PORTFOLIO MANAGEMENT [8 to 16 Marks)

We will discuss this chapter in following parts

PART I Modern portfolio Theory [MPT)

PART II Capital Asset pricing Model (CAPM)

PART III Arbitrage pricing Theory (APT)

PART IV portfolio Rebalancing

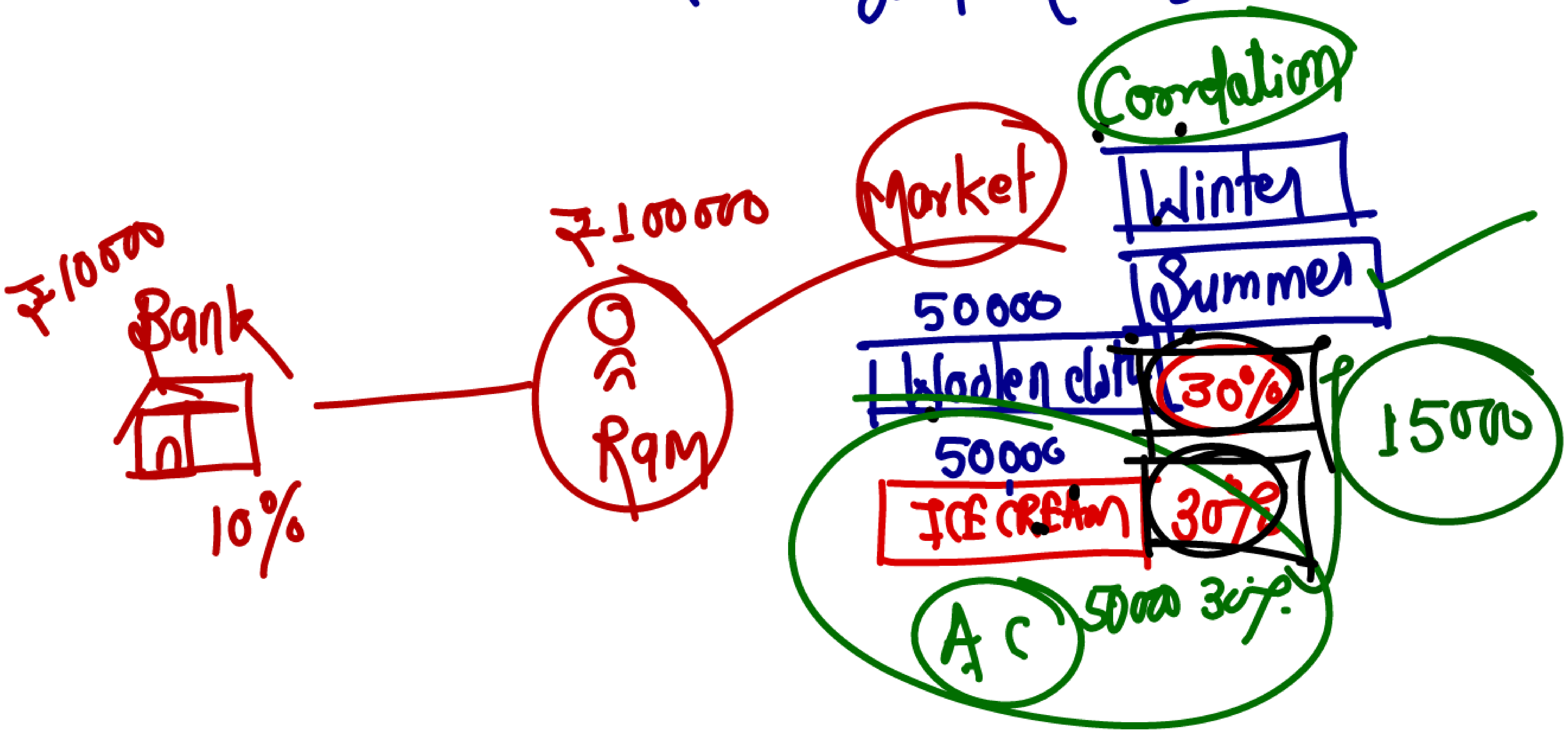
PART V Efficient Market Theory

PART VI Sharpe optimization Model

6 Questions

PART I MODERN PORTFOLIO THEORY

– Harry Markowitz



1 Portfolio is a bundle of securities. The whole purpose of MPT is risk reduction with the help of diversification.

If we invest in more than one stock (Two stocks) then Risk can be reduced through diversification & such diversification depends on "Correlation" between two stocks. Lower the correlation, lower the Risk

2. Expected Return & Risk of Single stock

(i) On the basis of past data [Ex-Post data]

Step 1 Annual Return

$$\text{Annual Return} = \frac{(P_1 - P_0) + D}{P_0} \times 100$$

Step 2 Expected Return

$$ER(\bar{x}) = \frac{\Sigma x}{n}$$

Step 3 Risk (standard deviation)

$$\sigma_x = \sqrt{\frac{\Sigma (x-\bar{x})^2}{n}}$$

2. On the basis of probability (Ex-Ante data)

Step 1 Expected Return

$$ER(\bar{X}) = \sum p(x)$$

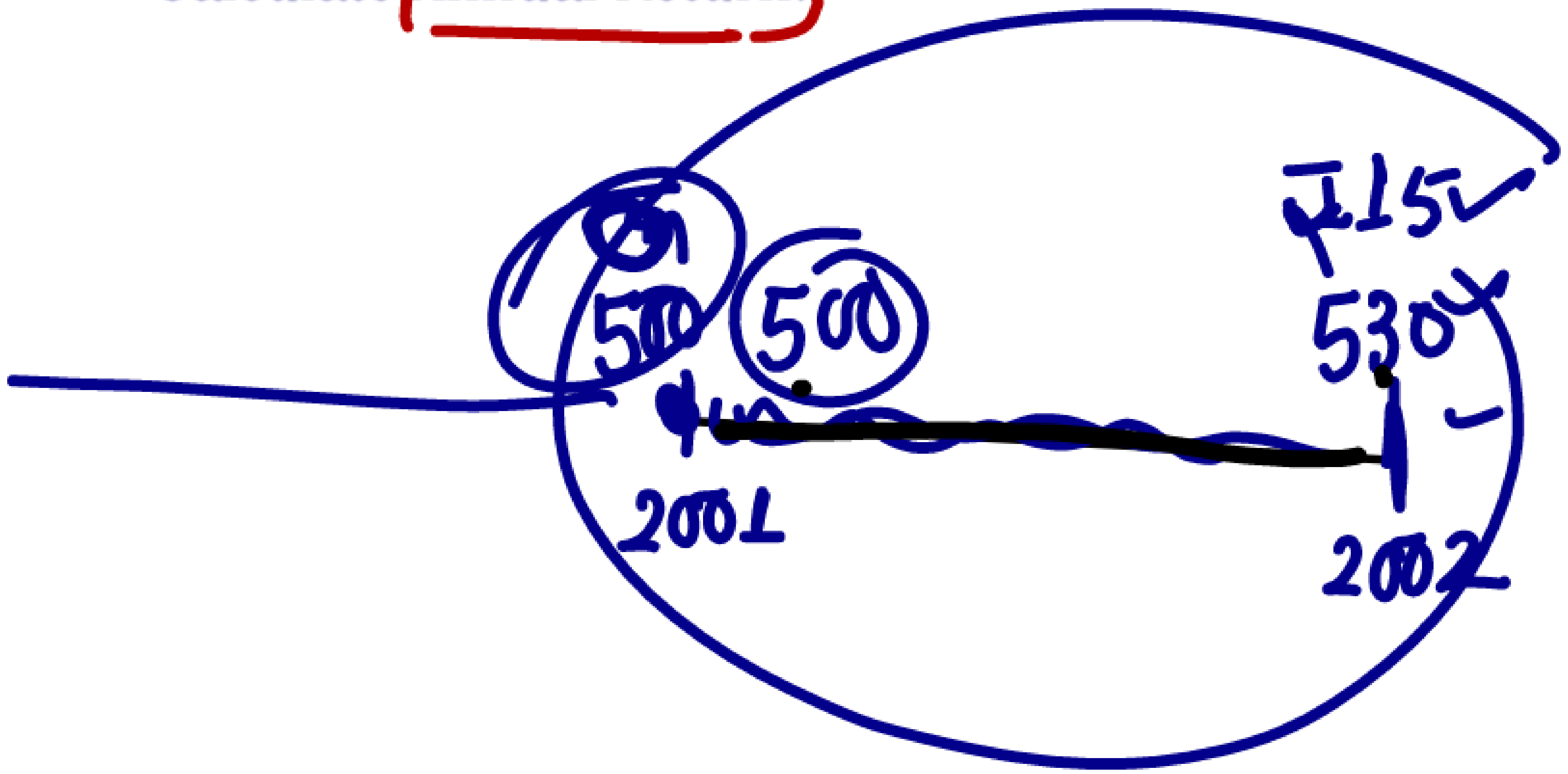
Step 2 Standard deviation

$$\sigma_x = \sqrt{\sum (x-\bar{x})^2 p}$$

Example: 01

YEAR	CLOSING PRICE	DPS
2001	500	~~20~~
2002	530	15
2003	550	25
2004	510	5
2005	535	10

Calculate Annual Return.



Calculation of Annual Return

$$2002 = \frac{(530-500)+15}{500} \times 100 = 9\%$$

$$2003 = \frac{(550-530)+25}{530} \times 100 = 8.50\%$$

$$2004 = \frac{(510-550)+5}{550} \times 100 = -6.36\%$$

$$2005 = \frac{(535-510)+10}{510} \times 100 = 6.86\%$$

Example: 02

YEAR	ANNUAL RETURN (%)
2001	10
2002	15
2003	-5
2004	20
2005	25

Calculate expected return and risk of single stock.

S.P.

Calculation of ER & S.D.

YEAR	x	$(x-\bar{x})$	$(x-\bar{x})^2$
1	10	-3	9
2	15	2	4
3	-5	-18	324
4	20	7	49
5	25	12	144
Σx	65		530

$\bar{x} = \frac{65}{5} = 13\%$

$\text{Variance} = \frac{530}{5} = 106(\%^2)$

$\sigma x = \sqrt{106(\%^2)} = 10.30\%$

Example: 03

Probability	Return(%)
0.25	25
0.30	15
0.20	10
0.25	5

Calculation expected return and risk of single stock.

P	x	$P(x)$	$(x-\bar{x})$	$(x-\bar{x})^2 P$
0.25	25	6.25	11	30.25
0.30	15	4.50	1	0.30
0.20	10	2.00	-4	3.20
0.25	5	1.25	-9	20.25
		14%		54

$\sigma x = \sqrt{54 (\%^2)}$

$= 7.35\%$

Question: 01

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

Required:

(i) Calculate the expected return.

(ii) Calculate the Standard deviation of returns.

(Study Material & PM)

① Calculation of Return

0.1 $\frac{115-120}{120} \times 100 = -4.17\%$

0.1 $\frac{120-120}{120} \times 100 = 0\%$

0.2 $\frac{125-120}{120} \times 100 = 4.17\%$

0.3 $\frac{130-120}{120} \times 100 = 8.33\%$

0.2 $\frac{135-120}{120} \times 100 = 12.5\%$

0.1 = $\frac{140-120}{120} \times 100 = 16.67\%$

Calculation of ER & S.D.

P	x	$P(x)$	$(x-\bar{x})$	$(x-\bar{x})^2 P$
0.1	-4.17	-0.417	-11.253	12.663
0.1	0	0	-7.083	5.017
0.2	4.17	0.834	-2.913	1.697
0.3	8.33	2.499	1.247	0.466
0.2	12.5	2.50	5.417	5.869
0.1	16.67	1.667	9.587	9.191
		$\bar{x} = 7.083$		$34.90\ (\%^2)$

$$\sigma_x = \sqrt{34.90}$$

$$= 5.908\%$$

Eg

	Stock A	Stock B
ER	12%	15%
S.D.	6%	9%

Which stock should be purchased?

Calculate coefficient of variation

$$C.V. = \frac{\sigma}{\bar{X}}$$

$$A = \frac{6}{12} = 0.5$$

$$B = \frac{9}{15} = 0.6$$

purchase stock A due to lower C.V.

③ Expected Return of Portfolio

Eg

	Investment	ER
Stock A	₹ 700000	20%
Stock B	₹ 300000	15%

$$ER_P = ?$$

$$ER_P = \frac{(700000 \times 20) + (300000 \times 15)}{1000000} = 18.50\%$$

or

$$\boxed{\begin{aligned} ER_P &= (ER_A \times W_A) + (ER_B \times W_B) \\ &= (20 \times 0.7) + (15 \times 0.3) = 18.5\% \end{aligned}}$$

Eg

$ER_A = 15\%$

$ER_B = 19\%$

$ER_P = 16.4\%$

$\omega A = ?$

$\omega B = ?$

$$ER_P = (ER_A \times \omega A) + (ER_B \times \omega B)$$

$$16.4 = (15 \times \omega A) + 19\,(1 - \omega A)$$

$$16.4 = 15\omega A + 19 - 19\omega A$$

$$2.6 = 4\omega A$$

$$\omega A = \frac{2.60}{4} = 0.65$$

$$\omega B = 1 - 0.65 = 0.35$$

3 Correlation (Imp)

1 Meaning
2 Calculation
3 Concept

1 MEANING

Correlation is a strength of relationship between two stocks & it lies between -1 to +1.

There are three types of Correlation in portfolio

1 perfect positive Correlation (+1)
2 perfect Negative Correlation (-1)
3 Other than perfect positive & perfect Negative

Example: 04

YEAR	STOCK X	STOCK Y
1	30%	14%
2	25%	8%
3	20%	12%
4	15%	16%
5	10%	20%

Calculate:

(i) Expected Return of X and Y

(ii) Standard Deviation of X and Y

(iii) Covariance X and Y

(iv) Correlation X and Y

(P

		2			3		
YEAR	x	$(x-\bar{x})$	$(x-\bar{x})^2$	Y	$(Y-\bar{Y})$	$(Y-\bar{Y})^2$	$(x-\bar{x})(Y-\bar{Y})$
1	30	10	100	14	0	0	0
2	25	5	25	8	-6	36	-30
3	20	0	0	12	-2	4	0
4	15	-5	25	16	2	4	-10
5	10	-10	100	20	6	36	-60
Σx	100		250	70		80	$-100\ (\%^2)$

$\bar{X} = \frac{100}{5} = 20\%$

$\sigma_x = \sqrt{\frac{250}{5}} = 7.07$

$\bar{Y} = \frac{70}{5} = 14\%$

$\sigma_y = \sqrt{\frac{80}{5}} = 4\%$

$Cov_{xy} = \frac{\Sigma(x-\bar{x})(Y-\bar{Y})}{n} = \frac{-100(\%^2)}{5} = -20\ (\%^2)$

$r_{xy} = \frac{Cov_{xy}}{\sigma_x \times \sigma_y}$

Calculation of Correlation x & y

$$r_{xy} = \frac{Cov_{xy}}{\sigma_x \times \sigma_y}$$

$$= \frac{-20\,(\%^2)}{7.07\% \times 4\%} = -0.71$$

2 Calculation of Correlation

- In order to calculate Correlation i.e. r_{xy}, we have to calculate Co-variance i.e. Cov_{xy}
- Cov_{xy} means joint deviation of x around $\bar{x}$ & y around $\bar{y}$. It is calculated as under

☞ **on the basis of Ex-Post data**

$$Cov_{xy} = \frac{\Sigma (x-\bar{x})(y-\bar{y})}{n}$$

☞ **on the basis of Ex-Ante data**

$$Cov_{xy} = \Sigma (x-\bar{x})(y-\bar{y}) p$$

- There ~~is~~ are two problems in Covariance
  - (i) It is not Range bound
  - (ii) It is expressed in $(\%^2)$

We want Range bound answer. for this we divide Covxy by σ_x & σ_y

$$\boxed{r_{xy} = \frac{Cov_{xy}}{\sigma_x \times \sigma_y}}$$

Example – 05

Probability	STOCK X	STOCK Y
0.3	20%	-2%
0.4	15%	10%
0.2	-5%	20%
0.1	10%	5%

Calculate:

(i) Expected Return of X and Y

(ii) Standard Deviation of X and Y

(iii) Covariance X and Y

(iv) Correlation X and Y

(Page No. 04)

P	x	$P(x)$	$(x-\bar{x})$	$(x-\bar{x})^2P$	Y	$P(Y)$	$(y-\bar{y})$	$(y-\bar{y})^2P$	$(x-\bar{x})(y-\bar{y})P$
0.3	20	6	8	19.2	−2	−0.6	−9.9	29.403	−28.76
0.4	15	6	3	3.60	10	4	2.10	1.764	2.52
0.2	−5	−1	−17	57.80	20	4	12.10	29.282	−41.14
0.1	10	1	−2	0.40	5	0.5	−2.90	0.841	0.58
	$\bar{x}=$	12		81	$\bar{y}=$	7.9%		61.29	−61.86

$$\sigma_x = \sqrt{81} = 9\%$$

$$\sigma_y = \sqrt{61.29} = 7.83\%$$

$$r_{xy} = \frac{Cov_{xy}}{\sigma_x \sigma_y} = \frac{-61.80}{9 \times 7.83} = -0.878$$

Imp Eg

YEAR	x	Y
1	15%	10%
2	13%	15%
3	20%	11%
4	25%	5%
5	17%	14%

① Calculate ER & S.D. of each stock ✓

② Calculate r_{xy} ✓

③ If we Invest 70% in x & 30% in Y Calculate ERp & S.D.p

ERp & σp

Alternative I

YEAR		ERp
1	$(15\times0.7)+(10\times0.3)$	13.5
2	$(13\times0.7)+(15\times0.3)$	13.6
3	$(20\times0.7)+(11\times0.3)$	17.3
4	$(25\times0.7)+(5\times0.3)$	19
5	$(17\times0.7)+(14\times0.3)$	16.10

Imp Eg

YEAR	70% x	30% Y
1	15%	10%
2	13%	15%
3	20%	11%
4	25%	5%
5	17%	14%

$\omega_x = 0.7$ $\omega_y = 0.3$

	x	Y
ER	18	11
S.D.	4.195	3.52

$r_{xy} = -0.84$

① Calculate ER & S.D. of each stock ✓

② Calculate r_{xy} ✓

③ If we Invest 70% in x & 30% in y Calculate ERp & S.D.p

Calculation of ER_p & σ_p

YEAR	z	$z-\bar{z}$	$(z-\bar{z})^2$
1	13.5	-2.4	5.76
2	13.6	-2.30	5.29
3	17.3	1.40	1.96
4	19	3.10	9.61
5	16.10	0.20	0.04
Σz	79.5		22.66

$ER_p = 15.90\%$

$\sigma_p = 2.129\%$

$\bar{z} = 15.90\%$

$\sigma_z : \sqrt{\frac{22.66}{5}} = 2.129$

Alternative II (Imp)

$$ER_p = (ER_x \, \omega_x) + (ER_y \times \omega_y)$$

$$= (18 \times 0.7) + (11 \times 0.3) = 15.90\%$$

$$\sigma_{AB}^2 = \underbrace{\sigma_A^2 \, \omega_A^2}_{} + \underbrace{\sigma_B^2 \, \omega_B^2}_{}$$

9^2 6^2

$$+ 2 \times \sigma_A \times \omega_A \times \sigma_B \times \omega_B \times r_{AB}$$

$$\sqrt{4.195^2 \, 0.7^2 + 3.52^2 \, 0.3^2 + 2 \times 4.195 \times 0.7 \times 3.52 \times 0.3 \times -0.84}$$

$$= 2.128$$

Eg

	A	B
ER	20%	12%
σ	5%	3%

$COV_{AB} = 13.5\ (\%^2)$

$\omega_A = 0.65,\ \omega_B = 0.35$

(i) ER_p (ii) σ_p

$\cancel{r_{xy} = \frac{Cov_{xy}}{\sigma_x \times \sigma_y}}$

$ER_p = 17.2\%$

$$\boxed{\sigma_p^2 = \sigma_A^2\omega_A^2 + \sigma_B^2\omega_B^2 + 2\times\sigma_A\times\omega_A\times\sigma_B\times\omega_B\times r_{AB}}$$

$$= \sigma_A^2\omega_A^2 + \sigma_B^2\omega_B^2 + 2\times\omega_A\times\omega_B\times\underbrace{\boxed{\sigma_A\times\sigma_B\times r_{AB}}}_{COV_{AB}}$$

$$\sqrt{= 5^2 0.65^2 + 3^2 0.35^2 + 2\times0.65\times0.35\times13.5} = 4.22$$

Example: 06

Hw

Seasons	Probability	Ice-Cream (x)	Woolen (y)
Summer	0.5	30%	10%
Winter	0.5	10%	40%

Calculate:

(i) Expected return of each stock.

(ii) Standard deviation of each stock.

(iii) Correlation between Ice-Cream and Woolen Clothes.

(iv) If we invest 60% in Ice-Cream and 40% in woolen clothes calculate expected return and standard deviation of portfolio.

H.W

HW

Example: 07

	Stock A	Stock B
Expected Return	20%	15%
Standard Deviation	10%	8%

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Weight of A = 70%

Weight of B = 30%

Correlation between A and B = 0.35

Calculate:

(i) Expected return of portfolio.

(ii) Standard deviation of portfolio.

Example: 08

	Stock A	Stock B
Expected Return	22%	15%
Standard Deviation	10%	8%

Correlation between A & B = 1 (Perfect Positive)X

Calculate expected return and standard Deviation of portfolio if we invest 60% in stock A and 40% in stock B.

① Expected Return of portfolio

$$ER_P = (ER_A \times \omega_A) + (ER_B \times \omega_B)$$

$$= (22 \times 0.60) + (15 \times 0.40)$$

$$= 19.2\%$$

② Standard deviation of portfolio

$$\sigma_P = (\sigma_A \times \omega_A) + (\sigma_B \times \omega_B)$$

$$= (10 \times 0.60) + (8 \times 0.40)$$

$$= 9.2\%$$

☞ If Correlation between two stocks is perfect positive (+1) then Risk of portfolio can be calculated as under

$$\sigma_P = (\sigma_A \times \omega_A) + (\sigma_B \times \omega_B)$$

Example – 09

	Stock A	Stock B
Expected Return	30%	20%
Standard Deviation	20%	5%

Correlation between A & B = -1 (Perfect Negative)

Calculate expected return and standard Deviation of portfolio if we invest 60% in stock A and 40% in stock B.

Suppose, we want a portfolio having zero Risk, what is the weight of stock A & stock B

① Expected Return of portfolio

$$ER_p = (30 \times 0.60) + (20 \times 0.4)$$
$$= 26\%$$

② Standard deviation of portfolio

$$\sigma_P = (\sigma_A \times w_A) - (\sigma_B \times w_B)$$
$$= (20 \times \cancel{0.6}\ w_A) - (5 \times \cancel{0.4}\ (1-w_A)) = \cancel{10}\ 0$$

$$(\sigma_A \times \omega_A) - (\sigma_B \times \omega_B) = 0$$

$$\sigma_A \times \omega_A = \sigma_B (1-\omega_A)$$

$$\sigma_A \times \omega_A = \sigma_B - \sigma_B \omega_A$$

$$(\sigma_A \times \omega_A) + (\sigma_B \times \omega_A) = \sigma_B$$

$$\omega_A (\sigma_A + \sigma_B) = \sigma_B$$

$$\omega_A = \frac{\sigma_B}{\sigma_A + \sigma_B}$$

☞ If Correlation Between Two stocks is Perfect Negative (-1) then Risk of Portfolio Can be reduced to "Zero" with the help of optimum weights & it is called "Zero Risk Portfolio"

How to calculate weights

$$\omega_A = \frac{\sigma_B}{\sigma_A + \sigma_B} \left(\frac{\text{दूसरे का S.D.}}{\text{दोनों का S.D.}} \right)$$

Example – 10

	Stock A	Stock B
Expected Return	25%	40%
Standard Deviation	10%	18%

Correlation between A & B = -1 (Perfect Negative)

Construct zero risk portfolio and calculate expected return and risk of such portfolio.

$ERp = 30.40\%$

$\sigma p = 0$

Zer

$$\omega A = \frac{\sigma B}{\sigma A + \sigma B}$$

$$\omega A = \frac{18}{10+18} = 0.64$$

$$\omega B = 1 - 0.64 = 0.36$$

$$ERp = (25 \times 0.64) + (40 \times 0.36)$$

$$= 30.40\%$$

$$\sigma p = \sqrt{\sigma A^2 \omega A^2 + \sigma B^2 \omega B^2 + 2 \times \sigma A \times \omega A \times \sigma B \times \omega B \times r AB}$$

$$= \sqrt{10^2 0.64^2 + 18^2 0.36^2 + 2 \times 10 \times 0.64 \times 18 \times 0.36 \times -1}$$

$$= 0$$

If Correlation Between two Stocks is perfect positive (+1) then Risk can not be reduced. It is only weighted Average

$(a+b)^2$

$\sigma_P = \cancel{\sqrt{\sigma_A^2 \times W_A^2 + \sigma_B}}$ $+ 2 r \sigma_A \sigma_B$

Example – 11

	Stock A	Stock B
Expected Return	12%	15%
Standard Deviation	5%	9%

Correlation between A & B = 0.15

Construct minimum risk portfolio and calculate expected return and risk of such portfolio.

Weight = ?

ER_P = ?

σ_P = ?

optimum weights are calculated as under

$$\boxed{\omega A = \frac{\sigma_B^2 - COV_{AB}}{\sigma_A^2 + \sigma_B^2 - 2\,COV_{AB}}}$$

☞ If Correlation between two stocks is other than perfect positive & perfect Negative then Risk of portfolio can be reduced but not zero with the help of optimum weights & it is called "Minimum Risk portfolio"

Question: 09

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 per cent)	12	8	7	14	16	15	18	20	16	22
Security 2: (Return per cent)	20	22	24	18	15	20	24	25	22	20

H.W

Class Work

(Study Material & PM)

Question: 10

Calculate the Covariance & Correlation Coefficient of the two securities, from the historical rates of return over the past 10 years.

Years	1	2	3	4	5	6	7	8	9	10
Security 1 (Return %)	15	10	12	8	18	16	20	24	16	14
Security 2 (Return %)	24	20	18	14	22	26	12	28	16	15

H.W

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Three Assets portfolio

$(a+b+c)^2$

$$ER_P = (ER_A \times \omega_A) + (ER_B \times \omega_B) + (ER_C \times \omega_C)$$

$$\sigma_P = \sqrt{\begin{aligned} &\sigma_A^2 \omega_A^2 + \sigma_B^2 \omega_B^2 + \sigma_C^2 \omega_C^2 \\ &+ 2 \times \omega_A \times \omega_B \times \boxed{COV_{AB}}\ \sigma_A \sigma_B r_{AB} \\ &+ 2 \times \omega_A \times \omega_C \times COV_{AC} \\ &+ 2 \times \omega_B \times \omega_C \times COV_{BC} \end{aligned}}$$

Example – 12

	Stock A	Stock B	Stock C
Expected Return	11%	15%	25%
Standard Deviation	5%	10%	12%
Weights	0.6	0.3	0.1

Correlation between A & B = 0.15

Correlation between A & C = 0.45

Correlation between B & C = 0.75

Expected return and risk of portfolio.

H.W

8 Marks

Question: 02

Consider the following information on two stocks, X and Y.

	Year	2016	2017
ERx	Return on X (%) 40%	10	16
ERy	Return on Y (%) 60%	12	18

You are required to calculate:

(i) The expected return on a portfolio containing X and Y in the proportion of 40% and 60% respectively.

(ii) The Standard Deviation of return from each of the two stocks.

(iii) The Covariance of returns from the two stocks.

(iv) The Correlation coefficient between the returns of the two stocks.

(v) The risk of a portfolio containing X and Y in the proportion of 40% and 60%.

(Study Material, PM & Exam May – 2018)

① $ER_p = (ER_A \times \omega_A) + (ER_B \times \omega_B)$

$= (13 \times 0.40) + (15 \times 0.60)$

$= 14.2\%$

② $\sigma_x = 3\%$, $\sigma_y = 8\%$

③ $Cov_{xy} = 9\ (\%^2)$

④ $r_{xy} = \frac{Cov_{xy}}{\sigma_x \times \sigma_y} = \frac{9}{3 \times 3} = 1$

⑤ $\sigma_p = (\sigma_A \times \omega_A) + (\sigma_B \times \omega_B)$

$= (3 \times 0.4) + (3 \times 0.6) = 3\%$

Calculation of ER, SD & Cov$_{xy}$

YEAR	x	$(x-\bar{x})$	$(x-\bar{x})^2$	y	$(y-\bar{y})$	$(y-\bar{y})^2$	$(x-\bar{x})(y-\bar{y})$
1	10	-3	9	12	-3	9	9
2	16	3	9	18	3	9	9
Σx	26		18 (%^{2})	30		18	18

$\bar{x} = 13\%$

$\sigma_x = \sqrt{\frac{18}{2}} = 3\%$

$\bar{y} = 15\%$

$\sigma_y = \sqrt{\frac{18}{2}} = 3\%$

$Cov_{xy} = \frac{18\,(\%^2)}{2} = 9\,(\%^2)$

Question: 03

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 (σ)	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?

(Study Material & PM)

$ER_P = (ER_A \times \omega_A) + (ER_B \times \omega_B)$

$\sigma_P = \sigma_A^2 \omega_A^2 + \sigma_B^2 \omega_B^2 + 2 \times \omega_A \times \omega_B \times COV_{AB}$

$10 \times 18 \times 0.15$

Portfolio I (100% in B)

$ER_P = 12\%$ $\sigma_P = 10\%$

PORTFOLIO II (50% in B, 50% in D)

$ER_P = (12 \times 0.5) + (20 \times 0.5) = 16\%$

$\sigma_P = \sqrt{10^2 0.5^2 + 18^2 0.5^2 + 2 \times 0.5 \times 0.5 \times 27} = 10.93\%$

PORTFOLIO III (75% in B & 25% in D)

$ER_P = (12 \times 0.75) + (20 \times 0.25) = 14\%$

$\sigma_P = \boxed{9.31\%}$

PORTFOLIO IV (100% in D)

$ER_p = 20\%$, $\sigma_p = 18\%$

PORTFOLIO III (75% in B & 25% in D) is the best from point of view of Risk due to Lowest S.D i.e. 9.31%

& from the point of view of Return portfolio IV (100% in D) is the best due to Highest Return i.e. 20%.

Question: 05

Mayuri is interested to construct a Portfolio of Securities X and Y. She has collected the following information:

	X	Y
Expected Return (R)	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?

(RTP May – 2022 & Exam November – 2020)

H.W

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Question: 04

An investor has decided to invest to invest ₹ 1,00,000 in the shares of two companies, namely, ABC and XYZ. The projection of returns from the shares of the two companies along with their probabilities are as follows:

Probabilities	ABC (%)	XYZ (%)
.20	12	16
.25	14	10
.25	-7	28
.30	28	-2

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 proportion.

0.5 & 0.5

(Study Material, PM & RTP May - 2019)

(iii) Calculate optimum weights

①

	ER	S.D.
ABC	12.55%	12.95%
XYZ	12.10%	11.27%
PORTFOLIO	12.325%	1.25%

Investor should Invest in portfolio because Risk reduced to 1.25%

Calculation of ER, S.D. Covxy

P	x	P(x)	$(x-\bar{x})$	$(x-\bar{x})^2 P$	y	P(y)	$(y-\bar{y})$	$(y-\bar{y})^2 P$	$(x-\bar{x})(y-\bar{y})P$
0.20	12	2.4	-0.55	0.0605	16	3.2	3.90	3.042	-0.429
0.25	14	3.5	1.45	0.5256	10	2.5	-2.10	1.1025	-0.761
0.25	-7	-1.75	-19.55	95.5506	28	7	15.90	63.2025	-77.71
0.30	28	8.40	15.45	71.6107	-2	-0.60	-14.10	59.643	-65.35
		$\bar{x}$ = 12.55		167.75	$\bar{y}$	12.10%		126.99	-144.25 (%²)

$\sigma_x = \sqrt{167.75} = 12.95\%$

$\sigma_y = \sqrt{126.99} = 11.27\%$

(ii) ER_p & σ_p

$$ER_p = (ER_A \times w_A) + (ER_B \times w_B)$$
$$= (12.55 \times 0.5) + (12.10 \times 0.5) = 12.325\%$$

$$\sigma_p = \sqrt{\sigma_A^2 w_A^2 + \sigma_B^2 w_B^2 + 2 \times w_A w_B \, Cov_{AB}}$$
$$\sqrt{12.95^2 \, 0.5^2 + 11.27^2 \, 0.5^2 + 2 \times 0.5 \times 0.5 \times \boxed{-144.25}}$$
$$= 1.25\%$$

(iii) optimum Weights

$$r_{xy} = \frac{Cov\,xy}{\sigma x \times \sigma y}$$

$$= \frac{-144.25}{12.95 \times 11.27} = -0.99$$

$$\omega A = \frac{\sigma_B^2 - COVAB}{\sigma A^2 + \sigma B^2 - 2\,COVAB}$$

$$= \frac{(11.27)^2 - (-144.25)}{(12.95)^2 + (11.27)^2 - (2 \times -144.95)} = 0.46$$

$$\omega B = 0.54$$

Group Drive

2 Hours

60 Marks

MCQ 10 Marks

H.W

Class Work

H.W

Question: 06

Ramesh has identified stocks of two companies A and B having good investment potential:

Following data is available for these stocks:

Year	A (Market Price per Share in ₹)	B (Market Price per Share in ₹)
2013	19.60	8.70
2014	18.75	12.80
2015	33.42	16.20
2016	42.64	18.25
2017	43.25	15.60
2018	44.60	13.25
2019	34.75	18.60

You are required to calculate:

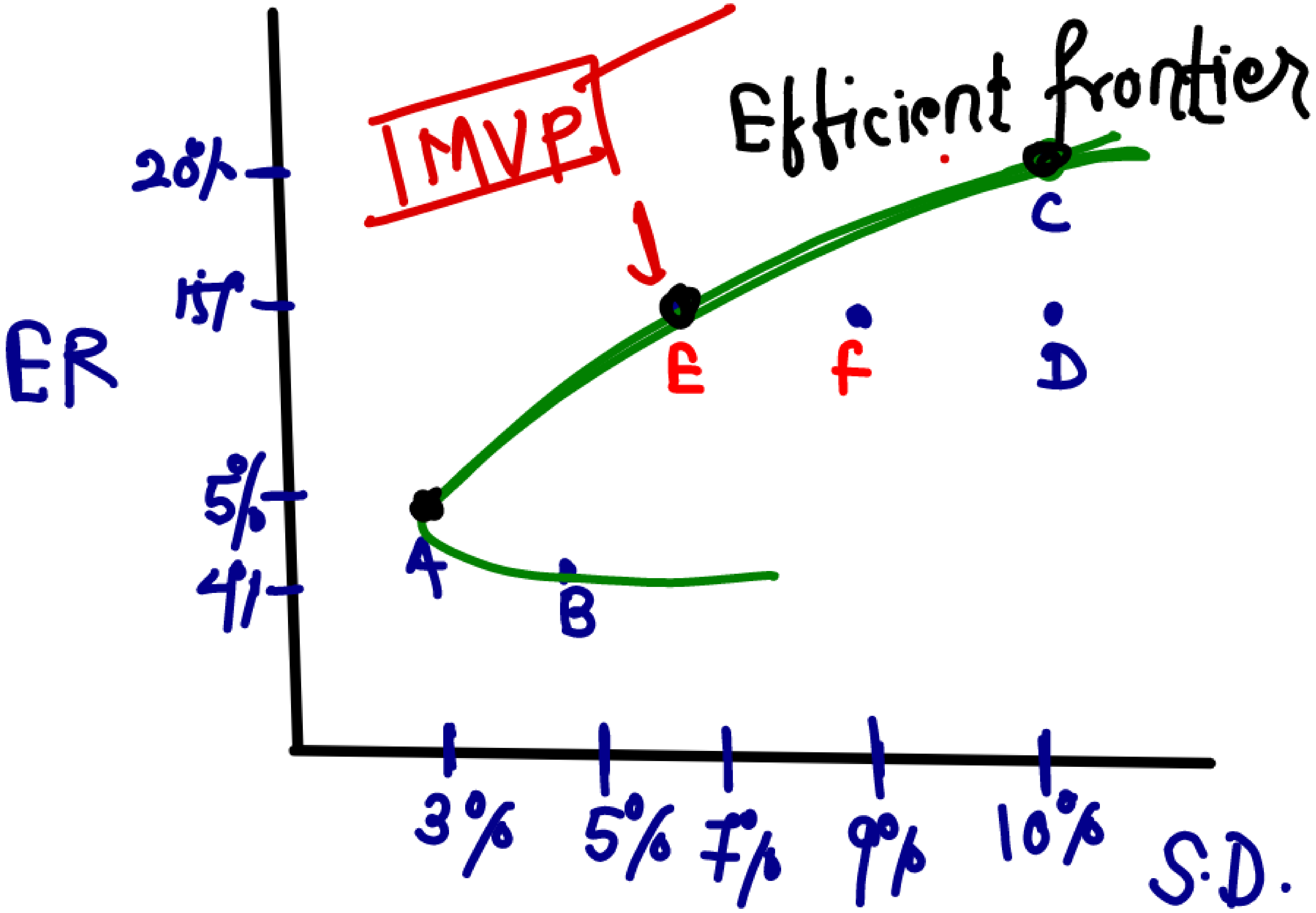
(i) The Risk and Return by investing in Stock A and B

(ii) The Risk and Return by investing in a portfolio of these Stocks if he invests in Stock A and B in proportion of 6 : 4.

(iii) The better opportunity for investment

(Exam January - 2021)

4 Efficient & optimum portfolio



MVP = Minimum Variance portfolio

Efficient A, C, E optimum

	A	~~B~~	C	~~D~~	E	~~F~~
ER	.15	20	.22	25	.28	15
σ	.8	10	.10	12	.11	9

Example: 13

Security	~~A~~	~~B~~	C	D	E	F
ER	~~13~~	~~13~~	14	18	11	25
SD	~~5~~	~~7~~	5	6	3	22

1. Find out efficient securities.
2. Find out optimal securities.

Risk free rate = 6%

(Page No.15)

1. Efficient Securities

- Security A is inefficient, because Security C provides higher Return at same Level of Risk.
- Security B is inefficient Because Security D provides same Return at Lower Level of Risk.

Efficient Securities are C, D, E & F

2. Optimal Security

After Selection of Efficient Securities, we have to Select optimal Security (Best)

1. On the basis C.V.

$$C.V. = \frac{\sigma}{\bar{X}}$$

$C = \frac{5}{14} = 0.36$

$D = \frac{6}{18} = 0.33$

$E = \frac{3}{11} = 0.27$

$F = \frac{22}{25} = 0.88$

optimal stock = Stock E (Lowest C.V)

2 On the basis of Sharpe Ratio

[If Rf is given]

$$\text{Sharpe Ratio} = \frac{ER - Rf}{\sigma}$$

$C = \frac{14-6}{5} = 1.6$

$D = \frac{18-6}{6} = 2$ Best

$E = \frac{11-6}{3} = 1.67$

$F = \frac{25-6}{22} = 0.86$

Highest

Question: 07

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.

position (+1)

(ii) Assuming perfect correlation, show whether it is preferable to invest 75% in A and 25% in C or to invest 100% in E

(Study Material & PM)

(Page No.15)

① Efficient Securities

- Security B & F is inefficient because Security A provides Same Return at Lower Risk

- Security D is inefficient because Security A provides Higher Return at Same Level of Risk.

Efficient Securities are A, C & E

(II) Calculation of ER & S.D.

(I) 75% in A & 25% in C

$$ER_p = (8 \times 75\%) + (12 \times 25\%) = 9\%$$

$$\sigma_p = (\sigma A \times wA) + (\sigma B \times wB)$$

$$= (4 \times 75\%) + (12 \times 25\%) = 6\%$$

(II) 100% in E

$$ER_p = 9\%$$

$$\sigma_p = 5\%$$

It is better to Invest 100% in E because E provides Same Return at Lower Level of Risk.

Question: 08

Following is the data regarding six securities:

	U	V	W	X	Y	Z
Return (%)	10	10	15	5	11	10
Risk (%) (Standard Deviation)	5	6	13	5	6	7

(i) Recommend at least three securities which shall be selected among the six securities mentioned above.

(ii) Assuming perfect correlation, evaluate whether it is preferable to invest 80% in security U and 20% in security W or to invest 100% in Y.

H.W

H.W Copy

(MTP: Mar – 2018)

(Page No.16)

Question: 50

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:

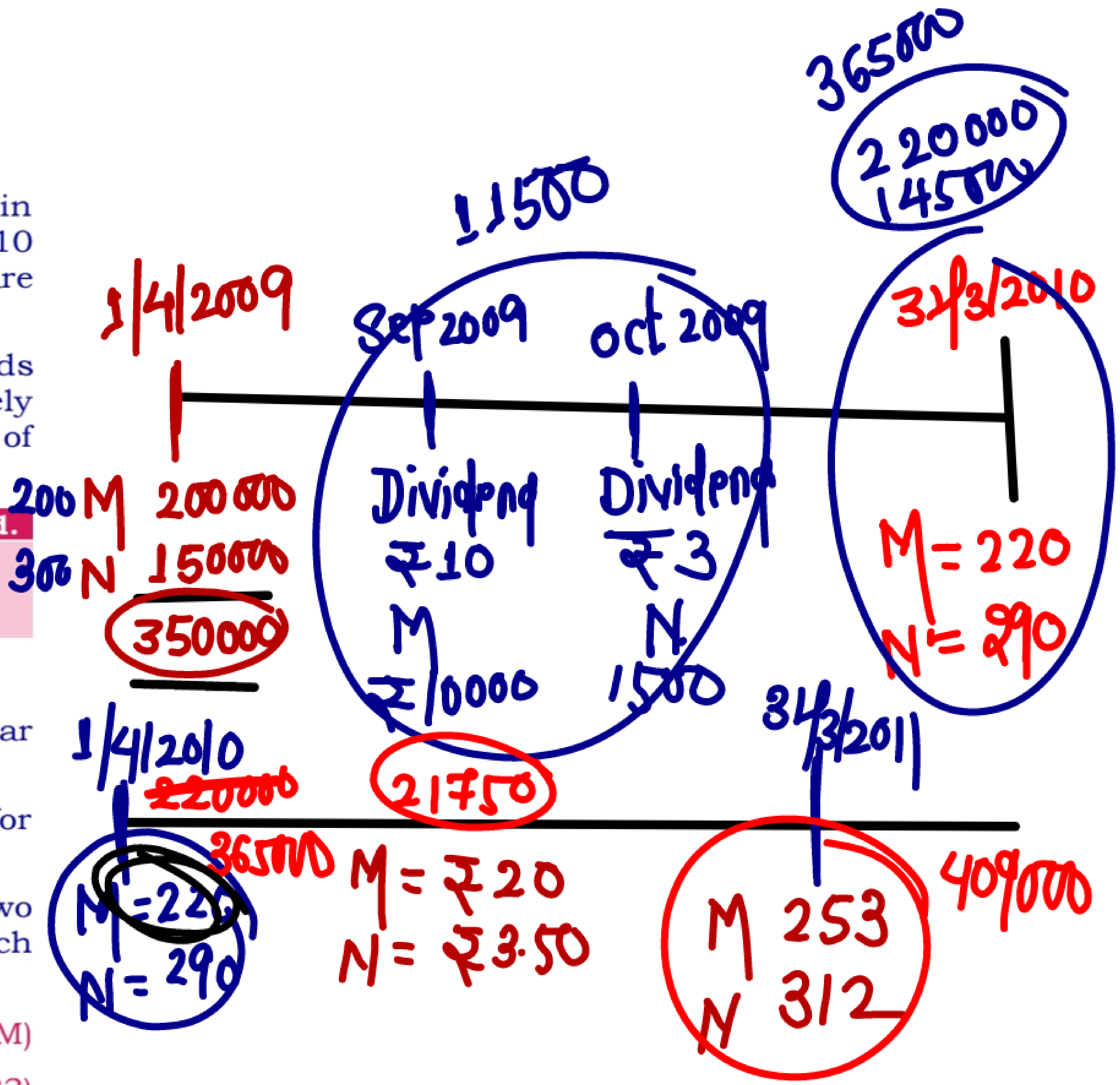
(i) Calculate the average return from the portfolio for the year ended 31.3.2010;

(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.

(Study Material & PM)

(Page No. 83)



① Calculation of Average Return of Portfolio for the year ended 31/03/2010

$$\text{Avg Return} = \frac{(P_1 - P_0) + \text{Dividend}}{P_0} \times 100$$

$$\text{M Ltd} = \frac{(220 - 200) + ₹10}{200} \times 100 = 15\%$$

$$\text{N Ltd} = \frac{(290 - 300) + 3}{300} \times 100 = -2.33\%$$

Calculation of Weights

		Weights
M	200000	0.57
N	150000	0.43
	350000	1.00

$$\text{Avg Return} = (15 \times 0.57) + (-2.33 \times 0.43)$$

$$= 7.55\%$$

(2) Calculation of Expected Return of PORTFOLIO

$$M\ 4d = \frac{(253-220)+20}{220} \times 100 = 24.09\%$$

$$N\ 4d = \frac{(312-290)+3.50}{290} \times 100 = 8.79\%$$

M	$1000 \times 220 =$	220000	0.60
N	$500 \times 290 =$	145000	0.40
		365000	

$$ERp = (24.09 \times 0.6) + (8.79 \times 0.40) = 17.97\%$$

(iii) Calculation of standard deviation

Calculation of Return (%)

P	Return
0.2	$\frac{(220-220)+20}{220} \times 100 = 9.09\%$
0.5	$\frac{(250-220)+20}{220} \times 100 = 22.73\%$
0.3	$\frac{(280-220)+20}{220} \times 100 = 36.36\%$

P	x	P(x)
0.2	9.09	
0.5	22.73	
0.3	36.36	

Question: 47

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

₹100

The existing market price of an equity share is ₹ 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.

And also advise-Whether to accept buy-back offer?

(Study Material & PM)

(Page No.79)

Calculation of Return in %

$$\text{Return} = \frac{(P_1 - P_0) + \text{Dividend}}{P_0} \times 100$$

$$0.25 = \frac{(115-100)+9}{100} \times 100 = 24\%$$

$$0.50 = \frac{(107-100)+5}{100} \times 100 = 12\%$$

$$0.25 = \frac{(97-100)+3}{100} \times 100 = 0\%$$

Calculation of ER & S.D.

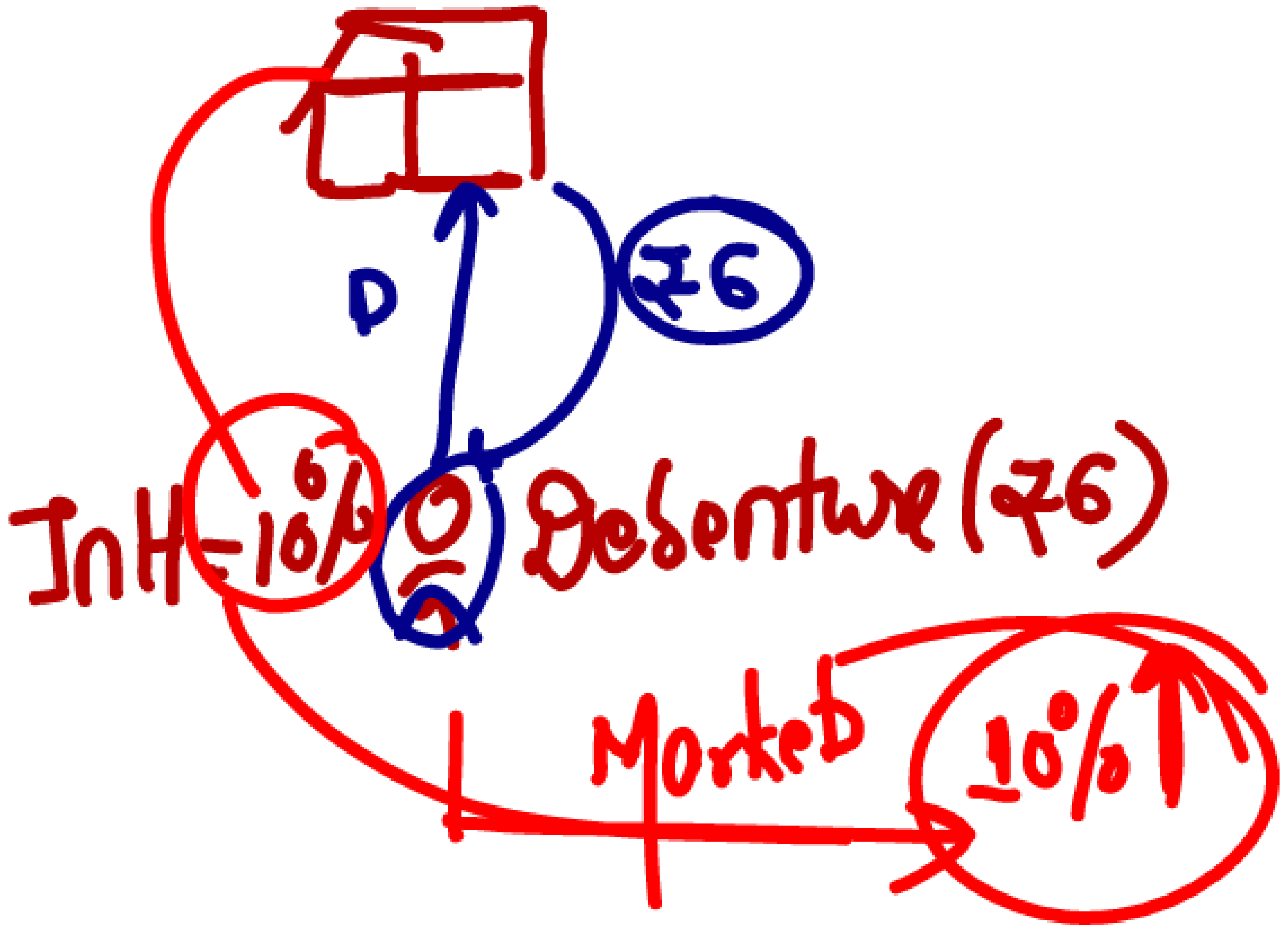
P	x	$P(x)$	$(x-\bar{x})$	$(x-\bar{x})^2 P$
0.25	24	6	12	36
0.50	12	6	0	0
0.25	0	0	-12	36
	$\bar{X}$	12%		72

ER = 12%

S.D. = 8.48%

$$\sigma_x = \sqrt{72}$$

$$= 8.48\%$$



- If yield of Similar debenture is more than 10% then investor should Accept the buy Back offer

Add

0.30

Investment

Economy A

Developed Country stock

10.5%

growing

FR 15% WA 10% 0.5

S.D. 30% 16%

Question: 49

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 (ρ)	0.30	

Rf = 3%

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%?

ERp =

(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?

(Study Material & PM)

(Page No.82)

(a) Calculation of Weights

$$ER_P = (ER_A \times \omega_A) + (ER_B \times \omega_B)$$

$$10.5\% = (10 \times \omega_A) + [15(1-\omega_A)]$$

$$10.5 = 10\omega_A + 15 - 15\omega_A$$

$$4.5 = 5\omega_A$$

$$\omega_A = \frac{4.5}{5} = 0.9, \quad \omega_B = 0.1$$

Hence Investment in Economy A stocks = 10%

Developed country stock = 90%

(b) Standard deviation of portfolio

$$\sigma_P = \sqrt{\sigma_A^2 \times \omega_A^2 + \sigma_B^2 \times \omega_B^2 + 2 \times \sigma_A \times \omega_A \times \sigma_B \times \omega_B \times r_{AB}}$$

$$= \sqrt{16^2 \, 0.9^2 + 30^2 \, 0.10^2 + 2 \times 16 \times 0.9 \times 30 \times 0.10 \times 0.30}$$

$$= 15.57\%$$

(C) Calculation of Sharpe Ratio

$$\text{Sharpe Ratio} = \frac{ER - Rf}{\sigma}$$

Developed country's stock (old) $= \dfrac{10-3}{16} = 0.4375$

PORTFOLIO (New) $= \dfrac{10.5-3}{15.57} = 0.4817$

Sharpe Ratio improved.

PART I MPT [Markowitz]

1 ER & S.D.

Single stock

- Ex post data

$$ER = \frac{\Sigma x}{n}$$

$$\sigma_x = \sqrt{\frac{\Sigma (x-\bar{x})^2}{n}}$$

- Ex-Ante data

$$ER = \Sigma px$$

$$\sigma_x = \sqrt{\Sigma (x-\bar{x})^2 p}$$

- $C.V. = \frac{\sigma}{\bar{x}}$

2. Covariance & correlation

- Cov xy
- Ex post data

$$Cov_{xy} = \frac{\Sigma (x-\bar{x})(y-\bar{y})}{n}$$

- Ex Ante data

$$Cov_{xy} = \Sigma (x-\bar{x})(y-\bar{y})p$$

$$r_{xy} = \frac{Cov_{xy}}{\sigma_x \times \sigma_y}$$

Concept

1. $r_{xy} = +1$

Risk can't Reduced

$$\sigma_p = (\sigma_x \times w_x) + (\sigma_y \times w_y)$$

2. $r_{xy} = -1$

Zero Risk portfolio

$$w_A = \frac{\sigma_B}{\sigma_A + \sigma_B}$$

$$\sigma_p = \sqrt{\sigma_A^2 w_A^2 + \sigma_B^2 w_B^2 + 2 \times \sigma_A \times w_A \times \sigma_B \times w_B \times r_{AB}}$$

3. r_{xy} = other

Minimum Risk portfolio

$$w_A = \frac{\sigma_B^2 - COV_{AB}}{\sigma_A^2 + \sigma_B^2 - 2\,COV_{AB}}$$

Sharpe Ratio

$$SR = \frac{ER - R_f}{\sigma_p}$$

- As per MPT, we creat a portfolio having many stocks to reduce Risk of portfolio
- In Capital Market Theory, we should invest fund in Market portfolio & Risk free Stock
- Suppose $R_m = 15\%$ $\sigma_m = 4\%$

  $R_f = 6\%$ $\sigma_{Rf} = 0\%$

  $W_{Rm} = 70\%$ $W_{Rf} = 30\%$

  ① ER_p

  ② σ_p

$$\sigma_p = \sigma_m \times W_m$$
$$= 4 \times 0.7 = 2.80\%$$

$$ER_p = \frac{10500 + 1800}{100000} = 12.3\%$$

₹100000

Market

70000

15%

= ₹10500

4% = 2800 ↑↓

6%

30000

= ₹1800

= 0%

= 0

$$ER_p = (R_m \times W_{Rm}) + (R_f \times W_{Rf})$$
$$(15 \times 0.7) + (6 \times 0.3) = 12.3\%$$

Eg $R_m = 15\%$ $\sigma_m = 4\%$

$R_f = 6\%$ $\sigma_{R_f} = 0\%$

we want to creat a portfolio such that σ_p should be 3%

Calculate ER_p

12.25% 12.75%

7.78%

$$\boxed{ER_p = R_f + \left(\frac{R_m - R_f}{\sigma_m}\right)\sigma_p}$$

$$= 6 + \left(\frac{15-6}{4}\right)3 = 12.75\%$$

$$\boxed{\sigma_p = \sigma_m \times w_m} \qquad w_m = \frac{\sigma_p}{\sigma_m}$$

$$ER_p = (R_m \times w_m) + (R_f \times w_{RF})$$

$$ER_p = (R_m \times w_m) + R_f(1 - w_m)$$

$$ER_p = \left(R_m \times \frac{\sigma_p}{\sigma_m}\right) + R_f - \left(R_f \frac{\sigma_p}{\sigma_m}\right)$$

$$\boxed{= R_f + (R_m - R_f)\frac{\sigma_p}{\sigma_m}}$$

Imp

Eg

$R_m = 20\%$

$\sigma_m = 5\%$

$R_f = 7\%$

$\sigma_p = 8\%$

① $ER_p = ?$

② $w_m = ?$, $w_{Rf} = ?$

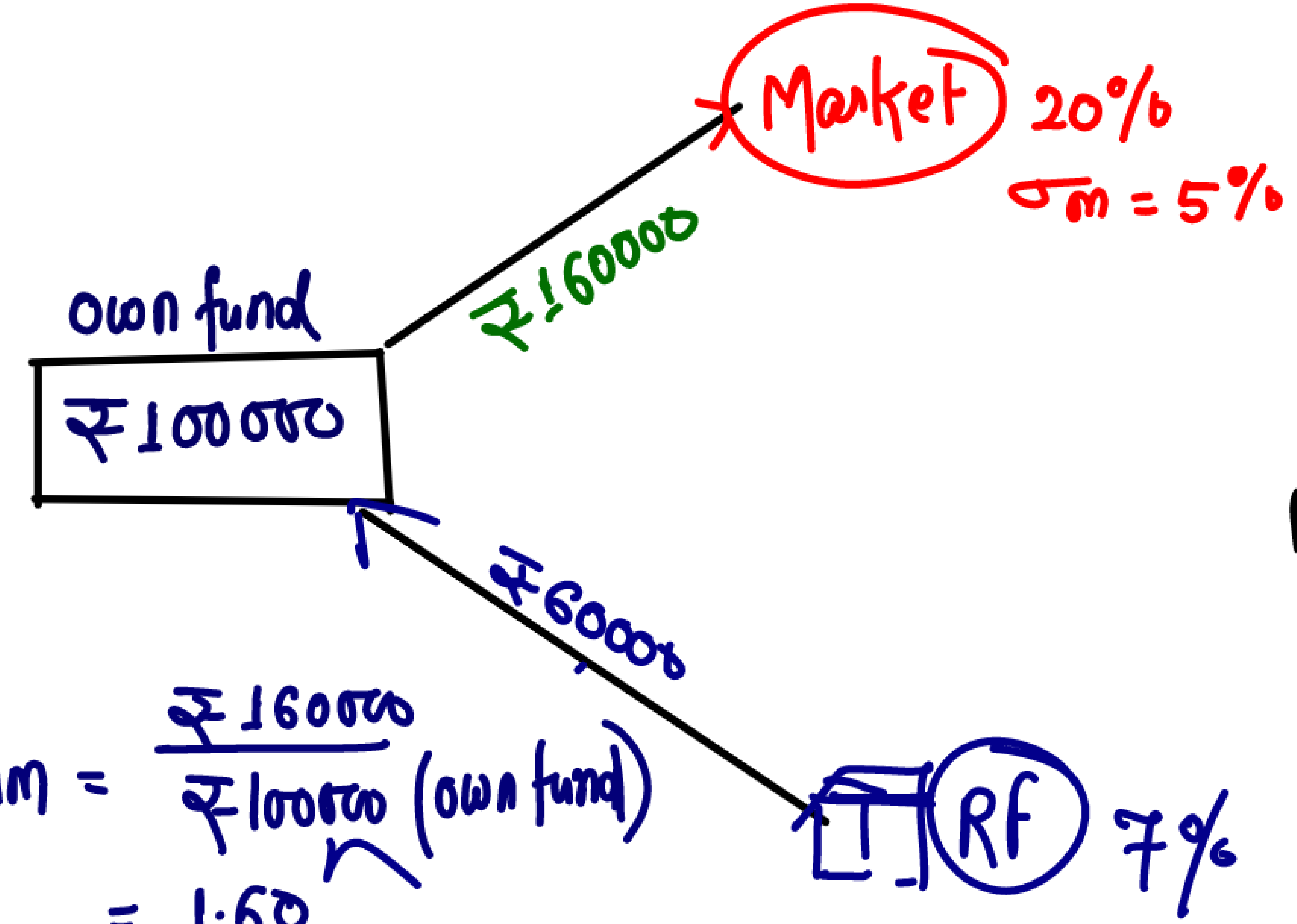
$$ER_p = R_f + \left(\frac{R_m - R_f}{\sigma_m}\right)\sigma_p$$

$$= 7 + \left(\frac{20-7}{5}\right)8 = 27.80\%$$

$\sigma_p = \sigma_m \times w_m$

$w_m = \frac{\sigma_p}{\sigma_m} = \frac{8}{5} = 1.6$

$w_{Rf} = 1 - 1.6 = -0.6$



$W_m = \frac{₹160000}{₹100000 \text{ (own fund)}} = 1.60$

$W_{Rf} = \frac{-60000}{100000} = -0.60$

① $ER_p = 27.80\%$

② $\sigma_p = 5 \times 1.60$
$= 8\%$

$ER_p = \frac{(160000 \times 20) - (60000 \times 7)}{100000}$

$= \left(\frac{160000}{100000} \times 20\right) + \left(\frac{-60000}{100000} \times 7\right)$

Weight

$= (1.60 \times 20) + (-0.60 \times 7)$

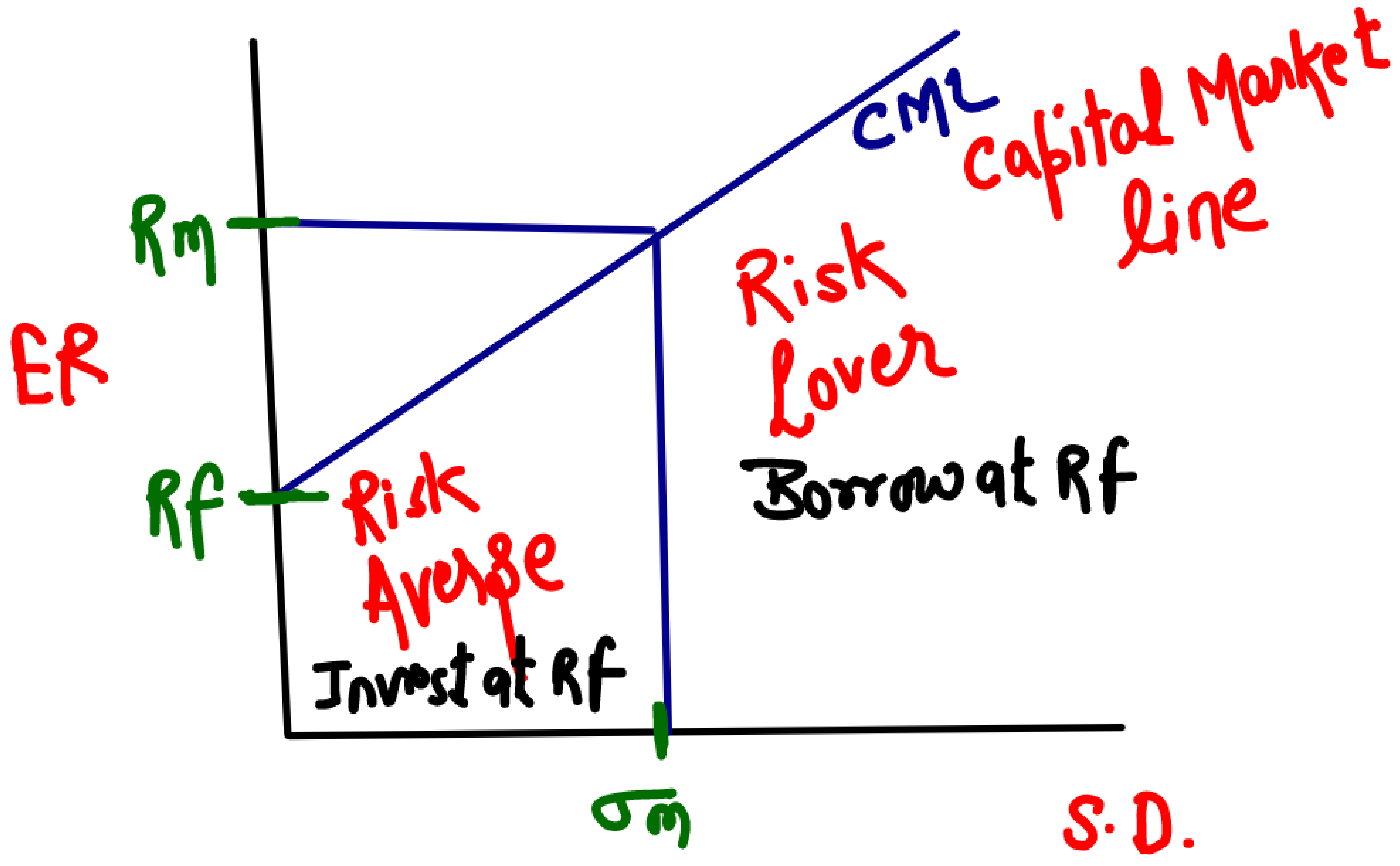
Weight

$= 27.80\%$

Project
20
160000

EBIT
(−) Int
EBT

ROE =



Equation of CML

$$ER_p = R_f + \left(\frac{R_m - R_f}{\sigma_m}\right)\sigma_p$$

Eg $R_f = 8\%$

$R_m = 18\%$

$\sigma_m = 5\%$

$\sigma_p = 7\%$

Calculate ER_p as per Capital Market Theory

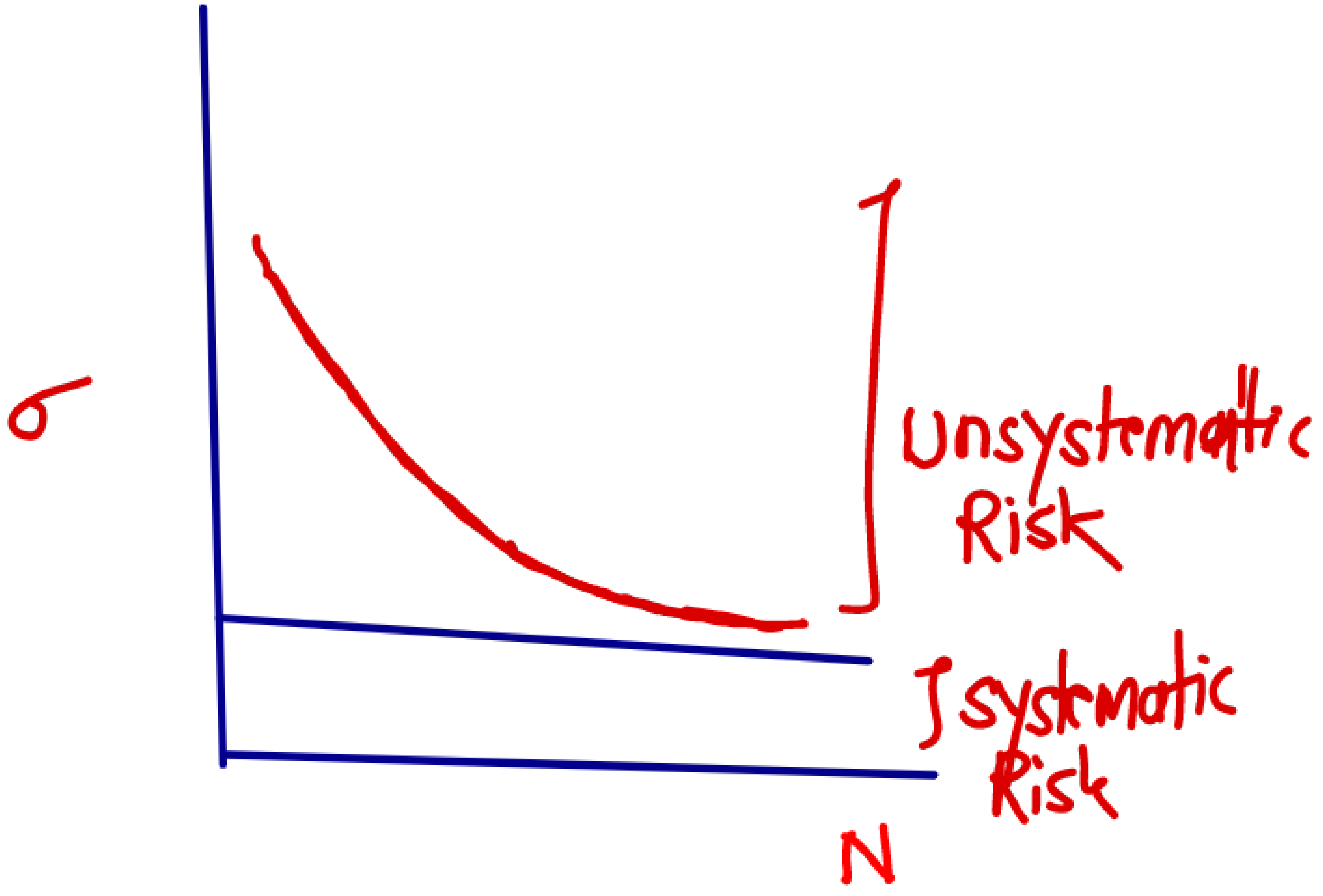
$ER_p = 22\%$

Capital Asset Pricing Model (CAPM)

① CAPM is used to Calculate price of Capital Asset (stock).

② As per CAPM, there are two types of Risk

Systematic Risk	Unsystematic Risk
(i) Market related Risk	(i) Company specific Risk
(ii) Can not be avoided	(ii) Can be avoided with the help of diversification
(iii) Example → GDP, Int Rate, Exchange Rate etc.	(iii) Example → Management inefficiency, liquidity Issue



③ Equation of CAPM

As per CAPM, required Rate of Return is Calculated as under

$$\boxed{Ke = Rf + (Rm - Rf)\beta}$$

Eg
a

$Rf = 6\%$

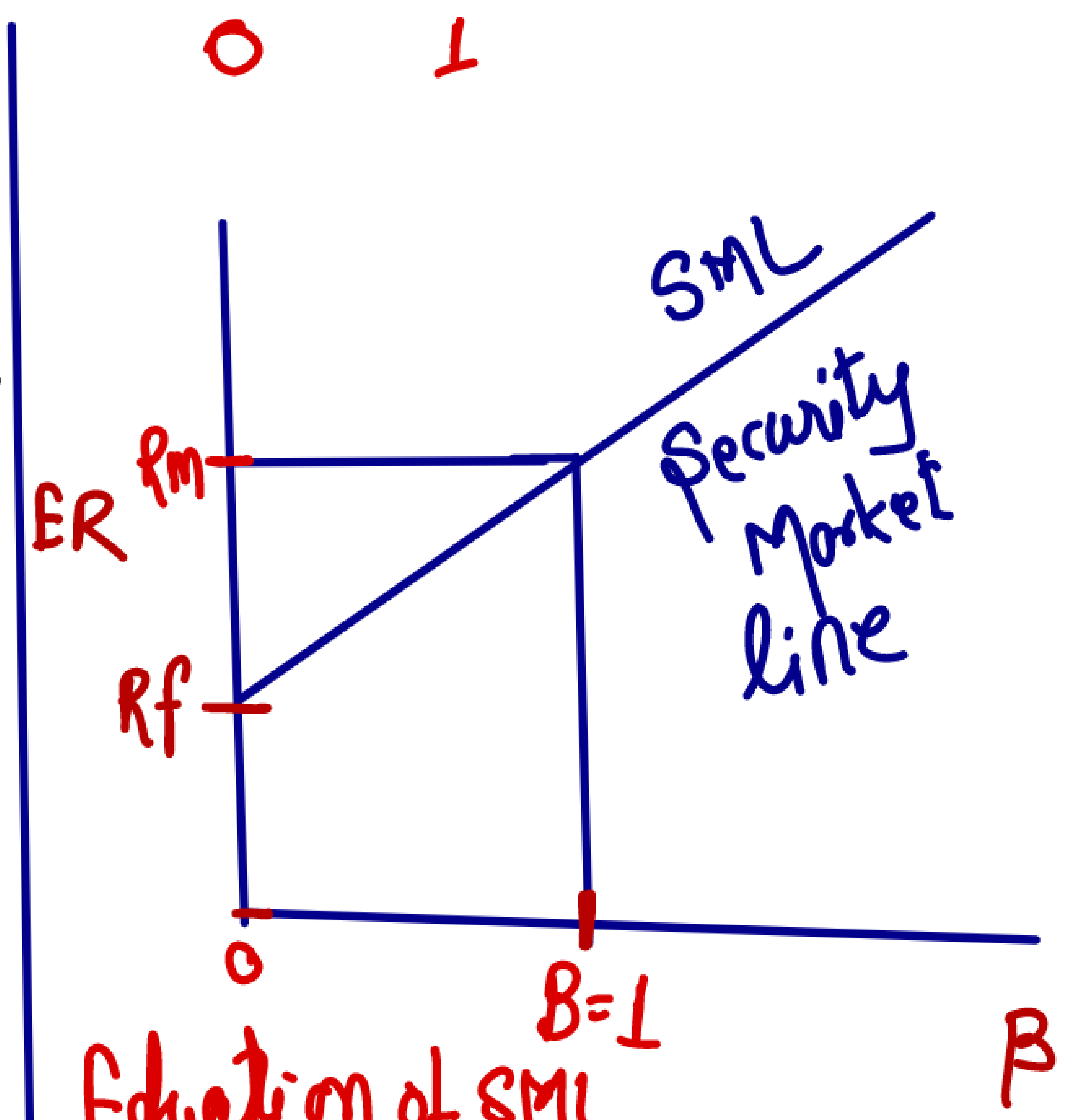
$Rm = 15\%$

$\beta = 1.5$

Calculate Ke

$6 + (15 - 6)1.5$

$= 19.5\%$

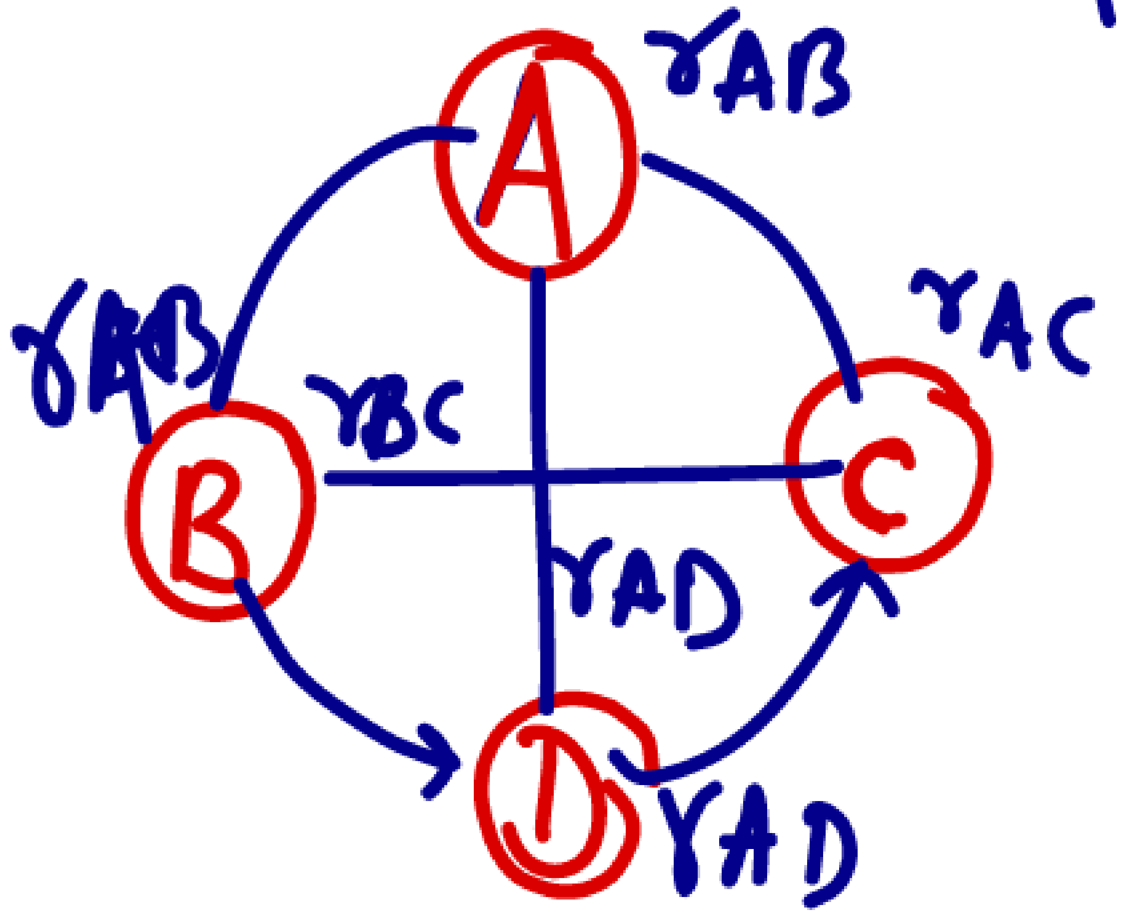


Equation of SML

$$ER = Rf + \frac{(Rm - Rf)}{Bm}\beta$$

④ Calculation of Beta

- In MPT, we find out correlation between two stocks & creat portfolio but there are two problems in MPT
  - (i) It is too much data demanding
  - (ii) It is difficult to find out correlation between two stocks of different sectors.



- In CAPM, we find out relationship of each stock with Market. Such relationship is called "Beta"

- <u>How to calculate Beta</u>

<u>Case 1</u> If only two years data are given

$$Beta = \frac{\text{change in stock Return}}{\text{change in Market Return}}$$

Eg

YEAR	Stock	Market
1	15%	10%
2	25%	15%

$$\beta = \frac{25-15}{15-10} = 2$$

Beta of stock 2 means if Market changes by 1% then stock Return will change by 2%.

Case 2 If More than 2 YEARS data are given

FORMULA 1

$$\beta = \frac{\sigma_x}{\sigma_m} \times r_{xm}$$

FORMULA 2

$$\beta = \frac{Cov_{xm}}{\sigma_m^2}$$

FORMULA 3

$$\beta = \frac{\Sigma xm - n\bar{x}\bar{m}}{\Sigma m^2 - n\bar{m}^2}$$

Example: 19

Risk free rate	= 6%
Market rate of return	= 10%
Beta of Reliance	= 1.5

Calculate expected return as per CAPM.

HW

(Page No.

Example: 20

Risk free rate	= 5%
Market rate of return	= 12%
Beta of portfolio	= 1.75

Calculate required return of portfolio.

HW

(Page No.59)

Eg Imp

YEARS	Stock x	Market
1	10%	13%
2	13%	14%
3	17%	18%
4	20%	23%
5	25%	22%

1. Calculate ER, SD of Stock x & Market
2. Calculate Cov_{xm} & r_{xm}
3. Calculate Beta of Stock x

Calculation of ER, SD, Covxm, rxm

YEAR	x	$(x-\bar{x})$	$(x-\bar{x})^2$	y	$(y-\bar{y})$	$(y-\bar{y})^2$	$(x-\bar{x})(y-\bar{y})$
1	10	-7	49	13	-5	25	35
2	13	-4	16	14	-4	16	16
3	17	0	0	18	0	0	0
4	20	3	9	23	5	25	15
5	25	8	64	22	4	16	32
	85		138	90		82	$\boxed{98}$

$\bar{x} = 17\%$

$\sigma_x = \sqrt{\frac{138}{5}} = 5.25\%$

$\bar{y} = 18\%$

$\sigma_y = \sqrt{82/5} = 16.4$

$= 4.05\%$

$Cov_{xy} = \frac{98}{5} = 19.6\ (\%^2)$

$\frac{Cov_{xm}}{\sigma_m^2} = \frac{98}{82}$

$r_{xy} = \frac{Cov_{xy}}{\sigma_x \sigma_y} = \frac{19.6}{5.25 \times 4.05} = 0.92$

Calculation of Beta

$$\beta = \frac{\Delta \text{ Stock Return}}{\Delta \text{ Market Return}} \quad [2 \text{ YEARS}]$$

$\sigma_x \sigma_m r_{xm}$

$$\frac{Cov_{xm}}{\cancel{\sigma_x} \times \sigma_m}$$

① $$\boxed{\beta = \frac{\sigma_x}{\sigma_m} \times r_{xm}}$$

$$= \frac{5.25}{4.05} \times 0.92$$

$$= 1.192$$

$$\frac{\cancel{\sigma_x}}{\sigma_m} \times \frac{Cov_{xm}}{\cancel{\sigma_x} \times \sigma_m}$$

②

$$\beta = \frac{Cov_{xm}}{\sigma_m^2} = \frac{19.6}{(4.05)^2} = 1.192$$

$\uparrow$

$$= \frac{\sigma_x \cancel{\sigma_m} \times r_{xm}}{\cancel{\sigma_m} \times \sigma_m}$$

$$= \frac{\sigma_x}{\sigma_m} \times r_{xm}$$

(3) $$\beta = \frac{\Sigma xm - n\bar{x}\bar{m}}{\Sigma m^2 - n\bar{m}^2} = \frac{1628 - 5 \times 17 \times 18}{1702 - 5 \times (18)^2}$$

YEAR	x	m	xm	m^2
1	10	13	130	169
2	13	14	182	196
3	17	18	306	324
4	20	23	460	529
5	25	22	550	484
	$\bar{x} = \frac{85}{5} = 17$	$\bar{y} = \frac{90}{5} = 18$	1628	1702

$$\beta = \frac{98}{82}$$

$$= \frac{\Sigma (x-\bar{x})(m-\bar{m})}{\Sigma (m-\bar{m})^2}$$

ये formula तब लीजिएगा। जब Ex post data हो।

Question: 14

The distribution of return of security 'F' and the market portfolio 'P' is given below:

Probability	Return % F	Return % P
0.30	30	-10
0.40	20	20
0.30	0	30

H.W

H.W

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.

(Study Material & PM)

(Page No.26)

HW copy

Question: 15

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.

H.W

(Study Material & PM)

H.W Copy

(Page No.27)

Question: 19

Mr. Gupta is considering investment in the shares of R. Ltd. He has the following expectations of return on the stock and the market:

	Return (%)	
Probability	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.

(Exam November - 2018)

(Page No.34)

P	x	$P(x)$	$(x-\bar{x})$	$(x-\bar{x})^2 P$	y	$P(y)$	$(y-\bar{y})$	$(y-\bar{y})^2 P$	$(x-\bar{x})(y-\bar{y})P$
0.35	30	10.50							
0.30	25	7.50							
0.15	40	6							
0.20	20	4							
		28%				21.95			

$ER_x = 28\%$

Variance $= 38.50$

$\sigma_x = 6.20\%$

$R_M = 21.95$

Variance $= 42.18$

37.5

$\sigma_m = 6.49$

$$\beta = \frac{37.50}{42.18} = 0.889$$

(iii) PORTFOLIO BETA & BETA MANAGEMENT (Most Imp)

- Beta of portfolio is weighted Average Beta of Individual Stock.
- Beta Management means changing of Beta on the basis of Market Expectation.
  - → If Market is expected to rise then portfolio Beta should be increased
  - → If Market is Expected to fall, then portfolio Beta should be decreased
- Techniques of Beta Management
  1. Using Risk free Securities
  2. Replace one security with others
  3. Stock Index future. (DERIVATIVES)

~~A~~ ~~2~~

B 1.5

C 0.8

Example: 15

Suppose there are four stocks is a portfolio

Stock	Investment	Beta
A	4,50,000	1.75
B	1,25,000	1.25
C	75,000	0.5
D	1,50,000	0.9

Risk free rate = 6%

Market Return = 12%

(i) ~~Calculate expected return of each security using~~ CAPM.

(ii) Calculate expected return of portfolio.

(iii) Calculate beta of portfolio.

(Page No.36)

① Calculation of ER

$ER = Rf + (Rm - Rf)\beta$

$= 6 + 6\beta$

$A = 6 + 6 \times 1.75 = 16.5\%$

$B = 6 + 6 \times 1.25 = 13.5\%$

$C = 6 + 6 \times 0.5 = 9\%$

$D = 6 + 6 \times 0.9 = 11.40\%$

② $ERp = \dfrac{(450000 \times 16.5) + (125000 \times 13.5) + (75000 \times 9) + (150000 \times 11.40)}{800000}$

$= 14.37\%$

③ Beta of portfolio

$ERp = Rf + (Rm - Rf)\beta p$

$14.37 = 6 + 6\beta p$

$\beta p = \dfrac{14.37 - 6}{6} = 1.395$

Example: 16

Suppose there are four stocks in a portfolio

Stock	Amount	Beta
A	5,00,000	1.2
B	3,00,000	2
C	1,00,000	0.5
D	3,00,000	0.8

(1) Calculate portfolio beta.

(2) If we want to invest ₹ 3,00,000 in risk free then calculate beta of portfolio.

(3) We want to reduce beta of portfolio to 0.85 then how much amount to be invested in risk free assets.

(Page No.36)

5 ① Calculation of Beta of portfolio

Stock	Amt	Weight	B	WxB
A	500000	0.417	1.2	0.5
B	300000	0.250	2	0.5
C	100000	0.083	0.5	0.0415
D	300000	0.250	0.8	0.20
	1200000			

$\beta p = 1.241$

Example: 16

Suppose there are four stocks in a portfolio

Stock	Amount	Beta
A	5,00,000	1.2
B	3,00,000	2
C	1,00,000	0.5
D	3,00,000	0.8

281386

(1) Calculate portfolio beta.

B = 0

(2) If we want to invest ₹ 3,00,000 in risk free then calculate beta of portfolio.

(3) We want to reduce beta of portfolio to 0.85 then how much amount to be invested in risk free assets.

Imp

(Page No.36)

④ We want to reduce Bp to 0.95 for this we sell Existing stocks & Buy RF asset in same Amt. Calculate Amt of RF Assets.

① Calculation of Beta

⑤ ✓ of portfolio

Stock	Amt	Weight	B	W×B
A	500000	0.417	1.2	0.5
B	300000	0.250	2	0.5
C	100000	0.083	0.5	0.0415
D	300000	0.250	0.8	0.20
	1200000			Bp = 1.241

② Beta of portfolio

$$B_p = \frac{(1200000 \times 1.241) + (300000 \times 0)}{1500000}$$

$$= 0.993$$

③ Calculation of Amount to be invested in Rf

Let assume, Rf Assets be x

$$0.85 = \frac{(\overset{A}{1200000} \times 1.241) + (\overset{B}{x} \times 0)}{1200000 + x}$$

$$1020000 + 0.85x = 1489200$$

$$x = \frac{1489200 - 1020000}{0.85} = 552000$$

ICAI

$$B_p = (B_A \times W_A) + (B_B \times W_B)$$

$$0.85 = (1.241 \times W_A) + (0 \times W_B)$$

$$W_A = \frac{B_T}{B_p} \quad \frac{0.85}{1.241}$$

$$W_A = \frac{0.85}{1.241} = \boxed{0.6849}$$

$$\text{own fund} = \frac{1200000}{0.6849} = ₹1752080$$

stock — 0.6849 → 1200000

Rf — 0.3151 → 552080

④ Calculation of Rf Asset

Let assumed, Amt to be invested in Rf Assets be x

$$0.95 = \frac{(1200000 \times 1.241) - (x \times 1.241) + (x \times 0)}{1200000 -}$$

$$1140000 = 1489200 - 1.241x$$

$$x = \frac{1489200 - 1140000}{1.241}$$

$$= 281386$$

It means

Investment in stocks = 918614

Investment in Rf = 281386

ICAI

$$WA = \frac{B_T}{B_P}$$

$$= \frac{0.95}{1.241}$$

$$= 0.7655$$

1200000

0.7655 → 918600

0.2345 → 281400

Example: 17

Suppose there are three stocks in a portfolio.

Stock	Amount	Beta
A	8,00,000	1.5
B	4,00,000	2
C	3,00,000	3

D

(1) Calculate portfolio beta.

(2) Suppose we want to replace security C with new security D having beta 1.25 then calculate beta portfolio.

(3) Suppose we want to replace security C with new security having lower beta so that beta of portfolio should be 1.75 the calculate beta of new security.

(Page No.37)

① PORTFOLIO BETA

$$B_p = \frac{(8 \times 1.5) + (4 \times 2) + (3 \times 3)}{15}$$

$$= 1.933$$

② PORTFOLIO BETA

$$B_p = \frac{(1500000 \times 1.933) - (300000 \times 3) + (300000 \times 1.25)}{1500000}$$

$$= 1.583$$

③ Beta of New Security

$$1.75 = \frac{(1500000 \times 1.933) - (300000 \times 3) + (300000 \times x)}{1500000}$$

$$x = 2.083$$

Example: 18

Suppose there are three stocks in a portfolio.

Stock	Amount	Beta
A	2,00,000	2
B	2,00,000	1.8
C	1,00,000	0.9

(1) Calculate $\boxed{\text{portfolio beta.}}$

(2) Suppose we want to increase beta to 1.90 then how much amount should be invested or borrowed at risk free rate.

(Page No.37)

① Bp

$$Bp = \frac{(200000 \times 2) + (200000 \times 1.80) + (100000 \times 0.9)}{500000}$$

$$= 1.70$$

② Amount of Rf

$$WA = \frac{BT}{BP} = \frac{1.90}{1.70} = 1.1176$$

$$\text{Own fund} = \frac{500000}{1.1176} = \boxed{447387}$$

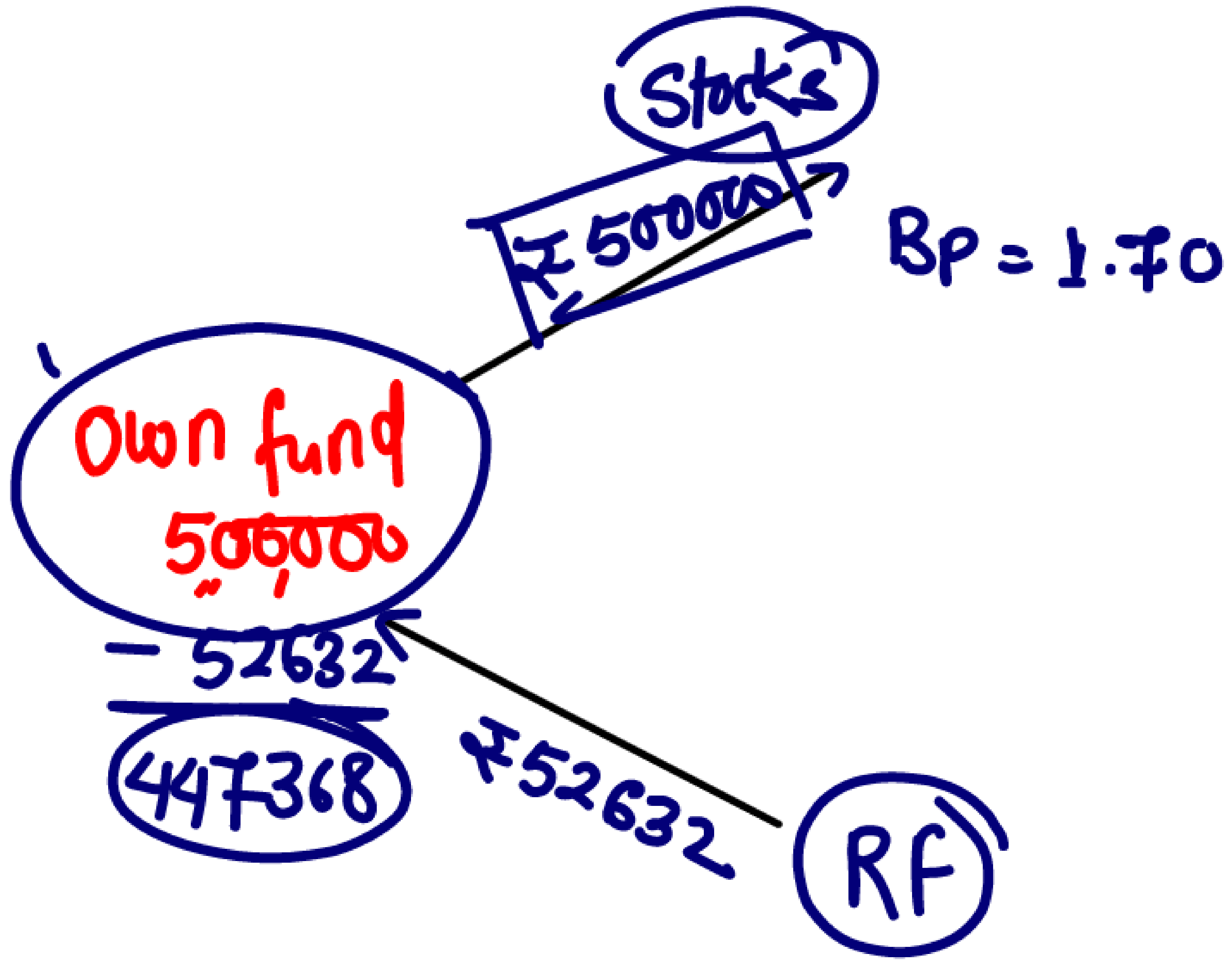
1.1176 ₹500000

0.1176 ₹52613

$$1.90 = \frac{(500000 \times 1.70) + (x \times 0)}{500000 + x}$$

$$950000 + 1.90x = 850000$$

$$x = \frac{-100000}{1.90} = -₹52632$$



CA, CMA, ICSI

Question: 16

A Portfolio Manager (PM) has the following four stocks in his portfolio:

Security	No. of Shares	Market Price per Share (₹)	β
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?

(Study Material & PM)

(Page No.29)

① Beta of portfolio

Stock	No.	MPS	Value	Weight	B	WxB
A	10000	50	500000	0.417	0.9	
B	5000	20	100000	0.083	1.0	
C	8000	25	200000	0.167	1.5	
D	2000	200	400000	0.333	1.2	
Rf			1200000		0	1.108

② Calculation of Rf Investment

0.8

$$WA = \frac{B_T}{B_P} \quad \frac{0.8}{1.108} = 0.7220$$

$$\text{own fund} = \frac{1200000}{0.7220} = 1662050$$

$$Rf = (1662050 - 1200000) = 462050$$

Calculation of Bp

Stocks	Amt	Weights	B	WxB
A	500000	0.3008	0.9	
B	100000	0.0602	1.0	
C	200000	0.1203	1.5	
D	400000	0.2407	1.2	
Rf	~~462050~~	0.2780	0	
	1662050			

Bp = 0.8

3 Calculation of Rf Amt

$$WA = \frac{B_T}{B_P} = \frac{1.20}{1.108} = 1.083$$

own fund $\frac{1200000}{1.083} = 1108033$

Stocks $1108033 \times 1.083 = 1200000$

$Rf = 1108033 \times -0.083 = 91967$ (Borrow)

Question: 26

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

H.W

You are required to advise Mr. FedUp in regard to the following, using Capital Asset Pricing Methodology:

$ER_p =$ C.W

(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.

(Study Material & PM)

(Page No.46)

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

Question: 27

Mr. Tempest has the following portfolio of four shares:

Name	Beta	Investment Lac.
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

H.W

H.W OPY

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.

(RTP November – 2018)

(Page No.47)

Question: 26

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.

(Study Material & PM)

(Page No.46)

(ii) Both Better & Nifty have same Beta i.e. "1", hence they will provide same return so replacing Better with Nifty will be No difference

Question: 31

M/s. Siri Ltd. Has a surplus amount of ₹ 3 crores to invest and has shortlisted the following equity shares:

Company	Beta
S Ltd.	1.6
K Ltd.	1
P Ltd.	-0.3
D Ltd.	2
C Ltd.	0.6

20%
60%
20%

Required:

(i) If M/s. Siri Ltd. invests an equal amount in all securities, what is the beta of the portfolio?

(ii) If M/s. Siri Ltd. invests 15% of its investment in S Ltd., 15% in P Ltd., 10% in C Ltd. and the balance in equal amount in the other two securities, 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 advi se the company to have a right mix of securities to maximize the return in the following two scenarios and also calculate the expected return:

(1) Bull Phase: Expected Market returns 10%

(2) Bear Phase: Expected Market returns — 5% -5%

(Exam Nov - 2022)

(Page No.52)

① Beta of portfolio

Stock	Amt	Weight	B	WxB
S	50	0.2	1.6	
K	60	0.2	1	
P	60	0.2	-0.30	
D	60	0.2	2	
C	60	0.2	0.60	
	300		Bp =	0.9

② Beta of portfolio

Stock	Amt	Weight	Beta	W × B
S	45	0.15	1.6	
K	90	0.30	1	
P	45	0.15	−0.30	
D	90	0.30	2	
C	30	0.10	0.60	
	300		B_p =	1.155

☞ Rf दिया नहीं है & Rf निकाला भी नहीं जा सकता so

$ER_p = R_m \times B_p$

③ Expected Return of portfolio

Situation I $\quad ER_p = 12 \times 0.98 = 11.76\%$

Situation II $\quad ER_p = 12 \times 1.155 = 13.86\%$

(iv) (1) Bull phase

Beta of portfolio

Stock	Amt	Weight	Beta	
S		0.2	1.60	
K		0.2	1	
D		0.6	2	
			$B_p =$	1.72

$ER_p = R_m \times B_p$

$= 10 \times 1.72 = 17.2\%$

(2) Bear phase

Beta of portfolio

K		0.20	1	
P		0.60	-0.3	
C		0.20	6	
			$B_p =$	0.14

$ER_p = -5 \times 0.14$

$= -0.70\%$

Question: 32

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%.

(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?

(RTP: May- 2022)

(Page No.54)

ER

$R_m = -2.5\%$

Calculation of ER_p

K Ltd $B = 1.40$

portfolio

$B_p = (1.20 \times 0.10) + (0.75 \times 0.10) + (0.40 \times 0.30) + (1.40 \times 0.50)$

$= 1.015$

$ER = R_f + (R_m - R_f)B$

K Ltd $= 8 + (12 - 8)1.40 = 13.6\%$

portfolio $= 8 + (12 - 8)1.015 = 12.06\%$

① (i) If Market goes up by 2.5% $[12+2.5) = 14.5\%$

Kqq ER $= 8 + (14.5 - 8)1.40 = 17.1\%$

portfolio ER $= 8 + (14.5 - 8)1.015 = 14.60\%$

② If Market goes down by 2.5% $(12 - 2.5\%) = 9.5\%$

Kqq ER $= 8 + (9.5 - 8)1.40 = 10.10\%$

PORTFOLIO ER $= 8 + (9.5 - 8)1.015 = 9.52\%$

③ If Market Return is -2.5%

Kqq $= 8 + (-2.5 - 8)1.40 = -6.7\%$

portfolio $= 8 + (-2.5 - 8)1.015 = -2.66\%$

(ii) It is better to invest in portfolio because β_p is less than beta of K Ltd.

Question: 32

Mr. X is having 1 lakh shares of M/s. Kannyaka Ltd. The beta of the company is 1.40.

Mr. Y a financial advisor has suggested for having the following portfolio:

HW

H.W Copy

Security	Beta	% Holding
S	1.20	10
K	0.75	10
P	0.40	30
D	1.40	50
		100

Market Return is 12%

Risk free rate is 8%

Required:

(i) CALCULATE the expected return based on CAPM for the present investment and suggested portfolio and also in the following scenarios

(1) If the market return goes up by 2.5%.

(2) If the market return goes down by 2.5%

(ii) ADVISE Mr. X whether to continue the holdings of M/s. Kannyaka Ltd. or to buy the portfolio as per the suggestion of Mr. Y if the probability of market giving negative return is more.

(MTP: Oct – 2022)
(Page No.56)

H.W

H.W copy

Question: 25

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	10
B	1.0	10
C	0.9	
D	2.0	
E	0.6	

.1

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?

(Study Material & PM)

(Page No.44)

Question : 30

A company has a choice of investments between several different equity oriented mutual funds. The company has an amount of ₹ 100 lakhs to invest. The details of the mutual funds are as follows:

Mutual Funds	A	B	C	D	E
Beta	1.5	1.0	0.8	2.0	0.7

PLAN I

H.W

If the company invests 20% of its investments in each of the first two mutual funds (A and B) and balance in equal amounts in the mutual funds C, D and E, what is the beta of the portfolio?

PLAN II

H.W

Copy

If the company invests 15% of its investment in C, 15% in A, 10% in E and the balance in equal amounts in the other two mutual funds, what is the beta of the portfolio?

If the expected return of market portfolio is 12% at a beta factor of 1.0, what will be the expected return on' the portfolio in both the plans given above?

(Exam July – 2021)

(Page No.51)

Question: 20

Your client is holding the following securities:

Particulars of Securities	Cost ₹	Dividends ₹	Market Price ₹	BETA
Equity shares:				
Co. X	8,000	800	8,200	0.8
Co. Y	10,000	800	10,500	0.7
Co. Z	16,000	800	22,000	0.5
PSU Bonds	34,000	3,400	32,300	0.2

Assuming a Risk-free rate of 15%, calculate:

– Expected rate of return in each, using the Capital Asset Pricing Model (CAPM).

– Simple Average return of the portfolio.

(Study Material & PM)

(Page No.37)

Expected Return [CAPM]

$ER = Rf + (Rm - Rf)\beta$

X Ltd = $15 + (15.88 - 15)0.8 = 15.70\%$

Y Ltd = $15 + (15.88 - 15)0.7 = 15.62\%$

Z Ltd = $15 + (15.88 - 15)0.5 = 15.44\%$

PSU Bond = $15 + (15.88 - 15)0.2 = 15.18\%$

W.N.1 Calculation of RM

	Cost	Dividend	MP
X	8000	800	8200
Y	10000	800	10500
Z	16000	800	22000
B	34000	3400	32300
	68000	5800	73000

$$RM = \frac{(73000 - 68000) + 5800}{68000} \times 100 = 15.88\%$$

② Average Return of Portfolio

$$\text{Average Return} = \frac{15.70 + 15.62 + 15.44 + 15.18}{4}$$

$$= 15.49\%$$

Question: 21

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

H.W

class work copy

(Study Material & PM)

(Page No.38)

Question: 22

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%.

H.W HW Copy

(Study Material & PM)

(Page No.40)

Question: 29

Mr. X holds the following portfolio:

Securities	Cost (₹)	Dividends (₹)	Market Price (₹)	Beta
Equity shares:				
A Ltd.	16,000	1,600	16,400	0.9
B Ltd.	20,000	1,600	21,000	0.8
C Ltd.	32,000	1,600	44,000	0.6
PSU Bonds	68,000	6,800	64,600	0.4

The risk-free rate of return is 12%.

Calculate the following:

(i) The expected rate of return on his portfolio using Capital Asset Pricing Model (CAPM).

(ii) The average return on his portfolio. (Calculate up to two decimal points)

H.W

HW Copy

(Exam November – 2019)

(Page No.49)

Question: 21

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

(Study Material & PM)

(Page No.38)

$ERp = Rf + (Rm - Rf)\beta p$

$15.7 = Rf + (16.7 - Rf)\,0.5025$

$15.7 = Rf + 8.35 - 0.5Rf$

$Rf = 14.7\%$

$RM = 16.7 \quad ERp = 15.7$

$\beta = 0.5025$

Question: 34 H.W Class Work

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%

CAPM

① SR&WR

Rf+

② Beta

③ Beta

Required:

ERp

(i) 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 return.

(ii) 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.

(Exam Nov - 2022)

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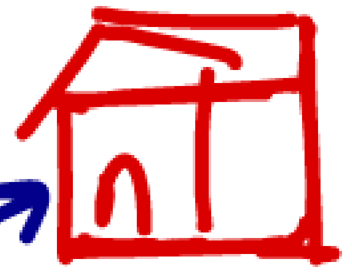
4. Alpha Calculation & Security Market line

- ER — ER
- Required Rate of Return — Ke

Company



Beta = 2

$P_0 = 500$

$P_1 = 520$
D = ₹30
] Expected

= 10% ER on the basis of Projection

16%

$R_f = 6\%$

$R_m = 11\%$

Ram

CAPM

$K_e = 16\%$

Risk को देखते हुए 16% Return मिलना चाहिए

Following steps are applied to calculate Alpha

Step 1 Calculate required rate of Return as per CAPM

$$K_e (R_e) = R_f + (R_m - R_f)\beta$$

Step 2 Calculate Expected Return as per projection

Decision criterion

If $ER > K_e$ - Underpriced - Buy

$ER < K_e \rightarrow$ Overpriced - Not Buy

$ER = K_e \rightarrow$ Correctly priced — Buy
[Equilibrium Return]

Step 3 **Calculation of Alpha**

Alpha = $ER - K_e$

- If Alpha is positive = Underpriced
- If Alpha is negative = Overpriced

Eg

	Stock A	Stock B
Beta	1.2	0.9
ER	15%	13%

$R_f = 5\%$ $R_m = 16\%$

Calculate Alpha & decide whether stock should be purchased or not?

Stock A

$K_e = R_f + (R_m - R_f)\beta$

$= 5 + 11\beta$ — SML

$A = 5 + 11 \times 1.2 = 18.2\%$

$ER = 15\%$

Alpha : $15 - 18.2\% = -3.2\%$. No

Stock B

$K_e = 5 + 11 \times 0.9 = 14.9\%$.

$ER = 13\%$

Alpha : $13 - 14.9 = -1.9$ NO

Eg

	A	B
Beta	1.2	0.9
ER	18.2	14.9

If both securities are correctly price then calculate

(i) Rf

(ii) Rm

(iii) SML

$$Ke = Rf + (Rm - Rf)\beta$$

$$18.2 = \cancel{Rf} + 1.20\,MRP \quad \text{— (i)}$$

$$14.9 = \cancel{Rf} + 0.90\,MRP \quad \text{— (ii)}$$

$$3.30 = 0.30\,MRP$$

$$MRP = \frac{3.30}{0.36} = 11\%$$

put MRP in equation (i)

$$18.20 = Rf + 1.20 \times 11$$

$$Rf = 5\%$$

$$MRP = Rm - Rf$$

$$11 = Rm - 5$$

$$Rm = 16\%$$

$$SML = 5 + 11\beta$$

Question: 36

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%	Kp
XYZ	0.9	17.1%	Ke

RF
RM

You are required to derive Security Market Line.

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(Study Material & PM)

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Question: 17 Imp

The following information are available with respect of Krishna Ltd.

Year	Krishna Ltd. Average share price	Dividend per Share	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 $\boxed{\text{beta value}}$ of the Krishna Ltd. at the end of 2015 and state your observation

1.897

(Study Material & PM)

(Page No.31)

• **Return of Krishna Ltd**

$$\text{Annual Return} = \frac{(P_1 - P_0) + \text{Dividend}}{P_0} \times 100$$

$$2013 = \frac{(253-245)+22}{245} = 12.24\%$$

$$2014 = \frac{(310-253)+25}{253} \times 100 = 32.41\%$$

$$2015 = \frac{(330-310)+30}{310} \times 100 = 16.13\%$$

• **Market Return**

$$2013 = \left[\frac{2130-2013}{2013} \times 100\right] + 5\% = 10.81\%$$

$$2014 = \left[\frac{2350-2130}{2130} \times 100\right] + 6\% = 16.33\%$$

$$2015 = \left[\frac{2580-2350}{2350} \times 100\right] + 7\% = 16.79\%$$

Calculation of Beta

YEAR	x	m	xm	m^2
1	12.24	10.81	132.31	116.86
2	32.41	16.33	529.25	266.67
3	16.13	16.79	270.82	281.90
	60.78	43.93	932.39	665.43

$\bar{X} = 20.26\%$ $\quad \bar{M} = 14.64$

$$B = \frac{\Sigma xM - n\bar{x}\bar{m}}{\Sigma M^2 - n\bar{m}^2} \qquad \frac{932.39 - 3 \times 20.26 \times 14.64}{665.43 - 3\,(14.64)^2}$$

$$= 1.897$$

Calculation of Alpha

YEAR	Return	$Ke = Rf + (Rm - Rf)\beta$	Alpha	Action
2013	12.24	$6 + (10.81 - 6)1.897 = 15.12$	-2.88	Sell
2014	32.41	$6 + (16.33 - 6)1.897 = 25.60$	6.81	Buy
2015	16.13	$6 + (16.79 - 6)1.897 = 26.47$	-10.34	Sell

Question: 18

You have been given the following information about Sweccha Ltd.

	Sweccha Ltd.		Market		
Year	**Average Share Price**	**Dividend per Share**	**Average Index**	**Dividend Yield%**	**Return on Govt. Bond%**
2017	460	30	4060	5	5.5
2018	497	33	4320	6.5	5.5
2019	523	38	4592	4.5	5.5
2020	556	43	4780	6	5.5
2021	589	50	4968	5.5	5.5

H.W

(i) Compute the Beta value of the company as at the end of year 2021.

(ii) What is your Observation?

(Exam May - 2022)

(Page No.33)

Question: 12

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.

(Study Material & PM)

(Page No.23)

① Calculation of Rf

$$Rf = \frac{\$7}{\$140} \times 100$$

$$= 5\%$$

[Assume FV of T.Bill $100]

② Calculation of Beta

$$Ke = Rf + (Rm - Rf)\beta$$

$$15 = 5 + (15 - 5)\beta$$

$$\beta = 1$$

S.D. of Mkt

$$\beta = \frac{Cov_{xm}}{\sigma_m^2}$$

$$1 = \frac{225}{\sigma_m^2}$$

$$\sigma_m^2 = 225$$

$$\sigma_m = \sqrt{225}$$

$$= 15\%$$

S.D. of Stock

$$\beta = \frac{\sigma_x}{\sigma_m} \times r_{xm}$$

$$1 = \frac{\sigma_x}{15} \times 0.75$$

$$\sigma_x = \frac{15}{0.75}$$

$$= 20\%$$

Question: 23

XYZ Ltd. has substantial cash flow and until the surplus funds are utilized 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 dividend 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	3.17	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.

(Study Material & PM)

(Page No.41)

① Calculation of Beta of portfolio

	No.	MPS	Amt	Weights	B
I	60000	4.29	257400	0.234	1.16
II	80000	2.92	233600	0.212	2.28
III	100000	2.17	217000	0.197	0.90
IV	125000	3.14	392500	0.355	1.50
			1100500		$B_p = 1.47$

Expected Return of portfolio

	Weight	ER	ER×W
I	0.234	19.50	
II	0.212	24	
III	0.197	17.50	
IV	0.355	26	
		ERp =	22.38%

Implicit Beta

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

$$22.38 = 11 + (19 - 11)\beta_p$$

$$\beta_p = 1.42$$

PORTFOLIO

Actual Beta = 1.47

But जो ER है उस Basis पर Beta 1.42 होना चाहिए

portfolio is Risky because Actual Beta of portfolio (1.47) is more than Implicit Beta (1.42)

(11) Calculation of Alpha

Investment	ER	$Ke = Rf + (Rm - Rf)\beta$	Alpha	Underpriced/ Overpriced
I	19.50	$11 + (19-11)1.16 = 20.28\%$	-0.78	Overpriced
II	24	$11 + (19-11)2.28 = 29.24\%$	-5.24	Overpriced
III	17.50	$11 + (19-11)\ 0.90 = 18.20\%$	-0.70	Overpriced
IV	26	$11 + (19-11)\ 1.50 = 23\%$	3%	Underpriced

XYZ should Sold Investment I, II, III because they are overpriced & hold Investment IV due to underpriced.

Question: 28

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:

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
Expected Dividend Yield	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 upto 4 decimal points.

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(RTP May – 2021)

(Page No.48)

Question: 24

Suppose one of your HNI clients is holding the following portfolio as per his risk appetite:

Particulars	Securities
Equity Shares:	
G Ltd.	1,000
S Ltd.	1,000
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	0.6
15,000	1,000	16,200	0.8
28,000	1,400	28,300	0.6
1,800	180	1,725	0.10

Your client is interested in investing some more funds in Bonds issued by GOI.

(1) 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 15.70%.

(2) Analyze whether this portfolio has out-performed the market or not assuming Risk Free Rate of Return as 7%.

(MTP: Nov – 2021)

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① Expected Return of portfolio (₹ in lacs)

Name	Cost	Dividend	Market price
G Ltd	100	17.25	98
S Ltd	150	10.00	162
B Ltd	140	7.00	141.50
PSU Bond	360	36.00	345
	750	70.25	746.50

$$ER_p = \frac{(746.50 - 750) + 70.25}{750} \times 100$$

$$= 8.9\%$$

② Beta of portfolio

$$\beta_p = \frac{(0.6\times100)+(0.8\times150)+(0.6\times140)+(0.1\times360)}{750}$$

$$= 0.40$$

① Calculation of Rf

$ER_p = R_f + (R_m - R_f)B_p$

$\boxed{8.90} = R_f + (12.70 - R_f)0.40$

$8.90 = R_f + 5.08 - 0.40R_f$

$3.82 = 0.60R_f$

$R_f = \frac{3.82}{0.60} = \boxed{6.37\%}$

② Calculation of Ke as per CAPM if Rf is 7%

$K_e = R_f + (R_m - R_f)\beta$

$= 7 + (12.7 - 7)0.40$

$K_e = 9.28\%$

Alpha $= ER - K_e$

$= 8.90 - 9.28 = -0.38$

Since Alpha is negative, hence portfolio has underperformed.

⑤ Asset pricing

A Ltd

Actual price
₹ 80

Ram — Theoretical price (P_0) $= \dfrac{D_1}{K_e - g}$

Value per share
or
Intrinsic value per share

CAPM

$K_e = R_f + (R_m - R_f)\beta$

Following steps are applied to calculate Value per share

Step 1 Calculate Ke as per CAPM

$$Ke = Rf + (Rm - Rf)\beta$$

Step 2 Calculate Value per share

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

D_1 = Expected dividend per share

If D_1 is not given

$D_1 = D_0(1+g)$

D_0 = Dividend paid or current dividend per share

g = growth Rate

Step 3 Decision

- If
  - → Value per share > Actual price → Underpriced → Buy
  - → Value per share < Actual price → Overpriced → Sell
  - → Value per share = Actual price → Correctly priced → Buy

Example: 21

Dividend per share = ₹ 5

Risk free rate = 6%

Market rate of return = 12%

S.D. of Security = 10%

S.D. of Market = 8%

Correlation between security & market = 0.9

Growth rate = 5%

Current market price of share = ₹ 70

(1) Calculate theoretical price of share

(2) Whether share should be purchased or not?

(Page No. 62)

(2) Since share is overpriced hence it should not be purchased.

① Calculation of Beta

$$\beta = \frac{\sigma_x}{\sigma_m} \times r_{xm}$$

$$= \frac{10}{8} \times 0.9$$

$$= 1.125$$

② Calculation of Ke

$$K_e = R_f + (R_m - R_f)\beta$$

$$= 6 + (12-6)1.125 = 12.75\%$$

③ Theoretical price

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

It is assumed that given dividend is D_0

$$P_0 = \frac{5(1.05)}{0.1275 - 0.05} = ₹\,67.75$$

Example: 22

	A Ltd.	B Ltd.
D1	8	8
Growth Rate	5%	5%
Beta	1.25	1.75
Actual price	₹ 125	₹ 40

Risk free rate = 5%

Market rate of return = 12%

Whether we should buy share of A Ltd. & B Ltd. or not?

H.W

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Question: 37

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 be changed during the course of the year as indicated below:

Actual

$D_0 = 2$

	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 by, hold or sell the shares? And why?

(Study Material & PM)

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- Existing Situation

$$K_e = 12 + 6 \times 1.4 = 20.4\%$$

$$P_0 = \frac{2(1.05)}{0.204 - 0.05} = ₹\ 13.64$$

As per Existing situation, share is overpriced, hence Investor should sell the shares.

Revised Situation

$K_e = 10 + 4 \times 1.25 = 15\%$

$$P_0 = \frac{2(1.09)}{0.15 - 0.09} = ₹\,36.33$$

In Revised situation, share is underpriced hence investor should hold the shares.

Question: 38

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:

Q38

H.W

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	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.

(Study Material & PM)

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Q.39 H.W Copy

⑥ Systematic Risk & Unsystematic Risk (Imp)

- Suppose Beta of Stock x is 1.5 means if market change by 1% then Stock will change by 1.5%.
- If $\sigma_m = 10\%$ then find out change in stock x because of Market

$$10 \times 1.5 = (15\%)^2$$

$$SR = (\beta\sigma_m)^2 \text{ or ICAI } \boxed{SR = \beta^2\sigma_m^2}$$

- **Single stock**

(i) $TR = (\sigma_x)^2$

(ii) $SR = \beta^2 \sigma_m^2$

(iii) $UR = TR - SR$

Eg S.D. of Stock x : 20%
S.D. of Market = 15%
Beta of Stock x = 0.9
Calculate TR, SR & UR

① $TR = 400 (\%)^2$

② $SR = \beta^2 \sigma_m^2$
$= 0.9^2 \, 15^2$
$= 182.25 (\%^2)$

③ UR
$\sigma e^2 = 400 - 182.25$
$= 217.75 (\%^2)$

$e^2 = UR$

Imp formula

$$\frac{SR}{TR} = 0.7$$

It means SR is 70% of TR

$$= \frac{\beta^2 \sigma_m^2}{\sigma_x^2}$$

$$= \frac{\left(\frac{\cancel{\sigma_x}}{\cancel{\sigma_m}} \times r\right)^{2} \cancel{\sigma_m^2}}{\cancel{\sigma_x^2}}$$

$$= r^2$$

$\boxed{r_{xm}^2 \text{ (coefficient of Determination)} \text{ It means Ratio of SR to TR}}$

Example: 23

Standard deviation of market = 10%

Standard deviation of stock = 16%

Standard deviation of error term = 4% $\sigma_e = 4\%$

Calculate $\boxed{\text{beta}}$ of stock.

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$$SR = \beta^2 \sigma_m^2$$

$$SR = TR - UR$$
$$= 16^2 - 4^2$$
$$= 256 - 16 = 240$$

$$SR = \beta^2 \sigma_m^2$$
$$240 = \beta^2 \, 10^2$$
$$\beta^2 = \frac{240}{100}$$
$$\beta^2 = 2.40$$
$$\beta = \sqrt{2.40} = 1.55$$

Example: 24

Beta of stock = 1.5

Standard deviation of market = 10%

Standard deviation of stock = 18% UR

Calculate Standard deviation of error term.

(Page No. 66)

① SR

$$SR = \beta^2 \sigma_m^2$$

$$= 1.5^2 \, 10^2 = 225$$

$$UR = 18^2 - 225$$

$$= 99$$

$$\sigma_e = \sqrt{99} = 9.95\%$$

Example: 25

Correlation between stock & market = 0.9

Standard deviation of stock = 20%

Calculate standard deviation of error term.

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$TR = 400 (\%^2)$

$r^2 = \frac{SR}{TR}$

$0.9^2 = \frac{SR}{400}$

$SR = 400 \times 0.81 = 324$

$UR = 400 - 324 = 76 (\%^2)$

$\sigma e = \sqrt{76} = 8.72\%$

$\sigma e = 8.72\%$

Example: 26

Stock	ER	Beta	Specific Risk	TR
A	18%	1.2	5%	? 18.56
B	10%	0.5	4%	?
C	? 20.28%	1.4	7%	22%

Calculate missing value. Assuming CAPM holding good.

(Page No. 67)

Standard deviation of Mark.

Stock C

$SR = TR - WR$

$= 484 - 49 = 435$

$SR = \beta^2 \sigma_m^2$

$435 = 1.40^2 \sigma_m^2$

$\sigma_m^2 = \frac{435}{1.96} = 221.94$

$\sigma_m = \sqrt{221.94} = 14.90\%$

Stock A

$SR = \beta^2 \sigma_m^2$

$= 1.2^2 \; 221.94$

$= 319.59$

$TR = 319.59 + 5^2$

$= 344.59 \; (\%^2)$

$\sigma_A = 18.56\%$

Stock B

$\sigma_B = 8.45$

Example: 27

	Stock X	Stock Y
Standard deviation	20%	25%
Beta	1.5	1.75

Standard deviation of market = 10%

(1) Calculate TR, SR and UR of each stock.

(2) Calculate correlation between

(a) X and market

(b) Y and market

(3) If we invest 80% in X and 20% Y then calculate.

(a) Beta of portfolio

(b) TR, SR & UR of portfolio

(Page No. 67)

(1)

(i) TR

$TR_x = 400\ (\%^2)$

$TR_y = 625\ (\%^2)$

(ii) SR

$SR = \beta^2 \sigma_m^2$

$SR_x = 1.5^2\ 100 = 225\ (\%^2)$

$SR_y = 1.75^2\ 100 = 306.25\ (\%^2)$

(iii) UR

$UR = TR - SR$

$UR_x = 400 - 225 = 175\ (\%^2)$

$UR_y = 625 - 306.25 = 318.75\ (\%^2)$

3 (a) Beta of portfolio

$$\beta_p = (1.5 \times 0.8) + (1.75 \times 0.2) = 1.55$$

3 (b) TR, SR & UR of portfolio [Imp]

(i) SRp

$$SR_p = \beta_p^2 \sigma_m^2$$
$$= 1.55^2 \, 100$$
$$= 240.25 \ (\%^2)$$

Alternative I

$$\sigma_p^2 = \sigma_x^2 w_x^2 + \sigma_y^2 w_y^2 + 2 \times w_x \times w_y \times cov_{xy}$$

$$= 20^2 \, 0.8^2 + 25^2 \, 0.2^2 + 2 \times 0.8 \times 0.2 \times 262.50$$

$$TR_p = 365 \ (\%^2)$$

$$UR_p = 365 - 240.25$$
$$= 124.75$$

In sharpe Model, Correlation between two stocks is possible because of Market. It means there is no correlation of Internal factors.

$$\boxed{r_{xy} = r_{xm} \times r_{ym}} \leftarrow \text{Sharpe Model}$$

It means

$$Cov_{xy} = \sigma_x \times \sigma_y \times r_{xy}$$

$$= \sigma_x \times \sigma_y \times r_{xm} \times r_{ym}$$

$$= \sigma_x \times r_{xm} \times \sigma_y \times r_{ym}$$

$$= \left[\left(\frac{\sigma_x \times r_{xm}}{\sigma_m}\right) \times \left(\frac{\sigma_y \times r_{ym}}{\sigma_m}\right)\right] \sigma_m^2$$

$$\boxed{Cov_{xy} = B_x B_y \sigma_m^2}$$

$$= 1.5 \times 1.75 \times 100$$

$$= 262.50 \ (\%^2)$$

Alternative II

- **WRp**

$$\sigma ep^2 = \sigma ex^2 \omega x^2 + \sigma ey^2 \omega y^2$$

$$= 175 \times 0.80^2 + 318.75 \times 0.20^2$$

$$= 124.75$$

$$TRp = SRp + WRp$$

$$= 240.25 + 124.75 = 365$$

② Calculation of Correlation

Correlation xm

$$B = \frac{\sigma_x}{\sigma_m} \times r_{xm}$$

$$1.5 = \frac{20}{10} \times r_{xm}$$

$$r_x = \frac{1.5}{2}$$

$$= 0.75$$

Correlation Y & M

$$1.75 = \frac{25}{10} \times r_{ym}$$

$$r_{ym} = \frac{1.75}{2.5}$$

$$= 0.7$$

TR, SR, UR

Single Stock

$TR = \sigma_x^2$

$SR = \beta^2 \sigma_m^2$

$UR = TR - SR$

$r^2 = \frac{SR}{TR}$

PORTFOLIO

① $SR_p = B_p^2 \sigma_m^2$

② TR_p

Markowitz

$\sigma_p^2 = \sigma_A^2 \omega_A^2 + \sigma_B^2 \omega_B^2 + 2 \times \omega_A \times \omega_B \times \sigma_x \sigma_y r_{xy}$

Sharpe

$\sigma_p^2 = \sigma_A^2 \omega_A^2 + \sigma_B^2 \omega_B^2 + 2 \omega_A \omega_B \times B_A B_B \sigma_m^2$

③ UR_p

(I) $UR_p = TR_p - SR_p$

(II) $\sigma e_p^2 = \sigma e_A^2 \omega_A^2 + \sigma e_B^2 \omega_B^2$

Question: 43

A has portfolio having following features:

Security	β	Random Error σ_{ei}	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%.

(Study Material & PM)

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$\sigma p = \sqrt{561.12}$

$= 23.69\%$

• Beta of portfolio

$Bp = (1.60 \times 0.25) + (1.15 \times 0.30)$
$+ (1.40 \times 0.25) + (1 \times 0.20)$
$= 1.295$

• SRp

$SRp = Bp^2 \sigma m^2$
$= (1.295)^2 (18)^2 = 543.36 (\%^2)$

• URp

$\sigma ep^2 = 7^2 0.25^2 + 11^2 \times 0.30^2$
$+ 3^2 0.25^2 + 9^2 0.20^2$
$= 17.76 (\%^2)$

$TRp = SRp + URp$
$= 543.36 + 17.76 = 561.12 (\%^2)$

Question – 42

A study by a Mutual fund has revealed the following data in respect of three securities:

Security	σ(%)	Correlation with Index, Pm
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 covariance's 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)?

(Study Material & PM)

(Page No. 72)

① Calculation of Beta

$$\beta = \frac{\sigma x}{\sigma m} \times r_{xm}$$

$$\beta_A = \frac{20}{15} \times 0.60 = 0.80$$

$$\beta_B = \frac{18}{15} \times 0.95 = 1.14$$

$$\beta_C = \frac{12}{15} \times 0.75 = 0.60$$

② Cov Between two stocks

$$Cov_{AB} = \beta_A \beta_B \sigma_m^2$$

$$Cov_{AB} = 0.80 \times 1.14 \times 15^2 = 205.20$$

$$Cov_{AC} = 0.80 \times 0.60 \times 15^2 = 108$$

$$Cov_{BC} = 1.14 \times 0.60 \times 15^2 = 153.90$$

③ Total Risk of Portfolio

$$\sigma_p^2 = \sigma_A^2 \omega_A^2 + \sigma_B^2 \times \omega_B^2 + \sigma_C^2 \times \omega_C^2$$
$$+ 2 \times \omega_A \times \omega_B \times COV_{AB}$$
$$+ 2 \times \omega_A \times \omega_C \times COV_{AC}$$
$$+ 2 \times \omega_B \times \omega_C \times COV_{BC}$$

$$= 20^2 \times (1/3)^2 + 18^2 \times (1/3)^2 + 12^2 \times (1/3)^2$$
$$+ 2 \times 1/3 \times 1/3 \times 205.20$$
$$+ 2 \times 1/3 \times 1/3 \times 108$$
$$+ 2 \times 1/3 \times 1/3 \times 153.90$$
$$= 200.24 (\%^2)$$

$$\sigma_p = 14.15\%$$

④ Beta of Portfolio

$$B_p = \frac{0.8 + 1.14 + 0.60}{3}$$
$$= 0.8467$$

⑤ TR, SR & UR of Portfolio

- $TR_p = 200.24 (\%^2)$
- $SR_p = B_p^2 \sigma_m^2$
  $= 0.8467^2 \, 15^2 = 161.30 (\%^2)$
- $UR_p = TR_p - SR_p$
  $= 200.24 - 161.30$
  $= 38.94 (\%^2)$

Question: 46

Following are risk and return estimates for two stocks :

TRP

TRP

SRP

Stock	Expected returns (%)	Beta	Specific SD of expected return (%)
A	14	0.8	35
B	18	1.2	45

The market index has a Standard Deviation (SD) of 25% and risk free rate on Treasury Bills is 6%.

You are required to calculate :

(i) The standard deviation of expected returns on A and B.

(ii) Suppose a portfolio is to be constructed with the proportions of 25%, 40% and 35% in stock A, B and Treasury Bills respectively, what would be the $\boxed{\text{expected return}}$, standard deviation of expected return of the portfolio?

(Exam November – 2019)

(Page No.77)

① Standard deviation

SR

$SR = \beta^2 \sigma_m^2$

$SR_A = 0.8^2\ 625 = 400\ (\%^2)$

$SR_B = 1.2^2\ 625 = 900\ (\%^2)$

$TR = SR + UR$

$TR_A = 400 + 35^2 = 1625\ (\%)^2$

$\sigma_A = \sqrt{1625} = 40.31\%$

$TR_B = 900 + 45^2 = 2925\ (\%^2)$

$\sigma_B = \sqrt{2925} = 54.08\%$

$(a+b+c)^2$

(11) ER_p & σ_p

$$ER_p = (14 \times 0.25) + (18 \times 0.4) + (6 \times 0.35) = 12.8\%$$

$$\sigma_p = \sqrt{1625 \times 0.25^2 + 2925 \times 0.40^2 + 2 \times 0.25 \times 0.40 \times \underbrace{0.8}_{B_A} \times \underbrace{1.2}_{B_B} \times \underbrace{625}_{\sigma_m^2}}$$

$$= 26.25\%$$

Question : 45

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)

(MTP: Aug – 2018)

(Page No.76)

① Portfolio Beta

$Bp = (0.4 \times 0.2) + (0.5 \times 0.5) + (0.3 \times 1.10)$

$= 0.66$

⑪ Residual Variance

$SR = \beta^2 \sigma m^2$

$SR_A = 0.40^2 \; 0.10^2 = 0.0016$

$SR_B = 0.50^2 \; 0.10^2 = 0.0025$

$SR_C = 1.10^2 \; 0.10^2 = 0.0121$

$UR = TR - SR$

$UR_A = 0.015 - 0.0016 = 0.0134$

$UR_B = 0.025 - 0.0025 = 0.0225$

$UR_C = 0.1000 - 0.0121 = 0.0879$

(iii) Portfolio Variance using Sharpe Index Model

$$\sigma_p^2 = \sigma_A^2 \omega_A^2 + \sigma_B^2 \omega_B^2 + \sigma_C^2 \omega_C^2$$
$$+ 2 \times \omega_A \times \omega_B \times \beta_A \beta_B \sigma_m^2$$
$$+ 2 \times \omega_A \times \omega_C \times \beta_A \beta_C \sigma_m^2$$
$$+ 2 \times \omega_B \times \omega_C \times \beta_B \beta_C \sigma_m^2$$

$$= 0.015 \times 0.20^2 + 0.025 \times 0.5^2 + 0.100 \times 0.30^2$$
$$+ 2 \times 0.20 \times 0.5 \times 0.40 \times 0.5 \times 0.10^2$$
$$+ 2 \times 0.20 \times 0.3 \times 0.40 \times 1.10 \times 0.10^2$$
$$+ 2 \times 0.5 \times 0.3 \times 0.5 \times 1.10 \times 0.10^2$$

$$\sigma_p^2 = 0.01842$$

(iv) Portfolio Variance on the basis of MPT

$$\sigma_p^2 = 0.015 \times 0.20^2 + 0.025 \times 0.5^2 + 0.100 \times 0.3^2$$
$$+ 2 \times 0.20 \times 0.50 \times 0.030$$
$$+ 2 \times 0.2 \times 0.30 \times 0.020$$
$$+ 2 \times 0.5 \times 0.3 \times 0.040$$

$$\sigma_p^2 = 0.03625$$

Question: 44

Following are the details of a portfolio consisting of 3 shares:

Shares	Portfolio Weight	Beta	Expected Return (%)	Total Variance
X Ltd.	0.3	0.50	15	0.020
Y Ltd.	0.5	0.60	16	0.010
Z Ltd.	0.2	1.20	20	0.120

H.W

H.W copy

Standard Deviation of Market Portfolio Return = 12% 0.12

You are required to calculate the following:

(i) The Portfolio Beta.

(ii) Residual Variance of each of the three shares.

(iii) Portfolio Variance using Sharpe Index Model.

(Exam May – 2019)

(Page No.74)

Question: 40

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

(Study Material & PM)

(Page No.67)

① Calculation of Variance

$Cov_{xy} = \sigma_x \sigma_y r_{xy}$

① $Cov_{xx} = \sigma_x \sigma_x r_{xx}$

$4.800 = \sigma_x^2 \times 1$

$\sigma_x^2 = 4.800$

(ii) $\sigma_y^2 = 4.250$ $\quad \sigma_m^2 = 3.100$

(11)

- Portfolio Return = $(15 \times 0.6) + (14 \times 0.4) = 14.6\%$
- Portfolio Beta

$$B_x : \frac{Cov_{xm}}{\sigma_m^2} = \frac{3.370}{3.100} = 1.087$$

$$B_y : \frac{2.800}{3.100} = 0.9032$$

$$B_p = (1.087 \times 0.6) + (0.9032 \times 0.4) = 1.013$$

- Portfolio Variance

$$\sigma_p^2 = \sigma_x^2 \omega A^2 + \sigma_y^2 \omega y^2 + 2 \times \omega x \times \omega y \times Cov_{xy}$$

$$= 4.800 \times 0.6^2 + 4.250 \times 0.40^2 + 2 \times 0.6 \times 0.4 \times 4.300$$

$$= 4.472$$

- Standard deviation

$$\sigma p = \sqrt{4.472} \simeq 2.115$$

(iii)

- **Expected Return**

$Ke = Rf + (Rm - Rf)\beta$

$x = 10 + (12 - 10)\,1.087 = 12.17\%$

$y = 10 + (12 - 10)\,0.9032 = 11.81\%$

portfolio $= 10 + (12 - 10)\,1.013 = 12.03\%$

- **Systematic Risk**

$SR = \beta^2 \sigma m^2$

$SRx = 1.087^2\ 3.100 = 3.663$

$SRy = 0.9032^2\ 3.100 = 2.529$

$SRp = 1.013^2\ 3.100 = 3.181$

- **Unsystematic Risk**

$UR = TR - SR$

$x = 4.800 - 3.663 = 1.137$

$y = 4.250 - 2.529 = 1.721$

portfolio $= 4.472 - 3.181 = 1.291$

(iv)

• Sharpe Ratio

$$\text{Sharpe Ratio} = \frac{\text{Average Return} - R_f}{S.D.}$$

$$MFX = \frac{15-10}{\sqrt{4.800}} = \frac{5}{2.191} = 2.282$$

$$MFY = \frac{14-10}{\sqrt{4.250}} = \frac{4}{2.061} = 1.941$$

$$\text{portfolio} = \frac{14.60-10}{2.115} = 2.175$$

• Treynor's Ratio

$$\text{Treynor's Ratio} = \frac{\text{Average Return} - R_f}{\beta}$$

$$MFX = \frac{15-10}{1.087} = 4.600$$

$$MFY = \frac{14-10}{0.9032} = 4.43$$

$$\text{portfolio} = \frac{14.60-10}{1.013} = 4.54$$

Alpha

$$\text{Alpha} = \text{Average Return} - K_e$$

MFX =

MFY =

portfolio =

PART III Arbitrage Pricing Theory (APT)

(Multifactors Model)

- In CAPM, we calculate expected Return on the basis of systematic Risk. Systematic Risk is captured on the basis of "Economy". In CAPM economy is captured by "Sensex or Nifty"

- As per APT, Economy is captured by multifactors like GDP, Inflation, Int. Rate, Exchange Rate etc. Hence ER is calculated on the basis of multifactors & it is called Multifactors model.

CAPM Equation

$$ER = Rf + \underset{\text{Index}}{MRP} \times B$$ [Single factor Model]

APT Equation

$$ER = Rf + FRP_1 \times B_1 + FRP_2 \times B_2 \text{ ..... } FRP_n B_n$$

[Multifactors Model]

FRP = factor Risk premium

Example: 28

Risk free rate = 6%

Factors	Risk Premium	Factor
Inflation	3%	1.5
Interest Rate	2%	0.9
Currency Rate	4%	1.2

Calculate expected return as per APT.

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$$ER = 6 + (3 \times 1.5) + (2 \times 0.9) + (4 \times 1.2)$$

$$= 17.1\%$$

Example: 29

Risk free rate = 6%

Factors	Factor 1	Factor 2
Risk Premium	5%	3%
Factor Sensitivity	B1	B2
A	1.2	0.9
B	0.5	1.5

(i) Calculate expected return of each stock using, APT.

(ii) Suppose we invest 80% in stock A and 20% in stock B then calculate factor sensitivity 1 of portfolio.

(iii) Suppose we want to create a portfolio so that factor sensitivity 2 of portfolio should be 1. How much amount should be invested in A & B.

(Page No.90)

(III) Calculation of Weights

$1 = 0.9 w_A + 1.5(1 - w_A)$

$1 = 0.9 w_A + 1.5 - 1.5 w_A$

$w_A = 0.833$ $w_B = 0.167$

(I) Calculation of ER

$ER = Rf + FRP_1 B_1 + FRP_2 B_2$

$14.7 = 6 + 5 \times 1.20 + 3 \times 0.9$

$= 14.7\%$

$13\% = 6 + 5 \times 0.5 + 3 \times 1.5$

$= 13\%$

(II) Portfolio Beta (factor 1)

$B_p = (1.2 \times 0.8) + (0.5 \times 0.20)$

$= 1.06$

Question: 54

Mr. Nirmal kumar has categorized all the available stock in the market into the following types:

(i) Small cap growth stocks

(ii) Small cap value stocks

(iii) Large cap growth stocks

(iv) Large cap value stocks

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 factor 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:

(a) Using Arbitrage Pricing Theory, determine the expected return on the market index.

(b) Using Capital Asset Pricing Model (CAPM), determine the expected return on the market index.

(c) 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.

(Study Material & PM)

(Page No.91)

① Calculation of Expected Return of Market using APT

Weighted Avg Beta

factor 1 $= (0.8 \times 25\%) + (0.9 \times 10\%) + (1.165 \times 50\%) + (0.85 \times 15\%)$

$= 1$

factor 2 $= 2.105$

factor 3 $= 5.80$

$ER_M = R_f + FRP_1 B_1 + FRP_2 B_2 + FRP_3 B_3$

$= 4.5 + (6.85 \times 1) + (-3.5 \times 2.105) + (0.65 \times 5.80)$

$= 7.7525\%$

(11) Expected Return on Market using CAPM

$$ER = Rf + MRP \times B$$

$$SCG = 4.5 + 6.85 \times 0.86 = 9.98\%$$

$$SCV = 4.5 + 6.85 \times 0.90 = 10.665\%$$

$$LCG = 4.5 + 6.81 \times 1.165 = 12.48\%$$

$$LCV = 4.5 + 6.85 \times 0.85 = 10.32\%$$

$$ER_M = (9.98 \times 25\%) + (10.665 \times 10\%) + (12.48 \times 50\%) + (10.32 \times 15\%)$$

$$= 11.35\%$$

③ Calculation of Weights

Target Beta = 1

$$1 = (0.9 \times wA) + 1.165(1 - wA)$$

$$1 = 0.9wA + 1.165 - 1.165wA$$

$$wA = 62.26\%$$

$$wB = 37.73\%$$

Example: 30

	B1	B2
A	1.2	0.9
B	0.5	1.5

ER (A) = 14.7%

ER (B) = 13%

R_f = 6%

Calculate factor risk premium 1 and factor risk premium 2.

(Page No.9

Calculation of FRP_1 & FRP_2

$14.7 = 6 + FRP_1\ 1.2 + FRP_2\ 0.9$

$13 = 6 + FRP_1\ 0.5 + FRP_2\ 1.5$

$8.7 = 1.2\ FRP_1 + 0.9\ FRP_2$ —— (I)

$7 = 0.5\ FRP_1 + 1.5\ FRP_2$ —— (II)

Multiply Equation (I) by 0.5 & Equation (II) by 1.2

$4.35 = \cancel{0.6\ FRP_1} + 0.45\ FRP_2$

$8.40 = \cancel{0.6\ FRP_1} + 1.80\ FRP_2$

$4.05 = 1.35\ FRP_2$

$FRP_2 = \frac{4.05}{1.35} = 3$

Put FRP_2 in Equation 1

$8.7 = 1.2\ FRP_1 + 0.9 \times 3$

$FRP_1 = 5\%$

Question : 55

Mr. Kapoor owns a portfolio with the following characteristics:

	Security X	Security Y	Risk Free Security
Factor 1 sensitivity	0.75	1.50	0
Factor 2 sensitivity	0.60	1.10	0
Expected Return	15%	20%	10%

It is assumed that security returns are generated by a two factor model.

(i) If Mr. Kapoor has ₹ 1,00,000 to invest and sells short ₹ 50,000 of security Y and purchases ₹ 1,50,000 of security X, what is the sensitivity of Mr. Kapoor's portfolio to the two factors?

(ii) If Mr. Kapoor borrows ₹ 1,00,000 at the risk free rate and invests the amount he borrows along with the original amount of ₹ 1,00,000 in security X and Y 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?

(Study Material & PM)

(Page No.90)

① Calculation of β_p

Calculation of Weights

Own fund = ₹ 100000

Short Sell (Y) = 50000

Investment (x) = ₹ 150000

$$W_x = \frac{₹150000}{₹100000} = 1.50$$

$$W_y = \frac{-50000}{100000} = -0.50$$

$$\text{factor 1} = (0.75 \times 1.50) + (1.50 \times -0.50) = 0.375$$

$$\text{factor 2} = (0.60 \times 1.50) + (1.10 \times -0.50) = 0.35$$

(III) Calculation of FRP_2

$$5 = FRP_1\, 0.75 + FRP_2\, 0.60 \quad \text{— (I)}$$

$$10 = FRP_1\, 1.50 + FRP_2\, 1.10 \quad \text{— (II)}$$

Multiply Equation (I) by 1.50 & Equation (II) by 0.75

$FRP_2 = 0$ $\quad$ $FRP_1 = 6.67\%$

(11) Calculation of Beta of Portfolio

Own fund = ₹ 100000

Rf Borrow = ₹ 100000

₹ 200000

X (1.5)

200000 × 1.5

= ₹ 300000

Y (−0.50)

200000 × −0.50

= −100000

$W_x = \frac{300000}{100000} = 3$

$W_y = \frac{-100000}{100000} = -1$

$W_{RF} = \frac{-100000}{100000} = -1$

$\underline{\underline{1}}$

Factor 1

$B_p = (0.75 \times 3) + (1.5 \times -1) = 0.75$

Factor 2

$B_p = (0.60 \times 3) + (1.10 \times -1) = 0.70$

Question: 53

Mr. Tamarind intends to invest in equity shares of a company the value of which depends upon various parameters as mentioned below:

Factor	Beta	Expected Value in %	Actual Value in %
GNP	1.20	7.70	7.70
Inflation	1.75	5.50	7.00
Interest rate	1.30	7.75	9.00
Stock market index	1.70	10.00	12.00
Industrial production	1.00	7.00	7.50

If the risk free rate of interest be 9.25%, how much is the return of the share under Arbitrage Pricing Theory?

(Study Material & PM)

(Page No. 90)

Calculation of Return

Factor	Actual	Expected	Difference	Beta	Diff x Beta
GNP	7.70	7.70	0	1.20	0
Inflat.	7.00	5.50	1.5	1.75	2.625
Int	9.00	7.75	1.25	1.30	1.625
Stock	12.00	10.00	2	1.70	3.40
IP	7.50	7.00	0.50	1.00	0.50

Risk Premium 8.15

(+) Rf 9.25

Return 17.40%

PART IV PORTFOLIO REBALANCING

or

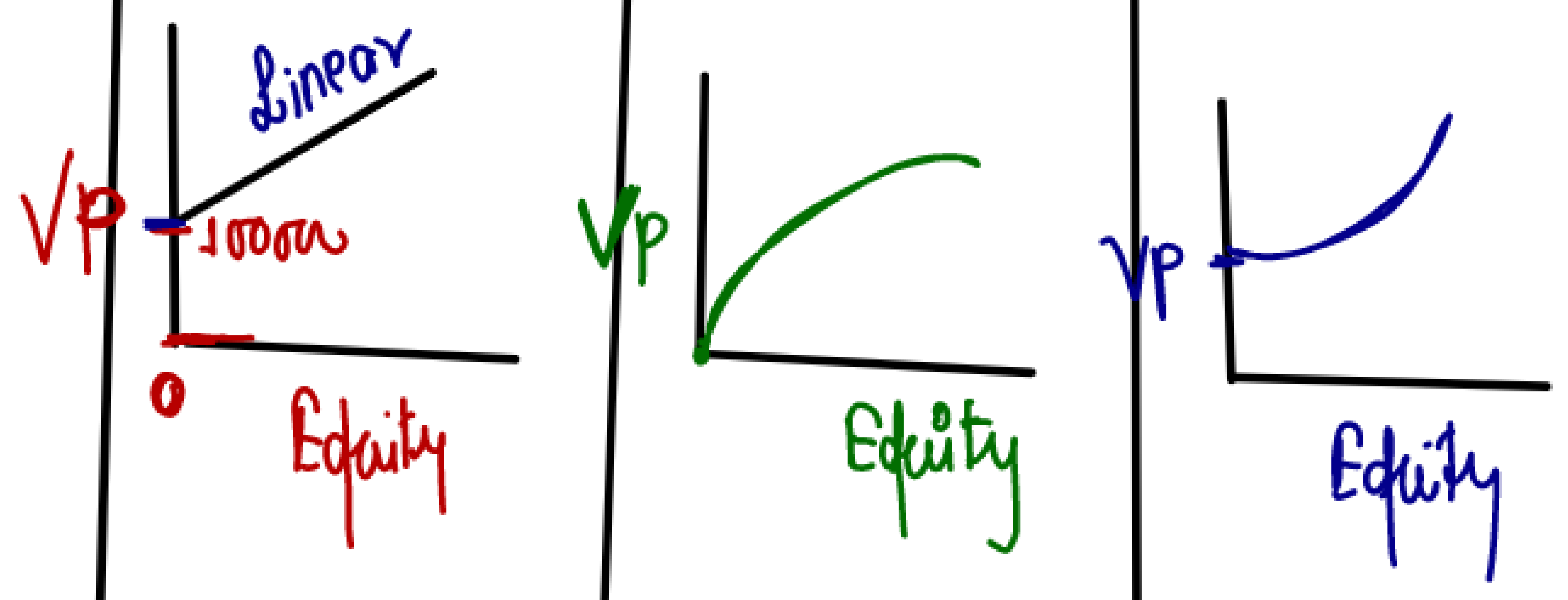
PORTFOLIO REVISION

There are three techniques of portfolio Rebalancing

1. Buy & Hold Strategy
2. Constant Ratio Plan
3. Constant proportion portfolio Insurance (CPPI)

B&H	Constant Mix	CPPI
Ram (₹200000) Bond = ₹100000 Equity = ₹100000 ₹200000	Shyam (200000) B 100000 E 100000 200000	Mohan (200000) B 100000 E 100000
E = 10% ↑ B = ₹100000 E = ₹110000 ₹210000 Rebalancing Do Nothing	Equity = 10% ↑ B 100000 E 110000 210000 Sell Equity & Buy Bonds B 105000 E 105000 210000	E = 10% ↑ B 100000 E 110000 210000 Buy Equity & Sell Bonds B 98000 E 112000 210000
E = 20% ↓ B = 100000 E = 88000 188000 Rebalancing Do Nothing	E = 20% ↓ B 105000 E 84000 189000 कम मे Buy ज्यादा मे Sell B 94500 E 94500 189000 Buy Equity & Sell Bond	E = 20% ↓ B 98000 E 89600 187600 Sell Equity & Buy Bonds B 102600 E 85000 187600

	B&H	Constant Ratio	CPPI
• If Equity Rise	Do Nothing	Sell Equity & Buy Bonds	Buy Equity & sell Bonds
• If Equity fall	Do Nothing	Buy Equity & sell Bonds	Sell Equity & Buy Bonds
• If Market is unidirection (up up up up or down, down, down)	Average	Worst	Best
• If Market is Range bound (up-down, up-down, up, down)	Average	Best	Worst
• Floor Available	Yes	No	Yes
• payoff	Linear	Concave	Convex



Question: 56

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:

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.

(Study Material & PM)

(Page No. 95)

Constant Ratio Plan

NAV	Bond	Equity	Total	Action	Balance (units)
40	100000	100000	200000	–	2500
25	100000	62500	162500	-	2500
	81250	81250	162500	Buy 750 units	3250
36	81250	117000	198250	–	3250
	99125	99125	198250	Sell 496.53 units	2753.47 units
32	99125	88111.04	187236.04	—	2753.47 units
38	99125	104631.86	203756.86		2753.47 units
	101878.43	101878.43	203756.86	Sell 72.46 units	2681.01 units
37	101878.43	99197.37	201075.80	—	2681.01
42	101878.43	112602.42	214480.85		2681.01
43	101878.43	115283.43	217161.86		2681.01
50	101878.43	134050.50	235928.93		2681.01
	117964.50	117964.50	235928.93	Sell 321.72 units	2359.39
52	117964.50	122683.08	240647.58		

Value of portfolio using Buy & Hold

Investment 200000

$$\text{Equity} = \frac{₹200000}{40} = 5000 \text{ Units}$$

$$V_p = 5000 \text{ Units} \times 52 = ₹260000$$

B&H is better

Question: 57

Ms. Sreenidhi is learning the portfolio management techniques and wants to test one of the techniques she has developed on KIFS Equity Fund and compare the gains and losses from the technique with those from a passive buy and hold strategy.

The KIFS Equity Fund consists of equities only and the ending NAVs of the fund she constructed for the last 10 months are given below:

Month Ending	NAV (₹/unit)
Jan-22	100
Feb-22	78
Mar-22	92
Apr-22	86
May-22	102
Jun-22	98
Jul-22	100
Aug-22	102
Sep-22	118
Oct-22	120

Assume

(i) Sreenidhi had invested a notional amount of ₹ 5 lakhs equally in the equity fund and a conservative portfolio (of bonds) in the beginning of January 2022 and the total portfolio was being rebalanced each time the NAV of the fund increased or decreased by 15% compared to the NAV of previous month.

H.W

C.W.

B&H

₹ 500000

B 250000

E $\frac{250000}{100}$ = 2500 Units

(ii) There is no income earned from the conservative portfolio during the period.

(iii) There is no taxation and entry/exit loads.

You are required to determine:

(i) Value of the portfolio for each level of NAV following the Constant Ratio Plan.

(ii) Whether there are any errors in the technique developed by Sreenidhi? If so briefly explain.

(Exam Nov - 2022)

(Page No. 96)

Constant Proportion Portfolio Insurance (CPPI)

- Calculation of Amount to be invested in Equity & Bonds

$$E = m(A - F)$$

E = Equity, A = Assets, F = Floor, m = multiplier

Investment in Bonds

$$B = A - E$$

Eg

Assets = ₹500000

Floor = ₹400000

m = 1.3

① Calculate (Today)

- Investment in Equity

&

- Investment in Bonds

Today

$E = m(A - F)$

$= 1.3(500000 - 400000) = ₹130000$

$B = 500000 - 130000 = ₹370000$

② Suppose After 10 days Equity rise by 20%, Calculate Revised Balance of Equity & Bond

$E = 130000 \times 1.20 = ₹156000$

$B = ₹370000$

$A = 370000 + 156000 = ₹526000$

Rebalancing

$E = 1.30(526000 - 400000) = 163800$

$B = 526000 - 163800 = 362200$

Question: 58

A

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. 60000 5326

(2) 10 days later-being the 1st day of rebalancing if NIFTY falls to 5122.96. E 57713 3.81%

(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.

(Practice Manual)

(Page No. 98)

$A = ₹\ 300000$

$m = 2$

$\text{Floor} = \dfrac{5326 - 4793.40}{5326} \times 100 = 10\%$

$F = ₹\ 300000 \times 90\% = 270000$

(1) Immediately

$E = m(A - F)$

$= 2(300000 - 270000) = ₹\ 60,000$

$\text{Bonds} = 300000 - 60000 = ₹\ 240000$

2. After 10 days

$$\text{Equity} = \frac{60000}{5326} \times 5122.96 = ₹\,57713$$

$$\text{Bond} = \qquad\qquad = ₹\,240000$$

$$A \qquad 297713$$

Rebalancing

$$E = 2(297713 - 270000) = 55426$$

$$\text{Bonds} = 297713 - 55426 = 242287$$

3 10 day further

$$E = \frac{55426}{5122.96} \times 5539.04 = 59928$$

$$\text{Bonds} \qquad = 242287$$

$$\text{Assets} \qquad 302215$$

Rebalancing

$$E = 2(302215 - 270000)$$

$$= 64430$$

$$\text{Bonds} = 302215 - 64430 = 237785$$

fund t/f from Bond to Equity

₹ 4502

PART V Sharpe optimization Model

Question: 62

Ramesh wants to invest in stock market. He has got the following information about individual securities:

Security	Expected Return	Beta	σ^2_{ci} (σ_e)
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?

(Study Material & PM)

(Page No.105)

Step 1 Calculate Treynor's Ratio & give Rank highest to lowest

$$\text{Treynor's Ratio} = \frac{ER - Rf}{B}$$

Stock	$\frac{ER-Rf}{B}$	Rank
A	5.33	I
B	2.50	III
C	1.20	V
D	2.00	IV
E	0.833	VI
F	4.667	II

Calculation of Cut off

1	2	3	4	5	6 (ii×v)	Σ	ER-
Stock	TR	B_i	σe_i^2	$\frac{B^2}{\sigma e_i^2}$	$\left(\frac{ER-Rf}{\sigma e_i^2}\right)B$	Cum. 6	Cumulation 5
A	5.33	1.5	40	0.056	0.30	0.30	0.056
F	4.667	1.5	30	0.075	0.35	0.65	0.131
B	2.50	2	20	0.20	0.50	1.15	0.331
D	2.00	1	10	0.10	0.20	1.35	0.431
C	1.20	2.5	30	0.208	0.25	1.60	0.639
E	0.833	1.2	20	0.072	0.06	1.66	0.711

$$C = \frac{\sigma_m^2 \times \Sigma \left(\frac{ER-Rf}{\sigma e_i^2}\right) B}{1 + \left(\sigma_m^2 \times \Sigma \frac{B^2}{\sigma e_i^2}\right)}$$

$$C_A = \frac{10 \times 0.30}{1 + (10 \times 0.056)} = 1.923$$

$$C_F = \frac{10 \times 0.65}{1 + (10 \times 0.131)} =$$

$C_A = 1.923$

$C_F = 2.814$

$C_B = 2.668$

$C_D = 2.542$

$C_C = 2.165$

$C_E = 2.047$

Highest cut off $= 2.814$

Step 3 Select the stock having Treynor's Ratio is more than Highest cutoff

Stock A & f should be selected because Treynor's Ratio is more than 2.814

Step 4 Calculation of Weights of Stock A & stock F

$$Z_i = \frac{B_i}{\sigma e_i^2}\left[\frac{ER - Rf}{B_i} - \text{Cutoff}\right]$$

$$Z_A = \frac{1.5}{40}\left[5.33 - 2.814\right] = 0.0943$$

$$Z_f = \frac{1.5}{30}\left[4.67 - 2.814\right] = 0.0928$$

$$\omega_A = \frac{0.0943}{0.0943 + 0.0928} = 0.504 \; [50.40\%]$$

$$\omega_f = 1 - 0.504 = 0.496 \; (49.60\%)$$

Step 2 Calculation of Cut off point

$$C = \frac{\sigma_m^2 \times \sum \left(\frac{ER - RF}{\sigma_{ei}^2}\right) \beta_i}{1 + \left(\sigma_m^2 \times \sum \frac{\beta_i^2}{\sigma_{ei}^2}\right)}$$

Question – 48

H.W [CW copy]

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%?

(Study Material & PM)

(Page No.80)

Question : 51

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:

P x x- (x-x̄)²P m

H.W (C.W copy)

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

Alpha

ER - Ke

11.5% -

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.

(Study Material & PM)
(Page No.86)

Concept of Critical line (Imp)

Eg

YEAR	A (x)	B (y)
1	15%	20%
2	18%	26%
3	20%	? 30%
4	12%	? 14%
5	−8	−26

$$y = b + mx$$

$$20 = b + m15 \quad \text{— (I)}$$

$$26 = b + m18 \quad \text{— (II)}$$

$$-6 = -3m$$

$$m = \frac{-6}{-3} = 2$$

$$20 = b + (2 \times 15)$$

$$b = -10$$

$$\boxed{y = -10 + 2x}$$

Corner theorem

Question: 11

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:

0.5

	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.

(i) 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?.

(ii) Suppose the investor invests ₹ 4,000 out of ₹ 8,000 in security A. How he will allocate the balance between security B and C to ensure that his portfolio is on minimum variance set?

(Study Material & PM)

(Page No.22)

① Calculation of Weights

	A	B	C
Portfolio X [5000]	1500	2000	1500
Portfolio Y (3000)	600	1500	900
Total	2100	3500	2400
Weight (out of 8000)	0.2625	0.4375	0.30

② Calculation of Weight of B & C using critical line

$$Y = a + bx$$

$$w_B = a + b w_A$$

$$0.40 = \cancel{a} + 0.30b \quad \text{— ①}$$

$$0.50 = \cancel{a} + 0.20b \quad \text{— ②}$$

$$-0.10 = 0.10b$$

$$b = \frac{-0.10}{0.10} = -1$$

Put value of WA in equation ①

$$0.40 = a + 0.30 \times -1$$

$$a = 0.70$$

$$w_B = 0.70 + -1 \times w_A$$

we want $w_A = 0.5$

$$w_B = 0.70 + (-1 \times 0.5)$$

$$w_B = 0.2$$

$$w_C = 1 - w_A - w_B$$

$$= 1 - 0.5 - 0.2 = 0.3$$

Investment in A $(8000 \times 0.5) = 4000$

Investment in B $(8000 \times 0.2) = 1600$

Investment in C $(8000 \times 0.3) = 2400$

H.W

CW copy

Question: 06 (b)

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 required to

(i) Calculate the weight of each stock.

(ii) Calculate the amount allocated to Y and Z if half of the funds are allocated to security X.

(Exam May - 2023)

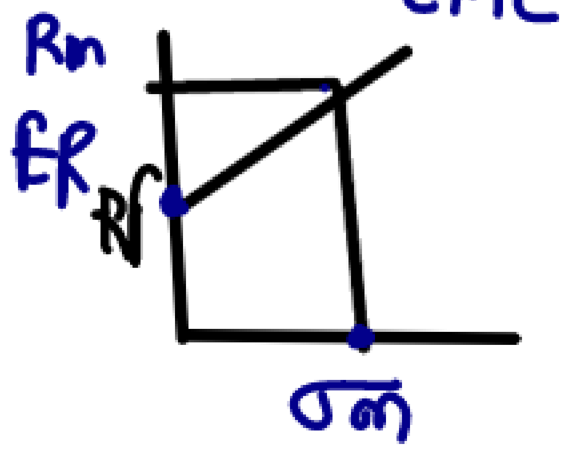
(Question Paper)

PART II CAPM

Capital Market Theory

- $ER_p = R_f + \left(\frac{R_m - R_f}{\sigma_m}\right)\sigma_p$
- $\sigma_p = \sigma_m \times w_m$

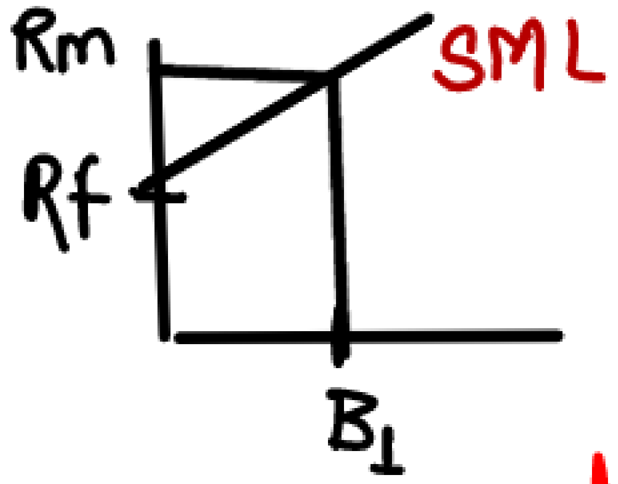
[Market & Rf]



① Equation

$ER = R_f + (R_m - R_f)\beta$

- SR = Market Related
- UR = Specific Risk



② Beta Calculation

(i) $\beta = \frac{\Delta \text{ Stock Return}}{\Delta \text{ Market Return}}$

(ii) $\beta = \frac{\sigma_x}{\sigma_y} \times r_{xy}$

(iii) $\beta = \frac{Cov_{xy}}{\sigma_m^2}$

(iv) $\beta = \frac{\Sigma xm - n\bar{x}\bar{m}}{\Sigma m^2 - n\bar{m}^2}$

③ Beta Management

β_p = Weighted Avg

- Using Rf

$W_A = \frac{\beta_T}{\beta_P}$

- Using other stock

④ Alpha

Alpha = ER − Ke

Positive → Buy

Negative → Sell

⑤ Asset pricing

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

Actual price > P_0 − Sell

Actual price < P_0 − Buy

⑥ TR, SR & UR

- **Single Stock**

$TR = \sigma_x^2$

$SR = \beta^2 \sigma_m^2$

$\sigma_{ex}^2 = TR - SR$

$r^2 = \frac{SR}{TR}$ [coefficient of Determination)

- **PORTFOLIO**

- $SR_p = \beta_p^2 \sigma_m^2$
- $\sigma_{ep}^2 =$ ① $TR_p - SR_p$
  ② $\sigma_{eA}^2 w_A^2 + \sigma_{eB}^2 w_B^2$
- $TR_p = \sigma_A^2 w_A^2 + \sigma_B^2 w_B^2 + 2 w_A w_B \, Cov_{AB}$

Sharpe: $\beta_A \beta_B \sigma_m^2$

Markowitz: $\sigma_A \sigma_B r_{AB}$

PART III

APT

(Multifactor Model)

$ER = Rf + FRP_1 B_1 + FRP_2 B_2 - - - -$

PART IV

PORTFOLIO REBALANCING

1. Buy & Hold
2. Contant Ratio [Equal Amt of Bond & Equity)
3. CPPI

$E = m(A - f)$

PART V

Sharpe optimization Model

(i) Treynor Ratio $= \frac{ER - Rf}{\beta}$

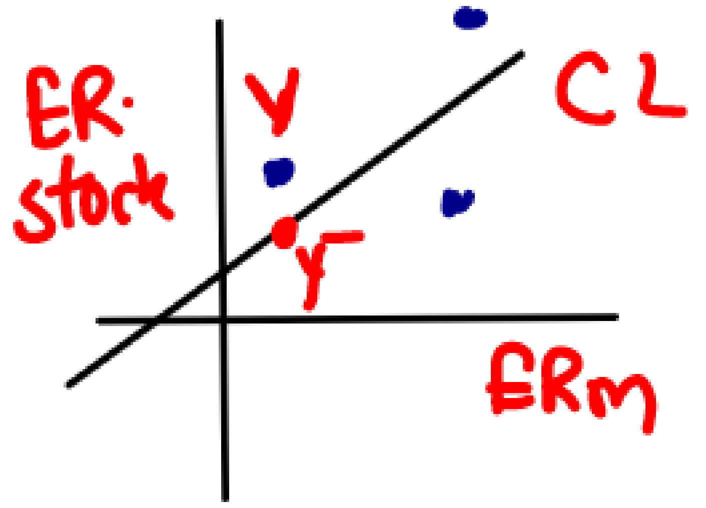
(ii) $C = \frac{\sigma_m^2 \times \sum \left(\frac{ER - Rf}{\sigma e^2}\right)\beta}{1 + \left(\sigma_m^2 \sum \frac{B_1^2}{\sigma e_1^2}\right)}$

Highest cut-off

(iii) $Z_i = \frac{\beta}{\sigma e_1^2}\left[\frac{ER - Rf}{\beta} - C\right]$

Characteristic Line

$\boxed{\bullet\ ER = \alpha + B R_m}$



Corner theory

$y = a + bx$

Question: 13

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?

(Study Material & PM)
(Page No.24)

① Calculation of Beta

x	M	xm	M^2
20	22	440	484
22	20	440	400
25	18	450	324
21	16	336	256
18	20	360	400
-5	8	-40	64
17	-6	-102	36
19	5	95	25
-7	6	-42	36
20	11	220	121
150	120%	2157	2146

$\bar{X} = 15\%$ $\bar{M} = 12\%$

$$\beta = \frac{\Sigma xm - n\bar{x}\bar{m}}{\Sigma m^2 - n\bar{m}^2}$$

$$= \frac{2157 - 10\times15\times12}{2146 - 10\times12^2}$$

$$= 0.505$$

② Characteristic Line

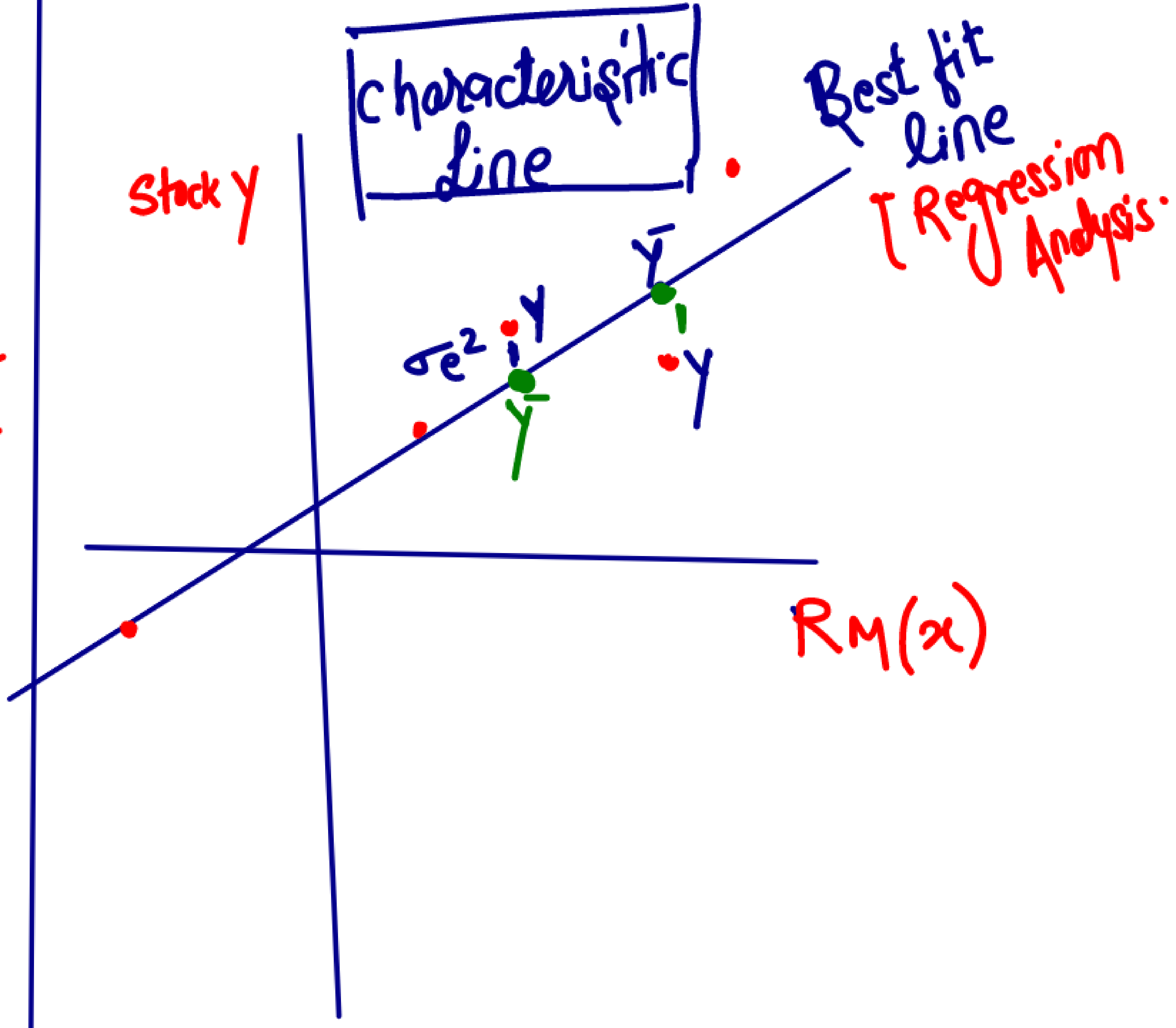
$$\bar{y} = \alpha + b\bar{RM}$$

$$15 = \alpha + 0.505\times12$$

$$\alpha = 8.94$$

Hence CL is

$$\bar{y} = 8.94 + 0.505\,RM$$



H.w

Question: 41

The returns on stock A and market portfolio for a period of 6 years are as follows:

C.w copy

β

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:

(i) Characteristic line for stock A

(ii) The systematic and unsystematic risk of stock A.

(Study Material & PM)

(Page No.71)

Question: 35

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%

ER = 22% (Aggressive); ER = 13.5% (Defensive)

18 | 2 | 0.5

Rf =

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%. RM = 16%

(d) The Alphas of the two stocks.

(Study Material & PM)

(Page No.60)

$ER = \cancel{\alpha} + \beta R_m$

SML

C.W Copy

$K_e = R_f + MRP\,\beta$

$= 7.5 + (16 - 7.5)\,\beta$

$= 7.5 + 8.5\,\beta$

Imp

Eg 1

fund = ₹100000

60% 40%

PORTFOLIO A PORTFOLIO B

₹60000 ₹40000

x y z x y z

30% 30% 40% 50% 40% 10%

Calculate w_x, w_y, w_z in Total

Calculation of Weights

	X	Y	Z
Portfolio A	18000	18000	24000
portfolio B	20000	16000	4000
Total	38000	34000	28000
Weights	0.38	0.34	0.28

Eg. 2

	w_x	w_y	w_z
A	0.5	0.3	0.2
B	0.4	0.1	0.5
C	0.3	−0.1	0.80

$\downarrow 0.1$ $\quad$ $\downarrow 0.2$

Creat portfolio C in which weight of x is 0.3 then Calculate w_y & w_z

Calculation of w_y & w_y

$$y = a + bx$$

$$w_y = a + b w_x$$

$$0.3 = \cancel{a} + 0.5b \quad \text{— (I)}$$

$$0.1 = \cancel{a} + 0.4b \quad \text{— (II)}$$

$$0.2 = 0.1b$$

$$b = \frac{0.2}{0.1} = 2$$

put Value of b in Equation (I)

$$0.3 = a + 0.5 \times 2$$

$$a = -0.7$$

$$w_y = -0.7 + 2w_x$$

Given

$$w_x = 0.3$$

$$w_y = -0.7 + 2 \times 0.3$$

$$= -0.1$$

$$w_z = 1 - 0.3 - (-1)$$

$$= 0.80$$