9 10	-7 20	-22 5	484 25	6 11	-6 -1	36 1	132 - 5
x =	15%	$\sum(x - \bar{x})^2$ =	1148 $(\%)^2$	y =120%		706$(\%)^2$	357$(\%)^2$

$$\sigma_x = \frac{\sqrt{1148}}{10} = 10.71\%$$

$$\sigma_y = \frac{\sqrt{706}}{10} = 8.402\%$$

$$Cov_{xy} = \frac{357\%}{10} = 35.7(\%)^2$$

(1) $$\text{Beta} = \frac{COV_{xm}}{\sigma_m^2} = \frac{35.7}{(8.402)^2} = 0.505$$

Or,

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

$$r_{xm} = \frac{COV_{xm}}{\sigma_x \times \sigma_y} = \frac{35.7}{10.71 \times 8.402} = 0.397$$

$$= \frac{10.71}{8.402} \times 0.397 = 0.505$$

Characteristic Line (CL): Characteristic Line is used to calculate Beta (β) & it starts from Alpha (α).

Equation of Characteristic Line

$$\bar{y} = a + b\bar{x}$$

$$\bar{y} = \alpha + bR_m$$

(2) Characteristic Line

$\bar{y}$ = $\alpha + b\bar{x}$ — $\bar{x}$ = Market

15 = $\alpha + 0.505 \times 12$ — $\bar{y}$ = Stock

15 = $\alpha + 6.06$

α = 8.94

Equation of Characteristic Line

$\bar{y}$ = 8.94 + 0.505x

Question – 16

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.

(SM TYK – 19)

Solution:

First we shall compute the β of Security X

$$\text{Risk Free Rate} = \frac{\text{Coupon Payment}}{\text{Current Market Price}} = \frac{7}{140} = 5\%$$

Assuming equilibrium return to be equal to CAPM return then:

$15\% = R_f + \beta_X(R_m - R_f)$

$15\% = 5\% + \beta_X(15\% - 5\%)$

$\beta_X = 1$

OR, It can also be computed as follows:

$$\frac{R_m}{R_s} = \frac{15\%}{15\%} = 1$$

(i) Standard Deviation of Market Return

$$\beta_x = \frac{Cov_{X,M}}{\sigma_m^2} = \frac{225\%}{\sigma_m^2} = 1$$

$\sigma_m^2 = 225$

$\sigma_m = \sqrt{225} = 15\%$

(ii) Standard Deviation of Security Return

$$\beta_X = \frac{\sigma_x}{\sigma_m} \times \sigma_{xm} = \frac{\sigma_x}{15} \times 0.75 = 1$$

$$\sigma_X = \frac{15}{0.75} = 20\%$$

PORTFOLIO BETA & BETA MANAGEMENT

Question – 17

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?

(SM TYK – 36)

Solution:

(I) Portfolio Beta

Security	Share	Market Price	Amount	Weight	Beta	Weight × Beta
VSL	10,000	50	5,00,000	0.416	0.9	0.375
CSL	5,000	20	1,00,000	08.33	1.0	0.083
SML	8,000	25	2,00,000	0.166	1.5	0.250
APL	2,000	200	4,00,000	0.333	1.2	0.400
			12,00,000			1.108

(II) B_T = 0.8

$W_A = \frac{B_T}{B_P} = \frac{0.8}{1.108} = 0.722$

Portfolio Amount $= \frac{12,00,000}{0.722} = 16,62,050$

R_f Amount = 16,62,050 – 12,00,000 = 4,62,050

Stock	Amount	Weight	Beta	Weight × Beta
VSL	5,00,000	0.301	0.9	0.271
CSL	1,00,000	0.060	1.0	0.060
SML	2,00,000	0.120	1.5	0.180
APL	4,00,000	0.241	1.2	0.289
Risk Free Asset	4,62,050	0.278	0	0
	16,62,050			0.800

(III) B_T = 1.2

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

Portfolio Amount $= \frac{12,00,000}{1.108} = 11,08,030$

R_f Amount = 11,08,030 – 12,00,000 = -91,967

Borrow at R_f = ₹ 91,967

Stock	Amount	Weight	Beta	W × B
VSL	5,00,000	0.451	0.9	0.406
CSL	1,00,000	0.090	1	0.909
SML	2,00,000	0.181	1.5	0.272
APL	4,00,000	0.361	1.2	0.433
Risk Free Asset	-91,967	-0.083	0	0
	11,08,030			1.20

Question – 18

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

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.

(SM TYK – 16, RTP November – 2018)

Solution:

Portfolio Beta

$$\beta_P = \frac{(0.45 \times 0.80) + (0.35 \times 1.50) + (1.15 \times 2.25) + (1.85 \times 4.50)}{9.05}$$

$= 1.3035$

(i) Portfolio Return

$E_{RP} = R_f + (R_m - R_f)\, B_p$

$= 7 + (14 - 7)\, 1.3035$

$= 16.1245\%$

(ii) Portfolio Beta

$\beta_P = 1.3035$

Question – 19

Mr. Fed Up wants to invest an amount of ₹ 520 lakhs and had approached his Portfolio Manager. The Portfolio Manager had advised Mr. Fed Up 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. Fed Up 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.

(SM TYK – 25)

Solution:

(1) Computation of Expected Return from Portfolio

Stock	Amount	Weight	Beta	Weight × Beta
Moderate	60	0.115	0.5	0.058
Better	80	0.154	1.00	0.154
Good	100	0.192	0.80	0.154
Very Good	120	0.231	1.20	0.277
Best	160	0.308	1.50	0.462
	520			1.105

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

$= 8 + (10 - 8) 1.105$

$= 10.21\%$

(2) As computed above the expected return from Better is 10% same as from Nifty, hence there will be no difference even if the replacement of security is made. The main logic behind this neutrality is that the beta of security 'Better' is 1 which clearly indicates that this security shall yield same return as market return.

Question – 20

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

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 advise 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%

(Exam Nov – 2022)

Solution:

(i) $B_P = \frac{1.6 + 1 - 0.30 + 2 + 0.6}{5}$

$= 0.98$

(ii) $B_P = (1.60 \times 0.15) + (1 \times 0.30) + (-0.3 \times 0.15) + (2 \times 0.30) + (0.6 \times 0.10)$

$= 1.155$

(iii) [Since R_f is not given hence we calculate ER_P as below]

$ER_P = R_m \times B_P$

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

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

(iv) **Bull Phase**

In this situation portfolio Beta should be higher hence we invest 20% in S Ltd. 20% in K Ltd. & 60% in D Ltd.

B_P = (1.60 × 0.20) + (1 × 0.20) + (2 × 0.60)

= 1.72

ER_P = 10 × 1.72

= 17.20%

Bearish Phase

20% in C Ltd.

20% in K Ltd.

60% in P Ltd.

B_P = (0.6 × 0.2) + (1 × 0.2) + (−0.3 × 0.6)

= 0.14

ER_P = -5 × 0.14

= -0.7%

Question – 21

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 up by 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)

Solution:

(i) Expected Return as per CAPM

Beta of K Ltd. = 1.40

B_P = (1.20 × 0.10) + (0.75 × 0.10) + (0.40 × 0.30) + (1.40 × 0.50)

= 1.015

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

K Ltd. = 8 + 1.40 (12 – 8) = 13.6%

Portfolio = 8 + 1.015 (12 – 8) = 12.06%

(1) If Market Return Goes Up By 2.5%

It means R_m = [12 + 2.5] = 14.5%

E_R K Ltd. = 8 + (14.5 – 8) 1.40 = 17.1%

Portfolio = 8 + (14.5 – 8) 1.015 = 14.6%

(2) If Market Goes Down By 25%

R_m = [12 – 2.5] = 9.5%

E_R K Ltd. = 8 + (9.5 – 8) 1.40 = 10.1%

Portfolio = 8 + (9.5 – 8) 1.015 = 9.52%

(3) R_m = -2.5

K Ltd. = 8 + (-2.5 – 8) 1.40 = -6.7%

Portfolio = 8 + (-2.5 – 8) 1.015 = -2.66%

(ii) Since B_P = 1.015 is less than Beta of K Ltd. (1.40) hence it is better to invest in portfolio.

Question – 22

Following is the information related to return on shares of three different companies:

Years	A Ltd.	B Ltd.	C Ltd.
2018	2%	3%	5%
2019	6%	8%	7%
2020	13%	14%	15%
2021	7%	9%	11%

Required:

(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)

Solution:

Year	A Ltd.	B Ltd.	C Ltd.
2018	2	3	5
2019	6	8	7
2020	13	14	15
2021	7	9	11
	7%	**8.5%**	**9.5%**

(I) No. of Portfolio & Return

(1) A & B (65:35)

ER_P = (0.65 × 7) + (0.35 × 8.5) = 7.525%

(2) B & A (65:35)