.15		7+ 1.15*7	15.05
Ellipse Ltd.	1.85		7+ 1.85*7	19.95

(i) $E\ (R)$ of Portfolio= $10.15 * \frac{0.8}{9.05} + 9.45 * \frac{1.5}{9.05} + 15.05 * \frac{2.25}{9.05} + 19.95 * \frac{4.5}{9.05}$

= 0.897+ 1.566+ 3.74+ 9.92 = **16.125**

(ii) β of Portfolio = $\sum_{i=1}^{n} w_i \beta_i$

$= 0.45 * \frac{0.8}{9.05} + 0.35 * \frac{1.5}{9.05} + 1.15 * \frac{2.25}{9.05} + 1.85 * \frac{4.5}{9.05}$

= 0.0397+ 0.058+ 0.2859+ 0.91989 = **1.3034**

19. Illustration

Amal Ltd. has been maintaining a growth rate of 12% in dividends. The company has paid dividend @ ₹3 per share. The rate of return on market portfolio is 15% and the risk -free rate of return in the market has been observed as10%. The beta co-efficient of the company's share is 1.2.

You are required to calculate the expected rate of return on the company's shares as per CAPM model and the equilibrium price per share by dividend growth model.

Solution:

g = 12%

d_0 = 3

d_1 = 3* 1.12 = 3.36

R_m = 15%

R_f = 10%

β = 1.2

$E\ (R)$ = $R_f + \beta\ (R_m - R_f)$ = 10% + 1.2(15-10) = 10+ 6 = **16% (=k_e)**

Price of Amal's Share,

P_0 = $\frac{d_1}{ke-g}$ = $\frac{3.36}{16\%-12\%}$ = **₹ 84 /share**

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20. Illustration

The following information is available in respect of Security X

Equilibrium Return	-	15%
Market Return	-	15%
7% Treasury Bond Trading at	-	$140
Covariance of Market Return and Security Return	-	225%
Coefficient of Correlation	-	0.75

You are required to determine the Standard Deviation of Market Return and Security Return.

Solution:

σ_{MX} = 225%

r = 0.75

R_M = 15%

R_X = 15%

Since Security return = Market Return,

β = 1

CY = $\frac{Coupon}{MP}$ (Assuming Bond Price= 100, C= 7)

= $\frac{7}{140}$ = 5% (Assume R_f= 5%)

$E(R)_X$ = $R_f + \beta (R_m - R_f)$

15% = 5% + β (15-5)

β = 1

β = $\frac{cov_{x,m}}{\sigma_m^2}$

1 = $\frac{225}{\sigma_m^2}$

σ_m^2 = 225

$\boldsymbol{\sigma_m}$ = $\sqrt{225}$ = **15%**

β = $\frac{r * \sigma_x}{\sigma_m}$

1 = $\frac{(0.75 * \sigma_x)}{15}$

$\boldsymbol{\sigma_x}$ = $\frac{15\%}{0.75}$ = **20%**

21. Illustration

Assuming that shares of ABC Ltd. and XYZ Ltd. are correctly priced according to Capital Asset Pricing Model. The expected return from and Beta of these shares are as follows:

Share	Beta	Expected return
ABC	1.2	19.8%
XYZ	0.9	17.1%

You are required to derive Security Market Line.

Solution:

Return = $R_f + \beta (MRP)$

19.8 = $R_f + 1.2 (MRP)$ (1 for ABC)

17.1 = $R_f + 0.9 (MRP)$ (2 for XYZ)

Subtracting equations (1) and (2)

2.7 = 0.3 MRP

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MRP = $\frac{2.7}{0.3}$ = 9

Substituting MRP is Equation (1)

19.8 = $R_f + 1.2\ (MRP)$

19.8 = $R_f + 1.2$ * 9

R_f = 19.8- 10.8 = **9%**

SML = 9% + β (9%)

22. Illustration

A Ltd. has an expected return of 22% and Standard deviation of 40%.
B Ltd. has an expected return of 24% and Standard deviation of 38%.
A Ltd. has a beta of 0.86 and B Ltd. a beta of 1.24.
The correlation coefficient between the return of A Ltd. and B Ltd. is 0.72.
The Standard deviation of the market return is 20%.

Suggest:

(i) Is investing in B Ltd. better than investing in A Ltd.?
(ii) If you invest 30% in B Ltd. and 70% in A Ltd., what is your expected rate of return and portfolio Standard deviation?
(iii) What is the market portfolios' expected rate of return and how much is the risk -free rate?
(iv) What is the beta of Portfolio if A Ltd.'s weight is 70% and B Ltd.'s weight is 30%?

Solution:

(i) Yes, Investing in B Ltd. is better than as it has lower S.D and higher return.

(ii) A= 70%, B= 30%

$E(R)$ = 70% * 22% + 30% * 24% = 15.4% + 7.2% = 22.6%

σ_p^2 = $\sigma_A^2 + w_B^2 + \sigma_A^2 + w_B^2 + 2 * \sigma_A \sigma_B w_A w_B r$

= $(0.7)^2$ * $(40)^2$ + $(0.3)^2$ * $(38)^2$ + 2* 0.7* 0.3* 40*38* 0.72

= 1373.608

σ_p = $\sqrt{1373.608}$ = **37.0622%**

(iii) 22% = $R_f + 0.86\ (MRP)$ (1) Return of A

24% = $R_f + 1.24\ (MRP)$ (2) Return of B

Subtracting, (2) – (1)

2 = 0.38 MRP

MRP = $\frac{2}{0.38}$ = 5.263

Substituting MRP in equation (1),

22% = $R_f + 0.86 * 5.263$

R_f = 22- 4.526 = 17.474

$R_m - R_f$ = 5.263

R_m = 5.263 + 17.474 = **22.737**

(iv) β_p = $\sum_{i=1}^{n} w_i \beta_i$ = 0.7* 0.86+ 0.3* 1.24 = **0.974**

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23. Illustration

XYZ Ltd. has substantial cash flow and until the surplus funds are utilised to meet the future capital expenditure, likely to happen after several months, are invested in a portfolio of short - term equity investments, details for which are given below:

Investment	No. of shares	Beta	Market price per share	Expected yield
I	60,000	1.16	4.29	19.50%
II	80,000	2.28	2.92	24.00%
III	1,00,000	0.90	2.17	17.50%
IV	1,25,000	1.50	3.14	26.00%

The current market return is 19% and the risk-free rate is 11%. Required to:

(i) Calculate the risk of XYZ's short-term investment portfolio relative to that of the market;
(ii) Whether XYZ should change the composition of its portfolio.

Solution:

Investment	No. Of Shares	Price	Value	Beta
I	60000	4.29	257400	1.16
II	80000	2.92	233600	2.28
III	100000	2.17	217000	0.9
IV	125000	3.14	392500	1.5
			1100500	

(i) β_p $= \sum_{i=1}^{n} w_i \beta_i$

= (1.16*257400/1100500) + (2.28*233600/1100500) + (0.9*217000/1100500) + (1.5*392500/1100500)

= **1.4677**

The portfolio is risky compared to market as it has a beta of 1.4677 v/s market beta of 1.

(ii) Return as per CAPM, = $R_f + \beta(MRP)$

	Calculation	Return	$E(R)$
I	11 + 1.16* 8%	20.28	19.5
II	11 + 2.28* 8%	29.24	24
III	11 + 0.9* 8%	18.2	17.5
IV	11 + 1.5* 8%	23	26

Only investment IV has an expected return more than CAPM Return, hence it is under-priced, should be bought and I, II, and III be sold, which are over-priced.

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24. Illustration

A company has a choice of investments between several different equity oriented mutual funds. The company has an amount of ₹1 crore to invest. The details of the mutual funds are as follows:

Mutual Fund	Beta
A	1.6
B	1.0
C	0.9
D	2.0
E	0.6

Required:

(i) If the company invests 20% of its investment in each of the first two mutual funds and an equal amount in the mutual funds C, D and E, what is the beta of the portfolio?

(ii) If the company invests 15% of its investment in C, 15% in A, 10% in E and the balance in equal amount in the other two mutual funds, what is the beta of the portfolio?

(iii) If the expected return of market portfolio is 12% at a beta factor of 1.0, what will be the portfolios expected return in both the situations given above?

(iv) If the Company changes its policy to invest in any 3 securities with a minimum of 20% in each of these 3 securities to diversify risk, you are requested to advise the company to have a right mix of securities to maximize the return in the following two scenarios and calculate the expected return:

(1) Bull Phase: Expected Market returns 10%

(2) Bear Phase: Expected Market returns – 5%

Solution:

Mutual Fund	β	Situation 1		Situation 2	
		Weights	**Weights β**	**Weights**	**Weights β**
A	1.6	0.2	0.32	0.15	0.24
B	1.0	0.2	0.2	0.3	0.3
C	0.9	0.2	0.18	0.15	0.135
D	2.0	0.2	0.4	0.3	0.6
E	0.6	0.2	0.12	0.10	0.06
		1.0	**1.22**	**1.0**	**1.335**

(i) β of Portfolio 1 =1.22

(ii) β of Portfolio 2 =1.335
R_M = 12%

(iii) Expected Return of Portfolios:
Portfolio 1 = 12% *1.22 = 14.64%
Portfolio 2 = 1.335* 12% = 16.02%

(iv) **Bull Phase:** High Beta Stocks are chosen.
Stocks A,B and D with Betas 1.6, 1 and 2 respectively in 20%, 20% and 60%, so that maximum can be allocated to the stock with highest beta.

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	Investment	Investment	β	Market Return	Stock Return	Weight	Weighted Return
A	20%	20 lakhs	1.6	10%	16%	20%	3.2%
B	20%	20 lakhs	1	10%	10%	20%	2%
D	60%	60 lakhs	2	10%	20%	60%	12%
		1 Crore					**17.2%**

Weighted Average β = 2*60% + 1*20% + 1.6*20%
= **1.72**
Market Return = 10*1.72 = **17.2%**

Bear Phase: Low Beta Stocks are chosen.
Stocks B, C and E with Betas 1, 0.9 and 0.6 respectively in 20%, 20% and 60%, so that maximum can be allocated to the stock with lowest beta.

	Investment	Investment	β	Market Return	Stock Return	Weight	Weighted Return
B	20%	20 lakhs	1	-5%	-5%	20%	-1%
C	20%	20 lakhs	0.9	-5%	-4.5%	20%	-0.9%
E	60%	60 lakhs	0.6	-5%	-3%	60%	-1.8%
		1 Crore					**-3.7%**

In the Bear Phase, the portfolio will generate -3.7% against the market return of -5%.
Weighted Average β = 0.6*60% + 0.9*20% + 1*20%
= 0.36+ 0.18+ 0.2
= **0.74**
Market Return = 0.74* -5 = **- 3.7%**

25. Illustration

Mr. FedUp wants to invest an amount of ₹520 lakhs and had approached his Portfolio Manager. The Portfolio Manager had advised Mr. FedUp to invest in the following manner:

Security	Moderate	Better	Good	Very Good	Best
Amount (in ₹ Lakhs)	60	80	100	120	160
Beta	0.5	1.00	0.80	1.20	1.50

You are required to advise Mr. FedUp in regard to the following, using Capital Asset Pricing Methodology:

(i) Expected return on the portfolio, if the Government Securities are at 8% and the NIFTY is yielding 10%.

(ii) Advisability of replacing Security 'Better' with NIFTY.

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Solution:

(i)

Security	Investment in Lakhs	β	Weight*β
Moderate	60	0.5	30
Better	80	1.00	80
Good	100	0.8	80
Very Good	120	1.20	144
Best	160	1.50	240
	520		**574**

β = $\frac{574}{520}$ = 1.1038

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

= 8% + 1.1038 (10% -8%) = 8% + 1.1038* 2% = **10.207%**

(ii) It is better replaced with NIFTY. Both have a β of 1 so ideally either one is okay, but NIFTY has higher liquidity and lower impact cost. Hence it is advised to replace Better with NIFTY.

26. Illustration

Your client is holding the following securities:

Particulars of Securities	Cost	Dividends/Interest	Market price	Beta
	₹	₹	₹	
Equity Shares:				
Gold Ltd.	10,000	1,725	9,800	0.6
Silver Ltd.	15,000	1,000	16,200	0.8
Bronze Ltd.	14,000	700	20,000	0.6
GOI Bonds	36,000	3,600	34,500	0.01

Average return of the portfolio is 15.7%, calculate:

(i) Expected rate of return in each, using the Capital Asset Pricing Model (CAPM).
(ii) Risk free rate of return.

Solution:

(i) Market Return = 15.7%

Weighted Average Return of Portfolio = $\frac{\text{dividend+closing−opening}}{\text{opening value}}$

= $\frac{7025+\ 80500-\ 75000}{75000}$ = **16.7%**

(ii) Risk free rate of return

GOI Bond Coupon = 10%

GOI Bond Return = $\frac{34500-\ 36000\ +\ 3600}{36000}$ = 5.83%

Assuming R_f= 5.83% because that is the return on GOI Bonds.

R_m= 15.7%

CAPM Return,

Gold Ltd. = 5.83+ 0.6 (15.7- 5.83) = **11.75%**

Silver Ltd. = 5.83+ 0.8 (15.7- 5.83) = **13.726%**

Bronze Ltd. = 5.83+ 0.6 (15.7- 5.83) = **11.75%**

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27. Illustration

A holds the following portfolio:

Share/Bond	Beta	Initial Price	Dividends	Market Price at end of year
		₹	₹	₹
Epsilon Ltd.	0.8	25	2	50
Sigma Ltd.	0.7	35	2	60
Omega Ltd.	0.5	45	2	135
GOI Bonds	0.01	1,000	140	1,005

Calculate:

(i) The expected rate of return of each security using Capital Asset Pricing Method (CAPM)

(ii) The average return of his portfolio. Risk-free return is 14%.

Solution:

(i) Assumption:

Portfolio Return = Market Return

Security	Price (1)	MP (2)	CG (1)- (2)	Dividend	Total Return	$E(R) = R_f + \beta(R_m - R_f)$
Epsilon Ltd	25	50	25	2	27	14% + 0.8 (26.33%-14%) = **23.864%**
Sigma Ltd	35	60	25	2	27	14% + 0.7 (12.33%) = **22.631%**
Omega Ltd	45	135	90	2	92	14% + 0.5 (12.33%) = **20.165%**
GOI Bonds	1000	1005	5	140	145	14% + 0.01 (12.33%) = **14.1233%**
	1105	**1450**	**145**	**146**	**291**	

Portfolio Return = $\frac{291}{1105}$ = 26.33%

Average Return = $\frac{23.864+22.631+20.165+14.123}{4}$ = **20.19575%**

28. Illustration

An investor is holding 1,000 shares of Fatlass Company. Presently the rate of dividend being paid by the company is ₹ 2 per share and the share is being sold at ₹ 25 per share in the market. However, several factors are likely to change during the course of the year as indicated below:

	Existing	Revised
Risk free rate	12%	10%
Market risk premium	6%	4%
Beta value	1.4	1.25
Expected growth rate	5%	9%

In view of the above factors whether the investor should buy, hold or sell the shares? And why?

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Solution:

Current MP = 25
D_0 = 2
$E\ (R)$ = $\frac{k_e\ of\ existing}{k_e of\ revised}$
k_e of existing = $R_f + \beta(R_m - R_f)$ = 12+ 1.4* 6 = 20.4%
k_e of revised = $R_f + \beta\ (R_m - R_f)$ = 10+ 1.25* 4 = 15%

Intrinsic Value of Shares

Existing	Revised
D_0= 2	D_0= 2
g= 5%	g= 9%
D_1= 2.1	D_1 = 2* 1.09 =2.18
k_e = 20.4%	k_e = 15%
P_0= 2.1/ (20.4%-5%) = 2.1/ 0.154 = 13.636	P_0= 2.18/ (0.15- 0.09 = 2.18/ 0.06 = 36.33

Currently the shares are trading at Rs 25 compared to its intrinsic value Rs 13.636. They are overpriced. However, if the investor is confident of the revised estimates, then CMP of Rs 25 is cheap as compared to the expected price of Rs 36.33. So, investor may retain and buy in such a case. Here it is better to dispose of.

29. Illustration

An investor is holding 5,000 shares of X Ltd. Current year dividend rate is ₹ 3/ share. Market price of the share is ₹ 40 each. The investor is concerned about several factors which are likely to change during the next financial year as indicated below:

	Current Year	Next Year
Dividend paid /anticipated per share (₹)	3	2.5
Risk free rate	12%	10%
Market Risk Premium	5%	4%
Beta Value	1.3	1.4
Expected growth	9%	7%

In view of the above, advise whether the investor should buy, hold or sell the shares.

Solution:

k_e under existing/ revised scenario
Existing = $R_f + \beta\ (R_m - R_f)$ = 12% + 1.3 (5%) = 18.5%
Next Year = 10% +1.4(4) = 15.6%
P_0 based on Current Year Data
P_0 = $\frac{d_1}{ke-g}$ (D_1=2.5, since next year dividend is already given)
= $\frac{2.5}{15.6\%-7\%}$ = **₹ 29.069**
P_0 based on Revised Data

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P_0 $= \frac{d_1}{ke-g}$ (D_0= 3, g= 9%, D_1= 3* 1.09= 3.27)

$= \frac{3.27}{18.5\%-9\%}$ = **₹ 34.42**

Current Market Price= ₹40, Intrinsic Value under existing/ revised circumstance are ₹ 34.42 and ₹29.069 respectively and are lower than CMP. So, the investor is advised to sell the securities of X Ltd

30. Illustration

X Co., Ltd., invested on 1.4.2009 in certain equity shares as below:

Name of Co.	No. of shares	Cost (₹)
M Ltd.	1,000 (₹ 100 each)	2,00,000
N Ltd.	500 (₹ 10 each)	1,50,000

In September, 2009, 10% dividend was paid out by M Ltd. and in October, 2009, 30% dividend paid out by N Ltd. On 31.3.2010 market quotations showed a value of ₹ 220 and ₹ 290 per share for M Ltd. and N Ltd. respectively.

On 1.4.2010, investment advisors indicate (a) that the dividends from M Ltd. and N Ltd. for the year ending 31.3.2011 are likely to be 20% and 35%, respectively and (b) that the probabilities of market quotations on 31.3.2011 are as below:

Probability factor	Price/share of M Ltd.	Price/share of N Ltd.
0.2	220	290
0.5	250	310
0.3	280	330

You are required to:

(i) Calculate the average return from the portfolio for the year ended 31.3.2010;

(ii) Calculate the expected average return from the portfolio for the year 2010 -11; and

(iii) Advise X Co. Ltd., of the comparative risk in the two investments by calculating the standard deviation in each case.

Solution:

(i)

	M	N	Total
Shares	1000	500	1500
Face Value (FV)	100	10	
FV Investment	100000	5000	
Investment made	200000	150000	350000
Cost per share	200	300	
Dividend	10%	30%	
Dividend Received	10000	1500	11500
Market Price	220	290	
Market price- Cost	20	-10	
Capital Gain	20* 1000	500* -10	
	20000	**-5000**	**15000**

Return $= \frac{Capital Gain + Dividend}{Opening\ Investment} = \frac{15000 + 11500}{350000}$

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R_e = **7.57%**

(ii) $E(R)$ = $\sum_{i=1}^{n} R_i P_i$

	M	N
Opening Share Price	220	290
Expected Price	0.2*220	0.2*290
	0.5*250	0.5*310
	0.3*280	0.3*330
	253	**312**
Capital gain	33	22
Dividend Per Share	20	3.5
Return per Share	53	25.6
No. Of shares	1000	500
Total absolute Return	53000	12750
Investment Value 01/04/2010	220000	145000

Return = $\frac{Capital Gain + Dividend}{Opening\ Investment} = \frac{53000 + 12750}{365000}$

R_e = **18.014%**

(iii)

	Stock Return	Yield	Total Return
A	0	9.09%	9.09%
B	13.63	9.09%	22.72%
C	27.27	9.09%	36.36%

$\bar{x}$ = average return = 9.09* 0.2 + 22.72* 0.5 + 36.36* 0.3 = 24.086%

σ_M^2 = $\sum_{i=1}^{n}(x - \bar{x})P_i$

= (9.09%) -24.086%)X 0.2 + (22.72%-24.086%) X 0.5+(36.36%-24.086%) X 0.3

=91.10%

σ_M = 9.54%

Probability	Closing	Opening	Gain	Div	Total	Return %
0.2	290	290	0	3.5	3.5	1.20%
0.5	310	290	20	3.5	23.5	8.10%
0.3	330	290	40	3.5	43.5	15%

$E(R)$ = 1.2* 0.2 + 8.1* 0.5 + 15*0.3 = 8.79%

σ_N^2 = $\sum_{i=1}^{n}(x - \bar{x})P_i$

= (1.2%- 8.79%) *0.2 +(8.1%- 8.79%) *0.5 + (15%- 8.79%) *0.3

= 11.52+ 0.238+ 11.569 = **23.32%**

σ_p = **4.83%**

Hence, M Ltd is riskier.

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31. Illustration

An investor holds two stocks A and B. An analyst prepared ex-ante probability distribution for the possible economic scenarios and the conditional returns for two stocks and the market index as shown below:

Economic scenario	Probability	Conditional Returns %		
		A	**B**	**Market**
Growth	0.40	25	20	18
Stagnation	0.30	10	15	13
Recession	0.30	-5	-8	-3

The risk-free rate during the next year is expected to be around 11%. Determine whether the investor should liquidate his holdings in stocks A and B or on the contrary make fresh investments in them. CAPM assumptions are holding true.

Solution:

Probability Based Returns

P_i	A	B	Market	P_i* A	P_i*B	P_i*M
0.4	25	20	18	10	8	7.2
0.3	10	15	13	3	4.5	3.9
0.3	-5	-8	-3	-1.5	-2.4	-0.9
			$E(R)$	**11.5**	**10.1**	**10.2**

CAPM

β = $\frac{cov_{ms}}{var_m}$

cov_{MA} = $\sum_{i=1}^{n}(x-\bar{x})(y-\bar{y})P_i$

P_i	a	$a-\bar{a}$	b	$b-\bar{b}$	$(a-\bar{a})(b-\bar{b})P_i$
0.4	25	13.5	18	7.8	42.12
0.3	10	-1.5	13	2.8	-1.26
0.3	-5	-16.5	-3	-13.2	65.34
					106.2

$\bar{a}$ = 11.5

$\bar{b}$ = 10.2

cov_{MB} = $\sum_{i=1}^{n}(x-\bar{x})(y-\bar{y})P_i$

P_i	a	$a-\bar{a}$	b	$b-\bar{b}$	$(a-\bar{a})(b-\bar{b})P_i$
0.4	20	7.8	18	7.8	30.888
0.3	15	4.9	13	2.8	4.116
0.3	-8	-18.1	-3	-13.2	71.676
					106.68

$\bar{a}$ = 10.1

$\bar{b}$ = 10.2

var_M = $\sum_{i=1}^{n}(x-\bar{x})^2P_i$ = $(7.8)^2$ *4 + $(28)^2$ *3 + $(13.2)^2$ *0.3 = 78.96

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β of A = $\frac{cov_{MA}}{var_M}$ = $\frac{106.2}{78.96}$ = 1.345

β of B = $\frac{106.68}{78.96}$ =1.351

$E(R)$ of A = $R_f + \beta\,(R_m - R_f)$ = 11+ 1.345(10.2- 11) = **9.924%**

$E(R)$ of B =11+ 1.351(10.2- 11) = **9.919**

Since expected returns are higher than CAPM investor should buy these securities as they are under-priced.

32. Illustration

A Portfolio Manager (PM) has the following four stocks in his portfolio:

Security	No. of Shares	Market Price per share (₹)	B
VSL	10,000	50	0.9
CSL	5,000	20	1.0
SML	8,000	25	1.5
APL	2,000	200	1.2

Compute the following:

(i) Portfolio beta.

(ii) If the PM seeks to reduce the beta to 0.8, how much risk-free investment should he bring in?

(iii) If the PM seeks to increase the beta to 1.2, how much risk-free investment should he bring in?

Solution:

(i)

Security	Shares	CMP	Portfolio Value	Beta	Beta* Portfolio
VSL	10000	50	500000	0.9	450000
CSL	5000	20	100000	1	100000
SML	8000	25	200000	1.5	300000
APL	2000	2	400000	1.2	480000
			1200000		**13,30,000**

Portfolio Beta = Weighted Average of Beta Values = $\frac{1330000}{1200000}$ = **1.1083**

(ii) Let value of risk-free security be R

0.8 = $\frac{1200000*1.1083+(R*0)}{1200000+R}$ = $\frac{1330000}{1200000+R}$

0.8*(1200000+R) = 1330000

R = **462500**

The PM should invest ₹ 462500 in Risk Free securities with a Beta of 0 to ensure the portfolio Beta is 0.8.

(iii) Let value of risk-free security be R

1.2 = $\frac{1200000*1.1083+(R*0)}{1200000+R}$ = $\frac{1330000}{1200000+R}$

1.2*(1200000+R) = 1330000

R = **-91667**

Total Portf. Value = 1200000- 91667 = 1108333

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In order to increase beta of portfolio to 1.2 one should borrow ₹ 91667 worth of risk-free investment

33. Illustration

The total market value of the equity share of O.R.E. Company is ₹60,00,000 and the total value of the debt is ₹ 40,00,000. The treasurer estimate that the beta of the stock is currently
1.5 and that the expected risk premium on the market is 10 per cent. The treasury bill rate is 8 per cent.
Required:

(i) What is the beta of the Company's existing portfolio of assets?
(ii) Estimate the Company's Cost of capital and the discount rate for an expansion of the company's present business.

Solution:

(i) Beta of Assets = $\frac{Equity * \beta_E + Debt * \beta_D}{D+E}$ = $\frac{60 * 1.5 + 40 * 0}{60+40}$ = 0.9

(ii) WACC = $k_d * \frac{D}{D+E} + k_e * \frac{E}{D+E}$

Since cost of debt is not given, we are assuming treasury bill rate as cost of debt. However, there is a spread usually for a corporate borrower's borrowings as compared to treasury bill rate.
Cost of Equity as per CAPM,
= $R_f + \beta\ (MRP)$ = 8%+ 1.5 (10%) = 23%
Assuming that Beta of assets cannot be used to compute cost of equity.
WACC = $k_d * \frac{D}{D+E} + k_e * \frac{E}{D+E}$ = (23% * 60 + 8% *40)/ 100 = **17%**
WACC is 17% and this rate is used to evaluate expansion of company's present business.

34. Illustration

A stock costing Rs.150 pays no dividends. The possible prices that the Stock might sell for at the end of the year with the respective probabilities are given below.

Price	130	150	160	165	170	180
Probability	0.2	0.1	0.1	0.3	0.1	0.2

Compute the Expected Return and its standard Deviation and show computations up to three decimals.

Solution:

Price	P_i	**Abs.** R_i	**Return %**	$R_i P_i$	$x - \bar{x}$	$(x-\bar{x})^2$	$(x-\bar{x})^2 P_i$
130	0.2	-20	-13.33%	-2.67%	-20%	400	80
150	0.1	0	0%	0	-6.67%	44.45	4.445
160	0.1	10	6.67%	0.667%	0	0	0
165	0.3	15	10%	3%	3.33%	11.08	3.324
170	0.1	25	16.67%	1.67%	10%	100	10
180	0.2	30	20%	4%	13.33%	177.689	35.5378
	1			**6.667%**			**133.307**
$E(R)$		= **6.667%**		($=\bar{x}$)			

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σ_s^2 = $\sum_{i=1}^{n}(x-\bar{x})^2 P_i$ = **133.307**

σ_s =**11.547**

35. Illustration

The return of security 'L' and security 'M' for the past five years are given below:

Year	Security – L Return %	Security – K Return %
2012	10	11
2013	04	-06
2014	05	13
2015	11	08
2016	15	14

Calculate the risk and return of portfolio consisting above information

Solution:

L(x)	K(y)	$x-\bar{x}$	$y-\bar{y}$	$(x-\bar{x})^2$	$(y-\bar{y})^2$	$(x-\bar{x})(y-\bar{y})$
10	11	1	3	1	9	3
4	-6	-5	-14	25	196	70
5	13	-4	5	16	25	-20
11	8	2	0	4	0	0
15	14	6	6	36	36	36
45	40	0	0	82	266	89

$E(R)$ of L = 9%

$E(R)$ of K =8%

Variance = $\frac{\sum(x-\bar{x})^2}{n}$

S. D = $\sqrt{variance}$

S. D of L = $\sqrt{82/5}$ = 4.05

S. D of K = $\sqrt{266/5}$ = 7.29

Return of Portfolio assuming weights to be in 50:50

$E(R)$ = 9%* 0.5 + 8%* 0.5 = 8.5%

cov_{xy} = $\frac{\sum(x-\bar{x})(y-\bar{y})}{n}$ = $\frac{89}{5}$ = 17.8

σ_p^2 = $\sigma_x^2 * w_x^2 + \sigma_y^2 * w_y^2 + 2 * \sigma_x \sigma_y w_x w_y r$

= 16.4* $(0.5)^2$ + 53.2* $(0.5)^2$ + 2*17.8* 0.5*0.5 = **26.3**

σ_p = **5.13**

36. Illustration

If the rate of return and Standard Deviation of Market Portfolio (Index) is 8% and 6% respectively and the risk-free rate of return is 5%, you are required to:

(i) Construct an efficient portfolio which produces expected return of 7.5%.

(ii) Calculate the risk of above portfolio.

(iii) Suppose if Mr. X has Rs.1,00,000 of his personal funds, then how he would construct his portfolio giving expected return of 10% and what will be risk of this portfolio.

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Solution:

(i) Expected Return of Portfolio = 7.5 %

Let Share of Risk-Free security be x

Then total will be 1 and Market will be 1- x

$E(R)$ = $W_1R_1 + W_2R_2$

7.5 = x* 5% + (1- x) * 8% = 5x+ 8 – 8x

3x = 0.5

x = $\frac{1}{6}$

= 16.67%

1- x = 83.33%

(ii)

σ_p^2 = $\sigma_x^2 * w_x^2 + \sigma_y^2 * w_y^2 + 2 * \sigma_x\sigma_y w_x w_y r$ (σ_1= SD of market, σ_2=Σ of risk-free)

= $(83.33)^2$* $(6)^2$

σ_p = 83.33* 6 = **5%**

(iii) New portfolio where return = 10%

$E(R)$ = 10% = $W_mR_m + W_{Rf}R_{Rf}$

Assuming W_{Rf}= y, then W_m= 1-y

10% = $R_m(1-y) + R_{Rf}(y)$

10% = $8\%(1-y) + 5\%(y)$

10% = 8%- 8y+ 5y

2% = -3%y

y = -66.67%

For ₹ 100000 of Portfolio -66.67% is invested in risk-free assets and 166.67% is invested in Market.

Borrowing -66.67% in risk-free from market and invest it in market.

Borrow ₹ 66667 and invest in market index a total of ₹ 166667.

Net Value of Portfolio= 100000

σ_p = 6% * 1.6667 = **10%**

37. Illustration

Mr. Gupta is considering investment in the shares of R. Ltd. He has the following expectations of return on the stock and the market:

Probability	Return (%)	
	R. Ltd.	Market
0.35	30	25
0.30	25	20
0.15	40	30
0.20	20	10

You are required to:

(i) Calculate the expected return, variance and standard deviation for R. Ltd.

(ii) Calculate the expected return variance and standard deviation for the market.

(iii) Find out the beta co-efficient for R. Ltd. shares.

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Solution:

$E(R)$ = $\sum_{i=1}^{n} P_i x_i$

σ_i^2 = $\sum_{i=1}^{n} (x - \bar{x})^2 P_i$

β = $\frac{cov_{x,y}}{\sigma_y^2}$

cov = $\sum_{i=1}^{n} (x - \bar{x})(y - \bar{y}) P_i$

Probability	R	$\bar{R}$	$(R - \bar{R})$	$(R - \bar{R})^2$	$(R - \bar{R})^2 P_i$
0.35	30	10.5	2	4	1.4
0.3	25	7.5	-3	9	2.7
0.15	40	6	12	144	21.6
0.2	20	4	-8	64	12.8
		28		**221**	**38.5**

Probability	M	$\bar{M}$	$(M - \bar{M})$	$(M - \bar{M})^2$	$(M - \bar{M})^2 P_i$
0.35	25	8.75	3.75	14.063	4.92188
0.3	20	6	-1.25	1.5625	0.46875
0.15	30	4.5	8.75	76.563	11.4844
0.2	10	2	-11.25	126.56	25.3125
		21.25		**218.75**	**42.1875**

Probability	$(R - \bar{R})$	$(M - \bar{M})$	$(R - \bar{R})\,(M - \bar{M})\,P_i$
0.35	2	3.75	2.625
0.3	-3	-1.25	1.125
0.15	12	8.75	15.75
0.2	-8	-11.25	18
			37.5

(i) $E(R)$ of Stock R = **28%**

σ_i^2 = $\sum_{i=1}^{n} (x - \bar{x})^2 P_i$

For R, = 38.5%

σ_R = $\sqrt{38.5}$ = **6.205%**

(ii) $E(R)$ of Market = **21.25%**

σ_i^2 = $\sum_{i=1}^{n} (x - \bar{x})^2 P_i$

For M = 42.1875%

σ_R = $\sqrt{42.1875}$ = **6.495%**

(iii) β = $\frac{cov_{x,y}}{\sigma_y^2}$

For R and M = $\frac{\sum (R-\bar{R})\,(M-\bar{M})\,P_i}{\sum (M-\bar{M})^2 P_i}$ = $\frac{37.5}{42.1875}$ = **0.889**

38. Illustration

XYZ Ltd. paid a dividend of ₹ 2 for the current year. The dividend is expected to grow at 40% for the next 5 years and at 15% per annum thereafter. The return on 182 days T-bills is 11% per annum and the market return is expected to be around 18% with a variance of 24%.

The co-variance of XYZ's return with that of the market is 30%. You are required to calculate the required rate of return and intrinsic value of the stock.

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Solution:

R_m = 18%

R_f = 11%

D_0 = 2

σ_m^2 = 24

$\sigma_{xyz,m}$ = 30%

β = $\frac{\sigma_{xyz,m}}{var_M}$ = $\frac{30}{24}$ = 1.25

$E(R)$ = $R_f + \beta\,(R_m - R_f)$

k_e = 11%+ 1.25(18%-11%) = 11% + 1.25(7%) = **19.75%**

Intrinsic Value Calculation,

D_0=	2	Dividend	PVIF @19.75%	PV of Dividends
D_1=	2*1.4	2.8	0.8350	2.338
D_2=	2*1.4^2	3.92	0.6973	2.733
D_3=	2*1.4^3	5.488	0.5823	3.196
D_4=	2*1.4^4	7.6832	0.4863	3.736
D_5=	2*1.4^5	10.75648	0.4061	4.368
			PV of Dividend	**16.3716**

Intrinsic Value of Stock in 2 Stage Dividend Discount Model

= PV of Dividend for Years 1-5 + $\frac{P_5}{(1+k_e)^5}$

P_5 = $\frac{d_6}{k_e - g}$ = $\frac{d_5(1+g_2)}{k_e - g_2}$ = $\frac{10.75648(1+15\%)}{19.75\% - 15\%}$ = 260.42

PV of P_5 = 260.42* 0.4061 = **105.757**

Intrinsic Value = 16.3716+ 105.757 = **₹ 122.128**

39. Illustration

M/s X Ltd. has paid a dividend of ₹ 2.5 per share on a face value of ₹10 in the financial year ending on 31st March, 2009. The details are as follows:

Current market price of share	₹ 60	
Growth rate of earnings and dividends	10%	
Beta of share	0.75	
Average market returns		15%
Risk free rate of return		9%

Calculate the intrinsic value of the share.

Solution:

R_m = 15%

R_f = 9%

β = 0.75

$E(R)$ = $R_f + \beta\,(R_m - R_f)$

k_e = 9%+ 0.75(15%-9%) = 9% + 0.75(6%) = 13.5%

Intrinsic Value,

P_0 = $\frac{d_1}{k_e - g}$ (D_0 = 2.5, g= 10%, D_1= 2.75)

= $\frac{2.75}{13.5\% - 10\%}$ = **₹ 78.571**

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40. Illustration

A Company pays a dividend of ₹ 2.00 per share with a growth rate of 7%. The risk-free rate is 9% and the market rate of return is 13%.
The Company has a beta factor of 1.50. However, due to a decision of the Finance Manager, beta is likely to increase to 1.75. Find out the present as well as the likely value of the share after the decision.

Solution:

Scenario 1:

β = 1.5

k_e = R_f + $\beta(R_m - R_f)$

= 9% +1.5(13-9) = 9% + 1.5* 4% = 9% + 6% = 15%

P_0 = $\frac{d_1}{ke-g}$ = $\frac{2(1+7\%)}{15\%-7\%}$ = **26.75**

Scenario 2:

β = 1.75

k_e = R_f + $\beta(R_m - R_f)$

= 9% +1.75(13-9) = 9% + 1.75* 4% = 9% + 7% = 16%

P_0 = $\frac{d_1}{ke-g}$ = $\frac{2(1+7\%)}{16\%-7\%}$ = **23.788**

41. Illustration

Two companies A Ltd. and B Ltd. paid a dividend of ₹3.50 per share. Both are anticipating that dividend shall grow @ 8%. The beta of A Ltd. and B Ltd. are 0.95 and 1.42 respectively.
The yield on GOI Bond is 7% and it is expected that stock market index shall increase at an annual rate of 13%. You are required to determine:

(i) Value of share of both companies.
(ii) Why there is a difference in the value of shares of two companies?
(iii) If current market price of share of A Ltd. and B Ltd. Are ₹74 and ₹55 respectively. As an investor what course of action should be followed?

Solution:

R_f = 7%

R_m =13%

MRP = 6%

	A	B
D_0	3.5	3.5
g	8%	8%
D_1	3.78	3.78
β	0.95	1.42

k_e of A = R_f + β (MRP) = 7% + 0.95(6%) =7% + 5.7% = 12.7%

k_e of B = R_f + β (MRP) = 7% + 1.42(6%) = 7% + 8.52% = 15.52%

(i) P_A = $\frac{d_1}{ke-g}$ = $\frac{3.78}{12.7\%-8\%}$ = ₹ 80.42

P_B = $\frac{d_1}{ke-g}$ = $\frac{3.78}{15.52\%-8\%}$ = ₹ 50.266

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(ii) Company B has a higher beta which means its returns vary lot more or are more sensitive to market returns. So, the volatility of returns with respect to market is high which leads to higher cost of equity i.e. a higher discount rate, which implies a lower price.

(iii)

Company	CMP	Intrinsic Value	Action
A Ltd.	74	80.42	Buy the stock as it is trading below intrinsic value.
B Ltd.	55	50.266	Sell the stock as it is trading above intrinsic value.

42. Illustration

Seawell Corporation, a manufacturer of do-it-yourself hardware and housewares, reported earnings per share of € 2.10 in 2003, on which it paid dividends per share of €0.69.
Earnings are expected to grow 15% a year from 2004 to 2008, during this period the dividend pay-out ratio is expected to remain unchanged. After 2008, the earnings growth rate is expected to drop to a stable rate of 6%, and the pay-out ratio is expected to increase to 65% of earnings.
The firm has a beta of 1.40 currently, and is expected to have a beta of 1.10 after 2008. The market risk premium is 5.5%. The Treasury bond rate is 6.25%.

(i) What is the expected price of the stock at the end of 2008?
(ii) What is the value of the stock, using the two-stage dividend discount model?

Solution:

	Year	EPS	DPS	g	Pay-out Ratio
2003	0	2.1	0.69	15%	0.3285
2004	1	2.415	0.7935	15%	0.3285
2005	2	2.77725	0.91253	15%	0.3285
2006	3	3.19384	1.0494	15%	0.3285
2007	4	3.67291	1.20681	15%	0.3285
2008	5	4.22385	1.38784	15%	0.3285
2009	6	4.47728	2.91	6%	0.65

(i) β Current = 1.4
MRP = 5.5%
β 2000 = 1.1
R_f = 6.25%
k_e in 2009 = R_f + β (MRP) = 6.25% + 1.1(5.5%) = 6.25% + 6.05% = 12.5%
P_0 at the end of,
2008 = $\frac{d_{2009}}{ke-g}$ = $\frac{2.91}{12.3-6}$ = **46.19**
₹ 46.19 is price at the end of 2008

(ii) Value of stock at the end of 2003
= PV of Dividend from 2004-08+ PV of price at the end of 2008
k_e applicable for this PV computation is based on Beta for period 2003-08
k_e = R_f + β (MRP) = 6.25% + 1.4 (5.5%) = 13.95%

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PV of Dividend from 2004-08

Year	Dividend	PVIF	Dividend* PVIF
2004	0.7935	0.8775	0.6929
2005	0.91253	0.7701	0.7027
2006	1.0494	0.6759	0.7093
2007	1.20681	0.5931	0.7157
2008	1.38784	0.5205	0.7223
			3.5463

P_0 today = 3.5463+ 4619*(0.5206) = **27.589**

43. Illustration

SRK Ltd. is a listed company and it has just announced annual dividend for the year ending 2013-14. Earnings Per Share (EPS) and Dividend Per Share (DPS) for 5 years is as follows:

	2013-14	2012-13	2011-12	2010-11	2009-10
EPS (Rs.)	14.00	13.60	13.10	12.70	12.20
DPS (Rs.)	8.20	8.10	7.90	7.80	7.70

In the opinion of MD of SRK Ltd., if current dividend policy is maintained annual growth in Earning and Dividends will be no better than the annual growth in earnings over the past years.
Since the Board of SRK Ltd. is reluctant to take debt to finance growth it is considering changing its dividend policy by retaining 50% of its earnings for investment in various projects having a post-tax rate of return of 15%. The beta of SRK Ltd. is 1.5, market risk premium is 4% and Risk-Free Rate of Return is 6%.
You are required to calculate expected market price of share, if

(1) SRK Ltd. does not announce a change in its Dividend Policy.
(2) SRK Ltd. does announce a change in its Dividend Policy by retaining 50% of its earnings.
Note: Growth Rate can be assumed to be remain stable.

Solution:

(1) β = 1.5
MRP = 4%
R_f = 6%
k_e = $R_f + \beta\ (R_m - R_f)$ = 6% + 1.5* 4% = 12%

Year	EPS	DPS	Payout	EPS (g)
09-10	12.2	7.7	63.11%	
10-11	12.7	7.8	61.42%	4.1%
11-12	13.1	7.9	60.3%	3.15%
12-13	13.6	8.1	59.56%	3.82%
13-14	14	**8.2**	**58.57%**	2.9%

Payout ratio is close to 60%
EPS Growth (13-14) =$(\frac{14}{12.2})^{1/4}$-1 = 1.035-1 = 3.5%
Dividend Growth = $\frac{8.2}{7.7}^{1/4}$ -1 = 1.585%
P_0 = $\frac{D_1}{ke-g}$ | D1 = 14 x 1.035 x 60%= 8.694

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P_0 in current payout of 60% is $\frac{8.694}{12\%-3.5\%}$ = ₹ **102.28**

(2) SRK Dividend policy changes, retention(b) and payout ratio are 50% each

g = $b * r$ (r= rate of return)

g = 50%* 15% = 7.5%

EPS = EPS_0 * growth rate = ₹ 14

EPS_1 = 14* (1+ 7.5%) = 15.05%

D_1 = EPS_1 * Payout Ratio = 15.05 * 50% = 7.525

P_0 = $\frac{D_1}{ke-g}$ = $\frac{7.525}{12\%-7.5\%}$ = **167.22**

Alternative 2 is better as it will lead to a much higher dividend growth rate in the long term

44. Illustration

Mr. A has short term investments in shares of the various companies. The details of these investments are as follows:

Name of Company	No. of shares	Geared Beta	Current Market Price (₹)	Current Dividend Yield (%)	Expected Return (%)
T Ltd. (Face Value ₹ 50)	1000	1.55	280	6.8	21.00
U Ltd. (Face Value ₹ 100)	1550	0.65	340	3.6	12.50
V Ltd. (Face Value ₹ 20)	2600	1.26	150	6.4	18.00
W Ltd. (Face Value ₹10)	4300	1.14	95	7.2	18.50

Risk Free Rate of Return and market return are 6% and 16% respectively. You are required to:

(a) Estimate the risk of Mr. A's portfolio relative to market.

(b) Whether the composition of portfolio should be changed if yes then how.

Solution:

a)

	Beta	Shares	CMP	MV	Beta* MV
T	1.55	1000	280	280000	434000
U	0.65	1550	340	527000	342550
V	1.26	2000	150	390000	491400
W	1.14	4300	95	408500	465690
				1605500	**1733640**

β_p = $\frac{1733640}{1605500}$ = 1.0798

b) Assuming Expected Return also includes dividend yield

	$E(R)$	CAPM Return		Comments
T	21	6% + 1.55(10%) =	21.50%	overvalued
U	12.5	6% + 0.65(10%) =	12.50%	rightly valued
V	18	6% + 1.26(10%) =	18.60%	overvalued
W	18.5	6% + 1.14(10%) =	17.40%	undervalued

Mr. A should sell overvalued stocks of T and V, should hold rightly valued stock of U and buy undervalued stock of W.

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45. Illustration

Following data is related to Company X, Market Index and Treasury Bonds for the current year and last 4 years:

Year	Company X		Market Index		Return on Treasury Bonds
	Average Share Price (P)	Dividend Per Share (D)	Average Market Index	Market Dividend Yield	
2009	₹ 139	₹ 7.00	1300	3%	7%
2010	₹ 147	₹ 8.50	1495	5%	9%
2011	₹ 163	₹ 9.00	1520	5.5%	8%
2012	₹ 179	₹ 9.50	1640	4.75%	8%
2013	₹ 203.51	₹ 10.00	1768	5.5%	8%

With the above data estimate the beta of Company X's share.

Solution:

$E\ (R)$ of stock $= \frac{\text{dividend}}{\text{opening value}} + \frac{\text{capital gain}}{\text{opening value}}$

	Op Stk Price	Closing Stk Price	Increase	Stk Return = (Cl - OP)/ OP	Dividend	Div / OP	Total Return (Stk + Div Yld)
2009-10	139	147	8	5.76%	8.50	6.12%	11.87%
2010-11	147	163	16	10.88%	9.00	6.12%	17.01%
2011-12	163	179	16	9.82%	9.50	5.83%	15.64%
2012-13	179	203.5	24.5	13.69%	10.00	5.59%	19.27%

	Opening Index Value	Closing Index Value	Increase	Index Return = (Cl - OP)/ OP	Div Yield	Total Return Index + Div
2009-10	1300	1495	195	15.00%	5.00%	20.00%
2010-11	1495	1520	25	1.67%	5.50%	7.17%
2011-12	1520	1640	120	7.89%	4.75%	12.64%
2012-13	1640	1768	128	7.80%	5.50%	13.30%

Average Return on Treasury Bond, $= \frac{7\% + 9\% + 8\% + 8\% + 8\%}{5}$

R_f = 8%

Beta = $\sum XY - n\,\bar{x}\bar{y} \;/\; \sum y^2 - n\,\bar{y}^2$

	X - Stock Return	Y - Market Return	XY	Y^2
2009-10	11.87	20.00	237.41	400.00
2010-11	17.01	7.17	121.98	51.41
2011-12	15.64	12.64	197.82	159.77
2012-13	19.27	13.30	256.42	176.89
Total	**63.80**	**53.12**	**813.53**	**788.07**
Average	15.95	13.28		

Beta = $(813.53 - 4 \times 15.95 \times 13.28) / (788.07 - 4 \times (13.28)^2)$ = -0.408

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46. Illustration

Ms. Preeti, a school teacher, after retirement has built up a portfolio of Rs. 1,20,000 which is as follow:

Stock	Shares	CMP (₹)	Beta
ABC Ltd.	1000	50	0.9
DEF Ltd.	500	20	1.0
GHI Ltd.	800	25	1.5
JKL Ltd.	200	200	1.2

Her portfolio consultant Sri Vijay has advised her to bring down the, beta to 0.8. You are required to compute:

(i) Present portfolio beta

(ii) How much risk-free investment should be bought in, to reduce the beta to 0.8?

Solution:

	Shares	CMP	Market Value	Beta	Beta* MV
ABC	1000	50	50000	0.9	45000
DEF	500	20	10000	1	10000
GHI	800	25	20000	1.5	30000
JKL	200	200	40000	1.2	48000
			120000		133000

(i) β_p = $\frac{133000}{120000}$ = **1.1083**

(ii) Let risk free investment be x, then value of portfolio is 1-x and total portfolio value becomes $(x + 1 - x)$ = 1

Risk free investments have NIL beta.

β_{RP} = 1.1083 (1-x) + 0*x

0.8 = 1.1083- 1.1083x

x = $\frac{0.3083}{1.1083}$

Weight of R_f Asset = 27.817%

R_f: Eq = 27.82: 72.18

Existing Equity = 120000

Total Portfolio = $\frac{120000}{72.18\%}$ = 166251

R_f = 166251- 120000 = **46251**

As new investment needs to be brought in and after that is brought in the ratio should be 27.82: 72.18. So, the overall portfolio value increases to ₹ 166251 and the value of risk free investment is ₹ 46251.

47. Illustration

Assuming that two securities X and Y are correctly priced on SML and expected return from these securities are 9.40% (R_x) and 13.40% (R_y) respectively. The Beta of these securities are 0.80 and 1.30 respectively.

Mr. A, an investment manager states that the return on market index is 9%. You are required to determine,

(a) Whether the claim of Mr. A is right. If not, then what is correct return on market index.

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(b) Risk Free Rate of Return

Solution:

$E(R)$ = $R_f + \beta\ (MRP)$

9.4 = $R_f + 0.8\ (MRP)$ (1)

13.4 = $R_f + 1.3\ (MRP)$ (2)

Subtracting (2) - (1)

4 = $0.5(MRP)$

MRP = $\frac{4}{0.5}$ = **8%**

Substituting (MRP) in equation (1)

9.4 = $R_f + 0.8\ (8)$

R_f = 9.4- 6.4 = **3%**

MRP = $R_m - R_f$

8 = $R_m - 3$

R_m = **11%**

a) Claim of Mr A is incorrect as R_m is 11 % and not 9%

b) R_f = 3%

48. Illustration

The returns of a portfolio A and market portfolio for the last 12 months are indicated as follows:

Month	Portfolio A	Market Portfolio
January	- 0.52	0.82
February	2.20	0.04
March	2.17	2.80
April	4.17	1.72
May	2.04	0.27
June	3.00	0.39
July	1.99	1.95
August	4.0	0.64
September	- 1.38	1.53
October'	2.67	2.70
November	3.99	2.52
December	1.86	2.09
Standard Deviation (σ)	**1.6223**	**0.9498**

(i) You are required to find out the monthly returns attributable to 'the sheer skill of the Portfolio Manager.

(ii) What part of the monthly return is attributable to the higher risk assumed by the Portfolio Manager?

Assume that the risk-free rate of return is 12% per annum and the portfolio is fully diversified.

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Solution:

x	y	$x-\bar{x}$	$y-\bar{y}$	$(x-\bar{x})\ (y-\bar{y})$
-0.52	0.82	-2.7025	-0.6358	1.71825
2.20	0.04	0.0175	-1.4158	-0.0248
2.17	2.8	-0.0125	1.3442	-0.0168
4.17	1.72	1.9875	0.2642	0.5251
2.04	0.27	-0.1425	-1.1858	0.16898
3.00	0.39	0.8175	-1.0658	-0.8713
1.99	1.95	-0.1925	0.4942	-0.0951
4.00	0.64	1.8175	-0.8158	-1.4827
-1.38	1.53	-3.5625	0.0742	-0.2643
2.67	2.7	0.4875	1.2442	0.60655
3.99	2.52	1.8075	1.0642	1.92354
1.86	2.09	-0.3225	0.6342	-0.2045
26.19	**17.47**			**1.98283**

$\bar{x}$ = 2.1825%

$\bar{y}$ = 1.4558%

$\beta = \frac{cov}{var_M} = \frac{(1.98283/12)}{0.9498^2}$ = **0.1832**

$E(R) = R_f + \beta\ (R_m - R_f)$

= 1% +0.183 (1.4558- 1%) = **1.083%**

Actual Return = 2.1825%

(i) Return due to Skill of PM,

= 2.1825- 1.083 = **1.0995% per month**

(ii) Return attributable to higher risk,

= Expected Return – Market Return

= 1.083- 1.4558 = **-0.3728%**

The investor has taken stock specific risk; hence this number is negative.

49. Illustration

ABC Ltd. manufactures Car Air Conditioners (ACs), Window ACs and Split ACs constituting 60%, 25% and 15% of total market value.

The stand-alone Standard Deviation and Coefficient of Correlation with market return of Car AC and Window AC is as follows:

	S.D.	Correlation
Car AC	0.30	0.6
Window AC	0.35	0.7

No data for stand-alone SD and Coefficient of Correlation of Split AC is not available. However, a company who derives its half value from Split AC and half from Window AC has a SD of 0.50 and Coefficient of correlation with market return is 0.85. Index has a return of 10% and has SD of 0.20. Further, the risk-free rate of return is 4%.

You are required to determine:

(i) Beta of ABC Ltd.

(ii) Cost of Equity of ABC Ltd. Assuming that ABC Ltd. wants to raise debt of an amount equal to half of its Market Value then determine equity beta, if yield of debt is 5%.

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Solution:

(i) R_f = 4%

R_m = 10%

σ_m = 0.2

β = $\frac{\rho * \sigma_s}{\sigma_m}$

A/C	S. D	Correlation	$\frac{\rho * \sigma_s}{\sigma_m}$	β
Car	0.3	0.6	0.6* 0.3/0.2	0.9
Window	0.35	0.7	0.7* 0.35/0.2	1.225
Split+ Window	0.5	0.85	0.85* 0.5/0.2	2.125

$\beta_{p\,(S+W)}$ = $\beta_s\,\beta_s + \beta_p\,\beta_p$

2.125 = $\beta_s * 0.5 + 1.225 * 0.5$

2.125 = $\beta_s * 0.5 + 0.6125$

$\beta_s * 0.5$ = 1.5125

β_s = $\frac{1.5125}{0.5}$ = **3.025**

A/C	β	w_i	$w_i\beta_i$
Car	0.9	60%	0.54
Window	1.225	25%	0.30625
Split	3.025	15%	0.45375
			1.3

Weighted Average, β_p = $\sum_{i=1}^{n} w_i\beta_i$ = **1.3**

$E(R)$ of ABC Ltd. = $R_f + \beta(R_m - R_f)$ = 4% +1.3 (10%-4%) = 4% + 1.3 (6%)

$E(R)$ of ABC Ltd. = **11.8%**

50. Illustration

With the help of following data determine the return on the security X.

Factor	Risk Premium associated with the Factor	β_i
Market	4%	1.3
Growth Rate of GDP	1%	0.3
Inflation	-4%	0.2

Risk Free Rate of Return is 8%.

Solution:

$E(R)$ = $R_f + \lambda_1\beta_1 + \lambda_2\beta_2 + \ldots\ldots\ldots \Lambda_n\beta_n$

= 8% + 4% (1.3) + 1% (0.3) -4% (0.2)

= 8% + 5.2% + 0.3% - 0.8%

$\boldsymbol{E(R)}$ = **12.7%**

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51. Illustration

Mr. X owns a portfolio with the following characteristics:

	Security A	Security B	Risk Free security
Factor 1 sensitivity	0.80	1.50	**0**
Factor 2 sensitivity	0.60	1.20	**0**
Expected Return	15%	20%	**10%**

It is assumed that security returns are generated by a two-factor model.

(i) If Mr. X has Rs. 1,00,000 to invest and sells short Rs. 50,000 of security B and purchases Rs. 1,50,000 of security A, what is the sensitivity of Mr. X's portfolio to the two factors?

(ii) If Mr. X borrows Rs. 1,00,000 at the risk-free rate and invests the amount he borrows along with the original amount of Rs. 1,00,000 in security A and B in the same proportion as described in part (i), what is the sensitivity of the portfolio to the two factors?

(iii) What is the expected return premium of factor 2?

Solution:

(i) Investment in A = 1,50,000
Investment in B = - 50,000
Total = 1,00,000
Portfolio Sensitivity to factor 1,
= 1.5 * 0.8 – 0.5 * 1.5 = 1.2 – 0.75 = **0.45**
Portfolio Sensitivity to factor 2,
= 1.5 * 0.6 – 0.5 * 1.2 = 0.9 – 0.60 = **0.30**
Portfolio Sensitivity to factor 1 is **0.45** and Portfolio Sensitivity to factor 2 is **0.30**.

(ii) Total = 1,00,000 + 1,00,000
Ratio = 3: -1
Portfolio Sensitivity to factor 1,
= 3* 0.8 – 1* 1.5 = 2.4– 1.5 = **0.9**
Portfolio Sensitivity to factor 2,
= 3* 0.6 – 1* 1.2 = 1.8 – 1.2 = **0.6**

(iii) $E(R)$ = $R_f + \lambda_1\beta_1 + \lambda_2\beta_2 + \ldots\ldots\ldots \lambda_n\beta_n$
A, 15% = 10% + λ_1 * 0.8 + λ_2 *0.6
B, 15% = 10% + λ_1 * 0.8 + λ_2 *0.6
Multiplying A* B
λ_1 = 0
λ_2 = **8.33**

52. Illustration

Mr. Nirmal Kumar has categorized all the available stock in the market into the following types:

(a) Small cap growth stocks
(b) Small cap value stocks
(c) Large cap growth stocks
(d) Large cap value stocks

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Mr. Nirmal Kumar also estimated the weights of the above categories of stocks in the market index. Further, the sensitivity of returns on these categories of stocks to the three important factors are estimated to be:

Category of Stocks	Weight in the Market Index	Factor I (Beta)	Factor II (Book Price)	Factor III (Inflation)
Small cap growth	25%	0.80	1.39	**1.35**
Small cap value	10%	0.90	0.75	**1.25**
Large cap growth	50%	1.165	2.75	**8.65**
Large cap value	15%	0.85	2.05	**6.75**
Risk Premium		**6.85%**	**-3.5%**	**0.65%**

The rate of return on treasury bonds is 4.5% Required:

(i) Using Arbitrage Pricing Theory, determine the expected return on the market index.

(ii) Using Capital Asset Pricing Model (CAPM), determine the expected return on the market index.

(iii) Mr. Nirmal Kumar wants to construct a portfolio constituting only the 'small cap value' and 'large cap growth' stocks. If the target beta for the desired portfolio is 1, determine the composition of his portfolio.

Solution:

(i) $E(R)$ using APT

Small Cap Growth

$E(R)$ = $R_f + \lambda_1\beta_1 + \lambda_2\beta_2 + \ldots\ldots\ldots\ldots \lambda_n\beta_n$

= 4.5% + (6.85* 0.8) + (-3.5%* 1.39) + (0.65* 1.35)

= 5.9925 %

Small Cap Value

$E(R)$ = $R_f + \lambda_1\beta_1 + \lambda_2\beta_2 + \ldots\ldots\ldots\ldots \lambda_n\beta_n$

= 4.5% + (6.85* 0.9) + (-3.5%* 0.75) + (0.65 * 1.25)

= 8.8525 %

Large Cap Growth

$E(R)$ = $R_f + \lambda_1\beta_1 + \lambda_2\beta_2 + \ldots\ldots\ldots\ldots \lambda_n\beta_n$

= 4.5% + (6.85* 1.165) + (-3.5%* 2.75) + (0.65 * 8.65)

= 8.47775 %

Large Cap Value

$E(R)$ = $R_f + \lambda_1\beta_1 + \lambda_2\beta_2 + \ldots\ldots\ldots\ldots \lambda_n\beta_n$

= 4.5% + (6.85* 0.85) + (-3.5% * 2.05) + (0.65 * 6.75)

= 7.535%

$E(R)$ of Market = Weighted Average of Returns

	Return	Weights	
Small Cap G	5.9925	0.25	1.498125
Small Cap V	8.8525	0.1	0.885250
Large Cap G	8.4775	0.5	4.238750
Large Cap v	7.535	0.15	1.130250
		$E(R)$ of Market	**7.752375**

(ii) CAPM based Return

	$R_f + \beta(MRP)$	Return	Weights	Return* Weight
Small Cap G	4.5+ 0.8*6.85	9.98	0.25	2.495
Small Cap V	4.5+ 0.9*6.85	10.665	0.1	1.0665

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Large Cap G	4.5+ 1.165*6.85	12.48025	0.5	6.240125
Large Cap v	4.5+ 0.85*6.85	10.3225	0.15	1.548375
				11.35%

(iii) Let weight of Small Cap Value be w_1, then of Large Cap growth w_2= 1-w_1

1 = 0.9* w_1 + 1.165* (1-w_1)
= 0.9 w_1 + 1.165- 1.165w_1
1.165 -1 = 1.165w_1 - 0.9 w_1
0.165 = 0.265w_1
w_1 = $\frac{0.165}{0.265}$ = **0.6226**
w_2 = 1- 0.6226 = **0.3774**

53. Illustration

The risk-free rate of return Rf is 9 %. The expected rate of return on the market portfolio Rm is 13 %. The expected rate of growth for the dividend of Platinum Ltd. is 7 %. The last dividend paid on the equity stock of firm A was ₹ 2.00. The beta of Platinum Ltd. equity stock is 1.2.

(i) What is the equilibrium price of the equity stock of Platinum Ltd.?

(ii) How would the equilibrium price change when

- The inflation premium increases by 2 %?
- The expected growth rate increases by 3 %?
- The beta of Platinum Ltd. equity rises to 1.3?

Solution:

(i) R_f = 9%
R_m = 13%
D_0 = 2
D_1 = 2.14
g = 7%
β = 1.2
k_e = $R_f + \beta (R_m - R_f)$ = 9% +1.2* 4% = 13.8%
P_0 for Platinum = $\frac{d_1}{ke-g}$ = $\frac{2.14}{(13.8\%-7\%)}$ = 2.14/6.8% = ₹ 31.47

(ii) ***Case 1:***
$E(R)$ = $R_f + \beta$ (MRP + Infl.)
= 9% +1.2 (4)+2 = 9+ 4.8 + 2 = 15.8%
P_0 when $E(R)$ =15.8%,
= $\frac{d_1}{ke-g}$ = $\frac{2.14}{15.8\%-7\%}$ = **₹ 24.32**

Price falls to ₹ 24.32 when inflation premium goes up by 2%

Case 2:
D_0 = 2
D_1 = 2*1.1
= 2.2
g = 7.1%
k_e = 13.8%
P_0 when $E(R)$ =13.8%,

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P_0 = $\frac{d_1}{ke-g}$ = $\frac{2.2}{13.8\%-7\%}$ = **₹ 57.89**

Price becomes ₹ 57.89

Case 3:

D_1 = 2.4

MRP = 4

k_e = $R_f + \beta(R_m - R_f)$

= 9% + 1.3* 4% = 9% + 5.2 = 14.2%

P_0 = $\frac{d_1}{ke-g}$ = $\frac{2.14}{14.2\%-7\%}$ = **₹29.72**

Price increases to ₹ 29.72.

Assumption: All factors in Part 2 affect the computation independently

54. Illustration

The following details are given for X and Y companies' stocks and the Bombay Sensex for a period of one year. Calculate the systematic and unsystematic risk for the companies' stocks. If equal amount of money is allocated for the stocks what would be the portfolio risk?

	X Stock	Y Stock	Sensex
Average return	0.15	0.25	0.06
Variance of return	6.30	5.86	2.25
β	0.71	0.685	

Correlation Co-efficient (r) 0.424

Co-efficient of determination (r^2) 0.18

Solution:

Systematic and Unsystematic Risk for stocks X and Y

Total Risk = Systematic Risk+ Unsystematic Risk

Systematic Risk = $\beta_i^2 \sigma_m^2$

For X Ltd,

Systematic Risk = $(0.71)^2$ *2.25 = 1.134

Total Risk = 6.3

Unsystematic Risk = 6.3 – 1.134 = 5.166

For Y Ltd,

Systematic Risk = $(0.685)^2$ *2.25 = 1.056

Total Risk = 5.86

Unsystematic Risk = 5.86 – 1.056 = 4.804

Variance of a 50:50 Portfolio of X and Y

	Weight	β_i	σ_e^2	σ_m^2
X	50	0.71	5.166	2.25
Y	50	0.685	4.804	

σ_p^2 = $(\sum x_i\beta_i)^2 * \sigma_m^2 + \sum x_i^2\sigma_e^2$

$(\sum x_i\beta_i)^2 * \sigma_m^2$ = [(0.5* 0.71) + (0.5* 0.685)]^2 * 2.25 = **1.095**

$\sum x_i^2\sigma_e^2$ = 0.5^2 *4.804 + 0.5^2 *5.166 = 1.201+ 1.2915 = **2.4925**

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σ_p^2 = 1.095+ 2.4925 = **3.588**

β = $\frac{r\,\sigma_x}{\sigma_y}$ = 0.424* $\frac{\sqrt{6.3}}{\sqrt{2.25}}$ = **0.70948**

Systematic Risk = $r^2 * \sigma_x^2$ = 0.18* 6.3 = **1.134**

Unsystematic Risk = 6.3(1-0.18) = **5.166**

55. Illustration

The returns on stock A and market portfolio for a period of 6 years are as follows:

Year	Return on A (%)	Return on market portfolio (%)
1	12	8
2	15	12
3	11	11
4	2	-4
5	10	9.5
6	-12	-2

You are required to determine:

- Characteristic line for stock A
- The systematic and unsystematic risk of stock A.

Solution:

A	M	A*M	M^2	$A-\bar{A}$	$M-\bar{M}$	$(A-\bar{A})*(M-\bar{M})$	$(M-\bar{M})^2$
12	8	96	64	5.67	2.25	12.758	5.0625
15	12	180	144	8.67	6.25	54.188	39.063
11	11	121	121	4.67	5.25	24.518	27.563
2	-4	-8	16	-4.33	-9.75	42.218	95.063
10	9.5	95	90.25	3.67	3.75	13.763	14.063
-12	-2	24	4	-18.33	-7.75	142.06	60.063
38	**34.5**	**508**	**439.25**			**289.5**	**240.88**

$\bar{A}$ = $\frac{38}{6}$ = 6.33

$\bar{M}$ = $\frac{34.5}{6}$ = 5.75

β = $\frac{\sum AM - n\bar{A}\bar{B}}{\sum m^2 - n\bar{m}^2}$ = $\frac{508-6*6.33*5.75}{439.25-(6*5.75)^2}$ = $\frac{289.5}{240.875}$= **1.202**

σ_m^2 = $\frac{240.875}{6}$= **40.146**

Characteristic Line

R_m = 5.75

R_A = 6.33

β = 1.202

R_A = α + β R_m

6.33 = α+ 1202*5.75

α = **-0.582**

R_s = -0.582 + 1.202 R_m

Systematic Risk of Stock A:

= $\beta_i^2\sigma_m^2$ = $(1.202)^2$ * 40.146 = **58.003**

Total Risk of Stock = $\frac{\sum(y-\bar{y})^2}{n}$

σ_A^2 = 497.33/ 6 = **82.889**

Unsystematic Risk =82.889- 58.003 = **24.884**

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56. Illustration

The rates of return on the security of Company X and market portfolio for 10 periods are given below:

Period	Return of Security X (%)	Return on Market Portfolio (%)
1	20	22
2	22	20
3	25	18
4	21	16
5	18	20
6	-5	8
7	17	6
8	19	5
9	-7	6
10	20	11

(i) What is the beta of Security X?

(ii) What is the characteristic line for Security X?

Solution:

	X	M	XM	M^2
1	20	22	440	484
2	22	20	440	400
3	25	18	450	324
4	21	16	336	256
5	18	20	360	400
6	-5	8	-40	64
7	17	-6	-102	36
8	19	5	95	25
9	-7	6	-42	36
10	20	11	220	121
	150	**120**	**2157**	**2146**

$\bar{X}$ = 150/10

= 15

$\bar{M}$ = 120/10

= 12

(i) β $= \frac{\sum xy - n\bar{x}\bar{y}}{\sum x^2 - n(\bar{x})^2}$

$= \frac{2157 - 10*15*12}{2146 - 10*144}$

= 357/706

= **0.5057**

(ii) R_s = $\beta\ R_m + \alpha$

15 = 12* 0.55057 + α

15 = 6.0680+ α

α = **8.9320**

$\boldsymbol{R_s}$ = **8.9320% + 0.5057R_M**

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57. Illustration

Expected returns on two stocks for particular market returns are given in the following table:

Market Return	Aggressive	Defensive
7%	4%	9%
25%	40%	18%

You are required to calculate:

(a) The Betas of the two stocks.

(b) Expected return of each stock, if the market return is equally likely to be 7% or 25%.

(c) The Security Market Line (SML), if the risk-free rate is 7.5% and market return is equally likely to be 7% or 25%.

(d) The Alphas of the two stocks.

Solution:

a) Beta Sharpe Model:

R_s = α+ β R_m

4% = α + β* 7% (1)

40% = α + β* 25% (2)

(2)- (1),

36% = β* 18%

β = **2**

α = 4- 14 = **- 10**

9% = α + β* 7% (3)

18% = α + β* 25% (4)

(4)- (3),

9% = β* 18%

β = **0.5**

α = 9-3.5 = **5.5**

b) Expected Return of Market = $\sum_{i=1}^{n} P_i R_i$ = 0.5* 7 + 0.5* 12.5 = 16%

Characteristic Line of Each security

Security 1:

R_1 = -10% + 2(R_M)

Security 2:

R_2 = 5.5% + 0.5(R_M)

At R_M= 16%,

R_1 = -10% + 2*16 = **22%**

R_2 = 5.5% + 0.5* 16 = **13.5%**

c) R_M = 0.5(7+25) = 16%

R_f = 7.5%

SML as per CAPM = 7.5% + β(16%-7.5%)

$E(R)$ = 7.5% + 8.5% β

d) α of Stock 1 = **-10**

α of Stock 2 = **5.5%**

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58. Illustration

A study by a Mutual fund has revealed the following data in respect of three securities:

Security	σ (%)	Correlation with Index, P_m
A	20	0.60
B	18	0.95
C	12	0.75

The standard deviation of market portfolio (BSE Sensex) is observed to be 15%.

(i) What is the sensitivity of returns of each stock with respect to the market?

(ii) What are the covariances among the various stocks?

(iii) What would be the risk of portfolio consisting of all the three stocks equally?

(iv) What is the beta of the portfolio consisting of equal investment in each stock?

(v) What is the total, systematic and unsystematic risk of the portfolio in (iv)?

Solution:

(i) $\beta = \frac{r\,\sigma_s}{\sigma_m}$

Stock	r	σ_s	σ_m	β
A	0.6	10	15	0.8
B	0.95	18	15	1.14
C	0.75	12	15	0.6

(ii) Covariances amongst stocks

Co variance between 2 stocks = Beta 1 x Beta 2 x Market Variance

Stock	A	B	C
A	20^2	0.8 x 1.14 x 225	0.8 x 0.6 x 225
B	0.8 x 1.14 x 225	18^2	0.6 x 1.14 x 225
C	0.8 x 0.6 x 225	0.6 x 1.14 x 225	12^2

Stock	A	B	C
A	400	205.2	108
B	205.2	324	153.9
C	108	153.90	144

(iii) Portfolio Variance for a portfolio with greater than 2 securities is computed using variance covariance matrix.

= $(1/3)^2$* 400 + $(1/3)^2$* 324 + $(1/3)^2$* 144 + $(1/3)^2$* 108 + $(1/3)^2$* 153.9*2 + $(1/3)^2$* 2* 205.2

= $(1/3)^2$ (400+324+144+216+ 307.8+ 410.4)

Total Risk = **200.24**

(iv) β_p = $\sum_{i=1}^{n} w_i\beta_i$ = 1/3 (0.8+ 1.14+ 0.6) = **0.847**

(v) Total Risk = 200.24

Systematic Risk = $\beta_i^2\sigma_m^2$ = $(0.847)^2$* $(15)^2$ = **161.417**

Unsystematic Risk = 200.24 – 161.417 = **38.822**

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59. Illustration

Following are the details of a portfolio consisting of three shares:

Share	Portfolio weight	Beta	Expected return in %	Total variance
A	0.20	0.40	14	0.015
B	0.50	0.50	15	0.025
C	0.30	1.10	21	0.100

Standard Deviation of Market Portfolio Returns = 10%

You are given the following additional data:

- Covariance (A, B) = 0.030
- Covariance (A, C) = 0.020
- Covariance (B, C) = 0.040

Calculate the following:

(i) The Portfolio Beta

(ii) Residual variance of each of the three shares

(iii) Portfolio variance using Sharpe Index Model

(iv) Portfolio variance (on the basis of modern portfolio theory given by Markowitz

Solution:

(i) β_p = $\sum_{i=1}^{n} w_i\beta_i$ = 0.2*0.4+ 0.5*0.5+ 0.3*1.10= 0.66

(ii) Residual Variance = Total Variance- Systematic Variance

	σ^2	β	σ_m^2	Systematic Risk	Unsystematic Risk
A	0.015	0.4	0.01	0.0016	0.0134
B	0.025	0.5	0.01	0.0025	0.0225
C	0.1	1.1	0.01	0.0121	0.0879

(iii) σ_p^2 = Systematic Risk+ Unsystematic Risk

= $(\sum x_i\beta_i)^2 * \sigma_m^2 + \sum x_i^2\sigma_e^2$

Systematic Risk = $\beta_p^2 * \sigma_m^2$ = $(0.66)^2$ + $(0.10)^2$ = 0.004356

Unsystematic Risk

= $(0.2)^2$ *0.0134 + $(0.5)^2$ *0.0225 + $(0.3)^2$*0.0879 = 0.014072

σ_p^2 = 0.004356+ 0.014072 = 0.018428

(iv) Variance as per modern portfolio theory of Markowitz using variance- covariance matrix

	A (0.2)	**B (0.5)**	**C (0.3)**
A (0.2)	0.015 * $(0.2)^2$	0.03* (0.5*0.2)	0.02 *(0.2*0.3)
B (0.5)	0.03* (0.5*0.2)	0.025* $(0.5)^2$	0.04* (0.3* 0.5)
C (0.3)	0.02* (0.2*0.3)	0.04* (0.3*0.5)	0.1* $(0.3)^2$

σ_p^2 = 0.015 * $(0.2)^2$ +0.025* $(0.5)^2$ +0.1* $(0.3)^2$ + 2(0.03*0.5*0.2 + 0.02*0.2*0.3 + 0.04*0.3*0.5)

= 0.0006+ 0.00625+ 0.0009+ 2(0.0003+ 0.0012+ 0.0006) = **0.03625**

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60. Illustration

A has portfolio having following features:

Security	B	Random Error σ_(ϵ_i)	Weight
L	1.60	7	0.25
M	1.15	11	0.30
N	1.40	3	0.25
K	1.00	9	0.20

You are required to find out the risk of the portfolio if the standard deviation of the market index (σ_m) is 18%.

Solution:

Total Risk = Systematic Risk + Unsystematic Risk = $(\sum x_i\beta_i)^2 * \sigma_m^2 + \sum x_i^2\sigma_e^2$

Systematic Risk = [(1.6* 0.25) + (1.15* 0.3) + (1.14*0.23) + (1*0.2)]^2 * (0.18)^2

= (1.295)^2 * (0.18)^2 = **0.054336**

Unsystematic Risk = $\sum x_i^2\sigma_e^2$

= [(0.07)^2 *(0.25)^2 + (0.11)^2 *(0.3)^2 +(0.03)^2 *(0.25)^2+(0.09)^2 *(0.2)^2]

= [0.00030625+ 0.001089+ 0.00005625+ 0.000324] = **0.0017755**

Total Variance = 0.054336+ 0.0017755

σ_p^2 = **0.0561115**

σ_p = **23.6878%**

61. Illustration

The following are the data on five mutual funds:

Fund	Return	Standard Deviation	Beta
A	15	7	1.25
B	18	10	0.75
C	14	5	1.40
D	12	6	0.98
E	16	9	1.50

You are required to compute Reward to Volatility Ratio and rank these portfolios using:

- Sharpe method and
- Treynor's method assuming the risk-free rate is 6%.

Solution:

Sharpe Ratio:

MF	R_i	R_f	$R_i - R_f$	S. D	$(R_i - R_f)$/S. D	Rank
A	15	6	9	7	1.2857	2
B	18	6	12	10	1.2	3
C	14	6	8	5	1.6	1
D	12	6	6	6	1	5
E	16	6	10	9	1.1111	4

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Treynor ratio:

MF	R_i	R_f	$R_i - R_f$	β	$(R_i - R_f)/\beta$	Rank
A	15	6	9	1.25	7.2	2
B	18	6	12	0.75	16	1
C	14	6	8	1.4	5.7143	5
D	12	6	6	0.98	6.1224	4
E	16	6	10	1.5	6.6667	3

62. Illustration

Mr. Abhishek is interested in investing ₹ 2,00,000 for which he is considering following three alternatives:

(i) Invest ₹ 2,00,000 in Mutual Fund X (MFX)
(ii) Invest ₹ 2,00,000 in Mutual Fund Y (MFY)
(iii) Invest ₹ 1,20,000 in Mutual Fund X (MFX) and ₹ 80,000 in Mutual Fund Y (MFY)

Average annual return earned by MFX and MFY is 15% and 14% respectively. Risk free rate of return is 10% and market rate of return is 12%.
Covariance of returns of MFX, MFY and market portfolio Mix are as follow:

	MFX	MFY	Mix
MFX	4.800	4.300	3.370
MFY	4.300	4.250	2.800
Mix	3.370	2.800	3.100

You are required to calculate:

(i) variance of return from MFX, MFY and market return,
(ii) portfolio return, beta, portfolio variance and portfolio standard deviation,
(iii) expected return, systematic risk and unsystematic risk; and
(iv) Sharpe ratio, Treynor ratio and Alpha of MFX, MFY and Portfolio Mix

Solution:

(i) Variance of MFX, MFY and MPM,
Covariance of a Stock/ Portfolio with itself or its own returns is its variance.
Variance MFX = 4.8
Variance MFY = 4.25
Variance MPM = 3.1

(ii)

	Beta	Return	σ_p^2	σ_p
MFX	1.0871	12.1742	4.8	2.1909
MFY	0.9032	11.8064	4.25	2.0616
X+Y	1.101354	12.0271	4.472	2.1147

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Working Notes:

1. β = SD of Stock Returns/ SD of Market Returns = $\frac{cov_{x,y}}{\sigma_y^2}$

   β MFX = 3.37/ 3.1 = **1.0871**

   β MFY = 2.8/ 3.1 = **0.9032**

   β_p of MFX and MFY is in the ratio 120: 80 i.e., 3:2

   $\sum_{i=1}^{n} x_i \beta_i$ = 3/5 * 1.0871 + 2/5 * 0.9032 = **1.01354**

2. $E(R)$ = $R_f + \beta(R_m - R_f)$

   $E(R)$ for MFX = 10% +1.0871(12-10)

   = 10+ 2.1742 = **12.1742%**

   $E(R)$ for MFY = 10% + 0.9032 (12-10) = **11.8064%**

   $E(R)$ for X+Y = 10% + 1.01354 *2% = 12.027

3. Variance

   σ_p^2 = $\sigma_x^2 + w_x^2 + \sigma_y^2 + w_y^2 + 2 * \sigma_x \sigma_y w_x w_y r$

   = 4.8* $(0.6)^2$ + 4.25* $(0.4)^2$ + 2*0.6* 0.4* 4.3

   = 4.472

   σ_p = 2.1147

(iii) Calculation:

	MFX	MFY	X+Y
Beta	1.0871	0.9032	1.0135
σ_m^2	3.1	3.1	3.1
Systematic Risk (1)	3.6635	3.5289	3.18
Total Risk (2)	4.8	4.25	4.472
Unsystematic risk (2)- (1)	1.1365	1.7211	1.2875
E(R)	12.1742	11.8064	12.027

(iv) Sharpe Ratio: $(\frac{R_i - R_f}{S.D})$

MFX = $\frac{15-10}{2.1909}$ = 2.2822

MFY = $\frac{14-10}{2.0616}$ = 1.9403

MFX+ MFY = $\frac{14.6-10}{2.1147}$ (6/10 *15+ 4/10 * 14 = 14.6)

= 2.1753

Treynor Ratio: $(\frac{R_i - R_f}{\beta})$

MFX = $\frac{15-10}{1.0871}$ = 4.60

MFY = $\frac{14-10}{0.9032}$ = **4.4287**

MFX+ MFY = $\frac{14.6-10}{1.01354}$ (6/10 *15+ 4/10 * 14 = 14.6)

= **4.5385**

Alpha = Actual Return – Expected Return

MFX = 15- 12.1742% = **2.8258**

MFY = 14%- 11.8064% = **2.1936**

MFX+ MFY = 14.6% - 12.0271% = **2.5729**

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63. Illustration

Suppose that economy A is growing rapidly and you are managing a global equity fund and so far, you have invested only in developed-country stocks only. Now you have decided to add stocks of economy A to your portfolio.

The table below shows the expected rates of return, standard deviations, and correlation coefficients (all estimates are for aggregate stock market of developed countries and stock market of Economy A).

	Developed Country Stocks	Stocks of Economy A
Expected rate of return (annualized percentage)	10	15
Risk [Annualized Standard Deviation (%)]	16	30
Correlation Coefficient (r)	0.30	

Assuming the risk-free interest rate to be 3%, you are required to determine:

(a) What percentage of your portfolio should you allocate to stocks of Economy A if you want to increase the expected rate of return on your portfolio by 0.5%?

(b) What will be the standard deviation of your portfolio assuming that stocks of Economy A are included in the portfolio as calculated above?

(c) Also show how well the Fund will be compensated for the risk undertaken due to inclusion of stocks of Economy A in the portfolio?

Solution:

a) Current R = 10%
Current σ = 16
Required return = 10.5%
Current Return = 10%
Weight of D = D
Weight of A = 1-D
10% (D)+ 15%(1-D) = 10.5%
10D+ 15- 15D = 10.5
-5d = 10.5- 15
-5D = -4.5
D = 0.9
Developing Economy A's share in portfolio is 10% (1-0.9)

b) w_1 = 90
w_2 = 10
σ_1 = 16
σ_2 = 30
r/ρ = 0.3
σ_p^2 = $\sigma_1^2 + w_1^2 + \sigma_2^2 + w_2^2 + 2 * \sigma_1\sigma_2 w_1 w_2 r$
= $(0.9*16)^2 + (0.1*30)^2 + 2*0.9*0.1*16*30*0.3$
= 207.36+ 0.9+ 25.92 = 242.28
σ_p = 15.565%

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c)

	Return	σ
D	10	16
P	10.5	15.565

Due to inclusion of stocks of Economy a, Portfolio Return has increased and SD has decreased, it is beneficial.

Sharpe Ratio:
Before: (10- 3)/16 = 0.4375
After: (10.5-3)/ 15.565 = 0.4819

Sharpe Ratio has increased hence the revised portfolio is benefitted due to inclusion of stocks of economy.

64. Illustration

The five portfolios of a mutual fund experienced following result during last 10 years periods:

Portfolio	Average annual return %	Standard deviation	Correlation with the market return
A	20.0	2.3	0.8869
B	17.0	1.8	0.6667
C	18.0	1.6	0.600
D	16.0	1.8	0.867
E	13.5	1.9	0.5437

- Market Risk 1.2
- Market rate of return 14.3%
- Risk free rate 10.1%

Beta may be calculated only up to two decimals. Rank the portfolio using JENSEN'S ALPHA method.

Solution:

	σ_p	r	σ_m	$\beta = r^*\sigma_p / \sigma_m$
A	2.3	0.8869	1.2	1.70
B	1.8	0.6667	1.2	1.00
C	1.6	0.6	1.2	0.80
D	1.8	0.867	1.2	1.30
E	1.9	0.5437	1.2	0.86

β	R_f	$(R_m - R_f$	$R_f + (R_m - R_f)$	$E(R)$	AR	AR $-E(R)$	Rank
1.70	10.1%	4.2%	0.101+1.7(0.042)	17.24	20	2.76	2
1.00	10.1%	4.2%	0.101+1.0(0.042)	14.3	17	2.7	3
0.80	10.1%	4.2%	0.101+0.8(0.042)	13.46	18	4.54	1
1.30	10.1%	4.2%	0.101+1.3(0.042)	15.56	16	0.44	4
0.86	10.1%	4.2%	0.101+0.86(0.042)	13.712	13.5	-0.212	5

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65. Illustration

Five portfolios experienced the following results during a 7- year period:

Portfolio	Average Annual Return (Rp) (%)	Standard Deviation (SD)	Correlation with the market returns (r)
A	19.0	2.5	0.84036
B	15.0	2.0	0.540
C	15.0	0.8	0.975
D	17.5	2.0	0.750
E	17.1	1.8	0.600

- Market Risk (σ_m) - 1.2
- Market rate of Return (R_m) - 14.0
- Risk-free Rate (R_f) - 9.0

Rank the portfolios using
(a) Sharpe's method,
(b) Treynor's method and
(c) Jensen's Alpha

Solution:

Sharpe Method:

	AR (1)	R_f(2)	(3) = (1)- (2)	SD	(3)/ SD	Rank
A	19	9	10	2.5	4	4
B	15	9	6	2	3	5
C	15	9	6	0.8	7.5	1
D	17.5	9	8.5	2	4.25	3
E	17.1	9	8.1	1.8	5.5	2

	σ_p	r	σ_m	$\beta = r^*\sigma_p / \sigma_m$	$R_f + (R_m - R_f)$	$E(R)$
A	2.5	0.84	1.2	1.75	9+1.75(14-9)	17.75
B	2	0.54	1.2	0.9	9+0.9(14-9)	13.5
C	0.8	0.975	1.2	0.65	9+0.65(14-9)	12.25
D	2	0.75	1.2	1.25	9+1.25(14-9)	15.25
E	1.8	0.6	1.2	0.9	9+0.9(14-9)	13.5

Treynor Method:

	AR (1)	R_f(2)	(3) = (1)- (2)	β	(3)/ β	Rank
A	19	9	10	1.75	5.7	5
B	15	9	6	0.9	6.67	4
C	15	9	6	0.65	9.23	1
D	17.5	9	8.5	1.25	6.8	3
E	17.1	9	8.1	0.9	9	2

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Jensen's Alpha Method:

	AR (1)	$E(R)$ (2)	α= (1)- (2)	Rank
A	19	17.75	1.25	5
B	15	13.5	1.5	4
C	15	12.25	2.75	2
D	17.5	15.25	2.25	3
E	17.1	13.5	3.6	1

66. Illustration

There are two mutual funds viz. D Mutual Fund Ltd. and K Mutual Fund Ltd. Each having close ended equity schemes.
NAV as on 31-12-2014 of equity schemes of D Mutual Fund Ltd. is Rs.70.71 (consisting 99% equity and remaining cash balance) and that of K Mutual Fund Ltd. is Rs.62.50 (consisting 96% equity and balance in cash).
Following is the other information:

Particulars	Equity Schemes	
	D Mutual Fund Ltd	K Mutual Fund Ltd.
Sharpe Ratio	2	3.3
Treynor Ratio	15	15
Standard Deviation	11.25	5

There is no change in portfolios during the next month and annual average cost is Rs.3 per unit for the schemes of both the Mutual Funds.
If Share Market goes down by 5% within a month, calculate expected NAV after a month for the schemes of both the Mutual funds.
For calculation, consider 12 months in a year and ignore number of days for particular month.

Solution:

	DMF	KMF
NAV	70.71	62.5
Equity	99%	96%
Cash	1%	4%
Equity	70.0029	60
Cash	0.7071	2.5

Sharpe Ratio: $(\frac{R_i - R_f}{S.D})$

For D Ltd

S, 2 $= \frac{R_i - R_f}{11.25}$

$R_i - R_f$ = 11.25* 2 = 22.5 (1)

Substituting (1),

T, 15 $= \frac{R_i - R_f}{\beta}$

15 = 22.5/ β

β = 15/22.5 = 1.5 (2)

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For K Ltd,

S, 3.3 $= \frac{R_i - R_f}{5}$

$R_i - R_f$ = 3.3* 5 = 16.51 (3)

T, 15 $= \frac{R_i - R_f}{\beta}$

15 = 16.51/ β

β = 15/16.51 = 1.1

If market goes down by 5%, value of D Ltd Portfolio goes down by β multiple of 5 i.e., 1.5*5= **7.5%** and for K Ltd, 1.1* 5= **5.5%.**

Revised NAV after one month

	D Ltd	K Ltd
Equity: Opening	70.0029	60
Less: Reduction in NAV	7.5%	5.5%
Closing Equity Value	**64.7527**	**56.7**
Cash: Opening	0.7071	2.5
Less: Management Expenses	-0.25	-0.25
Closing Cash value	**0.4571**	**2.25**
Closing NAV	64.7527+ 0.4571	56.7+ 2.25
	65.2098	**58.95**

67. Illustration

Ramesh wants to invest in stock market. He has got the following information about individual securities:

Security	Expected Return	Beta	σ^2 ci
A	15	1.5	40
B	12	2	20
C	10	2.5	30
D	09	1	10
E	08	1.2	20
F	14	1.5	30

Market index variance is 10 percent and the risk-free rate of return is 7%. What should be the optimum portfolio assuming no short sales?

Solution:

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

C^* = maximum value

Weights $= \frac{\beta_i^2}{\sigma_{ei}^2} * \left[\frac{R_i - R_f}{\beta_i} - C^* \right]$

Rank on the basis of Treynor= $\frac{R_i - R_f}{\beta_i}$

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	$E(R)$	R_f	β	$(E(R)-R_f)/\beta$	Ranks
A	15	7	1.5	5.33333	1
B	12	7	2	2.5	3
C	10	7	2.5	1.2	5
D	9	7	1	2	4
E	8	7	1.2	0.83333	6
F	14	7	1.5	4.66667	2

	Rank	$R_f - R_i$ (1)	β (2)	σ_E^2 (3)	4=1*2/3	β^2	β^2/σ_E^2
A	1	8	1.5	40	0.3	2.25	0.05625
F	2	7	1.5	30	0.35	2.25	0.075
B	3	5	2	20	0.5	4	0.2
D	4	2	1	10	0.2	1	0.1
C	5	3	2.5	30	0.25	6.25	0.20833
E	6	1	1.2	20	0.06	1.44	0.072

Stock	$\Sigma 4$	$\Sigma 6$	C_i	C^*	
A	0.3	0.05625	(10*0.3)/(1+10*0.05625)	1.92	Optimal
F	0.65	0.13125	(10*0.65)/(1+10*0.13125)	2.811	c*
B	1.15	0.33125	(10*1.15)/(1+10*0.33125)	2.667	Ignored
D	1.35	0.43125	(10*1.35)/(1+10*0.41325)	2.630	
C	1.6	0.63958	(10*1.6)/(1+10*0.63958)	2.163	
E	1.66	0.71158	(10*1.66)/(1+10*0.71158)	2.045	

Securities F and A are part of Optimal portfolios

Z_A $= \frac{\beta_i^2}{\sigma_{ei}^2} * \left[\frac{R_i - R_f}{\beta_i} - C^*\right]$

= 1.5/40 (5.33- 2.811) = 0.0944625

Z_F = 1.5/30 (4.67- 2.811) = 0.09295

$Z_A + Z_F$ = 0.0944625 + 0.09295 = 0.1874125

Z_A weights = 0.0944625/ 0.1874125 = **50.40%**

Z_F weights = 100 – 50.40 = **49.60%**

The optimal portfolio with no short sales will have A and F ratio 50.40% and 49.60%

68. Illustration

Compute the Optimal portfolio out of following stocks as per Sharpe's optimal portfolio model if risk-free rate of return is 4%

The following data is given:

S. No	Name	Return	Beta β	Variance (σ^2)
1	A	-0.21	0.66	21.77
2	B	1.92	1.07	104.4
3	C	2.44	0.16	44.12
4	D	2.56	0.98	49.49
5	E	-0.43	1.01	37.00

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6	F	3.18	0.77	31.04
7	G	1.69	0.15	48.30
8	H	2.69	0.77	34.63
9	I	0.39	0.88	63.60
10	J	3.15	0.89	60.34
	Mkt Return	**2.18**	**1.00**	**18.52**

Source: https://www.researchgate.net/publication/336602910

Solution:

R_f = 4% (expected)

$E(R)_m$ = 8%

σ_m^2 = 36% (historical)

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

C^* = maximum value

Weights = $\frac{\beta_i^2}{\sigma_{ei}^2} * \left[\frac{R_i - R_f}{\beta_i} - C^*\right]$

Rank on the basis of Treynor = $\frac{R_i - R_f}{\beta_i}$

$E(R)$ = $\propto + \beta * R_m + E_i$

$\propto$ = $AR - E(R)$

$\propto$ = $AR - \beta * R_m$

Numerator:

	AR	β	R_m	= $AR - \beta * R_m$	$\propto$
A	-0.21	0.66	2.18	-0.21-(0.66*2.18)	-1.65
B	1.92	1.07	2.18	1.92-(1.07*2.18)	-0.41
C	2.44	0.16	2.18	2.44-(0.16*2.18)	2.09
D	2.56	0.98	2.18	2.56-(0.98*2.18)	0.42
E	-0.42	1.01	2.18	-0.42-(1.01*2.18)	-2.62
F	3.18	0.77	2.18	3.18-(0.77*2.18)	1.50
G	1.69	0.15	2.18	1.69-(0.15*2.18)	1.36
H	2.69	0.77	2.18	2.69-(0.77*2.18)	1.01
I	0.39	0.88	2.18	0.39-(0.88*2.18)	-1.53
J	3.15	0.89	2.18	3.15-(0.89*2.18)	1.21

	$\propto$	β	R_m	= $\propto + \beta * R_m$	$E(R)$
A	-1.65	0.66	8	-1.6488+0.66*8	3.6312
B	-0.41	1.07	8	-0.4126+1.07*8	8.1474
C	2.09	0.16	8	2.0912+0.16*8	3.3712
D	0.42	0.98	8	0.4236+0.98*8	8.2636
E	-2.62	1.01	8	-2.6218+1.01*8	5.4582
F	1.50	0.77	8	1.5014+0.77*8	7.6614
G	1.36	0.15	8	1.363+0.15*8	2.563
H	1.01	0.77	8	1.0114+0.77*8	7.1714
I	-1.53	0.88	8	-1.5284+0.88*8	5.5116
J	1.21	0.89	8	1.2098+0.89*8	8.3298

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	$R_s - R_f$	β	$R_s - R_f / \beta$	Rank
A	-0.3688	0.66	-0.5588	8
B	4.1474	1.07	3.87607	5
C	-0.6288	0.16	-3.93	9
D	4.2636	0.98	4.35061	3
E	1.4582	1.01	1.44376	7
F	3.6614	0.77	4.75506	2
G	-1.437	0.15	-9.58	10
H	3.1714	0.77	4.1187	4
I	1.5116	0.88	1.71773	6
J	4.3298	0.89	4.86494	1

	Variance	β	Systematic Risk ($\beta * \sigma_m^2$)	Unsystematic Risk
A	21.77	0.66	8.06731	13.70
B	104.4	1.07	21.2035	83.20
C	44.12	0.16	0.47411	43.65
D	49.49	0.98	17.7866	31.70
E	37	1.01	18.8923	18.11
F	31.04	0.77	10.9805	20.06
G	48.3	0.15	0.4167	47.88
H	34.63	0.77	10.9805	23.65
I	63.6	0.88	14.3419	49.26
J	60.34	0.89	14.6697	45.67

	$R_s - R_f$	σ_{EI}^2	β	$(R_s - R_f)*\beta / \sigma_E^2$	Cumulative ($\Sigma 1$)	$\Sigma 1 * \sigma_m^2$
J	4.33	45.6703	0.89	0.08438	0.08438	**3.024**
F	3.66	20.0595	0.77	0.14049	0.22487	**8.064**
D	4.26	31.7034	0.98	0.13168	0.35656	**12.816**
H	3.17	23.6495	0.77	0.10321	0.45977	**16.524**
B	4.15	83.1965	1.07	0.05337	0.51314	**18.432**
I	1.51	49.2581	0.88	0.02698	0.54012	**19.404**
E	1.45	18.1077	1.01	0.08088	0.62099	**22.32**
A	-0.37	13.7027	0.66	-0.0178	0.60317	**21.672**
C	-0.63	43.6459	0.16	-0.0023	0.60086	**21.60**
G	-1.44	47.8833	0.15	-0.0045	0.59635	**21.42**

	Denominator:					
	β	β^2	σ_{EI}^2	β^2/σ_m^2	$\Sigma 1$	$1 + \sigma_m^2 * \Sigma 1$
J	0.89	0.7921	45.6703	0.017	0.17	**1.612**
F	0.77	0.5929	20.0595	0.030	0.047	**2.692**
D	0.98	0.9604	31.7034	0.030	0.077	**3.772**
H	0.77	0.5929	23.6495	0.025	0.102	**4.672**
B	1.07	1.1449	83.1965	0.014	0.116	**5.176**
I	0.88	0.7744	49.2581	0.016	0.132	**5.752**
E	1.01	1.0201	18.1077	0.056	0.188	**7.768**
A	0.66	0.4356	13.7027	0.032	0.22	**8.92**
C	0.16	0.0256	43.6459	0.001	0.221	**8.956**
G	0.15	0.0225	47.8833	0.001	0.222	**8.992**

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Calculation:

	Numerator	Denominator	Numerator/Denominator	
J	3.024	1.612	1.87593	Part of Optimal Portfolio
F	8.064	2.692	2.99554	
D	12.816	3.772	3.39767	
H	16.524	4.672	3.53682	
B	18.432	5.176	3.56105	C^*
I	19.404	5.752	3.37344	Ignored
E	22.32	7.768	2.87333	
A	21.672	8.92	2.4296	
C	21.6	8.956	2.41179	
G	21.42	8.992	2.38212	

	$(R_s - R_f)$*β	▪	$-C^*$	*β/ σ_E^2	= z_i	**Weights**
J	4.87		-3.561	*0.89	0.026	22.03%
F	4.25		-3.561	*0.77	0.046	38.98%
D	4.35		-3.561	*0.98	0.024	20.34%
H	4.12		-3.561	*0.76	0.018	15.25%
B	3.88		-3.561	*1.07	0.004	3.39%
					0.118	**100.00%**

	Weights (1)	∝ **(2)**	β **(3)**	R_m **(4)**	$E(R)$ **(5) = (2) + (3) *(4)**	**War (1) * (5)**
J	22.03%	1.21	0.89	8	8.33	1.83542
F	38.98%	1.5	0.77	8	7.66	2.9861
D	20.34%	0.42	0.98	8	8.26	1.68
H	15.25%	1.01	0.76	8	7.09	1.08153
B	3.39%	-0.41	1.07	8	8.15	0.27627
	100.00%				$E(R)_p$	**7.85932**

	x_i	β_i	$x_i\beta_i$	σ_e^2	$\sigma_e^2 * {x_i}^2$
J	22.03	0.89	19.6067	45.67	2.21648
F	38.98	0.77	30.0146	20.06	3.04792
D	20.34	0.98	19.9332	31.70	1.31162
H	15.35	0.76	11.666	23.65	0.55724
B	3.4	1.07	3.638	83.20	0.09618
			84.8585		**7.22942**

$\beta_i x_i$ = 0.8485 = **0.85**

$(\beta_i x_i)^2 \sigma_m^2$ = (0.85)^2*36 = **26.01**

σ_p^2 = 26.01+7.22942 = **33.24**

	Market	**Optimum Portfolio**
$E(R)$	8	7.86
σ_p^2	36	33.24

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69. Illustration

The following are the details of three mutual funds of MFL:

	Growth Fund	Balanced Fund	Regular Fund	Market
Average Return (%)	7	6	5	9
Variance	92.16	54.76	40.96	57.76
Coefficient of Determination	0.3025	0.6561	0.9604	

The yield on 182 days Treasury Bill is 9 per cent per annum. You are required to:

- Rank the funds as per Sharpe's measure.
- Rank the funds as per Treynor's measure.

Compare the performance with the market.

Solution:

Particulars	Growth Fund	Balanced Fund	Regular Fund	Market
R_s	7	6	5	9
σ^2	92.16	54.76	40.96	57.76
S. D	9.6	7.4	6.4	7.6
r^2	0.3025	0.6561	0.9604	
r	0.55	0.81	0.98	
R_f	9	9	9	9
$R_s - R_f$	-2	-3	-4	0
$\beta = r * \sigma_s/\sigma_m$	0.6947	0.7887	0.8253	1
Sharpe Ratio: $(R_s - R_f)/ S.D$	-0.2083	-0.4054	-0.6250	0
Ranks	1	2	3	
Treynor Ratio $(R_s - R_f)/\beta$	-2.8788	-3.8038	-4.8469	0
Ranks	1	2	3	

The market has Sharpe Ratio and Treynor Ratio values at 0, higher than all three funds.
The market has performed better than all three funds.

70. Illustration

Equity of ABC Ltd. (ABCL) is ₹ 500 Crores, its debt, is worth ₹ 290 Crores.
Printer Division segments value is attributable to 64%, which has an Asset Beta (β_p) of 1.55, balance value is applied on Spares and Consumables Division, which has an Asset Beta (β_sc) of 1.40 ; ABCL Debt beta (β_D) is 0.28. You are required to calculate:

(i) Equity Beta (β_E),
(ii) Ascertain Equity Beta (β_E), if ABC Ltd. decides to change its Debt Equity position by raising further debt and buying back of equity to have its Debt-to-Equity Ratio at 1.50.
Assume that the present Debt Beta (β_D1) is 0.45 and any further funds raised by way of Debt will have a Beta (β_D2) of 0.50.

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(iii) Whether the new Equity Beta (β_E) justifies increase in the value of equity on account of leverage?

Solution:

(i)

	Assets (%)	β	Weighted β
Printer	64	1.55	0.992
Spares	36	1.4	0.504
	100		**1.496**

Asset Beta = 1.496

$\beta_A = \frac{E}{E+D} * \beta_E + \frac{D}{E+D} * \beta_D$

$1.496 = \frac{500}{790} * \beta_E + \frac{290}{790} * 0.28$

$1.496 = 0.6329 * \beta_E + 0.1028$

$0.6329 * \beta_E = 1.496 - 0.1028$

$\beta_E =$ **2.2013**

(ii) Target Debt Equity Ratio is 1.5:1

$\frac{D}{E} = \frac{1.5}{1}$

D = 1.5 E

D+ E = 790

1.5 E + E = 790

2.5 E = 790

E = **316**

D = 790- 316 = **474**

	Existing	Revised	Change
Debt	290	474	+184
Equity	500	316	-184
Total	790	790	**0**
D/E	0.28	1.5	

(ii)

β_D for 290 is 0.45

β_D for 474- 290= 184 is 0.50

$\beta_A = \frac{E}{E+D1+D2} * \beta_E + \frac{D1}{E+D1+D2} * \beta_{D2}$

$1.496 = \frac{316}{790} * \beta_E + \frac{290}{790} * 0.45 + 0.1165$ (i.e 184/790 x 0.5)

$1.496 = 0.4 * \beta_E + 0.2817$

$0.4 * \beta_E = 1.496 - 0.2817$

$\beta_E = 3.0358$

(iii)Yes, the new beta justifies increase in value of equity when market moves positively.

71. Illustration

K Ltd. has invested in a portfolio of short-term equity investments. You are required to calculate the risk of K Ltd.'s short-term investment portfolio relative to that of the market from the information given below:

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Investment	A	B	C	D
No. of shares	1,20,000	1,60,000	2,00,000	2,50,000
Market price per share (₹)	8.58	5.84	4.34	6.28
Beta	2.32	4.56	1.80	3.00
Actual Return	9.50%	14.00%	7.50%	16.00%

The current market return is 20% and the risk-free return is 10%.
Advise whether K Ltd. should change the composition of its portfolio. If yes, then how.
Note: Make calculations up to 4 decimal points.

Solution:

	Shares	CMP	Value	Beta	Value* Beta
A	1.2	8.58	10.296	2.32	23.88672
B	1.6	5.84	9.344	4.56	42.60864
C	2	4.34	8.68	1.8	15.624
D	2.5	6.28	15.7	3	47.1
			44.02		**129.2194**

β_p $= \sum x_i \beta_i$

$= \frac{129.2194}{44.02} = 2.9355$

Compared to the market, the portfolio has higher beta of 2.9355

	Value	₹	Value* ₹
A	10.296	9.5	97.812
B	9.344	14	130.816
C	8.68	7.5	65.1
D	15.7	16	251.2
	44.02	**12.2805**	**544.928**

Actual Return = 12.28

$E(R)$ $= R_f + \beta\ (MRP)$

= 10% + 2.9355 (10%) = **39.355**

The portfolio significantly underperformed the market.

	AR	$R_f + \beta(MRP)$	$E(R)$	$AR - E(R)$
A	9.5	10+ 2.32(10)	33.20%	-23.70%
B	14	10+ 4.56(10)	55.60%	-41.60%
C	7.5	10+ 1.8(10)	28%	-20.50%
D	16	10+ 3(10)	40%	-24%

Yes. None of the stocks have performed or reached their E(R) as per CAPM. They all have significantly underperformed and so has the overall portfolio. Hence all the stocks should be removed from the portfolio and new stocks should be added.

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72. Illustration

Suppose one of your HNI clients is holding the following portfolio as per his risk appetite:

Particulars	Securities
Equity Shares:	
G Ltd.	1000
S Ltd.	1000
B Ltd.	500
PSU Bonds	20,000

The other data related to each of these securities is as follows:

Cost	Dividends/ Interest	Market price	Beta
₹	₹	₹	
10,000	1,725	9,800	0.60
15,000	1,000	16,200	0.80
28,000	1400	28,300	0.60
1,800	180	1,725	0.10

Your client is interested in investing some more funds in Bonds issued by GOI.

(i) Estimate the minimum rate of return that your client would expect from these Bonds keeping in view his risk appetite and assuming Market Return as 12.70%.

(ii) Analyze whether this portfolio has out-performed the market or not assuming Risk Free Rate of Return as 7%.

Solution:

(i) Minimum Return Expectation is Risk-free rate or can also be bond coupon rate (10%)

As per CAPM,

$$E(R) = R_f + \beta\,(R_m - R_f)$$

Securities	Cost	Number	Value	M.P	Gain or Loss
G	10000	1000	100	9800	-200
S	15000	1000	150	16200	1200
B	28000	500	140	28300	300
Bonds	1800	20000	360	1725	-75
			750		

Securities	Total Gain	Dividend/ Interest	Total Dividend/ Interest	Gain+ Dividend
G	-200000	1725	17.25	15.25
S	1200000	1000	10	2.2
B	150000	1400	7	8.5
Bonds	-1500000	180	36	21
	-350000		**70.25**	**66.75**

$$\text{Actual Return} = \frac{\text{capital gain+ dividend}}{\text{opening value}}$$

$$= \frac{66.75}{750} = \mathbf{8.9\%}$$

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Securities	Cost Value	Beta	Value* Beta
G	100	0.6	60
S	150	0.8	120
B	140	0.6	84
Bonds	360	0.1	36
	750		300

β_p $= \sum_{i=1}^{n} x_i \beta_i$

$= \frac{300}{750} = 0.40$

Assuming the portfolio returns follow CAPM

$E(R) = R_f + \beta (R_m - R_f)$

8.9 $= R_f + 5.08 - 0.4\ R_f$

8.09 – 5.08 $= 0.6\ R_f$

$\boldsymbol{R_f}$ = **6.37%**

Minimum return expected is 6.37% R_f or if annual coupon is 10% then that value.

(ii) R_f = 7%

R_m = 12.7%

β = 0.4

$E(R) = R_f + \beta (R_m - R_f)$

= 7+ 0.4 (12.7- 7)

= 7+ 2.28% = **9.28%**

Actual Return = **8.90%**

The portfolio underperformed with respect to the market return of 7% and its own beta of 0.4 as it generated 8.9% v/s expected return of 9.28%.

73. Illustration

Blue Tooth Mutual Fund is planning to float a fixed income fund of Rs.100 crore on 1 January 2015 with a term of 7 years.

If the target duration of fund is $5\frac{1}{2}$ years and has expected rate of return of 8.00%, then determine the amount of interest it has to earn annually on its investment after defraying management expenses of 10% of amount income earned.

Solution:

Let coupon/ interest p.a be x% of 100

Year	Coupon/ CF	PVF @8%	Time (T)	$PV * CF * T$
1	X	0.926	1	0.926x
2	X	0.857	2	1.714x
3	X	0.794	3	2.382x
4	X	0.735	4	2.94x
5	X	0.68	5	3.4x
6	X	0.63	6	3.78x
7	x+100	0.583	7	4.081x+ 408.1
				19.223x+ 408.1

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Duration = $\frac{\sum PV * CF * T}{P_0}$

5.5 = $\frac{19.223x + 408.1}{100}$

550- 408.1 = 19.223x

x = $\frac{141.9}{19.223}$ = **7.38%**

Annual return required post expenses is 7.38%

Pre-Expense Return,

= $\frac{7.38\%}{0.9}$ = **8.20%**

74. Illustration

Indira has a fund of ₹ 3 lacs which she wants to invest in share market with rebalancing target after every 10 days to start with for a period of one month from now. The present NIFTY is 5326. The minimum NIFTY within a month can at most be 4793.4. She wants to know as to how she should rebalance her portfolio under the following situations, according to the theory of Constant Proportion Portfolio Insurance Policy, using "2" as the multiplier:

(1) Immediately to start with.

(2) 10 days later-being the 1st day of rebalancing if NIFTY falls to 5122.96.

(3) 10 days further from the above date if the NIFTY touches 5539.04.

For the sake of simplicity, assume that the value of her equity component will change in tandem with that of the NIFTY and the risk-free securities in which she is going to invest will have no Beta.

Solution:

Current NIFTY = 5326

Max Loss = 10% (532.6)

Max Loss Level (NIFTY) = 4793.4

Assuming floor is at 10% level of loss from current level;

Current Value of Portfolio = ₹ 3,00,000

Floor = 90% of Portfolio Value = **₹ 2,70,000**

M = 2

F = 2.7

P. V = 3

S i.e., investment in Equity Shares

= 2* (3,00,000- 2,70,000)

= 2* 30,000 = **₹ 60,000**

Debt Investment = ₹ 2,40,000 (3,00,000- 60,000)

Day	NIFTY	Equity	Debt	Equity Value	Debt Value	Portfolio
0	5326	20%	80%	60000	240000	300000
11	5122.96	19.39%	80.61%	57713	240000	297713
11 (After Reb) *	5122.96	18.61%	81.39%	55426	242287	297713
21	5539.04	19.83%	80.17%	59928	242287	302215
21 (After Reb) *	5539.04	21.32%	78.68%	64430	237785	302215

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Working Notes:

1. Value of Equity on Day 11 when NIFTY falls to 5122.96 is
   = ₹ 60000* 5122.96/ 5326 = **57713**
2. After rebalancing on Day 11
   Equity Shares = 2* (297713- 270000) = **55426**
   On Day 11 Indira will have to rebalance the portfolio by withdrawing money of ₹ 2287 from equity investment and putting it in debt or risk-free securities.
3. Value of Equity portfolio when NIFTY rises from 5122.96 to 5539.04
   = 55426* 5539.04/ 5122.96 = **59928**
4. Equity Value = M(P-F)
   = 2 (302215- 27000) = **64430**

On Day 11 Indira will have to rebalance the portfolio by **withdrawing money of ₹ 2287 from equity investment** and putting it in debt or risk-free securities.

On Day 21 Indira will rebalance by **investing more in Equity i.e., Rs.4502 by withdrawing** this money from debt or risk-free securities.

75. Illustration

Ms. Kiran had a surplus fund of ₹ 2,00,000 on 31.03.2016. She is interested in constructing a portfolio of shares of the core sectors to be weighted equally in rupee value terms. Her friend Shaila based on her research advised her to purchase following shares:

Company	No. of Shares	Price Per Share
O Ltd.	100	400
H Ltd.	1000	40
A Ltd.	320	125
R Ltd.	400	100
T Ltd.	200	200

On April 1, 2016, the prices of these stocks were as follows:

Company	Price Per Share
O Ltd.	300
H Ltd.	60
A Ltd.	120
R Ltd.	150
T Ltd.	125

You are required to exhibit how Kiran can rebalance her portfolio on 1.4.2016 so that her exposure to individual stock is maintained at original level in terms of rupee value.

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Solution:

On **31/03/16;**

Company	Shares	Inv. Price	Value
O	100	400	40000
H	1000	40	40000
A	320	125	40000
R	400	100	40000
T	200	200	40000
			200000

Ms Kiran invested her surplus equally in each of the securities.

On **01/04/16;**

Company	Shares	Market price	Market Value	Desired Value	Action
O	100	300	30000	42680	Buy- 12680
H	1000	60	60000	42680	Sell- 17320
A	320	120	38400	42680	Buy- 4280
R	400	150	60000	42680	Sell- 17320
T	200	125	25000	42680	Buy- 17680
			213400		0

* Desired Value per security: Ms Kiran rebalances the portfolio in such a way that the total market value in each security is equal i.e., 2,13,400/5 = 42680.

Company	Action	Total Value	Price per Share	Shares sold/bought
O	Buy	12680	300	42.27
H	Sell	-17320	60	-288.67
A	Buy	4280	120	35.67
R	Sell	-17320	150	-115.47
T	Buy	17680	125	141.44
		0		

Post Rebalancing Portfolio of Ms Kiran:

Company	Shares	Price per Share	Market Value
O	142.27	300	42680
H	711.33	60	42680
A	355.67	120	42680
R	284.53	150	42680
T	341.44	125	42680

76. Illustration

Ms. Sunidhi is working with an MNC at Mumbai. She is well versant with the portfolio management techniques and wants to test one of the techniques on an equity fund she has constructed and compare the gains and losses from the technique with those from a passive buy and hold strategy. The fund consists of equities only and the ending NAVs of the fund he constructed for the last 10 months are given below:

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Month	Ending NAV (₹/unit)	Month	Ending NAV (₹/unit)
December 2008	40.00	May 2009	37.00
January 2009	25.00	June 2009	42.00
February 2009	36.00	July 2009	43.00
March 2009	32.00	August 2009	50.00
April 2009	38.00	September 2009	52.00

Assume Sunidhi had invested a notional amount of ₹ 2 lakhs equally in the equity fund and a conservative portfolio (of bonds) in the beginning of December 2008 and the total portfolio was being rebalanced each time the NAV of the fund increased or decreased by 15%.

You are required to determine the value of the portfolio for each level of NAV following the Constant Ratio Plan.

Are there any errors in the technique developed by Sunidhi? If So please explain?

Solution:

Constant Mix Policy

Period	E:D	Equity	Debt	PV	NAV	Units
01-12-2008	50:50	100000	100000	200000	40	2500
31-12-2008	38:62	100000	100000	200000	40	2500
Before Rebalance 31/01/2009	50:50	62500	100000	162500	25	2500
After Rebalance 31/01/2009	59:41	81250	81250	162500	25	3250
Before Rebalance 28/02/2009	50:50	117000	81250	198250	36	3250
After Rebalance 28/02/2009	47:53	99125	99125	198250	36	2753.47
Before Rebalance April	51:49	104631.86	991250	203765.86	38	2753.47
After Rebalance April	50:50	101878.43	101878.4	203756.86	38	2681.01
May	49:51	99197.37	101878.4	201075.8	37	2681.01
June	53:47	112602.42	101878.4	214480.85	42	2681.01
July	53:47	115283.43	101878.4	217161.86	43	2681.01
Before Rebalance August	57:43	134050.5	101878.4	235928.93	50	2681.01
After Rebalance August	50:50	117964.47	117964.5	235928.94	50	2359.29
September	51:49	122683.08	117964.5	**240647.55**	52	2359.29

BUY And HOLD

Month	Equity	Debt	NAV	Units	PV
Dec	100000	100000	40	2500	200000
Jan	62500	100000	25	2500	162500
Feb	90000	100000	36	2500	190000
Mar	80000	100000	32	2500	180000
Apr	95000	100000	38	2500	195000
May	92500	100000	37	2500	192500
Jun	105000	100000	42	2500	205000

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Jul	107500	100000	43	2500	207500
Aug	125000	100000	50	2500	225000
Sep	130000	100000	52	2500	**230000**

Value of Buy and Hold Portfolio with 50:50 Equity and Debt is ₹ 230000 v/s ₹ 240647.55 in constant mix policy

BUY and HOLD with E:D as 100:0

Month	NAV	Equity	Units
Dec	40	200000	5000
Jan	25	125000	5000
Feb	36	180000	5000
Mar	32	160000	5000
Apr	38	190000	5000
May	37	185000	5000
Jun	42	210000	5000
Jul	43	210000	5000
Aug	50	215000	5000
Sep	52	260000	5000

If Buy and Hold of E:D 100:0 is implemented, final portfolio is ₹ 260000 v/s ₹240647.55 in constant mix and ₹ 230000 in Buy and Hold E:D 50:50 rebalancing policies. The 100:0 E:D outperforms the other two strategies.

There are no errors. However, if the market is expected to be in the bull phase, then 100% equity allocation with Buy & Hold will give best results and if markets are expected to be in the unknown territory then, 50:50 constant mix policy with give both upside & also protect the downside. If market is in recessionary phase, then Buy & Hold of 100% Debt would be best suited.

77. Illustration (RTP May 22)

Mr. A is having 1 lakh shares of K Ltd. The beta of the company is 1.40. Mr. B a financial advisor has suggested having the following portfolio:

Security	Beta	% holding
L	1.20	**10**
M	0.75	**10**
N	0.40	**30**
O	1.40	**50**
		100

Market Return is 12%
Risk free rate is 8%

You are required to calculate the following for the present investment and suggested portfolio:

(i) What is the expected return based on CAPM and also
   (1) If the market goes upby 2.5%.
   (2) If the market goes down by 2.5%.
   (3) If the market is giving a negative return of 2.5%.

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(ii) If the probability of market giving negative return is more, please advise Mr. A whether to continue the holdings of M/s. K Ltd. or to buy the portfolio as per the suggestion of Mr. B. If so, why?

Solution:

Security	(β)	% Holding	$\beta *$%
L	1.2	10%	0.12
M	0.75	10%	0.075
N	0.4	30%	0.12
O	1.4	50%	0.7
			1.015

$E(R)$ = $R_f + \beta(MRP)$
R_m = 12%
R_f = 8%
MRP = $R_m - R_f$ = 4%
Return of K Ltd. As per CAPM,
β = 1.4
$E(R)$ = 8%+ 1.4* (4%) = **13.6%**
Return of Portfolio,
= 8%+ 1.015* (4%) = **12.06%**

(i) When R_m increases by 2.5%
Return of K Ltd.
$E(R)$ = 8%+ 1.4* (12%+ 2.5%- 8%)
= 8%+ 1.4* (6.5%) = **17.1%**
Return of Portfolio,
= 8%+ 1.015* (6.5%) = **14.5975%**

(ii) When R_m changes from 12% to 9.5% i.e., 2.5% decrease
Return of K Ltd.
$E(R)$ = 8%+ 1.4* (12%- 2.5%- 8%)
= 8%+ 1.4* (1.5%) = **10.1%**
Return of Portfolio,
= 8%+ 1.015* (1.5%) = **14.5975%**

(iii) When market return is -2.5%
Return of K Ltd.
$E(R)$ = 8%+ 1.4* (- 2.5%- 8%)
= 8%+ 1.4* (-10.5%) = **- 6.7%**
Return of Portfolio,
= 8%+ 1.015* (-10.5%) = **- 2.6575%**

If market is expected to generate negative returns, then portfolio of L, M, N, O is giving lower losses @ 2.6575% v/s loss of 6.71% in case of stock k. So, it is better to go with the portfolio of stocks suggested by B as this portfolio has lower Beta and hence when market gives negative returns its returns are not too different as compared to K Ltd. which has a higher Beta and hence leads to higher losses when market has negative returns.

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78. Illustration (RTP May 22)

Mayuri is interested to construct a Portfolio of Securities X and Y. She has collected the following information:

	X	Y
Expected Return (ER)	19%	23%
Risk (σ)	14%	18%

Mayuri has 5 Portfolio options of X and Y as follows:

(i) 50% of funds in each X and Y
(ii) 75% of funds in X and 25% in Y
(iii) 25% of funds in X and 75% in Y
(iv) 60% of funds in X and 40% in Y
(v) 35% of funds in X and 65% in Y

Suppose if Co-efficient of correlation (r) between X and Y is 0.16, you are required to calculate:

(i) Expected Return under different Portfolio Options.
(ii) Risk Factor associated with these Portfolio Options.
(iii) Which Portfolio is best from the point of view of Risk?
(iv) Which Portfolio is best from the point of view of Return?

Solution:

Weighted Average,

WAR = $W_A K_A + W_B K_B$

σ_p^2 = $(W_A * \sigma A)^2 + (W_B * \sigma B)^2 + 2\, W_A W_B\, \sigma A\, \sigma B\, r$

$E(R)_X$ = 19%

$E(R)_Y$ = 23%

σ_X = 14%

σ_Y = 18%

r = 0.16

Option 1:

W_x = 50%

W_Y = 50%

$E(R)_p$ = 0.5*19% + 0.5*23%
= 9.5+ 11.5 = **21%**

σ_p^2 = $(0.5)^2 (14)^2 + (0.5)^2(18)^2 + 2*14*18*0.5*0.5*0.16$
= 49+ 81+ 20.16 = **150.16**

σ_p = $\sqrt{150.16}$ = **12.25%**

Option 2:

W_x = 75%

W_Y = 25%

$E(R)_p$ = (0.75*19%) + (0.25*23%) = **20%**

σ_p^2 = $(0.75)^2 (14)^2 + (0.25)^2(18)^2 + 2*14*18*0.75*0.25*0.16$
= 110.25+ 20.25+ 15.12 = **145.62**

σ_p = $\sqrt{145.62}$ = **12.067%**

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Option 3:

W_x = 25%

W_Y = 75%

$E(R)_p$ = (0.25*19%) + (0.75*23%) = **22%**

σ_p^2 = $(0.25)^2 (14)^2 + (0.75)^2(18)^2 + 2*14*18*0.25*0.5*0.16$

= 12.25+ 182.25+ 15.12 = **209.62**

σ_p = $\sqrt{209.62}$ = **14.478%**

Option 4:

W_x = 60%

W_Y = 40%

$E(R)_p$ = (0.60*19%) + (0.40*23%) = **20.6%**

σ_p^2 = $(0.60)^2 (14)^2 + (0.40)^2(18)^2 + 2*14*18*0.60*0.40*0.16$

= 70.56+ 51.84+ 19.3536 = **141.7536**

σ_p = $\sqrt{141.7536}$ = **11.906%**

Option 5:

W_x = 35%

W_Y = 65%

$E(R)_p$ = (0.35*19%) + (0.65*23%) = 21.6%

σ_p^2 = $(0.35)^2 (14)^2 + (0.65)^2(18)^2 + 2*14*18*0.35*0.65*0.16$

= 24.01+ 136.89+ 18.3456 = **179.24**

σ_p = $\sqrt{179.24}$ = **13.388%**

Options	1	2	3	4	5
$E(R)_p$	21	20	22	20.6	21.6
σ_p	12.25	12.067	14.478	11.906	13.388

Portfolio 3 has highest return and Portfolio 4 has lowest risk, these are best suited from return and risk perspective respectively.

79. Illustration (Critical Line Theory)

An investor has two portfolios known to be on minimum variance set for a population of three securities A, B and C having below mentioned weights:

	WA	WB	WC
Portfolio X	0.30	0.40	0.30
Portfolio Y	0.20	0.50	0.30

It is supposed that there are no restrictions on short sales.

(1) What would be the weight for each stock for a portfolio constructed by investing? ₹5,000 in portfolio X and ₹3,000 in portfolio Y?

(2) Suppose the investor invests ₹4,000 out of ₹8,000 in security A. How will he allocate the balance between security B and C to ensure that his portfolio is on minimum variance set?

Solution

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(1)

	X		Y		X+Y	Ratio	Weights
A	0.3	1500	0.2	600	2100	21	26.25%
B	0.4	2000	0.5	1500	3500	35	43.75%
C	0.3	1500	0.3	900	2400	24	30%
	1	5000	1	3000	8000	80	

The weights of stocks A, B and C in combined portfolio is **26.35: 43.75:30**.

(2)

$w_A = \alpha + w_B \beta$

$y = C + mx$

For Portfolio X, $0.4 = \alpha + 0.3\,\beta$ **(a)**

For Portfolio Y, $0.5 = \alpha + 0.2\,\beta$ **(b)**

(b) –(a),

$0.1 = -0.1\,\beta$

$\beta = -1$

Substituting $\beta = -1$ in Equation **(a)**,

$0.4 = \alpha - 0.3 * 1$

$\alpha = 0.7$

₹ 4,000 invested in A i.e., 50%,

$w_A = \alpha + w_B \beta$

$0.5 = 0.7 - w_B * 1$

$w_B = 0.2 = 20\%$

$20\% * 8000$ = **1,600**

$w_C = 0.3 = 30\%$

$30\% * 8000$ = **2,400**

80. Illustration- Sharp & Treynor Ratios (Nov 22)

Following is the information related to three mutual funds:

Year	MF-A	MF-B	MF-C
2020	10%	5%	14%
2021	8%	10%	10%
2022	12%	8%	18%

Correlation between market and mutual fund:

	MF-A	MF-B	MF-C
Correlation with market	0.45	0.25	0.65

The variance of the market is 9% and rate of return of government bond is 7%. You are required to Rank the Mutual fund using Sharpe's ratio and Treynor's ratio.

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Solution

	A	B	C	$A-\bar{A}$	$(A-\bar{A})^2$	$B-\bar{B}$	$(B-\bar{B})^2$	$C-\bar{C}$	$(C-\bar{C})^2$
2020	10	5	14	0	0	2.67	7.1289	0	0
2021	8	10	10	-2	4	2.33	5.4289	-4	16
2022	12	8	18	2	4	0.33	0.1089	4	16
	30	23	42		**8**		**12.67**		**32**
Average	30%	7.67%	14%						
σ					$\sqrt{\frac{8}{3}}$ = **1.63**		$\sqrt{\frac{12.67}{3}}$ = **2.05**		$\sqrt{\frac{32}{3}}$ = **3.27**

	A	B	C
(1) Correlation	0.45	0.25	0.65
σ_m^2	9	9	9
(2) σ_m	3	3	3
(3) σ_p	1.63	2.05	3.27
$\beta = (1) * \frac{(3)}{(2)}$	0.2445	0.1708	0.708

	A	B	C
(1) R_p	10	7.67	14
(2) R_f	7	7	7
(3) σ_p	1.63	2.05	3.27
(4) β	0.2445	0.1708	0.708
$Sharpe\ Ratio = \frac{(1)-(2)}{(3)}$	**1.84**	**0.33**	**2.14**
Rank	**2**	**3**	**1**
Treynor Ratio $= \frac{(1)-(2)}{(4)}$	**12.26**	**3.92**	**9.88**
Rank	**1**	**3**	**2**

81. Illustration - Portfolio Return & Beta (Nov 22)

Following is the information related to return on shares of three different companies:

Years	A Ltd.	B Ltd.	C Ltd.
2018	2%	3%	5%
2019	6%	8%	7%
2020	13%	14%	15%
2021	7%	9%	11%

Required:

a. Construct maximum number of portfolio and its return, if each portfolio consists of any two Company's shares in proportion of 65% and 35% and suggest which portfolio provides highest

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return.

b. Calculate portfolio return and beta (β), if Mr. X invests ₹ 65,000 in A Ltd. having beta (β) of 0.45; ₹ 20,000 in B Ltd. having beta (β) of 1.15 and ₹15,000 in C Ltd. having beta (β) of 1.8

Solution:

	A	B	C
2018	2	3	5
2019	6	8	7
2020	13	14	15
2021	7	9	11
	28	34	38
Average	**7%**	**8.5%**	**9.5%**

	A	B	C	Return
1	0	65	35	(0*7)+ (0.65*8.5)+ (0.35*9.5)= **8.85**
2	0	35	65	(0*7)+ (0.35*8.5)+ (0.65*9.5)= **9.15**
3	65	0	35	(0.65*7)+ (0*8.5)+ (0.35*9.5)= **7.875**
4	35	0	65	(0.35*7)+ (0*8.5)+ (0.65*9.5)= **8.625**
5	65	35	0	(0.65*7)+ (0.35*8.5)+ (0*9.5)= **7.525**
6	35	65	0	(0.35*7)+ (0.65*8.5)+ (0*9.5)= **7.975**

The best performing portfolio consists of **Stock B @ 35% and Stock C at 65%.**

b.

		Return (1)	Beta (2)	Weights (3)	Weighted Average Return (1)*(3)	Weighted Average Beta (2)*(3)
A	65,000	7	0.45	0.65	4.55	0.2925
B	20,000	8.5	1.15	0.2	1.7	0.23
C	15,000	9.5	1.8	0.15	1.425	0.27
					7.675	**0.7925**

The **portfolio return** consisting of Stocks A ,B and C in ratio of 65,000: 20,000: 15,000 is **7.675%** and **Beta is 0.7925.**

82. Illustration - May'23

Mr. Potential has made investments in two mutual funds. The following information is available:

Mutual Fund	Smart	Growth
Jensen Alpha	1.10%	1.50%
Treynor's Ratio	0.0714	0.0775
Actual Return	8.50%	9.10%
Risk Premium	4%	

You are required to calculate:

(i) Beta for both the funds

(ii) Risk free Rate

(iii) Security Market Line

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Solution

(i)

Jenson's Alpha = Actual Return – Expected Return

For Smart:

1.1% = 8.5% - Expected Return

Expected Return = 8.5- 1.1 = 7.4 %

For Growth:

1.5% = 9.1% - Expected Return

Expected Return = 9.1- 1.5 = 7.6 %

Treynor Ratio = $\frac{Actual\ Return - Risk\ Free\ Rate}{\beta}$

For Smart:

0.0714 = $\frac{8.5\% - Rf}{\beta}$

β = $\frac{8.5\% - Rf}{0.0714}$ **(1)**

For Growth:

0.0775 = $\frac{9.1\% - R_f}{\beta}$

β = $\frac{9.1\% - R_f}{0.0775}$ **(2)**

CAPM,

Expected Return = $R_f + \beta(MRP)$

= $R_f + \beta(4\%)$

For Smart:

7.4% = $R_f + \beta(4\%)$

β = $\frac{7.4\% - R_f}{4\%}$ **(3)**

For Growth:

7.6% = $R_f + \beta(4\%)$

β = $\frac{7.6\% - R_f}{4\%}$ **(4)**

Equating **(1)** and **(3)**,

$\frac{8.5\% - R_f}{0.0714}$ = $\frac{7.4\% - R_f}{4\%}$

0.0034 – 0.04 R_f = 0.0052836 – 0.0714 R_f

0.0034 – 0.0052836 = 0.04 R_f – 0.0714 R_f

R_f = $\frac{0.0018836}{0.0314}$ = **0.06**

(ii)

For Smart, Substituting Value of R_f = 0.06 in Equation **(1)**

β = $\frac{8.5\% - 0.06}{0.0714}$ = $\frac{2.5\%}{0.0714}$ = **0.35**

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For Growth, Substituting Value of R_f = 0.06 in Equation **(2)**

β = $\frac{9.1\% - 0.06}{0.0775}$ = $\frac{3.1\%}{0.0775}$ = **0.4**

(iii) SML i.e., CAPM

Smart: = $R_f + \beta(MRP)$

= $R_f + \beta(R_m - R_f)$

= $6\% + 0.35(R_m - 6\%)$

MRP = $R_m - R_f$

4% = $R_m - 6\%$

R_m = 10%

SML for Smart = $6\% + \beta(4\%)$

SML for Growth = $6\% + \beta(4\%)$

83. Illustration - May'23

An Investor is proposing to invest 10,000/- in two Portfolios A and B in the ratio of 3:2. The Portfolios have three securities each with following weights:

	Wx	Wy	Wz
Portfolio A	0.30	0.25	0.45
Portfolio B	0.20	0.45	0.35

You are requested to

(i) Calculate the weight of each security

(ii) Calculate the amount allocated to securities y & z if half of the funds are allocated to security x.

Solution:

i)

			x	y	z	
A	3	6,000	0.30 1,800	0.25 1,500	0.45 2,700	6,000
B	2	4,000	0.20 800	0.45 1,800	0.35 1,400	4,000
	5	10,000	**2,600**	**3,300**	**4,100**	

Allocation amongst securities x,y,z is in the ratio 26: 33: 41 for an amount of ₹ 10,000.
Weight of each security in the combined portfolio is 26: 33: 41.

ii)

w_y = $a + b\, w_x$

Portfolio A: 0.25 = $a + b * 0.3$

Portfolio B: 0.45 = $a + b * 0.2$

A – B: – 0.20 = $b * 0.1$

b = $-\frac{0.20}{0.1}$

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b = – 2

Substituting, b = – 2 in equation of Portfolio A,

0.25 = $a - 2 * 0.3$

0.25 = $a - 0.6$

a = 0.85

w_x in new portfolio is 50 %,

w_y = $a + b\, w_x$

= $0.85 - 2 * 0.5$

= $0.85 - 1$ = – 0.15

Also,

$w_x + w_y + w_z = 1$

w_z = $1 - w_x - w_y$

= 1 – 0.5 + 0.15 = 0.65

Amount Allocated

x = 0.5* 10,000 =**₹ 5,000**

y = -0.15* 10,000 = –**₹ 1,500**, shorting

x = 0.65* 10,000 = **₹ 6,500**

84. Illustration - Nov'23

An investor has categorized all the available stock in the market into the following types and the estimated weights of the categories of stocks in the market index are givenbelow. Further, the sensitivity of returns of these categories of stocks to two factors Inflation and Stock market are also given below:

Category	Weight in Market Index	Factor 1 (Inflation)			Factor 2 (Stock Market)		
		Beta 1	Expected Value in %	Actual Value in %	Beta 2	Expected Value in %	Actual Value in %
Small Cap	20%	1.20	6.70	6.70	0.80	10.00	**10.50**
Medium Cap	30%	1.75	4.50	6.00	0.90	7.00	8.00
Large Cap	15%	1.30	6.75	8.00	1.165	9.00	10.00
Flexi Cap	35%	1.70	7.00	6.50	0.85	8.85	9.75

Risk Free Rate of Interest is 7.50%. Round off to 2 decimal.
You are required to calculate:

(i) Expected return on the market index for both the factors.
(ii) Expected return on the market index under Arbitrage Pricing Theory (Existing Scenario).
(iii) Expected return on the market index under Arbitrage Pricing Theory if the composition of the Portfolio is changed to 25% equally in all four categories.
(iii) Which alternative (Existing or Changed) will be more profitable?

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Solution:

(i) Expected Return on Market Index for Both factors

Factor 1 - Inflation

= 0.20 x 6.70% + 0.30 x 4.50% + 0.15 x 6.75% + 0.35 x 7.00%

= 1.34% + 1.35% + 1.01% + 2.45% = 6.1525%

Factor 2 – Stock Market Return

= 0.20 x 10% + 0.30 x 7% + 0.15 x 9% + 0.35 x 8.85%

= 2% + 2.10% + 1.35% + 3.10%

= 8.5475%

(ii)

As per APT modfied by Ross,

$E(R) = R_f + B_1 (AV_1-EV_1) + B2 (AV_2-EV_2)$.....

	Factor 1 (Inflation)				
Category	**Beta**	**Actual value**	**Expected value**	**Difference**	**Beta x Diff.**
	(a)	**(b) (%)**	**(c) (%)**	**(b) - (c) = (d) (%)**	**(e)**
Small Cap	1.20	6.70	6.70	0.00	0.00
Medium Cap	1.75	6.00	4.50	1.50	2.63
Large Cap	1.30	8.00	6.75	1.25	1.63
Flexi cap	1.70	6.50	7.00	(0.50)	(0.85)

	Factor 2 (Stock Market)				
Category	**Beta**	**Actual value**	**Expected value**	**Difference**	**Beta x Diff.**
	(a)	**(b) (%)**	**(c) (%)**	**(b) - (c) = (d) (%)**	**(e)**
Small Cap	0.80	10.50	10.00	0.50	0.40
Medium Cap	0.90	8.00	7.00	1.00	0.90
Large Cap	1.165	10.00	9.00	1.00	1.165
Flexi cap	0.85	9.75	8.85	0.90	0.765

	Combined Expected return				
Category	**Weight**	**A = B1 (AV1-EV1)**	**B = B2 (AV2-EV2)**	**Rf**	**E (R)= A + B + Rf**
Small Cap	0.20	0.00%	0.40%	7.5%	7.9%
Medium Cap	0.30	2.63%	0.90%	7.5%	11.025%
Large Cap	0.15	1.63%	1.165%	7.5%	10.29%
Flexi cap	0.35	-0.85%	0.765%	7.5%	7.415%
Weighted Average = Sum of (weights x E(R))					9.02625%

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(iii)

	Expected return with weights of 25% each				
Category	**Weight**	**A = B1 (AV1-EV1)**	**B = B2 (AV2-EV2)**	**Rf**	**E (R)= A + B + Rf**
Small Cap	0.25	0.00%	0.40%	7.5%	
Medium Cap	0.25	2.63%	0.90%	7.5%	
Large Cap	0.25	1.63%	1.165%	7.5%	
Flexi cap	0.25	-0.85%	0.765%	7.5%	
Weighted Average = Sum of (weights x E(R))					9.1575

(iv) The revised allocation where all weights are 25% each is better compared to existing scenario

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SECURITIZATION (1Q)

Illustration 1: – May'24 RTP

Grow More Ltd. an NBFC is in the need of funds and hence it sold its receivables to MAC Financial Corporation (MFC) for ₹ 100 million. MFC created a trust for this purpose called General Investment Trust (GIT) through which it issued securities carrying a different level of risk and return to the investors. Further, this structure also permits the GIT to reinvest surplus funds for short term as per their requirement.
MFC also appointed a third party, Safeguard Pvt. Ltd. (SPL) to collect the payment due from obligor(s) and passes it to GIT. It will also follow up with defaulting obligor and if required initiate appropriate legal action against them.

Based on above scenario, answer the following questions:

I. The securitized instrument issued for ₹ 100 million by the GIT falls under category of

(a) Pass Through certificate (PTCs)
(b) **Pay Through Security (PTS)**
(c) Stripped Security
(d) Debt Fund.

A PTS is one in which surplus money if any, is invested in order to even out cash flows. In a PTC, cash flows are passed on to the investors as received.

II. In the above scenario, the Originator is…….
(a) Grow More Ltd.
(b) **MAC Financial Corporation (MFC)**
(c) General Investment Trust (GIT)
(d) Safeguard Pvt. Ltd.

Since MAC has created the a trust, they are the originator and not Grow More

III. In the above scenario, the General Investment Trust (GIT) is a/an…….
(a) Obligor
(b) Originator
(c) **Special Purpose Vehicle (SPV)**
(d) Receiving and Paying Agent (RPA)

IV. In the above scenario, the Safeguard Pvt. Ltd. (SPL) is a/an……

(a) Obligor
(b) Originator
(c) Special Purpose Vehicle (SPV)
(d) **Receiving and Paying Agent (RPA)**

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V. Which of the following statement holds true?

(a) When Yield to Maturity in market rises, prices of Principal Only (PO) Securities tend to rise.
(b) When Yield to Maturity in market rises, prices of Principal Only (PO) Securities tend to fall.
(c) When Yield to Maturity in market falls, prices of Principal Only (PO) Securities tend to fall.
(d) When Yield to Maturity in market falls, prices of Principal Only (PO) Securities remain the same.

The holder of IO securities receives only interest while PO security holder receives only principal.

Interest rate in market	**Value of IO's securities**	**Value of PO's securities**
Raises	Raises	Falls (Borrower prefers to postpone the payment on cheaper loans)
Falls	Falls	Raises (Borrower tends to repay the loans as they prefer to borrow fresh loan at lower rate of interest)

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MUTUAL FUNDS (33Q)

1. Illustration

A mutual fund that had a net asset value of ₹16 at the beginning of a month, made capital gain and income distribution of ₹0.04 and ₹0.03 respectively per unit during the month, and then ended the month with a net asset value of ₹16.08. Calculate the monthly and annual returns.

Solution:

Particulars	₹	%
Opening NAV	16	
CG Distribution	0.04	
Income Distribution	0.03	
Closing NAV	16.08	
Return		
$= \frac{(Closing\ NAV - Opening\ NAV + CG + ID)}{Opening\ NAV}$		
$= \frac{16.08-16+0.04+0.03}{16} = \frac{0.15}{16} = 09375$		0.94%
Monthly Return		0.9375%
Annualized Return		11.25%
Annualised Return Based on Compounding		
$(1 + 0.9375\%)^{12} - 1$		**11.85%**

2. Illustration

A Mutual Fund having 300 units has shown its NAV of ₹8.75 and ₹9.45 at the beginning and at the end of the year, respectively.

The Mutual Fund has given two options:
(i) Pay ₹0.75 per unit as dividend and ₹0.60 per unit as a capital gain, or
(ii) These distributions are to be reinvested at an average NAV of ₹8.65 per unit.

What difference it would make in terms of return available and which option is preferable?

Solution:

Particulars	₹	%
Opening Units	300	
Opening NAV	8.75	
Closing NAV	9.45	
Dividend	0.75	
CG	0.60	
Reinvestment NAV	8.65	
Option 1:		
Return		
$= \frac{(Closing\ NAV - Opening\ NAV + CG + ID)}{Opening\ NAV} = \frac{2.05}{8.75}$		23.43%
Option 2:		

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$= \frac{Amount\ Reinvested}{Units}$	1.35	
Total Amount Reinvested	405	
Reinvestment NAV	8.65	
No of units allotted on account of Reinvestment (Units)	46.82	
Closing Units	346.82	
Return		
$= \frac{Closing\ Value\ of\ Investment - Opening\ Value\ of\ Investment}{Opening\ Value\ of\ Investment}$ $= \frac{652.46}{2625}$		**24.86%**

Option 2 is preferrable

3. Illustration

Mr. X, an investor had purchased 200 units of ABC Mutual Fund at the rate of ₹8.50 per unit, one year ago. Over the year Mr. X received ₹0.90 as dividend and had received a capital gains distribution of ₹0.75 per unit.

You are required to find out:

(a) Mr. X's holding period return, assuming that this no-load fund has a NAV of ₹9.10 as on today.

(b) Mr. X's holding period return, assuming all the dividends and capital gains distributions are reinvested into additional units at average price of ₹8.75 per unit.

Solution:

Particulars	Units	Rs.	%
Opening NAV	200	8.50	
Closing NAV		9.10	
Dividend		0.90	
CG		0.75	
Reinvestment NAV		8.75	
Option 1			
Return			
$= \frac{(Closing\ NAV - Opening\ NAV + CG + ID)}{Opening\ NAV} = \frac{2.25}{8.5}$			26.47%
Option 2:			
Dividend + CG		1.65	
Total Dividend + CG paid		330.0	
Reinvestment NAV		8.75	
No. of Units received on Re investment	37.71		
Closing Units	237.71		
$= \frac{Closing\ Value\ of\ Investment - Opening\ Value\ of\ Investment}{Opening\ Value\ of\ Investment}$			
$= \frac{463.2}{1700}$			**27.25%**

Mr X has to go for option 2 i.e reinvestment option as it provides higher return

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4. Illustration

The NAV of per unit of XYZ Mutual Fund (a Close Ended Fund) on 1.1.2014 was ₹28. The value of 31.12.2014 comes to ₹28.80. On the same date unit was trading in market at premium of 3% though on 1.1.2014 same was trading at a discount at 5%. On 31.12.2014, XYZ distributed a sum of ₹2.80 as incomes and capital gains. You are required to compute rate of return to the investors during the year.

Solution:

Particulars	Rs.	%
Opening NAV	28.00	
Closing NAV	28.80	
Opening Discount		5.00%
Closing Premium		3.00%
Opening Market price	26.60	
Closing Market Price	29.66	
CG + Divided	2.80	
Return $= \frac{(Closing\ NAV - Opening\ NAV + CG + ID)}{Opening\ NAV} = \frac{5.86}{26.6}$		**22.05%**

5. Illustration

The unit price of Equity Linked Savings Scheme (ELSS) of a mutual fund is ₹10. The public offer price (POP) of the unit is ₹10.204 and the redemption price is ₹9.80. Calculate:

(i) Front end Load

(ii) Back end Load

Solution:

Particulars	Rs.	%
FV	10.000	
NFO	10.204	
Redemption price	9.800	
Entry Load $= \frac{10.204 - 10}{10}$		**2.04%**
Exit Load $= \frac{10 - 9.8}{10}$		**2.00%**

6. Illustration

During the year 2017 an investor invested in a mutual fund. The capital gain and dividend for the year was ₹3 per unit, which were re-invested at the year-end NAV of ₹23.75. The investor had total units of 26,750 as at the end of the year. The NAV had appreciated by 18.75% during the year and there was an entry load of ₹0.05 at the time when the investment was made.

The investor lost his records and wants to find out the amount of investment made and the entry load in the mutual fund.

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Solution:

Particulars	Units	₹	%
Opening NAV		20.000	
Closing NAV	26750	23.750	18.75%
CG + Dividend		3.00	
Opening Units	x		
Reinvested CG + Dividend	x	3.00	
Total reinvestment value		3 * x	
Reinvested NV		23.75	
$x + \frac{3 * x}{23.75} = 26750$			
$\frac{23.75x + 3x}{23.75} = 26750$			
$26.75x = 23.75 * 26750$			
$x = \frac{26750 * 23.75}{26.75}$	23750.00		
Opening	23750	20.00	
Investment value		4,75,000.00	
Entry load	23750	0.05	
Total load		1,187.50	
Total outflow for investor		**4,76,187.50**	

7. Illustration

Mr. A can earn a return of 16 per cent by investing in equity shares on his own. Now he is considering a recently announced equity based mutual fund scheme in which initial expenses are 5.5 per cent and annual recurring expenses are 1.5 per cent.
How much should the mutual fund earn to provide Mr. A return of 16 per cent?

Solution:

Return = $\frac{Investor\ Return}{1 - Initial\ Expenses\ \%} + Recurring\ Expenses$

Particulars	₹ Per Unit	%
Required Return		16.00%
Initial expenses		5.50%
Annual recurring expenses		1.50%
Let MF return = x		
$x = \frac{1.5\% + 16\%}{1 - 5.5\%}$		**18.43%**
		-1.50%
	9.45	16.9312%
	1.60	
	10.00	**16.00%**

8. Illustration

Mr. X earns 10% on his investments in equity shares. He is considering a recently floated scheme of a Mutual Fund where the initial expenses are 6% and annual recurring expenses are expected to be 2%. How much should the Mutual Fund scheme earn to provide a return of 10% to Mr. X?

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Solution:

Particulars	%
Expected return	10.00%
Initial expenses	6.00%
Recurring expenses	2.00%
Required return = = $\frac{Investor\ Return\ (Desired)}{1-Initial\ Expenses\ \%} + Annual\ Expenses$	**12.64%**

9. Illustration

Mr. Alex, a practicing Chartered Accountant, can earn a return of 15 percent by investing in equity shares on his own. He is considering a recently announced equity based mutual fund scheme in which initial expenses are 6 percent and annual recurring expenses are 2 percent.

(i) How much should the mutual fund earn to provide Mr. Alex a return of 15 percent per annum?

(ii) Mr. Alex's current Annual Professional Income is ₹40 Lakhs. His portfolio value is ₹50 Lakhs and now he is spending 10% of his time to manage his portfolio. If he spends this time on profession, his professional income will go up in same proportion.

He is thinking to invest his entire portfolio into a Multicap Fund, assuming the fund's NAV will grow at 13% per annum (including dividend).

You are requested to advise Mr. Alex, whether he can invest the portfolio into Multicap Funds? If so, what is the net financial benefit?

Solution:

Particulars	Total Rs.	%
Part 1		
MF Return % = $\frac{Desired\ Return}{1-Initial\ Expenses\ \%} Recurring\ Expenses$		17.96% (15/(1-6%) +2
Part 2		
Annual Income	40,00,000.00	
Portfolio value	50,00,000.00	
% time in managing portfolio		10.00%
Present:		
Income from Profession	40,00,000.00	
Return on portfolio (50,00,000 *15%)	7,50,000.00	15.00%
Total income for the year	**47,50,000.00**	
Invest in MF	50,00,000.00	
Return on MF investment – 1	6,50,000.00	13.00%
Income from profession – 2	40,00,000.00	
Income from additional time spent – 3	4,00,000.00	10.00%
Total Income for the year (1+2+3)	**50,50,000.00**	

It is advisable to invest in multicap funds where income is higher.

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10. Illustration

Mr. P has invested in three Mutual Fund Schemes:

Particulars	MF X	MF Y	MF Z
Date of investment	01.11.2016	01.02.2017	01.03.2017
Amount of investment (₹)	1,00,000	2,00,000	2,00,000
Net Asset Value (NAV) at entry date (₹)	10.30	10	10.10
Dividend received up to 31-3-2017 (₹)	2,850	4,500	NIL
NAV as on 31-3-2017 (₹)	10.25	10.15	10

Assume a year has 365 days. Show the amount of rupees up to two decimal points.
You are required to find out the effective yield (up to 3 decimal points) on per annum basis in respect of each of the three schemes to Mr. P up to 31.03.2017?

Solution:

Particulars	Scheme X	Scheme Y	Scheme Z
Investment value	1,00,000	2,00,000	2,00,000
Date of Investment	01-Nov-16	01-Feb-17	01-Mar-17
Closing Date	31-Mar-17	31-Mar-17	31-Mar-17
Invested NAV	10.30	10.00	10.10
Closing NAV	10.25	10.15	10.00
Invested units (investment / Op NAV)	9,708.74	20,000.00	19,801.98
Closing investment value	99,514.56	2,03,000.00	1,98,019.80
Dividend	2,850.00	4,500.00	-
Absolute return in Rs.(Cl-OP + Div)	2,364.56	7,500.00	(1,980.20)
Absolute Return % (Abs return / Op invest)	2.365%	3.750%	-0.990%
No. of days	151	59.00	31.00
Effective annual yield (Abs return *365/ days)	**5.716%**	**23.199%**	**-11.658%**

11. Illustration

Mr. Y has invested in the three mutual funds (MF) as per the following details:

Particulars	MF X	MF Y	MF Z
Amount of investment (₹)	2,00,000	4,00,000	2,00,000
Net Assets Value (NAV) at the time of purchase (₹)	10.30	10.10	10
Dividend received up to 31-3-2018 (₹)	6,000	0	5,000
NAV as on 31-3-2018 (₹)	10.25	10	10.20
Effective Yield per annum as on 31.03.2018 (%)	9.66	-11.66	24.15

Assume 1 Year = 365 days
Mr. Y has misplaced the documents of his investment. Help him in finding the date of his original investment after ascertaining the following:

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(i) Number of units in each scheme
(ii) Total NAV
(iii) Total Yield; and
(iv) Number of days investment held

Solution:

Particulars	Scheme X	Scheme Y	Scheme Z
Amount of Investment	2,00,000.00	4,00,000.00	2,00,000.00
Purchase NAV	10.30	10.10	10.00
Dividend Received up to 31/3/2018	6,000.00	-	5,000.00
Closing NAV as on 31/3/2018	10.25	10.00	10.20
Effective Yield	9.66%	-11.66%	24.15%
Units in each scheme - invested	19,417.48	39,603.96	20,000.00
Total NAV / Closing investment value - 31/3/18	1,99,029.13	3,96,039.60	2,04,000.00
Total closing Investment	7,99,068.73		
CG + DI	6,000.00	-	5,000.00
Total return in Rs. Terms (closing +div-opening)	5,029.13	(3,960.40)	9,000.00
Total return from all 3 investments	10,068.73		
Annual Return in ₹ on original investment assuming investment was for full year	19,320.00	(46,640.00)	48,300.00
Actual Return	5,029.13	(3,960.40)	9,000.00
% of time (of a year) investments held (Actual return / Annual return)	0.26	0.08	0.19
No of days in a year	365	365.00	365.00
Period for which investment held	95.01	30.99	68.01
Reporting date	31-Mar-18	31-Mar-18	31-Mar-18
Investment date	26-Dec-18	28-Feb-18	22-Jan-18

12. Illustration

A Mutual Fund Company introduces two schemes - Dividend Plan and Bonus Plan. The face value of the Unit is ₹10 on 1-4-2014. Mr. R invested ₹5 lakh in Dividend Plan and ₹10 lakh in Bonus Plan. The NAV of Dividend Plan is ₹46 and NAV of Bonus Plan is ₹42. Both the plans matured on 31-03-2019.
The particulars of Dividend and Bonus declared over the period are as follows:

Date	Dividend %	Bonus Ratio	NAV of Dividend Plan	NAV of Bonus Plan
31-12-2014	12%	-	47.0	42.0
30-09-2015	-	1:4	48.0	43.0
31-03-2016	15%	-	49.5	41.5
30-09-2017	-	1:6	50.0	44.0
31-03-2018	10%	-	48.0	43.5
31-03-2019	-	-	49.0	44.0

You are required to calculate the effective yield per annum in respect of the above two plans.

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Solution:

Particulars	Units	Dividend	Reinvestment Units
Investment in Dividend – ₹ 5,00,000	10,869.57		
Investment in Bonus – ₹ 10,00,000	23,809.52		
Dividend Plan			
Opening	10,869.57		
31-Dec-14		13,043.48	277.52
Closing Units as on 31 Mar 2014	11,147.09		
31-Mar-16		16,720.63	337.79
Closing units as on 31 Mar 2016	11,484.88		
31-Mar-18		11,484.88	239.27
Closing units as on 31 Mar 2018	11,724.14		
Units matured	11,724.14		
NAV on date of maturity	49.00		
Total amount Realized	5,74,483.09		
Amount Invested	5,00,000.00		
Total Gain	74,483.09		
Absolute Return in %	14.90%		
Return p a %	**2.98%**		
Opening	23809.52		
bonus on 30 Sep 2015 1:4	5,952.38		
Closing Unit	29,761.90		
Bonus on 30 Sep 2018 - 1:6	4,960.32		
Closing units	34,722.22		
Maturity date NAV	44.00		
Maturity Value	15,27,777.78		
Investment value	10,00,000.00		
Absolute Gain	5,27,777.78		
Absolute gain %	52.78%		
Yearly return	**10.56%**		

13 Illustration

A mutual fund has two schemes i.e., Dividend plan (Plan-A) and Bonus plan (Plan-B). The face value of the unit is ₹10. On 01/04/2016 Mr. Anand invested ₹5,00,000 each in Plan-A and Plan-B when the NAV was ₹46 and ₹43.50 respectively, Both the Plans matured on 31/03/2019.
Particulars of dividend and bonus declared over the period are as follows:

Date	Dividend %	Bonus Ratio	Net Assets Value (₹)	
			Plan-A	Plan-B
30-06-2016	15%		46.80	44
31-08-2016		1:6	47.20	45.40
31-03-2017	10%		48	46.60
17-09-2017		1:8	48.40	47
21-11-2017	14%		49.60	47.20
25-02-2018	15%		50	47.80

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31-03-2018		1:10	50.50	48.80
30-06-2018	12%		51.80	49
31-03-2019			52.40	50

You are required to calculate the Effective Yield Per annum in respect of the above two plans.

Solution:

Particulars	**Units**	**Dividend**	**Reinvestment Units**
Investment in Plan A - Dividend 1/4/16	10,869.57		
30 June 2016 15% NAV 46.80		16,304.35	348.38
Closing units	11,217.95		
31 Mar 2017 10% NAV48		11,217.95	233.71
Closing units	11,451.66		
21 Nov 2017 14% NAV 49.60		16,032.32	323.23
Closing units	11,774.89		
25 Feb 2018 15% NAV 50		17,662.33	353.25
Closing Units	12,128.13		
30 June 2018 15% NAV 51.80		14,553.76	280.96
Closing units	12,409.10		
Maturity 31 Mar 2019 - NAV	52.40		
Maturity Value	6,50,236.60		
Investment Value	5,00,000.00		
Absolute return	1,50,236.60		
Absolute Return %	30.05%		
Return per annum	**10.02%**		

Outflow (01-04-2016)	**-5,00,000.00**
Inflow (31-03-2019)	6,50,236.60
IRR taken @ 10%	1.41936
PV of Inflow = $\frac{6,50,236.60}{(1.1)^3}$	488532.39
NPV	(11,467.61)
IRR taken at 9%	
PV of inflow= $\frac{6,50,236.60}{(1.09)^3}$	5,02,101.96
NPV	2,101.96
$5,02,101.96 - 488532.39$	13,569.58
$2,101.96 * \left(\frac{1\%}{13,569.58}\right)$	0.15%
IRR is 9% + 0.15%	9.15%
IRR taken at 9.15% = $\frac{6,50,236.60}{(1.0915)^3}$	5,00,034.76
Investment @NAV 43.5= $\frac{500000}{43.5}$	11,494.25
Add: 31 Aug 2016 Bonus 1:6 - NAV 45.4 = $\frac{11494.25}{6}$	1,915.71
= Closing units	13,409.96
Add: 17 Sep 2017 B: 1:8 - NAV 47 = $\frac{13,409.96}{8}$	1,676.25
= Closing units	15,086.21

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Add: 31 Mar 2018 Bonus - 1:10 @ NAV 48.80 = $\frac{15,086.21}{10}$	1,508.62
= Closing Units	16,594.83
Maturity NAV	50
Maturity Value = $16,594.83 * 50$	8,29,741.38
Less: Investment Value	5,00,000.00
= Absolute Gain	3,29,741.38
Absolute Gain %	65.95%
Annual Return / gain %	21.98%
Investment value	(5,00,000.00)
Maturity Inflow	8,29,741.38

Investment value	**(5,00,000.00)**
Maturity Inflow	8,29,741.38
IRR @ 22%	
PV of inflow = $\frac{8,29,741.38}{(1.22)^3}$	4,56,944.29
PV of outflow	(5,00,000.00)
NPV	(43,055.71)
IRR @18% = $\frac{8,29,741.38}{(1.18)^3}$	
PV of inflow	5,05,006.22
PV of outflow	(5,00,000.00)
NPV	5,006.22
IRR @19% = $\frac{8,29,741.38}{(1.19)^3}$	
PV of inflow	4,92,381.66
PV of outflow	(5,00,000.00)
NPV	(7,618.34)
$5,006.22 - (7,618.34)$	12,624.56
$5,006.22 * \left(\frac{1\%}{12,624.56}\right)$	0.40%
IRR	18% + 0.4%
Annualised return	**18.40%**

14. Illustration

Sun Moon Mutual Fund (Approved Mutual Fund) sponsored open-ended equity-oriented scheme Chanakya Opportunity Fund.
There were three plans viz.
A – Dividend Reinvestment Plan,
B – Bonus Plan &
C – Growth Plan

At the time of Initial Public Offer on 1.4.2009, Mr. Anand, Mr. Bacchan & Mrs Charu, three investors invested ₹1,00,000 each & chose B, C & A Plan respectively.
The History of the Fund is as follows:

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Date	Dividend %	Bonus Ratio	Net Asset Value per unit (F.V. ₹10)		
			Plan A	Plan B	Plan C
28.07.2013	20	-	30.70	31.40	33.42
31.03.2014	70	5:4	58.42	31.05	70.05
31.10.2017	40	-	42.18	25.02	56.15
15.03.2018	25	-	46.45	29.10	64.28
31.03.2018		1:3	42.18	20.05	60.12
24.03.2019	40	1:4	48.10	19.95	72.40
31.07.2019			53.75	22.98	82.07

On 31st July, 2019 all three investors redeemed all the balance units. Calculate:

(i) Annual rate of return of Mrs Charu who has invested in A – Dividend Re-investment Plan

(ii) Annual rate of return of Mr. Anand who has invested in B – Bonus Plan

(iii) Annual rate of return of Mr. Bacchan who has invested in C – Growth Plan

Assumptions

1. Long-term Capital Gain is exempt from Income tax.
2. Short-term Capital Gain is subject to 10% Income tax.
3. Security Transaction Tax 0.2 per cent only on sale/redemption of units.
4. Ignore Education Cess

Solution:

Particulars	₹	Units	Closing units
Mr. Charu Dividend Reinvestment Plan			
Investment on 1 St April 2009	1,00,000	10,000	
28 July 2013 - 20% Dividend - NAV 30.70	20,000	651.47	10,651.47
31 Mar 2014 - 70% Dividend - NAV 58.42	74,560.26	1,276.28	11,927.75
31 oct 2017 - 40% Dividend - NAV 42.18	47,710.98	1,131.13	13,058.87
15-03-2018 - 25% Dividend - NAV 46.45	32,647.18	702.85	13,761.72
24-03-2019 - 40% Dividend - NAV 48.10	55,046.88	1,144.43	14,906.15
31 July 2019 Redemption NAV 53.75	8,01,205.30		
STT @ 0.2%	1,602.41		
STCG @ 10% on 1144.43 x (53.75-48.10)	646.60		
Net Amount realized	7,98,956.28		
Amount invested	1,00,000		
Return	6,98,956.28		
Return % - Absolute	6.99		
Annual Return	67.64%		

Plan B - Bonus - Mr. Anand			
Mr. Anand - Bonus Plan			
Original Investment @ NAV 10	1,00,000	10,000	
31 Mar 2014 - Bonus 5:4 @ NAV 31.05		12,500	22,500
31-03-2018 - Bonus 1:3 @ NAV 20.05		7,500	30,000
24 March 2019 - Bonus 1:4 @ 19.95		7,500	37,500

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Redemption on 31 July 2019 @ 22.98	8,61,750		
STCG Computation			
Net realization / Net consideration	1,72,350		
Less: COA	-		
STCG	1,72,350		
Tax on STCG @ 10%	17,235		
Gross amount realized	8,61,750		
STT @ 0.2%	(1,723.50)		
Net amount realised	8,60,026.50		
Less: Tax paid	(17,235)		
Final amount realized	8,42,791.50		
Investment made	1,00,000		
Absolute return	7,42,791.50		
Absolute return %	743%		
Annualized return %	71.88%		

Mr. Bachchan Plan C – Growth			
Investment made	1,00,000	10,000	
Redemption value @ NAV 82.07	8,20,700		
Less: STT @ 0.2%	1,641.40		
Net Realization	8,19,058.60		
Absolute Return	7,19,058.60		
Absolute Return %	719%		
Annualized return %	69.59%		

15.Illustration

A mutual fund raised ₹150 lakhs on April 1, 2018 by issue of 15 lakh units at ₹10 per unit. The fund invested in several capital market instruments to build a portfolio of ₹140 lakhs; Initial expenses amounted to ₹8 lakhs.
During the month of April, the fund sold certain instruments costing ₹44.75 lakhs for ₹47 lakhs and used the proceeds to purchase certain other securities for ₹41.6 Lakhs. The fund management expenses for the month amounted to ₹6 lakhs of which ₹50,000 was in arrears The fund earned dividends amounting to ₹1.5 lakhs and it distributed 80% of the realized earnings. The market value of the portfolio on 30th April, 2018 was ₹147.85 Lakhs.

An investor subscribed to 1000 units on April 1 and disposed it off at closing NAV on 30th April. Determine his annual rate of earnings.

Solution:

Particulars	Units	NAV	Value
Investment Made @ 10 - 1000 units	1,000	10	10,000
Add: CG & Dividend			200
Redemption	1,000	9.85	9,850
Absolute Return			50
Absolute Return %			0.50%
Annualized Return %			**6%**

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WN: 1 - Cash Balance

	Amount ₹ Lakh	Closing Cash ₹ Lakh
1 April 2018 NFO @ ₹10 / Unit - 15 Lac Units	150	150
Less: Initial Expenses	(8)	142
Less: Investment 1	(44.75)	97.25
Less: Investment 2	(95.25)	2
Add: Investment sold	47	49
Less: Investment 3	(41.60)	7.40
Less: Fund Management Exp	(5.50)	1.90
Add: Dividend Earned	1.50	3.40
Less: Realized Earning Distributed 1	(1.20)	2.20
Less: Realized Earning Distributed 2	(1.80)	0.40
Closing Cash Balance		**0.40**

WN 2: NAV Computation

Market value of Securities	147.85
Less: Payable	0.50
Add Cash Balance	0.40
Total NAV	147.75
NAV Per unit	**9.85**

16.Illustration

On 1-4-2012 ABC Mutual Fund issued 20 lakh units at ₹10 per unit. Relevant initial expenses involved were ₹12 lakhs. It invested the fund so raised in capital market instruments to build a portfolio of ₹185 lakhs. During the month of April 2012, it disposed of some of the instruments costing ₹60 lakhs for ₹63 lakhs and used the proceeds in purchasing securities for ₹56 lakhs. Fund management expenses for the month of April 2012 was ₹8 lakhs of which 10% was in arrears In April 2012 the fund earned dividends amounting to ₹2 lakhs and it distributed 80% of the realized earnings. On 30-4-2012 the market value of the portfolio was ₹198 lakhs.

Mr. Akash, an investor, subscribed to 100 units on 1-4-2012 and disposed of the same at closing NAV on 30-4-2012. What was his annual rate of earning?

Solution:

Computation of Return of Mr. Akash	**Units**	**NAV**	**₹**
Initial Investment	100	10	1,000
Income received (CG+Div)			20
Redemption Value - Realized	100	9.90	990
Absolute return			10
Absolute Return % - for 1 Month			1%
Annualized return			**12%**

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WN 1: Cash Balance

	Amt ₹ Lacs	Cash Balance ₹ Lacs
NFO - 20 Lac Units @ ₹ 10	200	200
Initial Expenses	(12)	188
Less: Investment 1	(60)	128
Less: Investment 2	(125)	3
Add: Investment 1 realized	63	66
Less: Investment 3	(56)	10
Less: Fund Expenses	(7.20)	2.80
Add: Dividends	2	4.80
Less: Dividend Distributed	(1.60)	3.20
Less: CG Distributed	(2.40)	0.80
Closing Cash Balance		**0.80**

WN 2: NAV

Closing value of Marketable Securities	198
Ad: Cash Balance	0.80
Less: Fund Expenses arrears	(0.80)
Total NAV	198
NAV per unit	**9.90**

17. Illustration

On 1st April 2009 Fair Return Mutual Fund has the following assets and prices at 4 p.m.

Shares	No. of Shares	Market Price Per Share (₹)
A Ltd.	10000	19.70
B Ltd.	50000	482.60
C Ltd.	10000	264.40
D Ltd.	100000	674.90
E Ltd.	30000	25.90
No. of units of funds		8,00,000

Please calculate:

(a) NAV of the Fund on 1st April 2009

(b) Assuming that on 1st April 2009, Mr. X, a HNI, send a cheque of ₹50,00,000 to the Fund and Fund Manager immediately purchases 18000 shares of C Ltd. and balance is held in bank. Then what will be position of fund.

(c) Now suppose on 2 April 2009 at 4 p.m. the market price of shares is as follows:

Shares	₹
A Ltd.	20.30
B Ltd.	513.70
C Ltd.	290.80
D Ltd.	671.90
E Ltd.	44.20

Then what will be new NAV.

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Solution:

Particulars	Shares / Units	Price / NAV	Value / Total NAV
1. NAV Computation as on 1st April, 2009 at 4 PM			
A Ltd	10,000	19.70	1,97,000
B Ltd	50,000	482.60	2,41,30,000
C Ltd	10,000	264.40	26,44,000
D Ltd	1,00,000	674.90	6,74,90,000
E Ltd	30,000	25.90	7,77,000
Total Value of Investments			**9,52,38,000**
No of Units	8,00,000		
NAV per unit		**119.05**	
2. NAV post Investment by Mr. X			50,00,000
No. of Shares of C purchased	18,000	264.40	47,59,200
Balance held in cash			2,40,800
No. of Units allotted to Mr. X	42,000.04	119.05	50,00,000
Total Units in the scheme post investment by Mr. X	8,42,000.04		
NAV after investment by Mr. X			
Mkt value of investments			9,52,38,000
Add: New investments			50,00,000
Total value of investments			**10,02,38,000**
A Ltd	10,000	19.70	1,97,000
B Ltd	50,000	482.60	2,41,30,000
C Ltd	28,000	264.40	74,03,200
D Ltd	1,00,000	674.90	6,74,90,000
E Ltd	30,000	25.90	7,77,000
Total Value of Investments			**9,99,97,200**
Add: Cash balance			2,40,800
Total Market value	**8,42,000.04**	**119.05**	**10,02,38,000**
3. New NAV based on Shares prices as on 2nd April 2009 @ 4 PM			
A Ltd	10,000	20.30	2,03,000
B Ltd	50,000	513.70	2,56,85,000
C Ltd	28,000	290.80	81,42,400
D Ltd	1,00,000	671.90	6,71,90,000
E Ltd	30,000	44.20	13,26,000
Total Value of Investments			**10,25,46,400**
Add: Cash balance			2,40,800
Total Market value	**8,42,000.04**	**122.08**	**10,27,87,200**

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18. Illustration

A mutual fund made an issue of 10,00,000 units of ₹10 each on January 01, 2008. No entry load was charged. It made the following investments:

Particulars	₹
50,000 Equity shares of ₹100 each @₹160	80,00,000
7% Government Securities	8,00,000
9% Debentures (Unlisted)	5,00,000
10% Debentures (Listed)	5,00,000
	98,00,000

During the year, dividends of ₹12,00,000 were received on equity shares. Interest on all types of debt securities was received as and when due. At the end of the year equity shares and 10% debentures are quoted at 175% and 90% respectively. Other investments are at par.

Find out the Net Asset Value (NAV) per unit given that operating expenses paid during the year amounted to ₹5,00,000. Also find out the NAV, if the Mutual fund had distributed a dividend of ₹0.80 per unit during the year to the unit holders.

Solution:

Particulars	Shares / Units	Nav / Price	Value
1. Computation of NAV			
Equity Shares	50,000	175	87,50,000
7% GOI Securities			8,00,000
9% Unlisted debentures			5,00,000
10% Debentures @ 90% of PAR			4,50,000
Total Value of investments as at year end			**1,05,00,000**
Income			
Dividend on Equity shares			12,00,000
Interest on 7% GOI Securities			56,000
Interest on 9% unlisted debentures			45,000
Interest on 10% listed Debentures			50,000
Less: Operating expenses			5,00,000
Net Cash Received			8,51,000
Add: Cash not deployed			2,00,000
Total Cash Balance			**10,51,000**
Total Assets of the scheme & NAV	**10,00,000**	**11.55**	**1,15,51,000**
Less: Dividend during the year		0.80	
Revised NAV post Dividend		**10.75**	

19. Illustration

Calculate the NAV of a regular income scheme on per unit basis of Red Bull mutual fund from the following information:

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Particulars	₹ in crores
Listed shares at cost (ex-dividend)	30
Cash in hand	0.75
Bonds & Debentures at cost (ex-interest)	2.30
Of these, bonds not listed & not quoted	1.0
Other fixed interest securities at cost	2.50
Dividend accrued	0.8
Amount payable on shares	8.32
Expenditure accrued	1
Value of listed bonds & debentures at NAV value	10

Number of units (₹10 face value) 30 lakhs
Current realizable value of fixed
income securities of face value of ₹100 is 106.50
The listed shares were purchased when index was 7100 and
The Present Index is 9000
Unlisted bonds and debentures are at cost. Other fixed securities are also at cost.

Solution:

Particulars	Cost ₹ Cr	Mkt value ₹ Cr
Equity Shares	30	38.03
Bonds listed	1.30	10
Bonds unlisted	1	1
Other Fixed interest Securities	2.50	2.50
Add: Cash Balance		0.75
Total Value of Investments		52.28
Add: Dividend Accrued		0.80
Less: Expenditure accrued		1
Less: Amount Payable on Shares		8.32
Total Value of Investments + Incomes - Expenses		**43.76**
Number of Units		0.30
NAV per unit		**145.86**

20 Illustration

The following particulars relating to Vishnu Fund Schemes:

Particulars	Value ₹ in Crores
1. Investment in Shares (at cost)	
a. pharmaceuticals companies	79
b. Construction Industries	31
c. Service Sector Companies	56
d. IT Companies	34
e. Real Estate Companies	10
2. Investment in Bonds (Fixed Income)	
a. Listed Bonds (8000, 14% Bonds of ₹15,000 each)	12
b. Unlisted Bonds	7
3. No. of Units outstanding (crores)	4.2
4. Expenses Payable	3.5

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5. Cash and Cash equivalents	1.5
6. Market expectations on listed bonds	8.842%

Particulars relating to each sector are as follows:

Sector	Index on Purchase date	Index on Valuation date
Pharmaceutical companies	260	465
Construction Industries	210	450
Service Sector Companies	275	480
IT Companies	240	495
Real Estate Companies	255	410

The fund has incurred the following expenses:

Consultancy and Management fees	₹480 Lakhs
Office Expenses	₹150 Lakhs
Advertisement Expenses	₹38 Lakhs

You are required to calculate the following:

(i) Net Asset Value of the fund
(ii) Net Asset Value per unit
(iii) If the period of consideration is 2 years, and the fund has distributed ₹3 per unit per year as cash dividend, ascertain the Net return (Annualized)
(iv) Ascertain the Expenses ratio

Solution:

Particulars	Cost in ₹ Cr	Market Value working	Mkt Value in ₹ Cr
Shares			
- Pharma Companies	79	79 * 465/260	141.29
- Construction Industries	31	31 * 450/210	66.43
- Service Sector Companies	56	56 * 480/275	97.75
- IT Companies	34	34 * 495/240	70.13
- Real Estate Companies	10	10 * 410/255	16.08
Total value of shares	**210**		**391.67**
Bonds			
' - Listed 8000 14% FV 15000	12	12 * 14/8.842	19
Unlisted bonds	7		7
Total value of Bonds	**19**		**26**
Expenses			
1. Consultancy & Mgmt.			4.80
2. Office Expenses			1.50
3. Advertisement Expenses			0.38
Total expenses			**6.68**
Expenses payable			3.50

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Cash			1.50
Part 1- Fund NAV			**415.67**
No of Units			4.20
Part 2- NAV per unit			**98.97**
			Part 3 - Net return Annualized
Closing Value of Investments			417.67
Dividends paid		₹ 6 / unit x 4.2	25.20
Original Investment value			229
Expenses & Cash			(2)
Total return over 2-year period			211.87
Absolute Return %			92.52%
Annualized return			**46.26%**
Closing NAV			98.97
Opening NAV	229		54.52
Dividends			6
Absolute Return			50.44
Absolute Return %			92.52%
Annualized return %			**46.26%**
Part 4- Expense ratio			**1.607%**

21. Illustration

Mr. X on 1.7.2015, during the initial offer of some Mutual Fund invested in 10,000 units having face value of ₹10 for each unit. On 31.3.2016, the dividend paid by the M.F. was 10% and Mr. X found that his annualized yield was 153.33%. On 31.3.2017, 20% dividend was given. On 31.3.2018, Mr. X redeemed all his balance of 11,296.11 units when his annualized yield was 73.52%.
What are the NAVs as on 31.3.2016, 31.3.2017 and 31.3.2018?

Solution:

Particulars	Units	Dividend -% & Value	Yield %
Initial Investment - 1 July 2015 @ NAV 10	10,000		
Dividend Paid - 31 Mar 2016		10%	
Dividend Value		10,000	
Annualized yield 9 Months			153.33%
9-month Yield			115.0%
Total Return	1,15,000		
Less: Dividend	10,000		
Increase in NAV	1,05,000		
Increase in NAV per unit	10.50		

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Closing NAV - 31 Mar 2016	**20.50**		
Dividend Units allotted	487.80		
Total Units as at 31 Mar 2016	10,487.80		
31 Mar 2017 Dividend		20%	
Dividend Value		20,975.61	
NAV on Dividend Reinvestment date - 31 Mar 2017	**25.95**		
Units Reinvested	808.31		
31 Mar 2018 Total Units	11,296.11		
NAV	?		
Annualized yield over a 33-month period			73.52%
Absolute Return over 33 months %			202.2%
Absolute return Value over 33 months			2,02,180
Closing Value of Investment			3,02,180
Closing NAV on 31 Mar 2018			**26.75**

22.Illustration

M/S. Corpus an AMC, on 1.04.2015 has floated two schemes viz. Dividend Plan and Bonus Plan. Mr. X, an investor has invested in both the schemes. The following details (except the issue price) are available:

Date	Dividend (%)	Bonus Ratio	NAV	
			Dividend Plan	Bonus Plan
1.04.2015			?	?
31.12.2016		1 :4 (One unit on 4 units held)	47	40
31.03.2017	12		48	42
31.03.2018	10		50	39
31.12.2018		1 :5 (One unit on 5 units held)	46	43
31.03.2019	15		45	42
31.03.2020	-	-	49	44

Additional details

Investment (₹)	₹9,20,000	₹10,00,000
Average Profit (₹)	₹27, 748.60	
Average Yield (%)		6.40

You are required to calculate the issue price of both the schemes as on 1.04.2015.

Solution:

Particulars	Units	NAV	Value	% return
Investment - Dividend Plan			9,20,000	
Investment Bonus Plan			10,00,000	
Average Profit Dividend Plan - 5 years			27,748.60	
Total Profit over 5 years			1,38,743	

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Closing Value of Investment - Dividend Plan	21,607	49	10,58,743	
Bonus Plan - Average Yield				6.40%
5 Year Yield				32%
Return over 5 years			3,20,000	
Closing Value of Investment on 31/3/2020	30,000	44	13,20,000	
Bonus Plan	20,000	**50**	10,00,000	
31 Dec 2016 Bonus 1:4	20,000	40	8,00,000	
31 Dec 2018 Bonus 1:5	25,000	43	10,75,000	
31 mar 2020 - Closing	30,000	44	13,20,000	
Dividend Plan	20,000	**46**	9,20,000	
Dividend 31 Mar 2017	20,000	48	9,60,000	12%
Dividend 31 Mar 2018	20,500	50	10,25,000	10%
Dividend 31 Mar 2019	20,910	45	9,40,950	15%
31 Mar 2020 - Closing	21,607	49	10,58,743	

WN 1- Dividend for 31 Mar 2019

Opening Units	$= Y$
$\frac{Y + (Y\ x\ 10\ x\ 15\%)}{45}$	$= 21607$
$45Y + 1.5Y$	$= 21607 * 45$
$46.5Y$	$= 21607 * 45$
Y	$= \frac{972315}{46.5}$
	$= 20,910$

23. Illustration

On 01-07-2016, Mr. X Invested ₹50,000/- at initial offer in Mutual Funds at a face value of ₹10 each per unit. On 31-03-2017, a dividend was paid @ 10% and annualized yield was 120%. On 31-03-2018, 20% dividend and capital gain of ₹0.60 per unit was given. Mr. X redeemed all his 6271.98 units when his annualized yield was 71.50% over the period of holding.
Calculate NAV as on 31-03-2017, 31-03-2018 and 31-03-2019. For calculations consider a year of 12 months.

Solution:

Particulars	Units	NAV	Value	% return
Investment 1/7/2016	5,000	10	50,000	
31 Mar 2017 Dividend			5,000	10%
Total Return - Annualized				120%
Absolute Return % over 9 months				90%
Absolute Return Value			45,000	
Less: Dividend			5,000	
Increase in Investment			40,000	
Closing Value of Investment	5,000	18	90,000	
Dividend	277.78	18	5,000	
Closing Units 31 /3/17	**5,277.78**	**18**	**95,000**	

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31/3/18 Dividend			10,555.56	20%
31/3/18 CG			3,166.67	
Entire Amount Reinvested	**994.20**	**13.80**	**13,722.22**	
Redemption 31/3/19	6,271.98			
Annualized yield 33 months				71.50%
Absolute Yield over 33 Months				196.63%
Total Return over 33 months			98,312.50	
Closing Value of investment	**6,271.98**	**23.65**	**1,48,312.50**	
Assumption: CG is distributed in cash & is reinvested				

Particulars	Units	NAV	Value	% return
Investment 1/7/2016	5,000.00	10.00	50,000.00	
31 Mar 2017 Dividend			5,000.00	10.00%
Total Return - Annualized				120.00%
Absolute Return % over 9 months				90.00%
Absolute Return Value			45,000.00	
Less: Dividend			5,000.00	
Increase in Investment			40,000.00	
Closing Value of Investment	5,000.00	18.00	90,000.00	
Dividend	277.78	18.00	5,000.00	
Closing Units 31 /3/17	**5,277.78**	**18.00**	**95,000.00**	
31/3/18 CG	5,277.78	0.60	3,166.67	
31/3/ 18 / Dividend	**994.20**	**10.62**	**10,555.56**	
Redemption 31/3/19	6,271.98			
Annualized Yield 33 months				71.50%
Absolute yield 33 months				196.63%
Absolute return in ₹			98,312.50	
Less: CG			3,166.67	
Increase in Investment value			95,145.83	
Total closing value of investment	**6,271.98**	**23.14**	**1,45,145.83**	
Assumption: CG is distributed in cash & not reinvested				

24.Illustration

ANP Plan, a hedge fund currently has assets of ₹20 crore. CA. X, the manager of fund charges fee of 0.10% of portfolio asset. In addition to it the charges incentive fee of 2%. The incentive will be linked to gross return each year in excess of the portfolio maximum value since the inception of fund. The maximum value the fund achieved so far since inception of fund about one and half year ago was ₹21 crores. You are required to compute the fee payable to CA. X, if return on the fund this year turns out to be (a) 29%, (b) 4.5%, (c) -1.8%.

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Solution:

Particulars	₹ Cr
Opening Fund value	20.00
Highest value since inception	21.00
Fund management charges	0.10%
Incentive	2.00%

Return in CY	**29.00%**	**4.50%**	**-1.80%**
Management fees	0.02	0.02	0.02
Incentive Computation			
Portfolio Return %	29.00%	4.50%	-1.80%
Portfolio Return absolute	5.80	0.90	(0.36)
Total Value of Portfolio	25.80	20.90	19.64
Less: Max value of portfolio	21.00	21.00	21.00
Return eligible for incentive	4.80	-	-
Incentive	0.10	-	-
Total Fee + Incentive - Cr	0.12	0.02	0.02
Total Fee + Incentive in ₹	**11,60,000.00**	**2,00,000.00**	**2,00,000.00**

25. Illustration

On 1.4.2016, a mutual fund scheme had 9,00,000 units of face value of ₹10 each. The scheme earned ₹81 lakh in 2016-17, out of which ₹45 lakh was earned in first half year. 1 lakh units were sold on 30.9.2016 at NAV of ₹60. Compute the dividend equalization reserve value.

Solution:

Date	Particulars		Credit (₹)- In Lakhs	Debit (₹)- In Lakhs
	Bank A/c	Dr	65	
	To Unit Capital A/c			10
	To Reserves			50
	To Dividend Equalization Reserve			5
	Dividend A/c	Dr	81	
	Dividend Equalization Reserve A/c	Dr	6	
	To Bank A/c			86

	₹ in Lakhs
Original Unitholders (9*8.6)	77.4
New Unitholders	8.6
Total	86
Dividend Equalization	(5)
Dividend	81

Investment = ₹ 60 lakh+ ₹ 5 lakh
Money Available = ₹ 86 lakh
Dividend = ₹ 86 lakh/ 10
= ₹ 8.6

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26. Illustration

On 1st April, an open-ended scheme of mutual fund had 300 lakh units outstanding with Net Assets Value (NAV) of ₹18.75.
At the end of April, it issued 6 lakh units at opening NAV plus 2% load, adjusted for dividend equalization. At the end of May, 3 Lakh units were repurchased at opening NAV less 2% exit load adjusted for dividend equalization. At the end of June, 70% of its available income was distributed.
In respect of April-June quarter, the following additional information are available:

	₹ in lakh
Portfolio value appreciation	425.47
Income of April	22.950
Income for May	34.425
Income for June	45.450

You are required to calculate
(i) Income available for distribution;
(ii) Issue price at the end of April;
(iii) repurchase price at the end of May; and
(iv) net asset value (NAV) as on 30th June

Solution:

Particulars	Lakh Unit	Per Unit	₹ Lacs
Part 1- Income Available for Distribution			
' - Income for April	300.0000	0.0765	22.9500
New Investment	6.0000	0.0765	0.4590
	306.0000	**0.0765**	**23.4090**
' - Income for May	306.0000	0.1125	34.4250
Less: Units redeemed	(3.0000)	0.1890	(0.5670)
Income available at may End	303.0000	0.1890	57.2670
Income for June	303.0000	0.1500	45.4500
Income available at June end	**303.0000**	**0.3390**	**102.7170**
Less: Income Distributed	303.0000	(0.2373)	(71.9019)
Closing money available	**303.0000**	**0.1017**	**30.8151**
Part 2 - Issue price at end of April			
1st April Data	300.0000	18.7500	5,625.0000
Issue price on 30th April			
- Opening NAV		18.7500	
- 2% Entry Load		0.3750	
- Dividend Equivalization		0.0765	
Issue price on 30th April		**19.2015**	
Part 3 - Repurchase price at end of May			
- Opening NAV		18.7500	
- Less: Load 2%		(0.3750)	
Add: Dividend Equalization - May		0.1125	
Add: Dividend Equalization - April		0.0765	

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Repurchase price		**18.5640**	
Part 4- NAV as on June 30			
Opening Units - 1st April	300.0000	18.7500	5,625.0000
Portfolio Appreciation			425.4700
Income – April			22.9500
Income – May			34.4250
Income June			45.4500
Less: Dividend			-71.9019
Investment in April	6.0000	19.2015	115.2090
Repurchase in May	-3.0000	18.5640	-55.6920
Total Value of Assets	**303.0000**	**20.2670**	**6,140.9101**

27. Illustration

On 1st January 2020, an open-ended scheme of mutual fund had outstanding units of 300 lakhs with a NAV of ₹20.25.

At the end of January 2020, it had issued 5 lakh units at an opening NAV plus a load of 2%, adjusted for dividend equalisation. At the end of February 2020, it had repurchased 2.5 lakh units at an opening NAV less 2% exit load adjusted for dividend equalisation. At the end of March 2020, it had distributed 70 per cent of its available income.

In respect of January – March quarter, the following additional information is available:

Value appreciation of the Portfolio	₹460 lakhs
Income for January	₹24 lakhs
Income for February	₹36 lakhs
Income for March	₹47 lakhs

You are required to calculate:

(i) Income available for distribution
(ii) Issue price at the end of January
(iii) Repurchase price at the end of February
(iv) Closing value of Net Assets at the end of March

Solution:

Particulars	**Lakh Unit**	**Per Unit**	**₹ Lacs**
Part 1 - Income for Distribution			
Opening Units	300	20.25	6075
Income for Jan	300	0.08	24
New units issued	5	0.08	0.40
Income at end of Jan	305	0.08	24.40
Income for Feb	305	0.12	36
Less: Issued repurchased	2.50	0.20	0.50
Income at end of Feb	302.50	0.20	59.90
Income for March	302.50	0.16	47
Total Income (Jan - Mar)	302.50	0.35	106.90
Dividend Distribution @ 70%	302.50	0.25	74.83
Balance amount left	302.50	0.11	32.07

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Part 2 - Issue price Jan			
Opening NAV	5	20.25	101.25
Add: Entry Load @ 2%	5	0.41	2.03
Add: Dividend Equalization	5	0.08	0.40
Issue Price	5	20.74	103.68
Part 3 - Repurchase price Feb			
Opening NAV	2.50	20.25	50.63
Less: Exit Load @ 2%			1.01
Add: Dividend Equivalization	2.50	0.20	0.50
Repurchase price	2.50	20.04	50.11
Part 4 - Closing value of Net Assets			
Opening Units	300	20.25	6075
Add: Portfolio Appreciation			460
Add: New issue	5		103.68
Less: Repurchase	2.50		50.11
Add: Incomes (Jan - Mar)			107
Less: Dividend Distributed			74.83
Total	**302.50**	**21.89**	**6620.73**

28.Illustration

Based on the following data, estimate the Net Asset Value (NAV) on 1st July 2016 on per unit basis of a Debt Fund:

Security	Face Value (₹)	Purchase Price (₹)	Maturity Date	No. of Securities	Coupon Date(s)	Duration of Bonds
10.71% GOI 2028	100	104.78	31/03/28	100000	Mar 31	7.3494
10% GOI 2023	100	100	31/03/23	50000	Mar 31 & Sep 30	5.086
9.5% GOI 2021	100	97.93	31/12/21	40000	June 30 & Dec 31	4.3949
8.5% SGL 2025	100	91.36	30/06/25	20000	June 30	6.5205

Number of Units (₹ 10 face value each): 100000.
All securities were purchased at a time when applicable Yield to Maturity (YTM) was 10%.
On NAV date, the required yield increased by 75 basis point and Cash in hand and accrued expenses were ₹ 6,72,800 and ₹ 2,37,400 respectively.

Solution:

	Security	Purchase Price	No:	Purchase value (in lakhs)
1	10.71% GOI 2028	104.78	100000	104.78
2	10% GOI 2023	100	50000	50
3	9.5% GOI 2021	97.93	40000	39.172

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4	8.5% SGL 2025	91.36	20000	18.272
				212.224

	Portfolio Value	Macaulay Duration	Modified Duration	Δ Price	Revised/ Closing
1	10478000	7.3494	6.6813	-525048	9952952
2	5000000	5.086	4.8438	-181643	4818357
3	3917200	4.3949	4.1856	-122969	3794231
4	1827200	6.5205	5.9277	-81234	1745966
	21222400			**-910894**	**20311506**
			Closing Bond Value		**₹ 20311506**
			Add: Cash in Hand		₹ 672800
			Less: Accrued Expense		₹ 237400
			Add: Interest Accrued (WN 1)		₹ 392750
			Value of Net Assets		₹ 21139656
			Total Units		100000
			NAV per Unit		**₹ 211.3965**

Modified Duration = $\frac{Macaulay\ Duration}{1+\frac{y}{n}}$

-Δ price = Δ yield* modified duration* price

Working Note: 1

Security

10.71% GOI 2028	100* 100000* 10.71%* 3/12	267750
10% GOI 2023	100* 50000* 5%* 3/6	125000
		392750

29.Illustration (May 22 RTP)

On 1st April, an open-ended scheme of mutual fund had 400 lakh units outstanding with Net Assets Value (NAV) of ₹ 19. At the end of April, it issued 5 lakh units at an opening NAV plus 2% load, adjusted for dividend equalization. At the end of May, 4 Lakh units were repurchased at the opening NAV less 2% exit load adjusted for dividend equalisation. At the end of June, 60% of its available income was distributed.
In respect of April-June quarter, the following additional information is available:

Particulars	**₹ in Lakhs**
Portfolio value appreciation	515.67
Income of April	31.960
Income of May	46.125
Income for June	58.470

You are required to calculate:

(i) Income available for distribution
(ii) Issue price at the end of April
(iii) Repurchase price at the end of May; and
(iv) Net Asset Value (NAV) as on 30th June.

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Solution:

Income Available for Distribution

Particulars	Units in Lakhs	Per Unit	₹ Lacks Income
Income for April	400	0.0799	31.96
Units Issued	5	0.0799	0.3995
End of April	**405**	**0.0799**	**32.3595**
Income for May	405	0.113888889	46.125
Closing Before Repurchase	405	0.193788889	78.4845
Repurchase Units	-4	0.193788889	-0.775155556
End of May	**401**	**0.193788889**	**77.70934444**
Income for June	401	0.145810474	58.47
End of June	**401**	**0.339599363**	**136.1793444**
Distribution at 60%	401	-0.2038	-81.7076
	401	**0.1358**	**54.4717**

Issue Price at April End

Particulars	₹ per Unit
Opening NAV (5 lakh units)	₹ 19
Add: Entry Load at 2%	₹ 0.38
Add: Dividend Equalization	₹ 0.0799
	₹ 19.4599

Repurchase Price at May End

Particulars	₹ per Unit
Opening NAV (4 lakh units)	₹ 19
Less: Exit Load at 2%	₹ -0.38
Add: Dividend Equalization	₹ 0.1938
	₹ 18.8138

Closing NAV at June End

Particulars		Amount
Opening NAV (400 lakh units)	₹ 19	₹ 7,600
Add: Incomes		
April	₹ 31.9600	
May	₹ 46.1250	
June	₹ 58.47	₹ 136.5550
Less: Dividend		₹ -81.7076
Add: Portfolio Appreciation		₹ 515.670
Add: Units Issued		
5* 19.4599		₹ 97.2995
Less: Units Repurchased		
4* 18.8138		₹ -75.2552
401 Lakh Units		**₹ 8,192.5617**
NAV	8192.5617/ 401	**₹ 20.4303**

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30. Illustration (May22)

Mr. D had invested in three mutual funds (MF) as per the following details:

Particulars	MF 'A'	MF 'B'	MF 'C'
Amount of Investment	2,00,000	5,00,000	4,00,000
NAV at the time of purchase	10.00	25.00	20.00
Dividend Yield up to 31.03.2022	3%	5%	4%
NAV as on 31.03.2022	10.50	22.80	20.80
Annualized Yield as on 31.03.2022	9.733%	- 11.185%	15%

Assume 1 Year = 365 Days.

Mr. D has misplaced the documents regarding his investments. You are required to help Mr. D to find out the following:

(i) Number of units allotted in each scheme,

(ii) Value of his investments as on 31.03.2022,

(iii) Holding period of his investments in number of days as on 31.03.2022

(iv) Dates of original investments

(v) Total Return on investments

(vi) Assuming past performance of all three schemes will continue for next one year, what action the investor should take? What will be the expected return for the next one year after the above action?

(vii) Will your answer as above of point (vi) change is the MF charges exit load of 5% for investments redeemed within a year? If so advise the investor what and when should be taken to optimize the return.

Solution

i) Number of units allotted in each scheme

	Investment ₹ (A)	NAV (₹/unit) (B)	Units (A)/(B)
A	2,00,000	10	**20,000**
B	5,00,000	25	**20,000**
C	4,00,000	20	**20,000**

ii) Value of his investments as on 31.03.2022,

Units (A)	Closing NAV (₹/unit) (B)	Units (A)*(B)
20,000	10.5	2,10,000
20,000	22.8	4,56,000
20,000	20.8	4,16,000
		10,82,000

iii) Holding Period:

Total return % $= \frac{CG + Dividend}{Original\ Investment}$

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	Investment		CG	Dividend Yield	Dividend Value	Total Value	Return %
	Closing (A)	Opening (B)	(C) = (A)- (B)	(D)	(E) = (B)*(D)/100	(F) = (C) + (E)	(F)*(B)/100
A	2,10,000	2,00,000	10,000	3%	6,000	16,000	8%
B	4,56,000	5,00,000	-44,000	5%	25,000	-19,000	-3.8%
C	4,16,000	4,00,000	16,000	4%	16,000	32,000	8%
			18,000		47,000	29,000	

MF	Absolute Return % (X)	Annualized Return % (Y)	No. of Days: $\frac{X}{Y} * 365$
A	8%	9.733%	**300**
B	-3.8%	-11.185%	**124**
C	8%	15%	**195**

iv) Dates of Original Investments:

Mutual Fund A: 65 days (365-300)
Mutual Fund B: 241 days (365-124)
Mutual Fund C: 170 days (365-195)

	A	B	C
April	30		30
May	31		31
June	4		30
July			31
August			31
September			17
October			
November		3	
December		31	
January		31	
February		28	
March		31	
	65	241	170

A: = 4th June Evening or 5th June Morning
B: = 27th November Evening
C: = 17th September Evening

v) Total Return on Investments:

Total return % = $\frac{(CG + Dividend)*100}{Original\ Investment}$

= $\frac{29,000*100}{11,00,000}$ = **2.636%**

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vi) Redeem all investments in Mutual Funds a and B and reinvest it in Mutual Fund C. The expected return for next 1 year of this Portfolio will be 15%

vii) Redeem Mutual Fund B right away and invest in C as if it has to be redeemed after 1 Year. This implies additional 240 days it has to be invested during which loss of 8% (11.85*241/365) has to be incurred which is greater than 5% exit load.

31. Illustration (Nov'23)

Mr. S has invested in 3 different Mutual Fund Schemes. The following are the details of the same:

Particulars	Scheme A	Scheme B	Scheme C
Date of Investment	01-06-2022	01-07-2022	01-08-2022
Net Asset Value at Entry Date	₹ 11.00	₹ 10.50	₹ 12.00
Dividend received upto 31-03-23 (₹)	12,500.00	17,000.00	4,000.00
Unit NAV at 31-03-23 (₹)	11.25	11.48	10.80
Increase / (Decrease) in NAV (₹)	22,727.27	93,333.33	(50,000.00)
Effective Rate of Yield per annum	4.2296%	14.6978%	(-) 13.8190%

Ignore Entry/Exit load expenditure.

Assume 365 days in a year. Round off the investment to nearest ₹100. You are required to calculate:

- The amount of investments made initially by Mr. S in these schemes.
- Number of units invested in the three schemes by Mr. S.

Advise also whether he can continue to hold this investment or can he redeem now.

Solution

Method 1:

Particulars	Scheme A	Scheme B	Scheme C
NAV Opening / Investment Date	11.00	10.50	12.00
NAV Closing	11.25	11.48	10.80
Increase / (Decrease) in NAV (₹ per unit	0.25	0.98	-1.20
Increase / (Decrease) in NAV (₹)	22,727.27	93,333.33	(50,000.00)
Units = Inc in Scheme Value / Inc in NAV	22,727.27 / 0.25	93,333.33 / 0.98	(50,000.00) / -1.20
Units	90909.08	95238.09	41666.67
= > Investment value = Units X Investment NAV	11 x 90909.08	11.48 x 95238.09	12 x 41666.67
Investment Value	Rs.9,99,999.88	Rs.9,99,999.945	Rs.5,00,000.04
Investment value rounded off	Rs.10 lacs	Rs.10 Lacs	Rs.5 Lacs

Method 2:

Particulars	Scheme A	Scheme B	Scheme C
Date of Investment	1st June 2022	1st July 2022	01 August 2022
Days of Investment till 31st march 2023	304	274	243
Dividend	12500	17000	4000
Increase / (Decrease) in NAV (₹)	22,727.27	93,333.33	(50,000.00)

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Total Return Div + Inc in NAV - A	35227.27	110333.33	-46000
Yield Per Annum	4.2296%	14.6978%	-13.8190%
Yield of days of investment - B	4.2296% x 304 / 365 = 3.5227%	14.6978% x 274 / 365 = 11.0334%	-13.8190% X 243 /365 = -9.2000%
Investment Value C = A / B	Rs.10,00,007.66	Rs.10,00,000	Rs.5,00,000
Investment value rounded off	Rs.10 lacs	Rs.10 Lacs	Rs.5 Lacs
Units of Investment made = C / Opening NAV	Rs.10 Lacs / 11	Rs.10 Lacs / 10.5	Rs.5 Lacs / 12
Units of investment made	90909.08	95238.09	41666.67

The investor should redeem investments in Schemes A & C and invest the money in Scheme B as it has higher return

32. Illustration (May24)

Mr. Kar has invested in three mutual fund schemes as per details below :

	MFX	MFY	MFZ
Amount of investment (Rs.)	5,50,000	4,20,000	1,00,000
Dividend received up to 31.03.2023 (Rs.)	10,000	6,000	Nil
NAV as on 31.03.2023 (Rs.)	11.50	11.00	9.50
Effective yield p.a. as on 31.03.2023	19.345	22.59%	-36.50%
Holding period	120	100	50

You are required to calculate Net Asset Value (NAV) at the time of purchase assuming 365 days in a year.

Solution:

	MFX	MFY	MFZ
Amount of investment (Rs.) - A	5,50,000	4,20,000	1,00,000
Dividend received up to 31.03.2023 (Rs.)	10,000	6,000	Nil
NAV as on 31.03.2023 (Rs.)	11.50	11.00	9.50
Effective yield p.a. as on 31.03.2023	19.345	22.59%	-36.50%
Holding period	120	100	50 days
Yield for Holding Period	19.345% x 120 / 365	22.59% x 100/365	-36.50% x 50 / 365
Yield for Holding Period - B	6.36%	6.189%	-5%
Absolute yield generated in INR C = A x B / 100	34980	25994	(5000)
Less: Dividend - D	10,000	6,000	Nil
Increase in investment value in INR: E = C – D	24980	19994	(5000)
Closing value of Investment F = A + E	574980	439994	95000
Closing NAV – G	11.50	11.00	9.50
Closing Units H = F / G	49998.26	39999.45	10000
Opening NAV I = A / H	~11	~10.5	~10

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33. Illustration (May24)

Mr. A, has invested in the Growrich Mutual Fund's Scheme. The details of the Mutual Fund Scheme are given below :

Asset Value at the beginning of the month	**₹78.50**
Annualized Return	16%
Distribution made in the nature of Income and Capital Gain (per unit respectively)	**₹0.40& ₹ 0.30**

You are required to :

(i) Calculate the month end Net Asset Value of the Growrich Mutual Fund Scheme (Round off to 2 decimals)

(ii) Comment briefly on the Month end NAV.

Solution

Return = (Closing Value – Opening Value + Capital Gain Distributed + Dividend Distributed) / Opening Value

Annualised return = 16%

Monthly Return = 16/12 = 1.33%

1.33% = (Closing – 78.50+0.40 + 0.30) / 78.50

1.33% = (Closing – 77.80)/ 78.50

78.5 x 1.33% = Closing – 77.80

1.0467 = closing -77.80

Closing Value = 77.80 + 1.0467

Closing Value = 78.8467 = Rs.78.85

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1. Illustration

The 6-months forward price of a security is ₹208.18. The borrowing rate is 8% per annum payable with monthly rests. What should be the spot price?

Solution:

Particulars	₹	%	Period
Forward Rate	208.18		
Interest rate - PA - monthly rests		8%	
Contract tenure			6 months
Spot	?		
Forward Price = $Spot * (1 + r/n)$ ^ (nt)			
$F = S * (1 + 8\%/12)$ ^ $(12 * 0.5)$			
$208.18 = S * (1 + 0.67\%)$ ^6			
$208.18 = S * 1.0409$			
$S = 208.18/1.0409$	200		
Spot	**200**		

2. Illustration

The following data relate to Anand Ltd.'s share price:

- Current price per share ₹. 1,800
- 6 months future's price/share ₹. 1,950

Assuming it is possible to borrow money in the market for transactions in securities at 12% per annum, you are required:

(i) to calculate the theoretical minimum price of a 6-months forward purchase; and

(ii) to explain arbitrate opportunity.

Solution:

Particulars	₹	%	Period
Spot	1800		
Future price	1950		
Int rate %		0.12	
Contract Tenure			6 months
$Forward = Spot\ x\ (1 + Coc\%)$			
$Coc\% = 12\%\ x\ 6/12$			
$Coc\% = 6\%$			
$Forward = Spot\ X\ (1 + 6\%)$			
$F = 1800\ X\ (1.06)$	1908		
On day 0			

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Borrow money for 6 months @ 12%	1800	0.12	6 months
Invest in Stock of Anand Limited	-1800		
Short futures @	1950		
After 6 months			
Deliver Share	1950		
Repay loan 1800+ 12% interest	-1908		
Net gain	**42**		

3. Illustration

On 31-8-2011, the value of stock Index was ₹. 2,200. The risk-free rate of return has been 8% per annum. The dividend yield on this Stock Index is as under

Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Dividend p.a (%)	3	4	3	3	4	3	3	4	3	3	4	3

Assuming that interest is continuously compounded daily, find out the future price of contract deliverable on 31-12-2011. Given: $e^{0.01583}$= 1.01593.

Solution:

Particulars	**₹**	**%**	**Period**
Value of Index		8%	
Rf Rate			31-Dec-11
Maturity date of future contract			
Dividend Accrued in 4 months- 3%,3%,4%,3%		3.25%	
Average Dividend per month			
$F = Spot * e\text{^}((r-d)*t)$			
$F = Spot * e\text{^}((8\% - 3.255) * 4/12)$			
$F = 2200 * e\text{^}(1.5833\%)$			
$F = 2200 * e\text{^}(0.015833)$			
$F = 2200 * 1.01593$	**2235.046**		

4. Illustration

Calculate the price of 3 months PQR futures, if PQR (Face Value is ₹.10) quotes ₹. 220 on NSE and the three months future price quotes at ₹. 230 and the per annum borrowing rate is given as 15 percent and the expected annual dividend is 25 percent per annum payable before expiry. Also examine arbitrage opportunities.

Solution:

Particulars	**₹**	**%**
Spot of PQR (FV 10)	220	
3-month Future	230	
Borrowing Rate PA		0.15
Annual Expected Dividend	2.5	0.25
Theoretical price of Future		
$F = S + Coc - Div$		
$F = \frac{220 + 220 * 15\% * 3}{12 - 2.5}$		

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F =	**225.75**	
Day 0		
Borrow 220 @ 15%	220	
Invest in Stock in spot	-220	
Sell Futures @ 230	0	
Total Cash flow	**0**	
Day 91		
Deliver stock against futures & take cash	230	
Repay Loan	-220	
Repay interest	-8.25	
Dividend inflow	2.5	
Total Cash flow	**4.25**	

*** Assumption - Dividend is received on last day**

By borrowing & investing a stock and shorting futures on day zero & closing the positions on Day 90 / 91 by delivering the stock - one can make profit of ₹ 4.25.

5. Illustration

BSE	5000
Value of portfolio	₹.1010000
Risk free interest rate	9% p.a.
Dividend yield on Index	6% p.a
Beta of portfolio	1.5

We assume that a future contract on the BSE index with four months maturity is used to hedge the value of portfolio over next three months.

One future contract is for delivery of 50 times the index. Based on the above information calculate:

(i) Price of future contract.

(ii) The gain on short futures position if index turns out to be 4,500 in three months.

Solution:

Particulars	₹ / Index	%
BSE Spot	5000	
Portfolio Value	1010000	
R_f		9%
Y%		6%
Portfolio Beta	1.5	
BSE Futures - 4 months		
Hedging for 3 months		
Lot size - 50 units		
$F = S + Coc - D$		
$F = 5000 + 9\% * 4/12 * 5000 - 6\% * 4/12 * 5000$		
$F = 5000 + 5000 * 4/12 * (9\% - 6\%)$	5050	
Lot size	50	

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Single contract	252500	
Assuming Beta is 1 No of contracts to be entered into for portfolio to be fully hedged by using Short futures position	4	
For Beta of 1.5, No. of Contracts is	4 x 1.5	
For Beta of 1.5, No. of Contracts is	**6**	
Spot Value of Index after 3 months	4500	
1 Month future after 3 months is?	4511.25	
Price of future at time of shorting	5050	
Price of future at time of shorting	5050	
Price of future after 3 months	4511.25	
No of contracts	6	
Lot size	50	
Total Gain	**161625**	

6. Illustration

The share of X Ltd. is currently selling for ₹ 300. Risk free interest rate is 0.8% per month.
A three months futures contract is selling for ₹ 312. Develop an arbitrage strategy and show what your riskless profit will be 3 months hence assuming that X Ltd. will not pay any dividend in the next three months.

Solution:

Particulars	₹ / Index	%
Spot price of X Ltd Share	300	
3 Month future Price of X Ltd share	312	
R_f interest rate pm		0.008
Dividend		0
$Theoretical\ future\ price = S + Coc$		
$= 300 + 300 * 0.8\% * 3 - Simple\ Interest$	307.2	
$= 300 * (1 + 0.8\%)\text{^}3 - Compound\ Interest$	307.258	
$= 300X\ e\ \text{^}(0.8\% * 3) - Continous\ Compounding$	307.287	
Compound Interest based Futures price	307.258	
Current Futures price	312	
Transactions Day zero		
1. Short Future @312	0	
2. Buy Stock @ Spot - 300	-300	
3. Borrow money ₹300 @ 0.8% pm	300	
	0	
Transactions at maturity		
1. Return money	-307.26	
2. Deliver the stock against the future contract	0	
3. Take money on delivery of stock against future contract	312	
Net cash flow	**4.74225**	

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Difference between Futures price (theoretical - actual)	**-4.7422**	

Additional Case:

Particulars	₹ / Index	%
Spot price of X Ltd Share	300	
3 Month future Price of X Ltd share	303	
R_f interest rate pm		0.008
Dividend		0
$Theoretical\ future\ price = S + COC$		
$= 300 + 300 * 0.8\% * 3 - Simple\ Interest$	307.2	
$= 300 * (1 + 0.8\%)\text{^}3 - Compound\ Interest$	307.258	
$= 300X\ e\ \text{^}(0.8\% * 3) - Continous\ Compounding$	307.287	
Compound Interest based Futures price	307.258	
Current Futures price	303	
Transactions Day zero		
1. Buy Future @ 303	0	
2. Sell the stock - Shorting - 300	300	
3. Invest / lend cash @0.8% for 3 months	-300	
Transaction on maturity		
1. Cash returned to us	307.258	
2. Give cash & take stock delivery on futures contract	-303	
3. Hand over the stock to settle to the shorting of stock transaction	0	
Net cash flow	**4.25775**	
Difference between Futures price (theoretical - actual)	**4.26**	

7. Illustration

A Mutual Fund is holding the following assets in ₹ Crores

Investments in diversified equity shares	90.00
Cash and Bank Balances	10.00
Total	100.00

The Beta of the equity shares portfolio is 1.1. The index future is selling at 4300 level. The Fund Manager apprehends that the index will fall at the most by 10%. How many index futures he should short for perfect hedging? One index future consists of 50 units. Substantiate your answer assuming the Fund Manager's apprehension will materialize.

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Solution:

Particulars	₹ / Index	%
Index Future Value	4300	
Lot Size - 50 units		
MF Investments in Cr		
- Cash	10	
- Diversified Equity Shares	90	
Total	100	
Beta of Equity shares	1.1	
1. No. Of Futures to be shorted for a perfect hedge		
Contract Value of 1 futures contract	215000	
Value of Equity shares	900000000	
No of Futures contracts to be entered into	4604.6512	
Round off futures contracts	4605	
Future contracts shorted	4605	
2. In case index falls by 10% then		
Loss on Equity shares	99000000	11%
Gain on Short futures		
No. Of futures	4605	
Lot size	50	
Gain per contract	430	
Total Gain on Futures	**99007500**	
The Loss on Equity shares portfolio of Rs 9.9 Cr is offset by gain on futures & hence the hedging transaction served its purpose.		

8. Illustration

A trader is having in its portfolio shares worth ₹ 85 lakhs at current price and cash ₹ 15 lakhs. The beta of share portfolio is 1.6. After 3 months the price of shares dropped by 3.2%. Determine:

(i) Current portfolio beta

(ii) Portfolio beta after 3 months if the trader on current date goes for long position on ₹100 lakhs Nifty futures.

Solution:

Particulars	₹ Lacs / Index	Beta
Equity Portfolio	85	1.6
Cash	15	0
Total	100	1.36
Beta of portfolio = WA of Beta of respective components		

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$= \frac{85*1.6+15*0}{85+100}$ =1.36		
Part 2		
Price of Equity shares dropped by 3.2% after 3 months		
Given Beta of portfolio is 1.6; the market index dropped by 2% in 3 months (i.e., 3.2%/1.6)		
Portfolio beta = 1.6		
Change in Portfolio = 3.2% drop		
=> Change in market = $3.2\%/1.6$ = 2%		

Equity portfolio	85	1.6	-3.2%	82.28
Cash	15	0	0	15
Nifty Futures long	100	1	-2%	98
Beta of portfolio		**2.36**		4.72

9. Illustration

Which position on the index future gives a speculator, a complete hedge against the following transactions:

(i) The share of Right Limited is going to rise. He has a long position on the cash market of ₹ 50 lakhs on the Right Limited. The beta of the Right Limited is 1.25.

(ii) The share of Wrong Limited is going to depreciate. He has a short position on the cash market of ₹ 25lakhs on the Wrong Limited. The beta of the Wrong Limited is 0.90.

(iii) The share of Fair Limited is going to stagnant. He has a short position on the cash market of ₹ 20 lakhs of the Fair Limited. The beta of the Fair Limited is 0.75.

Solution:

Company Name	View / Position	₹ Lacs Investment	Beta	₹ Lacs Hegde	Hedge Position
Right Ltd	Rise - long	50	1.25	-62.5	Short Index
Wrong Ltd	Dep - Short	25	0.9	22.5	Long Index
Fair Ltd	Stagnant - Short	20	0.75	15	Long Index
				-25	Short Index

10. Illustration

Ram buys 10,000 shares of X Ltd. at a price of ₹ 22 per share whose beta value is 1.5 and sells 5,000 shares of A Ltd. at a price of ₹ 40 per share having a beta value of 2.

He obtains a complete hedge by Nifty futures at ₹ 1,000 each. He closes out his position at the closing price of the next day when the share of X Ltd. dropped by 2%, share of A Ltd. appreciated by 3% and Nifty futures dropped by 1.5%.

What is the overall profit/loss to Ram?

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Solution:

Company Name	Position	Shares & Price	₹ Lacs Investment	Beta	
X Ltd	Long / Buy	10000 x 22	2.2	1.5	
A Ltd	Short / Sell	5000 x 40	-2	2	
			0.2	-3.5	-0.7
Hedge using Nifty	Long	1000 x 70	0.7	1	0.7

Total position as per existing transactions – ₹ Lacs	-0.7
Hedge should be – ₹ Lac	0.7
Contract value – ₹	1000
Number of contracts	70

Part 2

Company Name	Position	₹ Lacs Investment	Change %	₹ Lacs Value	Change ₹ Lacs
X Ltd	Long / Buy	2.2	-2%	2.156	-0.044
A Ltd	Short / Sell	-2	3%	-2.06	-0.06
Nifty	Long	0.7	-1.5%	0.6895	-0.0105
		0.2			-0.1145
Total Loss on portfolio is ₹ 11450					

11. Illustration

On January1, 2013 an investor has a portfolio of 5 shares as given below.

Security	Price	Number of Shares	Beta
A	349.30	5,000	1.15
B	480.50	7,000	0.40
C	593.52	8,000	0.90
D	734.70	10,000	0.95
E	824.85	2,000	0.85

The cost of capital to the investor is 10.5% per annum. You are required to calculate

i. Beta of his portfolio
ii. The theoretical value of NIFTY futures for February 2013
iii. The number of contracts of NIFTY the investor needs to sell to get a full hedge until February for his portfolio if the current value of NIFTY is 5900 and NIFTY futures have a minimum trade lot requirement of 200 units. Assume that the futures are trading at their fair value.
iv. The number of future contracts the investor should trade if he desires to reduce the beta of his portfolios to 0.6. No. of days in a year be treated as 365.Given: In (1.105) = 0.0998 and $e^{(0.015858)}$= 1.01598

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Solution:

Security	Price	# Shares	₹ Lacs value	Beta
A	349.3	5000	17.465	1.15
B	480.5	7000	33.635	0.4
C	593.52	8000	47.4816	0.9
D	734.7	10000	73.47	0.95
E	824.85	2000	16.497	0.85
			188.5486	0.84907
Part 1: Portfolio Beta				**0.84907**

NIFTY Spot	5900
Coc	0.105
# of days in year	365
NIFTY Future	$= Spot * e^{\wedge}(r * t)$
Part 2: Nifty Future value	**5999.266924**

Short Nifty futures for Full hedge	
Nifty Futures value	5999.27
Lot size	200
Notional of 1 Nifty future contract	1199853
Part 3: Total Nifty future contracts to be shorted	**13.3426**

	₹ Lacs value	Beta	
Portfolio Data	188.5486	0.84907	160.091
Short Nifty	-46.96198	1	-46.962
Revised portfolio	188.5486	0.6	113.129
Notional short nifty position	-4696198		
1 Contract notional	1199853.385		
Part 4: No. of contracts to be shorted	**3.91397654**		

12. Illustration

Details about portfolio of shares of an investor is as below:

Share	No. of Shares (Lakhs)	Price per share	Beta
A Ltd.	3.00	₹ 500	1.40
B Ltd.	4.00	₹ 750	1.20
C Ltd.	2.00	₹ 250	1.60

The investor thinks that the risk of portfolio is very high and wants to reduce the portfolio beta to 0.91. He is considering two below mentioned alternative strategies:

(i) Dispose off a part of his existing portfolio to acquire risk free securities or

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(ii) Take appropriate position on Nifty Futures which are currently traded at ₹ 8125 and each NIFTY point is worth ₹ 200.

You are required to determine:
(1) portfolio beta,
(2) The value of risk-free securities to be acquired,
(3) The number of shares of each company to be disposed off,
(4) The number of Nifty contracts to be bought/sold; and
(5) The value of portfolio beta for 2% rise in Nifty

Solution:

Part 1

Security	Price	# Shares L	₹ Lacs value	Beta	Beta *Value	Weightage
A Ltd	500	3	1500	1.4	2100	0.3
B Ltd	750	4	3000	1.2	3600	0.6
C Ltd	250	2	500	1.6	800	0.1
			5000	1.3	6500	
Portfolio Beta is 1.3						

Part 2	₹ Lacs value	Beta
Target portfolio beta	5000	0.91
Total proportion of RF securities	R_f	0
Total value of portfolio	5000	0.91
Value of Equity Portfolio	5000-R_f	1.3
	$(R_f * 0 + (1 - R_f) * 1.3)/1 = 0.91$	
	$(0 + 1.3 - 1.3R_f) = 0.91$	
	$1.3 - 0.91 = 1.3R_f$	
	$0.39 = 1.3\,RF$	
	$R_f = 0.39/1.3$	
	$R_f = 0.3$	
	$R_f = 30\%$	
	Equity Portfolio = 70%	
Value of Risk-Free securities acquired	**1500**	

Part 3

Security	Price	# Shares L	₹ Lacs value	% Disposed	# of Shares Disposed
A Ltd	500	3	1500	0.3	0.9
B Ltd	750	4	3000	0.3	1.2
C Ltd	250	2	500	0.3	0.6
			5000	0.3	

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Part 4	₹ Lacs value	Beta	Beta x Value
Reduce Beta to 0.91 by Entering to Nifty contracts			
Current portfolio	5000	1.3	6500
Short Nifty	1950	-1	-1950
Target portfolio	5000	0.91	4550
Total NIFTY Contract Value Short	1950		
Current Nifty Futures	8125		
Each NIFTY is worth	200		
Total contracts	120		

Part 5	Price	₹ Lacs value	Beta	Beta* Value
NIFTY Change	0.02			
Loss on NIFT Short	39			
Equity portfolio		5000	1.3	
Change in portfolio value		130		
Revised portfolio value		5130		
Less: Loss on Nifty		-39		
Total value of portfolio		5091		
Net change in total portfolio		91		
% change in total portfolio		1.82%		
% change in NIFTY		2%		
Beta		0.91		
Revised portfolio Beta				
Equity		5130	1.3	6669
Nifty Short		1911	-1	-1911
Total Beta		**5130**	**0.92749**	**4758**

When there is a 2% Rise in NIFTY, the portfolio value will change by 1.82% because Beta of portfolio is 0.91

Once the portfolio weights change and no new transactions are entered into the BETA will change to 0.927

13. Illustration

On April 1, 2015, an investor has a portfolio consisting of eight securities as shown below:

Security	Market Price	No. of Shares	Beta Value
A	29.40	400	0.59
B	318.70	800	1.32
C	660.20	150	0.87
D	5.20	300	0.35
E	281.90	400	1.16
F	275.40	750	1.24
G	514.60	300	1.05

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H	170.50	900	0.76

The cost of capital for the investor is 20% p.a. continuously compounded. The investor fears a fall in the prices of the shares in the near future. Accordingly, he approaches you for the advice to protect the interest of his portfolio.

You can make use of the following information:

(1) The current NIFTY value is 8500.
(2) NIFTY futures can be traded in units of 25 only.
(3) Futures for May are currently quoted at 8700 and Futures for June are being quoted at 8850.

You are required to calculate:

(i) The beta of his portfolio.
(ii) The theoretical value of the futures contract for contracts expiring in May and June.. Given ($e^{0.03}$ =1.03045, $e^{0.04}$ = 1.04081, $e^{0.05}$ =1.05127)
(iii) The number of NIFTY contracts that he would have to sell if he desires to hedge until June in each of the following cases:

(A) His total portfolio
(B) 50% of his portfolio
(C) 120% of his portfolio

Solution:

Part 1

Security	Price	# of shares	₹	Beta
A	29.4	400	11760	0.59
B	318.7	800	254960	1.32
C	660.2	150	99030	0.87
D	5.2	300	1560	0.35
E	281.9	400	112760	1.16
F	275.4	750	206550	1.24
G	514.6	300	154380	1.05
H	170.5	900	153450	0.76
Portfolio Beta			994450	**1.10195**

Part 2

Nifty Spot	8500
COC	20%
May Futures	8700
June Futures	8850
May Theoretical Futures Price	8788.18
June Theoretical Futures Price	8935.8

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WN	t (days)	r	rt	e ^(rt)	$F = S * e$^(rt)
t May	60	0.2	0.032876712	1.0339	8788.17833
t June	90	0.2	0.049315068	1.05127	8935.795

e ^(0.03)	1.03045
e ^(0.04)	1.04081
e ^ (0.01)	0.01036
e ^ (0.033)	1.0339

Part 3

Hedge 100% of portfolio with NIFTY	% coverage	Total Notional of NIFTY Short (Portfolio value * % coverage * Portfolio Beta)	June Futures price	Lot size	# of contracts = Total Notional / Futures price / Lot size
Total NIFTY Notional to be shorted	1	1095832.3	8850	25	4.952914
Total NIFTY Notional to be shorted	0.5	547916.15	8850	25	2.476457
Total NIFTY Notional to be shorted	1.2	1314998.76	8850	25	5.943497

14. Illustration

Sensex futures are traded at a multiple of 50. Consider the following quotations of Sensex futures in the 10 trading days during February 2009:

Day	High	Low	Closing
04-02-2009	3306.40	3290.00	3296.50
05-02-2009	3298.00	3262.50	3294.40
06-02-2009	3256.20	3227.00	3230.40
07-02-2009	3233.00	3201.50	3212.30
10-02-2009	3281.50	3256.00	3267.50
11-02-2009	3283.50	3260.00	3263.80
12-02-2009	3315.00	3286.30	3292.00
14-02-2009	3315.00	3257.10	3309.30
17-02-2009	3278.00	3249.50	3257.80
18-02-2009	3118.00	3091.40	3102.60

Abhishek bought one Sensex futures contract on February 04. The average daily absolute change in the value of contract is ₹ 10,000 and standard deviation of these changes is ₹ 2,000.

The maintenance margin is 75% of initial margin. You are required to determine the daily balances in the margin account and payment on margin calls, if any.

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Solution:

Average Change in Contract value	**Mean**	**10000**
1 SD in average contract value	SD	2000
based on the principles of VAR, Margin is Mean + 3 SD		16000
Initial Margin		16000
Maintenance Margin	0.75	12000

Day	Closing	MTM Computation	MTM	Total Margin	Margin call	Closing margin
4th Feb	3296.5	0		16000	0	
5th Feb	3294.4	50 * (3294.4-3296.5)	-105	15895	0	
6th Feb	3230.4	50 * (3230.4-3294.4)	-3200	12695	0	
7th Feb	3212.3	50 * (3212.3-3230.4)	-905	11790	4210	16000
10th Feb	3267.5	50 * (3267.5-3212.3)	2760	18760	0	
11th Feb	3263.8	50 * (3263.8-3267.5)	-185	18575	0	
12th Feb	3292	50* (3292-3263.8)	1410	19985	0	
14th Feb	3309.3	50 * (3309.3-3292)	865	20850	0	
17th Feb	3257.8	50 * (3257.8-3309.3)	-2575	18275	0	
18th Feb	3102.6	50 * (3102.6-3257.8)	-7760	10515	5485	16000
Total Gain			-9695		9695	
Total Gain	(3102.6-3296.5) * 50	-9695				
*** Assumption purchase is made on Feb 4th at closing price**				3296.5		
Contracts	1					
Lot size	50					
Initial margin	16000					

15. Illustration

Suppose that there is a future contract on a share presently trading at ₹ 1000. The life of future contract is 90 days and during this time the company will pay dividends of ₹ 7.50 in 30 days, ₹ 8.50 in 60 days and ₹ 9.00 in 90 days.

Assuming that the Compounded Continuously Risk-free Rate of Interest (CCRRI) is 12% p.a. you are required to find out:

(a) Fair Value of the contract if no arbitrage opportunity exists.

(b) Value of Cost to Carry.

[Given $e^{-0.01} = 0.9905$, $e^{-0.02} = 0.9802$, $e^{-0.03} = 0.97045$ and $e^{0.03} = 1.03045$]

Solution:

Spot		**1000**
Dividend	30	7.5
	60	8.5
	90	9
CCROI		12% PA

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Given	
e ^(-0.01)	0.9905
e ^(-0.02)	0.9802
e ^(-0.03)	0.9705
e ^(0.03)	1.03045

PV of Div inflows	30	7.5	$7.5 * e$ ^$((-30/360) * 12\%)$	$7.5\ x\ e$^(-0.01)	7.42875
	60	8.5	$8.5 * e$ ^$((-60/360) * 12\%)$	$8.5\ x\ e$^(-0.02)	8.3317
	90	9	$9.0 * e$ ^$((-90/360) * 12\%)$	$9.0\ x\ e$^(-0.03)	8.7345
					24.49495

Futures price	$(1000 - 24.49495) * e$ ^$(90/360\ x\ 12\%)$	
	$(1000 - 24.49495) * e$ ^(0.03)	
	1005.21	
Cost of carry	29.7041	
PV of Div	-24.495	
Net cost of carry	5.20918	
e ^(-0.03)	0.97045	$= 1 /(e$ ^ $(0.03))$
e ^ (-0.01)	0.9905	
e ^(0.03)	1.03045	
	0.02005	
	0.01003	
e ^(-0.02)	0.98048	

16. Illustration

A futures contract is available on R Ltd that pays annual dividend of ₹ 4 whose stock is currently priced at ₹ 125. Each future contract calls for the delivery of 1000 shares to stock in one year. Corporate treasury bill is ₹ 8%.
Given the above information what should be the price of one future contract if the company's stock price decreases by 6%.
And as a result of the company's stock price decrease will the investor long position in one futures contract realise the gain or loss, what would be amount of gain or loss.
Ignore margin and taxation if any.

Solution:

R Ltd Spot price		125
Annual Dividend		4
Futures contract Duration		1 year
Futures lot size		1000
ROI		0.08
Price of Futures contract		$S + COC - D$
COC		10

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Futures price of a single share		131
Dividend is paid on the last day and dividend is directly deducted from cost of carry		
Futures price of a contract of 1000 shares		131000
Spot		125
Less: Reduction	0.06	7.5
		117.5
1 Futures contract price		$1000\ x\ (\ 117.5(1+8\%)-4$
		122900
Because of reduction in value of the stock, the Investor will Lose ₹8100		**8100**

17. Illustration

Mr. V decides to sell short 10,000 shares of ABC plc, when it was selling at yearly high of 5.60 pounds. His broker requested him to deposit a margin of 45% and commission of 1,550 pounds. While Mr. V was short the share, ABC plc. Paid a dividend of 0.25 pounds. At the end of one year, Mr. V buys 10,000 shares of ABC plc. at 4.50 pounds to close out the position and was charged a commission of 1,450 pounds.

You are required to calculate return on investment of Mr. V.

Solution:

# of shares of ABC Pls Short sold		10000	
Price at which short sold		5.6	
Margin Requirement	45%	25200	
Dividend paid during the year	25%	2500	
Year-end position close at		4.5	
Initial commission		1550	
Closure commission		1450	
ROI		$Profit\ /\ Investment$	0.2183
Profit		Reduction in price	11000
		Less: Commissions	-3000
		Less: Dividend	-2500
		Net return	**5500**
		Investment	25200

0	1
-29250	34750
10% NPV	2340.91
20% NPV	-291.667
19% NPV	-48.3193
0.01	-243.347

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	0.00199
ROI	19%-0.2%
	0.188

18. Illustration

Suppose current price of an INDEX is ₹ 13,800 and yield on INDEX is 4.8% per annum. 6 Month future contract of an INDEX is trading at ₹ 14,340.

Assuming the Risk-free rate of interest is 12%, show that Mr. X, an arbitrager can earn an abnormal rate of return irrespective of outcome after 6 months.

You can assume that after six months; INDEX closes at ₹ 10,200 or ₹ 15,600 and 50% of the stock including INDEX shall pay dividend in next 6 months.

Also calculate the implied Risk-free rate.

Solution:

Spot Index price	**13800**
Index Yield p.a.	0.048
6-month futures price	14340
Rf	0.12
Index closing value after 6 months	10200
	15600
Index stock paying div in 6 months	50%
F = S+ COC - Div.	
$= 13800 + 13800 * 12\% * 6/12 - 4.8\% * 50\% * 13800$	14296.8
Theo Futures price	**14296.8**
Spot	13800
COC	828
Dividend	331.2

		Cash Flow (Day 0)
Short Index Futures	14340	0
Buy Index spot (portfolio or ETF)	13800	-13800
Borrow Money @ 12%	13800	13800

Cash flow after 6 months

Dividend	331.2
Add: Cash	14340
Less: Loan	-13800
Less: Interest	-828
Profit	43.2

	Index 10200		**Index 15600**
Dividend	331.2	Dividend	331.2
Profit on Futures shorted	4140	Loss on Futures	-1260

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Loss on Shares	-3600	Gain on shares	1800
Less: Interest	-828	Less: Interest	-828
Net profit / loss	43.2	Net profit / loss	43.2

At Implied risk-free rate	$\mathbf{14340 = 13800 + 13800 * x\% * 6/12 - 4.8\% * 50\% * 13800}$
	$14340 - 13800 = 13800 * x\% * .5 - 331.2$
	$540 + 331.2 = 13800 * x\% * .5$
	$871.2 = 13800 * x\% * 1/2$
	$871.2 * 2/13800 = x\%$
Implied risk-free rate	$\mathbf{0.12626}$

19. Illustration

The NSE-50 Index futures are traded with rupee value being ₹ 100 per index point. On 15th September, the index closed at 1195, and December futures (last trading day December 15) were trading at 1225.
The historical dividend yield on the index has been 3% per annum and the borrowing rate was 9.5% per annum.

(i) Determine whether on September 15, the December futures were underpriced or overpriced?
(ii) What arbitrage transaction is possible to gain out this mispricing?
(iii) Calculate the gains and losses if the index on15th December closes at(a) 1260 (b) 1175.
Assume 365 days in a year for your calculations.

Solution:

Spot on 15th Sep	**1195**
15th Dec Future price	1225
Y	0.03
R	0.095
Lot size	100
Part 1	
Theoretical Futures price per 1 unit of index	$= S + S * (r - y) * t$
	1214.37
Futures price per contract	121437
December futures are overpriced on the stock exchange	

Part 2

Since Futures are overpriced. We will sell them. Secondly, since it is an arbitrage transaction with no risk, one will borrow money @9.5% and invest it in the spot value of Index in order to cover the short futures position. On the Maturity date, all positions will be closed out and profit will be booked.

Part 3	**(a)**	**(b)**
Gain / Loss if index value on Dec 15th is	1260	1175
Day 0 Cash flow		

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Short Futures 100 contracts @ 1225	0	0
Borrow money @ 9.5%	119500	119500
Buy Spot Index 100 units @ 1195	-119500	-119500
Total CF on Day 0	0	0
Day 91 CF		
(Loss)/ Profit on Futures	-3500	5000
Sell the index spot	126000	117500
Dividend @ 3%	893.7945205	893.7945
Repay Loan	-119500	-119500
Repay Interest @ 9.5%	-2830.349315	-2830.35
Total Cash flow	**1063.445205**	**1063.445**
Irrespective of the Index value the arbitrager can lock in profit of ₹1063.45 per lot of futures		

20. Illustration

On 1st April 2015, Sunidhi was holding a portfolio of 10 securities whose value was ₹ 9,94,450. The weighted average of beta of 9 securities was 1.10.
Since she was expecting a fall in the prices of the shares in near future to hedge her portfolio, she sold 5 contracts of NIFTY Futures (Multiplier of 25) expiring in May 2015, which was trading at 8767.07 on 1st April.

i. Calculate the beta of the 10th security.
ii. Reconcile the reasons in spite of 2% fall in the market as per Sunidhi's apprehension if she would have earned some profit on her cash position.

Solution:

Portfolio Value	**994450**
Beta of 9 Securities	1.1
Nifty Contracts Shorted	5
Lot size	25
Futures price	8767.07
Total Notional value Shorted	1095883.75
Beta of 10th Security	
First find out Total portfolio Beta	
Total futures value = Portfolio x beta	
Beta = Total Futures value /Portfolio value	
Beta of full portfolio of 10 securities =	1.10199985
Assuming weights of 9 securities & the 10th security are in same proportion	
9	1.1
1	B
10	1.102

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	10 X 1.102 = 9 x 1.1 + 1 x B	
	B = 10 x 1.102-9.9	1.12
		1.12
Part 1	Beta of 10th Security is	1.12
Part 2		
Even though portfolio beta is 1.1, & market fell by 2%, if Sunidhi has made a profit on her portfolio, it means some of her stocks may not have followed the overall market and as a result, the gains from those stocks, offset the negative impact of overall fall in the market		

21. Illustration

Miss K holds 10,000 shares of IBS Bank @ 2,738.70 when one month INDEX Future was trading at 6,086 and the share has a Beta of 1.2. How many INDEX Futures should she short to perfectly hedge her position? A single INDEX Future is a lot of 50 indices. Justify your result in the following cases:

i. When the INDEX zooms by 1%
ii. When the INDEX plummets by 2%

Solution:

Data Provided		
No of Shares of IBIS held by Miss K	10000	
Price per share	2738.7	
Total portfolio value	27387000	
Beta	1.2	
Futures price	6086	
Futures lot size	50	
Notional contract value of 1 Future	304300	
Part 1		
Number of futures contracts to be shorted	$= (portfolio\ value / notional\ contract\ value\ of\ 1\ future) * Beta$	
Number of futures contracts to be shorted	108	
Part 2		
Value of IBS Shares + Future Short when Index changes by	0.01	-0.02
IBS Shares	$beta * index\ gain * IBS\ value$	
Future position Short	$(Index\ Future - Spot) * contracts * lot\ size * Future\ price$	

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IBS Shares gain / (loss)	328644	-657288
Short futures gain / (loss)	-328644	657288
Total Gain / (loss)	0	0
Because Miss K has fully hedged shares of IBS bank with Index futures, the movement in market will not affect her portfolio value		

22. Illustration

BSE	30,000
Value of Portfolio	₹ 60,60,000
Risk free interest rate	9% p.a.
Dividend yield on INDEX	6% p.a.
Beta of Portfolio	1.5

We assume that a future contract on the BSE index with four months maturity is used to hedge the value of portfolio over next three months. One future contract is for delivery of 50 times the index.
Based on the above information calculate:

(i) Price of future contract.

(ii) The gain on short futures position if index turns out to be 27,000 in three months.

Solution:

BSE Spot	**30000**
Portfolio value	6060000
r	0.09
y	0.06
Beta of portfolio	1.50
Lot size of futures	50.00
Part 1	
Futures price - 4 months	**30300**
Part 2	
Index position in 3 months	27000
Total Futures Shorted to hedge the portfolio	90,90,000.00
No of futures contracts shorted	6.00
1 Month future price after 3 months when spot is 27000	27067.5
Gain on single unit of futures is	3232.5
Total gain on futures	**969750**

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23. Illustration

On April 1, 2019, Kasi has a portfolio consisting of four securities as shown below

Security	A	K	S	P
Market Price	₹ 48.50	₹ 332.68	₹ 13.99	₹ 292.82
No. of Shares	673	480	721	358
Beta Value	0.74	1.28	0.54	0.46

Cost of Capital is 16% p.a. compounded continuously. Kasi fears a fall in prices of shares in future. Accordingly, he approaches you for the advice to protect the interest of his Portfolio.

You can make use of the following information:

(i) The current NIFTY Value is 9380.

(ii) NIFTY Futures can be traded in units of 25 only.

(iii) Futures for September are currently quoted at 9540 and Futures for October are being quoted at 9820.

You are required to calculate:

The Beta of his Portfolio.

Theoretical Value of Futures for contracts expiring in September & October.

Given ($e^{0.067}$ = 1.0693, $e^{0.08}$ = 1.0833, $e^{0.093}$ = 1.0975)

The number of NIFTY Contract that he would have to sell, if he desires to hedge 150% of the Portfolio until October.

Solution:

Part 1

Security	Price	Shares	Total Value	Beta	B X value
A	48.50	673.00	32640.50	0.74	24153.97
K	332.68	480.00	159686.40	1.28	204398.59
S	13.99	721.00	10086.79	0.54	5446.87
P	292.82	358.00	104829.56	0.46	48221.60
			307243.25	0.92	282221.03
Portfolio Beta is				0.92	

Part 2

NIFTY Spot	9380.00	
COC	16%	
Futures lot size	25.00	
Futures value theoretical	$F = S * e\text{^}(rt)$	Market quote
- Sep	10161.35	9540
- Oct	10294.55	9820

WN 1

Cost of carry for Sep	$e\text{ ^}(16\% * 6/12)$	$e\text{^}(0.08)$	1.0833
Cost of carry for Oct	$e\text{ ^ }(16\% * 7/12)$	$e\text{^}(0.093)$	1.0975

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Part 3

No. of contracts for hedging 150% of the portfolio till October	
Portfolio value	307243.25
Beta	0.92
October futures price	9820.00
Lot size	25.00
Total number of contracts for 100% hedge	**1.15**
For 150% hedge	**1.73**

Kasi has to short 1.73 or 2 contracts of NIFTY October futures to hedge 150% of his portfolio

24. Illustration

Mr. A has a portfolio of ₹ 5 crores consisting of equity shares of X Ltd. and Y Ltd. with beta of 1.15.
Other information is as follows: Spot Value of Index Future = 21000
Multiplier = 150
You are requested to reduce beta of portfolio to 0.85 and increase beta to 1.45 by using:

(a) Change in composition through Risk Free securities
(b) Index futures

Solution:

	in ₹	in ₹ Cr
Portfolio value	50000000	5
Portfolio Beta		1.15
Index futures current price	21000	
Lot size	150	

Reduce portfolio beta to 0.85 using Risk free securities.

Let proportion of Risk-free securities be R_f		
$0.85 = (1 - R_f) * 1.15 + R_f * 0$		In Cr
$0.85 = 1.15 - 1.15RF$		
$1.15R_f = 0.30$		
$R_f = 0.30/1.15$	-0.26.0869	1.304348

26.09% of portfolio i.e., Rs.1.30 Cr should be taken out of X & Y Ltd.'s in their respective weights & invested in Risk free securities to reduce portfolio beta to 0.85

Increase Beta to 1.45 by Changing composition using Risk free securities

	in ₹	in ₹ Cr
$1.45 = (1 - R_f) * 1.15 + R_f * 0$		
$1.45 = 1.15 - 1.15R_f$		
$1.45 - 1.15 = -1.15R_f$		
$0.30 = -1.15R_f$		
$R_f = -0.30/1.15$	-0.26086957	-1.304348

₹ 1.30 Cr should be borrowed by shorting risk-free securities and invested in X & Y Ltd.'s in their respective weights in order to increase portfolio beta to 1.45

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Changing beta by using Futures	
Reducing Beta to 0.85	
	$0.85 * 5 = 5 * 1.15 - F * 1$
	$4.25 = 5.75 - F$
	$F = 1.5$
Notional value of Futures contract to be shorted	15000000
Futures value current	21000
Lot size	150
No of futures contracts shorted	4.761904762

For increasing Beta to 1.45	**Beta**	**₹ Cr**
Portfolio	1.45	5
Equity shares	1.15	5
Index long	1	F
	$1.45x\ 5\ =\ 1.15\ x\ 5 + 1 * F$	
	$7.25 - 5.75 = F$	
	$F = 1.5$	

Notional contract value of Futures to be purchased	**15000000**
Current futures price	21000
Lot size	150
No of Future contracts gone long	4.761904762

25. Illustration

Mr. X, is a Senior Portfolio Manager at ABC Asset Management Company. He expects to purchase a portfolio of shares in 90 days. However, he is worried about the expected price increase in shares in coming day and to hedge against this potential price increase he decides to take a position on a 90-day forward contract on the Index.

The index is currently trading at 2290. Assuming that the continuously compounded dividend yield is 1.75% and risk-free rate of interest is 4.16%, you are required to determine:

(a) Calculate the justified forward price on this contract.

(b) Suppose after 28 days of the purchase of the contract the index value stands at 2450 then determine gain/ loss on the above long position.

(c) If at expiration of 90 days, the Index Value is 2470 then what will be gain on long position.

Note: Take 365 days in a year and value of $e^{0.005942}$ = 1.005960, $e^{0.001849}$ = 1.001851.

Solution:

Given data	
Spot on Day 0	2290
Forward contract tenure in days (t)	90
Dividend Yield (y)	0.0175
Risk Free rate (r)	0.0416
(a)	

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$F = S * e\ \hat{}((r-y)*t/365)$	$2290 * e\hat{}(4.16\% - 1.75\%) * 90/365$
	$2290 * e\ \hat{}(2.41\% \ x\ 90/365)$
	$2290 * e\hat{}\ (0.0059425)$
90 Day forward price	**2303.6484**
(b)	
Current Spot	2450
Original spot	2290
28 Day forward price for original spot	$2290\ x\ e\ \hat{}(2.41\% * 28/365)$
Forward price	2294.23879
Gain / Loss	**155.76121**
(c)	
90-day spot	2470
90-day that day maturity forward price	2470
Original forward contract price	2303.6484
Gain / loss	**166.3516**

26. Illustration

A is an investor and having in its Portfolio Shares worth ₹. 1,20,00,000 at current price and Cash ₹ 10,00,000. The Beta of Share Portfolio is 1.4. After four months the price of shares dropped by 1.8%.

You are required to determine:

(i) Current Portfolio Beta and

(ii) Portfolio Beta after four months-if A on current date goes for long position on ₹ 1,30,00,000 Nifty futures.

(iii) Show calculations in ₹. Lakhs with four decimal points.

Solution:

Share portfolio in Rs. Lacs	120
Cash (₹ Lacs)	10
Beta	1.4
Reduction in portfolio prices in 4 months	-1.8%
Nifty Futures Long (Rs. Lacs)	130

(a)

	Rs. Lacs	Beta	Beta x Rs. L
Share portfolio	120	1.4	168
Cash	10	0	0
Total	130	1.292308	168
Portfolio Beta is		**1.292308**	

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(b)

Change in Value of portfolio	-0.018
Change in NIFTY	$change\ in\ portfolio$ $/portfolio\ beta$
Change in NIFTY	-0.01285714

Current date portfolio beta with NIFTY	**₹ Lacs**	**Beta**	**Beta * ₹ L**
Share portfolio	120	1.4	168
Cash	10	0	0
NIFTY Futures	130	1	130
Total	130	2.292308	298
Portfolio Beta is		**2.292308**	

	₹ Lacs	**Change**	**Value after 4 months**	**Change**
Change in Value of Equity Shares	120	-0.018	117.84	2.16
Change in NIFTY contract	130	-0.012857	128.3286	1.671429
Cash	10	0	10	0
Total	130	0.029473		3.831429
Portfolio Beta	$Change\ in\ portfolio\ (\%)$ $/\ Change\ in\ index\ (\%)$			
Portfolio Beta	**2.292307692**			

27. Illustration

The price of March Nifty Futures Contract on a particular day was 9170. The minimum trading lot on Nifty Futures is 50. The initial margin is 8% and the maintenance margin is 6%. The index closed at the following levels on next five days:

Day	**1**	**2**	**3**	**4**	**5**
Settlement Price	9380	9520	9100	8960	9140

You are required to calculate:

(i) Mark to market cash flows and daily closing balances on account of

(a) An investor who has taken a long position at 9170

(b) An investor who has taken a short position at 9170

(ii)Net profit/ loss on each of the contracts

Solution:

Spot	**9,170.00**
Lot size	50
Day	Price ₹
1	9,380.00

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2	9,520.00
3	9,100.00
4	8,960.00
5	9,140.00

Scenario A - Long NIFTY @ 9170

Day	Settlement price	Index movement	size	MTM Gain /loss	OP Margin A/C	Add margin	Closing margin, A/C	Main margin req @ 6%	Margin shortfall recouped
0	9,170.00	0.00	50.00	0		36680	36680	27510	
1	9,380.00	210.00	50.00	10,500	36680		47180	28140	
2	9,520.00	140	50.00	7,000	47180		54180	28560	
3	9,100.00	-420.00	50.00	-21,000	54180		33180	27300	
4	8,960.00	-140.00	50.00	-7,000	33180	9660	35840	26880	9660
5	9,140.00	180.00	50.00	9,000	35840	0	44840	27420	
Total				-1,500					
Gain / loss	-1,500.00								
Change in margin A/c							-1500		

Scenario A - Short NIFTY @ 9170

Day	Settlement price	Index movement	Lot size	MTM Gain/ loss	OP Margin A/C	Add margin	Closing margin, A/C	Main margin req @ 6%	Margin shortfall recouped
0.00	9,170.00	0.00	50.00	0		36680	36680	27510	
1	9,380.00	-210.00	50.00	-10,500	36680	11340	37520	28140	11340
2	9,520.00	-140.00	50.00	-7,000	37520		30520	28560	
3	9,100.00	420.00	50.00	21,000	30520		51520	27300	
4	8,960.00	140.00	50.00	7,000	51520		58520	26880	
5	9,140.00	-180.00	50.00	-9,000	58520		49520		
Total Gain / (loss)				1,500					
Gain / loss	1,500.00								
Change in margin A/c							1500		

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28. Illustration

Following information is available for consideration;

BSE Index	**25,000**
Value of portfolio	₹ 50,50,000
Risk free interest rate	9% p.a.
Dividend yield on Index	6% p.a.
Beta of portfolio	1.5

We assume that a future contract on the BSE index with 4 months maturity is used to hedge the value of portfolio over next 3 months. One future contract is for delivery of 50 times the index.
Based on the above information calculate:

(i) Price of future contract.
(ii) Gain on short futures position if index turns out to be 22,500 in 3 months.

Note: Daily compounding (exponential) formula is not required to be used.

Solution:

f = spot+ cost of carry-on spot- dividend on spot = $s * e^{(r-y)t}$

(i) Price of Future Contract;

f = 25000+ 25000* $(\frac{9\%*4}{12})$ - 25000* $(\frac{6\%*4}{12})$

= 25000+ 25000* $(\frac{3\%*4}{12})$ = 25000+ 250 = **25250**

One future contract has lot size of 50 times the index value
So, future price = 50* 25250 = **₹ 1262500**

(ii) Gain on Short future position if index turns out to be 22500 in 3 months;
Index value after 3 months = 22500
4 months futures value after 3 months

= 25000+ 25000* $(\frac{9\%-6\%*1}{12})$ = 22500+ 56.25 = **22556.26**

No. of contracts hedged = $\frac{portfolio\ value*portfolio\ \beta}{price\ of\ future\ contract}$ = $\frac{5050000*1.5}{1262500}$ = **6 contracts**

Original futures value shorted = 1262500* 6 = **₹ 7575000**
At expiry, 6 futures contracts are worth = 50 lot size* future value* 6 no. of contracts
= 50* 22556.25* 6 = ₹ 6766875

Short Value = 7575000
Square up Value = 6766875
Gain = **₹ 808125**

29. Illustration – RTP – Nov'23

A company is long on 10 MT of copper @ ₹ 474 per kg (spot) and intends to remain so for the ensuing quarter. The standard deviation of changes of its spot and future prices are 4% and 6% respectively, having correlation coefficient of 0.75.
What is its hedge ratio? What is the amount of the copper future it should short to achieve a perfect hedge if initial margin is 8%?

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Solution

σ (Spot) = 4%
σ (Future) = 6%
r = 0.75

Hedge Ratio, $= \rho * \frac{\sigma_s}{\sigma_f}$ $= 0.75 * \frac{4\%}{6\%}$ = 0.75*0.67 = **0.5**

Hedge using 10 MT*0.5 = 5 MT of Futures of Copper (short) in order to Hedge the spot exposure.

Initial Margin = 5000 kg* 8% * 474/kg
= **₹ 1,89,600**

30. Illustration – Nov'23

On August 1, 2023, an investor has a portfolio consisting of 5 securities as shown below:

Security	Market Price (₹)	No. of Shares	Beta
A	60.00	450	0.87
B	320.00	850	1.31
C	640.00	200	0.94
D	130.00	500	0.66
E	480.00	600	1.50

The cost of capital for the investor is 20% p.a. compounded. The current NIFTY value is 19,500. NIFTY futures are available with expiry for 3 months (Oct-23) and 4 months (Nov-23) and are currently quoted at 19,700 and 19,900 respectively. Each NIFTY futures can be traded in units of 50 only.

You are required to calculate:

(i) The beta of his portfolio;
(ii) Theoretical value of Futures contract for contracts expiring in Oct. and Nov. (Given e0.05 = 1.05127, e0.06=1.06184, e0.07=1.07251)
(iii) The number of contracts the NIFTY the investor needs to sell to get a full hedge until November for his portfolio.
(iv) The number of future contracts the investor should trade if he desires to reduce the beta of his portfolio to 0.25.

Solution:

(i) Calculation of Portfolio Beta

Security	Price of the Stock	No. of shares	Value	Weightage w_i	BetaB_i	Weighted Beta
A	60.00	450	27,000	0.0346	0.87	0.0301
B	320.00	850	2,72,000	0.3488	1.31	0.4569
C	640.00	200	1,28,000	0.1641	0.94	0.1543
D	130.00	500	65,000	0.0833	0.66	0.0550
E	480.00	600	2,88,000	0.3692	1.50	0.5538
			7,80,000			**1.2501**

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(ii) Calculation of Theoretical Value of Future Contracts Cost of Capital = 20% p.a.

Theoretical futures price = Spot + Coc – Dividend

(1) For October contract, t = 3/12 = 0.25 Further $F = Se^{rt}$
$F = ₹ 19,500e^{(0.20)(0.25)}$ $F = ₹ 19,500e^{0.05}$
F = ₹ 19,500 X 1.05127 = ₹ 20,499.77

(2) For November contract, t = 4/12 = 0.3333 Further $F= Se^{rt}$
$F = ₹ 19,500e^{(0.20)(0.3333)}$
$F = ₹ 19,500e^{0.0667}$

$e^{0.0667}$ shall be computed using Interpolation Formula as follows:

$e^{0.07}$ = 1.07251
$e^{0.06}$ = 1.06184
$e^{0.01}$ = 0.01067
$e^{0.007}$ = 0.00747
$e^{0.0033}$ = 0.00352
$e^{0.0667}$ = 1.06184 + 2/3 x (0.01067)
= 1.06184 + 0.00711
= 1.068953
Accordingly, the price of the November Contract

19500 X 1.068953 = ₹ 20,844.59

(iii) When total portfolio is to be hedged:
= Value of Spot Position requiring hedging X Portfolio Beta /Value of Future Contract
= 7,80,000 × 1.25 / 19,900 x 50
= 0.9799 contracts say 1 contract
The investor has to short one lot of Nifty Contracts to fully hedge his / her portfolio of equity shares

(iv) When total portfolio beta is to be reduced to 0.25:

Number of Contracts to be sold =

Portfolio Value (Beta of Portfolio – Desired Beta of Portfolio) /
(Contract price x Lot size)

October Contracts
= 7,80,000 × (1.25 - 0.25) / 19,700 X 50
= 0.79 contracts say 1 contract

Alternatively, if we use November Contracts
= 7,80,000 × (1.25 - 0.25) / 19,900x 50
= 0.78 contracts say 1 contract

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DERIVATIVE ANALYSIS AND VALUATION – OPTIONS (35Q)

1. Illustration

Mr. A purchased a 3-month call option for 100 shares in XYZ Ltd. at a premium of Rs. 30 per share, with an exercise price of Rs.550. He also purchased a 3-month put option for 100 shares of the same company at a premium of Rs. 5 per share with an exercise price of Rs. 450. The market price of the share on the date of Mr. A's purchase of options, is Rs. 500. Calculate the profit or loss that Mr. A would make assuming that the market price falls to Rs. 350 at the end of 3 months.

Solution:

	Call option	Put Option	Total
Spot	₹ 500	₹ 500	
X	₹ 550	₹ 450	
Type	Buy	Buy	
Premia	₹ 30	₹ 5	₹ 35
# of Shares/ Options	100	100	
Expiry in Months	3	3	
Closing Price	₹ 350	₹ 350	
Profit/ Loss	0	(450-350) *100	= ₹ 10,000
Less: Premia			₹ 3,500
Net Pay Off for 1 Put + 1 Call an option of share each respectively			₹ 65
Lot Size			100
Total Net Pay off for 1 Call& 1 Put with lot size of 100 shares each			₹ 6,500

2. Illustration

The market received rumor about ABC corporation's tie-up with a multinational company. This has induced the market price to move up. If the rumor is false, the ABC corporation stock price will probably fall dramatically.

To protect from this an investor has bought the call and put options.

He purchased one 3 months call with a striking price of Rs. 42 for Rs. 2 premium, and paid Rs.1 per share premium for 3 months put with a striking price of Rs. 40.

Determine the Investor's position if the tie up offers bids the price of ABC Corporation's stock up to Rs. 43 in 3 months.

Determine the Investor's ending position, if the tie up program fails, and the price of the stocks falls to Rs. 36 in 3 months.

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Solution:

Type	Call option	Put Option	Total
Action	Buy	Buy	
X	₹ 42	₹ 40	
Premia	₹ 2	₹ 1	
Expiry in Months	3	3	
Case (a)			
Closing Price	₹ 43	₹ 43	
Gain/ Loss on option	₹ 1	₹ 0	₹ 1
Less: Premia Paid			₹ -3
Net Gain/ Loss			₹ -2
Case (b)			
Closing Price	₹ 36	₹ 36	
Gain/ Loss on option	₹ 0	₹ 4	₹ 4
Less: Premia Paid			₹ 3
Net Gain/ Loss			₹ 1
Assumption: Each Call/ Put Option is for 1 share of ABC Ltd.			

3. Illustration

Equity share of PQR Ltd. is presently quoted at Rs. 320. The Market Price of the share after 6 months has the following probability distribution:

Market Price in Rs.	Probability
180	0.1
260	0.2
280	0.5
320	0.1
400	0.1

A put option with a strike price of Rs. 300 can be written.
You are required to find out expected value of option at maturity (i.e., 6 months)

Solution:

Spot	₹ 320
X	₹ 300
Option Type	Put
Expiry in Months	6

Stock Price after 6 Months	₹ 180	₹ 260	₹ 280	₹ 320	₹ 400	
Probabilities	0.1	0.2	0.5	0.1	0.1	1
Expected Stock Price (Irrelevant)	18	52	140	32	40	282
Payoff from Buy Put	₹ 120	₹ 40	₹ 20	₹ 0	₹ 0	
Probabilities	0.1	0.2	0.5	0.1	0.1	1
Expected Pay Off of a Buy Put	₹ 12	₹ 8	₹ 10	₹ 0	₹ 0	₹ 30
Expected value of option at maturity i.e., after 6 months	**₹ 30**					

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4. Illustration

You as an investor had purchased a 4-month call option on the equity shares of X Ltd. of Rs.10, of which the current market price is Rs. 132 and the exercise price Rs. 150. You expect the price to range between Rs. 120 to Rs. 190. The expected share price of X Ltd. and related probability is given below:

Expected Price	Rs. 120	Rs. 140	Rs. 160	Rs. 180	Rs. 190
Probability	0.05	0.20	0.50	0.10	0.15

Compute the following:

(i) Expected Share price at the end of 4 months.

(ii) Value of Call Option at the end of 4 months, if the exercise price prevails.

(iii) In case the option is held to its maturity, what will be the expected value of the call option?

Solution:

Option Type	Call	Expected Price	Probability	Probability Weighted Expected Share Price	Value of Option	Probability Weighted Expected Value of Call Option	
Action	Buy	₹ 120	5%	6	₹ 0	-	*
Expiry	4 months	₹ 140	20%	28	₹ 0	-	
Premia	₹ 10	₹ 160	50%	₹ 80	₹ 10	₹ 5	
Spot	₹ 132	₹ 180	10%	18	₹ 30	₹ 3	
X	₹ 150	₹ 190	15%	28.5	₹ 40	₹ 6	
Price Range	₹ 120-190			**160.5**		**₹ 14**	

i) **Expected Share Price after 4 months is ₹ 160.5**

ii) **If Exercise Price and Closing Price on Date of Expiry are the same @ ₹ 150, then the value of the call option is zero**

iii) **If the Option is held till maturity the expected value of the call option is ₹ 14**

***- When Market Price is below the strike price, call options are not exercised and hence they do not have any value at that time.**

5. Illustration

Mr. X established the following strategy on the Delta Corporation's stock:

- Purchased one 3-month call option with a premium of Rs. 30 and an exercise price of Rs. 550.
- Purchased one 3-month put option with a premium of Rs. 5 and an exercise price of Rs. 450.

Delta Corporation's stock is currently selling at Rs. 500. Determine profit or loss, if the price of Delta Corporation's:

i. Remains at Rs. 500 after 3 months.

ii. Falls at Rs. 350 after 3 months.

iii. Rises to Rs. 600.

Assume the size option is 100 shares of Delta Corporation.

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Solution:

Company Name	Delta Corp
Buy Put X	₹ 450
Buy Put Premia	₹ 5
Option Expiry (Call and Put)	+ 3 months

Stock Price	₹ 500	₹ 350	₹ 600
Pay off from Buy Call	₹ 0	₹ 0	₹ 50
Pay off from Buy Put	₹ 0	₹ 100	₹ 0
Total Premia Paid	- ₹ 35	-₹ 35	-₹ 35
Net Gain/ Loss - From Call and Put Options with Lot size of 1 share each	-₹ 35	₹ 65	₹ 15
Lot size for each Put/ Call Option	100	100	100
Net Pay Off from both Put and Call for Lot sizes of 100 shares for each option	-₹ 3500	₹ 6,500	₹ 1,500

6. Illustration

The equity share of VCC Ltd. is quoted at Rs. 210. A 3-month call option is available at a premium of Rs. 6 per share and a 3-month put option is available at a premium of Rs. 5 per share.
Ascertain the net payoffs to the option holder of a call option and a put option separately.

(i) the strike price in both cases in Rs. 220; and
(ii) the share price on the exercise day is Rs. 200,210,220,230,240.

Also indicate the price range at which the call and the put options may be gainfully exercised.

Solution:

Company	VCC Ltd
Spot	₹ 210.00
Buy Call X	₹ 220.00
Buy Call Premia	₹ 6.00
Buy Put X	₹ 220.00
Buy Put premia	₹ 5.00
Call & Put Expiry	3 months

Closing price on Expiry	₹ 200.00	₹ 210.00	₹ 220.00	₹ 230.00	₹ 240.00
Pay off From Call	Max (0, Closing price - X)				
Pay off from Call	₹ 0.00	₹ 0.00	₹ 0.00	₹ 10.00	₹ 20.00
Premia Paid	-₹ 6.00	-₹ 6.00	-₹ 6.00	-₹ 6.00	-₹ 6.00
Net Pay off call	-₹ 6.00	-₹ 6.00	-₹ 6.00	₹ 4.00	₹ 14.00
Pay off from Put	Max (0, X-Closing price)				
Pay off from Put	₹ 20.00	₹ 10.00	₹ 0.00	₹ 0.00	₹ 0.00
Premia Paid	-₹ 5.00	-₹ 5.00	-₹ 5.00	-₹ 5.00	-₹ 5.00

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Net Pay off Put	₹ 15.00	₹ 5.00	-₹ 5.00	-₹ 5.00	-₹ 5.00

The Call option will be exercised at every level where the closing price is > X i.e., ₹220. However, the net pay off will be positive (the option will achieve breakeven) @ closing price >226

The Put option will be exercised at every level where the closing price is < X i.e., ₹220. However, the net pay off will be positive (the option will achieve breakeven) @ closing price <215

7. Illustration

Sumana wanted to buy shares of EIL which has a range of Rs. 411 to Rs. 592 a month later. The present price per share is Rs. 421. Her broker informs her that the price of this share can soar up to Rs. 522 within a month or so, so that she should buy a one-month CALL of EIL.

In order to be prudent in buying the call, the share price should be more than or at least Rs. 522 the assurance of which could not be given by her broker.

Though she understands the uncertainty of the market, she wants to know the probability of attaining the share price Rs. 592 so that buying of a one-month CALL of EIL at the execution price of Rs. 522 is justified. Advise her.

Take the risk-free interest for one month to be 3.60% and $e^{0.036}$ = 1.037.

Solution:

Company Name	EIL
Price Range	411 -592
Spot	₹ 421.00
X	₹ 522.00
Option	Call
Action	Buy
S_{0u}	₹ 592.00
S_{0d}	₹ 411.00
u	1.406
d	0.976
$e^{(3.6\%)}$	1.037
p	?
p	$\frac{(e^{rt}) - d}{u - d}$
p	**14.19%**

Probability of achieving a price of ₹592 is 14.19%

8. Illustration

Mr. Dayal is interested in purchasing equity shares of ABC Ltd. which are currently selling at Rs. 600 each. He expects that price of share may go up to Rs. 780 or may go down to Rs. 480 in three months. The chances of occurring such variations are 60% and 40% respectively. A call option on the shares of ABC Ltd. can be exercised at the end of three months with a strike price of Rs. 630.

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i. What combination of share and option should Mr. Dayal select if he wants a perfect hedge?
ii. What should be the value of option today (the risk-free rate is 10% p.a.)?
iii. What is the expected rate of return on the option?

Solution:

Company name	ABC Ltd	
S_0	₹600	
S_{0U}	₹ 780	60%
S_{0d}	₹ 480	40%
X	₹ 630	
Expiry	3months	
$R_f$pa	0.1	
u	1.3	
d	0.8	
Interest rate for 3 months	3%	
FV factor	1.025	
p	$\frac{(e^{rt}) - d}{u - d}$	
p	45%	
$1 - p$	55%	

Part 1

Δ	$\frac{C_U - C_d}{S_U - S_d}$	=	$\frac{₹150 - 0}{₹780 - 480}$	0.5
C_U	₹ 150.00 (780-630)			
C_d	0			
Mr. Dayal Should Sell 1 Call & Buy 0.50 Shares or If he buys 1 Share, he has to sell 2 calls				
Part 2				
Expected value of the option	$\frac{(P * (C_U)) + (1 - P) * C_d}{FV\ Factor}$	$\frac{₹67.50}{1.025}$	₹ 65.85	
Assumption: Probabilities of 60% & 40% provided in the questions are not relevant as u / d/ & FV are already provided and p can be computed from there				

Part 3			
Expected Value of the option			
PV	FV	Return for 3 months	PA Return
₹ 65.85	₹ 67.50	2.5%	10.0%

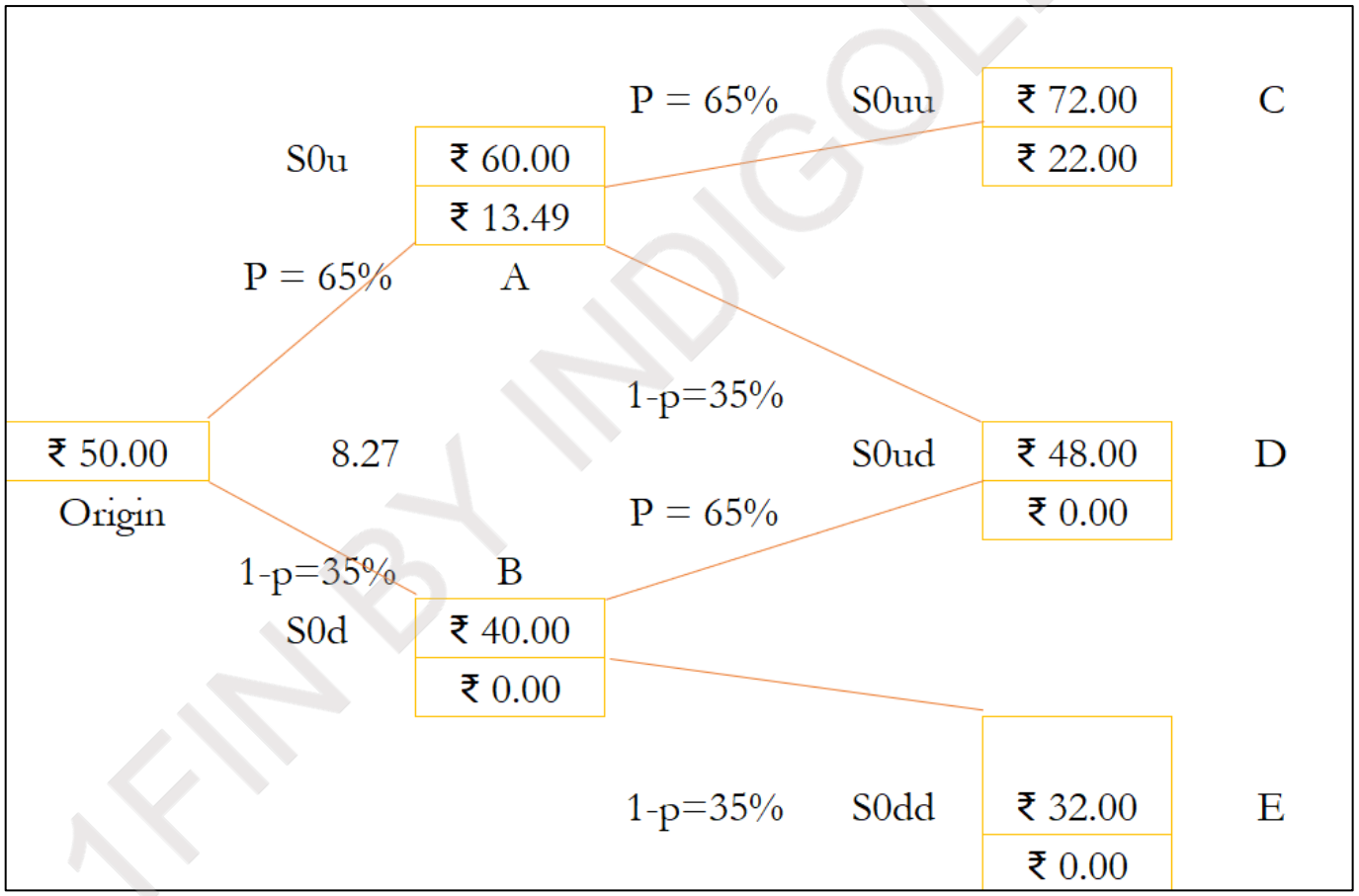
9. Illustration

Consider a two-year call option with a strike price of Rs. 50 on a stock the current price of which is also Rs. 50. Assume that there are two-time periods of one year and in each year the stock price can move up or down by equal percentage of 20%.
The risk-free interest rate is 6%. Using binominal option model, calculate the probability of price moving up and down. Also draw a two-step binomial tree showing prices and payoffs at each node.

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Solution:

Option Type	Call
Action	Buy
S_0	50
X	50
u	1.2
d	0.8
Periods	2
R_f	0.06
e^{rt}	R
R	1.06
A/ E	European
p	$\frac{R-d}{u-d}$
p	0.65



Node	Option Value	Option Value
A	((65%*22) + (35%*0))/1.06	13.4906
B		Nil
Origin	(65%*13.49+35%*0)/1.06	8.27217

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Probability of price moving up is 65%
Probability of price moving down is 35%

10. Illustration

The current market price of an equity shares of Penchant Ltd is Rs. 420. Within a period of 3 months, the maximum and minimum price of it is expected to be Rs. 500 and Rs. 400 respectively. If the risk-free rate of interest be 8% p.a., what should be the value of a 3 months Call option under the "Risk Neutral" method at the strike rate of Rs. 450? Given $e^{0.02}$ = 1.0202.

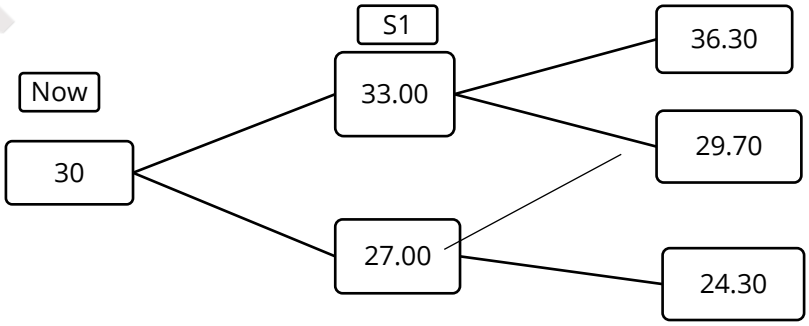
Solution:

Company	Penchant Ltd
S_0	420
Expiry	3 months
S_{0U}	500
S_{0D}	400
U	1.19047619
D	0.952380952
R_f	0.08
Option type	Call
X	450
Value of 3-month call	?
$e^{\wedge}(0.02)$	1.0202

P	$\frac{(e^{rt}) - d}{u - d}$	$\frac{0.067819}{0.238095}$	0.28484	
Option price	$\frac{\{(C_{0U}\ x\ P) + (C_{0D}\ x\ (1-p))\}}{e^{\wedge}rt}$	$\frac{28.48\%\ x\ 50 + 71.52x\ 0}{1.0202}$	$\frac{14.242}{1.0202}$	13.96

11. Illustration

Following is a two sub-periods tree of 6-months each for the share of CAB Ltd.:



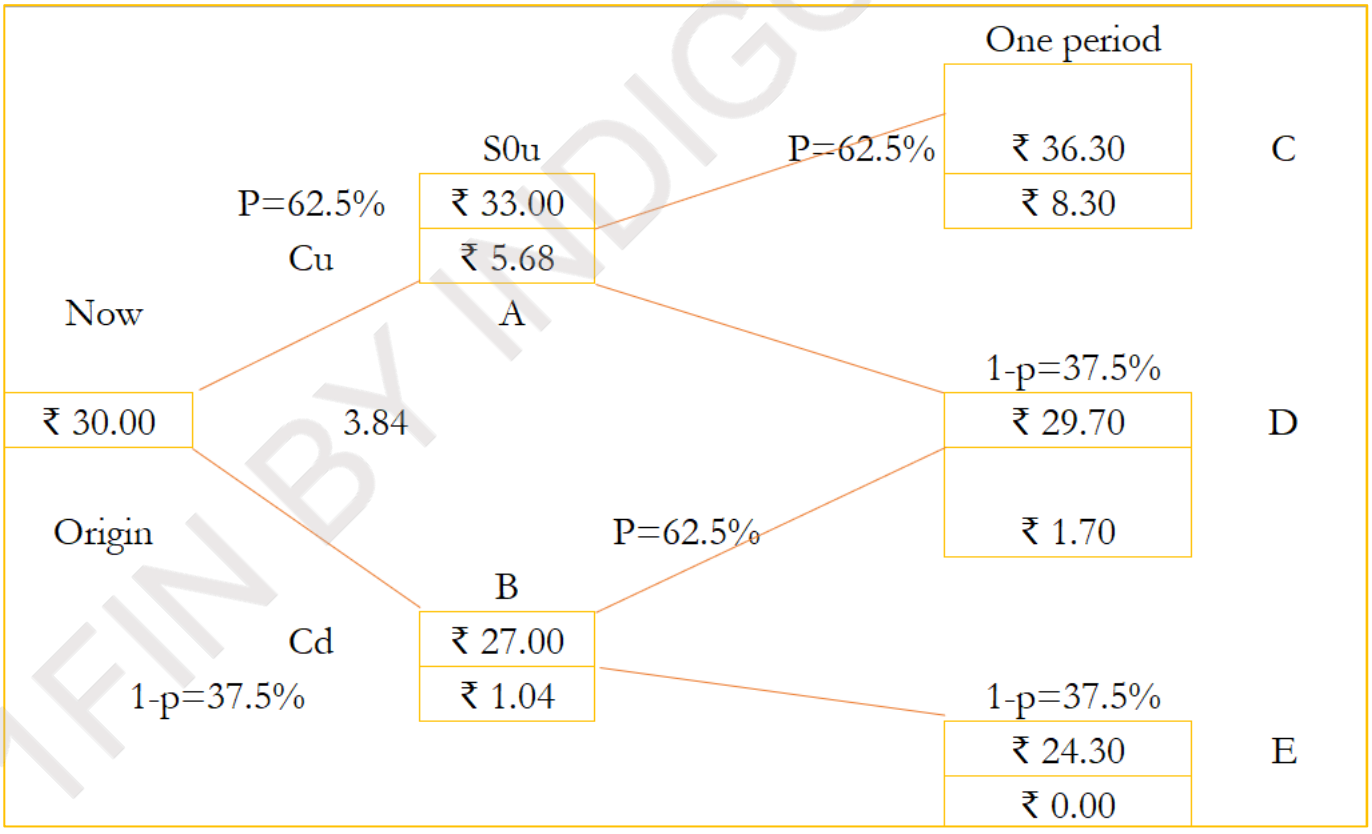
Using the binomial model, calculate the current fair value of a regular call option on CAB Stock with the following characteristics: X = Rs. 28, Risk Free Rate = 5 percent p.a. You should also indicate the composition of the implied riskless hedge portfolio at the valuation date.

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Solution:

S_0	₹ 30.00
S_{0U}	₹ 33.00
S_{0D}	₹ 27.00
U	1.1
D	0.9
X	28
Period	6 months
R_f	5%
R	FV

R	1.025	Assumed that half year rate is 1.025	$(1.05)^{\wedge}\left(\frac{1}{2}\right)$	1.025
p	$\frac{R-d}{u-d}$	$\frac{1.025-0.90}{1.1-0.9}$	$\frac{0.125}{0.2}$	0.525
$1-p$				0.375
A/E	European			



Node	Option Value	Option Value		
A	(62.5% x 8.3+37.5% x 1.7)/1.0247	**5.68293**		
B	(62.5% x 1.7+37.5% x 0)/1.0247	**1.03659**		
Origin	(62.5% x 5.68+37.5% x 1.04)/ (1.0247)	**3.84444**		

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Δ	$(C_U - C_d)/(S_U - S_D)$	$\frac{5-0}{33-27}$	$\frac{5}{6}$	0.83333

For every Call option sold - One should go along on 5/6 Shares **in order to create a riskless portfolio.**

12. Illustration

Mr. KK purchased a three-month call option for 100 shares in PQR limited at a premium of Rs. 40 per share with exercise price of Rs. 560. He also purchased three month put option for 100 shares of the same company at a premium of Rs. 10 per share with an exercise price of Rs. 460.
The market price of shares on the date of KK purchase of options is Rs. 500. Compute the profit or loss that KK would make assuming the market price falls to Rs. 360 at the end of three months.

Solution:

Company Name	**PQR Ltd**
Spot	500
Call expiry	3 months
XC	560
C_0	40
Lot size	100
Put expiry	3 months
P_0	10
XP	460
Lot size	100
Closing price 3 months	**360**

	Call option	**Put Option**	**Total**
Closing Spot	360	360	
X	560	460	
Pay off from Option	0	100	
Premia paid	-40	-10	
Net payoff per 1 share	-40	90	
Lot size	100	100	
Total Pay off	-4000	9000	**5000**

Mr. KK would make a net profit of ₹5000 **at the expiry date from the call and put options, if the** closing price **on expiry date** is ₹360

13. Illustration

Mr John established the following spread on TTK Ltd's stock.

1. Purchased one three month put option with a premium of Rs. 15 and an exercise price of Rs. 900
2. Purchased one three-month call option with a premium of Rs. 90 and an exercise price of Rs. 1,100

TTK Ltd stock is currently selling at Rs. 1,000. Calculate gain or loss if the price of stock of TTK Ltd

i. Remains at Rs. 1,000 after 3 months
ii. Falls to Rs. 700 after 3 months

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iii. Raises to Rs. 1200 after 3 months

Assume the size of option is 200 shares of TTK Ltd.

Solution:

Company Name	TTK Ltd	
Investor	John	
Spot	1000	
	Call	Put
Expiry	3 months	3 months
X	1100	900
Premia	90	15
Lot size	200	200
Closing price A	1000	
Closing price B	700	
Closing price C	1200	

Closing Price	1000	700	1200
Call option			
X	1100	1100	1100
Pay off from Call	0	0	100
Call premia	90	90	90
Total Pay off per 1 share	-90	-90	10
Lot size	200	200	200
Total pay off for 200 shares	-18000	-18000	2000
Put option			
Closing Price	1000	700	1200
X	900	900	900
Pay off	0	200	0
Premia	15	15	15
Net Pay off	-15	185	-15
Lot Size	200	200	200
Total Pay off for 200 shares	-3000	37000	-3000
Total Gain or loss for Call + Put	**-21000**	**19000**	**-1000**

14. Illustration

Fresh Bakery Ltd.' s share price has suddenly started moving both upward and downward on a rumour that the company is going to have a collaboration agreement with a multinational company in bakery business. If the rumour turns to be true, then the stock price will go up but if the rumour turns to be false, then the market price of the share will crash.

To protect from this an investor has purchased the following call and put options:

i. One 3 months call with a striking price of Rs. 52 for Rs. 2 premium per share.

ii. One 3 months put with a striking price of Rs. 50 for Rs. 1 premium per share.

Assuming a lot size of 50 shares, determine the followings:

1. The investor's position, if the collaboration agreement pushes the share price to Rs. 53 in 3 months.

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2. The investor's ending position, if the collaboration agreement fails and the price crashes to Rs. 46 in 3 months' time.

Solution:

Company Name	Fresh Bakery	
Option	Call	Put
Expiry	3 months	3 months
X	₹ 52.00	₹ 50.00
Premia	₹ 2.00	₹ 1.00
Lot size	50.00	50.00
Closing Price A	₹ 53.00	
Closing Price B	₹ 46.00	

	Case A	Case B
Closing Price	₹ 53.00	₹ 46.00
Call Option		
X	₹ 52.00	₹ 52.00
Pay off from call	₹ 1.00	₹ 0.00
Les: Premia	-₹ 2.00	-₹ 2.00
Net Pay off	-₹ 1.00	-₹ 2.00
Lot size	50.00	50.00
Total pay off from call	**-₹ 50.00**	**-₹ 100.00**
Put Option		
X	₹ 50.00	₹ 50.00
Closing Spot	₹ 53.00	₹ 46.00
Option Pay off	₹ 0.00	₹ 4.00
Less: Premia	-₹ 1.00	-₹ 1.00
Net payoff	-₹ 1.00	₹ 3.00
Lot size	50.00	50.00
Total pay off from Put	**-₹ 50.00**	**₹ 150.00**
Total pay off from Call + Put	**-₹ 100.00**	**₹ 50.00**

15. Illustration

A call and put exist on the same stock each of which is exercisable at Rs. 60. They now trade for:

Market price of Stock or stock index	Rs. 55
Market price of call	Rs. 9
Market price of put	Rs. 1

Calculate the expiration date cash flow, investment value, and net profit from:

(i) Buy 1.0 call
(ii) Write 1.0 call
(iii) Buy 1.0 put
(iv) Write 1.0 put

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for expiration date stock prices of Rs. 50, Rs. 55, Rs. 60, Rs. 65, Rs. 70.

Solution:

	Call	Put
Spot	₹ 55.00	₹ 55.00
Premia	₹ 9.00	₹ 1.00
X	₹ 60.00	₹ 60.00

Expiry date CF

Closing prices	₹ 50.00	₹ 55.00	₹ 60.00	₹ 65.00	₹ 70.00
Buy Call	₹ 0.00	₹ 0.00	₹ 0.00	-₹ 60.00	-₹ 60.00
Sell Call	₹ 0.00	₹ 0.00	₹ 0.00	₹ 60.00	₹ 60.00
Buy Put	₹ 60.00	₹ 60.00	₹ 0.00	₹ 0.00	₹ 0.00
Sell Put	-₹ 60.00	-₹ 60.00	₹ 0.00	₹ 0.00	₹ 0.00

Expiry Date Investment Value

Closing prices	₹ 50.00	₹ 55.00	₹ 60.00	₹ 65.00	₹ 70.00
Buy Call	₹ 0.00	₹ 0.00	₹ 0.00	₹ 5.00	₹ 10.00
Sell Call	₹ 0.00	₹ 0.00	₹ 0.00	-₹ 5.00	-₹ 10.00
Buy Put	₹ 10.00	₹ 5.00	₹ 0.00	₹ 0.00	₹ 0.00
Sell Put	-₹ 10.00	-₹ 5.00	₹ 0.00	₹ 0.00	₹ 0.00

Net Profit

Closing prices	₹ 50.00	₹ 55.00	₹ 60.00	₹ 65.00	₹ 70.00
Buy Call	-₹ 9.00	-₹ 9.00	-₹ 9.00	-₹ 4.00	₹ 1.00
Sell Call	₹ 9.00	₹ 9.00	₹ 9.00	₹ 4.00	-₹ 1.00
Buy Put	₹ 9.00	₹ 4.00	-₹ 1.00	-₹ 1.00	-₹ 1.00
Sell Put	-₹ 9.00	-₹ 4.00	₹ 1.00	₹ 1.00	₹ 1.00

16. Illustration

Ram holding shares of Reliance Industries Ltd. which is currently selling at Rs. 1000. He is expecting that this price will further fall due to lower-than-expected level of profits to be announced after one month. As on following option contract are available in Reliance Share

Strike Price	**Option**	**Premium**
1030	Call	40
1010	Call	35
1000	Call	30
990	Put	35
970	Put	20
950	Put	8
930	Put	5

Ram is interested in selling his stock holding as he cannot afford to lose more than 5% of its value. Recommend a hedging strategy with option and show how his position will be protected.

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Solution:

Company	RIL
Investor	Ram
Shares Held	?
S0	₹ 1,000.00
Max loss	5%
Min sale price	₹ 950.00
Strategy	Buy Put
950 Put premia	₹ 8.00

Mr. Ram intends to protect his downside from reduction in share price - So he has to buy a Put. Since he wants a loss no more than 5%, he should but a put with X of S0-5% i.e., ₹1000-5% i.e., ₹950

Net payoff		
Scenario	A	B
Closing Spot	>950	<950
Pay off	ST / Closing Price	950.00
Premia Paid	(8.00)	(8.00)
Net Pay off	ST-8	942.00

Mr. Ram gets a minimum value of ₹942 from hedging his RIL shares by buying a put @K of 950 & Premia of ₹8

17. Illustration

A call option has been entered into by Arnav for delivery of share of X Ltd. at Rs. 460. The expected future prices at the time of expiry of contract are as follows:

Price in Rs.	Probability
470	0.20
450	0.25
480	0.35
490	0.05
500	0.15

Determine the premium at which Arnav will break even.

Solution:

Company Name	X ltd
Investor	Arnav
Option Type	Call
Action	Buy
K	₹ 460.00

Price	₹ 470.00	₹ 450.00	₹ 480.00	₹ 490.00	₹ 500.00	Total
Probability	0.20	0.25	0.35	0.05	0.15	
Option payoff	₹ 10.00	₹ 0.00	₹ 20.00	₹ 30.00	₹ 40.00	

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Expected option payoff	₹ 2.00	₹ 0.00	₹ 7.00	₹ 1.50	₹ 6.00	₹ 16.50
Break-even Premia	**₹ 16.50**					

18. Illustration

AB Ltd.'s equity shares are presently selling at a price of Rs. 500 each. 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 Rs. 650 or a 30% chance that it will go down to Rs. 450, three months from now. There is a call option on the shares of the firm that can be exercised only at the end of three months at an exercise price of Rs. 550.
Calculate the following:

(i) If the investor wants a perfect hedge, what combination of the share and option should he select?
(ii) Explain how the investor will be able to maintain identical position regardless of the share price.
(iii) If the risk-free rate of return is 5% for the three months period, what is the value of the option at the beginning of the period?
(iv) What is the expected return on the option?

Solution:

Company Name	AB Ltd				
Spot	₹ 500.00				
Investor expectation					
70%	₹ 650.00	u	1.30		
30%	₹ 450.00	d	0.90		
Option	Call				
Action	Sell				
X	₹ 550.00				
Expiry period	3 months				
Part 1					
Delta Δ	$\frac{(Change\ in\ Option\ price)}{\text{Change in Stock Price}}$	$\frac{C_U - C_d}{S_U - S_d}$	$\frac{100-0}{650-450}$	$\frac{100}{200}$	0.50

Give that Delta is 0.5, The investor should Buy 0.5 shares for every call sold in order to have a perfect hedge

Part 2

Position / Stock Price	₹ 650.00	₹ 450.00
Portfolio	0.5 Stock - 1 Call	0.5 Stock - 1 Call
Value of 0.5 Stock	₹ 325.00	₹ 225.00
Value of 1 call sold	-₹ 100.00	₹ 0.00
Total Portfolio value	₹ 225.00	₹ 225.00

Part 3

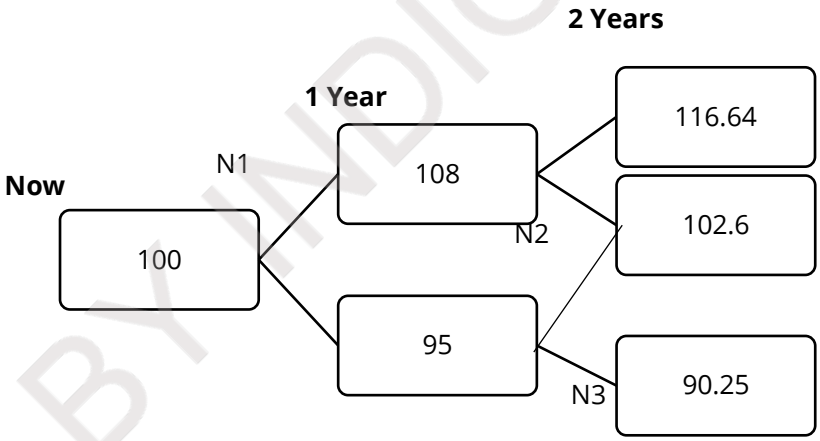
3-month R_f	5%
(0.5 stock PV - 1 Call) * (1+R_f)	=FV of portfolio
$(250 - C) * (1 + 5\%)$	₹ 225.00
$250 - C$	225/1.05

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$250 - C$	214.29
C	250-214.29
C	35.71
Using Risk Neutral Method	
P	$\frac{R-d}{u-d}$
P	(1.05-.9) / (1.3-.9)
P	37.50%
$1 - P$	62.50%
FV of C	37.50
PV of C	35.71
Return =	$\frac{EV}{PV} - 1$
EV	70.00
PV	35.71
Return	96.00%

19. Illustration

A two-year tree for a share of stock in ABC Ltd., is as follows:



Consider a two-year American call option on the stock of ABC Ltd., with a strike price of Rs. 98. The current price of the stock is Rs. 100. Risk free return is 5 per cent per annum with a continuous compounding and $e^{0.05}$ = 1.05127. Assume two time periods of one year each.

Using the Binomial Model, calculate:

(i) The probability of price moving up and down;

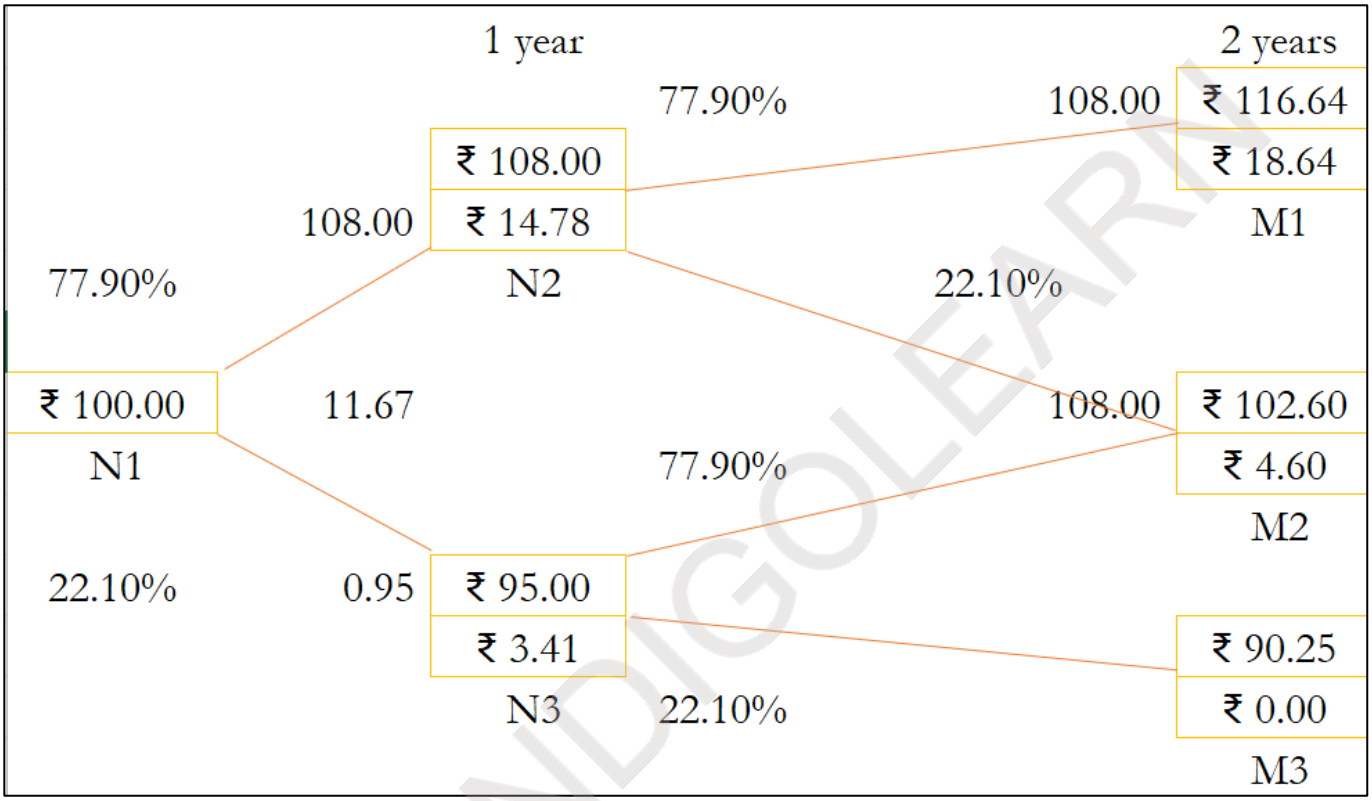
(ii) (ii) Expected pay offs at each node i.e., N1, N2 and N3 (round off up to 2 decimal points).

Solution:

S_0	₹ 100.00
X	₹ 98.00
$e\text{^}(0.05)$	1.05127
u	1.08000
d	0.95000
p	$\frac{R-d}{u-d}$

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R	$e^{\wedge}(rt)$
R	1.05127
p	77.90%
$1-p$	22.10%



N1	11.67	(14.78*77.90%+3.41*22.10%)/1.05127
N2	14.78	(18.64*77.90%+4.60*22.10%)/1.05127
N3	3.41	(0*22.1%+4.60*77.90%)/1.05127

20. Illustration

Mr. P established the following spread on the Coastal Corporation's stock:

(i) Purchased one 3-month call option with a premium of Rs. 6.5 and an Exercise price of Rs. 110.
(ii) Purchased one 3-month put option with a premium of Rs. 10 and an Exercise price of Rs. 90.

Coastal Corporation's stock is currently selling at Rs. 100.
Determine profit or loss, if the price of Coastal Corporation's stock:

(i) Remains at Rs. 100 after 3 months.
(ii) Falls at Rs. 70 after 3 months.
(iii) Rises to Rs. 138 after 3 months.

Assume the size of option is 1,000 shares of Coastal Corporation.

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Solution:

Company	Coastal Corp.		
Investor	Mr. P		
Option	Call	Put	
Action	Buy	Buy	
X	₹ 110.00	₹ 90.00	
Expiry	3 months	3 months	
Premia	₹ 6.50	₹ 10.00	
Spot	₹ 100.00	₹ 100.00	
Lot Size	1000	1000	
Scenario	*A*	B	*C*
Stock Price	100	70	138
Call Option			
Pay Off	₹ 0	₹ 0	₹ 28
Premia Paid	-₹ 6.5	-₹ 6.5	-₹ 6.5
Net Pay off	-₹ 6.5	-₹ 6.5	₹ 21.50
Lot Size	1000	1000	1000
Total Net Pay off from Call Option	-₹ 6,500.00	-₹ 6,500.00	₹ 21,500.00
Scenario	*A*	B	*C*
Closing Price	₹ 100	₹ 70	₹ 138
Put Option			
Pay Off	₹ 0	₹ 20	₹ 0
Premia Paid	- ₹ 10	- ₹ 10	- ₹ 10
Net Pay Off Per Single Share	- ₹ 10	₹ 10	- ₹ 10
Lot Size	1000	1000	1000
Total Net Pay off from Put Option	-₹ 10,000.00	₹ 10,000.00	-₹ 10,000.00
Total Pay off from 1 Call+ 1 Put of 1000 shares each of Coastal Corporation	-₹ 16,500.00	₹ 3,500.00	₹ 11,500.00

21. Illustration

The following information is available for X company's share and Call option

Current Share Price	Rs. 185
Option Exercise Price	Rs. 170
Risk free Interest Rate	7%
Time of the expiry of the option	3 years
Standard deviation	0.18

Calculate the value of the option using Black Scholes formula.

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Solution:

S_0	185.00
K	170.00
R	7%
T	3.00
Σ	0.18

Value of Call Option

c	$S_0 * N(d_1) - Ke^{-rT}N(d_2)$				
d_1	$\ln\left(\frac{S_0}{k}\right) + \left(r + \frac{\sigma^2}{2}\right)T$	0.08456	0.25860	0.34316	
	---	---	---	---	1.10068
	$\sigma\sqrt{T}$			0.31177	
$N(d_1)$	0.86448				
d_2	$d_1 - \sigma\sqrt{T}$	0.78891			
$N(d_2)$	0.78492				

c	$S_0 * N(d_1) - Ke^{-rT}N(d_2)$
Price of call option	**₹ 51.77**

22. Illustration

(i) The shares of TIC Ltd. are currently priced at Rs. 415 and call option exercisable in three months' time has an exercise rate of Rs. 400. Risk free interest rate is 5% p.a. and standard deviation (volatility) of share price is 22%. Based on the assumption that TIC Ltd. is not going to declare any dividend over the next three months, is the option worth buying for Rs. 25?

(ii) Calculate value of aforesaid call option based on Block Scholes valuation model if the current price is considered as Rs. 380.

(iii) What would be the worth of put option if current price is considered Rs. 380.

(iv) If TIC Ltd. share price at present is taken as Rs. 408 and a dividend of Rs. 10 is expected to be paid in the two months' time, then, calculate value of the call option.

Solution:

Part 1

	Case 1	Case 2
Company	TIC Limited	TIC Limited
S_0	₹ 415.00	₹ 380.00
K	₹ 400.00	₹ 400.00
R_f	5%	5%
Σ	22%	22%
T	3 months	3 months
T	0.25	0.25

c	$S_0 * N(d_1) - Ke^{-rT}N(d_2)$			
d_1	$\frac{\ln\left(\frac{S_0}{k}\right) + \left(r + \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}}$	$\frac{0.05536}{0.1100}$	0.50331	

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$N(d_1)$	0.69266		0.50000	0.69150
			0.51000	0.69500
d_2	$d_1 - \sigma\sqrt{T}$		0.01000	0.00350
d_2	0.39331		0.00331	0.00116
$N(d_2)$	0.65292			
			0.39000	0.65170
c	₹ 29.53		0.4000	0.65540
			0.01000	0.00370
			0.00331	0.00122

The value of the call option as per the Black Scholes Merton Method is ₹29.53. Whereas in the market it is trading at ₹25. So, the option is under-priced in the market and hence worth buying

Part 2

c	$S_0 * N(d_1) - Ke^{-rT}N(d_2)$			
d_1	$\frac{\ln\left(\frac{S_0}{k}\right) + \left(r + \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}}$	$\frac{0.03274}{0.1100}$	(0.29767)	
d_2	$d_1 - \sigma\sqrt{T}$	(0.40767)		
$N(d_1)$	N (-0.29767)			
	1-N (0.29767)			
N (0.29767)	0.61701		0.29000	0.61410
1-N (0.29767)	0.38299		0.30000	0.61790
N (-0.29767)	0.38299		0.01000	0.00380
			0.00767	0.00291
N (-0.40767)	1-N (0.40767)			
N (0.40767)	0.65824		0.40000	0.65540
1-N (0.40767)	0.34176		0.41000	0.65910
N (-0.40767)	0.34176		0.01000	0.00370
			0.00767	0.00284
c	₹ 10.53			

Part 3

Value of Put option		
$c + Ke^{-rT}$	=	P+ S_0
₹ 405.56	=	P+₹380
P	=	₹405.56-₹380
P	=	₹25.56

Part 4

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S_0	₹ 408.00			
Dividend	₹ 10.00			
Time	2 months			
t	16.67%			
PV of dividend	₹ 9.92			
Adjusted S_0	₹ 398.08			
K	₹ 400.00			
R_f	5%			
Σ	22%			
T	0.25			
c	$S_0 * N(d_1) - Ke^{-rT}N(d_2)$			
d_1	$\ln\left(\frac{S_0}{k}\right) + \left(r + \frac{\sigma^2}{2}\right)T$	0.01375		
	--------	--------	0.12496	
	$\sigma\sqrt{T}$	0.11000		
$N(d_1)$	0.54974		0.12000	0.54780
			0.13000	0.55170
d_2	$d_1 - \sigma\sqrt{T}$		0.01000	0.00390
d_2	0.01496		0.00496	0.00194
$N(d_2)$	0.50599		0.01000	0.50400
			0.02000	0.50800
c	₹ 18.96		0.01000	0.00400
			0.00496	0.00199

23. Illustration

From the following data for certain stock, find the value of a call option:

Price of stock now	**Rs. 80**
Exercise price	Rs. 75
Standard deviation of continuously compounded annual return	0.40
Maturity period	6 Months
Annual interest rate	12%

Given,

Number of S.D. from Mean, (z)	Area of the left or right (one tail)
0.25	0.4013
0.30	0.3821
0.55	0.2912
0.60	0.2743

$e^{0.12 \times 0.5}$=1.062; In 1.0667= 0.0646

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Solution:

S_0	₹ 80.00	
K	₹ 75.00	1.0667
R_f	12%	
σ	40%	
t	6 months	
t	0.50	
Ln1.0667	0.06460	
$e^{(0.12*0.5)}$	1.06200	
$e^{(-0.12*0.5)}$	0.942	
c	$S_0 * N(d_1) - Ke^{-rT}N(d_2)$	

d_1	$\frac{\ln\left(\frac{S_0}{k}\right) + \left(r + \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}}$	$\frac{(0.0646) + (12\% + ((40\%)\ ^2)/2) * 0.5}{0.40 * \sqrt{(0.5)}}$	$\frac{0.16460}{0.28}$	0.58195
d_2	$d_1 - \sigma\sqrt{T}$			0.29911
$N(d_1)$	N (0.58195)	0.71960		
$N(d_2)$	N (0.29911)	0.61755		

No of Sd from Mean	Area of left or right	Cumul. Area			
0.25	0.40130	0.59870	0.01920	0.01885	0.04911
0.30	0.38210	0.61790		0.61755	
0.55	0.29120	0.70880			
0.60	0.27430	0.72570	0.01690	0.01080	
				0.03195	
c	$S_0 * N(d_1) - Ke^{-rT}N(d_2)$		₹ 13.96		

24. Illustration - Growth Option

ABC Ltd. is a pharmaceutical company possessing a patent of a drug called 'Aidrex', a medicine for aids patient. Being an approach drug ABC Ltd. holds the right of production of drugs and its marketing. The period of patent is 15 years after which any other pharmaceutical company produce the drug with same formula. It is estimated that company shall require to incur $ 12.5 million for development and market of the drug. As per a survey conducted the expected present value of cashflows from the sale of drug during the period of 15 years shall be $ 16.7 million. Cash flow from the previous similar type of drug have exhibited a variance of 26.8% of the present value of cashflows. The current yield on Treasury Bonds of similar duration (15 years) is 7.8%.

Determine the value of the patent.

Given

ln(1.336) =0.2897

e1.0005 = 0.3677 and e -1.17 = 0.3104

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Solution

Black Scholes,

C = N(d1) * St - N(d2) * k* e^-rt

d1 = ln(st/k) + (r+ σ^2/2)t /sig root t

d2 = d1- sig root t

$C = N(d_1) * S * e^{-qt} - N(d_2) * k * e^{-rt}$

$d_1 = \frac{ln\left(\frac{S}{k}\right) + \left(r - q + \frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}}$

$d_2 = d_1 - \sigma\sqrt{t}$

q, dividend yield rate = 6.67%

k, strike = 12.5

r, risk-free rate = 7.8%

S, spot = 16.7

t, time in years = 15

σ^2, = 26.8%

$d_1 = \frac{ln\left(\frac{S}{k}\right) + \left(r - q + \frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}}$

$d_1 = \frac{ln\left(\frac{16.7}{12.5}\right) + \left(7.8\% - 6.67\% + \frac{26.8\%}{2}\right)15}{\sqrt{26.8\%}\sqrt{15}}$

$= \frac{0.2897 + (0.145333)15}{0.517687 * 3.87298}$

$= \frac{2.4696995}{2.00499}$ = 1.23177

$N(d_1)$ = 0.8910

$d_2 = d_1 - \sigma\sqrt{t}$

$= 1.23177 - \sqrt{26.8\%}\sqrt{15}$

= 1.2377 – 2.00499 = -0.7732

$N(-d_2)$ = 1-N(d2)

= 0.2196

$C = N(d_1) * S * e^{-qt} - N(d_2) * k * e^{-rt}$

$= 0.8910 * 16.7 * e^{-0.06667*15} - 0.2196 * 12.5 * e^{-0.078*15}$

$= 0.8910 * 16.7 * e^{-1.0005} - 0.2196 * 12.5 * e^{-1.17}$

$= 0.8910 * 16.7 * 0.3677 - 0.2196 * 12.5 * 0.3104$

Value of Option = **$4.6192 million**

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25. Illustration - Abandonment option

IPL already in production of Fertilizer is considering a proposal of building a new plant to produce pesticides. Suppose the PV of proposal is ₹100 crore without the abandonment option. However, if market conditions for pesticide turns out to be favourable the PV of proposal shall increase by 30%. On the other hand, market conditions remain sluggish the PV of the proposal shall be reduced by 40%. In case company is not interested in continuation of the project it can be disposed of for ₹ 80 crore.
If the risk-free rate of interest is 8% then what will be value of abandonment option.

Solution

Assume abandonment option exists after a year.

u = 1+30% = 1.3

d = 1- 40% = 0.6

$P = \frac{e^{rt}-d}{u-d} = \frac{1.08-0.6}{1.3-0.6} = \frac{0.48}{0.7}$ = **0.6857**

$1-P$ = 0.3143

Expected Value of abandonment option (Put Option) at the end of year 1;

= 0.6875* 0 + 0.3143*20

= 6.286

PV of the abandonment option;

$= \frac{6.286}{1.08}$ = **$5.8204 million**

26. Illustration - Abandonment option

Airbus is considering a joint venture with Lear Aircraft to produce a small commercial airplane (capable of carrying 40-50 passengers on short haul flights)

Airbus will have to invest $ 500 million for a 50% share of the venture

Its share of the present value of expected cash flows is 480 million.

Lear Aircraft, which is eager to enter into the deal, offers to buy Airbus's 50% share of the investment anytime over the next five years for $ 400 million, if Airbus decides to get out of the venture.

A simulation of the cash flows on this time share investment yields a variance in the present value of the cash flows from being in the partnership is 0.16.

The project has a life of 30 years and risk free rate is 6% p.a

Should Airbus enter into the joint venture?

Solution

S = 480 million

σ^2 = 0.16

t = 30 yrs

r = 6%

k = 400 million

Put Option, Black Scholes Formula,

$= N(-d_2) * k * e^{-rt} - N(d_1) * S * e^{-qt}$

$d_1 = \frac{ln\left(\frac{S}{k}\right) + \left(r - q + \frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}}$

$= \frac{ln\left(\frac{480}{400}\right) + \left(6\% - 3.3\% + \frac{16\%}{2}\right)5}{0.8944}$

$= \frac{ln(1.2) + 0.5333}{0.8944}$

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$= \frac{0.18232 + 0.5333}{0.8944}$ = 0.8001

$N(d_1)$ = 0.7881

d_2 $= d_1 - \sigma\sqrt{t}$
= 0.8001- 0.8944 = -0.0943

$N(d_2)$ = 1- N(0.0943)
= 0.4641

$k * e^{-rt} * N(-d_2) - S * e^{-qt} * N(d_1)$ $= 400 * e^{-6\%*5}(1-0.4641) - 480 * e^{-0.1666}(1-0.7881)$
$= 400 * e^{-0.3}(0.5359) - 480 * e^{-0.1666}(0.2119)$
$= 400 * 0.7408 * (0.5359) - 480 * 0.864 * (0.2119)$
= 157.79 – 86.09

PV of Put Option = **$72.7 million**

Project Value Including Option = PV of Outflow+ PV of Inflow+ PV of Option
= -500 + 480 + 72.7
= **$ 52.7 million**

The joint venture is viable.

We have valued the abandonment option i.e American put using Black Scholes Merton Model. However, BSM is used to value European Options only. Given that the value of an American option is at least equal to or greater than the value of a European Option, the abandonment option in the case is worth atleast $ 52.7 Million

27. Illustration - Timing option

Suppose MIS Ltd. is considering installation of solar electricity generating plant for light the staff quarters. The plant shall cost ₹ 2.50 crore and shall lead to saving in electricity expenses at the current tariff by ₹ 21 lakh per year forever.
However, with change in Government in state, the rate of electricity is subject to change. Accordingly, the saving in electricity can be of ₹ 12 lakh or ₹ 35 lakh per year and forever.
Assuming WACC of MIS Ltd. is 10% and risk-free rate of rate of return is 8%.
Decide whether MIS Ltd. should accept the project or wait and see.

Solution

Investment = ₹ 2.5 Cr
Current Savings = ₹ 25 lakhs per year (WACC @10%)
PV of Current Savings = $\frac{21}{0.1}$ = ₹ 2.1 Cr
Current NPV = -2.5+ 2.1 = -0.4 Cr

Delay Timing: Options

NPV	$\frac{12}{0.1}$	$\frac{35}{0.1}$
Inflow	120 Lakhs	350 Lakhs
Less: Outflow	250 Lakhs	100 Lakhs
	- 130 Lakhs	100 Lakhs

u = $\frac{350}{250}$ = 1.4

d = $\frac{120}{250}$ = 0.48

P = $\frac{R_f - d}{u - d}$ = $\frac{1.08 - 0.48}{1.4 - 0.48}$ = $\frac{0.6}{0.92}$ = **0.652**

$1 - P$ = 0.348

Pay Off (after 1 year) = 100*0.652 + (-130*0.348)
= 65.2 – 45.24 = **19.96 Lakhs**

Current Value of Option = $\frac{19.96}{1.08}$ = **₹ 18.48 Lakhs**

Option has +ve Value hence the company should wait and decide

28. Illustration - MCQs

Describe each of the following situations in the language of options:

a. Drilling rights to undeveloped heavy crude oil in Northern Alberta. Development and production of the oil is a negative-NPV endeavour. (The break-even oil price is C$32 per barrel, versus a spot price of C$20.) However, the decision to develop can be put off for up to five years. Development costs are expected to increase by 5% per year.
Answer: The case depicts an American call option regarding drilling rights for undeveloped heavy crude oil. With an initial exercise price of $32 per barrel and the ability to delay development for up to five years due to increasing costs, it falls under the category of a timing option.

b. A restaurant is producing net cash flows, after all out-of-pocket expenses, of $700,000 per year. There is no upward or downward trend in the cash flows, but they fluctuate as a random walk, with an annual standard deviation of 15%. The real estate occupied by the restaurant is owned, not leased, and could be sold for $5 million. Ignore taxes.
Answer: This represents an American put option, related to an abandonment option for selling a restaurant's real estate, considering annual cash flows of $700,000, an exercise price of $5 million, and an annual standard deviation of 15% in cash flow variability.

c. A variation on part (b): Assume the restaurant faces known fixed costs of $300,000 per year, incurred as long as the restaurant is operating. Thus,
Net cash flow = revenue less variable costs — fixed costs
$700,000 = 1,000,000 — 300,000
The annual standard deviation of the forecast error of revenue less variable costs is 10.5%. The interest rate is 10%. Ignore taxes.
Answer: The fluctuating annual cash flows of $1,000,000 by 10.5% in a scenario with fixed costs of three lakes annually indicate an American put option, indicating an abandonment option with varying cash flows and an exercise price of $8 million inclusive of property sale and annual savings.

d. A paper mill can be shut down in periods of low demand and restarted if demand improves sufficiently. The costs of closing and reopening the mill are fixed.
Answer: The paper mill's ability to temporarily shut down and restart operations with fixed closure and reopening costs reflects a compound option, a combination of an American put for abandonment and an American call for temporary restart, offering operational flexibility.

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e. A real estate developer uses a parcel of urban land as a parking lot, although construction of either a hotel or an apartment building on the land would be a positive-NPV investment.
Answer: In a situation where a real estate developer can choose between building a hotel or an apartment building, both profitable options, it represents an in-the-money American call option, allowing for the deferment of the decision (timing option) to select the most lucrative option during the waiting period.

f. Air France negotiates a purchase option for 10 Boeing 787s. Air France must confirm the order by 2030. Otherwise, Boeing will be free to sell the aircraft to other airlines.
Answer: Air France negotiating a purchase option for 10 Boeing 787 planes by 2030 represents a timing option, specifically an American call option. This grants Air France the flexibility to confirm the purchase at any time until 2030, resembling a timing decision rather than a growth or abandonment choice.

29. Illustration

You own a one-year call option on one acre of Los Angeles real estate. The exercise price is $2 million, and the current, appraised market value of the land is $1.7 million. The land is currently used as a parking lot, generating just enough money to cover real estate taxes. The annual standard deviation is 15% and the interest rate 12%. How much is your call worth?

Solution

$S_0 = 1.7 \mid X = 2 \mid S.D = 0.15 \mid t = 1.0 \mid r_f = 0.12$

$$d1 = \frac{\text{Ln}(1.7/2.0) + (0.12 + (0.15)^2 / 2) \times 1}{(0.15) \times 1}$$

$$d1 = \frac{-0.16252 + (0.13125)}{0.15}$$

$d1 = -0.20846;$

$d2 = d1 - 0.15 \times 1$
$d2 = -0.20846 - 0.15$

$N(d1) = 0.41744$
$N(d2) = 0.36000$

Price of call $= 1.7 \times 0.41744 - 2.0 \times e^{-0.12} \times 0.3600$
$C = ₹ 71,057$

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30. Illustration

Consumers appear to require returns of 25 percent or more before they are prepared to make energy-efficient investments, even though a more reasonable estimate of the might be around 15 percent.

Suppose you have the opportunity to invest $1,000 in new space-heating equipment that would generate fuel savings of $250 a year forever given current fuel prices. What is the PV of this investment if cost of capital is 15 percent? What is the NPV?

Now recognize that fuel prices are uncertain and that the savings could well turn out to be $50 a year or $450 a year. If the risk-free interest rate is 10 percent, would you invest in the new equipment now or wait and see how fuel prices change? Explain.

Solution

Investment		= $1000
Current Savings		= $ 250 per year
Cost of capital		= 15%
Rf		= 10%
PV of Current Savings	$= \frac{250}{0.15}$	= $ 1,667
Current NPV	= 1,667-1,000	= $ 667

Savings on upside = 450/15% = 3000 | Payoff on upside = 3000-1000 = 2000

Savings on downside = 50/15% = 333 | Payoff on downside = 333-1000 = -667

u	$= \frac{3000}{1667}$	= 1.8		
d	$= \frac{333}{1667}$	= 0.20		
P	$= \frac{k-d}{u-d}$	$= \frac{1.1-0.2}{1.8-0.2}$	$= \frac{0.9}{1.6}$	**= 0.5625**
$1-P$	= 0.4375			

Pay Off $= \frac{2{,}000*0.5625 + (-667*0.4375)}{1.1}$

= $ 757

It is **advisable to wait** as option to wait is worth $757 vs current NPV value of the project is at $667.

31. Illustration

A Rice Trader has planned to sell 22000 kg of Rice after 3 months from now. The spot price of the Rice is Rs. 60 per kg and 3 months future on the same is trading at Rs. 59 per kg. Size of the contract is 1000 kg. The price is expected to fall as low as Rs. 56 per kg, 3 months hence.

What the trader can do to mitigate its risk of reduced profit? If he decides to make use of future market, what would be the effective realized price for its sale when after 3 months, spot price is Rs. 57 per kg and future contract price for 3 months is Rs. 58 per kg?

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Solution:

Commodity	Rice
Action	Plans to sell
Time duration	3 months
S_0	₹ 60.00
Futures price	₹ 59.00
Expected price fall to	₹ 56.00
3 months later	
Spot	₹ 57.00
Futures price	₹ 58.00
Effective realized price after 3 months	
Qty	22000 KG
Lot Size	1000 KG

In order to mitigate the risk, the trader should sell futures today for 22 MT i.e., 22 contracts.

Price of Futures contract on Day 0 per KG	₹ 59.00
No of contracts to be sold	22.00
Lot size of each contract in KG	1,000.00
Total Notional value sold	₹ 12,98,000.00
After 3 months	
Futures that are sold are bought back	22.00
@ price of	₹ 58.00
Lot size	1,000
Notional value of Futures purchased	₹ 12,76,000.00
Gain from Futures transaction	₹ 22,000.00
Spot rate in market per KG of Rice after 3 months	₹ 57.00
Qty of rice sold in spot	22000
Value realised	₹ 12,54,000.00
Add: Gain on futures	₹ 22,000.00
Total Amount realised	₹ 12,76,000.00
Total Qty sold	22,000.00
Amount Realized per KG	₹ 58.00

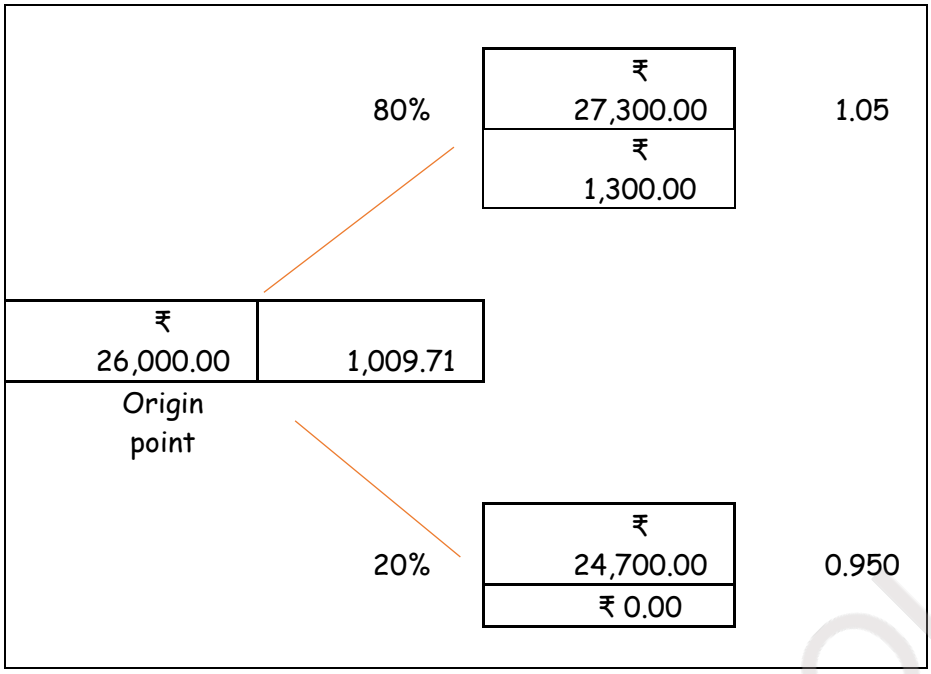
32. Illustration

A call option on gold with exercise price of Rs. 26,000 for 10 grams and 3 months to expire is being traded at a premium of Rs. 1,010 per 10 grams. It is expected that 3 months from now, the spot price might change to Rs. 27,300 or Rs. 24,700. At present, the option is At the Money. Rate of interest at simple compounding is 12 percent per annum.

Is the current premium for the option is justified? Evaluate the option and comment.

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Solution:



Commodity	Gold		
Price unit	10 Grams		
Spot	₹ 26,000.00		
U price	₹ 27,300.00	u	1.05
D price	₹ 24,700.00	d	0.95
K / X	₹ 26,000.00		
Premia	₹ 1,010.00		
Expiry	3 months		
Interest rate	12%		
Is the premia justified?			

P	=	$\frac{R-d}{u-d}$		
R	=	1.03		
P	=	$\frac{1.03-0.95}{1.05-0.95}$	$\frac{0.08}{0.10}$	0.8
Option price as per binomial tree		PV of Expected FV of payoffs from Exercise of option		
Expected FV	=	P x Pay off on up move +(1-P) x Pay off on down move		
Expected FV	=	80% x 1300 +20% x 0		
Expected FV	=	₹ 1,040.00		
PV of expected FV	=	₹ 1,009.71		
The call option for purchase of 10 grams of gold @ ₹26000 is appropriately priced @ ₹1010				

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Delta	$\frac{C_U - C_d}{S_U - S_d}$	$\frac{1300 - 0}{27300 - 24700}$	$\frac{1300}{2600}$ =0.5
Delta			0.50
Buy 0.5 x 10 grams of gold + Sell a call	=	R_f rate	
Buy 5 grams of gold + Sell a call	=	R_f rate	
$13000 - c$	=	R_f rate	
Up move value of portfolio		5 grams of gold - call option	
Up move value of portfolio	=	27300 * 0.5 -1300	12,350.00
Down move value of portfolio	=	24700 * 0.5-0	12,350.00
$13000 - c$	11,990.29		
C	1,009.71		

33. Illustration

TMC holding limited has a portfolio of shares of diversified companies valued at Rs. 400 crore enters into a swap arrangement with None Bank on the terms that it will get 1.15% quarterly on notional principal of Rs. 400 crores in exchange of return on portfolio which is exactly tracking the Sensex which is presently 21,600. You are required to determine the net payment to be received or paid if Sensex turns out to be 21,860; 21,780; 22,080; 21,960; at the end of each quarter.

Solution:

Portfolio value in ₹ Crores	400.00
Sensex current value	21,600.00
Quarterly fixed return requirement	1.15%

Q	Sensex	Return on Sensex %	Fixed return for TMC	Fixed return in ₹ Cr	Variable Return on Portfolio in ₹ Cr	Amount to be paid/ received by TMC Holding ltd in ₹ Cr
1.00	21,860.00	1.2037%	1.15%	4.6	4.8148	**(0.2148)**
2.00	21,780.00	-0.3660%	1.15%	4.6000	(1.4639)	**6.0639**
3.00	22,080.00	1.3774%	1.15%	4.6000	5.5096	**(0.9096)**
4.00	21,960.00	-0.5435%	1.15%	4.6000	-2.1739	**6.7739**
				18.4000	6.6867	**11.7133**

34. Illustration

You had purchased a 3-month call option on the Equity shares of Satya Ltd for a premium of ₹ 30 each, the current market price of the share is ₹ 560 and the exercise price is ₹ 590. You expect the price range between ₹ 540 to ₹ 640.
The expected share price of Satya Ltd and related probability is given below:

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Expected price (₹)	540	560	580	600	620	640
Probability	0.10	0.15	0.05	0.35	0.20	0.15

Compute the following:

(i) Expected share price at the end of 3 months,

(ii) Value of call option at the end of 3 months, if the exercise price prevails,

(iii) In case the option is held to its maturity, what will be the expected value of the call option?

(iv) Find out the price of the shares quoted at the stock exchange to get the value of the call option as computed in (iii) above.

Solution:

Expected Share price after 3 months

Expected Price (A)	Probability (B)	(A) * (B)
540	0.10	54
560	0.15	84
580	0.05	29
600	0.35	210
620	0.20	124
640	0.15	96
	Expected Share Price after 3 months	**597**

ii) Value of call option at the end of 3 months, if the exercise price prevails

Exercise Price = ₹ 590

If on maturity, the spot is equal to the exercise price, then value of the option,

= SPOT on Maturity – exercise Price

= 590 – 590= **₹ 0**

iii) The expected value of the call option case the option is held to its maturity

Expected Share Price	Price	Value of Option	Probability	Probability Weighted Value
540	590	-	-	-
560	590	-	-	-
580	590	-	-	-
600	590	10	0.35	3.5
620	590	30	0.20	6
640	590	50	0.15	7.5
				17

Expected Value of the Call Option = **₹ 17**

iv)

If the value of the option on Maturity date = ₹ 17

Exercise Price = ₹ 590

Maturity/ Spot price of shares on the date of Maturity

= ₹ 17+ ₹ 590 = **₹ 607**

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35. Illustration – Nov'23

Following is the information available pertaining to shares of Omni Ltd.:

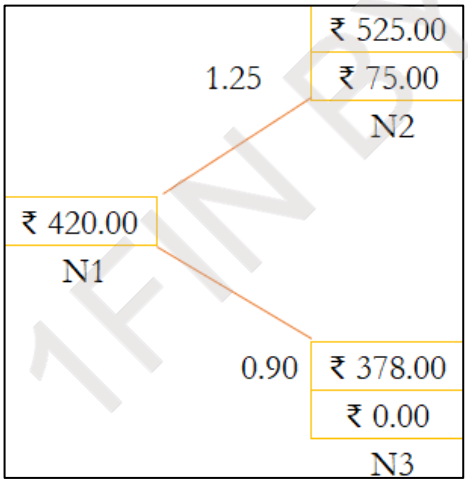
Current Market Price (₹)	**₹ 420.00**
Strike Price (₹)	₹ 450.00
Maximum Price (₹) expected in next 3 months' time	₹ 525.00
Minimum Price (₹) expected in next 3 months' time	₹ 378.00
Continuously Compounded Rate of Interest (p.a.) (%)	8.00%
ert	1.0202

From the above:

- Calculate the 3 months call option by using Binomial Method and Risk Neutral Method.
- Are the calculated values under both the models are same?
- State also clearly the basis of Valuation of options under these models

Solution:

Given:
S0 = 420
K = 450
S0u =525
S0d =378
U = 525 / 450 = 1.25
D = 378 / 420 = 0.90
e^{rt} = 1.0202



Binomial Method

Method 1: Delta Hedging i.e using Delta Shares

Delta = Change in option price / Change in Share price
Delta = 75-0 / 525-378

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Delta = 75/147
Delta = 0.5102

Create a portfolio of Long Delta Shares and Short 1 call option – This portfolio should generate risk free returns

Present value of this portfolio = 0.5102 x S0 – C0
= 0.5102 x 420 – C0
= 214.284 – C0 ----------(1)

	When stock Moves up	When stock Moves down
FV of this portfolio	0.5102 X S0U – Cu	0.5102 X S0d – Cd
	= 0.5102 x 525 – 75	0.5102 x 378 – 0
	= 192.855	192.855

The future value of this portfolio is same despite volatility i.e both on upside or downside. Such a portfolio has not risk despite volatility so it generates Rf return
FV of portfolio = 192.855
Assuming Rf of 8% over 3 month of continuous compounding PV of this portfolio
= 192.855/1.0202
= 189.037 ----------(2)

Equating (1) & (2)
214.284 – C0 = 189.037
=> C0 = 214.284 – 189.037
C0 = 25.247

Value of option = 25.247

Method 2 under binomial

Replicating portfolio – a portfolio that generates same returns as other portfolio will have same value as the other portfolio.

Assume a portfolio of Delta shares + Loan which generates same return as call option, then the value of the option is equal to the value of the portfolio.

PV of portfolio = Delta Shares + Loan = 0.5102 Shares + Loan
= 0.5102 X 420 + Loan
= 214.284 + Loan ---------- (A)
Future value of portfolio in Sou = 525 x 0.5102 + Loan
= 267.855 + Loan ---- (B)
Future value of portfolio in Sod = 378 x 0.5102 + Loan
= 192.855 + Loan ---- (C)

If Future value of Portfolio = Future pay off of call then
267.855 + Loan = 75 &
192.855 + Loan = 0

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=> Loan = - 192.855 in both the above equations
FV of loan = -192.855 @ Rf of 8% continuous compounding means
PV of loan = -192.855 / 1.0202 = 189.04
Substituting PV of loan in Equation …(A)
214.284 – 189.04 = PV Value of Call

PV Value of Call = Rs.25.244

Risk Neutral method

Method 1

$P = e^{rt} - d / u-d$
P = 1.0202 – 0.90 / 1.25-0.90
P = 0.1202 / 0.35
P = 34.34%
1-P = 65.66%

Value of call = PV of expected value of future payoffs from call
$C0 = Cu \times P + Cd \times (1-P) / e^{rt}$
C0 = 75 x 34.34% + 0 x 65.66% / 1.0202

C0 = 25.247

Value of call is Rs.25.25

Method 2:
Expected value of stock based on options volatilities = Expected Future value of stock
$525 \times P + 378 (1-P) = 420 \times e^{rt}$
525P + 378 – 378P = 428.484
147P = 50.484
P = 50.484 / 147
P = 34.34%

Value of call = PV of expected value of future payoffs from call
$C0 = Cu \times P + Cd \times (1-P) / e^{rt}$
C0 = 75 x 34.34% + 0 x 65.66% / 1.0202

C0 = 25.247

Value of call is Rs.25.25

Part 2

Yes the value of the option computed under the binomial method and the Risk Netural Method have same value

Part 3

Under binomial method we use delta shares to hedge and each portfolio has same value – generating Risk free returns. Under Risk Neutral method, risk neutral probabilities are used and based on the principle of No arbitrage the value of the options is arrived at.

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FOREIGN EXCHANGE EXPOSURE AND RISK MANAGEMENT (99Q)

Basic questions

1. Illustration

The price of a bond just before a year of maturity is $ 5,000. Its redemption value is $ 5,250 at the end of the said period. Interest is $ 350 p.a. The Dollar appreciates by 2% during the said period. Calculate the rate of return. (ICAI SM)

Solution:

Particulars	Amount($)
Redemption Value of Bond	5250
Add: Interest P.a	350
Less: Price of bond one year ago	5000
Return	**600**

$$\textbf{Return} = \frac{\text{Capital Gains} + \text{Dividend/Interest}}{\text{Opening Investment}}$$

$$\text{Return} = \frac{600}{5000} = 12\%$$

Thus, return for a US Bond investor is 12%.

Return for a Non-US Investor is 12% + Impact of 2%,

=(1+12%)(1+2%) – 1

=(1.12)(1.02) – 1

=1.1424 -1

=14.24%.

Thus, return for Non-US Investor is 14.24%

Alternatively, since principal return of $ 5250 and return of $350 will be valued at appreciated US Dollar of 2% (1+2%) and original investment will be valued at original rate (1), then return can also be calculated as:

$$\text{Return} = \frac{5250 \times 1.02 + 350 \times 1.02 - 5000}{5000}$$

$$\text{Return} = \frac{5712}{5000}$$

Return =14.24%

2. Illustration

Your forex dealer entered into a cross currency deal and sold US$ 10,00,000 against Euro @ US$ 1 = 1.4400 for Spot delivery. However, later during the day, the market became volatile and the dealer in compliance with his management's guidelines had to square – up the position when the quotations were:

Spot US $ 1 INR 61.4300/4500
Spot US $ 1 EURO 1.4250/4350

What will be the gain or loss in the transaction? (RTP NOV14)

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Solution:

Phase 1 of transaction: Sold USD and bought Euro at 1.4400 per USD
Since the forex dealer has squared of the position, the dealer will do the opposite of the previous transaction.

Phase 2 of transaction : Buy USD and sold Euro at 1.4350 per USD
Gain = 0.0050 Euro per USD
Since transaction involves US $ 10,00,000 the total gain would be:
Gain = $10,00,000 × 0.0050
= 5000 Euros

Alternatively,
Forex dealer sold USD and bought Euro at 1.44.

Thus, Number of Euros bought = $10,00,000 ×1.4400
= 14,40,000 Euros

In the transaction of squaring of, amount of Euro sold for buying US $10,00,000 will be done at $1=1.4350 Euros
Hence, Euros sold = 14,35,000 (10,00,000 × 1.4350)

Thus, gain = 14,40,000 Euros -14,35,000 Euros
= 5000 Euros

Since dealer is based out of India, we need to calculate gain in INR as well.
The bank will sell USD at 1.4350 and will buy USD at INR 61.43,
Gain in INR = $\frac{5000 \times 61.43}{1.4350}$
= Rs 21,40,148.81 or rounded off to 21,40,149.

3. Illustration

Your forex dealer had entered into a cross currency deal and had sold US $ 10,00,000 against EURO at US $ 1 = EURO 1.4400 for spot delivery.

However, later during the day, the market became volatile and the dealer in compliance with his management's guidelines had to square – up the position when the quotations were:

Spot US $ 1	INR 31.4300/4500
1 month margin	25/20
2 months margin	45/35

Spot US $ 1	EURO 1.4400/4450
1 month forward	1.4425/4490
2 months forward	1.4460/4530

What will be the gain or loss in the transaction? (SM)

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Solution:

Phase 1 of the transaction: Sold $10,00,000 and bought Euros at 1.44 Euro/Dollar.
Phase 2 of the transaction (Squaring of): Buy US $ 10,00,000 and sell Euros.

Bank will buy Euro and sell dollars at 1.4450 Euros/Dollar.(Correspondingly customer will buy dollar and sell Euro at the same rate)
Note that the transaction is spot delivery only, hence spot rates will only be considered. Forward rates are irrelevant.

In simple words, customer sold US $ at 1.44 Euros and bought back again from the market at 1.4450 Euros.

Hence, the loss is Euro 0.0050 per dollar .
Total loss = $10,00,000 × 0.0050
=5000 Euros

The loss of 5000 Euros represents shorting, which means you have sold extra Euros which you don't have. Now in order to make good the loss, you have to buy back again 5000 Euros from the market.

USD/EUR Quote : 1.4400/1.4450

Rate which is applicable will be 1.4400 (**B**anker **B**ids to **B**uy the **B**ase **C**urrency)
US $ got =5000/1.4400
=$3472.22

Since the dealer is based out of India as Cross currency rate are USD/EUR, loss will be calculated in INR terms.

USD/INR Quote : 31.4300/31.4500

Rate which is applicable will be 31.4500 as Customer has to Get INR Equivalent for $3472.22, so banker will sell US $ at 31.45 and give INR.

Loss in INR =3472.22 × 31.45 =INR 1,09,201.40

4. Illustration

Edelweiss Bank Ltd. sold Hong Kong dollar 2 crores value spot to its customer at ₹ 8.025 and covered itself in the London market on the same day, when the exchange rates were US$ 1 = HK $ 7.5880 - 7.5920.
Local interbank market rates for US $ were Spot US $ 1 = ₹ 60.70-61.00
Calculate the cover rate and ascertain the profit or loss on the transaction. Ignore brokerage. (Nov 14)

Solution :

Given, Edelweiss Sold HKD 2 Crores at Rs 8.025.
In order to cover up the position, the bank needs to Buy same 2 Crores HKD and sell INR. Since direct rate is not given, Cross rate of HKD/INR needs to be found out. First Customer will sell INR and Buy USD and then will sell USD and get back HKD.

Rate	Bid	Ask
USD INR	60.70	**61**
USD HKD	**7.588**	7.592

Thus, HKD/INR =61/7.588
Hence Cover rate is HKD/INR=8.039
Loss = 8.039-8.025 =0.014 per HKD (as Edelweiss sold at 8.039 and bought back same at 8.025.
Total Loss = 20,000,000 × 0.014=INR 2,80,000.
Hence total loss in INR is Rs 2,80,000.

5. Illustration

With relaxation of norms in India for investment in international market up to $2,50,000, Mr. X to hedge himself against the risk of declining Indian economy and weakening of Indian Rupee during last few years, decided to diversify in the International Market.

Accordingly, Mr. X invested a sum of Rs. 1.58 crore on 1.1.20x1 in Standard & Poor Index. On 1.1.20x2 Mr. X sold his investment. The other relevant data is given below:

	1.1.20x1	1.1.20x2
Index of Stock Market in India	7395	?
Standard & Poor Index	2028	1919
Exchange Rate (Rs./$)	62.00/62.25	67.25/67.50

You are required to calculate:
(i) The return for a US investor.
(ii) Holding Period Return to Mr. X.
(iii) The value of Index of Stock Market in India as on 1.1.20x2 at which Mr. X would be indifferent between investment in Standard & Poor Index and India Stock Market. (MTP April 19).

Solution:

(i) $$\textbf{Return} = \frac{\text{Capital Gains+Dividend/Interest}}{\text{Opening Investment}}$$

$$\text{Return} = \frac{1919-2028}{2028} = \textbf{-5.37\%}$$

(ii) US $ purchased by Mr. X for Rs 1.58 Crores

$$\$ \text{ Got} = \frac{1,58,00,000}{\text{USD INR } 62.25}$$

$ Got = $253,815.26
Closing value of $ investment of Mr. X
=253815.26 × (1-5.37%)
= $240,185.38
$ remitted to India at a rate of 67.25
=2,40,185.39 * 67.25
= Rs 1,61,52,466.91

$$\text{Return} = \frac{1,61,52,466.91-1,58,00,00,000}{1,58,00,000} \times 100 = 2.23\%$$

Hence holding period return is 2.23%

(iii) Closing Indian Market index value for 2.23 % return from opening value of 7395 is computed as follows:

Closing Value = 7395 +7395 × 2.23%
Closing Value = 7559.91

6. Illustration

Bharat Silk Limited, an established exporter of silk materials, has a surplus of US$ 20 million as on 31st May 2015. The banker of the company informs the following exchange rates that are quoted at three different forex markets:

GBP/ INR	99.10	at London
INR/ GBP	0.01	at London
USD/ INR	64.10	at Mumbai
INR/ US$	0.02	at Mumbai
USD/ GBP	0.65	at New York
GBP/ USD	1.5530	at New York

Assuming that there are no transaction costs, advice the company how to avail the arbitrage gain from the above quoted spot exchange rates. (RTP MAY 17)

Solution:

Relevant Rates are as follows :

Exchange Rate	Rate	Market
GBP INR	99.10	London
USD INR	64.10	Mumbai
GBP USD	1.5530	New York

Note : *Other three rate given in the question are just inverse of these above three rates and are given in approximate values. Ignore those.*

Step 1	**Convert US $20 Million into INR at 64.10**	
	Bharat Silk would get = 20,000,000 × 64.10	=INR 1282 Million
Step 2	Convert the INR 1282 Million into GBP at 99.10	
	Number of equivalent GBP=1282 Million/99.10	=GBP 12,936,427.85
Step 3	In order to get back the same $ 20 Million, Sell GBP and get back USD at 1.5530	
	Equivalent USD= GBP 12,936,427.85*1.5530	= US $ 20,090,272.45

Thus, Arbitrage gain = $ 20,090,272.45 - $ 20,000,00
= $ 90,272.45

Hence Bharat Silk Limited would get Arbitrage gain of $ 90,272.45 by following the above steps.

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7. Illustration

You sold Hong Kong Dollar 1,00,00,000 value spot to your customer at ₹ 5.70 & covered yourself in London market on the same day, when the exchange rates were: US$ 1 = H.K.$ 7.5880 / 7.5920
Local inter-bank market rates for US$ were Spot US$ 1 = ₹ 42.70/42.85
Calculate cover rate and ascertain the profit or loss in the transaction. Ignore brokerage. (SM)

Solution :

Given, we Sold HKD 1 Crore at Rs 5.70.
In order to cover up the position, the bank needs to Buy same 1 Crore HKD and sell INR. Since direct rates are not given, Cross rate of HKD/INR needs to be found out. First Customer will sell INR and Buy USD and then will sell USD and get back HKD.

Rate	Bid	Ask
USD INR	42.70	**42.85**
USD HKD	**7.588**	7.5920

Thus, HKD/INR =42.85/7.588
Hence Cover rate is HKD/INR=5.647
Profit = 5.70-5.647 =0.053 per HKD (as you sold at 5.70 and bought back same at 5.647.
Total profit = 10,000,000 × 0.053=INR 5,30,000.
Hence total gain in INR is Rs 5,30,000.

8. Illustration

You, a foreign exchange dealer of your bank, are informed that your bank has sold a T.T. on Copenhagen for Danish Kroner 10,00,000 at the rate of Danish Kroner 1 = ₹ 6.5150. You are required to cover the transaction either in London or New York market. The rates on that date are as under:

Mumbai-London	₹ 74.3000	₹ 74.3200
Mumbai-New York	₹ 49.2500	₹ 49.2625
London-Copenhagen	DKK 11.4200	DKK 11.4350
New York-Copenhagen	DKK 07.5670	DKK 07.5840

In which market will you cover the transaction, London, or New York, and what will be the exchange profit or loss on the transaction? Ignore brokerages. (SM)

Solution :

The two legs of the transaction will be,
1. USD INR – Buy USD, Sell INR and then Sell USD and Buy DKK.
2. GBP INR – Buy GBP, sell INR and then sell GBP and Buy DKK.

Case 1 : USD INR

Rate	Bid	Ask
USD INR	49.25	**49.2625**
USD DKK	**7.5670**	7.5840

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Since, the banker has sold DKK and has INR, they need to sell INR and get USD at 49.2625 (Banker Bids to Buy Base Currency)

So, USD get = $\frac{10,00,000 \times 6.5150}{49.2625}$

USD get = $ 132,250.6978
Now by selling USD and get DKK at 7.5670
DKK get = 132,250.6978 × 7.5670
=10,00,741.030 DKK
Gain made = 10,00741.030 – 10,00,000
= **741.030 DKK**

Alternatively,
DKK INR = 49.2625/7.5670
=6.5102
So, Banker sold DKK at INR 6.5150 and bought back same at INR 6.5102.
Profit = 6.5150 – 6.5102
= **0.0048 INR per DKK or 4800 INR**

Case 2 : GBP INR

Rate	Bid	Ask
GBP INR	74.3000	**74.3200**
GBP DKK	**11.4200**	11.4350

Since, the banker has sold DKK and has INR, they need to sell INR and get GBP at 74.3200 (Banker Bids to Buy Base Currency)
So, GBP get = $\frac{10,00,000 \times 6.5150}{74.3200}$
GBP get = GBP 87,661.4639
Now by selling GBP and get DKK at 11.4200
DKK get = 87,661.4639 × 11.4200
=10,01,093.918 DKK
Gain made = 10,01,093.918 – 10,00,000
= **1093.918 DKK**

Alternatively,
DKK INR = 74.3200/11.4200
=6.5079
So, Banker sold DKK at INR 6.5150 and bought back same at INR 6.5079.
Profit = 6.5150 – 6.5079
= **0.0071 INR per DKK or 7100 INR**

Summary :

Rate	Profit in DKK	Profit in INR
USD INR (Case 1)	741	4800
GBP INR (Case 2)	**1093**	**7100**

Since Profit is higher in Case 2 i.e., by following GBP INR route, the dealer has to cover via London.

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9. Illustration

On January 28,2013 an importer customer requested a Bank to remit Singapore Dollar (SGD) 2,500,000 under an irrevocable Letter of Credit (LC). However, due to unavoidable factors, the Bank could affect the remittances only on February 4, 2013. The inter-bank market rates were as follows:

	January 28, 2013	**February 4, 2013**
US$ 1	₹ 45.85/45.90	₹ 45.91/45.97
GBP £ 1	US$ 1.7840/1.7850	US$ 1.7765/1.7775
GBP £ 1	SGD 3.1575/3.1590	SGD 3. 1380/3.1390

The Bank wishes to retain an exchange margin of 0.125% Required:
How much does the customer stand to gain or lose due to the delay? (Note: Calculate the rate in multiples of 0.0001) (SM)

Solution :

Case 1 : Transaction happening on 28th January :

Rate	**Bid**	**Ask**
USD INR	45.85	**45.90**
GBP USD	1.7840	**1.7850**
GBP SGD	**3.1575**	3.1590

First you (Banker) need to sell INR and get USD at 45.90 (Banker Bids to Buy Base Currency)
Then sell USD and get GBP at 1.7850.
Lastly sell GBP and get SGD at 3.1575.
Now to get SGD INR (No of INR required per SGD) = $\frac{45.90 \times 1.7850}{3.1575}$
= 25.9482
Hence SGD/INR = 25.9482
+ Margin @ 0.125%
SGD INR = 25.9806

Case 2: Transaction on February 4th

Rate	**Bid**	**Ask**
USD INR	45.91	**45.97**
GBP USD	1.7765	**1.7775**
GBP SGD	**3.1380**	3.1390

Similar working to Case 1,
SGD INR = $\frac{45.97 \times 1.7775}{3.1380}$
SGD INR = 26.0394
+ Margin @ 0.125%
SGD INR =26.0719

Now, Remittance in SGD = 2.5 Million
Exchange Rate on 28th Jan = 25.9806
Exchange Rate on 04th Feb = 26.0719

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Loss to Customer(as Exchange rate is higher on 4th Feb than on 28th Jan) = INR remitted on Feb 4th – INR Could have been remitted on 28th Jan
= 2.5 Million × (26.0719 – 25.9806)
=2.5 Million × (0.0913)
= Rs 2,28,250

Hence loss to customer due to delay in remittance is Rs 2,28,250.

10. Illustration

Followings are the spot exchange rates quoted at three different forex markets:

USD/INR	48.30 in Mumbai
GBP/INR	77.52 in London
GBP/USD	1.6231 in New York

The arbitrageur has USD1,00,00,000. Assuming that there are no transaction costs, explain whether there is any arbitrage gain possible from the quoted spot exchange rates. (SM)

Solution :

Two possible scenario which can be possible are :

1. Arbitrageur has $ 100,00,000. First, he can sell USD and Get INR. Then Sell INR and get GBP. And then sell GBP and get USD.
2. Arbitrageur has $ 100,00,000. First, he can sell USD and Get GBP. Then Sell GBP and get INR. And then sell INR and get USD.

In first case,

Step 1 : Sell USD $ 100,00,000 and get INR at 48.30
INR get = 100,00,000 × 48.30
= 483,000,000
Step 2 : Sell INR and get GBP at 77.52
GBP get = 483,000,000/77.52
= 6230650.1548
Step 3 : Sell GBP and Get USD at 1.6231
USD get = 6230650.1548 × 1.6231
= $ 10,112,968.2662
You sold US $ 100,00,000 initially and get $10,112,969.2662 at the end.
So, profit =$ 10,112,969.2662 – $100,00,000
= $112,969.2662

In second case,
Step 1 : Sell USD $ 100,00,000 and get GBP at 1.6231
GBP get = 100,00,000/1.6231
= 6161049.8429
Step 2 : Sell GBP and get INR at 77.52
GBP get = 6161049.8429 × 77.52
= 477,604,583.82

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Step 3 : Sell INR and Get USD at 48.30
USD get = 477,604,583.82/48.30
= $ 98,88,293.66
You sold US $ 100,00,000 initially and get $98,88,293.66 at the end.
So, loss = $ 111706.34

Hence the first case is preferable as there is gain of $112,969 as compared to loss in case 2.
Note : In such type of questions, it is better to go with the order of question and solve accordingly. If you get doubt regarding which case to start with, do small rough work instead of doing whole calculation and proceed accordingly.

11. Illustration

In International Monetary Market, an international forward bid for December 15 on pound sterling is $ 1.2816 at the same time that the price of IMM sterling future for delivery on December 15 is $ 1.2806. The contract size of pound sterling is £ 62,500. How could the dealer use arbitrage in profit from this situation and how much profit is earned? (SM)

Solution :

Given on December 15th,
Forward Contract 1 £ =1.2186 $
Future Contract 1 £ =1.2806 $
In order to get arbitrage gain, a dealer needs to :

Buy Future for 15th December at	**1.2806 $**
Sell Forward for 15th December	1.2816 $
Gain	0.001 $/£
Total Contract size	62,500 £
Gain per lot of Pounds =62,500 × 0.001	62.5 $

12. Illustration

You have following quotes from Bank A and Bank B:

	Bank A	Bank B
SPOT	USD/CHF 1.4650/55	USD/CHF 1.4653/60
3 months	5/10	
6 months	10/15	
SPOT	GBP/USD 1.7645/60	GBP/USD 1.7640/50
3 months	25/20	
6 months	35/25	

Calculate:
(i) How much minimum CHF amount you have to pay for 1 million GBP spot?
(ii) Considering the quotes from Bank A only, for GBP/CHF what are the Implied Swap points for Spot over 3 months? (SM)

Solution :

i) Given Spot Rates,

Rate	Bank A	Bank B
USD CHF	1.4650/**55**	1.4653/60
GBP USD	1.7645/60	1.7640/**50**

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Since CHF GBP quotes are not given, first we have to convert CHF to USD and then Convert USD to get GBP.
Step 1 : As per **B**anker **B**ids to **B**uy **B**ase **C**urrency,
We will exchange CHF to USD with Bank A at 1.4655 CHF per USD
Step 2: After getting USD, we will now exchange, USD to GBP with Bank B at 1.7650 USD per GBP.
In order to get 1 Million GBP,
USD $ required = 1,000,000 × 1.7650 = **$ 1,765,000**
Now, 1 $ = 1.4655 CHF,
CHF required = 1,765,000 × 1.4655 = **CHF 2,586,607.5**
Thus, to get 1 Million pounds one needs to pay minimum of 2,586,607.5 CHF

ii) USD CHF 3M Forward,

Rate	**Bid**	**Ask**
Spot	1.4650	1.4655
Add :Forward Premium	0.0005	0.0010
Forward Rate	1.4655	1.4665

GBP USD 3M Forward,

Rate	**Bid**	**Ask**
Spot	1.7645	1.7660
Less :Forward Discount	0.0025	0.0020
Forward Rate	1.7620	1.7640

For GBP / CHF, similar to part i) above, we need to multiply ask to get ask points and similarly need to multiply both the bids to get bid points,

GBP CHF	**Bid**	**Ask**
	1.4655	1.4665
	×1.7620	×1.7640
3M Forward	=2.582211	=2.586906

Similarly spot rates can be found out as:

GBP CHF	**Bid**	**Ask**
	1.4650	1.4655
	×1.7645	×1.7660
3M Spot	=2.5849925	=2.588073

Now in order to calculate forward points, we need to subtract spot from forward.

GBP CHF	**Bid**	**Ask**
Forward	2.58221	2.58691
Spot	2.58499	2.58807
Points	-0.00278 ~ -0.0028	-0.00117 ~ -0.0012

Hence swap points will be 28/12.

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13. Illustration

Citi Bank quotes JPY/USD 105.00-106.50 and Honk Kong Bank quotes USD/JPY 0.0090-0.0093.

(a) Are these quotes identical if not then how they are different?

(b) Is there a possibility of arbitrage?

(c) If there is an arbitrage opportunity, then show how would you make profit from the given quotation in both cases if you are having JPY 1,00,000 or US$ 1,000. (Nov 20 RTP N)

Solution :

Given,

	Citi Bank		Honk Kong Bank	
	Bid	**Ask**	**Bid**	**Ask**
USD JPY	105	106.50	=1/0.0093 = 107.53	=1/0.0090=111.11
JPY USD	=1/106.5 =0.0094	=1/105 = 0.0095	0.0090	0.0093

a) The quotes are not identical as,

USD JPY 105/106.6 is a direct quote for Japanese resident and Indirect quote for US resident. And JPY USD 0.0090/0.0093 is a direct quote for USD Resident and Indirect quote for Japanese resident.

b) Yes, there is possibility of arbitrage.

One can buy USD from Citi Bank and sell it to HK Bank.
One can buy JPY from HK and sell It to Citi Bank.

c) When one has US $ 1,000.

Step 1 :Buy Yen from Citi Bank and sell US $ to HK Bank.
So, $ 1000 = 107.53 × 1000 yen
=107,530 Yen
Step 2: Sell Yen to Citi Bank and buy US $ from them at 106.50 Yen per USD.
So, 107,530 Yen will give = 107,530/106.50
= 1009.67$
Hence one can make arbitrage gain of 9.67$ (1009.67 $ - 1000 $) from this kind of transaction for every 1000 $.

d) When one has Yen 1,000.

Step 1 :Sell Yen to Citi Bank and buy from them @ 106.50
So, Yen 100,000/106.50 = $ 938.97

Step 2: Sell USD to HK Bank and buy from them at 107.53 Yen per USD.
So, $ 938.97 will give = 938.97 × 107.53
= Yen 100,967.14

Hence one can make arbitrage gain of 967.14 Yen(100.967 Yen - 100,000 Yen) from this kind of transaction for every 100,000 Yen.

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14. Illustration

Given:

US$ 1 = ¥ 107.31

£ 1 = US$ 1.26

A$ 1 = US$ 0.70

(i) Calculate the cross rate for Pound in Yen terms

(ii) Calculate the cross rate for Australian Dollar in Yen terms

(iii) Calculate the cross rate for Pounds in Australian Dollar terms (Nov 20 N RTP)

Solution :

Given,

US $ 1 = Yen 107.31, which can be written as Yen 107.31 per US $.

£ 1 = US$ 1.26, which can be written as $ 1.26 per GBP.

A$ 1 = US$ 0.70, which can be written as US $ 0.70 per A$.

i) Cross rate for pound in Yen = Number of yen per pound

= 1 GBP = US $1.26 and US $ = Yen 107.31

Hence Yen per pound = US $ 1.26 × 107.31 = **Yen 135.21**

ii) Cross rate for pound in A $ = Number of yen per A$

= 1 A$ = US $0.70 and US $ = Yen 107.31

Hence Yen per Australian $ = US $ 0.70 × 107.31 = Yen 75.12

iii) Cross rate for pound in A $ = Number of Australian Dollars per GBP

= 1 GBP = US $1.26 and US $0.70 = A$ 1

Hence Australian Dollar per GBP = $\frac{1.26 \times 1}{0.70}$ = 1.8 A$

15. Illustration

USD 10,000 is lying idle in your Bank Account. You get the following quotes from the dealers:

Dealer	Quote	
A	EUR/USD	1.1539
B	EUR/GBP	0.9094
C	GBP/USD	1.2752

Is there an opportunity of gain from these quotes? (Nov 20 N)

Solution :

Relevant Rates are as follows :

Dealer	Rate	
A	EUR/USD	1.1539
B	EUR/GBP	0.9094
C	GBP/USD	1.2752

Two possible scenario which can be possible are :

1. Arbitrageur has $ 10,000. First, he can sell USD and Get EUR. Then Sell EUR and get GBP. And then sell GBP and get USD.
2. Arbitrageur has $ 10,000. First, he can sell USD and Get GBP. Then Sell GBP and get EUR. And then sell EUR and get USD.

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In first case,
Step 1 : Sell USD $ 10,000 and get EUR at 1.1539 US $ per EUR
EUR get = 10,000/1.1539
= 8,666.26
Step 2 : Sell EUR and get GBP at 0.9094 GBP per EUR
GBP get = 8,666.26 × 0.9094
= GBP 7,881.10
Step 3 : Sell GBP and Get USD at 1.2752
USD get = 7,881.10× 1.2752
= $ 10,049.98
You sold US $ 10,000 initially and get $10,049.98 at the end.
So, profit =$ 10,049.98 – $10,000
= $49.98

In second case,
Step 1 : Sell USD $ 10,000 and get GBP at 1.2752
GBP get = 10,000/1.2752
= 7841.91
Step 2 : Sell GBP and get EUR at 0.9094
GBP get = 7841.91/0.9094
= EUR 8,623.17
Step 3 : Sell EUR and Get USD at 1.1539
USD get = 8,623.17 × 1.1539
= $ 9,950.28

You sold US $ 10,000 initially and get $9,950.28 at the end.
So, loss = $ 49.72

Hence the first case is preferable as there is gain of $ 49.98 as compared to loss in case 2.
Note : In such type of questions, it is better to go with the order of question and solve accordingly. If you get doubt regarding which case to start with, do small rough work instead of doing whole calculation and proceed accordingly.

Arbitrage, IRP, PPP related

16. Illustration

On April 1, 3 months interest rate in the UK £ and US $ are 7.5% and 3.5% per annum respectively. The UK £/US $ spot rate is 0.7570. What would be the forward rate for US $ for delivery on 30th June? (SM)

Solution : Given,

UK £	7.5% P.a
US $	3.5% P.a
USD/GBP	0.7570 £

As per Interest Rate Parity,

$$\textbf{Forward Rate (Se)} = \frac{\text{Current Spot rate (S0)} \times (1 + \text{Domestic Interest Rate (Dr)})}{(1 + \text{Foreign Interest Rate (Fr)})}$$

So, $Se = \frac{0.7570 \times (1+7.5\%/4)}{(1+3.5\%/4)}$ = 0.7570 × 1.01875/1.00875

USD GBP =0.7645, i.e., 0.7645 GBP per 1 USD.

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17. Illustration

Given the following information:
Exchange rate – Canadian dollar 0.665 per DM (spot)
Canadian dollar 0.670 per DM (3 months)
Interest rates – DM 7% p.a., Canadian Dollar – 9% p.a.
What operations would be carried out to take the possible arbitrage gains? (SM)

Solution: Given,
DM/CAD Spot = 0.665 and DM/CAD 3 Month Forward =0.670
Interest Rate DM =7% P.a and CAD =9% P.a

Depreciation of CAD as per Forward quote $= \frac{(0.670-0.665)}{0.665} = 0.75\%$ for 3 Months
Annualised Depreciation = 0.75%× 4 = 3% P.a.
Ideal Depreciation as per Interest rate $= \frac{1.09}{1.07} - 1 = 1.87\%$

Ideal DM/CAD Forward for 3 Months $= 0.665 \times (1 + \frac{1.87\%}{4}) = 0.6681$

If Forward Premium is Greater than Interest Differential then borrow in Domestic Currency & Invest abroad, i.e Funds outflow
If forward premium is less than Interest differential then borrow in foreign currency & invest in Local currency i.e Funds inflow

Step 1	**Enter into 3 Month forward to sell 1 DM & get 0.670 CAD**
Step 2	Borrow 1000 (take any number) in CAD
Step 3	Convert into DM at Spot = 1000/0.665=1503.76 DM
Step 4	Invest 1503.76 DM @7% for 3 Months
Step 5	Have DM together with interest = 1503.76 + (1503.76 × 7% ×3/12) =1503.76+ 26.3158 = 1530.0758 DM
Step 6	Sell DM and get CAD as per 3 M forward = 1530.76 × 0.670 =1025.15 CAD
Step 7	Repay CAD loan with Interest = 1000 + 1000 × 9% × 3/12 = 1000 +22.5= 1022.5 CAD
Step 8	Profit = 1025.15- 1022.5 = **2.65 CAD**

18. Illustration

The following table shows interest rates for the United States Dollar and French Franc. The spot exchange rate is 7.05 Franc per Dollar. Complete the missing entries:

	3 Months	6 Months	1 Year
Dollar interest rate			
(annually compounded)	$11\frac{1}{2}\%$	$12\frac{1}{4}\%$	?
Franc interest rate			

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(annually compounded)	$19\frac{1}{2}\%$	?	20%
Forward Franc per Dollar	?	?	7.5200
Forward discount per Franc			
percent per year	?	6.3%	?

(Practice Manual)

Solution :

Forward franc per Dollar

As per Interest Rate Parity,

$$\textbf{Forward Rate (Se)} = \frac{\text{Current Spot rate (S0)} \times (1 + \text{Domestic Interest Rate (Dr)})}{(1 + \text{Foreign Interest Rate (Fr)})}$$

$$= \frac{7.05 \times (1+19.5\% \times \frac{3}{12})}{\left(1+11.5\% \times \frac{3}{12}\right)} = \mathbf{7.05} \times \frac{\mathbf{1+0.04875}}{\mathbf{1+0.02875}} = \mathbf{7.187}$$

I.e., 7.187 F Franc per USD

Forward discount per Franc : Indirect quote of Franc Forward

Spot ($ per FFR)	1/7.05	=0.141844
Forward	1/7.187	=0.139139
Discount		=0.002705
Discount %		=0.002705/0.142844 =1.907% (3months) Or 7.628% (Annualized)

French Franc Interest Rate :

Given $ interest rate =12.25% and discount rate =6.3%

We know that Discount = (S-F)/S in indirect quote, and in direct quote,

$$\textbf{Forward} = \frac{\text{Spot (S0)} \times (1 + \text{Domestic (Dr)})}{(1 + \text{Foreign (Fr)})}$$

So, substituting the value of Forward in Indirect quote, we get Discount $= \frac{S-S(1+F)/(1+D)}{S}$

$6.3\%/2 = 1 - \frac{1+12.25\% \times 6/12}{1+D-\times 6/12}$

$= 1 - \frac{1.06125}{1+0.5D} = 3.15\%$

$1 + 0.5d = \frac{1.06125}{0.9695}$ $\quad 0.5d = 0.09576$

D= 19.153%, thus domestic interest rate is 19.153%.

Note: *Discount will also be divided by two as both numerator and denominator's interest rate are also halved.*

Forward Franc per Dollar

$$\textbf{Forward} = \frac{\text{Spot (S0)} \times (1 + \text{Domestic (Dr)})}{(1 + \text{Foreign (Fr)})}$$

$$\mathbf{F} = \frac{\mathbf{7.05 \times (1+19.153\%)/2}}{\mathbf{(1+12{,}25\%)/2}}$$

$$F = \frac{\mathbf{7.05 \times 1.095765}}{\mathbf{(1.06125}} = \mathbf{7.28\ FFR}$$

USD Interest Rate

Spot = 7.05 and Forward = 7.52, Domestic = 20% and Foreign = ?

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$$\textbf{Forward} = \frac{\text{Spot } (S0) \times (1 + \text{Domestic } (Dr))}{(1 + \text{Foreign } (Fr))}$$

$7.52=\frac{7.05 \times 1.2}{(1+F} = 1 + F = \frac{8.46}{7.52}$

1+F=1.125, **F=12.5%**

Forward Franc per Dollar,

Discount = (S-F)/S, S= 7.05 and F =7.52

Indirect quote, 1/S = 0.14184.4 and 1/F =0.132978

Disc % = (0.14184.4 – 0.132978)/0.14184.4 = **6.25%**

Alternatively,

Substituting the value of Forward in Indirect quote, we get Discount $= \frac{S-S(1+F)/(1+D)}{S}$

Discount = $1 - \frac{1+12.5\%)}{1+20\%}$

19. Illustration

Spot rate 1 US $ = ₹ 48.0123

180 days Forward rate for 1 US $ = ₹ 48.8190

Annualised interest rate for 6 months – INR = 12%

Annualised interest rate for 6 months – US $ = 8%

Is there any arbitrage possibility? If yes how an arbitrageur can take advantage of the situation, if he is willing to borrow ₹ 40,00,000 or US $83,312. (SM)

Solution : Theoretical forward as per Interest rate parity will be :

$$\textbf{Forward} = \frac{\text{Spot } (S0) \times (1 + \text{Domestic } (Dr))}{(1 + \text{Foreign } (Fr))}$$

$$F = \frac{48.0123 \times (1 + 12\%)/2}{(1 + 8\%)/2}$$

F= 48.9356 INR per USD

Actual Forward = 48.8190 INR per USD

Another way to look at it is,

Forward Premium = $\frac{48.8190-48.0123}{48.0123} \times 2 = \mathbf{3.36\%}$

Interest Rate differential = $\frac{1+(12\%)/2}{1+(8\%)/2} \times 2$ = **3.84%**

Since Interest rate differential is higher than forward premium or forward premium is not fully reflecting the price, you buy in foreign currency. And hence in the above case we have borrowed in $. Similarly, if Forward premium is higher than interest rate differential, you buy in local currency.

Step 1	**Enter into 6 Month forward to Buy USD @ 48.8190**
Step 2	Borrow 83,312 USD
Step 3	Convert USD into INR at spot = 83,312 × 48.0123= INR 40,00,000
Step 4	Invest 40,00,000 INR @12% for 6 Months

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Step 5	Have INR together with interest = 40,00,000 + 40,00,000 × 12% ×6/12 =40,00,000+2,40,000 = 42,40,000 INR
Step 6	Sell INR and convert into USD as per 6 M forward @48.8190 = 42,40,000/48.8190 = 86,851.43 USD
Step 7	Repay USD loan with Interest = 83,312 + 83,312 × 8% × 6/12 = 83,312 +3,332.48= 86,644.48 CAD
Step 8	Profit = 86,851.43- 86,644.48 = **USD 206.95**

20. Illustration

The rate of inflation in USA is likely to be 3% per annum and in India it is likely to be 6.5%. The current spot rate of US $ in India is ₹ 43.40. Find the expected rate of US $ in India after one year and 3 years from now using purchasing power parity theory. (PM)

Solution :

As per PPP theory, exchange rate of country with higher interest rate will depreciate.

USD INR Theoretical forward :

$$\textbf{Forward} = \frac{\text{Spot (S0)} \times (1 + \text{Domestic (Dr)})}{(1 + \text{Foreign (Fr)})}$$

Spot after 1 year=$\frac{43.4 \times 1.065}{1.03}$ = Rs 44.88 per USD

Spot after 3 years=$\frac{43.4 \times 1.065\text{^}3}{1.03\text{^}3}$ = Rs 47.98 per USD

21. Illustration

The rate of inflation in India is 8% per annum and in the U.S.A., it is 4%. The current spot rate for USD in India is ₹ 46. What will be the expected rate after 1 year and after 4 years applying the Purchasing Power Parity Theory? (SM)

Solution :

As per PPP theory, exchange rate of country with higher interest rate will depreciate.

USD INR Theoretical forward :

$$\textbf{Forward} = \frac{\text{Spot (S0)} \times (1 + \text{Domestic (Dr)})}{(1 + \text{Foreign (Fr)})}$$

Spot after 1 year=$\frac{46 \times 1.08}{1.04}$ = Rs 47.77 per USD

Spot after 3 years=$\frac{46 \times 1.08\text{^}4}{1.04\text{^}4}$ = Rs 53.50 per USD

22. Illustration

Following are the rates quoted at Mumbai for British Pound (£):

Spot (£/₹)	52.60/70	Interest Rates	India	London
3 m Forward	20/70	3 months	8%	5%
6 m Forward	50/75	6 months	10%	8%

Verify whether there is any scope for covered interest arbitrage if you can borrow in rupees. (RTP MAY16)

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Solution :

Steps	What needs to be done	3M Forward	6M Forward
Step 1	Borrow INR , equivalent of 1000 GBP at spot of 52.70	INR 52,7000 @ 8%	INR 52,700 @ 10%
Step 2	Convert INR to GBP	GBP 1000	GBP 1000
Step 3	Invest in FD in GBP	GBP 1000	GBP 1000
Step 4	On due date, get principal and interest back in GBP	1000 × (1+5% × 3/12) =1000 × (1 + 1.25%) =GBP 1012.5	1000 × (1+8% × 6/12) =1000 × (1 + 1.4%) =GBP 1040
Step 5	Convert GBP to INR (As per **B**anker **B**ids to **B**uy **B**ase **C**urrency)	Rate applicable = 52.60 + 20= 52.80 INR equivalent = 1012.5 × 52.80 = INR 53,460	Rate applicable = 52.60 + 50= 53.10 INR equivalent = 1040 × 53.10 = INR 55,224
Step 6	Repay INR loan together with interest	=52700 + (1 +8% × 3/12) =52700 ×1.02 = INR 53,754	52700 + (1 +10% × 6/12) =52700 ×1.05 = INR 55,335
Step 7	Net benefit/(loss)	= 53,460 – 53,754 = **(294)**	= 55,224 – 55,335 = **(111)**

Hence, there is no scope for covered interest arbitrage if one borrows in INR.

23. Illustration

Spot rate 1 US$ = ₹ 68.50

USD premium on a six-month forward is 3%. The annualized interest in US is 4% and 9% in India. Is there any arbitrage possibility? If yes, how a trader can take advantage of the situation if he is willing to borrow USD 3 million. (NOV 18, OLD)

Solution :

Given, Spot USD INR = 68.50
6 M forward Premia = 3% on 68.50 =2.055
Thus, 6 Month forward rate = 70.555
Interest rates : India = 9% and USA = 4%
6M interest rate differential = $\frac{1+(9\%/2)}{1+(4\%/2)}$ = 1.0245 i.e., 2.45%
Yes, arbitrage possibility exists as premia % is 3% and interest rate differential is 2.45%.
As per interest rate differential, ideal forward rate should be = 68.5 × (1+ 2.45%) = INR 70.18
Since market premia (3%) is higher than theoretical premia (2.45%), **you borrow in domestic currency** i.e., INR.

Step 1	**Enter into 6 Month forward to Sell USD @ 70.555**
Step 2	Borrow INR equivalent of USD 3 Million @ spot of 68.5 = 30,00,000 × 68.5 = 20,55,00,000
Step 3	Convert INR into USD at spot = 20,55,00,000/68.5 = USD 3,000,0000
Step 4	Invest 3,000,000 USD @4% for 6 Months

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Step 5	Have USD together with interest = 3,000,000 + 3,000,000 × 4% ×6/12 =3,000,000+60,000 = 3,060,000 USD
Step 6	Sell USD and convert into INR as per 6 M forward @ 70.555 = 3,060,000 × 70.555 = INR 21,58,98,300
Step 7	Repay INR loan with Interest = 20,55,00,000 + 20,55,00,000 × 9% × 6/12 = 20,55,00,000 +92,47,500= INR 21,47,47,500
Step 8	Profit = INR 21,58,98,300 – 21,47,47,500 = **INR 11,50,800**

24. Illustration

The US dollar is selling in India at ₹ 55.50. If the interest rate for 6 months borrowing in India is 10% per annum and the corresponding rate in USA is 4%.

(i) Do you expect that US dollar will be at a premium or at discount in the Indian Forex Market?

(ii) What will be the expected 6-months forward rate for US dollar in India? And

(iii) What will be the rate of forward premium or discount? (SM)

Solution :

i) USD at a premium as it has lower interest rate (4%) as compared to Indian interest rate (10%).

ii) $\textbf{Forward} = \frac{\text{Spot (S0)} \times (1 + \text{Domestic (Dr)})}{(1+\text{Foreign (Fr)})}$

$= 55.50 \times \frac{1+(10\%/2)}{1+(4\%/2)}$ = 55.50 × 1.05/1.02

= **57.13**

Forward premium/discount = (57.13-55.50)/55.50

=**2.94%**

25. Illustration

An Indian exporting firm, Rohit and Bros., would be covering itself against a likely depreciation of pound sterling. The following data is given:

Receivables of Rohit and Bros	:	£500,000
Spot rate	:	₹ 56.00/£
Payment date	:	3-months
3 months interest rate	:	India 12% PA UK 5 % PA

What should the exporter do? (SM)

Solution :

A) If forward contracts are available

In order to protect against GBP INR forex volatility, Rohit & Bros should enter into a forward contract to sell GBP 500,000 after 3 months at a rate determined today in the forward market.

Theoretical future spot = $56 \times \frac{1+(12\% \times \frac{3}{12})}{1+(5\% \times 3/12)} = 56 \times \frac{1.03}{1.0125}$ = 56.97

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If exporter hedges receivable @ 56.97 vs 56 spot , the gain would be = (56.97 – 56) × 500,000 = Rs **4,83,951**

B) If forward contracts are not available

Steps	What needs to be done	3M Forward
Step 1	Borrow GBP @5%	=500,000/1.0125 = GBP 4,93,827
Step 2	Convert GBP to INR @ 56	INR = 4,93,827 × 56 = INR 2,76,54,312
Step 3	Invest in FD in INR	INR 2,76,54,312
Step 4	On due date, get principal and interest back in INR	2,76,54,312 × (1+12% × 3/12) =2,76,54,312 × (1 + 0.3%) =INR 2,84,83,941
Step 5	Net benefit/(loss)	INR Equivalent at spot = 500,000 × 56 = 2,80,00,000 Gain = 2,84,83,941 – 2,80,00,000 = **4,83,941**

By doing these transactions of borrowings in pound and using export proceeds to repay, Rohit & Bros has made a gain of INR 4,83,941 which is locked in.

26. Illustration

Merry is a Forex Dealer with XYZ Bank. She notices following information relating to Canadian Dollar (CAD) and German Deutschmark (DEM):
Exchange rate – CAD 0.775 per DEM (spot)
CAD 0.780 per DEM (3 months)
Interest rates – DEM 7% p.a.; CAD 9% p.a.

(i) Assuming that there is no transaction cost, determine does the Interest Rate Parity holds in above quotations.
(ii) If yes, then explain the steps that would be required to make an arbitrage profit if Merry is authorized to work with CAD 1 million for the same purpose. Also determine the profit that would be made in CAD.

Note: Ignore the decimal points in the amounts. (MTP OCT19)

Solution :

Given,

Currency	Spot	Forward
DEM/CAD	0.775	0.780

$$\textbf{Forward} = \frac{\text{Spot (S0)} \times (1 + \text{Domestic (Dr)})}{(1 + \text{Foreign (Fr)})}$$

$F = 0.775 \times \frac{1+(9\%/4)}{1+(7\%/4)}$ = 0.775 ×1.0225/1.0175
= 0.779

Hence, 3 Month theoretical forward price based on Interest rate parity (IRP), DEM/CAD is 0.779.
Current quote of forward is 0. 780.
Theoretical price is not equal to current quote.

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Hence IRP does not hold true in the above quote.
Following steps needs to be undertaken to calculate profit if any, can be made:

Step 1	**Enter into 3 Month forward to Sell 1,312,904DEM @ 0.780**
Step 2	Borrow CAD 1 Million @ 9% spot of 0.775 per DEM
Step 3	Convert CAD into DEM at spot = 1,000,000/0.775 =DEM 1,290,323
Step 4	Invest 1,290,323 DEM @7% for 3 Months
Step 5	Have DEM together with interest = 1,290,323 + 1,290,323 × 7% ×3/12 =1,290,323+ 22,581 = 1,312,904
Step 6	Sell DEM and convert into CAD as per 3 M forward @ 0.780 = 1,312,904 × 0.780 = CAD 10,24,065
Step 7	Repay CAD loan with Interest = 1,000,000 + 1,000,000 × 9% × 3/12 = 1,000,000 +22,500= CAD 1,022,500
Step 8	Profit = CAD 1,024,065 – 1,022,500 = **CAD 1,565**

So, Merry will make risk less profit of **CAD 1,565** by entering into above transactions.

27. Illustration

Given the following information:
Exchange rate – Canadian dollar 0.665 per DM (spot)
Canadian dollar 0.670 per DM (3 months)
Interest rates – DM 7% p.a.
Canadian Dollar – 9% p.a.
What operations would be carried out to take the possible arbitrage gains? (Practice Manual)

Solution :

Given,

Currency	Spot	Forward
DEM/CAD	0.665	0.670

$$\textbf{Forward} = \frac{\text{Spot (S0)} \times (1 + \text{Domestic (Dr)})}{(1 + \text{Foreign (Fr)})}$$

$F = 0.665 \times \frac{1+(9\%/4)}{1+(7\%/4)}$ = 0.665 ×1.0225/1.0175
= 0.668 CAD per DEM

Hence, 3 Month theoretical forward price based on Interest rate parity (IRP), DEM/CAD is 0.668.
Current quote of forward is 0.670.Theoretical price is not equal to current quote.
Hence IRP does not hold true in the above quote.
Since the current forward quote is costlier than theoretical forward, we will sell actual forward and make arbitrage gain.

Step 1	**Enter into 3 Month forward to Sell DEM @ 0.670**
Step 2	Borrow CAD 1 Million @ 9% spot of 0.665 per DEM

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Step 3	Convert CAD into DEM at spot = 1,000,000/0.665 =DEM 1,503,759.40
Step 4	Invest 1,503,759.40DEM @7% for 3 Months
Step 5	Have DEM together with interest = 1,503,759.40+ 1,503,759.40 × 7% ×3/12 =1,503,759.40+ 26,315.79 = 1,530,075.19
Step 6	Sell DEM and convert into CAD as per 3 M forward @ 0.670 = 1,530,075.19 × 0.670 = CAD 10,25,150.38
Step 7	Repay CAD loan with Interest = 1,000,000 + 1,000,000 × 9% × 3/12 = 1,000,000 +22,500= CAD 1,022,500
Step 8	Profit = CAD 1,025,150.38 – 1,022,500 = **CAD 2,650.38**

So, we can make risk less profit of **CAD 2,650.38** by entering into above transactions.

28. Illustration

On April 3, 2016, a Bank quotes the following:

Spot Rate (US $ 1)	₹ 66.2525	₹ 67.5945
2 months ₹ swap points	70	90
3 months ₹ swap points	160	186

In a spot transaction, delivery is made after two days. Assume spot date as April 5, 2016.
Assume 1 swap point = 0.0001, You are required to:

(i) ascertain swap points for 2 months and 15 days. (For June 20, 2016),
(ii) determine foreign exchange rate for June 20, 2016, and
(iii) compute the annual rate of premium/discount of US$ on INR, on an average rate. (ICAI SM)

Solution :

Swap Points	**Bid**	**Ask**
2 Months	70	90
3 Months	160	186
2.5 Months	=(160 + 70)/2	=(186 +90)/2
2.5 M Swap Points	=115	=138

Forward Rate	**Bid**	**Ask**
Spot	66.2525	67.5945
Add :Swap Points	115	138
Forward Rate	=66.2640	=67.6083

	Bid	Ask
Spot	66.2525	67.5945
2.5 M Forward	66.2640	67.6083
Premia	115	138

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Average Rate	(66.2525 + 66.2640)/2 = 66.2583	(67.5945 + 67.6083)/2 = 67.6014
Implied Premia % (Annualized)	$= \frac{0.0115 \times 12}{66.2583 \times 2.5} \times 100$ = 0.0833%	$= \frac{0.0138 \times 12}{67.6014 \times 2.5} \times 100$ = 0.09799%

29. Illustration

The risk-free rate of interest rate in USA is 8% p.a. and in UK is 5% p.a. The spot exchange rate between US $ and UK £ is 1$ = £ 0.75.

Assuming that interest is compounded on daily basis then at which forward rate of 2 year there will be no opportunity for arbitrage.

Further, show how an investor could make risk-less profit, if two years forward price is 1 $ = 0.85 £. Given $e^{-0.06}$ = 0.9413 & $e^{-0.16}$ = 0.852, $e^{0.16}$ = 1.1735, $e^{-0.1}$ = 0.9051 (RTP MAY 12)

Solution :

We know that $F = S \times e^{rt}$
USD/GBP =0.75,
2 Year forward rate : $F = S \times e^{dt} / e^{ft}$

$F = 0.75 \times e^{5\% \times 2} / e^{8\% \times 2}$

$= 0.75 \times e^{5\% \times 2} \times e^{-8\% \times 2} = 0.75 \times e^{2(5\%-8\%)} = 0.75 \times e^{-0.06}$
= 0.75 × 0.9413 = 0.7060
F = 0.7060 GBP per USD

Now, Forward rate USD/GBP =0.850 and theoretical rate USD/GBP = 0.706
Since there is difference as per actual and theoretical forward, we will sell actual forward of 0.850 GBP per USD.

Step 1	Enter into 2 Month forward to Sell GBP @ 0.85
Step 2	Borrow GBP 1000 @ 2% spot of 0.75 per GBP
Step 3	Convert GBP into USD at spot = 1,000/0.75 =USD 1,333.33
Step 4	Invest 1,333.33 USD @8% for 2 Months
Step 5	Have USD together with interest $= 1,333.33 \times e^{2 \times .08}$ =USD 1564.67
Step 6	Sell USD and convert into GBP as per 2 M forward @ 0.85 = 1564.67 × 0.85 = GBP 1330
Step 7	Repay GBP loan with Interest $= 1,000 \times e^{1/-0.1}$ = 1,000 / 0.9051 = GBP 1104.85
Step 8	Profit = GBP 1330 – 1104.85 = **GBP 225.15**

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An investor can make riskless profit of **GBP 225.15** for an investment of 1000 GBP over two years using given exchange rates and interest rates.

> In study Material they have invested Present value of Theoretical forward i.e., PV of 0.706 for 2 years,
> Which comes out to 0.639 GBP. Even in that case profit will be proportionate of above working.
> i.e., Profit = 225.15 × 0.639/1000 = **0.1439 GBP**

In the question, it is not mentioned how much GBP you should borrow, in such scenario you can take any number and solve for the above steps.

30. Illustration

An Indian company obtains the following quotes

(Rs./$) Spot : 35.90/36.10

3 - Months forward rate: 36.00/36.25

6 - Months forward rate: 36.10/36.40

The company needs $ funds for six months. Determine whether the company should borrow in $ or Rs. Interest rates are :

3 - Month's interest rate : Rs. : 12%, $: 6%

6 - Month's interest rate : Rs. : 11.50%, $: 5.5%

Also determine what should be the rate of interest after 3-months to make the company indifferent between 3-months borrowing and 6-months borrowing in the case of:

(i) Rupee borrowing

(ii) Dollar borrowing

Note: For the purpose of calculation, you can take the units of dollar and rupee as 100 each. (MTP MAY 20 OLD)

Solution :

i) Borrowing in USD

Amount Borrowed	**100**
Interest @ 5.5% for 6 Months	2.75
USD to be repaid	102.75
Equivalent INR to be repaid (As per Banker Bids to Buy Base Currency)	=102.75 × 36.40 = INR 3740.1

Assuming the company enters into a forward contract on Day 0.

INR borrowing

Amount Borrowed equivalent of USD 100	**100 × 36.10 = 3610**
Add :Interest @ 11.5% for 6 Months	207.58
INR to be repaid	3817.58

Since, USD borrowing is cheaper as only INR 3740 has to be paid against INR 3817.58, the Indian company should borrow in USD.

ii) INR Borrowing :

Let borrowing rate for months 4-6 be x %

Then, 1 +(12% ×3/12) × 1 +(x% ×3/12) = 1 +(11.5% ×3/12)

= 1.03 × 1 +(x% ×3/12) = 1.0575

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1 +(x% ×3/12)= 1.0267
x% = 0.0267 × 4
x% = 10.68%

10.68 % is the rate at which 3M INR borrowing for months 4-6- and 3-Months INR borrowings for months 1-3 @12 % is same as 11.5% P.a for 6 Months.
USD Borrowing : Let borrowing rate for months 4-6 be x %
Then, (1 +6% ×3/12) × (1 +x% ×3/12) = (1 +5.5% ×3/12)
= 1.015 × (1 +x% ×3/12) = 1.0275
1 +(x% ×3/12)= 1.0123
x% = 0.0123 × 4
x% = 4.93%

Hence, 4.93 % is the rate at which 3M USD borrowing for months 4-6- and 3-Months USD borrowings for months 1-3 @6 % is same as 5.5% P.a for 6 Months.

31. Illustration

True Blue Cosmetics Ltd. is an old-line producer of cosmetics products made up of herbals. Their products are popular in India and all over the world but are more popular in Europe.
The company invoice in Indian Rupee when it exports to guard itself against the fluctuation in exchange rate. As the company is enjoying monopoly position, the buyer normally never objected to such invoices. However, recently, an order has been received from a whole-saler of France for FFR 80,00,000. The other conditions of the order are as follows:

(a) The delivery shall be made within 3 months.
(b) The invoice should be FFR.

Since company is not interested in losing this contract only because of practice of invoicing in Indian Rupee. The Export Manger Mr. E approached the banker of Company seeking their guidance and further course of action.

The banker provided following information to Mr. E.

(a) Spot rate 1 FFR = ₹ 6.60
(b) Forward rate (90 days) of 1 FFR = ₹ 6.50
(c) Interest rate in India is 9% and in France is 12%.

Mr. E entered in forward contract with banker for 90 days to sell FFR at above mentioned rate.
When the matter come for consideration before Mr. A, Accounts Manager of company, he approaches you. You as a Forex consultant is required to comment on:

(i) Whether there is an arbitrage opportunity exists or not.
(ii) Whether the action taken by Mr. E is correct and if bank agrees for negotiation of rate, then at what forward rate company should sell FFR to bank. (RTP MAY 12)

Solution :

i) FFR INR Spot = 6.6 and 90 days forward = 6.5

Interest rates – India = 9% and France =12%

Based on Interest rate parity, theoretical forward should be :

$$\textbf{Forward} = \frac{\text{Spot (S0)} \times (1 + \text{Domestic (Dr)})}{(1 + \text{Foreign (Fr)})}$$

F= $6.6 \times \frac{\frac{1.09}{4}}{1.12/4}$; F= 6.6 × 1.0225/1.03

F = INR 6.55 per FFR. Since theoretical and actual forward rates are different, arbitrage opportunity exists.

ii) If Mr. E enters into a transaction forward rate of INR 6.5 per FFR, they would be losing out :

= 8,000,000 × 0.05(6.55-6.50) = INR 4,00,000

Instead, Mr. E should negotiate a rate of INR 6.55 per FFR for 8 million FFR delivery after 90 days.

32. Illustration

AMK Ltd. an Indian based company has subsidiaries in U.S. and U.K.

Forecasts of surplus funds for the next 30 days from two subsidiaries are as below:

U.S. $12.5 million

U.K. £ 6 million

Following exchange rate information is obtained:

	$/₹	£/₹
Spot	0.0215	0.0149
30 days forward	0.0217	0.0150

Annual borrowing/deposit rates (Simple) are available.

₹6.4%/6.2%

$1.6%/1.5%

£ 3.9%/3.7%

The Indian operation is forecasting a cash deficit of ₹500 million. It is assumed that interest rates are based on a year of 360 days.

(i) Calculate the cash balance at the end of 30 days period in ₹ for each company under each of the following scenarios ignoring transaction costs and taxes:
   (a) Each company invests/finances its own cash balances/deficits in local currency independently.
   (b) Cash balances are pooled immediately in India and the net balances are invested/borrowed for the 30 days period.

(ii) Which method do you think is preferable from the parent company's point of view? (PM)

Solution :

i)

a) Each company invests in local currency independently

b)

Company	Amount in Mn Borrowing(-) and Surplus(+)	Interest	Closing Value (Amount in Mn + Interest)	INR Rate	Amount in INR
India	-INR 500	6.4%	500 + 2.66 = 502.66	1	-502.66
US	USD 12.5	1.5%	12.5 + 0.015625 = 12.515625	0.0217	=12.515625/0.0217 = 576.76

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UK	GBP 6	3.7%	6 + 0.0185 = 6.0185	0.0150	=6.0185/0.0150 =401.23

Total Surplus in equivalent INR after 30 days = **INR 475.33**

c) Pooling of Money

Day 0

Amount in Million	**Exchange Rate**	**INR equivalent**
INR -500	1	-500
USD 12.5	0.0215	=12.5/0.0215 = 581.40
GBP 6	0.0149	=6/0.0149 = 402.68

Surplus at Day 0 in INR equivalent = INR 484.08. Now this money is deposited in India for 30 days @ 6.2%.
Closing principal + interest = 484.08 + 484.08 × 6.2% × 1/12 = **INR 486.58**

ii) Pooling of surplus is better from parent point of view as closing value of surplus is higher @ INR 486.58 Million than INR 475.33 million.

33. Illustration

KGF Bank's Sydney branch has surplus funds of USD $ 7,00,000 for a period of 2 months. Cost of funds to the bank is 6% p.a. They propose to invest these funds in Sydney, New York or Tokyo and obtain the best yield, without any exchange risk to the bank. The Following rates of interest are available at the three centres for investment of domestic funds there for a period of 2 Months.

Sydney 7.5% p.a.
New York 8% p.a.
Tokyo 4% p.a.
The market rates in Australia for US Dollars and Yen are as under:
Sydney on New York:
Spot 0.7100/0.7300
1 Months 10/20
2 Months 25/30
Sydney on Tokyo:
Spot 79.0900/79.2000
1 Months 40/30
2 Months 55/50
At which centre, will the investment be made & what will be the net gain to the bank on the invested funds? (May 19 O)

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Solution :

Investment in USD

Surplus	**USD 700,000**
Cost for 2 Months @6%	= 700,000 × 6% × 2/12 = USD 7000
Investment @8% for 2 Months	Interest = 700,000 × 8% × 2/12 = USD 9,333.33
Gain	= USD 9333.33 – USD 7000 = **USD 2,333.33**

Investment in AUD

Surplus	**USD 700,000**
Exchange Rate Applicable (As per Banker Bids to Buy Base Currency)	AUD USD 0.73
Equivalent AUD	= 700,000/0.73 =AUD 958,904.11
Cost for 2 Months @6%	= 700,000 × 6% × 2/12 = USD 7000
Investment AUD @7.5% for 2 Months	Interest = 958,904.11 × 7.5% × 2/12 = AUD 11,986.30
Total Value of Investment	= AUD 958,904.11 + 11,986.30 = AUD 970,890.41
Exchange Rate applicable	AUD USD 0.7125 (0.7100+0.0025)
Value of Investment in USD	= 970,890.41 × 0.7125 = USD 691,759.42
Loss	= USD 707000 – USD 691,759.42 = **USD 15,240.58**

Investment in JPY

Surplus	**USD 700,000**
Exchange Rate Applicable (As per Banker Bids to Buy Base Currency)	AUD USD = 0.73 AUD JPY = 79.09
Equivalent JPY	= 700,000/0.73 × 79.09 = JPY 75,839,726.06
Cost for 2 Months @6%	= 700,000 × 6% × 2/12 = USD 7000
Investment JPY @4% for 2 Months	Interest = 75,839,726.06 × 4% × 2/12 = JPY 505,598.17
Total Value of Investment	= JPY 75,839,726.06 + 505,598.17 = JPY 76,345,324.23
Exchange Rate applicable	AUD YEN 79.195 (79.2000 - 0.0050) AUD USD 0.7125 (0.7100 + 0.0025)
Value of Investment in USD	= 75,839,726.06 /79.195 × 0.7125 = USD 686,862.09
Loss	= USD 707000 – USD 686,862.09 = **USD 20,137.91**

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Hence, KGF bank should invest the money in New York so that they make gain instead of loss in case of JPY and AUD.

34. Illustration

Suppose you are a treasurer of XYZ plc in the UK. XYZ have two overseas subsidiaries, one based in Amsterdam and one in Switzerland. The Dutch subsidiary has surplus Euros in the amount of 725,000 which it does not need for the next three months but which will be needed at the end of that period (91 days). The Swiss subsidiary has a surplus of Swiss Francs in the amount of 998,077 that, again, it will need on day 91. The XYZ plc in UK has a net balance of £75,000 that is not needed for the foreseeable future.

Given the rates below, what is the advantage of swapping Euros and Swiss Francs into Sterling?

Spot Rate (€)	£0.6858- 0.6869
91-day Pts	0.0037 0.0040
Spot Rate (£)	CHF 2.3295- 2.3326
91-day Pts	0.0242 0.0228

Interest rates for the Deposits

Amount of Currency	**91-day Interest Rate % pa**		
	£	€	CHF
0 – 100,000	1	$\frac{1}{4}$	0
100,001 – 500,000	2	$1\frac{1}{2}$	$\frac{1}{4}$
500,001 – 1,000,000	4	2	$\frac{1}{2}$
Over 1,000,000	5.375	3	1

Assume 360 days in a year (PM)

Solution :

Each company independently invest

Currency	**Amount of Borrowing(-) and Surplus(+)**	**Interest Rate P.a**	**Closing Value (Amount in + Interest)**	**GBP Rate**	**Amount in GBP**
GBP	75,000	1%	75000 + 189.583 = 75,189.583	1	75,189.583
EURO	725,000	2%	725,000 +3665.28 = 728,665.28	0.6895 (0.6858+0.0037)	=728,665.28 × 0.6895 = 502,414.71
CHF	998,077	0.5%	998,077 + 1261.46 = 999,338.46	2.3098 (2.3326 -0.228)	=999,338.46/2.3098 = 432,651.49

Total equivalent value of surplus in GBP after 91 days = GBP 1,010,255.78

Now, computing all surplus into GBP and investing in GBP at spot

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Amount in	Exchange Rate	GBP equivalent
GBP 75,000	1	75,000
EURO 725,000	0.6858	=725,000 × 0.6858 = 497,205
CHF 998,077	2.3326	=998,077/2.3326 = 427,881.76

Surplus at Day 0 in GBP equivalent =GBP 1,000,086.76. Now this money is deposited in GBP for 91 days @ 5.375% P.a.
Closing principal + interest = 1,000,086.76+ 1,000,086.76 × 5.375% ×91/360 = GBP 1,000,086.76 + GBP 13,587.98
=**GBP 1,013,674.74**

If CHF and EURO are swapped at day 0 and resulting amount is deposited in GBP, the end investment value including interest is higher by **GBP 3418.96** (1,013,674.74 – 1,010,255.78)

35. Illustration

The Treasury desk of a global bank incorporated in UK wants to invest GBP 200 million on 1st January, 2019 for a period of 6 months and has the following options:

(1) The Equity Trading desk in Japan wants to invest the entire GBP 200 million in high dividend yielding Japanese securities that would earn a dividend income of JPY 1,182 million. The dividends are declared and paid on 29th June. Post dividend, the securities are expected to quote at a 2% discount. The desk also plans to earn JPY 10 million on a stock borrow lending activity because of this investment. The securities are to be sold on June 29 with a T+1 settlement and the amount remitted back to the Treasury in London.
(2) The Fixed Income desk of US proposed to invest the amount in 6-month G-Secs that provides a return of 5% p.a.

The exchange rates are as follows:

Currency Pair	1 Jan 2019 (Spot)	30 Jun 2019 (Forward)
GBP - JPY	148.0002	150.0000
GBP- USD	1.28000	1.30331

As a treasurer, advise the bank on the best investment option. What would be your decision from a risk perspective? You may ignore taxation. (MTP May20)
Solution :

1)

Surplus Money in GBP	200 Million
Exchange rate applicable	GBP JPY 148.0002
Equivalent JPY (A)	=200 Mn × 148.0002 = JPY 29,600.04 Million
Add :Dividend (B)	JPY 1182 Million
Less: Reduction in price @ 2% on JPY 29,600 Million (C)	JPY (592.0008) Million

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Add: Gain from stock lending (D)	JPY 10 Million
Net Investment at the end of 6 months (A+B-C+D)	**JPY 30,200.0392 Million**
Exchange rate applicable on conversion	GBP JPY 150
6 Months investment value in GBP	**GBP 201.33359 Mn**

2) Investment in US G Secs

Surplus amount in GBP	**200 million**
Exchange rate applicable	GBP USD 1.28
Equivalent USD	=200 Mn × 1.28 = USD 256 Mn
Investment in G Sec for 6 Months @ 5%	Interest = 256 Mn × 5% × 6/12 = 6.4 Mn
Investment value in USD	= 256 + 6.4 = USD 262.4 Mn
Exchange rate on conversion	GBP USD 1.30331
Equivalent GBP	= 262.4/1.30331 = **GBP 201.33353 Mn**

Gain from JPY Equities = 201.33359 – 210.33353 = **GBP 0.00006 Mn ~ GBP 60**

By investing in JPY Equities one can make 60 GBP over 6 Months. However, given the fact that 60 GBP is **very small** after investing in JPY equities as compared to US G secs, **one should invest in US G secs** considering investment in G Secs to **be less risky** as compared to JPY Equities.

36. Illustration

India Imports Co. purchased USD 100,000 worth of machines from a firm in New York, USA. The value of the rupee in terms of the Dollar has been decreasing. The firm in New York offers 2/10, net 90 terms. The spot rate for the USD is ₹ 55; the 90 days forward rate is ₹ 56.

i. Compute the Rupee cost of paying the account within the 10 days.
ii. Compute the Rupee cost of buying a forward contract to liquidate the account in 90 days.
iii. The difference between part a and part b is the result of the time value of money (the discount for prepayment) and protection from currency value fluctuation. Determine the magnitude of each of these components. (RTP NOV 17)

Solution:

i) INR cost for payment in 10 days. USD amount to be paid = 100,000

Discount if paid within 10 days = 2%
Assuming USD INR will be at INR 55 for this 10-day period, then USD cost will be
= USD 100,000 – 2% = USD 98,000
Equivalent INR = 98,000 × 55 = **INR 53,90,000**

ii) Forward rate = INR 56 per USD

Amount payable = USD 100,000
INR Equivalent to be paid = 56 × 100,000 = **INR 56,00,000**

iii) Difference between i) and ii) = 56,00,000 – 53,90,000 = INR 2,10,000

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Out of these 2,10,000 :

Time value of money impact = USD 2,000 × INR 55 = INR 1,10,000

Protection against fluctuation of Exchange rate = INR 56 – INR 55) × 100,000 = INR 100,000

37. Illustration

H Ltd. is an Indian firm exporting handicrafts to North America. All the exports are invoiced in US$. The firm is considering the use of money market or forward market to cover the receivable of $50,000 expected to be realized in 3 months time and has the following information from its banker:

	Exchange Rates
Spot	₹ /$ 72.65/73
3-m forward	₹ /$ 72.95/73.40

The borrowing rates in US and India are 6 % and 12% p.a. and the deposit rates are 4% and 9% p.a. respectively.

(i) Which option is better for H Ltd.?

(ii) Assume that H Ltd. anticipates the spot exchange rate in 3-months time to be equal to the current 3-months forward rate. After 3-months the spot exchange rate turned out to be ₹/$: 73/73.42. What is the foreign exchange exposure and risk of H Ltd.? (Nov 19 O)

Solution :

i)Forward Cover cost

Given, USD INR 72.95/73.40

Total amount required after 3 months = USD 50,000 × 72.95 = **INR 36,47,500**

Money Market Transaction

Borrow in USD such that loan + Interest = USD 50,000	**Let loan taken be x and interest rate applicable is 6%**
Loan to be borrowed	X + x × 6% × 3/12 = 50,000 1.015 x = 50,000 X = 49,261.08
Convert USD to INR : **Exchange rate applicable USD INR 72.65**	INR equivalent = 49,261.08 × 72.65 = INR 35,78,817.73
Invest INR in INR deposits @ 9% for 3 months	Interest = 35,78,817.73 × 9% × 3/12 = 80,523.40
Total value of Investment after 3 months	= INR 35,78,817.73 + 80,523.40 = **INR 36,59,341.13**

Money market hedge is better for the exported by **INR 11,841.13** (INR 36,59,341.13 – 36,47,400).

ii) If H Ltd does not hedge believing that future spot will be equal to forward, then their exposure will be USD 50,000.

The risk will be difference of expected spot and actual spot.

=USD 50,000 × 0.05 (73 – 72.95)

= INR 2,500

INR 2,500 is the gain by taking risk and keeping USD 50,000 exposure open

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38. Illustration

ABC Ltd. of UK has exported goods worth Can $ 5,00,000 receivable in 6 months. The exporter wants to hedge the receipt in the forward market. The following information is available:

Spot Exchange Rate	Can $ 2.5/£
Interest Rate in UK	12%
Interest Rate In Canada	15%

The forward rates truly reflect the interest rates differential. Find out the gain/loss to UK exporter if Can $ spot rates (i) declines 2%, (ii) gains 4% or (iii) remains unchanged over next 6 months. (ICAI SM)

Solution :

Given, Current Spot GBP CAD = 2.5, Interest rate UK 12% and CAD =15%

$$\textbf{Forward for Indirect quote} = \frac{\text{Spot (S0)} \times (1 + \text{Foreign (Fr)})}{(1 + \text{Domestic (Dr)})}$$

$F = 2.5 \times \frac{1+15\%/2}{1+12\%/2} = 2.5 \times \frac{1.075}{1.06}$

F= 2.5354 CAD per GBP

Exchange Rate	Forward Rate	2% Decrease from 2.5	4% Increase from 2.5	Unchanged
GBP CAD	2.5354	2.55 (2 × 1.02)	2.4 (2.5 ×0.96)	2.5
Spot	2.5	2.5	2.5	2.5
Gain/(loss) if forward contract is entered	-	2.5354	2.5354	2.5354
Gain/(loss)		Gain =GBP 197207.54 - GBP 196078.43 (500000/2.5354 - 500000/2.55) = **GBP 1129.11**	Loss = GBP 208,333.33 – GBP 197,207.54 = **GBP 11,025.79**	Loss =GBP 200,000 - GBP 197,207.54 =**GBP 2792.46**

39. Illustration

JKL Ltd., an Indian company has an export exposure of JPY 10,000,000 receivable August 31, 2014. Japanese Yen (JPY) is not directly quoted against Indian Rupee.

The current spot rates are:

INR/US $	=	₹62.22
JPY/US$	=	JPY 102.34

It is estimated that Japanese Yen will depreciate to 124 level and Indian Rupee to depreciate against US $ to ₹65.

Forward rates for August 2014 are

INR/US $	=	₹ 66.50
JPY/US$	=	JPY 110.35

(i) Calculate the expected loss if the hedging is not done. How will the position change if the firm takes forward cover?

(ii) If the spot rates on August 31, 2014, are:

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INR/US $ = ₹ 66.25
JPY/US$ = JPY 110.85
Is the decision to take forward cover justified? (SM)

Solution :

Given spot rates : INR/US $=₹62.22
JPY/US$=JPY 102.34
INR 62.22 = JPY 102.34
INR 1 = 102.34/62.22 = 1.6448 JPY
Thus INR JPY = 1.6448 and similarly JPY INR = 1/1.6448 = 0.6080

Exchange Rate	Spot	Estimate 31/08	Forward 31/08	Actual 31/08
USD INR	62.22	65	66.50	66.25
USD JPY	102.34	124	110.35	110.85
JPY INR	0.6080	0.5242	0.6026	0.5977

i) If hedging not done, 10 Million JPY will get 0.5242 INR per JPY against spot of 0.6080.

So, the loss will be 10 Mn × (0.6080 – 0.5242)
= **INR 8,38,000**

ii) Forward cover

Loss = 10 Mn × (0.6026 – 0.6080)INR per JPY = **INR 54,000**
Because of hedging, loss will come down from INR 8,38,000 to INR 54,000, i.e., reduction of INR 7,84,000.

iii) If actual spot is USD INR 66.25 and USD JPY 110.85

Then gain/loss = 10 Mn × (0.5977 -0.6080) INR per JPY
Loss = INR 103,000
In case forward cover is taken, the loss is 54,000 as against loss of INR 103,000 in no forward cover.
Hence the decision to take forward cover is **justified**.

40. Illustration

The following 2-way quotes appear in the foreign exchange market:

	Spot	2-months forward
RS/US $	₹46.00/₹46.25	₹47.00/₹47.50

Required:

(i) How many US dollars should a firm sell to get ₹ 25 lakhs after 2 months?
(ii) How many Rupees is the firm required to pay to obtain US $ 2,00,000 in the spot market?
(iii) Assume the firm has US $ 69,000 in current account earning no interest. ROI on Rupee investment is 10% p.a. Should the firm encash the US $ now or 2 months later? (SM)

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Solution :

i) No of USD to sell to get INR 25,00,000 = 25,00,000/ 47 = USD 53,191.49

ii) INR required to buy USD 2,00,00 = INR 92,50,000

Convert USD to INR at spot	= **USD 69000 × 46** = **INR 31,74,000**
Deposit INR @ 10% for 2 months	Interest = 31,74,000 × 10% ×2/12 = 52,900
Total value of investment after 2 months	= 31,74,000 + 52,900 = INR 32,26,900
Convert back to USD at 2 Month forward	= 32,26,900/47.50 = **USD 67,934.74**

Since the final amount is lower than initial deposit by USD **1065.26** (69000 – 67934.74), it is not worth pursuing this strategy of using idle USD funds for INR deposit.

41. Illustration

Z Ltd. importing goods worth USD 2 million, requires 90 days to make the payment. The overseas supplier has offered a 60 days interest free credit period and for additional credit for 30 days an interest of 8% per annum.

The bankers of Z Ltd offer a 30 days loan at 10% per annum and their quote for foreign exchange is as follows:

	₹
Spot 1 USD	56.50
60 days forward for 1 USD	57.10
90 days forward for 1 USD	57.50

You are required to evaluate the following options:

(i) Pay the supplier in 60 days, or

(ii) Avail the supplier's offer of 90 days credit. (SM)

Solution:

i) Pay supplier in 60 days and avail bank loan @10% P.a for 30 days and payments are made at forward rates.

USD 2 Million 60 days forward @57.10 = INR 11.42 Crores paid on 60th day.
Interest on 11.42 crores for 30 days @ 10% = 11.42 cr × 10% × 30/365 = INR 9,38,630.
Total amount = 11,42,00,000 + 9,38,630 = **INR 11,51,38,630**.

ii) 90-day credit from supplier

Base payable = USD 2 Mn and 30-day supplier interest @8%
Interest = 2Mn × 8% × 30/365 = USD 13,150.68
Total USD outflow= 2,013,150.68
INR equivalent @57.5 = **INR 11,57,56,164**

It is **better to pay the supplier in 60 days** and take bank loan for 30 days as the outflow in that case is less than 90 days supplier credit.

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42. Illustration

DEF Ltd. has imported goods to the extent of US$ 1 crore. The payment terms are 60 days interest-free credit. For additional credit of 30 days, interest at the rate of 7.75% p.a. will be charged.
The banker of DEF Ltd. has offered a 30 days loan at the rate of 9.5% p.a. Their quote for the foreign exchange is as follows:

Spot rate INR/US$	62.50
60 days forward rate INR/US$	63.15
90 days forward rate INR/US$	63.45

Which one of the following options would be better?

(i) Pay the supplier on 60th day and avail bank loan for 30 days.
(ii) Avail the supplier's offer of 90 days credit. (SM)

Solution :

i) Pay supplier in 60 days and avail bank loan @9.5% P.a for 30 days and payments are made at forward rates.

USD 1 Crore 60 days forward @63.15 = INR 63.15 Crores paid on 60th day.
Interest on 63.15 crores for 30 days @ 9.5% = 63.15 cr × 9.5% × 30/360 = INR 49,99,375.
Total amount = 63,15,00,000 + 49,99,375 = **INR 63,64,99,375**.

ii) 90-day credit from supplier

Base payable = USD 1 Cr and 30-day supplier interest @7.75%
Interest =1 Cr × 7.75% × 30/360 = USD 64,583.33
Total USD outflow= 10,064,583.33
INR equivalent @63.45 = **INR 63,85,97,812.5**

It is **better to pay the supplier in 60 days** and take bank loan for 30 days as the outflow in that case is less than 90 days supplier credit.

43. Illustration

Following information relates to AKC Ltd. which manufactures some parts of an electronics device which are exported to USA, Japan & Europe on 90 days credit terms.
Cost and Sales information

	Japan	USA	Europe
Variable cost per unit	₹225	₹395	₹510
Export sale price per unit	Yen 650	US$10.23	Euro 11.99
Receipts from sale due in 90 days	Yen 78,00,000	US$1,02,300	Euro 95,920

Foreign exchange rate information:

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	Yen/₹	US$/₹	Euro/₹
Spot market	2.417-2.437	0.0214-0.0217	0.0177-0.0180
3 months forward	2.397-2.427	0.0213-0.0216	0.0176-0.0178
3 months spot	2.423-2.459	0.02144-0.02156	0.0177-0.0179

Advise AKC Ltd. by calculating average contribution to sales ratio whether it should hedge its foreign currency risk or not. (SM)

Solution :

Particulars	**Yen**	**USD**	**EURO**
Receipt due for Sale	7.8 Million	102,300	95,920
Price/unit	JPY 650	USD 10.23	EURO 11.99
No of units sold = Receipt/ Price per unit	12,000	10,000	8,000
Cost/unit in INR	225	395	510
Total Cost in INR	27,00,000	39,50,000	40,80,000

Revenue in INR by hedging

Revenue in Foreign Currency	**7.8 Million**	**102,300**	**95,920**
Exchange rate applicable	2.427 JPY per INR	0.0216 USD per INR	0.0178 EURO per INR
Total Revenue in INR	32,13,844.25	47,36,111	53,88,764
Total cost in INR	27,00,000	39,50,000	40,80,000
Contribution = Revenue – variable cost	5,13,844.25	786,111	13,08,764

Total Contribution = 26,08,719 and total sales = 1,33,38,719| **Contribution % = 19.55%**

Without Hedging,

Revenue in Foreign Currency	**7.8 Million**	**102,300**	**95,920**
Exchange rate applicable	2.459 JPY per INR	0.02156 USD per INR	0.0179 EURO per INR
Total Revenue in INR	31,72,021	47,44,898	53,58,659
Total cost in INR	27,00,000	39,50,000	40,80,000
Contribution = Revenue – variable cost	4,72,021	794,898	12,78,659

Total Revenue = 1,32,75,578 and total contribution = 25,45,578 | **Contribution % = 19.17%**
Since contribution % is better on hedging, the Co AKC Ltd is advised to hedge.

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44. Illustration

An exporter is a UK based company. Invoice amount is $3,50,000. Credit period is three months. Exchange rates in London are:

Spot Rate ($/£) 1.5865 – 1.5905
3-month Forward Rate ($/£) 1.6100 – 1.6140

Rates of interest in Money Market:

	Deposit	Loan
$	7%	9%
£	5%	8%

Compute and show how a money market hedge can be put in place. Compare and contrast the outcome with a forward contract. (SM)

Solution :

Money market hedge :

Borrow in USD such that loan + Interest = USD 3,50,000	**Let loan taken be x and interest rate applicable is 9%**
Loan to be borrowed	X + x × 9% × 3/12 = 3,50,000 1.0225 x =3, 50,000 X = 3,42,298.29
Convert USD to GBP : **Exchange rate applicable USD INR 1.5905**	GBP equivalent = 3,42,298.29/1.5905 = GBP 215,214.27
Invest GBP in deposits @ 5% for 90 days	Interest = 215,214.27 × 5% × 90/360 = GBP 2,690.18
Total value of Investment after 3 months	= GBP 215,214.27+ 2,690 = **GBP 217,904.45**

In case forward contract is entered into :
Exchange rate applicable : GBP USD = 1.6140
GBP realized = 3,50,000/1.6140 = 2,16,852.54

The money market results in GBP realization of 217,904.45 Vs 2,16,852.54 from a forward contract . **Hence the money market hedge is better by GBP 1051.9**

45. Illustration

Gibraltar Limited has imported 5000 bottles of shampoo at landed cost in Mumbai, of US $ 20 each. The company has the choice for paying for the goods immediately or in 3 months₹ time. It has a clean overdraft limited where 14% p.a. rate of interest is charged.

Calculate which of the following method would be cheaper to Gibraltar Limited.

(i) Pay in 3 months' time with interest @ 10% p.a. and cover risk forward for 3 months.

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(ii) Settle now at a current spot rate and pay interest of the overdraft for 3 months. The rates are as follows:

Mumbai ₹ /$ spot	:	60.25-60.55
3 months swap points	:	35/25 (SM)

Solution :

i) Pay after 3 months
Total amount = 5000 × USD 20 = USD 100,000
Interest @10% P.a. for 3 Months = USD 2500
Total payable = USD 102,500
Forward rate applicable: 60.55- 0.25= 60.30
Total INR Payable = 102,500 × 60.30= INR 61,80,750

ii) Pay on spot and avail Overdraft @14% for 3 Months
Amount payable in USD = 100,000
Spot Rate = 60.55
Amount in INR = 100,000 × 60.55 = 60,55,000
O/D interest @14% for 3 Months on 60.55 Lakhs = 60,55,000 × 14% × 3/12= 2,11,925
Total outflow = INR 62,66,925

Since Option 1 is cheaper by INR 86,175, Gibraltar Ltd should go for it.

46. Illustration

Sun Ltd. is planning to import equipment from Japan at a cost of 3,400 lakh yen. The company may avail loans at 18 percent per annum with quarterly rests with which it can import the equipment. The company has also an offer from Osaka branch of an India based bank extending credit of 180 days at 2 percent per annum against opening of an irrevocable letter of credit.

Additional information:
Present exchange rate ₹ 100 = 340 yen
180 day's forward rate ₹ 100 = 345 yen
Commission charges for letter of credit at 2 per cent per 12 months.

Advice the company whether the offer from the foreign branch should be accepted. (SM)

Solution :

Option 1 : Borrow in INR and Buy
Cost of equipment JPY 3400 Lakhs
INR JPY rate = 340 JPY per 100 INR
Cost of equipment in INR = 3400 Lakhs/340 × 100 = INR 1,000 lakhs
Interest @18% P.a for 6 Months with quarterly rests = 1000 lakhs × (1+18%/4)^2 = **INR 1092.025 Lakhs**

Option 2 : Open LC and get JPY Funding @2%
Interest payable to foreign bank on due date and LC commission @2% P.a. is payable.
LC Value in JPY = 3400 Lakhs
Spot on opening date = 340 JPY per 100 INR
LC Value = 1000 Lakhs
LC commission = 1000 Lakhs ×2% ×180/365 = INR 9,86,301
Interest on credit by bank = JPY 3400 Lakhs × 2% ×180/365 = JPY 33,53,425 (due on repayment date)

Forward rate = JPY 345 per INR 100
Interest in forward rate = JPY 33,53,425 /345 ×100 = INR 9,72,007
Loan amount = JPY 3400 lakhs /345 × 100 = INR 985.51 lakhs
Total amount paid in Option 2 = 985.51 Lakhs + 9.86 Lakhs + 9.72 Lakhs =**INR 1005.09 Lakhs**
Hence, option 2 is better than option 1 by 86.94 Lakhs (1092.025 Lakhs – 1005.09 Lakhs)
Company is advised to accept the LC offer from foreign branch of local bank.

47. Illustration

Your bank's London office has surplus funds to the extent of USD 5,00,000/- for a period of 3 months. The cost of the funds to the bank is 4% p.a. It proposes to invest these funds in London, New York or Frankfurt and obtain the best yield, without any exchange risk to the bank. The following rates of interest are available at the three centres for investment of domestic funds there at for a period of 3 months.

London	5 % p.a.
New York	8% p.a.
Frankfurt	3% p.a.

The market rates in London for US dollars and Euro are as under:

London on New York

Spot	1.5350/90
1 month	15/18
2 months	30/35
3 months	80/85

London on Frankfurt

Spot	1.8260/90
1 month	60/55
2 months	95/90
3 months	145/140

At which centre, will investment be made & what will be the net gain (to the nearest pound) to the bank on the invested funds? (SM)

Solution :

Investment in GBP

Surplus	**USD 500,000**
Exchange Rate Applicable (As per Banker Bids to Buy Base Currency)	1.5390 $ per 1 GBP
Equivalent GBP	=500,000/1.5390 = GBP 324,886.29
Cost for 3 Months @4%	= 500,000 × 4% × 3/12 = USD 5000
Investment @5% for 3 Months	Interest = 324,886.29 × 5% × 3/12 = GBP 4061.08
Total Investment value	= GBP 324,886.29 + 4061.08 = **GBP 328,947.37**

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No of GBP required after 3 months to repay USD 505,000	Relevant Exchange rate = 1.5350 + .0080 = 1.5430 USD per 1GBP = 505,000/1.5430 = **GBP 327,284.51**
Gain	= GBP 328,947.37 – GBP 327,284.51 = **GBP 1662.86**

Investment in USD

Surplus	**USD 500,000**
Cost for 3 Months @4%	= 500,000 × 4% × 3/12 = USD 5000
Investment @8% for 3 Months	Interest = 500,000 × 8% × 3/12 = USD 10,000
Net gain	USD 10000- USD 5000 = USD 5,000
Exchange Rate applicable after 3 months	GBP USD 1.5475 (1.5390+0.0085)
Value of Gain in GBP	= 5000/1.5475 = **GBP 3,231.02**

Investment in EURO

Surplus	**USD 500,000**
Exchange Rate Applicable (As per Banker Bids to Buy Base Currency)	GBP USD 1.5390 GBP EURO 1.8260
Equivalent EURO	= 500,000/1.5390 × 1.8260 = EURO 593,250
Cost for 3 Months @4%	= 500,000 × 4% × 3/12 = USD 5000
Investment EURO @3% for 3 Months	Interest = 593,250 × 3% × 3/12 = EURO 4449.375
Total Value of Investment	= EURO 593,250 + 4449.375 = EURO 597,699.375
Exchange Rate applicable	GBP EURO 1.8150 (1.8290 -0.140)
Value of Investment in GBP	= 597,669.375/1.8150 = GBP 329,310.95
Equivalent GBP required to repay USD 505,000 Loan	= GBP 327,284.51 (As calculated above)
Loss	= GBP 329,310.95 – GBP 327,284.51 = **GBP 2026.44**

Hence, the bank is advised to invest in USD to get best returns.

48. Illustration

XP Pharma Ltd. has acquired an export order for ₹ 10 million for formulations to a European company. The Company has also planned to import bulk drugs worth ₹ 5 million from a company in UK. The proceeds of exports will be realized in 3 months from now and the payments for imports will be due after 6 months from

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now. The invoicing of these exports and imports can be done in any currency i.e., Dollar, Euro, or Pounds sterling at company's choice.

The following market quotes are available.

Spot Rate	Annualized Premium
₹ / $ 67.10/67.20	$ — 7%
₹ / Euro 63.15/63.20	Euro — 6%
₹ /Pound88.65/88.75	Pound — 5%

Advice XP Pharma Ltd. about invoicing in which currency. (Calculation should be upto three decimal places). (Jul 21 N)

Solution :

Exports :

Spot	Equivalent Foreign Currency	Forward Rate	Equivalent INR	Gain
67.10	INR 1,00,00,000/67.10 = USD 149031.3	= 67.1 + 67.1 × 7% ×3/12 = 68.274	=149031.3 × 68.274 =101,75,000	**175,000**
63.15	INR 1,00,00,000/63.15 = EURO 158353.13	= 63.15 + 63.15 × 6% ×3/12 = 64.097	= 158353.13 ×64.097 = 10149960.57	149,960.57
88.65	INR 1,00,00,000/88.65 = 112,803.16	88.65 + 88.65 × 5% × 3/12 =89.758	= 112,803.16/89.758 =10,124,986.03	124,986.03

Imports:

Spot	Equivalent Foreign Currency	Forward Rate	Equivalent INR	Loss
67.20	INR 50,00,000/67.20 = USD 74404.76	= 67.2 + 67.2 × 7% ×6/12 = 69.595	= 74404.76 × 69.595 =5174479.034	174,479.034
63.20	INR 50,00,000/63.20 = EURO 79113.92	= 63.20 + 63.20 × 6% ×6/12 = 65.096	= 79,113.92 ×65.096 = 5149999.73	149,999.73
88.75	INR 50,00,000/88.75 = 56338.03	88.75 + 88.75 × 5% × 6/12 =90.969	= 56,338.03 ×90.969 = 5,125,014.25	**125,014.25**

Hence, Imports should be denominated in Pounds and Exports in Dollar as they are best possible combination of loss and gain respectively on account of Forward Premia

49. Illustration

A US investor chose to invest in Sensex for a period of one year. The relevant information is given below.

Size of investment ($)	20,00,000	
Spot rate 1year ago (₹/$)		42.50/60
Spot rate now (₹/$)	43.85/90	

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Sensex 1 year ago	3,256
Senex now	3,765
Inflation in US	5%
Inflation in India	9%

(i) Compute the nominal rate of return to the US investor.
(ii) Compute the real depreciation /appreciation of Rupee.
(iii) What should be the exchange rate if relevant purchasing power parity holds good?
(iv) What will be the real return to an Indian investor in Sensex? (Jan 21 O)

Solution :

i)

Amount invested	= 20,00,000
Exchange rate applicable on conversion	42.50
Equivalent INR	=20,00,000 × 42.5 = INR 85,000,000
Return for Sensex in one year	= (Closing – opening + dividend)/opening = (3765-3256)/3256 × 100 = 15.633 %
Value of investment in INR after one year	= 85,000,000 ×(1 + 15.633%) = INR 98,287,776
Equivalent USD converted	98,287,776/43.90 = 2238901.51
Gain in USD	2238901.51 – 2,000,000 = 238,901.51
Gain %	=238,901.51/2,000,000 ×100 = **11.95%**

Assuming no taxes and transaction costs

ii)

	Bid	**Ask**
Spot	42.50	42.60
Forward	43.85	43.90
Inflation in India	9%	9%
Depreciation % in 1 year	(43.85-42.50)/42.50 ×100 = 3.17%	((43.90-42.60)/42.60) × 100 = 3.05%
Ideal Depreciation % in 1 year	(1.09/1.05 – 1)× 100 = 3.81%	(1.09/1.05 – 1)× 100 = 3.81%
Real appreciation	=(1.0317/1.0381) -1 = 0.62%	=(1.0305/1.0381) -1 = 0.73%

iii)

	Bid	Ask
Spot	42.50	42.00
Interest Rate	5%	9%
Exchange Rate based on PPP = Spot × (1 +d)/(1+f) =		
Exchange rate based on PPP	42.50 × 1.09/1.05 = 44.12	42.60 × 1.09/1.05 = 44.22

iv)

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Return on Sensex in INR terms	**15.633%**
Indian Inflation	**9%**
Real Return	**1.15637/1.09 -1 = 6.085%**

50. Illustration

TT Ltd. is planning to hedge its foreign exchange risk. It has made a purchase on 1st April 2021 for which it has to make a payment of US $1 Lakh on 30/09/2021. The present exchange rate is I US $ = ₹ 73. It can purchase forward US $ at ₹ 74. TT Ltd. will have to make an upfront premium @ 1% of the forward amount purchased. The cost of the funds to the company is 10% p.a.

In the following situations, compute the Gain/(Loss) the TT Ltd. will make if they hedge with exchange rate on 30/09/2021 as:

i. ₹ 76/US $
ii. ₹ 70/US $
iii. ₹ 79/US $

Note: Calculation to be done on monthly basis. (Dec'21 N)

Solution :

Assumption : The upfront premia paid is included in INR 74 of forward exchange rate that the company agrees to buy USD for from the bank.

Total amount in USD = 100,000
Spot USD INR = 73 and 6M forward = USD INR 74
Upfront premia paid 1% of forward contract = 1% × 74 = 0.74
Add :Cost of funds @10% P.a.= 0.74 × 10% × 6/12 = 0.037
All in forward cost = 74 +0.74 + 0.037 = INR 74.777

Exchange Rate	**Spot as on 30/09/202**		
	76	**70**	**79**
All in Forward Rate	74.777	74.777	74.777
Gain/(loss)	= 76 - 74.777 = 1.223	= 70- 74.777 = (4.777)	=79- 74.777 = 4.223
Total USD	1,00,000	1,00,000	1,00,000
Gain/(loss) in INR due to forward contract	= 1.223 × 100,000 = 1,22,300	=(4.777) × 1,00,000 = (4,77,700)	=4.223 × 100,000 = 4,22,300

51. Illustration

Interest rates for 3 months in USA and Canada are as follows:

Currency	Borrow	Interest
US $	4%	2.5%
Canadian $	4.5%	3.5 %
Can $/ US $ spot	1.235 ---- 1.240	
3 months forward	1.255 ---- 1.260	

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Advice, the currency in which borrowing, and lending for 3 months needs to be done for the US company. Take 3 months = 90/360 days. (Jan 21 O)

Solution :

Assuming, the US company has US $1000. This is invested at 2.5% in US , then return would be
= 1000 × 2.5% × 90/360 = USD 6.25

Total value of investment at end = 1000 + 6.25 = **USD 1006.25**
Investment in CAD :

	Deposit	Borrow
Exchange rate applicable (Banker Bids to Buy Base Currency)	USD CAD 1.235	USD CAD 1.240
Equivalent CAD	= 1000 × 1.235 = 1235 CAD	= 1000 × 1.24 = 1240 CAD
Interest earned/paid on depositing/borrowing	= 1235 × 3.5% × 90/360 = 10.806 CAD	=1240 × 4.5% × 90/360 = 13.95 CAD
Total value of investment at end/ to be repaid	= 1235 + 10.806 CAD = 1245.806 CAD	= 1240 + 13.95 CAD = 1253.95 CAD
Exchange rate on conversion	USD CAD 1.260	USD CAD 1.255
Equivalent USD	= 1245.806/1.260 = **USD 988.735**	= 1253.95/1.255 = **USD 999.16**

Hence, the company should invest in US (USD 1006.25) as investing in CAD results in loss (USD 988.735)
Assuming the US Company borrows USD 1000 at 4%. Interest paid = 1000 ×4% × 90/360 = USD 10
Amount to be repaid = 1000 + 10 = USD 1010

In case of borrowing, **Borrowing in CAD is better** as repayment amount is lower(USD 999.16) than in case of direct US $ (USD 1010)

Forwards

52. Illustration

On 1st June 2015 the bank enters into a forward contract for 2 months for selling US$ 1,00,000 at ₹ 65.5000. On 31st July 2015 the spot rate was ₹ 65.7500/65.2500. Calculate the amount to be debited in the customer's account. (SM)

Solution :

The amount debited to customers account = USD 1,00,000 × 65.5000= INR 65,50,000

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53. Illustration

In March, 2009, the Multinational Industries make the following assessment of dollar rates per British pound to prevail as on 1.9.2009:

$/Pound	Probability
1.60	0.15
1.70	0.20
1.80	0.25
1.90	0.20
2.00	0.20

(i) What is the expected spot rate for 1.9.2009?

(ii) If, as of March 2009, the 6-month forward rate is $ 1.80, should the firm sell forward its pound receivables due in September, 2009? (SM)

Solution :

$E(R) = \sum P_i \times X_i$

USD per GBP	Probability	Probability Exchange Rate
1.6	0.15	0.24
1.7	0.20	0.34
1.8	0.25	0.45
1.9	0.20	0.38
2	0.20	0.40
	Total	**1.81**

So, expected spot USD per GBP = 1.81 on 1st sept 2009
6M forward = GBP USD 1.80 and expected spot = 1.81

If Multinational industries have GBP Receivables, then assuming that they are American firm based on the information provided, they will need to convert GBP receivable to USD.
It is better not to enter into the GBP forward @1.80 USD per GBP because expected rate is higher i.e., 1.81 USD per GBP.

54. Illustration

A company is considering hedging its foreign exchange risk. It has made a purchase on 1st July, 2016 for which it has to make a payment of US$ 60,000 on December 31, 2016. The present exchange rate is 1 US $ = ₹ 65. It can purchase forward 1 $ at ₹ 64. The company will have to make an upfront premium @ 2% of the forward amount purchased. The cost of funds to the company is 12% per annum.
In the following situations, compute the profit/loss the company will make if it hedges its foreign exchange risk with the exchange rate on 31st December 2016 as:

(i) ₹ 68 per US $
(ii) ₹ 62 per US $
(iii) ₹ 70 per US $
(iv) ₹ 65 per US $ (SM)

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Solution :

Assumption : The upfront premia is paid in addition to the forward rate agreed. **Alternatively**, you can also assume the upfront premia paid is included in the forward rate and compute gain/loss as per Question 50.

Forward rate = INR 64 per USD and contract is of USD 60,000
Total forward contract value = 60,000 × 64 = INR 38,40,000
Upfront premia to be paid = 2%
Upfront premia = 38,40,000 × 2% = INR **76,800**
Cost of funds @12% P.a. = 76,800 × 12% × 6/12 = INR **4608**
Total cost of entering into forward = INR 81,408

Exchange Rate	**Spot as on 30/09/202**			
	68	62	70	65
Forward Rate	64	64	64	64
Gain/(loss)	= 68-64 = 4	= 62- 64 = (2)	=70- 64 = 6	=65 -64 = 1
Total USD	60,000	60,000	60,000	60,000
Gain/(loss) in INR due to forward contract	= 4 × 60,000 = 2,40,000	=(2) × 60,000 = (1,20,000)	=6 × 60,000 = 3,60,000	=1 × 60,000 = 60,000
Less : premia and cost of funds	(81408)	(81408)	(81408)	(81408)
Net Gain/(loss)	158,592	(201,408)	278,592	(21,408)

55. Illustration

An importer customer of your bank wishes to book a forward contract with your bank on 3rd September for sale to him of SGD 5,00,000 to be delivered on 30th October.
The spot rates on 3rd September are USD/INR 49.3700/3800 and USD/SGD 1.7058/68. The swap points are:

USD / INR		USD/SGD	
Spot/September	0300/0400	1st month forward	48/49
Spot/October	1100/1300	2nd month forward	96/97
Spot/November	1900/2200	3rd month forward	138/140
Spot/December	2700/3100		
Spot/January	3500/4000		

Calculate the rate to be quoted to the importer by assuming an exchange margin of 5 paisa. (SM)

Solution :

Assumption : The forward points for USD INR and USD SGD are for delivery of currency as on 30th October.

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	USD INR	USD SGD
Spot	49.37/38	1.7058/1.7068
Relevant Spot	49.38	1.7058
Add: Forward Points	0.13	0.0096
	49.51	1.7154
Add : Margin	0.05	
	49.56	

USD INR = 49.56 and USD SGD = 1.7154
On comparing both exchange rates, we get SGD 1.7154 = INR 49.56
So, 1 SGD = 49.56/1.7154 INR = 28.8912
Hence, SGD INR = 28.8912 (This Working is made on real world assumption that margin is usually quoted in Indian markets for USDINR and not on other crosses). If Margin is added to SGD instead of USD, then solution will be ₹49.51 /1.7154 = ₹28.8621 + 5 paise = ₹28.9121

56. Illustration

XYZ Ltd. is an export-oriented business house based in Mumbai. The Company invoices in customers' currency. Its receipt of US $ 1,00,000 is due on September 1, 2009.
Market information as at June 1, 2009 is:

Exchange Rates		**Currency Futures**		
US $/₹		US $/₹	Contract size	₹4,72,000
Spot	0.02140	June	0.02126	
1 Month Forward	0.02136	September	0.02118	
3 Months Forward	0.02127			

	Initial Margin	**Interest Rates in India**
June	₹ 10,000	**7.50%**
September	₹ 15,000	**8.00%**

On September 1, 2009 the spot rate US$ ₹ is 0.02133 and currency future rate is 0.02134. Comment which of the following methods would be most advantageous for XYZ Ltd.
(a) Using forward contract
(b) Using currency futures
(c) Not hedging currency risks.

It may be assumed that variation in margin would be settled on the maturity of the futures contract. (PM)

Solution :

a) Total inflow using a forward contract @0.02127 USD per INR, so 1 Lakh receivable after 3 months = USD 100,000/0.02127 = INR 47,01,457.45
d) Inflow if no hedging is done , INR equivalent of USD 100,000 @ 0.02133 = 100,000/0.02133

= INR 46,88,232.54

Using currency futures :

INR receivable @3M future rate = USD 100,000/0.02118 = INR 47,21,435.31
Each lot is for Rs 4,72,000, then the number of contracts would be = 47,21,435.31/4,72,000
= 10.003 ~10 Lots
i.e., 10 Lots of futures contracts are entered into, each lot being INR 4,72,000.

i) **Cost of Funds**

Initial margin of INR 15,000 given in the question is for each contract. So, total margin deposited = 10 × 15,000 = IR 1,50,000
Cost @8% for 3m on 1,50,000 = 150,000 × 8% × 3/12= 3000

ii) **Transaction at Spot** :

USD 100,000 converted to INR at spot rate of @0.02133 USD per INR = 100,000/0.02133 = INR 46,88,232.54

iii)**Gain/loss in net cash settlement**

Gain = (0.02134 -0.02118) USD per INR × 10 Lots × 4,72,000 = USD 755.2
INR equivalent of gain of USD 755.2 @ 0.02133 = 755.2/0.02133 = INR 35,405.53

So net cashflow from future contract = 46,88,232.54 + 35,405.53 – 3000 = **INR 47,20,638.07**

Option	Amount (INR)
Forward Contract	47,01,457.45
No hedging	46,88,232.54
Currency Futures	47,20,638.07

Hence, comparing the above the three options, future contract is better of all and hence it is advised to hedge using futures.

57. Illustration

A company operating in Japan has today effected sales to an Indian company, the payment being due 3 months from the date of invoice. The invoice amount is 108 lakhs yen. At today's spot rate, it is equivalent to ₹ 30 lakhs. It is anticipated that the exchange rate will decline by 10% over the 3 months period and in order to protect the yen payments, the importer proposes to take appropriate action in the foreign exchange market. The 3 months forward rate is presently quoted as 3.3 yen per rupee. You are required to calculate the expected loss and to show how it can be hedged by a forward contract. (PM)

Solution :

Spot rate : 108 Lakhs JPY = 30 Lakhs INR, so 3.6 JPY is equal to 1 INR
Hence, INR JPY = 3.6
If a forward contract is entered into then Cashflow will be as follows :
Purchase value @spot of JPY 3.6 per INR = INR 30,00,000

Forward contract rate = JPY 3.3 per INR = JPY 108,00,000
Equivalent INR as per forward contract = 108,00,000/3.3 = **INR 32,72,727.27**
If no forward contract is entered, then the exchange rate applicable = 3.6 JPY -10% = 3.24 JPY per INR
Equivalent INR = 108,00,000/3.24 = **INR 33,33,333.33**
Difference between hedging and not hedging = 33,33,333.33 – 32,72,727.27 = INR 60,606.06

Hence, if a forward contract is entered into, then the loss is reduced by INR 60,606.06

58. Illustration

ABC Technologic is expecting to receive a sum of US$ 4,00,000 after 3 months. The company decided to go for future contract to hedge against the risk. The standard size of future contract available in the market is $1000. As on date spot and futures $ contract are quoting at ₹ 44.00 & ₹ 45.00 respectively. Suppose after 3 months the company closes out its position, futures are quoting at ₹ 44.50 and spot rate is also quoting at ₹ 44.50. You are required to calculate effective realization for the company while selling the receivable. Also calculate how company has been benefitted by using the future option. (SM)

Solution :

Spot rate USD INR	44
3M Future USD INR	45
USD Receivable	400,000
Lot size	1000
Number of contracts	= USD 400,000/1000 = 400 Contracts
Company closes out contract at USD INR	44.50
Gain on 400 contracts of USD 1000 each	= (45- 44.50) × 400 × 1000 = INR 2,00,000
Equivalent INR realized	= 400,000 × 44.5 = INR 1,78,00,000
Add : Gain on Future	INR 200,000
Total cash flow	= 1,80,00,000
Effective realization rate	= 1,80,00,000/ USD 400,000 = INR 45 per USD

Because of entering into future contract, the company has realized receivable at INR 45 instead of spot rate of 44.5 INR per USD. Due to this, the company has gained INR 2,00,000 (0.5 × 400,000 USD)

59. Illustration

JKL Ltd. is an export business house. The company prepares invoice in customers' currency. Its debtors of US $. 20,000,000 is due on April 1, 2017. Market information as at January 1, 2017 is:

Exchange rates US$/INR		**Currency Futures US $/INR**	
Spot	0.016667	Contract size: 31,021,218	
1- month forward	0.016529	1- month	0.016519
3- month forward	0.016129	3- month	0.016118

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	Initial Margin	Interest rates in India
1- month	₹ 32,500	7%
3- month	₹ 50,000	8%

On April 1, 2017; the spot rate US$/INR is 0.016136 and currency future rate is 0.016134. Which of the following methods would be most advantageous to JKL Ltd.?

(i) Using forward contract
(ii) Using currency futures
(iii) Not hedging the currency risk (Nov 17)

Solution :

a) Total inflow using a forward contract @0.016129 USD per INR, so 200 Lakh receivable after 3 months = USD 20,000,000/0.016129 = INR 124,00,02,480.
b) Inflow if no hedging is done, INR equivalent of USD 20,000,000 @ 0.016136 = 20,000,000/0.016136

= INR 123,94,64,551.31

Using currency futures :

INR receivable @3M future rate @ 0.016118 = INR 31021218 × 0.016118 = USD 500,000
Each lot is for Rs 31,021,218, then the number of contracts would be = 20,000,000/5,00,000 = 40 Lots
i.e., 40 Lots of futures contracts are entered into, each lot being INR 31,021,218

Cost of Funds

Initial margin of INR 50,000 given in the question is for each contract. So, total margin deposited = 40 × 50,000 = INR 20,00,000
Cost @8% for 3m on 20,00,000 = 20,00,000 × 8% × 3/12= INR 40,000

Transaction at Spot :

USD 20,000,000 converted to INR at spot rate of @0.016136 USD per INR = 20,000,000/0.016136 = INR 123,94,64,551.31

Gain/loss in net cash settlement

Gain = (0.016134 -0.016118) INR × 40 Lots × 31,021,218 = USD 19853.58

INR equivalent of gain of USD 19853.58 @ 0.016136 = 19583.58/0.016136 = INR 12,30,390.40

So net cashflow from future contract = 123,94,64,551.31 + 12,30,390.40 - 40,000 = **INR 124,06,54941.71**

Option	Amount (INR)
Forward Contract	124,00,02,480
No hedging	123,94,64,551.31
Currency Futures	124,06,54941.71

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Hence, comparing the above the three options, future contract is better of all and hence it is advised to hedge using futures.

60. Illustration

ABC Co. have taken a 6-month loan from their foreign collaborators for US Dollars 2 million. Interest payable on maturity is at LIBOR plus 1.0%. Current 6-month LIBOR is 2%.
Enquiries regarding exchange rates with their bank elicits the following information:

Spot USD 1	₹ 48.5275
6 months forward	₹ 48.4575

(i) What would be their total commitment in Rupees if they enter into a forward contract?
(ii) Will you advise them to do so? Explain giving reasons. (SM)

Solution :

i)

Loan Value	**USD 2,000,000**
Interest rate applicable	6M LIBOR + 1% = 2% + 1% = 3%
Interest cost	2,000,000 ×3% × 6/12 = USD 30,000
Total commitment	= Principal + interest = USD 2,000,000 + USD 30,000 = USD 2,030,000
Forward Contract rate USD INR	48.4575
INR equivalent	= USD 2,030,000 × 48.4575 = **INR 9,83,68,725**

ii)Yes, ABC Co should hedge.

Here market expectation is dollar will depreciate. India has higher interest /inflation rate than US, implying that ₹ will ideally depreciate. So, company should take advantage of this and hedge exposure.

61. Illustration

Excel Exporters are holding an Export bill in United States Dollar (USD) 1,00,000 due 60 days hence. They are worried about the falling USD value which is currently at ₹ 45.60 per USD. The concerned Export Consignment has been priced on an Exchange rate of ₹ 45.50 per USD. The Firm's Bankers have quoted a 60-day forward rate of ₹ 45.20.

Calculate:
(i) Rate of discount quoted by the Bank
(ii) The probable loss of operating profit if the forward sale is agreed to. (SM)

Solution :

i) Rate of discount = Forward – Spot

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= 45.2 -45.6
= (0.40)
Annualized Discount % = 0.40/45.60 × 365/60 = **5.336%**

ii) Probable loss/USD = Forward rate – Pricing rate

= 45.2 – 45.5 = 0.30/USD
Total consignment value = USD 100,000
Total loss = INR 0.30 × 100,000 = **INR 30,000**
Loss (%) = Loss/ original value of shipment
= 30,000/45.5 × 100,000
= **0.659%**

62. Illustration

An Indian importer has to settle an import bill for $ 1,30,000. The exporter has given the Indian importer two options:
(i) Pay immediately without any interest charges.
(ii) Pay after three months with interest at 5 percent per annum.

The importer's bank charges 15 percent per annum on overdrafts. The exchange rates in the market are as follows:

Spot rate (₹ /$) : 48.35/ 48.36
3-Months forward rate (₹/$) : 48.81/ 48.83
The importer seeks your advice. Give your advice. (SM)

Solution:
i) Cost of import when paid on spot = USD 1,30,000 × 48.36

= INR 62,86,800
Add : Interest on OD @15% = 62,86,800 × 15% × 3/12 = 2,35,755
Total cost of import after 3 Months = INR **65,22,555**

ii) Cost of import with 3 months forward

Output value	**USD 130,000**
Add : 5% P.a interest	USD 1625
Total USD payable	USD 131,625
3 Month forward exchange rate	48.83
Equivalent INR payable after 3 months	= USD 131,625 × 48.83 = INR **64,27,248**

Hence it is better to take supplier credit at 5% P.a and pay using 3 month forward.

63. Illustration

Zaz plc, a UK Company is in the process of negotiating an order amounting € 2.8 million with a large German retailer on 6 months credit. If successful, this will be first time for Zaz has exported goods

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into the highly competitive German Market. The Zaz is considering following 3 alternatives for managing the transaction risk before the order is finalized.

(a) Mr. Peter the Marketing head has suggested that in order to remove transaction risk completely Zaz should invoice the German firm in Sterling using the current €/£ average spot rate to calculate the invoice amount.

(b) Mr. Wilson, CE is doubtful about Mr. Peter's proposal and suggested an alternative of invoicing the German firm in € and using a forward exchange contract to hedge the transaction risk.

(c) Ms. Karen, CFO is agreed with the proposal of Mr. Wilson to invoice the German first in €, but she is of opinion that Zaz should use sufficient 6 month sterling future contracts (to the nearest whole number) to hedge the transaction risk.

Following data is available

Spot Rate	€ 1.1960 - €1.1970/£
6 months forward points	0.60 – 0.55 Euro Cents
6 month future contract is currently trading at	€ 1.1943/£
6 month future contract size is	£62,500
After 6 month Spot rate and future rate	€ 1.1873/£

You are required to

(a) Calculate (to the nearest £) the £ receipt for Zaz plc, under each of 3 above proposals.
(b) In your opinion which alternative you consider to be most appropriate. (SM)

Solution:

a) Option 1: Billing in GBP @ Spot rate

Applicable exchange rate	**GBP EURO 1.1965**
Order size	EURO 2.8 million
GBP Invoiced	=EURO 2.8 Mn/1.1965 =**GBP 2,340,158.80**

Option 2: Forward contract

Original Contract Value = EURO 2.8 Million

Exchange rate	**Bid**	**Ask**
Spot	1.1960	1.1970
Less :Forward Points	0.0060	0.0055
Forward Rate	1.1900	**1.1915**

Exchange rate applicable (As per **B**anker **B**ids to **B**uy **B**ase **C**urrency) = 1.1915
GBP realized after 6 months from a forward hedge = EURO 2,800,000/1.1915= **GBP 2,349,979.02**.

Option 3: Futures Contract

Future Rate	**GBP EURO 1.1943**
Total EURO to be sold	EUR 2.8 Million
Equivalent GBP	GBP 2,344,469.51

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Lot Size	GBP 62,500
No of lot size	2344469.51/62,500 = 37.51 Lots ~ 37 Lots
Total Hedge quantity	=37 × GBP 62500 = GBP 2,312,500
Future Settlement Rate	GBP EURO 1.1873
Future Original contract rate	GBP EURO 1.1943
Loss	GBP EURO 0.0070
Future net settlement value : **Loss**	=2312500 × 0.0070 = EUR 16187.5
Loss in GBP	16187.5/1.1873 = GBP 13633.88
Amount realized in spot	= GBP 2.8 Million/1.1873 = GBP 2,358,291.92
Total Cashflow	= 2,358,291.92 – 13,633.88 = **GBP 2,344,658.05**

b) On comparing Option 1,2 and 3, Option 2 (forward contract) is the best option.

64. Illustration

Columbus Surgicals Inc. is based in US, has recently imported surgical raw materials from the UK and has been invoiced for £ 480,000, payable in 3 months. It has also exported surgical goods to India and France. The Indian customer has been invoiced for £ 138,000, payable in 3 months, and the French customer has been invoiced for € 590,000, payable in 4 months. Current spot and forward rates are as follows:

£ / US$
Spot: 0.9830 - 0.9850
3 months forward: 0.9520 - 0.9545

US$ / €
Spot: 1.8890 – 1.8920
4 months forward: 1.9510 – 1.9540

Current money market rates are as follows:
UK: 10.0% – 12.0% p.a.
France: 14.0% – 16.0% p.a.
USA: 11.5% – 13.0% p.a.

You as Treasury Manager are required to show how the company can hedge its foreign exchange exposure using Forward markets and Money markets hedge and suggest which the best hedging technique is. (SM)

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Solution:

	3 Month Exposure	4M exposure
Export Receivable	GBP 138,000	EURO 590,000
Import Payable	GBP 480,000	
Net Exposure after 3 months	GBP 342,000 Payable	EURO 590,000 Receivable

GBP Payable exposure in Forward market = GBP 342,000
Exchange rate applicable : USD GBP 0.9520
Equivalent USD which need to be paid = GBP 342,000/0.9520 = **USD 359,243.70**

Money Market Hedge :

Borrow in USD loan @13% P.a	**Let loan taken be x and interest rate applicable is 2.5%**
Deposit	X + x × 10% × 3/12 = 342,000 1.025 x = 342,000 X = 333,658.54
Make a deposit in GBP	GBP 333,658.54
Convert USD to GBP : Exchange rate applicable USD GBP 0.9830	USD equivalent = 333,658.54/0.9830 = USD 339,428.83
Get out GBP proceeds with interest	342,000
Make payment in GBP	GBP 342,000
Borrowing repayment	Repayment =339,428.83 + 339,428.83 × 13% × 3/12 = **USD 350,460.26**

So, for import payment, money market hedges are better suited as outflow is only USD 350,460.26 as compared to outflow of USD 359,243.70 in forward contract.

Export Receivable of 4 Months	EURO 590,000
Exchange rate applicable	EURO USD 1.9510
USD received on realised export receivable using a 4 month forward	= 590,000 × 1.9510 = USD 1,151,090
Amount realised	**USD 1,151,090**

Borrow in EURO @16% for 4 months	**Let loan taken be x and interest rate applicable is 16%**
Convert EURO to USD @spot of 1.8890	= 560,144.31 × 1.8890 = USD 1,058,112.60
Put USD into deposits @11.5% for 4 months	= 1,058,112.60 × 11.5% ×4/12 = USD 40,560.98
Get deposit along with interest	**USD 1,098,673.58**
Original EURO loan	X + x × 16% × 4/12 = EURO 590,000 1.0533x = 590,000 X = 590,000/1.0533 = 5,60,144.31
Interest on EURO loan @16%	= 590,000 – 560,144.31 = EURO 29,855.69

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Repay EURO loan along with interest	EURO 590,000

In this case of receivable, company is better of **using forward contract** of realising USD 11,51,090 instead of USD 1,098,673.58 from money market hedge.

65. Illustration

The current spot exchange rate is $1.35/£ and the three-month forward rate is $1.30/£. According to your analysis of the exchange rate, you are quite confident that the spot exchange rate will be $1.32/£ after 3 months.

(i) Suppose you want to speculate in the forward market then what course of action would be required and what is the expected dollar Profit (Loss) from this speculation?

(ii) What would be your Profit (Loss) in Dollar terms on the position taken as per your speculation if the spot exchange rate turns out to be $1.26/£.

Assume that you would like to buy or sell £1,000,000. (Nov 20 RTP N)

Solution :

GBP USD	USD per GBP
Spot	1.35
3 M forward	1.30
3 M future spot exchange	1.32
3 M future spot actual	1.26

i) Expected speculative gain = GBP 1,000,000 × (1.32-1.30)

Profit will be = 1,000,000 × 0.02
= **USD 20,000**

ii) If spot falls to GBP USD 1.26,

Loss will be = 1,000,000 × (1.30 -1.26)
= **USD 40,000**

66. Illustration

M/s. Sky products Ltd., of Mumbai, an exporter of sea foods has submitted a 60 day bill for EUR 5,00,000 drawn under an irrevocable Letter of Credit for negotiation. The company has desired to keep 50% of the bill amount under the Exchange Earners Foreign Currency Account (EEFC). The rates for ₹/USD and USD/EUR in inter-bank market are quoted as follows :

	₹/ USD	USD/EUR
Spot	67.8000/ 8100	1.0775 /8000
1 month forward	10/11 Paise	0.20/0.25 Cents
2 months forward	21/22 Paise	0.40/0.45 Cents
3 months forward	32/33 Paise	0.70/0.75 Cents

Transit Period is 20 days. Interest on post shipment credit is 8% p.a.

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Exchange Margin is 0.1%. Assume 365 days in a year. You are required to calculate:

(i) Exchange rate quoted to the company
(ii) Cash inflow to the company
(iii) Interest amount to be paid to bank by the company. (Jan21 N)

Solution :

Exchange Rate	Bid	Ask
USD INR Spot	67.80	67.81
2 M Forward Points	0.21	0.22
	68.01	68.03
EUR USD	1.0775	1.0800
Forward Points	0.0040	0.0045
	1.0815	1.0845

INR Rate	68.01
Less: Margin @ 0.1%	- 0.06801
	= 67.9420
EUR USD	1.0815
EUR INR	= 67.9420 × 1.0815
	= **73.4793**

Note : Alternatively, since margin is given as %, you can also find EUR INR by multiplying 68.01 and 1.0815 and then deduct the margin. However, if margin is given in paisa then you have to deduct with rupee only first.

i) Exchange rate quoted to company = **EUR INR 73.4793**
ii) Cash inflow to the company : 50% EEFC and 50% converted to INR

Amount converted to INR = EUR 500,000 × 50% = 250,000
Equivalent INR =EUR 250,000 × 73.4793 = **INR 1,83,69,825**

iii) Interest amount is on post shipment credit since LC is Usance LC for 60 days. Post shipment credit is also for 60 days.

Interest = 1,83,69,825 × 8% × 60/365 = **INR 2,41,575.78**

67. Illustration

ZX Ltd. has made purchases worth USD 80,000 on 1st May 2020 for which it has to make a payment on 1st November 2020. The present exchange rate is INR/USD 75. The company can purchase forward dollars at INR/USD 74. The company will have to make an upfront premium @ 1 per cent of the forward amount purchased. The cost of funds to ZX Ltd. is 10 per cent per annum.

The company can hedge its position with the following expected rate of USD in foreign exchange market on 1st May 2020:

	Exchange Rate	Probability
(i)	INR/USD 77	0.15
(ii)	INR/USD 71	0.25

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(iii) INR/USD 79 0.20
(iv) INR/USD 74 0.40

You are required to advise the company for a suitable cover for risk. (Nov 20 N)

Solution :

Assumption :

i) The upfront premia paid is not included forward exchange rate that the company agrees to buy USD for from the bank.

ii) The given expected exchange rates with probabilities are expected spot rates on 1 Nov 20

Total amount in USD	80,000
Forward Rate USD INR	74
Total payable	=80,000 × 74 = INR 59,20,000
Add: Premia paid upfront @1%	= INR 59,20,000 ×1% = INR 59,200
Add: Interest lost @10% P.a for 6 Months	= 59,200 × 10% × 6/12 = INR 2,960
Total Cash outflow	= **INR 59,82,160**

Do not hedge and leave exposure open:

Exchange Rate (1)	**Probability (2)**	**=1 × 2**
77	0.15	11.55
71	0.25	17.75
79	0.20	15.80
74	0.40	29.60
Expected USD INR		=74.70
Expected Cash outflow	80,000 × 74.70 = **INR 59,76,000**	

Expected spot rate results in lower outflow and hence company is advised to leave its exposure unhedged.

68. Illustration

Mr. Mammen, an Indian investor invests in a listed bond in USA. If the price of the bond at the beginning of the year is USD 100 and it is USD 103 at the end of the year. The coupon rate is 3% payable annually. Find the return on investment in terms of home country currency if:

(i) USD is Flat.
(ii) USD appreciates during the year by 3%.
(iii) USD depreciates during the year by 3%.
(iv) Indian Rupee appreciates during the year by 5%.
(v) Will your answer differ if Mr. Mammen invests in the bond just before the interest payable? (Jul 21 O)

Solution :

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Assumption :

a) Investment is made at USD 100
b) Interest is received during the year.

i) If USD is flat, return is computed as follows :

Return = (Capital Gain + Dividend)/Opening
= 103 – 100 + (100 ×3%)/ 100 = 3+3/100 = **6%**

ii) USD appreciated by 3% which means INR depreciates, thus more INR will be given.

Return = 1.06 × 1.03 -1 = **9.18%**

iii) USD Depreciated by 3% which means INR appreciates, thus fewer INR will be refunded.

Return = 1.06 × (1-0.03) -1 = 1.06 × 0.97 -1 = **2.82%**

iv) INR appreciates by 5% which means USD depreciates, thus fewer INR will be refunded.

Return = 1.06 × (1 -0.05) -1 = 1.06 × 0.95 -1 = **0.7%**

v) No answer will not defer, if Mr Mammen invests just before interest payment.

69. Illustration

Humata Ltd., a Japanese Corporation, has sold goods today to Peacock Ltd., an Indian company for an amount of JPY 74 lakhs. The payment will be due in three months from the date of invoice. At today's spot rate, it is equivalent to INR 50 lakhs. It is anticipated that the INR will decline by 10% over the 3-months period and in order to protect the Yen payments, Peacock decides to take appropriate action in the foreign exchange market. The 3-months forward rate is presently quoted at JPY/INR 1.44.

You are required to calculate:
(i) The expected loss to the importer and
(ii) Impact of hedging by a forward contract. (Dec 21 O)

Solution :

ii) Total Payable : JPY 74
Payable in spot exchange rate of INR 50 Lakhs
INR JPY (No of JPY per INR) = 74 Lakhs/50 Lakhs = 1.48
INR is expected to depreciate by 10% which means less JPY is required for 1 INR
INR JPY Spot after 3 months = 1.48 – (1-10%) = 1.48 × 0.90 = **1.332**
Hedging is done INR JPY 3 month forward @1.44
74 Lakhs JPY @ 1.44 JPY per INR = INR Value of remittance
= 74/1.44 = INR 51.389 Lakhs
Expected loss = Payment value – Initial value
= 51.389 Lakhs – 50 Lakhs = **INR 1.389 Lakhs**

iii) If no hedging is done then, exchange rate after 10% depreciation of INR would be 1.332
The payment of 74 Lakh JPY would be = 74/1.332 = INR 55.555 Lakhs
The total loss would have been = 55.555 Lakhs – 50 lakhs = **INR 5.555 Lakhs**

Hence, because of hedging the loss is reduced by **INR 4.166 Lakhs** (5.555 Lakhs – 1.389 Lakhs)

Exposure

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70. Illustration

Following are the details of cash inflows and outflows in foreign currency denominations of MNP Co. an Indian export firm, which has no foreign subsidiaries:

Currency	Inflow	Outflow	Spot rate	Forward rate
US $	4,00,00,000	2,00,00,000	48.01	48.82
French Franc (FFR)	2,00,00,000	80,00,000	7.45	8.12
U.K. £	3,00,00,000	2,00,00,000	75.57	75.98
Japanese Yen	1,50,00,000	2,50,00,000	3.20	2.40

(i) Determine the net exposure of each foreign currency in terms of Rupees.
(ii) Are any of the exposure positions offsetting to some extent? (ICAI SM)

Solution :

Assumptions:

a) All inflows and outflows are for same date and can be netted off.
b) The forward rate pertains to the same tenure for which there are exposures.
c) USD, FFR and GBP are in direct quotes (No of units of INR for foreign currency) and JPY is in Indirect quotes (No of units of foreign currency for 1INR)

i)

Currency	Inflow (Million)	Outflow (Million)	Net Exposure (Million) FC Inflow	Spot Exchange rate	Net Exposure (INR) Million Inflow
USD	40	20	20	48.01	960.2
FFR	20	8	12	7.45	89.4
GBP	30	20	10	75.57	755.7
JPY	15	25	-10	3.20	-3.125

Impact of the exposure

Currency	Net exposure (FC inflow in Million)	Spot	Forward	Premium=Forward - Spot	INR Million (Premium × Net exposure)
USD	20	48.01	48.82	0.81	16.2
FFR	12	7.45	8.12	0.67	8.04
GBP	10	75.57	75.98	0.41	4.1
JPY	-10	3.20	2.40	1/3.2 – 1/2.4 = -0.1042	-1.0417

ii) Yes, in all currencies inflows and outflows can be netted. In case of JPY payments, the impact is negative due to INR depreciation, for other currencies it is positive.

71. Illustration

Shanti exported 200 pieces of designer jewellery to USA at $ 200 each. To manufacture and design this jewellery she imported raw material from Japan of the cost of JP¥ 6000 for each piece.
The labour cost and variable overhead incurred in producing each piece of jewellery are Rs. 1,300 and Rs. 650 respectively.

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Suppose Spot Rates are:

Rs./ US$ Rs. 65.00 – Rs. 66.00

JP¥/ US$ JP¥ 115 – JP¥ 120

Shanti is expecting that by the time the export remittance is received, and payment of import is made the expected Spot Rates are likely to be as follows:

Rs./ US$ Rs. 68.90 – Rs. 69.25

JP¥/ US$ JP¥ 105 – JP¥ 112

You are required to calculate the resultant transaction exposure. (MTP MAR 2016)

Solution :

Initial exposure and profit based on exchange rates at the time of transaction

	No of units	Per unit rate	Exchange Rate	Total Value in INR
Export	200	USD 200	USD INR 65	26,00,000
Import	200	JPY 6000	JPY INR 66/115 (WN 1)	-6,88,695.65
Labour + variable cost	200	1950	1	-3,90,000
Profit				15,21,304.35

Transaction exposure:

Payable JPY = JPY 12,00,000r

Receivable USD = USD 40,000

Revised foreign exchange rates :

USD INR = 68.90/69.25

USD JPY = 105/112

Exposure Type	Foreign Currency	Foreign Currency Amount	Original Exchange Rate	Revised Exchange Rate	Difference	Impact
Import	JPY	12,00,000	66/115	69.25/105	-0.0856	-102,732.91
Export	USD	40,000	65	68.90	+3.90	+156,000
						+53,267.08

Revised profit = original profit + impact of changes in exchange rate on the transaction exposure

= 15,21,304.35 + 53,267.08 = **15,74,571.43**

WN 1 : JPY INR (No of INR per JPY)

Given USD INR = 65/66 and USD JPY = 115/120

INR JPY = INR/USD × USD/JPY = 66 × 1/115 = 66/115

72. Illustration

M/s Omega Electronics Ltd. exports air conditioners to Germany by importing all the components from Singapore. The company is exporting 2,400 units at a price of Euro 500 per unit. The cost of imported components is S$ 800 per unit. The fixed cost and other variables cost per unit are ₹ 1,000 and ₹ 1,500

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respectively. The cash flows in Foreign currencies are due in six months. The current exchange rates are as follows:

₹/Euro	51.50/55
₹/S$	27.20/25

After six months the exchange rates turn out as follows:

₹/Euro	52.00/05
₹/S$	27.70/75

A. You are required to calculate loss/gain due to transaction exposure.
B. Based on the following additional information calculate the loss/gain due to transaction and operating exposure if the contracted price of air conditioners is ₹ 25,000:
   (i) the current exchange rate changes to

₹/Euro	51.75/80
₹/S$	27.10/15

   (ii) Price elasticity of demand is estimated to be 1.5
   (iii) Payments and receipts are to be settled at the end of six months. (SM)

Solution :

Part A

Transaction	Foreign Currency	FC Units	A/C units	Total FC	INR per EUR	INR
Export	EURO	500	2400	12,00,000	51.5	6,18,00,000
Import	SGD	800	2400	19,20,000	27.25	(5,23,20,000)
Local Expense	INR	2500	2400	60,00,000	1	(0,60,00,000)
Profit						34,80,000

Transaction exposure : Receivable EURO 12,00,000
Payable SGD 19,20,000

Impact of changes in exchange rates on transaction exposures

Exposure Type	Foreign Currency	Foreign Currency Amount	Original Exchange Rate	Revised Exchange Rate	Difference	Impact
Export	EURO	12,00,000	51.5	52	+0.5	+600,000
Import	SGD	19,20,000	27.25	27.75	(0.5)	(9,60,000)
						(3,60,000)

Revised profit = original profit + impact of changes in exchange rate on the transaction exposure
= 34,80,000 + (3,60,000) = 31,20,000

Part B:

Based on revised sale price

Revised spot on date of crystallisation of exposure is as follows:

Transaction	Foreign Currency	Cost/Units	A/C units	Exchange Rate	INR

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Export	EURO	25000	2400	1	6,00,00,000
Import	SGD	800	2400	27.15	(5,21,28,000)
Local Expense	INR	2500	2400	1	(60,00,000)
Profit					18,72,000

Hence revised profit on revised spot = INR 18,72,000
Contracted price = INR 25,000 and current spot = EUR 51.75/80
Implied EURO Price = EURO 483.09

Currency	Earlier	Current
INR	25000	25000
EUR	51.50	51.75
Price in EURO	485.47	483.09

There is reduction in price of EURO by 0.49%
Reduction in price by 0.49% will increase the demand by 0.7246% (0.49 × 1.5)
New quantity demanded will be =2400 × (1+0.7246%) = 2417 Units

Transaction	Foreign Currency	Cost/Units	A/C units	Exchange Rate	INR
Export	INR	25000	2417	1	6,04,25,000
Import	SGD	800	2417	27.75	(5,36,74,000)
Local Expense :Variable	INR	1500	2417	1	(36,25,500)
Local Expense :Fixed					(24,00,000)
Revised Profit					7,42,100

Profit has reduced from INR 18,72,000 to INR 7,42,100, i.e., reduction of **INR 11,29,900**

Options

73. Illustration

Sun Limited, an Indian company will need $ 5,00,000 in 90 days. In this connection, following information is given below:
Spot Rate - $1 = ₹ 71
90 days forward rate of $1 as of today = ₹ 73.
Interest Rates are as follows:

Particulars	US	India
90 days Deposit Rate	2.50%	4.00%
90 days Borrowing Rate	4.00%	6.00%

A call option on $ that expires in 90 days has an exercise price of ₹ 74 and a premium of Re. 0.10. Sun Limited has forecasted the spot rates for 90 days as below:

Future Rate	Probability
₹ 72.50	25%
₹ 73.00	50%
₹ 74.50	25%

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Which of the following strategies would be the most preferable to Sun Limited:

(i) A Forward Contract;
(ii) A Money Market hedge;
(iii) An Option Contract;
(iv) No Hedging.

Show your calculations in each case. (May 19 N)

Solutions:

i) **Forward Contract**: At forward rate of INR 73 per 1 USD

The total payable of USD 500,000 in INR terms = 500,000 × Rs 73 = **INR 3,65,00,000**

ii) **Money Market** :

Borrow INR for 90 days @6% PA (WN 2)	₹3,52,82,505
Convert USD to INR @spot of 71	₹3,52,82,505 / ₹71 per $ = $ 4,96,936.69
Principal (WN 1)	$ 4,96,936.69
Interest @2.5% P.a for 90 days (	$3,063.31
Principal + Interest of USD deposit	$500,000
Get USD	$500,000
Repay INR loan + 6% Interest p.a WN 3)	₹3,58,04,492.75

WN 1: USD 500,000 after 90 days @2.5% pa
Let original investment be x.
x × (1+2.5%*90/365) = 500,000
1.00616 x = 500,000
x = 500,000/1.00616 = 4,96,936.69

WN 2: ₹ Required to be borrowed = 4,96,936.69 x 71

W.N 3: INR Repayment = ₹3,52,82,505 X (1 + 6%*90/365) = ₹3,58,04,492.75

Assumption : interest rate given in the question are per annum rates.

iii) **No hedging** :

Expected spot after 90days	Probability	Probability weighted
72.50	0.25	18.125
73.00	0.50	36.500
74.50	0.25	18.625
		73.25

Expected outflow = 500,000 × 73.25 = **INR 3,66,25,000**

iv) **Option contract** :

Expected Rate	Option Strike price	Option exercised	Applicable Rate	Probability

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72.50	74.00	No	72.50	0.25
73.00	74.00	No	73.00	0.50
74.50	74.00	**Yes**	**74.00**	**0.25**
			Probability weighted Rate	**73.125**

Total outflow	500,000 × 73.125 = 3,65,62,500
Add: Option premia	500,000 × 0.1/USD = INR 50,000
Interest cost on Premia	= 50,000 × 6% x 90/365 = INR 739.73
Total cost	= **INR 3,66,13,239.73**

On comparing all four options, **monet market hedge** is best suited in case of sun limited as it results in least outflow of ₹3,58,04,492.75

74. Illustration

XYZ, an Indian firm, will need to pay JAPANESE YEN (JY) 5,00,000 on 30th June. In order to hedge the risk involved in foreign currency transaction, the firm is considering two alternative methods i.e., forward market cover and currency option contract.

On 1st April, following quotations (JY/INR) are made available:

Spot	3 months forward
1.9516/1.9711.	1.9726./1.9923

The prices for forex currency option on purchase are as follows:

Strike Price	JY 2.125
Call option (June)	JY 0.047
Put option (June)	JY 0.098

For excess or balance of JY covered, the firm would use forward rate as future spot rate. You are required to recommend cheaper hedging alternative for XYZ. (SM)

Solution :

Forward :
INR JPY 3 M forward = 1.9726/9923
Rate applicable as per **B**anker **B**ids to **B**uy **B**ase **C**urrency = INR JPY 1.9726
Equivalent INR outflow = 500,000/1.9726 = **2,53,472.57**

Option :
Strike price INR JPY = 2.1250
5,00,000 JPY to INR = 500,000 / 2.1250 = INR2,35,294.12
Put option premia is applicable as we need to sell INR and buy JPY and the quotes are given in Indirect quote. We need to enter option to sell INR and buy JPY.

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Premia = 0.098 JPY per INR
Total Premia = 235,294.12 × 0.098 = 23058.82 JPY

Equivalent Premia in INR as premia is paid on initiation date i.e., using spot rate 1.9516
INR premia = 23058.82 /1.9516 = 11,815.34
Interest cost on upfront premia paid is ignored.
Total cost of 500,000 JPY in case of any option = 11,815.34 + 2,35,294.12 = **2,47,109.46**
On comparing forward and option, option is cheaper alternative 2,47,109.46 as compared to INR 2,53,472.57

75. Illustration

An American firm is under obligation to pay interest of Can$ 1,010,000 and Can$ 705,000 on 31st July and 30th September respectively. The Firm is risk averse and its policy is to hedge the risks involved in all foreign currency transactions. The Finance Manager of the firm is thinking of hedging the risk considering two methods i.e., fixed forward or option contracts.
It is now June 30. Following quotations regarding rates of exchange, US$ per Can$, from the firm's bank were obtained:

Spot	1 Month Forward	3 Months Forward
0.9284-0.9288	0.9301	0.9356

Price for a US$ /CAN$ option on a U.S. stock exchange (cents per Can$, payable on purchase of the option, contract size Can$ 50000) are as follows:

Strike Price	**Calls**		**Puts**	
(US$/Can$)	July	Sept.	July	Sept.
0.93	1.56	2.56	0.88	1.75
0.94	1.02	NA	NA	NA
0.95	0.65	1.64	1.92	2.34

According to the suggestion of finance manager if options are to be used, one month option should be bought at a strike price of 94 cents and three-month option at a strike price of 95 cents and for the remainder uncovered by the options the firm would bear the risk itself. For this, it would use forward rate as the best estimate of spot. Transaction costs are ignored.
Recommend, which of the above two methods would be appropriate for the American firm to hedge its foreign exchange risk on the two interest payments? (SM)

Solution :

Hedging using 1Month and 3 Month forward:

	1M	**3M**
Exposure in CAD	10,10,000	705,000
USD for 1 CAD	0.9301	0.9356
USD outflow if forward is entered	= 10,10,000 × 0.9301 = 939,401	= 705,000 × 0.9356 = 659,598

Option :

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	1M	3M
Exposure	10,10,000	705,000
Option Lot size	50,000	50,000
Rounded Lots	=10,10,000/50,000 = 20	=705,000/50,000 = 14
Hedged Portion	CAD 10,00,000	CAD 700,000
Unhedged Portion	CAD 10,000	CAD 5000
Call option strike	0.94 USD per CAD	0.95 USD per CAD
Amount payable on option exercise in USD (1)	10,00,000 × 0.94 = USD 9,40,000	700,000 × 0.95 USD 6,65,000
Premia paid	0.0102 USD per CAD	0.0164 USD Per CAD
Total Premia (2)	= 10,00,000 × 0.0102 CAD = USD 10,200	700,000 × 0.0164 = USD 11,480
Unhedged exposure	CAD 10,000	CAD 5000
Forward rate	USD 0.9301 per CAD	USD 0.9356 per CAD
Unhedged exposure paid (3)	USD 9301	USD 4678
Total payable under option (1+2+3)	**USD 959,501**	**USD 681,158**

On comparing option and forward, the best option for firm is to **hedge using forward** as they are cheaper as compared to options.

76. Illustration

A Ltd. of U.K. has imported some chemical worth of USD 3,64,897 from one of the U.S. suppliers. The amount is payable in six months' time. The relevant spot and forward rates are:

Spot rate	USD 1.5617-1.5673
6 months' forward rate	USD 1.5455 –1.5609

The borrowing rates in U.K. and U.S. are 7% and 6% respectively and the deposit rates are 5.5% and 4.5% respectively.

Currency options are available under which one option contract is for GBP 12,500. The option premium for GBP at a strike price of USD 1.70/GBP is USD 0.037 (call option) and USD 0.096 (put option) for 6 months period.

The company has 3 choices:

(i) Forward cover
(ii) Money market cover, and
(iii) Currency option

Which of the alternatives is preferable by the company? (SM)

Solution :

i) **Forward Cover**

Exposure USD 6M	364,897
Exchange rate applicable (As per Banker Bids to Buy Base Currency)	1.5455
Amount paid in GBP on account for forward cover	=364,897/1.5455 = **GBP 236,102.88**

ii) **Money Market hedge**:

Borrow GBP @7% P.a	**GBP 228,512.19**
GBP in hand	= 356,867.48/1.5617 = **GBP 228,512.19**
Convert GBP into USD @ 1.5617 USD per GBP	USD 356,867.48
Principal	=364,897/1.0225 = **USD 356,867.48**
Interest @4.5 % P.a (2.25% for 6 Months)	= 364,897- 356,867.48 = 8029.52
Deposit matures in USD	USD 364,897
Get USD in hands	USD 364,897
Repay GBP loan with interest	= 228,512.19 × 1.035 = **GBP 236,510.12**

iii) **Currency option** :

Lot Size	**GBP 12,500**
Strike price	1.70 USD per GBP
1 lot in USD equivalent	= 12,500 × 1.70 = USD 21,250
Exposure	USD 364,897
Lots required	= 364,897/21,250 = 17.17 ~ 17 Lots
Hedged exposure	= 21250 × 17 = USD 361,250 or **GBP 212,500**
Amount unhedged	= 364,897 – 361,250 = USD 3647

For strike price of 1.70 USD per GBP, base currency is GBP so Put option has to be entered into to sell GBP and buy USD.

Put premia	**= 0.096 USD for selling 1 GBP**
Total put premia	= 0.096 × GBP212,500 = USD 20,400
Spot rate	GBP USD 1.5617
Equivalent GBP premia (1)	= 20,400/1.5617 = GBP 13,062.69
Unhedged portion	USD 3647
Equivalent GBP outflow (2)	= 3647/1.5455 = GBP 2,359.75

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Option exercised and equivalent GBP outflow (3)	GBP 212,500
Interest on premia paid (4)	GBP 13,062.69 × 7% × 6/12 = GBP 457.19
Total outflow on account of option = 1+2+3+4	= **GBP 228,379.63**

On comparing three ways of hedging, **Currency Option** is the cheapest as compared to both forward and money market.

NOSTRO, VORO, LORO

77. Illustration

Suppose you are a dealer of ABC Bank and on 20.10.2014 you found that balance in your Nostro account with XYZ Bank in London is £65,000 and you had overbought £35,000. During the day following transaction have taken place:

	£
DD purchased	12,500
Purchased a Bill on London	40,000
Sold forward TT	30,000
Forward purchase contract cancelled	15,000
Remitted by TT	37,500
Draft on London cancelled	15,000

What steps would you take, if you are required to maintain a credit Balance of £7,500 in the Nostro A/c and keep as overbought position on £7,500? (SM)

Solution :

Exchange Position	GBP Purchased	GBP Sold
Opening balance over brought	35,000	
DD Bought	+12,500	
Purchased Bill	+40,000	
Sold forward TT		30,000
Forward Purchase cancelled		15,000
TT remittance		37,500
Draft on London Cancelled	15,000	
	102,500	**82,500**
Closing Balance Overbought	**20,000**	

Nostro Account	GBP (Dr)	GBP (Cr)
Opening Balance		65,000
TT Remittance	37,500	
Closing Balance	**27,500**	

To keep credit balance of GBP 7,500 in Nostro account, you will have to sell GBP 20,000 in spot.

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To keep overbought position in exchange Account one must buy in forward market GBP 7,500 as balance is NIL before this transaction in the exchange account.

78. Illustration

XYZ Bank, Amsterdam, wants to purchase ₹ 25 million against £ for funding their Nostro account and they have credited LORO account with Bank of London, London.
Calculate the amount of £'s credited. Ongoing inter-bank rates are per $, ₹ 61.3625/3700 & per £, $ 1.5260/70. (SM)

Solution :

Given,

	Bid	Ask
USD INR	61.3625	61.3700
GBP USD	1.5260	1.5270

GBP INR (As per **B**anker **B**ids to **B**uy **B**ase **C**urrency) = 61.3625 × 1.5260
GBP INR = 93.6392
If remittance of INR 2,50,00,000 is required then equivalent GBP = 250,00,000/93.6392 = GBP 266,982.20

GBP required to be credited to Bank of London, LORO = GBP 266,982.20

79. Illustration

ABN-Amro Bank, Amsterdam, wants to purchase ₹ 15 million against US$ for funding their Nostro account with Canara Bank, New Delhi. Assuming the inter-bank, rates of US$ is 51.3625/3700, what would be the rate Canara Bank would quote to ABN-Amro Bank? Further, if the deal is struck, what would be the equivalent US$ amount. (SM)

Solution :

Exchange rate applicable (As per **B**anker **B**ids to **B**uy **B**ase **C**urrency)= USD INR 51.3625
The rate Canara bank would quote to ABN Amro in indirect quote (INR USD) will be = 1/51.3625 = USD 0.01947 per INR.
Equivalent USD amount = 15000000 × 0.01947 = **USD 292,050**

80. Illustration

You as a forex dealer have dealing position in your account in London:

Particulars	£
Opening Balance (Oversold)	187,500
Purchase of cheques not credited to the account	164,000
Outstanding Forward Contracts:	
Sales	4,096,500
Purchases	3,651,500
DD issued not yet presented for payment	610,040
Bill purchased in hand not due for	1,442,820

What must you do to square up your position? (Sep14 MTP)

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Solution :

Exchange Position	GBP Purchased	GBP Sold
Opening balance over sold		187,500
Purchased cheques not credited	164,000	
Forward Contracts:		
Sales		4,096,500
Purchases	3,651,500	
DD Issued		610,040
Bill purchased not yet due	1,442,820	
	5,258,320	4894040
Overbought position	**364,280**	

In order to square this position, one has to sell **GBP 364,280**.

81. Illustration

You as a dealer in foreign exchange have the following position in Swiss Francs on 31st October, 2009:

	Swiss Francs
Balance in the Nostro A/c Credit	1,00,000
Opening Position Overbought	50,000
Purchased a bill on Zurich	80,000
Sold forward TT	60,000
Forward purchase contract cancelled	30,000
Remitted by TT	75,000
Draft on Zurich cancelled	30,000

What steps would you take, if you are required to maintain a credit Balance of Swiss Francs 30,000 in the Nostro A/c and keep as overbought position on Swiss Francs 10,000? (SM)

Solution :

Exchange Position	CHF Purchased	CHF Sold
Opening balance over bought	50,000	
Purchase bill on Zurich	80,000	
Sold Forward TT		60,000
Forward Purchase cancelled		30,000
Remitted by TT		75,000
Draft on Zurich cancelled	30,000	
	160,000	**165,000**
Oversold position		**5000**
Add: Spot purchase	**5000**	
Balance	**Nil**	

Nostro Account	CHF (Dr)	CHF (Cr)
Opening Balance		100,000
TT Remittance	75,000	
Add: Spot purchases		5,000

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Closing Nostro Balance	30,000	

Exchange account balance to be 10,000, so 10,000 forward has to be bought. (Balance of Nil to 10,000 over bought)

Fate of Forward Contracts

82. Illustration

On 1 October 2015 Mr. X an exporter enters into a forward contract with a BNP Bank to sell US$ 1,00,000 on 31 December 2015 at ₹ 65.40/$. However, due to the request of the importer, Mr. X received amount on 28 November 2015. Mr. X requested the bank to take delivery of the remittance on 30 November 2015 i.e., before due date. The inter-banking rates on 28 November 2015 was as follows:

Spot	₹ 65.22/65.27
One Month Premium	10/15

If bank agrees to take early delivery, then what will be net inflow to Mr. X assuming that the prevailing prime lending rate is 18%. (SM)

Solution :

Date	X Ltd	BNP Bank
On 1/10	To sell USD 100,000 @ 65.40 on 31/12	Buy USD 100,000 @65.40 on 31/12
		Back to Back : Agree to sell USD 100,000 @ rate on 31/12
On 28/11	**Early Delivery** X ltd sells USD on 28/11 @ 65.40	Bank buys 100,000 USD @ 65.40 on 28/11
		A. Sell USD 100,000 at Spot @ 65.22
		B. Buy 1 month forward for 31/12 @ 65.42
	Swap	**Interest**
28/11	Sell USD 100,000 @ 65.22	Bought USD 100,000 @ 65.40 (Outflow)
	Buy USD 100,000 @ 65.42	Sold USD 100,000 @ 65.22 (Inflow)
	Loss = USD 100,000 × (65.22-65.42) = USD 100,000 × (0.20) per USD = INR (20,000)	Net outflow = USD 100,000 × (65.40 – 65.22) = (18,000)
		Interest cost on net outflow = 18,000 × 18% × 31/365 = (275.18)

Inflow to Mr X

Contract	USD 100,000 @ 65.40 = INR 65,40,000
Less: Swap loss	(20,000)
Less : Interest cost	(275.18)
Net cash inflow	**65,19,724.82**
Cost of early delivery	= 20,000 + 275.18

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	= **20,275.18**

83. Illustration

On 15th January 2015 you as a banker booked a forward contract for US$ 250000 for your import customer deliverable on 15th March 2015 at ₹ 65.3450. On due date customer request, you to cancel the contract. On this date quotation for US$ in the inter-bank market is as follows:

Spot	₹ 65.2900/2975 per US$
Spot/ April	3000/ 3100
Spot/ May	6000/ 6100

Assuming that the flat charges for the cancellation is ₹ 100 and exchange margin is 0.10%, then determine the cancellation charges payable by the customer. (SM)

Solution :

Date	Customer	Bank
15/1	Buy USD 250,000 @ 65.3450 on 15/3	To Sell USD 250,000 @ 65.3450 on 15/3
		Back to Back : Agree to buy USD 250,000 in interbank @ rate on 15/3
15/3	Cancel the contract	Buy USD 250,000 @ 65.3450
	Pay exchange difference loss of INR 30,000	Sell in market @ spot 65.29
	Add : Flat charges INR 100	Less :exchange margin @ 0.1% = (0.06529)
	Total borne by customer = **INR 30,100**	Applicable rate = **65.2250** (rounded off)
		Loss = USD 250,000 × (65.2250 – 65.3450) = INR 30,000

Hence as a result of cancellation of contract on due date, customer has to bear cost of **INR 30,100**.

84. Illustration

You as a banker has entered into a 3 month's forward contract with your customer to purchase AUD 1,00,000 at the rate of ₹ 47.2500. However, after 2 months your customer comes to you and requests cancellation of the contract. On this date quotation for AUD in the market is as follows:

Spot	₹ 47.3000/3500 per AUD
1 month forward	₹ 47.4500/5200 per AUD

Determine the cancellation charges payable by the customer. (SM)

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Solution :

Date	Customer	Bank
1/1	Sell AUD 100,000 @ 47.25 on 31/3	To Buy AUD 100,000 @ 47.25 on 31/3
		Back to Back : Agree to sell AUD 100,000 in interbank @ rate on 31/3
1/3	Cancel the contract	Enter into 1M Buy AUD 100,000 contract @ 47.5200
		Buy from market @ 47.52 instead of customer @ 47.25
		Exchange difference Loss for bank = AUD 100,000 × (47.52 – 47.25) = 100,000 × 0.27 = INR 27,000

Hence, because of early cancellation by customer, customer has to bear loss of **INR 27,000**.

85. Illustration

Suppose you are a banker and one of your export customers has booked a US$ 1,00,000 forward sale contract for 2 months with you at the rate of ₹ 62.5200 and simultaneously you covered yourself in the interbank market at ₹ 62.5900. However, on due date, after 2 months your customer comes to you and requests for cancellation of the contract and, also requests for extension of the contract by one month. On this date quotation for US$ in the market was as follows:

Spot ₹ 62.6800/62.7200
1 month forward ₹ 62.6400/62.7400

Determine the extension charges payable by the customer assuming exchange margin of 0.10% on buying as well as selling. (SM)

Solution :

Date	Customer	Bank
1/1	Agree to sell USD 100,000 @ 62.52 on 28/2	Agrees to buy USD 100,000 @ 62.52 on 28/2
		Back to Back : Agrees to sell USD 100,000 in interbank @ 62.59 on 28/2
28/2	Seeks extension	Buy at spot @ 62.72 + 0.1% margin = 68.78272 or 68.7825 (rounded off)
	Contra : Customer to buy USD 100,000 @ 62.72 + 0.1% margin = 62.7825 (rounded off)	Instead of buying from customer @ 62.52,bank is forced to buy from market @ 62.7825

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		Hence exchange loss = USD 100,000 × (62.7825 – 62.52 = USD 100,000 × 0.2625 = INR 26,250
28/2	New contract : Sell USD 100,000 on 31/3 @ 62.64 less 0.1% margin = 62.5775 (rounded off)	New contract : Buy 100,000 USD on 31/3 @ 62.5775

The customer will enter into a new contract for USD 100,000 @ 62.5775 to be sold on 31/3 and the cancellation loss to be borne is **INR 26,250**.

86. Illustration

Suppose you as a banker entered into a forward purchase contract for US$ 50,000 on 5th March with an export customer for 3 months at the rate of ₹ 59.6000. On the same day you also covered yourself in the market at ₹ 60.6025. However, on 5th May your customer comes to you and requests extension of the contract to 5th July. On this date (5th May) quotation for US$ in the market is as follows:

Spot	₹ 59.1300/1400 per US$
Spot/ 5th June	₹ 59.2300/2425 per US$
Spot/ 5thJuly	₹ 59.6300/6425 per US$

Assuming a margin 0.10% on buying and selling, determine the extension charges payable by the customer and the new rate quoted to the customer.
Note: Rates to be rounded off to 4 decimals in multiples of 0.0025. (SM)

Solution :

Date	Customer	Bank
5/3	Agree to sell USD 50,000 @ 59.60 on 5/6	Agrees to buy USD 50,000 @ 59.60 on 5/6
		Back to Back : Agrees to sell USD 50,000 in interbank @ on 5/6
5/5	Seeks extension by 1 month	Buy 1 month forward at @59.2425 + 0.1% margin = 59.3017 or 59.3025 (rounded off)
	Contra : Customer to buy USD 50,000 @ 59.2425 + 0.1% margin = 59.3025 (rounded off)	Instead of buying from customer @ 59.60,bank is forced to buy from market @ 59.3025
		Hence exchange gain = USD 50,000 × (59.60 – 59.3025 = USD 50,000 × 0.2975 = INR 14,875
5/5	New contract : Sell USD 50,000 on 5/7 @ 59.63 less 0.1% margin = 59.5700 (rounded off)	New contract : Buy 50,000 USD on 5/7 @ 59.5700

Hence, customer will get exchange gain of INR 14,875

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87. Illustration

On 10th July, an importer entered into a forward contract with bank for US $ 50,000 due on 10th September at an exchange rate of ₹ 66.8400. The bank covered its position in the interbank market at ₹ 66.6800. How the bank would react if the customer requested on 12th September:

(i) to cancel the contract?
(ii) to execute the contract?
(iii) to extend the contract with due date to fall on 10th November?

The exchange rates for US$ in the interbank market were as below:

		10th September	12th September
Spot	US$1 =	66.1500/1700	65.9600/9900
Spot/September		66.2800/3200	66.1200/1800
Spot/October		66.4100/4300	66.2500/3300
Spot/November		66.5600/6100	66.4000/4900

Exchange margin was 0.1% on buying and selling. Interest on outlay of funds was 12% p.a. You are required to show the calculations to:

(i) cancel the Contract,
(ii) execute the Contract, and
(iii) extend the Contract as above. (PM)

Solution :

Date	Customer	Bank
10/7	2 Month forward Buy USD 50,000 @ 66.84 on 10/9	To sell USD 50,000 @ 66.84 on 10/9
		Back to Back : Agree to buy USD 50,000 in interbank @ 66.68 rate on 10/9
I		
10/9	No action	Buy interbank USD 50,000 @ 66.68
		Sell on spot USD 50,000 @ 66.15 instead of selling it to customer
		Optionally deliverable forward contract: To buy USD 50,000 @ 66.3200
12/9	Cancel request	Buy USD 50,000 on 12/9 @ 66.3200
		Sell on spot USD 50,000 @ 65.9600 (Cancellation Price) less 0.1% margin = 65.8950 (rounded off)
	Swap : Spot sold @ 66.15 USD 50,000 and Forward buy @ 66.32 USD 50,000 Loss = USD 50,000 × (66.32-66.15) = 50,000 × 0.17 INR per USD	

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	= **INR 8,500**
	Interest on cashflows : spot sale @ 66.15 USD 50,000 and Forward buy @ 66.68 USD 50,000 Loss = USD 50,000 × (66.68 -66.15) = 50,000 × 0.53 INR per USD = INR 26,500 Interest = 26,500 × 2/365 × 12% = **INR 17.42**
	Exchange difference Loss for bank = USD 50,000 × (65.8950 – 66.8400) = 50,000 × 0.945 = **INR 47,250**
	Total loss to be borne by customer on account of cancellation = 47,250 + 8,500 +17.42 = INR 55,767.42
II	Customer ask for execution
	Cancellation + New spot = INR 55,767 + USD 50,000 × (65.9900+ 0.1% margin) = 55,767 + 50,000 × 66.0550 = **INR 33,58,517**
III	Extension on 10/11 Cancellation loss + extension with new contract @ 66.49 +0.1% margin = INR 55,767 + 50,000 × 66.5575 = **INR 33,83,642**

88. Illustration

Y has to remit USD $ 1,00,000 for his son's education on 4th April 2018. Accordingly, he has booked a forward contract with his bank on 4th January @ ₹ 63.8775. The Bank has covered its position in the market @ ₹ 63.7575.

The exchange rates for USD $ in the interbank market on 4th April and 6th April were:

	4th April (₹)	6th April (₹)
Spot USD 1=	63.2775/63.2975	**63.1575/63.1975**
Spot/April	63.3975/63.4275	**63.2775/63.3275**
May	63.5275/63.5675	**63.4075/63.7650**
June	63.7775/63.8250	**63.6575/63.7275**
July	64.0700/64.1325	**63.9575/64.0675**

Exchange margin of 0.10 percent and interest outlay of funds @12 percent are applicable. The remitter, due to rescheduling of the semester, has requested on 6th April 2018 for extension of contract with due date on 14th June 2018.

Rates must be rounded to 4 decimal place in multiples of 0.0025. Calculate:

(i) Cancellation Rate;

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(ii) Amount Payable on $ 100,000;
(iii) Swap loss;
(iv) Interest on outlay of funds, if any;
(v) New Contract Rate; and
(vi) Total Cost (May 18 O)

Solution :

Date	Customer	Bank
4/1	Agree to Buy 3 Month forward USD 100,000 @ 63.8775 on 4/4	Agrees to sell USD 100,000 @ 63.8775 on 4/4
		Back to Back : Agrees to Buy USD 100,000 in interbank @ 63.7575 on 4/4
4/4	No show up	Buy USD 100,000 @ 63.7575 Sell USD 100,000 @ 63.2775
		Optionally deliverable forward contract (ODFC): Buy USD 100,000 @ 63.4275
6/4	Request for extension USD 100,000 30/6 @ 63.7275	Sell ODFC @spot 63.1575 Cancellation rate = 63.1575 – 0.1% margin = 63.0950
		New contract for USD 100,000 @ 63.7275 + 0.1% margin = 63.7900 (rounded off)
	Cancellation gain/loss = USD 100,000 × (63.8775 – 63.0950) = 100,000 × 0.7825 = **INR 78,250**	
	Swap charges : Buy USD 100,000 @63.4275 and sell USD 100,000 @ 63.2775 Loss = 100,000 × (63.4275 – 63.2775) = USD 100,000 × 0.1500 INR per USD = **INR 15,000**	
	Interest on cashflows : Buy USD 100,000 @ 63.7575 and sell USD 100,000 @ 63.2775 Cash outflow = USD 100,000 × (63.7575-63.2775) = 100,000 × 0.48 = INR 48,000 Interest for 2 days @ 12% = 48,000 × 2/365 × 12% = **INR 31.56**	
	Total amount payable on account of automatic cancellation = 78,250 + 15,000 + 32 = **INR 93,282**	

i) Cancellation rate	63.0950
ii) Exchange gain loss	INR 78,250
iii) Swap loss	INR 15,000

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iv) Interest	INR 32
v) New contract rate	63.7900
vi) Total cost	INR 93,282

89. Illustration

An importer booked a forward contract with his bank on 10th April for USD 2,00,000 due on 10th June @ ₹ 64.4000. The bank covered its position in the market at ₹ 64.2800.
The exchange rates for dollar in the interbank market on 10th June and 13th June were:

	10th June	13th June
Spot USD 1=	₹ 63.8000/8200	₹ 63.6800/7200
Spot/June	₹ 63.9200/9500	₹ 63.8000/8500
July	₹ 64.0500/0900	₹ 63.9300/9900
August	₹ 64.3000/3500	₹ 64.1800/2500
September	₹ 64.6000/6600	₹ 64.4800/5600

Exchange Margin 0.10% and interest on outlay of funds @ 12%. The importer requested on 13th June for extension of contract with due date on 10th August.
Rates to be rounded off to 4 decimals in multiples of 0.0025.
On 10th June, Bank Swaps by selling spot and buying one month forward. Calculate:

(i) Cancellation rate
(ii) Amount payable on $ 2,00,000
(iii) Swap loss
(iv) Interest on outlay of funds if any
(v) New contract rate
(vi) Total Cost (SM)

Solution :

Date	Customer	Bank
10/4	Agree to Buy 2 Month forward USD 200,000 @ 64.40 on 10/6	Agrees to sell USD 200,000 @ 64.40 on 10/6
		Back to Back : Agrees to buy USD 200,000 in interbank @ 64.2800 on 10/6
10/6	No show up	Buy USD 200,000 @ 64.2800 Sell USD 200,000 @ 63.80
		Optionally deliverable forward contract (ODFC): Buy USD 200,000 @ 63.95
13/6	Request for extension USD 200,000 10/8 @ 63	Sell ODFC @spot 63.68 Cancellation rate = 63.68 – 0.1% margin = 63.6175 (rounded off)
		New contract on 10/8 for USD 200,000 @ 64.25 + 0.1% margin = **64.3150** (rounded off)

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	Cancellation gain/loss = USD 200,000 × (64.4000– 63.6175) = 200,000 × 0.7825 = **INR 156,500**
	Swap charges : Buy USD 200,000 @ 63.9500 and sell USD 200,000 @ 63.8000 Loss = 200,000 × (63.9500 – 63.8000) = USD 200,000 × 0.1500 INR per USD = **INR 30,000**
	Interest on cashflows : Buy USD 200,000 @ 64.28 and sell USD 200,000 @ 63.8000 Cash outflow = USD 200,000 × (64.2800-63.8000) = 200,000 × 0.48 = INR 96,000 Interest for 3 days @ 12% = 96,000 × 3/365 × 12% = **INR 95**
	Total amount payable on account of automatic cancellation = 156,500 + 30,000 + 95 = **INR 186,595**

i) Cancellation rate	63.6175
ii) Exchange gain loss	INR 156,500
iii) Swap loss	INR 30,000
iv) Interest	INR 95
v) New contract rate	64.3150
vi) Total cost	INR 186,595

90. Illustration

An exporter requests his bank to extend the forward contract for US$ 20,000 which is due for maturity on 31st October, 2014, for a further period of 3 months. He agrees to pay the required margin money for such extension of the contract.

Contracted Rate – US$ 1= ₹ 62.32 The US Dollar quoted on 31-10-2014:-
Spot – 61.5000/61.5200
3 months' Discount – 0.93%/ 0.87%

Margin money from bank's point of view for buying and selling rate is 0.45% and 0.20% respectively.
Compute:
(i) The cost to the exporter in respect of the extension of the forward contract, and
(ii) The rate of new forward contract. (RTP May 15)

Solution :

Given, USD 20,000 forward maturing on 31/10/14. Forward maturity @ 62.32 INR per USD
Cancellation spot on 31/10 = 61.5000/5200
New forward for 31/10 for 3 month

i) **Cost for extension** : Since cancellation and extension is on due date, a new contract will be entered into for revised date @ spot and for existing contract cancellation gain/loss will have to be borne.

Date	Customer	Bank
31/10	Agree to sell USD 20,000 @ 62.32	Agrees to buy USD 20,000 @ 62.32 on 31/10
		Back to Back : Agrees to sell USD 20,000 in interbank @ on 31/10
31/10	Seeks extension	Cancel the contract: Spot rate applicable = 61.5200 + margin @ 0.20% = 61.6425 (rounded off)
		Exchange gain = USD 20,000 × (62.32 – 61.6425 = USD 20,000 × 0.6775 = INR 13,550

New forward contract for 3 month = Spot 61.50 – 0.93% (discount) = 60.92805
Less: Margin @ 0.45% = (0.27417)
= 60.65387 ~ 60.6550 (rounded off)
The new forward for 3 month is 60.6550

91. Illustration

An importer requests his bank to extend the forward contract for US$ 20,000 which is due for maturity on 30th October, 2010, for a further period of 3 months. He agrees to pay the required margin money for such extension of the contract.

Contracted Rate – US$ 1= ₹ 42.32
The US Dollar quoted on 30-10-2010
Spot – 41.5000/41.5200
3 months' Premium – 0.87% /0.93%

Margin money for buying and selling rate is 0.075% and 0.20% respectively. Compute:
(i) The cost to the importer in respect of the extension of the forward contract, and
(ii) The rate of new forward contract. (SM)

Solution :

Given, USD 20,000 forward maturing on 30/10/10. Forward maturity @ 42.32 INR per USD
Cancellation spot on 30/10 = 41.5000/5200
New forward for 30/10 for 3 month.

Date	Customer	Bank
Unknown	Agree to buy USD 20,000 @ 42.32	Agrees to sell USD 20,000 @ 42.32 on 30/10
		Back to Back : Agrees to buy USD 20,000 in interbank @ on 30/10
30/10	Seeks extension	Cancel the contract: Spot rate applicable = 41.5000 - margin @ 0.075%

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		= 41.4700 (rounded off)
		Exchange gain = USD 20,000 × (42.32 – 41.4700) = USD 20,000 × 0.85 = INR 17,000

i)

Rate of new forward contract:

Spot selling rate	41.5200
Add: Premium @ 0.93%	0.3861
	41.9061
Add: Margin money @ 0.20%	0.0838
	41.9899

92. Illustration

NP and Co. has imported goods for US $ 7,00,000. The amount is payable after three months. The company has also exported goods for US $ 4,50,000 and this amount is receivable in two months. For receivable amount a forward contract is already taken at ₹ 48.90.
The market rates for Rupee and Dollar are as under:

Spot	₹ 48.50/70
Two months	25/30 points
Three months	40/45 points

The company wants to cover the risk and it has two options as under:

a. To cover payables in the forward market and
b. To lag the receivables by one month and cover the risk only for the net amount. No interest for delaying the receivables is earned.

Evaluate both the options if the cost of Rupee Funds is 12%. Which option is preferable? (SM)

Solution :

a)

USD 700,000 3 Month payable cover USD INR	**48.70**
Add: 3 Month premia	0.45
	49.15
Total amount paid after 3 months	700,000 × 49.15 = INR 3,44,05,000
Export proceeds received	= USD 450,000 × 48.90 INR 2,20,05,000
Add : Interest for 1 Month on depositing export proceeds @12% P.a	= 2,20,05,000 × 12% × 1/12 = INR 2,20,050
Total inflow after 3 months	= 2,20,05,000 + 2,20,050 = **INR 2,22,25,050**
After 3 months outflow	= **INR 3,44,05,000**

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Net outflow	**= INR 1,21,79,950**

b) Lag receivable by 1 month

Payable after 3 month	**USD 700,000**
Receivable after 3 month	USD 4,50,000
Net payable after 3 month	USD 2,50,000
Enter into forward contract for 3 month USD 250,000 payable @ 49.15	
Net amount paid = 250,000 × 49.15 = **INR** 1,22,87,500	
Cancellation of receivable forward contract :	
Original rate to sell USD 450,000 after 2 months= USD INR 48.90	
To cancel : Buy USD 450,000 after 2 months = USD INR 48.70 + 0.30 = USD INR 49	
Loss = USD 450,000 × (49-48.90) = USD 450,000 × 0.10 INR per USD = **INR** 45,000	

Loss of INR 45,000 to be paid after 2 months but paid after 3 months to match cashflows.
= 45,000 × (1+1%) = 45,000 × 1.01 = **INR 45,450**
Total amount to be paid after 3 months = INR 1,22,87,500 + 45,450 = **INR 1,23,32,950**
Hence, after comparing both the options, option A is preferable as total amount to be paid is INR 1,21,79,950 as compared to INR 1,23,32,950 in option B.

93. Illustration

On 1st January 2019 Global Ltd., an exporter entered into a forward contract with BBC Bank to sell US$ 2,00,000 on 31st March 2019 at ₹ 71.50/$. However, due to the request of the importer, Global Ltd. received the amount on 28 February 2019. Global Ltd. requested the Bank to take delivery of the remittance on 2nd March 2019. The Inter- banking rates on 28th February were as follows:

Spot Rate	₹ 71.20/71.25
One month premium	5/10

If Bank agrees to take early delivery then what will be the net inflow to Global Ltd. assuming that the prevailing prime lending rate is 15%. Assume 365 days in a year. (May'19 New)

Solution :

Date	Customer	Bank
1/1/19	Agree to sell 3 Month forward USD 200,000 @ 71.50	Agrees to buy USD 200,000 @ 71.50 on 31/3
		Back to Back : Agrees to sell USD 200,000 in interbank @
28/2	Early delivery	Buy from customer USD 200,000 @ 71.50
		Buy 1M forward in interbank @ 71.25 + 0.10 = 71.35
		Sell USD 200,000 at spot @ 71.20
	Swap :	

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	Sell spot USD 200,000 @	71.20
	Buy USD 200,000 @	71.35
	Swap Loss on USD 200,000	**0.15**
	Total loss	= 200,000 × 0.15 = INR 30,000
	Interest on cashflows :	
	Buy USD 200,000	71.50
	Sell USD 200,000	71.20
	Loss on USD 200,000	**0.30**
	Total loss	= 200,000 × 0.30 = INR 60,000
	Interest = 60,000 × 15% × 31/365 = INR 764	
	Early deliver charges = INR 30,000 + 764 = INR 30,764 Net amount received = (200,000 × 71.50) – 30,764 = **INR 1,42,69,236**	

94. Illustration

On 19th January, Bank A entered into forward contract with a customer for a forward sale of US$ 7,000, delivery 20th March at ₹ 46.67. On the same day, it covered its position by buying forward from the market due 19th March, at the rate of ₹ 46.655. On 19th February, the customer approaches the bank and requests for early delivery of US$. Rates prevailing in the interbank markets on that date are as under:

Spot (₹/$) 46.5725/5800
March 46.3550/3650
Interest on outflow of funds is 16% and on inflow of funds is 12%. Flat charges for early delivery are ₹ 100.

What is the amount that would be recovered from the customer on the transaction?
Note: Calculation should be made on months basis than on days basis. (Nov 18 N)

Solution :

Date	Customer	Bank
19/1	Agree to buy 2 Month forward USD 7,000 @ 46.67	Agrees to sell forward USD 7,000 @ 46.67 on 18/3
		Back to Back : Agrees to buy USD 7,000 in interbank @ 46.655
19/2	Early delivery	Sell to customer USD 7,000 @ 46.67
		Buy USD 7,000 at spot @ 46.58
		Sell forward USD 7,000 on 20/3 @ 46.355
	Swap :	
	Sell spot USD 7,000 @	46.355
	Buy USD 7,000 @	46.58
	Swap Loss on USD 7,000	**0.225**
	Total loss	= 7,000 × 0.225 = INR 1,575
	Interest on cashflows :	
	Buy USD 7,000	46.67

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	Sell USD 7,000	46.58
	Loss on USD 7,000	**0.09**
	Total net inflow	= 7,000 × 0.09 = INR 630
	Interest received= 630 × 12% × 1/12 = INR 6.30	
	Early deliver charges = INR 1,575 - 6.30 + 100 = INR 1,668.7 Net amount paid = (7,000 × 46.67) + 1,668.7 = **INR 3,28,358.70**	

95. Illustration

A customer with whom the Bank had entered into 3 months' forward purchase contract for Swiss Francs 10,000 at the rate of ₹ 27.25 comes to the bank after 2 months and requests cancellation of the contract. On this date, the rates, prevailing, are:

Spot CHF 1 = ₹ 27.30/27.35
One month forward ₹ 27.45/27.52

What is the loss/gain to the customer on cancellation? (SM)

Solution :

Date	Customer	Bank
Day 0	Agree to sell CHF 10,000 @ 27.25	Agrees to sell CHF 10,000 @ 27.25 after 3 months
		Back to Back : Agrees to buy CHF 10,000 in interbank @ after 3 months
After 2 M	Cancellation	Buy CHF 10,000 forward 1Month @ 27.52
	Agreed to buy from customer @ 27.25 but had to purchase on 60th Day @ 27.52	
	Loss = 27.52 – 27.25 = 0.27 INR per CHF Total loss = CHF 10,000 × 0.27 = **INR 2,700**	

96. Illustration

On 1st October, 2020 Mr. Guru, an exporter, enters into a forward contract with the Bank to sell USD 1,00,000 on 31st December 2020 at INR/USD 75.40. However, at the request of the importer, Mr. Guru received the amount on 30th November, 2020. Mr. Guru requested the bank take delivery of the remittance on 30th November, 2020 i.e., before due date.

The inter-bank rate on 30th November 2020 was as follows:
Spot INR/USD 75.22-75.27
One Month Premium 10/15 Assume 365 days in a year.

(i) If bank agrees to take early delivery then what will be net inflow to Mr. Guru assuming that the prevailing prime lending rate is 18% per annum.

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(ii) If Mr. Guru can deploy these funds in USD, he gets return at the rate of 3% per annum. Which is better? Why? (Jul 21 O)

Solution :

i)

Date	Customer	Bank
1/10	Agree to sell 3 Month forward USD 100,000 @ 75.4 on 31/12	Agrees to Buy 3 Month forward USD 100,000 @ 75.4 on 31/12
		Back to Back : Agrees to sell USD 100,000 3Month forward in interbank @ 75.4
30/9	Early delivery	Buy from customer USD 100,000 @ 75.4
		Sell USD 100,000 at spot @ 75.22
		Buy forward 1Month USD 100,000 @ 75.27 + 0.15 = 75.42
	Swap :	
	Sell spot USD 100,000 @	75.22
	Buy USD 100,000 @	75.42
	Swap Loss on USD 100,000	**0.20**
	Total loss	= 100,000 × 0.20 = INR 20,000
	Interest on cashflows :	
	Buy USD 100,000	75.22
	Sell USD 100,000	75.40
	Loss on USD 100,000	**0.18**
	Total net inflow	= 100,000 × 0.18 = INR 18,000
	Interest received= 18,000 × 18% × 31/365 = INR 275.18	
	Early deliver charges = INR 20,000 + 275.18 = INR 20,275.18 Net amount received = (100,000 × 75.40) + 20,275.18 = **INR 75,19,724.82**	

ii)

If money in USD received early, they can be deployed @ 3% P.a

Interest = USD 100,000 × 3% × 31/365 **= USD 254.79**
Forward contract for 1 month to sell USD 254.79 @ 75.32 per USD ; **Amount realised = USD 254.79 × 75.32 = INR 19,190.78**
Add : Export proceeds on 31/12 @ forward rate of INR 75.4 = 100,000 × 75.4 = INR 75,40,000
Total amount received in hand = 75,40,000 + 19,190.78 = INR 75,59,190.78

On comparing above two methods, it is better to place export proceeds in USD deposit and realise higher amount.

However, the early delivery proceeds of INR 75,19,724.82 is received on 30/11 as compared to export proceeds by deposit on 30/12.

So, considering, 18% P.a is available to deposit for 1 month, amount realised after 1 month will be

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= INR 75,19,724.82 + 75,19,724.82 ×18% × 31/365 = **INR 76,34,683.90**

Hence in this case, early delivery is better.

97. Illustration

A bank enters into a forward purchase TT covering an export bill for Swiss Francs 1,00,000 at ₹ 32.4000 due 25th April and covered itself for same delivery in the local interbank market at ₹ 32.4200. However, on 25th March, exporter sought for cancellation of the contract as the tenor of the bill is changed.

In Singapore market, Swiss Francs were quoted against dollars as under:

Spot	USD 1 = Sw. Fcs.	1.5076/1.5120
One month forward		1.5150/ 1.5160
Two months forward		1.5250 / 1.5270
Three months forward		1.5415/ 1.5445

And in the interbank market US dollars were quoted as under:

Spot	USD 1 = ₹	49.4302/.4455
Spot/April		.4100/.4200
Spot/May		.4300/.4400
Spot/June		.4500/.4600

Calculate the cancellation charges, payable by the customer if exchange margin required by the bank is 0.10% on buying and selling. (SM)

Solution :

Given,

	Spot	April 25 Forward
USD INR	49.4302/4455	49.8402/**8655** (WN 1)
USD CHF	1.5076/5172	**1.5150**/5160

Date	Customer	Bank
Day 0	Agree to sell CHF 100,000 on 25/4 @ 32.40	Agrees to Buy CHF 100,000 @ 32.40 on April 25
		Back to Back : Agrees to sell CHF 100,000 in interbank @ 32.42 on April 25
After 2 M	Cancellation	Buy CHF 100,000 1 Month forward @ 32.9475 (WN 2)
	Booking rate = 32.40 and cancellation rate = 32.9475	
	Cancellation loss = 0.5475 INR per CHF	
	Total loss = CHF 100,000 × 0.5475 = **INR 54,750**	

WN 1:

Spot rate 49.4302/49.4455

Add : Forward points 0.4100/4200

Forward rate 1 Month 49.8402/8655

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WN 2:
USD CHF = 1.5150 and USD INR = 49.8655
So, CHF INR = 49.8655/1.5150 = 32.9145
Add : Margin @ 0.1% = 0.329
CHF INR = 32.9474 ~ 32.9475 (rounded off)

Others

98. Illustration – May 2022

M/s. Daksh Ltd is planning to import multipurpose machines from the USA at a cost of $15000. The company can avail loans at 19% Interest per annum with quarterly rests with which it can import the machine.

However, there is an offer from New York branch of an Indian based bank extending credit of 180 days at 2% per annum against opening of an irrevocable letter of credit.

Other Information:

Spot rate US$ 1 = ₹ 75
180 days forward rate US $ 1 = ₹ 77
The commission charges for a letter of credit at 2% per 12 months.

(i) Justify why the offer from the foreign branch should be accepted?
(ii) Based on the present market condition the company is not interested in taking the risk of currency fluctuations and wanted to hedge with an additional expense of ₹ 30,000, if so, what is your advice to the company?

Assume 360 days in the year.

Solution:

Machine Import Cost = $15,000
Local Borrowing = 19% (with Quarterly Rest)
Foreign Currency LC based borrowing = 2% p.a
LC Commission paid upfront = 2% p.a
LC tenor = 180 days
Day Convention = 360 days

USD/INR
Spot = 75
180 Forward = 77

Cost of Local Borrowing from Importer
USD to be paid = $15,000
USDINR Spot = 75
INR to be paid = 15,000* 75 = ₹ 11,25,000

Borrow at 19% p.a with Quarterly rests
A = $P * (1 + r/n)^{nt}$

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Here, n = 4
r = 19%
t = 0.5

Amount to be repaid after 180 days ,A = $11,25,000 * (1 + \frac{19\%}{4})^{4*0.5}$
= ₹ 12,34,413

Foreign Currency Borrowing
LC Value = ₹ 11,25,000
LC Commission @2% for 180 Days = $11,25,000 * 2\% * \frac{180}{360}$
= ₹ 11,250

FV of LC Commission paid = $11250 * 1.0475^2$
FV of LC Commission paid = ₹ 12,344.13 **(A)**

Interest in USD = $\$15,000 * \frac{180}{360} * 2\%$ = $ 150
Amount to be repaid after 180 days in USD = 15,000+150
= $15,150
Forward Rate after 180 days USDINR = 77
Amount to be repaid after 180 days in INR = 15,150* 77
= ₹ 11,66,550 **(B)**

Total Cost of opening LC and making a FC borrowing
A+B = ₹ 11,78,894.13

i) Offer from foreign branch of Indian bank **should be accepted** as the overall cost of Import + Borrowing is cheaper by ₹ 55,519

ii) Even if the company incurs additional amount of ₹ 30,000 towards hedging the FC borrowing is cheaper by ₹ 25,519. Hence, the **Company should borrow in FC** even in this scenario.

99. Illustration – Nov'23

A Japanese company imports hi-tech printer cartridges from US worth $1 million. The chief financial officer of the company wishes to know the best strategy for protection against uncertainty, for the payment that has to be made at the end of 3 months. Financial team of the company has collected the following options for evaluation:

Table-1: Exchange rates quoted in FOREX Market:

¥/$ Quotations	Bid Price	Offer/Ask Price
Spot Rates	146.03	146.63
3M – Forward Rates	144.03	145.00
6M – Forward Rates	146.35	146.70

Table-2 : Options Market rates for European options with 3 months expiry :

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Type of Option	Strike Price (X) (¥/$)	Premium (%) for Call & Put Options
Call & Put	145.20	1.6766% (Call) & 1.7414% (Put)
Call & Put	146.00	1.3505% (Call) & 2.1006% (Put)

The expected spot price at expiry is ¥/$: 144.90/145.05

Suggest the best strategy for CFO of the Japanese Company to protect against uncertainty, with respect to the following alternatives :

(a) Forward Hedge

(b) Buy 3 months call, X = 145.20

(c) Sell 3 months put, X = 145.20

(d) Buy call & sell put both having X = 146.00

Solution:

(i) Forward Hedge

Amount payable after 3 months

$ 1,000,000 @ Forward rate of Yen 145 Per USD = ¥ 145 million

(ii) Buy 3 month call option | Strike Price = ¥ 145.20

Premium = 1 Mio x 145.20 x 1.6766%

= Yen 2434423

= Yen 2.43 Million

Spot on Maturity Date = ¥ 145.05 The option to buy @ 145.20 will not be exercised

Accordingly the cost of import will be

Spot	¥ 145.05 million
Add: Premium Paid*	¥ 2.43 million
Total	**¥ 147.48 million**

*Time value ignored

(iii) Selling 3 month Put at Strike of ¥ 145.20

Premium Receipt ¥ 145.20 x 1.7414%x $ 1 million = ¥ 2.528 million

On Maturity the put option will be exercised as spot bid rate is 144.90 compared to put strike of ¥ 145.20

Total cost of imports will be

Buying Yen in under option after 3 month	¥ 145.20 million
Less: Premium Receipt ¥ 145.20 x 1.7414%x $ 1 million	¥ 2.528 million
Net Cost	¥ 142.67 million

(iv) Buying Call and selling Put at Strike of ¥ 146

Premium paid on call option = ¥ 146.00 x 1.3505% = ¥ 1.9717 million

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Premium Receipt on Put option = ¥ 146.00 x 2.1006% = ¥ 3.0669 million

Net premium Received = ¥ 1.0952 million

Option	Buy Call	Sell Put
Strike	146	146
Spot on Maturity	145.05	144.90
Exercised	No	Yes

Put option by buyer will be exercised. Accordingly, cost of 1 Mio USD will be

Buying US$ under Put Option	¥ 146.00 million
Less: Receipt of Net Premium	¥ 1.09520 million
Net	**¥ 144.905 million**

Decision: Selling a put option is the best course of action as the net cost buying 1 Mio USD is lowest @ Yen 142.67 Mio

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INTEREST RATE RISK MANAGEMENT (31Q)

Examples

Example 1

On 1st February 20X1 Reliance Industries Limited requires a loan for Rs.1 crore for a period of 3 months. The Company entered into a Forward Rate Agreement with SBI on 1st of January 20X1 at 7% interest per annum for a nominal of Rs.1 crore repayable after 3 months effective from 1st February. The actual rate of interest on 1st of February as per SBI is 8%. Compute the settlement amount.

Illustrations

1 Illustration (SM)

M/s. Parker & Co. is contemplating to borrow an amount of ₹ 60 crores for a Period of 3 months in the coming 6 months' time from now. The current rate of interest is 9% p.a., but it may go up in 6 months' time. The company wants to hedge itself against the likely increase in interest rate.
The Company's Bankers quoted an FRA (Forward Rate Agreement) at 9.30% p.a.
What will be the Final settlement amount, if the actual rate of interest after 6 months happens to be (i) 9.60% p.a. and (ii) 8.80% p.a.?

Solution :

Assumptions :

1) Ms. Parker & Co. entered into 6 × 9 FRA for INR 60 Crores notional @9.3% P.a
2) All the time periods are considered in months.

i) Settlement Date = 6 Months from today
Settlement value @ interest rate of 9.6% Reference rate.

Forward Agreed rate	9.3%
Notional	INR 60 Crores
Period of loan	3 Months
Loan settlement	6 Months
Reference Rate > Forward Rate	Long FRA Will gain

Settlement Value = Notional (Reference Rate – Forward Rate)× (Days to Maturity/Days in year) / (1 + Reference Rate × Days to maturity/Days in Year)

IN other Words, Settlement Value = $\frac{\mathbf{N\,(RR-FR)\times DTM/Dy}}{\mathbf{1+(RR\times\frac{DTM}{Dy})}}$

$= \frac{60\text{ Cr}\times(9.6\%-9.3\%)\times 3/12}{(1+9.6\%\times\frac{3}{12})}$ = 60 × 0.075%/1+2.4%

= 60,00,00,000 × 0.00075/1.024 = **INR 4,39,453.13.**

This amount has to be paid by bank to Ms Parker & Co.

ii) If reference rate is 8.8%, then FRA settlement value will be :

$\frac{60\text{ Cr}\times(8.8\%-9.3\%)\times 3/12}{(1+8.8\%\times\frac{3}{12})}$ = 60 × -0.5% × 0.25/1+2.2%

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= (750,000)/1.022 = INR (7,33,855.19)

This amount will be paid by Ms Parker & Co to bank on settlement date as reference rate is lower than forward rate.

2 Illustration (SM)

TM Fincorp has bought a 6 x 9 Rs. 100 crore Forward Rate Agreement (FRA) at 5.25%. On fixing date reference rate i.e., MIBOR turns out be as follows:

Period	Rate (%)
3 months	5.50
6 months	5.70
9 months	5.85

You are required to determine:

(a) Profit/Loss to TM Fincorp. in terms of basis points.

(b) The settlement amounts. (Assume 360 days in a year)

Solution :

a) 6 × 9 FRA means a loan made for 3 months. After 6 months the relevant MIBOR rate is 5.5%

Hence Reference rate (RR) = 5.5% and Forward rate(FR) = 5.25%

Profit to TM Fincorp = RR – FR = 5.5% - 5.25% = 0.25% i.e., **25 Basis Points**

Settlement Value = $\frac{N\ (RR-FR)\times DTM/Dy}{1+(RR\times\frac{DTM}{Dy})}$

$$\frac{100\ Cr\ \times (5.5\% - 5.25\%) \times 90/360}{(1 + 5.5\%\ \times \frac{90}{360})}$$

= 100 × 0.25% ×0.25 / 1 + 1.375%

= **INR 6,16,522.81**.

This money will be paid by bank to TM Fincorp.

3 Illustration (MTP April 2014)

The treasurer of Company A expects to receive a cash inflow of $15,000,000 in 90 days. The treasurer expects short-term interest rates to fall during the next 90 days. In order to hedge against this risk, the treasurer decides to use an FRA that expires in 90 days and is based on 90-day LIBOR. The FRA is quoted at 1.5%. At expiration, LIBOR is 1.25%. Assume that the notational principal on the contract is $15,000,000.

A. Indicate whether the treasurer should take a long or short position to hedge interest rate risk.

B. Using the appropriate terminology, identifying the type of FRA used here

C. Calculate the gain or loss to Company A as a consequence of entering the FRA

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Solution :

A) Since the treasurer is lending/depositing/investing and not borrowing, the treasurer will short the FRA.
B) The FRA is for 3 months deposit after 3 months, i.e., the 3 month deposit will mature in 6 months. The FRA is 3 × 6 for notional USD 15 Million.
C) Since A ltd has shorted FRA and interest rate went down, they will make a gain.

Settlement value for Long FRA = $\frac{N\,(RR-FR)\times DTM/Dy}{1+(RR\times\frac{DTM}{Dy})}$

Settlement value for short FRA = $\frac{N\,(FR-RR)\times DTM/Dy}{1+(RR\times\frac{DTM}{Dy})}$

= USD 15 Million × (1.5%-1.25%) × (90/360)/1 +1.25% × 90/360
= USD 15 Million × 0.0625%/1.3125%
= **USD 9,345.79**
Hence, The gain of USD 9,345.79 will be paid **by banker to Company A**.

4. Illustration (Nov 2019 Question Paper)

P Ltd. is contemplating to borrow an amount of ₹ 50 crores for a period of 3 months in the coming 6 months' time from now. The current rate of interest is 8% per annum but it may go up in 6 months' time. The company wants to hedge itself against the likely increase in interest rate.
The Company's Bankers quoted an FRA (Forward Rate Agreement) at 8.30% per annum.
Compute the effect of FRA and actual rate of interest cost to the company, if the actual rate of interest during consideration period happens to be (i) 8.60% p.a., or (ii) 7.80% p.a.

Solution :

i) P ltd will go long on 6 × 9 INR 50 Crores FRA @8.3%.

On fixing date if Interest rate is 8.6%. Then reference rate is greater than forward rate then P ltd will gain.
Settlement value for Long FRA = $\frac{N\,(RR-FR)\times DTM/Dy}{1+(RR\times\frac{DTM}{Dy})}$

I.e., = $\frac{50\text{ Cr}\times(8{,}6\%-8.3\%)\times3/12}{1+8.6\%\times3/12}$ = INR 50 Crores × 0.075%/1.215%
= 375,000/1.0215 = INR 367,107.20
The banker will pay to company INR 367,107.2 towards FRA. If company borrows 8.6% on fixing date then interest cost would be :
= 50 Crores × 8.6% × 3/12 = INR 1,07,50,000 payable on loan maturity date.
But it has received INR 3,67,107.2 on loan commencement date. Ignoring the FV of the amount received on FRA Settlement then, total cost of borrowing
= 107,50,000 – 367,107.20 = INR 1,03,82,892.8
Effective interest cost = 1,03,82,892.8 /50 × 12/3 = **8.306%.**
If FV of settlement amount is considered, then net interest cost = (1,07,50,000) - (367,107.2 × 1.0215) = (103,75,000).
Interest cost % = 103,75,000/50 × 12/3 = **8.3%**
Note : In previous case, we have not taken the Future Value of the amount on settlement date hence we got 8.306%, otherwise if we have considered FV of settlement amount as in latter case, we got exact 8.3%.

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ii) If interest rate is 7.8%, then settlement amount will be

$\frac{50\ Cr \times (7.8\% - 8.3\%) \times 3/12}{1 + 7.8\% \times 3/12}$ = INR 625,000/1.0195 = INR (613,045.61).

P ltd will have to pay INR 613,045.61 to bank.

Effective interest rate :

Interest cost on 50 Cr @ 7.8% for 3 months = 50 Crores × 7.8% × 3/12 = INR 97,50,000.

Add : Outflow on account of FRA = 613,045.61

Total Outflow = 97,50,000 + 613,045.61 = INR 1,03,63,045.61.

Effective cost = 103,63,045.61/ 50 Crores × 12/3 = **8.29**%.

Similarly, if we take FV of Settlement amount, we will get exact 8.3% as in case of (i).

5 Illustration (Practice Manual)

The following market data is available: Spot USD/JPY 116.00

Deposit rates p.a.	USD	JPY
3 months	4.50%	0.25%
6 months	5.00%	0.25%

Forward Rate Agreement (FRA) for Yen is Nil.

1.What should be 3 months FRA rate at 3 months forward?

2. The 6 & 12 months LIBORS are 5% & 6.5% respectively. A bank is quoting 6/12 USD FRA at 6.50 – 6.75%. Is any arbitrage opportunity available?

Solution :

1) The question is only talking about USD rates as the forward rate agreement for Yen is Nil.

Given,

0 to 3 Months deposit rate = 4.5% and 0 to 6 Months deposit rate = 5%.

Then , we need to find out deposit rate for 4 to 6 Months.

Let rate for period 4 to 6 months be X.

Then, (1+ 5%/2) = (1 +4.5%/4) × (1+X%/4)

1.025 = 1.01125 × (1+X%/4)

X%/4 = 0.013597 = X% = 0.054388

X= 5.4388%.

Hence, the 3 × 6 FRA rate for USD should be 5.4388%.

2) Given,

USD LIBORS		USD Deposit Rates	
6 Months	5%	3 Months	4.5%
12 Months	6.5%	6 Months	5%
6 × 12 USD FRA = 6.50% - 6.75%			

a) There is only 3 Months deposit rate is available and **hence no possibility of arbitrage**.

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b) For 6 months both Lending and deposit rates are same at 5%, hence there is no opportunity for arbitrage.

Let us assume the rates of lending for months 7-12 be X.
1.065 = (1+0.05/2) × (1+X%/2)
X% = 0.07804 or X = 7.804%
Thus, Interest rate for LIBOR 7 -12 Months is **7.804%.**
FRA for months 7-12 i.e., 6 × 12 FRA is at 6.5%-6.75%. Hence there is arbitrage opportunity that exists as bootstrapped rate based on LIBORs for months 7-12 is 7.804%.
Case 1 : Borrow at 5% for 6 months and 6.75% for 7 to 12 Months
: Rate for 12 months will be
= (1+5%/2) × (1+6.75%/2) -1 = (1.025) × (1.03375) -1 = **5.96%**
Borrow for 12 Months USD 100 @ 5.96% and lend @ 6.5%,
Gain = USD 0.54 per USD 100

Note : The other case of borrow at 6.5% will not result in arbitrage opportunity, as deposit rates for 6 months and 7 to 12 months are itself 5% and 6.5% respectively. Hence the weighted average lending rate will be but obvious lower than 6.5% or between 5% to 6.5%. Thus, you cannot lend at below 6.5% rate and make profit.

6 Illustration

Consider a party with a short position in IRF having to deliver a bond and there are three options available to it with spot prices as mentioned below. If the futures settlement price is Rs.110 find out which is the cheapest to deliver bond:

S. No	Bond Price ₹	Conversion Factor
1	109.55	0.88
2	106.01	0.84
3	102.09	0.83

Solution :

Futures Price	Bond	Conversion Factor	Equivalent Value	Bond Price	Gain/(Loss)
110	1	0.88	96.8	109.55	(12.75)
110	2	0.84	92.4	106.01	(13.61)
110	3	0.83	91.3	102.09	**(10.79)**

The cheapest to deliver bond is **Bond 3** as the loss is the least.

7 Illustration (CFA Institute)

A trader has sold 10-year US Treasury bond futures contracts expiring in June 20X1 and now has the obligation to deliver and the right to choose which security to deliver (the CTD bond). The futures contract reference security is a US Treasury bond with 20 years to maturity and a coupon of 6%. The T-bond futures contract size is $100,000. The futures contract settlement price is $143.47.

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The trader now needs to determine which of the two bonds in the following table is cheapest to deliver.

	Bond A	Bond B
Bond Maturity	15/02/20X7	15/05/20X8
Price ($)	120.75	128.50
Futures Settlement price	143.47	143.47
Conversion Factor	0.8388	0.8883
FV Of Bond ($)	100	100
Lot size (# of bonds)	1000	1000

Solution :

Bond	Market Price	Futures Price	Conversion Factor	Equivalent Value	Gain/(Loss)
A	120.75	143.47	0.8388	120.3426	**(0.4074)**
B	128.50	143.47	0.8883	127.4444	(1.0556)

Bond A has lower loss of USD 0.4074 per bond. Hence the trader will choose to deliver that. On one contract of 1000 Bonds, loss will be incurred:

Bond A= USD 0.4074 × 1000 = **USD 407.4** and Bond B = USD 1.0556 × 1000 = **USD 1055.6**
Hence **Bond A is chosen**.

8 Illustration (MTP FEB'14)

Suppose that a 1-year cap has a cap rate of 8% and a notional amount of ₹ 100 crore. The frequency of settlement is quarterly and the reference rate is 3-month MIBOR. Assume that 3-month MIBOR for the next four quarters is as shown below.

Quarters	3-months MIBOR (%)
1	8.70
2	8.00
3	7.80
4	8.20

You are required to compute payoff for each quarter.

Solution :

Payoff = Notional × Max (0,[R_A – R_C)] × Days/Days in a year
#*Assuming month convention*

Quarter	Reference Rate Cap	Rate Actual	Pay Off	Pay off Actual
1	8%	8.7%	100 Cr × [Max,(0,8.7% - 8%) ×3/12]	INR 17.5 Lakhs
2	8%	8%	0	0

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3	8%	7.8%	0	0
4	8%	8.2%	100 Cr × [Max,(0,8.2% - 8%) ×3/12]	INR 5 Lakhs

9 Illustration (CFA Material)

Suppose that a 1-year cap has a cap rate of 8% and a notional amount of $100 million. The frequency of settlement is quarterly, and the reference rate is 3-month LIBOR. Assume that 3-month LIBOR for the next four quarters is as shown in the following figure. Calculate the payoff for each quarter

Payoff to 8% Interest Rate Cap

Quarter	3-month LIBOR	Payoff
1	7.7%	?
2	8.0%	?
3	8.4%	?
4	8.6%	?

Solution :

Payoff = Notional × Max(0,[R_A – R_C)] × Days/Days in a year

Quarter	Reference Rate Cap	Rate Actual	Pay Off	Pay off Actual
1	8%	7.7%	USD 100 Mn × [Max,(0,7.7% -8%) ×3/12]	0
2	8%	8%	0	0
3	8%	8.4%	USD 100 Mn × [Max,(0,8.4% -8%) ×3/12]	USD 100,000
4	8%	8.6%	USD 100 MN × [Max,(0,8.6% -8%) ×3/12]	USD 150,000

10 Illustration (CFA Material)

On April 15, DH Bank makes (i.e gives) a one-year floating rate loan for $10 million. Interest payments are quarterly at LIBOR plus 200 basis points based on actual days in the period over 360. The payments are due July 15, January 15, and April 15. DH Bank purchases a nine-month quarterly pay cap for $85,000 with a strike rate of 8.5%.

Assuming LIBOR rates on April 15, July 15, October 15, and January 15 are 8.0%, 8.4%, 8.65%, and 8.4% respectively, determine the four payoff dates on the loan, the loan interest received, any option payment received, and the effective net interest earned by DH Bank.

Solution :

Given,

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Loan = USD 10 Million, Loan Start = April 15/Y1, Interest Rate = Libor + 200 Bps, Convention = A/360

Loan Interest Service Dates	Days in Period
July 15th (Year 1)	91 Days
October 15th (Year 1)	92 Days
January 15th (Year 2)	92 Days
April 15th (Year 2)	90 Days

First Floorlet is for LIBOR set on July 15th (Year 1)

Quarter	Interest Received from Borrower	Pay off from floor if any
Q1 July 15th	USD 10 Mn × (L+2%) ×91/360 = USD 10 Mn × (10%) × 91/360 = USD 252,777.78	NIL, as first floorlet starts from July 15th
Q2 October 15th (Libor on July 15th)	= USD 10 Mn × (8.4% + 2%) × 92/360 = USD 265,777.78	USD 10 Mn × Max (0,8.5%-8.4%) × 92/360 = USD 2,555.56
Q3 Jan 15th (Libor on Oct 15th)	= USD 10 Mn × (8.65% + 2%) × 92/360 = USD 272,166.67	NIL, as floor has no value, as strike price of 8.5% < Actual 8.65%
Q4 April 15th (Libor on Jan 15th)	= USD 10 Mn × (8.4% + 2%) × 90/360 = USD 260,000	=USD 10 Mn × Max (0,8.5%-8.4%) × 90/360 = USD 2,500

Total Inflow :

Quarters	Interest on floating rate loan (USD)	Floor Pay off	Total
1	252,777.78	0	USD 252,777.78
2	265,777.78	2,555.56	USD 268,333.34
3	272,166.67	0	USD 272,166.67
4	260,000	2,500	USD 265,000
Total			**USD 10,55,777.79**
Less : Cost of floor			USD 85,000
Net Interest Income			**USD 9,70,777.79**

11 Illustration (CFA Material)

On December 15, DH Bank issues a $50 million "two year" floating rate liability. The four interest payments are based on 180-day LIBOR plus 150 basis points. The first interest rate is set today with payment 180 days thereafter. Each loan payment is 180 days after the preceding payment. To hedge against rising interest rates, the bank buys an appropriate interest rate cap with a strike rate of 4.75%. To fully offset the initial cost of the cap, the bank sells a floor with a strike rate of 2.25%.

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Initial LIBOR is 3.40%. Assuming that in 180, 360, 540 and 720 days LIBOR rates are 4.00%, 5.10%, 2.00% and 1.75%, respectively, calculate the net interest paid by the bank on each payment date and show all the cash flows leading to that next payment.
Explain the cost of the collar.

Solution:

DH Bank = USD 50 Mn Bank 2 Year 6 M LIBOR + 150 Bps Loan
CAP = 4.75% and Floor = 2.25%

LIBOR Rates	Days	From Date	Applicable Rate	Loan Rate (LIBOR + 150 Bps)
3.4%	0	1/1/20X1	**3.4%**	**4.9%**
4%	180	30/6/20X1	**4%**	**5.5%**
5%	360	1/1/20X2	**5.1%**	**6.6%**
2%	540	30/6/20X2	**2%**	**3.5%**
1.75%	720	1/1/20X3		

Period	LIBOR Applicable	Impact of CAP Max [0, $R_a - R_c$] (4.75%)	Impact of Floor -Max [0, $R_f - R_a$] (2.25%)
H1 180 Days	3.4%	0	0
H2 360 Days	4%	0	0
H3 540 Days	5.1%	0.35%	0
H4 720 Days	2%	0	-0.25%

Total Interest Cost :

Periods	Loan USD Million	Loan Interest Rate	Interest (USD Million)	Collar	Impact of collar (USD Million)
H1	50	4.9%	1.225	0	
H2	50	5.5%	1.375	0	
H3	50	6.6%	1.65	+ 0.35%	+0.0875
H4	50	3.5%	0.875	- 0.25%	- 0.0625

Total Interest cost including impact of collar :

Periods	Total Interest (USD Million)
H1	1.225
H2	1.375
H3	=1.65- 0.0875 = 1.5625
H4	= 0.875 – (0.0625) = 0.9375 = 0.9375

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12 Illustration (Practice Manual)

XYZ Inc. issues a £ 10 million floating rate loan on July 1, 2013 with resetting of coupon rate every 6 months equal to LIBOR + 50 bp. XYZ is interested in a collar strategy by selling a Floor and buying a Cap. XYZ buys the 3 years Cap and sell 3 years Floor as per the following details on July 1, 2013:

Notional Principal Amount	**$ 10 million**
Reference Rate	6 months LIBOR
Strike Rate	4% for Floor and 7% for Cap
Premium	0*

*Since Premium paid for Cap = Premium received for Floor

Using the following data, you are required to determine:

(i) Effective interest paid out at each reset date,

(ii) The average overall effective rate of interest p.a.

Reset Date	**LIBOR (%)**
31-12-2013	6.00
30-06-2014	7.50
31-12-2014	5.00
30-06-2015	4.00
31-12-2015	3.75
30-06-2016	4.25

Solution :

Given, Loan & Collar Notional GBP 10 Million, Start Date = 1/7/2013, Loan Rate = 6M L + 50 Bps Floor = 4% Cap = 7% and 3 Year Loan

Assumption : Actual/365 Days Convention Used

Interest Service Dates	**LIBOR (%)**	**Outflow (Floor) 4%**	**Inflow (Cap) 7%**	**Total Cost (L+ 50 Bps – Cap + Floor**
31/12/2013	6			6.5%
30/6/2014	7.5		Max (0,7.5%-7%) =0.5%	7.5%
31/12/2014	5			5.5%
30/6/2015	4			4.5%
31/12/2015	3.75	Max (0,4-3.75%) =0.25%		4.5%
30/6/16	4.25			4.75%

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Interest paid:

Dates	Total Interest Rate	Days	Total Interest Cost (GBP)	Cap Inflow (GBP)	Floor Outflow (GBP)
31/12/2013	6.5%	184	327,671		
30/6/2014	7.5%	181	371,918	24,795	
31/12/2014	5.5%	184	277,260		
30/6/2015	4.5%	181	223,151		
31/12/2015	4.5%	184	226,849		12,603
30/6/16	4.75%	182	236,849		
Total Interest					**16,63,698**

Effective Interest Rate
=16,63,698/30,000,000
= 5.55%
If compounded HY, interest rate will be 5.62%

13 Illustration (SM)

XYZ Limited borrows £ 15 Million of six months LIBOR + 10.00% for a period of 24 months. The company anticipates a rise in LIBOR; hence it proposes to buy a Cap Option from its Bankers at the strike rate of 8.00%. The lump sum premium is 1.00% for the entire reset periods and the fixed rate of interest is 7.00% per annum. The actual position of LIBOR during the forthcoming reset period is as under:

Reset Period	LIBOR
1	9.00%
2	9.50%
3	10.00%

You are required to show how far interest rate risk is hedged through Cap Option.

For calculation, work out figures at each stage up to three decimal points and amount nearest to £. It should be part of working notes.

Solution :

Given, GBP 15 Million Loan
Premia = 1% Paid over the period
Premia = Prem% × loan Value / PVIF (4 Periods, 3.5%)
= (1% × GBP 15 Million)/PVIFA (3.5%,4)
= 150,000/3.673
= GBP 40,837

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Periods	GBP	Cap	Cap Payoff Max (0, R_a- R_c)	Total Interest rate (LIBOR CAP + 10%)
H2	9%	8%	1%	18%
H3	9.5%	8%	1.5%	18%
H4	10%	8%	2%	18%

Periods	Interest Before Cap		Cap Payoff		Interest after Cap
	%	GBP (Mn)	%	GBP	GBP (Mn)
H2	19	1.425	1	75,000	13,50,000
H3	19.5	1.4625	1.5	112,500	13,50,000
H4	20	1.5	2	150,000	13,50,000

Net Interest Cost after premia

Period	Interest	Less : Cap Premia	Net Inflow
H2	13,50,000	40,837	13,09,163
H3	13,50,000	40,837	13,09,163
H4	13,50,000	40,837	13,09,163

Cap Payoff after Inflow	Premia Outflow	Net Received
75,000	40,837	34,163
112,500	40,837	71,663
150,000	40,837	109,163
337,500	122,511	**214,989**

Benefit from using Cap is **GBP 214,989** as the cost is reduced from 337,500 which is increase in Interest rate.

14 Illustration (Practice Manual)

Two companies ABC Ltd. and XYZ Ltd. approach the DEF Bank for FRA (Forward Rate Agreement). They want to borrow a sum of ₹ 100 crores after 2 years for a period of 1 year. Bank has calculated Yield Curve of both companies as follows:

Year	XYZ Ltd.	ABC Ltd.*
1	3.86	4.12
2	4.20	5.48
3	4.48	5.78

*The difference in yield curve is due to the lower credit rating of ABC Ltd. compared to XYZ Ltd.

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(i) You are required to calculate the rate of interest DEF Bank would quote under 2V3 FRA, using the companies yield information as quoted above.

(ii) Suppose bank offers Interest Rate Guarantee for a premium of 0.1% of the amount of loan, you are required to calculate the interest payable by XYZ Ltd. if interest rate in 2 years turns out to be
(a) 4.50%
(b) 5.50%

Solution:

i)

Year	XYZ	ABC
1	3.86	4.12
2	4.20	5.48
3	4.48	5.78

XYZ Ltd:

By bootstrapping, forward rate for year 2 will be
$(1.0386) \times (1+f2) = (1.042)^2$, F2 = 4.54%
Similarly for year 3, $(1.042)^2 \times (1+F3) = (1+0.0448)^3$, F3 = 5.04%
Hence, FRA Rate for 2V3 for XYZ = **5.04%**

ABC Ltd:

$(1+ Y2)^2 \times (1+ F3) = (1+Y3)^3$
$(1+ 0.548)^2 (1+F3) = (1.0578)^3$, F3 = 6.38%
Hence, FRA Rate for 2V3 for ABC = **6.38%**

ii) Premia = 0.1% of INR 100 cr= INR 10 Lakhs

XYZ Paid premia and entered into FRA

a) In case of 4.5% Interest, XYZ will forego premia and avail the loan at 4.5%.Interest cost = INR 100 Crores × 4.5% = INR 4,50,00,000.
Add : Premia Paid = 10,00,000

Total Cost = INR 4,60,00,000

b) In case of interest rate at 5.5%,then company will exercise the option and borrowing will be at 5.04%

Interest cost = INR 100 Crores × 5.04% = INR 5,04,00,000
Add: Premia paid = INR 10,00,000
Total Cost = INR 5,14,00,000

15 Illustration (Practice Manual)

Electraspace is consumer electronics wholesaler. The business of the firm is highly seasonal in nature. In 6 months of a year, firm has a huge cash deposits and especially near Christmas time and other 6

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months firm cash crunch, leading to borrowing of money to cover up its exposures for running the business.

It is expected that firm shall borrow a sum of €50 million for the entire period of slack season in about 3 months.

A Bank has given the following quotations:

Spot	5.50% - 5.75%
3 × 6 FRA	5.59% - 5.82%
3 × 9 FRA	5.64% - 5.94%

3 month €50,000 future contract maturing in a period of 3 months is quoted at 94.15 (5.85%). You are required to determine:

(a) How an FRA, shall be useful if the actual interest rate after 3 months turnout to be:
(i) 4.5%
(ii) 6.5%

(b) How 3 months Future contract shall be useful for company if interest rate turns out as mentioned in part (a) above.

Solution :

a)

Interest Rate	4.5%	6.5%
EURO 50 Million FRA, 3 × 9 FRA @ 5.94%		
Interest paid by Electraspace (Mn)	(1.125)	1.625
FRA Receipt on net cash settlement (Mn)	= 50 Mn × (5.94%-4.5%) ×6/12 = (0.360)	=50 Mn × (6.5%-5.94%) ×6/12 = 0.140
Total Outflow	EURO 1.485 Mn	EURO 1.485 Mn

Due to FRA, interest cost of Electraspace is frozen @ EURO 1.485/50Mn × 12/6= 5.94 %

b) Futures rate contract instead of FRA.

Electraspace will short futures worth EURO 50 Mn.

No of contracts = EURO 50 Mn/50,000 × Duration of loan/Future Maturity

= 1000 × 6/3= 2000 Contracts

Interest Rate	**4.5%**	**6.5%**
Future sale price on Day 0 @ 5.85%	94.15	94.15
Futures Price after 3 Months	100-4.5 =95.5	100-6.5= 93.5
Loss	= 95.5 – 94.15 = 1.35%	
Gain		= 94.15-93.5 = 0.65%

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Total Gain/(loss)	=50,000 × 2000 × 1.35% ×3/12 = (3,37,500)	=50,000 × 2000 × 0.65% ×3/12 = 1,62,500
Interest Cost @ Market rate	= EURO 50 Mn × 4.5% ×6/12 = EURO 1.125 Mn	= EURO 50 Mn × 6.5% ×6/12 = EURO 1.625 Mn
Add : Gain/(Loss)	0.3375 Mn	(0.1625 Mn)
Net	**1.4625 Mn**	**1.4625 Mn**
Implied Interest Rate = 1.4625 /50 × 12/6 = 5.85%		

16 Illustration (SM)

A textile manufacturer has taken floating interest rate loan of ₹ 40,00,000 on 1st April, 2012. The rate of interest at the inception of loan is 8.5% p.a. interest is to be paid every year on 31st March. In the month of October 2012, the Central bank of the country releases following projections about the interest rates likely to prevail in future.

(i) On 31st March, 2013, at 8.75%; on 31st March, 2014 at 10% on 31st March, 2015 at 10.5% and on 31st March, 2016 at 7.75%. Show how this borrowing can hedge the risk arising out of expected rise in the rate of interest when he wants to peg his interest cost at 8.50% p.a.

(ii) Assume that the premium negotiated by both the parties is 0.75% to be paid on 1st October, 2012 and the actual rate of interest on the respective due dates happens to be as: on 31st March, 2013 at 10.2%; on 31st March, 2014 at 11.5%; on 31st March, 2015 at 9.25%; on 31st March, 2016 at 8.25%. Show how the settlement will be executed on the perspective interest due dates.

Solution :

Loan Date : 1/04/12, Loan Amount = INR 40 Lakhs

Period	Interest Rate Cap (%)	Interest Rate Actual (%)
12-13	8.5	8.5
13-14	8.75	10.2
14-15	10	11.5
15-16	10.5	9.25
16-17	7.75	8.25

i) The textile manufacturer should go long on Interest rate cap to ensure interest rate borrowing is capped at 8.5%.

ii) Premia to be paid = 0.75% × 40 Lakhs = **INR 30,000**

Particulars	Interest on Loan	Cap Pay off (8.5%)	Total
2012-13	@ 8.5% on 40 Lakhs = 3.4 Lakhs	-	3.4 Lakhs
2013-14	@10.2% on 40 lakhs = 4.08 Lakhs	(10.2%-8.5%) × 40 lakhs = INR 68 Lakhs	= 4.08 – 0.68 = 3.4 Lakhs
2014-15	@11.5% on 40 lakhs = 4.6 Lakhs	(11.5%-8.5%) × 40 lakhs = INR 1.2 Lakhs	= 4.6 – 1.2 = 3.4 Lakhs
2015-16	@9.25% on 40 Lakhs = 3.7 Lakhs	Gain = (9.25%- 8.5%) × 40 lakhs = 0.3 Lakhs	= 3.7 – 0.3 Lakhs = 3.4 Lakhs

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Assumption : The borrowing was made on 1/4/12. So, for year 12-13, rate as on 1/4/12 will be applicable and not as on 31/3/13 and hence the rate as on 31/3/13 the last payment date is not relevant.

17 Illustration (SM)

Suppose a dealer quotes 'All-in-cost' for a generic swap at 8% against six month LIBOR flat. If the notional principal amount of swap is ₹5,00,000.

(i) Calculate semi-annual fixed payment.

(ii) Find the first floating rate payment for (i) above if the six-month period from the effective date of swap to the settlement date comprises 181 days and that the corresponding LIBOR was 6% on the effective date of swap.
In (ii) above, if the settlement is on 'Net' basis, how much the fixed rate payer would pay to the floating rate payer?

Generic swap is based on 30/360 days basis.

Solution :

i) Semi-annual fixed payment = Notional ×Dt/360 × Interest Rate

= INR 500,000 × $\frac{1}{2}$ ×8% = 20,000

ii) INR 500,000 × 181/360 × 6% = INR 15,083

iii) If settlement is on net basis, the fixed rate payer will pay INR 4,917 i.e., (INR 20,000 -15,083)

Assumption : For floating rate payment, 181/360 day convention is used, and for fixed rate payment, $\frac{1}{2}$ Month convention is used.

18 Illustration (Jul'21 New)

P Ltd., a dealer quotes 'All-in-cost' for a generic swap at 6% against six months LIBOR flat. If the Notional principal amount of swap is ₹ 8,00,000:

(i) Calculate semi-annual fixed payment.

(ii) Find the first floating rate payment for (i) above if the six month period from the effective date of swap to the settlement date comprises 181 days and that the corresponding LIBOR was 5% on the effective date of swap. (Consider up to three decimal places).

(iii) In question number (ii) above, if the settlement is on 'Net' basis, how much the fixed rate payer would pay to the floating rate payer?

Note: Generic swap is based on 30/360 days basis.

Solution :

For generic swap the semi fixed annual fixed rate payment = Notional × All in Cost × 180/360

i) Semi Annual fixed payment =800,000 × 6% × 180/360 = **INR 24,000**

ii) Floating Rate payment =INR 800,000 × 181/360 × 5% = **INR 20,111.111**

iii) If settlement is on net basis, the fixed rate payer will pay **INR 3,888.88** i.e., (INR 24,000 -20,111.11)

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19 Illustration (SM)

Derivative Bank entered into a plain vanilla swap through on OIS (Overnight Index Swap) on a principal of ₹ 10 crores and agreed to receive MIBOR overnight floating rate for a fixed payment on the principal. The swap was entered into on Monday, 2nd August, 2010 and was to commence on 3rd August, 2010 and run for a period of 7 days.

Respective MIBOR rates for Tuesday to Monday were:
7.75%,8.15%,8.12%,7.95%,7.98%,8.15%.
If Derivative Bank received ₹ 317 net on settlement, calculate Fixed rate and interest under both legs.

Notes:

(i) Sunday is Holiday.

(ii) Work in rounded rupees and avoid decimal working.

Solution :

Days	Interest Rate (%)	Principal	Interest
Tuesday	7.75	10,00,00,000	21,233
Wednesday	8.15	10,00,21,233	22,334
Thursday	8.12	10,00,43,567	22,256
Friday	7.95	10,00,65,823	21,795
Saturday	7.98	10,00,87,618	21,882
Sunday	7.98	10,01,09,500	21,887
Monday	8.15	10,01,31,387	22,358
Total			**153,745**

If on Sunday interest is also compounded, then interest for Sunday is INR 21,887, otherwise it is INR 21,882.

To be received on floating = 153,745
Net received = INR 317
Paid fixed = 153,745 – 317 = INR **153,428**
Fixed rate for which interest is INR 153,428 on INR 10,00,00,000 for 7 days is **8%** (153,428/10 Cr ×365/7)

20 Illustration (May 2018 New)

Punjab Bank has entered into a plain vanilla swap through on Overnight Index Swap (OIS) on a principal of ₹ 2 crore and agreed to receive MIBOR overnight floating rate for a fixed payment on the principal. The swap was entered into on Monday, 24th July, 2017 and was to commence on 25th July, 2017 and run for a period of 7 days.
Respective MIBOR rates for Tuesday to Monday were:
8.70%, 9.10%, 9.12%, 8.95%, 8.98% and 9.10%.
If Punjab Bank received ₹ 507 net on settlement, calculate Fixed rate and interest under both legs.

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Notes:

(i) Sunday is a Holiday.

(ii) Workout in rounded rupees and avoid decimal working.

(iii) Consider a year consists of 365 days.

Solution :

Days	Interest Rate (%)	Principal	Interest
Tuesday	8.7	2,00,00,000	4767
Wednesday	9.1	2,00,04,767	4987
Thursday	9.12	2,00,09,754	5000
Friday	8.95	2,00,14,754	4908
Saturday	8.98	2,00,19,662	9851
Sunday	8.98	2,00,19,662	
Monday	9.10	2,00,29,153	4994
Total			**34,507**

To be received on floating = 34,507

Net received = INR 507

Paid fixed = 34,507 – 507 = **INR 34,000**

Fixed rate for which interest is INR 34,000 on INR 2,00,00,000 for 7 days is **8.86%** (34,000/2 Cr ×365/7)

Interest rate for Saturday and Sunday is computed as 2 Day interest based on rate prevailing on Saturday.

21 Illustration (Nov '20 New)

IB an Indian firm has its subsidiary in Japan and Zaki a Japanese firm has its subsidiary in India and face the following interest rates:

Company	IB	Zaki
INR floating rate	BPLR + 0.50%	BPLR + 2.50%
JPY (Fixed rate)	2%	2.25%

Zaki wishes to borrow Rupee Loan at a floating rate and IB wishes to borrow JPY at a fixed rate. The amount of loan required by both the firms is same at the current exchange rate. A financial institution may arrange a swap and requires 25 basis points as its commission. Gain, if any, is to be shared by the firms equally.

You are required to find out:

(i) Whether a swap can be arranged which may be beneficial to both the firms?

(ii) What rate of interest will the firms end up paying?

Solution :

Given,

	Zaki	IB
Wanted	YEN Fixed	INR Floating
Got	INR Floating	YEN Fixed

i) Yes, Swap is possible

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ii) IB wants YEN fixed rate loan and Zaki wants INR Floating rate loan.

Total loan required = 2% + BPLR + 2.5% = **BPLR + 4.5%**

Alternatively,
IB get floating at BPLR + 0.5% and Zaki Gets fixed at 2.25%.
Total cost then would be = **BPLR + 2.75%**

Total Saving if swap is entered into	= (BPLR +4.5% - BPLR + 2.75%) = 1.75%
Less : Commission	0.25%
Net Gain	1.5%
Shared Equally	0.75% each

Firms	**Zaki**	**IB**
Original Cost	BPLR + 2.5%	2%
Less : Savings (As calculated above)	0.75%	0.75%
Net Cost	**BPLR + 1.75%**	**1.25%**

22 Illustration (May 19 Old)

IM is an American firm having its subsidiary in Japan and JI is a Japanese firm having its subsidiary in USA: They face the following interest rates

	IM	**JI**
USD Floating rate	LIBOR+0.5%	LIBOR+2.5%
JPY Fixed rate	4%	4.25%

IM wishes to borrow USD at floating rate and JI JY at fixed rate. The amount required by both the companies is same at the current Exchange Rate. A financial institution requires 75 basis points as commission for arranging Swap. The companies agree to share the benefit/ loss equally.
You are required to find out

(i) Whether a beneficial swap can be arranged?
(ii) What is the rate of interest for both IM and JI ?

Solution :

Cost of loan want	= LIBOR+ 0.5% + 4.25% = LIBOR +4.75%
Cost of loan after swap	= LIBOR + 2.5% + 4% = LIBOR + 6.5%

i) No, a beneficial swap cannot be arranged as on **swapping cost increases** from LIBOR + 4.75% to LIBOR + 6.5%

ii) Their **existing rates are better**, IM @ LIBOR + 0.5% and JI @ 4.25%.

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23 Illustration (SM)

A Inc. and B Inc. intend to borrow $200,000 and $200,000 in ¥ respectively for a time horizon of one year. The prevalent interest rates are as follows:

Company	¥ Loan	$ Loan
A Inc	5%	9%
B Inc	8%	10%

The prevalent exchange rate is $1 = ¥120.

They entered in a currency swap under which it is agreed that B Inc will pay An Inc @ 1% over the ¥ Loan interest rate which the later will have to pay as a result of the agreed currency swap whereas A Inc will reimburse interest to B Inc only to the extent of 9%. Keeping the exchange rate invariant, quantify the opportunity gain or loss component of the ultimate outcome, resulting from the designed currency swap.

Solution :

B Books

Borrow in USD	**200,000 @ 10%**
Pay Interest in USD	(20,000)
Receive Interest from A @9%	18,000
Shortfall (USD)	2,000
B will Pay A 6% in YEN on equivalent of USD 200	
USD payment	=200,000 × 6% = USD 12,000 or YEN = 12,000 × 120 = YEN 14,40,000
Add : Shortfall in YEN	= 2000 × 120 = 2,40,000
Total YEN Costs	YEN 16,80,000
Interest %	= 16,80,000/120= USD 14000 = 14000/200000 =**7%**

A's Books

Paid Interest in YEN	200,000 × 120 ×5% = (YEN 12,00,000)
Add: YEN interest received from B	= YEN 14,40,000
Gain in YEN	YEN 2,40,000
Gain in USD	= 2,40,000/120 = USD 2,000
Interest paid to B on B's Loan	USD 18,000
Net Interest Outflow	= USD 16,000
Interest %	= 16,000/200,000 = **8%**

Hence, both the parties have reduced the cost as explained above.
A will borrow in YEN 2,40,00,000 and **swap it with B** for USD 200,000 who has borrowed same from its bank.

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24 Illustration (RTP Nov'11)

Euroloan Bank has a differential advantage in issuing variable-rate loans, but wishes to avoid the income risk associated with such loan. Currently bank has a portfolio €25,000,000 loans with PLR + 150bp, reset monthly PLR is currently 4%.
IB an investment bank has arranged for Euroloan to swap into a fixed interest payment of 6.5% on notional amount of loan for its variable interest income.
If Euroloan agrees to this, what amount of interest is received and given in the first month? Further, assume that PLR increased by 200 bp.

Solution :

PLR + 150 Vs	6.5%
Loan	EURO 25 Million
Interest on Var loan is swapped for fixed payment. So fixed rate is received on account of swap and whatever variable interest is received from borrower is passed onto the other party is swapped.	

Step 1: Receive PLR + 1.5% on EURO 25 Million	= 25 Mn × 5.5% ×1/12 = EURO 114,583.33
Step 2: Pass on this interest to swap counterparty	(114,583.33)
Step 3: Receive fixed payment @6.5%	EURO 135,416.66
Net Gain	**EURO 20,833.33**
On Second month, if PLR Rises by 2%	
Step 1: Receive interest from borrowers @ 7.5%	EURO 156,250
Step 2: Pay to swap counterparty	(EURO 156,250)
Step 3: Receive interest 6.5% from swap counterparty	(EURO 135,416.67)
Net Loss	**EURO 20,833.33**

Hence, If PLR increases, the bank losses **EURO 20,833.33**

25 Illustration (RTP Nov 11)

A Ltd. is considering a ₹ 50 crores 3 year interest rate swap. The company is interested in borrowing at floating rate however, due to its good credit rating, it has a comparative advantage over lower rated companies in fixed rate market. It can borrow at fixed rate of 6.25% or floating rate MIBOR+0.75%.
Presently, MIBOR is 5.25% but is expected to change in 6 months due to political situation in the country. X Ltd. an intermediary bank agreed to arrange a swap. The bank will offset the swap risk with a counter party (B. Ltd.) a comparative lower credit rated company, which could borrow at a fixed rate of 7.25% and floating rate of MIBOR + 1.25%. X Ltd. would charge ₹ 12,00,000 per year as its fee from each party. Mr. Fin the CFO, of A Ltd. desires that A Ltd. should receive 60% of any arbitrage saving (before payment of fees) from the swap as A Ltd. enjoying high credit rating.

Any fees paid to the bank are tax allowable. The applicable tax rate is 30%. You are required to:

(a) Evaluate whether the proposal is beneficial for both parties or not.

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(b) Assuming that MIBOR was to increase to 5.75% immediately after political crisis over and shall remain constant for the period of swap. Evaluate the present value of savings from the swap for A Ltd., assuming that interest payment are made semi-annually in arrears.

Solution :

Loan = INR 50 Crores

	Fixed	Floating
A Ltd	MIBOR + 75 Bps	6.25%
B Ltd	MIBOR + 125 Bps	7.25%

a) If A Borrows fixed and B Floating, then total cost would be M + 750 Bps which is 50 Bps lower than A floating and B Fixed and they both will swap.

Total saving P.a = 50 Bps on INR 50 Crores i.e., 25 Lakhs.

A will get INR 15 Lakhs (60%) and B will get 10 Lakhs (40%), I.e., 30 Bps and 20 Bps respectively.

Benefit	**A**	**B**
Reduction in Interest P.a	INR 15 Lakhs	INR 10 Lakhs
Banker Fees P.a	INR 12 Lakhs	INR 12 Lakhs
Net Saving	3 Lakhs	(2 Lakhs)
Less : Tax @30%	INR 90,000	(INR 60,000)
	INR 2,10,000	**INR 1,40,000**

Hence, the swap is beneficial only for A as their net savings (Post tax) is INR 2,10,000 Vs net loss on INR 140,000 for B Ltd.

b) MIBOR for next 2.5 years = 5.75%; Cost of loan to A :

Original Cost	MIBOR + 75 Bps
Less: Savings on Account of Swap	30 Bps
Net Cost	**MIBOR + 45 Bps**

Savings to A :	**30 Bps P.a per Interest Payment**
Loan = 50 Crores	
Discount Rate	= 5.75% + 0.45% = 6.2% or 3.1% for 3 Months
PVIFA @ 3.1% for 5 Periods	4.5667
After tax savings	= 4.5667 × 5.25 Lakhs = INR 23.97 Lakhs
Payment to X Ltd	12 Lakhs P.a
Present value for brokerage for 5 periods	= 600,000 × 4.5667 × 0.7 = INR 19.18 Lakhs
Net savings	= 23.97 – 19.18 = **INR 4.79 Lakhs**

Interest Payments	**Savings @ 30 Bps**	**Less : Tax @ 30%**	**Discounting @ 3.1%**
1	Done		
2	750,000	525,000	0.9699
3	750,000	525,000	0.9407
4	750,000	525,000	0.9125

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5	750,000	525,000	0.8850
6	750,000	525,000	0.8584

Note : If post tax interest rate is considered i.e., 6.2% × 0.7= 4.34% P.a then net savings will be INR 4.92 Lakhs

26 Illustration (SM Forex)

Drilldip Inc. a US based company has a won a contract in India for drilling oil field. The project will require an initial investment of ₹ 500 crore. The oil field along with equipment will be sold to Indian Government for ₹ 740 crore in one year time. Since the Indian Government will pay for the amount in Indian Rupee (₹) the company is worried about exposure due exchange rate volatility.

You are required to:

(a) Construct a swap that will help the Drill dip to reduce the exchange rate risk.

(b) Assuming that Indian Government offers a swap at spot rate which is 1US$ = ₹ 50 in one year, then the company should opt for this option or should it just do nothing. The spot rate after one year is expected to be 1US$ = ₹ 54. Further you may also assume that the Drill dip can also take a US$ loan at 8% p.a. (SM Forex)

Solution:

a) Drill dip should **hedge** its INR receivables that it will convert at later date today itself so that it is not exposed to forex risks. If INR depreciates they will get **fewer dollars to remit back.**

b) Swap with GOI

Investment 500 crores @USD INR 50	USD 100 Million
Less : Interest Cost @8% on Borrowings	(USD 8 Million)
Add: Sale Proceeds INR 740 Crores @ USD INR 50	USD 148 Million
Net Gain	**USD 40 Million**
Assumption : GOI Agrees to Swap	

If GOI Swaps only initial investment then with swap gains is as follows

Investment 500 crores @USD INR 50	USD 100 Million
Less : Interest Cost @8% on Borrowings	(USD 8 Million)
Add: Sale Proceeds INR 500 Crores @ USD INR 50	USD 100 Million
Profit Converted INR 240 Crores USD INR 54	USD 44.44 **Million**
Net Gain	**USD 36.44 Million**

Without Swap

Investment 500 crores @USD INR 50	USD 100 Million
Less : Interest Cost @8% on Borrowings	(USD 8 Million)
Add: Sale Proceeds INR 740 Crores @ USD INR 54	USD 137.04 Million
Net Gain	**USD 29.04 Million**

Hence, Drill Dip **should swap** and lock gain of **USD 40 Million**.

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27 Illustration (Jan'21 New)

XYZ has taken a six-month loan from its foreign collaborator for USD 2 million. Interest is payable on maturity @ LIBOR plus 1%. The following information is available:

Spot Rate	**INR/USD**	**68.5275**
6 months Forward rate	INR/USD	68.4575
6 months LIBOR for USD		2%
6 months LIBOR for INR		6%

You are required to :

(i) Calculate Rupee requirements if forward cover is taken.

(ii) Advise the company on the forward cover.

What will be your opinion if spot rate of INR/USD is 68.4275 ?

Solution : i)

Loan	USD 2 Million
Period	6 Months
Interest	L+ 100 Bps = 2% + 1% = 3% P.a
Interest Payable	= USD 2 Million ×3% × 6/12 = USD 30,000
Total Payment after 6 Months	= USD 2,000,000 + 30,000 = **USD 2,030,000**
Forward rate	USD INR 68.4575
Total INR Required after 6 Months	= 2,030,000 × 68.4575 = INR **13,89,68,725**

ii) Ideal Spot as per Interest rate parity = S × (1+D)/(1+F) = 68.5275 × (1+6%/2)/(1+2%/2)
= **INR 69.8844**

Current forward = 68.4575
Forward is better than probable spot after 6 months. Hence take forward cover.
If Spot is 68.4275, then as per IRP, expected spot after 6 Months is 69.7825 (68.4275 × 1.03/1.01)
Even then, **take forward cover** as expected spot is greater than forward rate.

28 Illustration (May'19 New)

K Ltd. currently operates from 4 different buildings and wants to consolidate its operations into one building which is expected to cost ₹90 crores. The Board of K Ltd. had approved the above plan and to fund the above cost, agreed to avail an External Commercial

Borrowing (ECB) of GBP 10 m from G Bank Ltd. on the following conditions:
(i) The Loan will be availed on 1st April, 2019 with interest payable on half yearly rest.
(ii)Average Loan Maturity life will be 3.4 years with an overall tenure of 5 years.
(iii) Upfront Fee of 1.20%.
(iv) Interest Cost is GBP 6 months LIBOR + Margin of 2.50%.

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(v) The 6 month LIBOR is expected to be 1.05%.

K Ltd. also entered into a GBP-INR hedge at 1 GBP = INR 90 to cover the exposure on account of the above ECB Loan and the cost of the hedge is coming to 4.00% p.a.

As a Finance Manager, given the above information and taking the 1 GBP = INR 90:

(i) Calculate the overall cost both in percentage and rupee terms on an annual basis.
(ii) What is the cost of hedging in rupee terms?
(iii) If K Ltd. wants to pursue an aggressive approach, what would be the net gain/loss for K Ltd. if the INR depreciates/appreciates against GBP by 10% at the end of the 5 years assuming that the loan is repaid in GBP at the end of 5 years?

Ignore time value and taxes and calculate to two decimals.

Solution

(i)

Overall Cost in INR and % basis
6 months Libor = 1.05%
Total Cost of Loan = 6 months Libor + 250 bps (2.50%)
= 3.55%
Upfront fees = $\frac{1.2\%}{3.4yrs}$ = **0.35% p.a.** (Assuming amortized over average tenure)

Hedging Cost (currency) = 4%
Total = 3.55% + 0.35% + 4%
= **7.9%**

Cost of Loan in INR terms
= 1 Cr (GBP) * 90 INR/GBP *7.9%
= 90 Cr * 7.9% = **7.11 Crores p.a.**

(ii)

Cost of Hedging in INR
Loan value = 90 Cr
Hedging Cost = 4%
Annual Hedging Cost = 3.6 Cr

(iii)

Assuming INR is not hedged, **if INR depreciates by 10%** from 90 to 99,
GBPINR from 90 to 99.
Value of Loan = GBP 10 million
So, the Loan value increases from 90 Crores to 99 Crores, thereby a loss of 9 Crore.
Actual Loss = 9 Crores – 3.6 Crores (Cost of Hedging)
= **5.4 Crores**

If INR appreciates by 10%, there is a gain of 9 Crores.
Actual Gain = 9 Crores+ 3.6 Crores (by not hedging) = **12.6 Crores**

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29. Illustration (Nov'23)

In March, 2022, SMD Bank sold 7% Interest Rate Futures underlying Notional 7.5% Coupon Bonds. The Exchange provides following details of eligible securities that can be delivered :

Security	Quoted Spot Price of Bonds	Conversion Factor
6.55 GOI 2025	9264.0	0.9060
6.80 GOI 2029	8775.5	0.9195
6.85 GOI 2026	9723.0	0.9643
8.44 GOI 2027	11463.0	1.1734
8.85 GOI 2028	12017.0	1.2428

Recommend the Cheapest to Deliver (CTD) security that should be delivered by SMD Bank if Future settlement price is 10000.

Solution:

Cheapest to Deliver Bond (CTD)

Futures Sales Price x Conversion Factor = Equivalent Bond to be delivered

Profit = Deliverable Bond price – Quoted spot price of deliverable Bond

Security	Future Settlement Price	Conversion factor	FSP x Con. Factor A	Quoted spot priceB	Profit / loss A-B
6.55GOI 2025	10000	0.9060	9060	9264	(204)
6.80 GOI 2029	10000	0.9195	9195	8775	420
6.85 GOI 2026	10000	0.9643	9643	9723	(80)
8.44 GOI 2027	10000	1.1734	11743	11463	280
8.85 GOI 2028	10000	1.2428	12428	12017	411

The seller will choose to deliver the 6.80% GOI bond as it has highest profit – it is the CTD Bond

30. Illustration (Nov'23)

Suppose a dealer bank quotes for a generic swap "AIC 8%/8.20% vs. 6M LIBOR Flat". Notional principal amount of swap is ₹ 1 Million, and the same is for a period of three years, reset after every six months.

In this context, answer the following questions:

(1) Interpret the dealer bank quote.

(2) If a firm is buying a swap, what is the nature of cash flows?

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(3) If a firm is selling a swap, what is the nature of cash flows?

(4) Calculate semi-annual fixed payment for the buyer of swap at the end of every six months.

(5) If the six month period from the effective date of swap to the settlement date comprises of 181 days and that the corresponding LIBOR was 5% on the effective date of swap, then what will be the first floating rate payment for the buyer?

(6) If the settlement is on "Net Basis", how much the buyer of swap has to pay or receive at the end of first six months?

[Assume 30/360 days basis]

Solution:

1. Dealer quote interpretation:
    - Generic Swap here means swap to exchange cashflows for floating rate loan with a fixed rate loan and vice versa
    - AIC means "all in cost" of fixed rate of 8% / 8.2% with no additional charges over and above this quoted number
    - 8.00% is the bid i.e at this rate the bank will pay fixed rate of 8% and receive floating rate
    - 8.20% is the ask i.e at this rate the bank will receive fixed rate of 8.2% and pay floating rate
    - Floating rate is 6M Libor
    - Flat refers to no additional changes on the floating rate
2. If a firm is Buying a swap, it means that the firm will receive floating rate and pay fixed rate of 8.2%
3. If a firm is Sellting a swap, it means that the firm will swap it will pay floating rate and receive fixed rate of 8.0%
4. Semi – Annual fixed payments at the the end of 6 months for a buyer swap will be as follows: Rs. 1 Mio x 180/360 x 8.2% = Rs. 41000
5. Floating rate payment made to the buyer (i.e amount received by buyer)
   = Notional x Libor x (dt / 360)
   = Rs.1 Mio x 5% x 181/360
   = Rs.25,138.89
6. Net settlement for Buyer swap after 1st 6 months

   Fixed rate payment made by the buyer (i.e amount paid by buyer)
   = Notional x Fixed Rate x (dt / 360)
   = Rs.1 Mio x 8.2% x 181/360
   = Rs.41,227.78

   Less Amount received by the buyer from 5 above = Rs.25,138.89

   Net amount pid by the buyer = Rs.41,227.78 - Rs.25,138.89 = Rs.16,088.89

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31. Illustration (May'24)

A manufacturer of electronic components has taken floating interest rate of 10%. Loan of ₹2 Crore on 1st April, 2023. The rate of interest at the inception of loan is 9% per annum. Interest is to be paid every year on 31st March.
In the month of October 2023, the Central Bank of the country releases the following projections about the interest rates likely to prevail in future.

(i) On 31st March, 2024. — 9.25%
On 31' March 2025 — 9.50%
On 31st March, 2026 — 10.00%
On 31st March, 2027 — 9.00%
On 31st March, 2028 — 8.25%

You are required to show how the borrower can hedge the risk using Option Cap arising out of expected rise in the rate of interest when he wants to peg his interest cost at 9% per annum.

(ii) Assume that the premium negotiated by both the parties is 0.80% to be paid at once on 1st October, 2023 and the actual rate of interest on the respective due dates happens to be as:

On 31st March, 2024 — 9.50%
On 31st March, 2025 — 11.00%
On 31st March, 2026 — 9.25%
On 31st March, 2027 — 9.00%
On 31st March, 2028 — 8.50%

You are required to show how the settlement will be executed on the perspective interest due dates.
(iii) State whether this option is advantageous when compared to Interest Rate Collar option. Explain.

Solution:

1. By using an INtereat rate cap the borrower can limit the maximum interest he / she pays when the interest rates rise. That is at inception the interest rate is 9% and if a cap @ 9% is entered into then th einterest expense annually will be a mxium of 9% only. If floating rates fall below 9% the investor's annual interest cost will be lowe as per market floating rates. However if floating rates go above 9%, the investors interest cost is capped i.e restricted at 9%

   Loan is taken on 1st April 2023 and the floating interest rate on 1st April 2023 is 9%

Period	Interest Set Date	Interest	Remarks
1st April 2023 to 1st April 2024	31st March 2023	9%	Rate as on borrowing date
1st April 2024 to 1st April 2025	31st March 2024	9.25%	Central Bank estimate
1st April 2025 to 1st April 2026	31st March 2025	9.50%	Central Bank estimate
1st April 2026 to 1st April 2027	31st March 2026	10.00%	Central Bank estimate
1st April 2027 to 1st April 2028	31st March 2027	9.00%	Central Bank estimate
1st April 2028 to 1st April 2029	31st March 2028	8.25%	Central Bank estimate

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If a cap is entered into after October 2023 then the following will be the interest cost for the borrower

Period	Expected Interest Rate in %	CAP rate in %	Effective rate i.e Min (Cap , Market Rate)	Effective Interest Cost in₹ for ₹ 2 Cr loan
1st April 2023 to 1st April 2024	9%	*	9%	₹ 18 Lacs
1st April 2024 to 1st April 2025	9.25%	9%	9%	₹ 18 Lacs
1st April 2025 to 1st April 2026	9.50%	9%	9%	₹ 18 Lacs
1st April 2026 to 1st April 2027	10.00%	9%	9%	₹ 18 Lacs
1st April 2027 to 1st April 2028	9.00%	9%	9%	₹ 18 Lacs
1st April 2028 to 1st April 2029	8.25%	9%	8.25%	₹ 16.50 Lacs

*For the First year CAP is not relevant as the applicable rate for the year has already been decided on the inception date

If the Central Bank's predicted interest rates pan out then the effective interest cost will be as computed above.

Cost of CAP is ignored as the information s not provided for this part of the question

2. Cap pay off and effective cost in case interest rates are different as compared to the central bank's predictions

Period	Actual Interest Rate in %	CAP rate in %	Interest Outflow in ₹ Lacs for ₹ 2 Cr loan based on floating rate (A)	CAP Triggered	Cap Inflow in ₹ Lacs (B)	Effective Int cost in ₹ Lacs (A + B)
1st April 2023 to 1st April 2024	9%	*	18.00	No	-	18.00
1st April 2024 to 1st April 2025	9.50%	9%	19.00	Yes	1(WN1)	18.00
1st April 2025 to 1st April 2026	11.00%	9%	22.00	Yes	4(WN2)	18.00
1st April 2026 to 1st April 2027	9.25%%	9%	18.50	Yes	0.5(WN3)	18.00
1st April 2027 to 1st April 2028	9.00%	9%	18.00	No	-	18.00
1st April 2028 to 1st April 2029	8.50%	9%	17.00	No	-	17.00

Working Notes: Cap Inflows

Working Note	1	2	3
Cap Inflow	(Market Rate – Cap rate) x ₹ 2 Cr	(Market Rate – Cap rate) x ₹ 2 Cr	(Market Rate – Cap rate) x ₹ 2 Cr
Cap Inflow in ₹ lacs	(9.5% - 9%) x ₹ 2 cr	(11.0% - 9%) x ₹ 2 cr	(9.25% - 9%) x ₹ 2 cr
Cap Inflow in ₹ lacs	₹ 1 Lac	₹ 4 Lacs	₹ 50,000

Premia Paid = 0.8% x ₹ 2 Cr = ₹ 1.6 Lacs of one-time fees. If the fees is to be paid every year then the fees will Rs.1.6 Lacs x 5 years = Rs.8 Lacs

3. In a collar a Cap is purchased and Floor is sold. Premium paid on the Cap is compensated by the premium received on a Floor.Whether a collar is advantageous or not compared to a cap depends on :
   - Premiua amounts paid / received on Cap & Floor
   - How the interest rates actually move

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- The gap between the Cap and the Floor

Eg: if a Floor was below 8.5%n the current case, the collar would be advantageous as the floor premium would offset the cap premium and based on the above interest rates the floor would not have been triggered. However if the floor was above 8.5% then it cannot be clearly said if it would have been advantageous or not without knowing the premia received.

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1. Illustration (SM)

Perfect Inc., a U.S. based Pharmaceutical Company has received an offer from Aids cure Ltd., a company engaged in manufacturing of drugs to cure Dengue, to set up a manufacturing unit in Baddi (H.P.), India in a joint venture.

As per the Joint Venture agreement, Perfect Inc. will receive 55% share of revenues plus a royalty @ US $0.01 per bottle. The initial investment will be ₹ 200 crores for machinery and factory. The scrap value of machinery and factory is estimated at the end of five (5) year to be ₹ 5 crores. The machinery is depreciable @ 20% on the value net of salvage value using Straight Line Method. An initial working capital to the tune of ₹ 50 crores shall be required and thereafter ₹ 5 crores each year.

As per GOI directions, it is estimated that the price per bottle will be ₹ 7.50, and production will be 24 crores bottles per year. The price in addition to inflation of respective years shall be increased by ₹ 1 each year. The production cost shall be 40% of the revenues.

The applicable tax rate in India is 30% and 35% in US and there is Double Taxation Avoidance Agreement between India and US. According to the agreement tax credit shall be given in US for the tax paid in India. In both the countries, taxes shall be paid in the following year in which profit have arisen/ remittance received.

The Spot rate of $ is ₹ 57. The inflation in India is 6% (expected to decrease by 0.50% every year) and 5% in US.

As per the policy of GOI, only 50% of the share can be remitted in the year in which they are realised and remaining in the following year.

Though WACC of Perfect Inc. is 13% but due to risky nature of the project it expects a return of 15%.

Determine whether Perfect Inc. should invest in the project or not (from subsidiary point of view).

Solution :

Year	0	1	2	3	4	5	6
Exchange Rate	57	$=57 \times \frac{1.06}{1.05}$ =57.54	$=57.54 \times \frac{1.055}{1.05}$ = 57.82	$=57.82 \times \frac{1.05}{1.05}$ =57.82	$= 57.82 \times \frac{1.045}{1.05}$ = 57.54	$=57.54 \times \frac{1.04}{1.05}$ = 56.99	$=56.99 \times \frac{1.035}{1.05}$ = 56.18
Inf India	6%	6.00%	5.50%	5.00%	4.50%	4.00%	3.50%
Inf US		5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Sales Volume (Cr)		24	24	24	24	24	
Price initial (INR)		7.5	=7.5+1 = 8.5	=8.5+1 =9.5	=9.5+1 =10.5	=10.5+1 =11.5	
Inflation (%)		6%	5.50%	5%	4.50%	4%	
Post Inf price (INR)		=7.5 × (1+6%) =7.95	=8.5 × (1+5.5%) =8.97	=9.5 × (1+5%) =9.98	=10.5 × (1+4.5%) =10.97	=11.5 × (1+4%) =11.96	
Total Revenue (INR Cr)		= 24 ×7.95 =190.8	= 24×8.97 =215.22	= 24 × 9.98 =239.40	=24×10.97 =263.34	= 24 × 11.5 =287.04	

Share of 55%	A	=190.8 × 55% =104.94	=215.22 × 55% = 118.37	=239.4 × 55% =131.67	=263.34 × 55% =144.84	= 287.04 × 55% = 157.87	
Royalty @ 0.01 USD per bottle (USD Cr)		=24 × 0.01 = 0.24	=24 ×0.01 = 0.24	=24 × 0.01 = 0.24	=24 × 0.01 = 0.24	=24 × 0.01 = 0.24	
Royalty in USD Rs. Cr	B	= 57.54 × 0.24 =13.81	=57.82 × 0.24 = 13.88	=57.82 × 0.24 = 13.88	= 57.54 × 0.24 = 13.81	= 56.99 × 0.24 = 13.68	
Production costs Rs. Cr @ 40%	C	=104.94 × 40% = 41.98	= 118.37 × 40% = 47.35	= 131.67 × 40% = 52.67	= 144.84 × 40% = 57.93	= 157.87 × 40% = 63.15	
Less: Dep	D	39	39	39	39	39	
PBT	A + B -C -D	= 37.77	=45.90	=53.88	=61.71	=69.40	

Depreciation	**20%**
Project Cost	200
Less: Salvage Value	(5)
Depreciable Value	195
SLM Depreciation	= 195 × 0.2 = 39

Assumption : Entire project cost borne by perfect Inc and Aids cure only does marketing

Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Tax @30% INR Cr-India		=37.77 × 30% = 11.33	= 45.90 × 30% = 13.77	= 53.88 × 30% = 16.16	= 61.71 × 30% = 18.51	= 69.40 × 30% = 20.82	
Tax @ 35% INR Cr – USA		=37.77 × 35% = 13.22	= 45.90 × 35% = 16.06	= 53.88 × 35% = 18.86	= 61.71 × 35% = 21.60	= 69.40 × 35% = 24.29	
Extra Tax		=13.22-11.33 = 1.89	=16.06 – 13.77 = 2.29	= 18.86 – 16.16 = 2.69	= 21.60 – 18.51 = 3.09	= 24.29 – 20.82 = 3.47	
Indian Co PAT		= 37.77 - 11.33 = 26.44	= 45.90 – 13.77 = 32.13	= 53.88 – 16.16 = 37.71	= 61.71 – 18.51 = 43.20	= 69.40 – 20.82 = 48.58	
FCF to Perfect							
PAT		26.44	32.13	37.72	43.20	48.58	
Add : Dep		39.00	39.00	39.00	39.00	39.00	

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Add : Tax		11.33	13.77	16.16	18.51	20.82	
Investment	(200)					5	
WC Adj	(50)	(5.00)	(5.00)	(5.00)	(5.00)	70.00	
Less : Tax paid			(11.33)	(13.77)	(16.16)	(18.51)	(20.82)
Net FCF	**(250)**	**71.77**	**68.57**	**74.11**	**79.55**	**164.89**	**(20.82)**
Actual Remittance (CY)	(250)	35.89	34.28	37.05	39.77	82.44	(20.82)
Remittance (PY)			35.89	34.28	37.05	39.77	82.44
Total Remittance	**(250)**	**35.89**	**70.17**	**71.34**	**76.83**	**122.22**	**61.62**
Exchange Rate	57.00	57.54	57.82	57.82	57.54	56.99	56.18
CF to Perfect in USD Mn	$=\frac{(250)\times10}{57}$ =(43.86)	$=\frac{35.89\times10}{57.54}$ = 6.24	$=\frac{70.17\times10}{57.82}$ = 12.14	$=\frac{71.34\times10}{57.82}$ = 12.34	$=\frac{76.83\times10}{57.54}$ = 13.35	$=\frac{122.22\times10}{56.99}$ = 21.44	$=\frac{61.62\times10}{56.18}$ = 10.97
Extra Tax US in INR Cr			1.89	2.29	2.69	3.09	3.47
Extra Tax US in USD Mn			$=\frac{(1.89)\times10}{57.82}$ = (0.33)	$=\frac{(2.29)\times10}{57.82}$ = (0.40)	$=\frac{(2.69)\times10}{57.54}$ = (0.47)	$=\frac{(3.09)\times10}{56.99}$ = (0.54)	$=\frac{(3.47)\times10}{56.18}$ = (0.62)
Net CF after Tax	(43.86)	6.24	=12.14+(0.33) = 11.81	= 12.34 + (0.40) = 11.94	= 13.35 + (0.47) = 12.88	=21.44+ (0.54) = 20.90	=10.97 + (0.62) = 10.35
Assumption - tax is on profits & not CF hence WC and investment scrap value are excluded in this							
PVIF @15%	1.00	0.87	0.76	0.66	0.57	0.50	0.43
PVCF	(43.86)	= 6.24 × 0.87 = 5.42	=11.81 × 0.76 = 8.93	=11.94 × 0.66 =7.85	=12.88 × 0.57 =7.37	=20.90 × 0.5 = 10.39	=10.35 × 0.43 = 4.48
NPV		**0.58**					
Exchange Rate	57.00	57.54	57.82	57.82	57.54	56.99	56.18
CF to Perfect in USD Mn	$=\frac{(250)\times10}{57}$ =(43.86)	$=\frac{35.89\times10}{57.54}$ = 6.24	$=\frac{70.17\times10}{57.82}$ = 12.14	$=\frac{71.34\times10}{57.82}$ = 12.34	$=\frac{76.83\times10}{57.54}$ = 13.35	$=\frac{122.22\times10}{56.99}$ = 21.44	$=\frac{61.62\times10}{56.18}$ = 10.97
Tax in US in USD Mn@35%			=6.24 × 35% = 2.18	=12.14 × 35% = 4.25	=13.35 × 35% =4.32	=21.44 × 35% = 4.67	=10.97 × 35% = 7.51
Tax in India in INR Cr			11.33	13.77	16.16	18.51	20.82
Tax in India in $ Mio			$=\frac{(1.89)\times10}{57.82}$ = (0.33)	$=\frac{(2.29)\times10}{57.82}$ = (0.40)	$=\frac{(2.69)\times10}{57.54}$ = (0.47)	$=\frac{(3.09)\times10}{56.99}$ = (0.54)	$=\frac{(3.47)\times10}{56.18}$ = (0.62)
Diff in US & Indian tax			= 1.96-2.18 = (0.22)	= 2.38 – 4.25 = (1.87)	= 2.81 – 4.32 = (1.51)	= 3.25 – 4.67 = (1.42)	= 3.71 – (7.51) = (3.80)
Net CF after tax	**(43.86)**	**6.24**	**=12.14 +(0.22) = 11.91**	**=12.34 + (1.87) = 10.47**	**= 13.35 + (1.51) = 11.84**	**= 21.44 + (1.42) = 20.02**	**= 10.97 + (3.80) = 7.17**

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Assumption : Tax is on profits in India and on CF in US							
PVIF @15%	1.00	0.870	0.756	0.658	0.572	0.497	0.432
PVCF	(43.86)	= 6.24 × 0.870 = 5.42	= 11.91 × 0.756 = 9.01	= 10.47 × 0.658 = 6.89	= 11.84 × 0.572 = 6.77	= 20.02 × 0.497 = 9.95	= 7.17 × 0.432 = 3.10
7th Year PVCF	=(3.84) × 0.376 = (1.44)						
NPV	= **(4.16)**						

2. Illustration (SM)

Its Entertainment Ltd., an Indian Amusement Company is happy with the success of its Water Park in India. The company wants to repeat its success in Nepal also where it is planning to establish a Grand Water Park with world class amenities. The company is also encouraged by a marketing research report on which it has just spent ₹ 20,00,000 lacs.

The estimated cost of construction would be Nepali Rupee (NPR) 450 crores and it would be completed in one years' time. Half of the construction cost will be paid in the beginning and rest at the end of year. In addition, working capital requirement would be NPR 65 crores from the year end one. The after-tax realizable value of fixed assets after four years of operation is expected to be NPR 250 crores. Under the Foreign Capital Encouragement Policy of Nepal, company is allowed to claim 20% depreciation allowance per year on reducing balance basis subject to maximum capital limit of NPR 200 crore. The company can raise loan for theme park in Nepal @ 9%.

The water park will have a maximum capacity of 20,000 visitors per day. On an average, it is expected to achieve 70% capacity for first operational four years. The entry ticket is expected to be NPR 220 per person. In addition to entry tickets revenue, the company could earn revenue from sale of food and beverages and fancy gift items. The average sales expected to be NPR 150 per visitor for food and beverages and NPR 50 per visitor for fancy gift items. The sales margin on food and beverages and fancy gift items is 20% and 50% respectively. The park would open for 360 days a year.

The annual staffing cost would be NPR 65 crores per annum. The annual insurance cost would be NPR 5 crores. The other running and maintenance costs are expected to be NPR 25 crores in the first year of operation which is expected to increase NPR 4 crores every year. The company would apportion existing overheads to the tune of NPR 5 crores to the park.

All costs and receipts (excluding construction costs, assets realizable value and other running and maintenance costs) mentioned above are at current prices (i.e., 0 point of time) which are expected to increase by 5% per year.

The current spot rate is NPR 1.60 per rupee. The tax rate in India is 30% and in Nepal it is 20%.

The average market return is 11% and interest rate on treasury bond is 8%. The company's current equity beta is 0.45. The company's funding ratio for the Water Park would be 55% equity and 45% debt.

Being a tourist Place, the amusement industry in Nepal is competitive and very different from its Indian counterpart. The company has gathered the relevant information about its nearest competitor in Nepal. The competitor's market value of the equity is NPR 1850 crores, and the debt is NPR 510 crores, and the equity beta is 1.35.

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State whether Its Entertainment Ltd. should undertake Water Park project in Nepal or not.

Solution :

Particulars/Year	0	1	2	3	4	5
Depreciation Allowance :						
Opening			200	160	128	102.4
Depreciation @20%			(40)	(32)	(25.6)	(20.48)
Closing			**160**	**128**	**102.4**	**81.92**
Profit & Loss						
Revenue						
Capacity per Day			20,000	20,000	20,000	20,000
Utilisation			70%	70%	70%	70%
Days per year			360	360	360	360
Visitors per year			= 20,000 × 70% × 360 = 50,40,000	= 20,000 × 70% × 360 = 50,40,000	= 20,000 × 70% × 360 =50,40,000	= 20,000 × 70% × 360 =50,40,000
Ticket Price	220	=220 × 1.05 = 231	=231 × 1.05 = 242.55	=242.55× 1.05 = 254.68	=254.68× 1.05= 267.41	= 267 ×1.05 = 280.78
F&B Margin	30	=30 × 1.05 = 31.5	=31.5×1.05 = 33.08	=33.08 × 1.05 = 34.73	= 34.73 × 1.05 = 36.47	=36.47 × 1.05 = 38.29
Gifts Margin	25	=25 × 1.05 = 26.25	=26.25 × 1.05 = 27.56	=27.56 × 1.05 = 28.94	=28.94 × 1.05 = 30.39	=30.39 × 1.05 = 31.91
Total Revenue (Ticket Price + F&B + Gifts)	275.00	288.75	303.19	318.35	334.26	350.98
Revenue in NPR in INR Cr			=303.19 × 0.504 = 152.81	=318.35 × 0.504 =160.45	= 334.26 × 0.504 = 168.47	= 350.98 × 0.504 = 176.89
Costs						
Staffing Cost	(65)	= (65) × 1.05 = (68.25)	= (68.25) × 1.05 = (71.66)	= (71.66) × 1.05 = (75.25)	= (75.25) × 1.05 = (79.01)	= (79.01) × 1.05 = (82.96)
Insurance	(5)	= (5) × 1.05 = (5.25)	= (5.25) × 1.05 = (5.51)	= (5.79) × 1.05 = (5.79)	= (5.79) × 1.05 = (6.08)	= (6.08) × 1.05 = (6.38)
Maintenance			=(25)	=(25)-4 = (29)	= (29)-4 = (33)	=(33)-4 = (37)
Depreciation			(40)	(32)	(25.6)	(20.48)
PBT			10.63	18.41	24.78	30.07
Tax @20%			(2.13)	(3.68)	(4.96)	(6.01)

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PAT			**8.51**	**14.73**	**19.83**	**24.06**
FCF						
PAT			8.51	14.73	19.83	24.06
Add :Depreciation			40	32	25.6	20.48
WC		(65)	= (65) × 1.05 =(3.25)	=(65+3.25) × 1.05 = (3.41)	=(65+3.25+ 3.41) × 1.05 = (3.58)	(65+3.25+ 3.41+3.58) = 75.25
Investment	(225)	(225)				
Free Cash Flow	**(225)**	**(290)**	**45.26**	**43.32**	**41.84**	**369.78**

Competitor	Market Value NPR Cr	Beta	%
Equity	1,850	1.35	$=\frac{1850\times100}{2360}$ = 78%
Debt	510		$=\frac{510\times100}{2360}$ = 22%
Total	**2,360**		

Particulars	Amount
Asset Beta	$=\text{Equity Beta}\times\frac{E}{E+D(\text{Post Tax})}$
AB of Competitor	1.11
Its Entertainment Asset Beta	1.11
Asset Beta	$=\text{Equity Beta}\times\frac{E}{E+D(\text{Post Tax})}$
	$1.11=\frac{EB\times247.5}{(247.5+202.5)\times(1-20\%)}$ 1.11 = 0.60 × EB EB = 1.84
Its Entertainment	
Project Cost	450
Equity @55%	247.50
Debt @45%	=450 – 247.50 = 202.5
Ke	Ke = Rf + MRP × EB Ke = 8% + 1.84 (3%) Ke =13.51%
Kd	9%
WACC	=13.51% × 0.55 + 9% (1-20%) × 0.45 = 10.67%

Free Cash Flow	(225)	(290)	45.26	43.32	41.84	369.78
PVIF @ 10.67%	1	0.9036	0.8165	0.7377	0.6666	0.6023
PVCF	**= (225) × 1 = (225)**	**= (290) × 0.9036**	**= 45.26 × 0.8165**	**= 43.32 × 0.7377**	**= 41.84 × 0.6666**	**= 369.78 × 0.6023**

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		= (262.04)	= 36.95	= 31.96	= 27.89	= 222.74
NPV	(167.50)					

The Company Its entertainment should not invest in this project as NPV is Negative at project level

3 Illustration (SM)

X Ltd. is interested in expanding its operation and planning to install manufacturing plant at US. For the proposed project it requires a fund of $ 10 million (net of issue expenses/ floatation cost). The estimated floatation cost is 2%. To finance this project, it proposes to issue GD ₹

You as financial consultant is required to compute the number of GDRs to be issued and cost of the GDR with the help of following additional information.

(i) Expected market price of share at the time of issue of GDR is ₹ 250 (Face Value ₹ 100)
(ii) 2 Shares shall underly each GDR and shall be priced at 10% discount to market price.
(iii) Expected exchange rate ₹ 60/$.
(iv) Dividend expected to be paid is 20% with growth rate 12%.

Solution :

Particulars	Amount (INR)
Market Price of share	250
GDR Equivalent MP of equity shares	250 × 2 = 500
GDR Price	= 10% of Equity Share Market Price = 500 × 90% = 450
USD price per share	$= \frac{450}{60}$ = USD 7.5
Funds required	USD 10 Million
Floatation Cost	2%
Issue Size	$= \frac{10\text{ Million}}{98\%}$ = USD 10.2048 Million
USD Price per GDR	USD 7.5
Total GDR Issued	= USD $\frac{10.2048\text{ Million}}{7.5}$ = 1,360,544 GDRs
Money raised per GDR	USD 7.5 × INR 60 = 450
Money received is 98%	= 450 × 98% = INR 441

Particulars	CASE A : When Price is 441 (Net proceeds)	CASE B : When Price is 450 (Gross proceeds)
D1	= Face Value per share × Number of shares per GDR × 20% = 100 × 2 × 20% = INR 40	= Face Value per share × Number of shares per GDR × 20% = 100 × 2 × 20% = INR 40
g	12%	12%

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P0	= D1/(Ke – g) 441 = 40/(Ke-12%) Ke -12% = 9.07% Ke = **21.07%**	P0 = D1/(Ke – g) 450 = 40/(Ke – 12%) Ke – 12 % = 10.88% Ke = **22.88%**

*If listed price is consider, then Cost is **22.88%** whereas if net proceeds are considered, cost will be **21.07%**.*

4 Illustration (RTP May 21 (N))

Right Limited has proposed to expand its operations for which it requires funds of $ 30 million, net of issue expenses which amount to 4% of the issue size. It proposed to raise the funds though a GDR issue. It considers the following factors in pricing the issue:

(i) The expected domestic market price of the share is ₹ 300 (Face Value of ₹ 10 each share)
(ii) 4 shares underly each GDR
(iii) Underlying shares are priced at 20% discount to the market price
(iv) Expected exchange rate is ₹ 70/$

You are required to compute the number of GDR's to be issued and cost of GDR to Right Limited, if 20% dividend is expected to be paid with a growth rate of 20%.

Solution :

Particulars	**Amount (INR)**
Market Price of share	300
GDR Equivalent MP of equity shares	300 × 4 = 1200
GDR Price	= 20% of Equity Share Market Price = 1200 × 80% = 960
Expected Exchange rate	USD INR 70
USD price per share	$= \frac{960}{70}$ = USD 13.7142
Total Funds required	USD 30 Million
Floatation Cost	4%
Funds raised	USD $\frac{30 \text{ Million}}{96\%}$ = USD 31.25 Mn
GDRs issued	$= \frac{\text{Funds Raised}}{\text{Price of GDR}}$ = USD $\frac{31.25 \text{ Mn}}{13.7142}$ = 2,278,660

Cost of GDR

Particulars	**Gross of Floatation Cost**	**Net of Floatation Cost**
GDR in INR Equivalent	INR 960	INR 960 – 4% = INR 921.60
D1	20% of FV of 10 × 4 shares per GDR = 10 × 7 × 20%	20% of FV of 10 × 4 shares per GDR = 10 × 7 × 20%

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	= 8	= 8
Ke	$=\frac{D1}{p0}+g$ $=\frac{8}{960}$ **+ 20%** **= 20.83%**	= $\frac{8}{921.6}$ **+ 20%** **= 20.868%**

Cost of GDR – Gross is 20.83% and Net of Floatation Cost is 20.868%.

5. Illustration (SM)

Opus Technologies Ltd., an Indian IT company is planning to make an investment through a wholly owned subsidiary in a software project in China with a shelf life of two years. The inflation in China is estimated as 8 percent. Operating cash flows are received at the year end.

For the project an initial investment of Chinese Yuan (CN¥) 30,00,000 will be in land. The land will be sold after the completion of project at estimated value of CN¥ 35,00,000. The project also requires an office complex at cost of CN¥ 15,00,000 payables at the beginning of project. The complex will be depreciated on straight-line basis over two years to a zero-salvage value. This complex is expected to fetch CN¥ 5,00,000 at the end of project.

The company is planning to raise the required funds through GDR issue in Mauritius. Each GDR will have 5 common equity shares of the company as underlying security which are currently trading at ₹ 200 per share (Face Value = ₹ 10) in the domestic market. The company has currently paid the dividend of 25% which is expected to grow at 10% p.a. The total issue cost is estimated to be 1 percent of issue size.

The annual sales are expected to be 10,000 units at the rate of CN¥ 500 per unit. The price of unit is expected to rise at the rate of inflation. Variable operating costs are 40 percent of sales. Fixed operating costs will be CN¥ 22,00,000 per year and expected to rise at the rate of inflation.

The tax rate applicable in China for income and capital gain is 25 percent and as per GOI Policy no further tax shall be payable in India. The current spot rate of CN¥ 1 is ₹ 9.50. The nominal interest rate in India and China is 12% and 10% respectively and the international parity conditions hold

You are required to

(a) Identify expected future cash flows in China and determine NPV of the project in CN¥.

(b) Determine whether Opus Technologies should go for the project or not assuming that there neither there is restriction on the transfer of funds from China to India nor any charges/taxes payable on the transfer of funds.

Solution :

Particulars	Amount (CNY)
Shares per GDR	5
MP per share INR	200
Equivalent value of GDR INR	1000
D0	25%
FV of GDR	50
D0 per GDR	= 50 × 25% = 12.5
G	10%
D1	= 12.5 × 1.1 = 13.75
Floatation Cost	1%

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Net Proceeds from GDR	$= \frac{1000}{100\%-1\%}$ = 990
Ke	$= \frac{D1}{NP} + g$ = 13.75/990 + 10% = 11.39%

CNY Lakhs/Year	0	1	2
Land	(30)		
Office Complex	(15)		
Depreciation on Office Complex		=15/2 =(7.5)	=15/2 =(7.5)
Complex Sale Value			5
Complex NFA			0
Capital Gain			5
Tax @25%			= 5 × 25% = (1.25)
Net Cash Flow			3.75
Land Sale Value			35
Land NFA			30
Capital Gain			5
Tax @25%			(1.25)
Net Cash Flow			33.75
Inflation	8%		
Inflation rate India	12%		
Int China	10%		
CNY /INR	9.5	$= 9.5 \times (1+12\%) / (1+10\%)$ = 9.67	$= \frac{9.67 \times (1+12\%)}{(1+10\%)}$ = 9.85
Profit & Loss			
Units Sold		10,000	10,000
Sale Price in CNY	500	= 500 × (1+8%) = 540	= 540 × (1+8%) = 583.20
Total Sales Value – CNY Lakhs		$= \frac{540 \times 10,000}{100,000}$ = 54	$= 583.2 \times 10,000 / 100,000$ = 58.32
Variable Cost @40%		= 54 × 40% = (21.6)	= 58.32 × 40% = (23.33)
Fixed Cost	(22)	(23.76)	(25.66)
Depreciation		(7.5)	(7.5)
Profit before tax		1.140	1.831
Less : Tax @25%		(0.28)	(0.46)
Profit After Tax		0.855	1.373

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FCF			
PAT		0.855	1.373
Add : Depreciation		7.5	7.5
Investment Outflow	(45)		
Investment Inflow (Net of tax)			= 33.75 + 3.75 = 37.5
FCF	(45)	= 0.855 + 7.5 = 8.355	= 1.373 + 7.5 + 37.5 = 46.373
Discount Rate 11.39%			
PVF	1	0.898	0.806
PVCF in CNY lakhs	(45) × 1 = (45)	= 8.355 × 0.898 = 7.501	= 46.373 × 0.806 = 37.375
NPV CNY Lakhs	**(0.12)**		
CNY INR	9.5	9.67	9.85
PVCF in INR Lakhs	= (45) × 9.5 = (427.5)	= 7.501 × 9.67 = 72.53	= 37.375 × 9.85 = 368.14
NPV INR Lakhs	**13.17**		
PVF @12%	1	0.893	0.797
CNY Lakhs CF	(45)	8.36	46.37
CNY INR Rate	9.5	9.67	9.85
INR Lakhs CF	(427.5)	= 8.36 × 9.67 = 80.79	= 46.37 × 9.85 = 456.78
PV of INR CF Lakhs	(427.5)	= 80.79 × 0.893 = 72.14	= 456.78 × 0.797 = 364.14
NPV INR Lakhs	**8.78**		

Assumption : CF are remitted in Same year & The discount rate is taken as the cost of GDR.

6. Illustration (SM)

ABC Ltd. is considering a project in US, which will involve an initial investment of US $ 1,10,00,000. The project will have 5 years of life. Current spot exchange rate is ₹ 48 per US $. The risk-free rate in US is 8% and the same in India is 12%. Cash inflow from the project is as follows

Year	Cash Inflow
1	$ 20,00,000
2	$ 25,00,000
3	$ 30,00,000
4	$ 40,00,000
5	$ 50,00,000

Calculate the NPV of the project using foreign currency approach. Required rate of return on this project is 14%.

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Solution :

Particulars	0	1	2	3	4	5
Project Cost (USD Mn)	11					
Cash Inflow (USD Mn)		2	2.5	3	4	5
PVF @14%	1	0.877	0.769	0.675	0.592	0.519
Exchange Rate (WN1)	48	49.78	51.62	53.53	55.52	57.57
INR CF Mn	= 48 ×11 = (528)	= 49.78 × 2 = 99.56	=51.62×2.5 = 129.05	= 53.53 × 3 = 160.60	= 55.52 × 4 = 222.06	= 57.57 × 5 = 287.86
PV of INR CF Mn	= (528) × 1 =(528)	= 99.56 ×0.877 = 87.33	= 129.05 × 0.769 = 99.30	= 160.60 × 0.675 = 108.40	= 222.06 ×0.592 = 131.48	= 287.86 × 0.519 = 149.51
NPV INR Mn	48.02					
WN1:						
Interest Rate India	12%					
Interest Rate US	8%					
Required Rate of return	14%					
Spot	48	$=\frac{48\times(1+12\%)}{(1+8\%)}$ = 49.78	$=\frac{49.78\times(1+12\%)}{(1+8\%)}$ = 51.62	$=\frac{51.62\times(1+12\%)}{(1+8\%)}$ =53.53	$=\frac{53.53\times(1+12\%)}{(1+8\%)}$ =55.52	$=\frac{55.52\times(1+12\%)}{(1+8\%)}$ =57.57

7. Illustration (SM)

A USA based company is planning to set up a software development unit in India. Software developed at the Indian unit will be bought back by the US parent at a transfer price of US $10 million. The unit will remain in existence in India for one year; the software is expected to get developed within this time frame.

The US based company will be subject to corporate tax of 30 per cent and a withholding tax of 10 per cent in India and will not be eligible for tax credit in the US. The software developed will be sold in the US market for US $ 12.0 million. Other estimates are as follows:

Rent for fully furnished unit with necessary hardware in India	₹ 15,00,000
Manpower cost (80 software professional will be working for 10 hours each day)	₹ 400 per man hour
Administrative and other costs	₹ 12,00,000

Advise the US Company on the financial viability of the project. The rupee-dollar rate is ₹ 48/$.

Note: Assume 365 days a year.

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Solution :

Manpower Cost

Particulars	Amount
People	80
Hours per day	10
Days	365
Rs/ man hour	400
Manpower Cost	= 80 × 10 × 365 × 400 = INR 11,68,00,000
Rent	15,00,000
Administrative and other cost	12,00,000
Total Cost	**11,95,00,000**
Indian Entity Revenue	TP of USD 10 Mn @ INR 48 per USD
Revenue	= INR 48,00,00,000
Total Cost	INR (11,95,00,000)
Profit Before Tax	36,05,00,000
Less : Corporation Tax @30%	(10,81,50,000)
Profit After tax	**25,23,50,000**
Less : withholding tax remitted @10%	2,52,35,000
	22,71,15,000
Amount received in USD @ INR 48 per USD	= $\frac{22,71,15,000}{48 \times 10}$ = **USD 4.7315 Mn**

At TP of 10 Million , profit before US Taxes is USD 4.7315 Mn. If sale price is higher @12 Mn , then profit will be even higher.

Assumptions :

1. Witholding tax of 10% has no tax credit.
2. Corporate tax in India of 30% has also no tax credit.

8. Illustration (SM)

XY Limited is engaged in large retail business in India. It is contemplating for expansion into a country of Africa by acquiring a group of stores having the same line of operation as that of India.

The exchange rate for the currency of the proposed African country is extremely volatile. Rate of inflation is presently 40% a year. Inflation in India is currently 10% a year. Management of XY Limited expects these rates likely to continue for the foreseeable future.

Estimated projected cash flows, in real terms, in India as well as African country for the first three years of the project are as follows:

	Year 0	Year 1	Year 2	Year 3
Cash Flow in ₹ (000)	-50,000	-1,500	-2,000	-2,500
Cash Flows in African Rands (000)	-2,00,000	+50,000	+70,000	+90,000

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XY Ltd. assumes the year 3 nominal cash flows will continue to be earned each year indefinitely. It evaluates all investments using nominal cash flows and a nominal discounting rate. The present exchange rate is African Rand 6 to ₹ 1.

You are required to calculate the net present value of the proposed investment considering the following:

(i) African Rand cash flows are converted into rupees and discounted at a risk adjusted rate.
(ii) All cash flows for these projects will be discounted at a rate of 20% to reflect it's high risk.
(iii) Ignore taxation.

	Year 1	Year 2	Year 3
PVIF @ 20%	0.833	0.694	0.579

Solution :

Particulars	**0**	**1**	**2**	**3**
Inflation Rate India		10%	10%	10%
Inflation Rate Africa		40%	40%	40%
Exchange Rate Rand / INR	6	$= \frac{6 \times (1+40\%)}{(1+10\%)}$ = 7.6364	$= \frac{7.6364 \times (1+40\%)}{(1+10\%)}$ = 9.7190	$= \frac{9.7190 \times (1+40\%)}{(1+10\%)}$ = 12.3696
Cashflows Real (INR Thousands)	(50,000)	(1,500)	(2000)	(2500)
Cashflows Nominal (INR Thousands)	(50,000)	= (1500) × 1.1 = (1650)	= (2000) × 1.1^2 = (2420)	= 2500 × 1.1^3 =(3327.5)
Cashflow Real (Rand Thousands)	(200,000)	50,000	70,000	90,000
Cashflow Nominal (Rand Thousands)	(200,000)	= 50,000 × 1.4 = 70,000	= 70,000 × 1.4^2 = 137,200	= 90,000 × 1.4^3 = 246,960
INR Equivalent Rand Cashflows	$\frac{= (200,000)}{6}$ = (33,333.33)	$= \frac{70,000}{7.6364}$ = 9,166.67	$= \frac{137,200}{9.7190}$ = 14,116.67	$= \frac{246,690}{12.3696}$ = 19,965
Total Cashflows	(50,000)+(33,333.33) = (83,333.33)	(1650)+9,166.67 = 7,516.67	(2420)+14,116.67 = 11,696.67	(3,327.5)+19,965 = 16,637.5
Terminal Cashflow				$= \frac{16,637.5}{20\%}$ = 83,187.5
Total Cashflow	**(83,333.33)**	**7,516.67**	**11,696.67**	**= 16,637.5 + 83,187.5 = 99,825**
PVF	1	0.833	0.694	0.579
PVCF	(83,333.33) ×1 = (83,333.33)	7,516.67 ×0.833 = 6,261.38	11,696.67×0.694 = 8,117.49	99,825 × 0.579 = 57,798.68
NPV in ₹ Thousands	**(11,155.79)**			

As NPV **is negative**, XY Ltd should **not proceed** with this project.
Assumption : All profits are repatriated to India.

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9. Illustration (SM)

A multinational company is planning to set up a subsidiary company in India (where hitherto it was exporting) in view of growing demand for its product and competition from other MNCs. The initial project cost (consisting of Plant and Machinery including installation) is estimated to be US$ 500 million. The net working capital requirements are estimated at US$ 50 million. The company follows straight line method of depreciation. Presently, the company is exporting two million units every year at a unit price of US$ 80, its variable cost per unit being US$ 40.

The Chief Financial Officer has estimated the following operating cost and other data in respect of proposed project:

(i) Variable operating cost will be US $ 20 per unit of production
(ii) Additional cash fixed cost will be US $ 30 million p.a. and project's share of allocated fixed cost will be US $ 3 million p.a. based on principle of ability to share
(iii) Production capacity of the proposed project in India will be 5 million units
(iv) Expected useful life of the proposed plant is five years with no salvage value
(v) Existing working capital investment for production & sale of two million units through exports was US $ 15 million
(vi) Export of the product in the coming year will decrease to 1.5 million units in case the company does not open subsidiary company in India, in view of the presence of competing MNCs that are in the process of setting up their subsidiaries in India
(vii) Applicable Corporate Income Tax rate is 35%
(viii) Required rate of return for such project is 12%.

Assuming that there will be no variation in the exchange rate of two currencies and all profits will be repatriated, as there will be no withholding tax, estimate Net Present Value (NPV) of the proposed project in India.

Present Value Interest Factors (PVIF) @ 12% for five years are as below:

Year	1	2	3	4	5
PVIF	0.8929	0.7972	0.7118	0.6355	0.5674

Solution :

Particulars	Amount (USD Million)
Capex :	
Plant and Machinery	(500)
Working Capital	(50)
Total Investment	**(550)**
Export Sales :	
Units	1.5
Price per Unit	80
VC per unit	40
Contribution per unit	=80 – 40 =40
Total Contribution	= 40 × 1.5 = 60
Tax @35%	= 60 × 35% = (21)

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Post-Tax contribution	39
Subsidiary :	
Units	5
Price	80
VC	(20)
Contribution per unit	60
Total contribution	=60 × 5 =300
Less: FC	(30)
Dep @ 100 Mio for 5 years	(100)
PBT	170
Tax @ 35%	170 × 35% = (59.5)
Profit After Tax	**110.5**
Incremental Cashflow:	
PAT of Indian Subsidiary	110.5
Add : Depreciation	100
Less : Cashflow of US Exports	(39)
Yearly Incremental CF	171.5
PVIFA @12% for 1-5	3.6048
PV of Incremental Cashflow	= 171.5 × 3.6048 = 618.22
Total Investment	(550)
Add : WC already deployed in existing business	15
Net Investment	(535)
5th year Cash inflow of WC	35
PV Factor of year 5	0.5674
PV of cash inflow of year 5	= 35 × 0.5674 = 19.8590
NPV	**= 618.22 - 535 + 19.8590** **= 103.0822**

Since NPV is positive, company should invest in it.

10. Illustration (SM)

XYZ Ltd., a company based in India, manufactures very high-quality modern furniture, and sells to a small number of retail outlets in India and Nepal. It is facing tough competition. Recent studies on marketability of products have clearly indicated that the customers are now more interested in variety and choice rather than exclusivity and exceptional quality. Since the cost of quality wood in India is very high, the company is reviewing the proposal for import of woods in bulk from Nepalese supplier.

The estimate of net Indian (₹) and Nepalese Currency (NC) cash flows in Nominal terms for this proposal is shown below:

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Year	Net Cash Flows (in millions)			
	0	1	2	3
NC	-25.000	2.600	3.800	4.100
Indian (₹)	0	2.869	4.200	4.600

The following information is relevant:

(i) XYZ Ltd. evaluates all investments by using a discount rate of 9% p.a. All Nepalese customers are invoiced in NC. NC cash flows are converted to Indian (₹) at the forward rate and discounted at the Indian rate.

(ii) Inflation rates in Nepal and India are expected to be 9% and 8% p.a. respectively. The current exchange rate is ₹ 1= NC 1.6

Assuming that you are the finance manager of XYZ Ltd., calculate the net present value (NPV) and modified internal rate of return (MIRR) of the proposal

You may use following values with respect to discount factor for ₹1 @9%.

	Present value	Future Value
Year 1	0.917	1.188
Year 2	0.842	1.090
Year 3	0.772	1

Solution :

Particulars/Years	0	1	2	3
India Inflation		8%	8%	8%
Nepal Inflation		9%	9%	9%
NC per INR	1.6	$= \frac{1.6 \times 1.09}{1.08}$ = 1.6148	$= \frac{1.6148 \times 1.09}{1.08}$ = 1.6298	$= \frac{1.6298 \times 1.09}{1.08}$ = 1.6449
CF NC Mn	(25)	2.6	3.8	4.1
CF NC Mn converted to INR (A)	$= \frac{(25)}{1.6}$ = (15.6250)	$= \frac{2.6}{1.6148}$ = 1.6101	$= \frac{3.8}{1.6298}$ = 2.3316	$= \frac{4.1}{1.6449}$ = 2.4926
CF in INR Mn (B)	0	2.8690	4.2	4.6
Total Cashflow (A+B)	**(15.6250)**	**= 1.6101 +2.8690 = 4.4791**	**= 4.2+2.3316 = 6.5316**	**= 4.6 + 2.4926 = 7.0926**
PV @9%	1	0.9170	0.8420	0.7720
PVCF	= (15.6250) × 1 = (15.6250)	= 4.4791 × 0.9170 = 4.1073	= 6.5316 × 0.8420 = 5.4996	= 7.0926 × 0.7720 = 5.4755
NPV	**(0.5425)**			

MIRR Computation:

Year	CF	Reinvestment Rate	Fin Rate	PV	FVF	FV
0	(15.6250)	9%	9%	(15.6250)		

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1	4.4791	9%	9%		1.188	= 4.4791 × 1.188 = 5.32116
2	6.5316	9%	9%		1.090	= 6.5316 × 1.090 = 7.11947
3	7.0926	9%	9%		1	= 7.09262
						19.53325

MIRR = 19.5332/15.6250 $^{1/3}$ -1
= **7.725%**
Since NPV Is negative, XYZ Ltd should not proceed further.

11. Illustration (Nov 20 (N))

The Management of a multinational company TL Ltd. is engaged in construction of Infrastructure Project. A proposal to construct a Toll Road in Nepal is under consideration of the Management.
The following information is available:
The initial investment will be in purchase of equipment costing USD 250 lakhs. The economic life of the equipment is 10 years. The depreciation on the equipment will be charged on straight line method.
EBIDTA to be collected from the Toll Road is projected to be USD 33 lakhs per annum for a period of 20 years.
To encourage investment Nepalese government is offering a 15-year term loan of USD 150 lakhs at an interest rate of 6 per cent per annum. The interest is to be paid annually. The loan will be repaid at the end of 15 year in one tranche.
The required rate of return for the project under all equity financing is 12 per cent per annum.
Post tax cost of debt is 5.6 per cent per annum.
Corporate Tax Rate is 30 per cent.
All cash Flows will be in USD.
Ignore inflation.
You are required to advise the management on the viability of the proposal by using Adjusted Net Present Value method.
Given
PVIFA (12%, 10) = 5.650, PVIFA (12%, 20) = 7.469, PVIFA (8%,15) = 8.559, PVIF (8%, 15) = 0.315.

Solution :

Operating Cashflow :

Particulars	Years	USD Lakhs	Ke	PVIFA	PVCF USD Lakhs
EBITDA	1-20	33	12%	7.4690	= 33 × 7.4690 = 246.4770
Less : Depreciation	1-10	25	12%	5.6500	= 25 × 5.6500 = (141.2500)
PBT					105.2270
Less : Tax @30%					(31.5681)
PAT					**73.6589**
Add : Depreciation					141.25
CFAT					214.9089

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Less : Initial Investment					(250)
NPV from Operations					(35.0911)

Tax Shield on Interest	**Years**	**USD Lakhs**	**Kd for Interest Payment**	**PVIFA @8%**	**PVCF USD Lakhs**
Loan	1-15				150
Interest	1-15	9	6%	8.5590	= 9 × 8.5590 = 77.0310
Tax on Interest Paid @30%					23.1093
NPV on Tax shield Interest					23.1093
APV based evaluation	Base NPV				(35.0911)
	PV of Tax shield				23.1093
	Net APV				**(11.9818)**

As APV is negative, TL Ltd should not proceed with the project.

WN 1 : Debt Discount Rate

Post-tax rate	5.6
Tax rate	30%
Pretax rate	= 5.6/1-30% = 8%

PV of Interest Subsidy	**Amount**	**Years**	**PVIFA**	**PVCF**
Market Interest	8%			
Int of currency loan	6%			
Int subsidy	2%			
Loan value in US Lakhs	150			
Int subsidy PA	3	1-15	8.559	= 8.559 × 3 = 25.677
APV:				
Base	(35.0911)			
Tax Shield on Interest	23.1093			
Subsidy PV	25.6770			
Net APV	**13.6952**			

If interest subsidy is also considered, then the project can be undertaken as APV is Positive.

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12.Illustration (Jan 21 (N))

A proposed foreign investment involves creation of a plant with an annual output of 1 million units. The entire production will be exported at a selling price of USD 10 per unit.
At the current rate of exchange dollar cost of local production equals to USD 6 per unit. Dollar is expected to decline by 10% or 15%. The change in local cost of production and probability from the expected current level will be as follows:

Decline in value of USD (%)	Reduction in local cost of production (USD/unit)	Probability
0	-	0.4
10	0.30	0.4
15	0.15 Additional reduction	0.2

The plant at the current rate of exchange will have a depreciation of USD 1 million annually. Assume local Tax rate as 30%.
You are required to find out:

(i) Annual Cash Flow After Tax (CFAT) under all the different scenarios of exchange rate.
(ii) Expected value of CFAT assuming no repatriation of profits.
(iii) Viability of the investment proposal assuming an initial investment of USD 25 million on plant and working capital with a required rate of return of 11% on investment and on the basis of CFAT arrived under option (ii). The CFAT will grow @ 3% per annum in perpetuity.

Solution :

Particulars	Scenario 1	Scenario 2	Scenario 3
Probability	40%	40%	20%
Depreciation	0%	10%	15%
Selling price USD	10.00	10.00	10.00
Reduction in Local COP	0.00	0.30	0.45
Local COP in USD terms	6.00	= 6 – 0.3 =5.70	=5.7 – 0.15 =5.55
Margin USD	= 10 -6 =4.00	= 10 – 5.7 =4.30	=10 – 5.55 =4.45
Annual Output	10,00,000	10,00,000	10,00,000
Annual Margin (A)	= 10,00,000 × 4 =40,00,000	= 10,00,000 × 4.3 =43,00,000	=10,00,000 × 4.45 =44,50,000
Depreciation (B)	10,00,000	= 10,00,000 × 0.9 =9,00,000	=10,00,000 × 0.85 =8,50,000
PBT (A-B)	**30,00,000**	**34,00,000**	**36,00,000**
Tax @ 30%	(9,00,000)	(10,20,000)	(10,80,000)
PAT	21,00,000	23,80,000	25,20,000
Add: Dep	10,00,000	9,00,000	8,50,000
CFAT	**31,00,000**	**32,80,000**	**33,70,000**

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Expected Value of CFAT			
Probability	40%	40%	20%
CFAT	31,00,000	32,80,000	33,70,000
Weighted CFAT	=31,00,000 × 40% =12,40,000	= 32,80,000 × 40% =13,12,000	= 33,70,000 × 20% =6,74,000
Probability weighted CFAT	**32,26,000**		

Depreciation is also assumed to reduce by 10% & 15% respectively.

Kc	11%
CFAT g	3%
PV of CFAT taken to perpetuity	$=\frac{\text{CFAT}\ (1+g)}{Kc-g}$ $=\frac{32,26,000 \times (1+3\%)}{11\%-3\%}$ =4,15,34,750
Less: Investment	2,50,00,000.00
NPV of the project	1,65,34,750.00

The project is viable as NPV is positive.

13.Illustration (Dec 21 (N))

A US company wants to setup a manufacturing plant in India which g requires an initial outlay of ₹ 8 Million. It is expected to have a useful life of 5 years with a salvage of ₹ 2 Million. The company follows straight line method of depreciation. To support additional level of activity, investment would require one-time additional working capital of ₹ 1 Million.

Since the cost of production lower in India, the variable cost of production would be ₹ 30 per unit. Additional fixed cost per annum is estimated at ₹0.5 Million. The company is projecting its annual sales to 80000 units at the price of ₹ 100 per unit. Applicable tax rate to the company is 34% and its cost of capital is 8%.

Inflation rates in US and India are expected to be 8% and 9%

respectively. The current exchange rate is ₹ 72 per US Dollar.

Assuming that all profit will be repatriated every year and there will be no withholding taxes, estimate the net present value of the proposed project in India and evaluate its feasibility.

PVF @ 8% for the five years are as under:

Rate	Year 1	Year 2	Year 3	Year 4	Year 5
8%	0.926	0.857	0.794	0.735	0.681

Solution:

Particulars / Year	0	1	2	3	4	5
Sales Units		80,000.00	80,000.00	80,000.00	80,000.00	80,000.00
Sales price in Rs.		100.00	100.00	100.00	100.00	100.00
VC in Rs. Per Unit		30.00	30.00	30.00	30.00	30.00
Contribution per unit in Rs.		70.00	70.00	70.00	70.00	70.00
Total Contribution in Rs. Million		5.60	5.60	5.60	5.60	5.60
Less FC in Rs. Mn		0.50	0.50		0.50	0.50
EBITDA in Rs. Mn		5.10	5.10	5.10	5.10	5.10
Less: Depreciation in Rs. Mn		1.20	1.20	1.20	1.20	1.20

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PBT in Rs. Mn		3.90	3.90	3.90	3.90	3.90
Tax @ 34% in Rs. Mn		1.33	1.33	1.33	1.33	1.33
PAT in Rs. MN		2.57	2.57	2.57	2.57	2.57
Add: Dep in Rs. Mn		1.20	1.20	1.20	1.20	1.20
CFAT in Rs. Mn		3.77	3.77	3.77	3.77	3.77
Add: WC withdrawal in Ys. 5						1.00
Add: Salvage value in Yr 5						2.00
Cash Inflows in Rs. Mn		3.77	3.77	3.77	3.77	6.77
USD INR exchange rate		72.67	73.34	74.02	74.70	75.40
Cash Inflows in USD INR		51,935.78	51,459.30	50,987.20	50,519.43	89,846.05
PVF @ 8%		0.926	0.857	0.794	0.735	0.681
PVCIF in USD		48,092.53	44,100.62	40,483.84	37,131.78	61,185.16
PVCIF in USD	2,30,994					
Original Investment made in USD	1,25,000					
NPV of project in USD	1,05,994					
The project has + ve NPV & hence the company should go ahead with it						

WN 1:

Initial Outlay	80,00,000
Project life	5 years
Salvage value	20,00,000
Depreciable value	60,00,000
Asset Life in Yrs	5.00
Annual SLM Dep	12,00,000
Addtl WC in ₹	10,00,000

WN 2 USD INR Exchange rate

Year	-	1.00	2.00	3.00	4.00	5.00
Indian Inflation		9%	9%	9%	9%	9%
US Inflation		8%	8%	8%	8%	8%
USDINR	72.00	72.67	73.34	74.02	74.70	75.40

WN 3

Initial investment in INR (Capex + WC)	90,00,000
USD INR	72
Initial investment in USD	1,25,000.00

14.Illustration (RTP May 19(N))

The directors of Implant Inc. wish to make an equity issue to finance a $10 m (million) expansion scheme which has an excepted Net Present Value of $2.2m and to re-finance an existing $6 m 15% Bonds due for maturity in 5 years' time. For early redemption of these bonds there is a $3,50,000 penalty charges. The Co. has also obtained approval to suspend these pre-emptive rights and make a $15 m placement of shares which will be at a price of $0.5 per share. The floatation cost of issue will be 4% of Gross proceeds. Any surplus funds from issue will be invested in IDRs which is currently yielding 10% per year.

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The Present capital structure of Co. is as under:

	'000
Ordinary Share ($1 per share)	7,000
Share Premium	10,500
Free Reserves	25,500
	43,000
15% Term Bonds	6,000
11% Debenture (2012-2020)	8,000
	57,000

Current share price is $2 per share and debenture price is $ 103 per debenture. Cost of capital of Co. is 10%. It may be further presumed that stock market is semi-strong form efficient and no information about the proposed use of funds from the issue has been made available to the public. You are required to calculate expected share price of company once full details of the placement and to which the finance is to be put, are announced.

Solution :

Particulars	**USD**	**Shares**	**USD**
Current market Value	2	7 Million	14 Mn
Fresh issue	0.5	30	15 Mn
Less : Repay Loan			(6 Mn)
Prepayment Charges			(0.35 Mn)
Cost of issue 4% of 15 Mn			(0.6 Mn)
Less : Investment in New Project			(10 Mn)
Add : Benefit from Project			12.2 Mn
Add : Benefit from Refinance of Debenture @15% #			
Interest @15% on 6 Mn for 5 Years (Discount @10%)			= PVIFA 900,000 [5 years, 10%] = 900,000 × 3.791 = USD 34,11,708
Principal Repayment 6Mn after 5 years (Discount @10%)			= PVIF 6Mn [5th year @10%] = 6 Mn × 0.621 = USD 37,26,000
Total			31,387,708
Total Market Value equivalent revised			31,387,708
Equity Shares (Old + new)			37,000,000
Revised Share Price			$\frac{31,387,708}{37,000,000}$ = USD 0.8483

Since it is a semi strong market the information that is private is not already reflecting in the share price and hence the price of equity share will fall from USD 2 to USD 0.8483

The benefit on account of nonpayment of Debenture interest and principal repayment should be discounted at WACC of 10%

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15. Illustration (RTP May 22)

M/s. Raghu Ltd. is interested in expanding its operation and planning to install manufacturing plant at US. It requires 8.82 million USD (net of issue expenses/ floatation cost) to fund the proposed project. GDRs are proposed to be issued to finance this project. The estimated floatation cost of GDRs is 2%.
Additional information:

(i) Expected market price of share at the time of issue of GDR is ₹ 360 (Face Value ₹ 100)
(ii) Each GDR will represent two underlying Shares.
(iii) The issue shall be priced at 10% discount to the market price.
(iv) Expected exchange rate is INR/USD 72.
(v) Dividend is expected to be paid at the rate of 20% with growth rate of 12%.

(1) You, as a financial consultant, are required to compute the number of GDRs to be issued and cost of the GDR.
(2) What is your suggestion if the company receives an offer from a US Bank willing to provide an equivalent loan with an interest rate of 12%?
(3) How much company can save by choosing the option as recommended by you?

Solution :

1)

Particulars	USD Million
Project Cost (Net)	8.82
Floatation Cost of GDR	2%
Total fund to be raised (gross)	$= \frac{8.82}{0.98} = 9$
CMP of share	360
Shares per GDR	2
Equivalent MV of GDR in INR	= 360 × 2 = 720
Discount at the time of issue	10%
GDR Issue price in Equivalent INR	= 720 × 0.9 = 648
USD INR	72
GDR Issue price in USD	9
Total Issue proceeds in USD Mn	9
No of GDRs to be issued in Mn	=9/9 =1
D1	20% of FV
FV per share in INR	100
FV per GDR in INR	=100 × 2 = 200
D1 in INR	= 200 × 20% = 40
g	12%
GDR Issue price	648
Less : Floatation Cost	2%
GDR Proceeds	635.04
Ke	$= \frac{D1}{Mp} + g = \frac{40}{635.04} + 12\%$ $= 18.30\%$
Cost of GDR	18.30%

2) If the company receives a quote for USD loan @ 12% , then it is preferrable to take that loan instead of issue GDR @ 18.30%

3) The cost saving when the company goes through the loan route is 6.3% (18.3% - 12%)

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Additional Illustrations for Practice

16. Illustration

A US based company is planning to set up a subsidiary company in India (where so far it was exporting) in view of growing demand for its product and competition from other US based companies. The initial project cost consisting of plant and machinery including installation is estimated to be US$ 490 million. The net working capital requirements are estimated at US$ 60 million. The company follows straight line method of depreciation. Currently, the company is exporting two million units every year at a unit price of US$ 90, its variable cost per unit being US$ 50.

The CFO of the Company has estimated the following operating cost and other data in respect of proposed project:

(i) Variable operating cost will be US $ 30 per unit of production
(ii) Additional cash fixed cost will be US $ 30 million p.a. and project's share of allocated fixed cost will be US $ 3 million p.a. based on principle of ability to share
(iii) Expected useful life of the proposed plant is five years with no salvage value
(iv) Production capacity of the proposed project in India will be 5 million units
(v) Existing working capital investment for production and sale of two million units through exports was US $ 25 million
(vi) Export of the product in the coming year will decrease to 1.5 million units, provided the company does not set up subsidiary company in India, in view of the presence of competing other US based companies that are in the process of setting up their subsidiaries in India
(vii) Applicable Corporate Income Tax rate is 35%, and
(viii) Required rate of return for such project is 12%.

Assuming that there will be no variation in the exchange rate of two currencies and all profits will be repatriated as there will be no withholding tax,
Estimate Net Present Value of the proposed project in India and give your advice. Present Value Interest Factors (PVIF) @ 12% for five years is as below:

Year	1	2	3	4	5
PVIF	0.8929	0.7972	0.7118	0.6355	0.5674

(July 21 – New)

Solution :

Particulars	Amount (USD Million)
Capex :	
Plant and Machinery	(490)
Working Capital	(60)
Total Investment	**(550)**
Export Sales :	
Units	1.5
Price per Unit	90
VC per unit	50
Contribution per unit	=90 – 50 =40
Total Contribution	= 40 × 1.5 = 60
Tax @35%	= (21)
Post-Tax contribution	39

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Subsidiary :	
Units	5
Price	90
VC	(30)
Contribution per unit	60
Total contribution	=60 × 5 =300
Less: FC	(30)
Dep @ 98 Mn for 5 years	(98)
PBT	172
Tax @ 35%	(60.2)
Profit After Tax	**111.8**
Incremental Cashflow:	
PAT of Indian Subsidiary	111.8
Add : Depreciation	98
Less : Cashflow of US Exports	(39)
Yearly Incremental CF	170.8
PVIFA @12% for 1-5	3.6048
PV of Incremental Cashflow	= 170.8 × 3.6048 = 615.6998
Total Investment	(550)
Add : WC already deployed in existing business	25
Net Investment	(525)
5th year Cash inflow of WC	35
PV Factor of year 5	0.5674
PV of cash inflow of year 5	= 35 × 0.5674 = 19.8590
NPV	**= 615.6998 - 525 + 19.8590 = 110.5588**

Since NPV is positive, company should proceed with the project.

17. Illustration

A USA based company is planning to set up a software development unit in India. Software developed at the Indian unit will be bought back by the US parent at a transfer price of US $10 million. The unit will remain in existence in India for one year; the software is expected to get developed within this time frame.

The US based company will be subject to corporate tax of 30 per cent and a withholding tax of 10 per cent in India and will be eligible for tax credit in India. The software developed will be sold in the US market and many companies are ready to acquire the same. Other estimates are as follows:

Rent for fully furnished unit with necessary hardware in India	₹ 18,75,000
Manpower cost (80 software professional will be working for 10 hours each day)	500 per man hour
Administrative and other costs	₹ 15,00,000

Advise the US Company the minimum amount it should charge from the prospective buyer. The rupee-dollar rate is ₹ 60/$.

Note: Assume 365 days a year

(NOV 21(N) – RTP)

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Solution :

Particulars	Amount
People	80
Hours per day	10
Days	365
Rs/ man hour	500
Manpower Cost	= 80 × 10 × 365 × 500 = INR 14,60,00,000
Rent	18,75,000
Administrative and other cost	15,00,000
Total Cost	**14,93,75,000**
Indian Entity Revenue	TP of USD 10 Mn @ INR 60 per USD
Revenue	= INR 60,00,00,000
Total Cost	INR (14,93,75,000)
Profit Before Tax	45,06,25,000
Less : Corporation Tax @30% (inc WHT)	(13,51,87,500)
Profit After tax	**31,54,37,500**
Amount received in USD @ INR 60 per USD	= $\frac{31,54,37,500}{60 \times 10}$ = **USD 5.257292 Mn**

18. Illustration (RTP Nov'23)

Mr. Vishwas, a friend of Mr. Pramod who is one of the Directors of Ashirwad Limited, is a citizen of Mauritius. His immediate family members including his parents, born in India are residing in India. He has many friends in different parts of India, due to which he happens to visit India on frequent basis. He along with Mr. Pramod evince interest in setting up business in India and formally incorporate a company to commence their operations. Accordingly, a company is called "Aerious Private Ltd." got incorporated in Mumbai.

To start with he received a business proposal from one of his friends Nimish a consultant. It is estimated that in equivalent terms the business shall require an initial investment of MUR 100 Million and thereafter MUR 2 Million each year will be needed as working capital fund.

He wished to evaluate whether the business proposal is viable or not. The information related to exchange rate and inflation rate is as follows:

Spot Rate for 1 Mauritian Dollar (MUR) = 1.88 Indian Rupee (INR) The inflation in India is 6% and in Mauritius is 5%.

It is expected that this inflation rate will remain unchanged for the next 4 years.

INR 8 Crore out of initial investment shall be required for setting up a plant. The useful life of the plant is 4 years. At the end of 4th year estimated salvage value of this plant shall be INR 80 lakhs. Depreciation of the plant shall be charged on the basis of straight-line method.

40 % of the investment shall be through debt funds from Mauritius at the cost of 10% (post tax) while remaining funds shall be arranged by him and his friends. They expect a rate of return of 12% on their funds.

Expected revenues & costs (excluding depreciation) in real term are as under:

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Year	1	2	3	4
Revenues (₹ Crore)	6.00	7.00	8.00	8.00
Costs (₹ Crore)	3.00	4.00	4.00	4.00

Assume that applicable tax rate in India is 30%. Since there is Double tax avoidance agreement between India and Mauritius, the company is not required to pay tax in Mauritius if tax has been paid in India.

The applicable inflation rates for revenues & costs are as follows:

Year	Revenues	Costs
1	10%	12%
2	9%	10%
3	8%	9%
4	7%	8%

He wants an expert opinion for the same investment proposal. Demonstrate whether investment in this project is viable option or not.

Note:

1. Round off calculations upto 4 decimal points.
2. Show INR calculations in Crore and MUR calculations in Million.

Solution:

Initial Investment	MUR Million	100.00				
Annual WC	MUR Million	2.00				
Years		0	1	2	3	4
Exchange rate INR per MUR		1.88	1.8979	1.9160	1.9342	1.9526
Inflation MUR	5%					
Inflation INR	6%					
Fx rate fr Yr 2 = Y1 * (1+D)/ (1+F)						
Amount of Investment	Rs. Cr	-18.80				
Amount of WC	MUR Mn		2	2	2	2
Amount of WC	Rs. Cr		-0.3796	-0.3832	-0.3868	-0.3905
Revenue	Rs. Cr real		6.00	7.00	8.00	8.00
Revenue Inflation	%		10%	9%	8%	7%
Revenue	Rs. Cr Nominal		6.6000	8.3930	10.3594	11.0845
Costs	Rs. Cr real		3.00	4.00	4.00	4.00
Cost inflation	%		12%	10%	9%	8%
Cost nominal	Rs. Cr Nominal		3.3600	4.9280	5.3715	5.8012

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EBITDA	INR Cr		3.2400	3.4650	4.9878	5.2833
Depreciation	INR Cr		-1.8000	-1.8000	-1.8000	-1.8000
EBIT	INR Cr		1.4400	1.6650	3.1878	3.4833
Interest	INR CR					
Assumed that loan is taken by vishwas and not aerious						
PBT	INR CR		1.4400	1.6650	3.1878	3.4833
Tax @ 30%	INR CR		- 0.4320	- 0.4995	- 0.9564	- 1.0450
PAT	INR CR		1.0080	1.1655	2.2315	2.4383
Add: Dep	INR CR		1.8000	1.8000	1.8000	1.8000
CFAT	INR CR		2.8080	2.9655	4.0315	4.2383
Cash Outflow (Inv + WC)	INR CR	-18.80	-0.3796	-0.3832	-0.3868	-0.3905
Cash inflow	INR CR		2.8080	2.9655	4.0315	4.2383
WC Recovery	INR CR					1.5402
Scrap value	INR CR					0.80
Net CF	INR CR	- 18.8000	2.4284	2.5823	3.6446	6.1879
Net CF In MUD	MUD Mn	- 100.0000	12.7953	13.4777	18.8429	31.6898
PVF on MUD money	@ 11.2%	1.0000	0.8993	0.8087	0.7273	0.6540
Net PV of CF in MUD	MUD Mn	- 100.0000	11.5065	10.8995	13.7035	20.7253
NPV	MUD Mn	- 43.1651				
Since the NPV of the project in MUD terms in -ve the proposal is a no go						

WN 1 on depreciation

Plant cost	INR Cr	8.0000	
Salvage value	INR Cr	0.8	
Life	Years	4.00	
Depreciable value		7.20	
SLM PA Dep	INR Cr	1.80	
Project cost in Inr cr		18.80	
Debt	40%	7.52	
Equity	60%	11.28	
Int cost on loan post tax	10%		
WN 2 on Disc rate			
WACC	**Debt**	**Equity**	**WACC**
% of capital	40%	60%	
Cost of Capital	10%	12%	
Weighted Average	4.000%	7.200%	11.200%

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