Numerical 1

Case 1: 80 shares of Ray Co. can be bought with Rs 1200 (Rs 1200/15)

Economic Condition	Overall Return	Probability
High growth	80 (20) = 1600	0.3
Low growth	80 (18) = 1440	0.2
Stagnation	80 (25) = 2000	0.4
Recession	80 (28) = 2240	0.1

Expected Return

$$= 0.3\,(1600) + 0.2\,(1440) + 0.4\,(2000) + 0.1\,(2240)$$

$$= 1792$$

Standard Deviation of Return

$$= \left[0.3\,(1600-1792)^2 + 0.2\,(1440-1792)^2 + 0.4\,(2000-1792)^2 + 0.1\,(2240-1792)^2\right]^{1/2}$$

$$= 270.58$$

Case 2 : 80 shares of DK Co. can be bought with Rs 1200

Economic condition	Overall Return	Probability
High Growth	80(25) = 2000	0.3
Low Growth	80(20) = 1600	0.2
Stagnation	80(18) = 1440	0.4
Recession	80(16) = 1280	0.1

Expected Return

$= 0.3(2000) + 0.2(1600) + 0.4(1440) + 0.1(1280)$

$= 1624$

Standard deviation of return

$= [0.3(2000-1624)^2 + 0.2(1600-1624)^2 + 0.4(1440-1624)^2 + 0.1(1280-1624)^2]^{1/2}$

$= \underline{260.58}$

Case 3: 40 shares of each Ray Co. & OK Co. can be bought

Economic Condition	Overall Return (Ray Co.)	Overall Return (OK Co.)	Total	Probability
High growth	40(20) = 800	+ 40(25) = 1000	1800	0.3
Low growth	40(18) = 720	+ 40(20) = 800	1520	0.2
Stagnation	40(25) = 1000	+ 40(18) = 720	1720	0.4
Recession	40(28) = 1120	+ 40(16) = 640	1760	0.1

Expected Return

$= 0.3(1800) + 0.2(1520) + 0.4(1720) + 0.1(1760)$

$= 1708$

Standard deviation of return

$= [0.3(1800-1708)^2 + 0.2(1520-1708)^2 + 0.4(1720-1708)^2 + 0.1(1760-1708)^2]^{1/2}$

$= \boxed{99.68}$

Case 4 : 60 shares of Ray Co. and 20 shares of DK Co. can be bought

Economic Condition	Overall Return (Ray Co.)	Overall Return (DK Co.)	Total	Probability
High growth	60(20) = 1200 +	20(25) = 500	1700	0.3
Low growth	60(18) = 1080 +	20(20) = 400	1480	0.2
Stagnation	60(25) = 1500 +	20(18) = 360	1860	0.4
Recession	60(28) = 1680 +	20(16) = 320	2000	0.1

Expected Return

$$= 0.3(1700) + 0.2(1480) + 0.4(1860) + 0.1(2000)$$

$$= 1750$$

Standard deviation of return

$$= [0.3(1700-1750)^2 + 0.2(1480-1750)^2 + 0.4(1860-1750)^2 + 0.1(2000-1750)^2]^{1/2}$$

$$= \underline{162.54}$$

Numerical 2

Year	R_G	R_M	$R_G - \bar{R}_G$	$R_m - \bar{R}_m$	$(R_G - \bar{R}_G)(R_m - \bar{R}_m)$	$(R_m - \bar{R}_m)^2$
1	4	5	-1.64	-0.82	1.34	0.67
2	-2	2	-7.64	-3.82	29.18	14.59
3	6	6	0.36	0.18	0.06	0.03
4	11	7	5.36	1.18	6.32	1.39
5	5	6	-0.64	0.18	-0.12	0.03
6	8	11	2.36	5.18	12.22	26.83
7	2	-2	-3.64	-7.82	28.46	61.15
8	8	9	2.36	3.18	7.50	10.11
9	7	6	1.36	0.18	0.24	0.03
10	9	9	3.36	3.18	10.68	10.11
11	4	5	-1.64	-0.82	1.34	0.67
	62	64			97.27	125.64

$$\bar{R}_G = \frac{62}{11} = 5.64 \qquad \bar{R}_m = \frac{64}{11} = 5.82$$

$$\sigma^2_m = \frac{\Sigma (R_m - \bar{R}_m)^2}{n-1} = \frac{125.64}{10} = 12.56$$

$$COV_{G,m} = \frac{\Sigma (R_G - \bar{R}_G)(R_m - \bar{R}_m)}{n-1} = \frac{97.27}{10} = 9.73$$

Beta : $\beta_G = \dfrac{COV_{G,m}}{\sigma^2_m} = \dfrac{9.73}{12.56} = 0.77$

Alpha : $\alpha_G = \bar{R}_G - \beta_G \bar{R}_m = 5.64 - (0.77)(5.82) = 1.16$

Characteristic line : $R_G = 1.16 + 0.77 \bar{R}_m$

Numerical 3

Expected Return of KL Ltd.

$= 0.4(-0.5) + 0.3(2) + 0.2(3) + 0.1(2.5)$

$= 1.25$

Expected Return of VK Ltd

$= 0.4(2) + 0.3(2.5) + 0.2(3) + 0.1(4)$

$= 2.55$

Standard Deviation of Return (KL Ltd.)

$= [0.4(-0.5-1.25)^2 + 0.3(2-1.25)^2 + 0.2(3-1.25)^2 + 0.1(2.5-1.25)^2]^{1/2}$

$= ~~2.87~~ \ 1.47$

Standard deviation of return (VK Ltd.)

$= [0.4(2-2.55)^2 + 0.3(2.5-2.55)^2 + 0.2(3-2.55)^2 + 0.1(4-2.55)^2]^{1/2}$

$= ~~1.62~~ \ 0.61$

(6) AP & JR = 2.33-1

* Covariance between returns of PR Ltd. & SP Ltd.

Situation	R_{KL}	R_{VK}	$R_{KL} - \bar{R}_{KL}$	$R_{VK} - \bar{R}_{VK}$	Probability x $(R_{KL} - \bar{R}_{KL}) \times (R_{VK} - \bar{R}_{VK})$
1 (0.4)	-0.5	2	-1.75	-0.55	0.39
2 (0.3)	2	2.5	0.75	-0.05	-0.01
3 (0.2)	3	3	1.75	0.45	0.16
4 (0.1)	2.5	4	1.25	1.45	0.18
				Covariance →	0.71

* Coefficient of correlation - R_{KL} & R_{VK}

$$= \frac{\text{Covariance}}{\sigma_{KL} \times \sigma_{VK}}$$

$$= \frac{0.71}{1.47 \times 0.61}$$

$$= 0.79$$

Numerical 4

RS ltd. = (7+9-9+12-3+17) / 6 = 5.5

AP Ltd = (5+1+12+9+7+3) / 6 = 6.17

MS Ltd = (4+5+9+6+7+9) / 6 = 6.67

JB Ltd = (6+6+8+1+5+13) / 6 = 6.5

⟹ Portfolio of one stock

(same as individual expected returns)

RS Ltd = 5.5 % AP Ltd = 6.17 %

MS Ltd = 6.67 % JB Ltd = 6.5 %

⟹ Portfolio of two stocks (0.5 weightage each)

① RS Ltd & AP Ltd

= 0.5(5.5) + 0.5(6.17) = ~~2.92~~ 5.83 %

② AP Ltd & MS Ltd

= 0.5(6.17) + 0.5(6.67) = 6.42 %

③ MS Ltd & JB Ltd.

= 0.5(6.67) + 0.5(6.5) = 6.58 %

④ JB Ltd & RS Ltd

= 0.5(6.5) + 0.5(5.5) = 6 %

⑤ RS Ltd & MS Ltd = 0.5(5.5) + 0.5(6.67) = 6.08 %

⑥ AP & JB = 6.33-1.

⟹ Portfolio of 3 stocks (0.33 Weightage each)

① RS Ltd, AP Ltd & MS Ltd.

$= 0.33(5.5) + 0.33(6.17) + 0.33(6.67) = 6.05\%$

② AP Ltd, MS Ltd & JB Ltd

$= 0.33(6.17) + 0.33(6.67) + 0.33(6.5) = 6.38\%$

③ MS Ltd, JB Ltd & RS Ltd

$= 0.33(6.67) + 0.33(6.5) + 0.33(5.5) = 6.16\%$

④ RS, AP, JB = $5.99 \simeq 6$

⟹ Portfolio of 4 stocks (0.25 Weightage each)

① RS Ltd, AP Ltd, MS Ltd & JB Ltd

$= 0.25(5.5) + 0.25(6.17) + 0.25(6.67) + 0.25(6.5)$

$= 6.21\%$

Numerical 5

Case 1: 20 shares of SP Ltd. can be bought

Economic Condition	Overall Return	Probability
High growth	20(11) = 220	0.4
Low growth	20(10) = 200	0.2
Stagnation	20(12) = 240	0.3
Recession	20(14) = 280	0.1

Expected Return

$$= 0.4(220) + 0.2(200) + 0.3(240) + 0.1(280)$$

$$= 228$$

standard deviation

$$= [0.4(220-228)^2 + 0.2(200-228)^2 + 0.3(240-228)^2 + 0.1(280-228)^2]^{1/2}$$

$$= \sqrt{161.89}\ 22.27$$

Case 2 : 20 shares of E&C can be bought

Economic Condition	Overall Return	Probability
High growth	20(15) = 300	0.4
low growth	20 (13) = 260	0.2
Stagnation	20 (10) = 200	0.3
Recession	20 (8) = 160	0.1

Expected Return

$$= 0.4\,(300) + 0.2(260) + 0.3\,(200) + 0.1\,(160)$$

$$= 248$$

Standard deviation

$$= [0.4\,(300-248)^2 + 0.2\,(260-248)^2 + 0.3(200-248)^2 + 0.1\,(160-248)^2]^{1/2}$$

$$= 50.75$$

Case 3 : 10 shares of OP Ltd. and 10 shares of E&C Ltd.

Economic Condition	Overall Return (OP)		Overall return (E&C)	Total	Probability
High growth	10(11) = 110	+	10(15) = 150	260	0.4
Low growth	10(10) = 100	+	10(13) = 130	230	0.2
Stagnation	10(12) = 120	+	10(10) = 100	220	0.3
Recession	10(14) = 140	+	10(8) = 80	220	0.1

Expected Return

$= 0.4(260) + 0.2(230) + 0.3(220) + 0.1(220)$

$= 238$

Standard deviation

$= [0.4(260-238)^2 + 0.2(230-238)^2 + 0.3(220-238)^2 + 0.1(220-238)^2]^{1/2}$

$= 18.33$

Case 4 : 14 shares of DP Ltd. and 6 shares of E&C can be bought

Economic condition	overall return (DP)	overall return (E&C)	Total	Probability
High growth	14(11)=154 +	6(15)=90	244	0.4
Low growth	14(10)=140 +	6(13)=78	218	0.2
Stagnation	14(12)=168 +	6(10)=60	228	0.3
Recession	14(14)=196 +	6(8)=48	244	0.1

Expected Return

$= 0.4(244) + 0.2(218) + 0.3(228) + 0.1(244)$

$= 234$

Standard deviation

$= [0.4(244-234)^2 + 0.2(218-234)^2 + 0.3(228-234)^2 + 0.1(244-234)^2]^{1/2}$

$= 10.58$

⟹ Numerical 6

year	R_{FCA}	R_M	$R_{FCA}-\bar{R}_{FCA}$	$R_m-\bar{R}_m$	$(R_{FCA}-\bar{R}_{FCA})(R_m-\bar{R}_m)$	$(R_m-\bar{R}_m)^2$
1	9	12	-6	-2.45	14.72	6.02
2	-3	3	-18	-31.45	206.18	131.21
3	18	15	3	0.54	1.63	0.29
4	30	12	15	-2.45	-36.481	6.02
5	12	15	-3	0.54	-1.63	0.29
6	24	30	9	15.54	139.09	241.66
7	3	-3	-12	-17.45	209.45	304.66
8	21	24	6	9.54	57.27	91.11
9	18	15	3	0.54	1.63	0.29
10	24	24	9	9.54	85.90	91.11
11	9	12	-6	-2.45	14.72	6.02
					693	878.72

$\bar{R}_{FCA} = \frac{165}{11} = 15 \quad \bar{R}_m = \frac{159}{11} = 14.45$

$\sigma^2_m = \frac{\Sigma(R_m-\bar{R}_m)^2}{n-1} = \frac{878.7}{11-1} = 87.87$

$COV_{FCA,M} = \frac{\Sigma(R_{FCA}-\bar{R}_{FCA})(R_m-\bar{R}_m)}{n-1} = \frac{693}{11-1} = 69.3$

Beta : $\beta_{FCA} = \frac{COV_{FCA,M}}{\sigma^2_m} = \frac{69.3}{87.87} = 0.79$

Alpha: $\alpha_{FCA} = \bar{R}_{FCA} - \beta_{FCA}\bar{R}_M = 15 - (0.79)(14.45) = 3.6$

Characteristic line: $R_{FCA} = 3.6 + 0.79\,\bar{R}_m$

Numerical 7

Expected Return (SS Ltd.)

$= 0.4(-5) + 0.3(15) + 0.2(20) + 0.1(25)$

$= 9$

Expected Return (AB Ltd.)

$= 0.4(10) + 0.3(15) + 0.2(15) + 0.1(20)$

$= 13.5$

Standard deviation (SS Ltd.)

$= [0.4(-5-9)^2 + 0.3(15-9)^2 + 0.2(20-9)^2 + 0.1(25-9)^2]^{1/2}$

$= 24.67$

Standard deviation (AB Ltd.)

$= [0.4(10-13.5)^2 + 0.3(15-13.5)^2 + 0.2(\cancel{15}-13.5)^2 + 0.1(20-13.5)^2]^{1/2}$

$= 7.68$

situation	R_{SS}	R_{AB}	$R_{SS} - \bar{R}_{SS}$	$R_{AB} - \bar{R}_{AB}$	Prob × $(R_{SS} - \bar{R}_{SS})(R_{AB} - \bar{R}_{AB})$
1 (0.4)	-5	10	-14	-3.5	19.6
2 (0.3)	15	15	6	1.5	4.5
3 (0.2)	20	15	11	1.5	3.3
4 (0.1)	25	20	16	6.5	10.4
				Covariance →	37.8

Coefficient of correlation

$$= \frac{\text{Covariance}}{\sigma_{SS} \times \sigma_{AB}}$$

$$= \frac{37.8}{24.67 \times 7.68}$$

$$= 0.19$$

⇒ Numerical 8

Expected Return

JR Ltd = (18 + 22 − 14 + 28 − 2 + 38) / 6 = 15

AR Ltd = (14 + 6 + 28 + 22 + 18 + 10) / 6 = 16.33

HR Ltd = (12 + 14 + 22 + 16 + 10 + 22) / 6 = 16

KR Ltd = (16 + 16 + 20 + 6 + 14 + 30) / 6 = 17

* Portfolio of one stock
[same as expected return]

JR Ltd = 15 ; AR Ltd = 16.33 ; HR Ltd = 16 ; KR Ltd = 17

* Portfolio of two stocks

1) JR Ltd & AR Ltd
= 0.5 (15) + 0.5 (16.33) = 15.67

2) AR Ltd & HR Ltd
= 0.5 (16.33) + 0.5 (16) = 16.17

3) HR Ltd & KR Ltd
= 0.5 (16) + 0.5 (17) = 16.5

4) KR Ltd & JR Ltd
= 0.5 (17) + 0.5 (15) = 16

5) JR & HR = 15.5 6) AR & KR = 16.67 ~1.

Portfolio of three stocks

* JR Ltd, AR Ltd & HR Ltd

$= 0.33(15) + 0.33(16.33) + 0.33(16)$

$= 15.62$

* AR Ltd, HR Ltd & KR Ltd

$= 0.33(16.33) + 0.33(16) + 0.33(17) = 16.28$

* HR Ltd, KR Ltd & JR Ltd

$= 0.33(16) + 0.33(17) + 0.33(15) = 15.84$

* KR, JR, AR $= 15.95$

Portfolio of 4 Stocks

JR Ltd, AR Ltd, HR Ltd & KR Ltd

$= 0.25(15) + 0.25(16.33) + 0.25(16)$

$+ 0.25(17) \quad = 16.08$