Situation 2 If correlation is perfect positive [+1]

No Risk reduction, only weighted Average

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

Situation 3 If correlation is other [other than +1 & -1]

Risk reduction, but not zero

Optimum weights $\omega_A = \dfrac{\sigma_B^2 - \sigma_A \times \sigma_B \times r_{AB}}{\sigma_A^2 + \sigma_B^2 - 2 \times \sigma_A \times \sigma_B \times r_{AB}}$

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

Three Assets portfolio

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

3 Efficient & optimum portfolio

	A	B	C	D	E	F
ER	13	18	14	18	11	25
S.D	5	7	5	6	3	22

Efficient stock (i) Higher Return at same Risk

(ii) Lower risk at same return

Optimum stock from Efficient stock

(i) Lowest C.V. (ii) Highest sharpe Ratio = $\dfrac{ER - Rf}{\sigma}$

4. Capital Market Line

"portfolio of Market [Index] & Risk free stock"

$$ER_p = Rf + (RM - RF) \times \frac{\sigma_p}{\sigma_m}$$

- Weight = $\frac{\text{Investment}}{\text{own fund}}$
- Weight of Individual Stock can be more than 1.
- Weight of Individual Stock can be Negative. If Weight is negative means borrowing or short sell.

5. Corner portfolio or minimum variance portfolio

Equation of Critical line → $y = a + bx$

	X	Y	Z
A	0.50	0.30	0.20
B	0.40	0.50	0.10
C	0.35	?	?

$Wy = a + b\,wx$

$0.30 = a + 0.50b$ — (I)

$0.50 = a + 0.40\,b$ — (II)

$b = -2$ $\qquad a = 1.30$

Hence $w_y = 1.30 + (-2 \times 0.35) = 0.60$

$w_z = 1 - 0.30 - 0.60 = 0.05$

PART II Capital Asset pricing Model

① Equation of CAPM

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

$Rm - Rf$ = Market Risk premium

② Calculation of Beta

- If only two years data are given

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

- If more than 2 years data are given

Formula 1 $$\beta = \frac{\sigma x}{\sigma m} \times rxm$$

Formula 2 $$\beta = \frac{Covxm}{\sigma m^2}$$

Formula 3 $$\beta = \frac{\Sigma xm - n\bar{x}\bar{m}}{\Sigma m^2 - n\bar{m}^2}$$

Characteristic line

$Y = a + bx$

= Alpha + b × Market Return

③ Beta Management

Beta of portfolio should be increased or decreased on the basis of Market Expectation

① using risk free stock

Beta should be decreased → Investment in RF

Beta should be increased → Borrow from RF

$$\text{Weight of portfolio} = \frac{\beta_T}{\beta_P}$$

② Replacement of one stock with others.