

PORTFOLIO MANAGEMENT

CLASS 10

CLASS WORK COVERAGE

To streamline our learning process, I've categorized the questions we'll tackle in class into four distinct groups:

1. **Classic:** These questions are exactly as presented in your book, providing a familiar foundation.
2. **Transformed:** Here, we've converted book questions into multiple-choice format to enhance your analytical skills.
3. **Adapted:** These are similar to book questions but with altered numbers or names, presented as multiple-choice questions for varied practice.
4. **Original:** These are entirely new questions not found in your book, designed to challenge and expand your understanding.

This structure will help us navigate through a range of problems, ensuring a comprehensive grasp of the material. Looking forward to our next session!

Q. No.	Type	Book	Page No.
39	Classic	CW Q BOOK	57
40	Classic	CW Q BOOK	58
41	Classic	CW Q BOOK	58
42	Classic	CW Q BOOK	59
43	Classic	CW Q BOOK	59
44	Classic	CW Q BOOK	59

PART II: CAPITAL MARKET THEORY (CMT)**Topic 15 TR, SR AND UR OF A PORTFOLIO****Question 39: SSEI CW Book Page No. 57**

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

Security	σ (%)	Correlation with Index, P_m
A	20	0.60
B	18	0.95
C	12	0.75

The standard deviation of market portfolio (BSE Sensex) is observed to be 15%.

- What is the sensitivity of returns of each stock with respect to the market?
- What are the covariances among the various stocks?
- What would be the risk of portfolio consisting of all the three stocks equally?
- What is the beta of the portfolio consisting of equal investment in each stock?
- What is the total, systematic and unsystematic risk of the portfolio in (iv)?

(Source: ICAI)

ANSWER:

i. Sensitivity of each stock with market is given by its beta.

Standard deviation of market Index = 15%

Variance of market Index = 0.0225

Beta of stocks = $\sigma_i r / \sigma_m$

A = $20 \times 0.60 / 15 = 0.80$

B = $18 \times 0.95 / 15 = 1.14$

C = $12 \times 0.75 / 15 = 0.60$

ii. Covariance between any 2 stocks = $\beta_1 \beta_2 \sigma_m^2$

Covariance matrix

Stock/Beta	0.80	1.14	0.60
A	400.000	205.200	108.000
B	205.200	324.000	153.900
C	108.000	153.900	144.000

iii. Total risk of the equally weighted portfolio (Variance)

$$= 400(1/3)^2 + 324(1/3)^2 + 144(1/3)^2 + 2(205.20)(1/3)^2 + 2(108.0)(1/3)^2 + 2(153.900)(1/3)^2 = 200.244$$

iv. β of equally weighted portfolio =

$$\beta_p = \sum \beta_i / N = \frac{0.80 + 1.14 + 0.60}{3}$$

$$= 0.8467$$

v. Systematic Risk $\beta_p^2 \sigma_m^2 = (0.8467)^2 (15)^2 = 161.303$

Unsystematic Risk = Total Risk – Systematic Risk

$$= 200.244 - 161.303 = 38.941$$

Question 40: SSEI CW Book Page No. 58

The following data are available to you as a portfolio manager.

Security	Expected Return	Beta	Standard Deviation
O	0.32	1.70	0.50
P	0.30	1.40	0.35
Q	0.25	1.10	0.40
R	0.22	0.95	0.24
S	0.20	1.05	0.28
T	0.14	0.70	0.18
Composite Index	0.12	1.000	0.20
T-bills	0.08	0.00	0.00

- i. In terms of a security market line (SML), which of the securities listed above are undervalued? Why?
- ii. Assume that a portfolio is constructed using equal portions of the six stocks listed above.
 - a. Why is the expected return of such a portfolio?
 - b. What would the expected return if this portfolio was increased by 40% through borrowed funds with the cost of borrowing at 12%?

(Source: ICAI)

ANSWER:

i.

Security	Expected Return	Beta (β)	Required Return =0.08 + 0.04β	Under Valued Security
O	0.32	1.70	0.148	UVS
P	0.30	1.40	0.136	UVS
Q	0.25	1.10	0.124	UVS
R	0.22	0.95	0.118	UVS
S	0.20	1.05	0.122	UVS
T	0.14	0.70	0.108	UVS

U = Under Valued Security

All the securities listed above are undervalued because their expected returns plot above the SML

ii. a. Expected return on the portfolio

$$= \frac{1}{6} (0.32 + 0.30 + 0.25 + 0.22 + 0.20 + 0.14) = 0.2383$$

b. Expected return on the portfolio

$$R_p = X R_M - (X - 1) R_p$$

$$= (1.4) (0.2383) - (0.4) (0.12) = 0.33362 - 0.048 = 0.28562$$

Question 41: SSEI CW Book Page No. 58

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

Analyse the risk of the portfolio if the standard deviation of the market index (σ_m) is 18%.

(Source: ICAI)

ANSWER

The risk of the Portfolio can be analyzed as follows:

$$\beta_p = \sum_{i=1}^4 x_i \beta_i$$

$$= 1.60 \times 0.25 + 1.15 \times 0.30 + 1.40 \times 0.25 + 1.00 \times 0.20$$

$$= 0.4 + 0.345 + 0.35 + 0.20 = 1.295$$

The Standard Deviation (Risk) of the portfolio is

$$= [(1.295)^2(18)^2 + (0.25)^2(7)^2 + (0.30)^2(11)^2 + (0.25)^2(3)^2 + (0.20)^2(9)^2]$$

$$= [543.36 + 3.0625 + 10.89 + 0.5625 + 3.24] = [561.115]^{1/2} = 23.69\%$$

Alternatively, it can be analyzed as follows:

The variance of Security's Return

$$\sigma^2 = \beta_i^2 \sigma_m^2 + \sigma_{ei}^2$$

Accordingly, variance of various securities

		σ^2	Weight(w)	$\sigma^2 Xw$
L	$(1.60)^2 (18)^2 + 7^2 =$	878.44	0.25	219.61
M	$(1.15)^2 (18)^2 + 11^2 =$	549.49	0.30	164.85
N	$(1.40)^2 (18)^2 + 3^2 =$	644.04	0.25	161.01
K	$(1.00)^2 (18)^2 + 9^2 =$	405.00	0.20	81
		Variance		<u>626.47</u>

$$SD = \sqrt{626.47} = 25.03$$

Question 42: SSEI CW Book Page No. 59

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

Share	Portfolio weight	Beta	Expected return in %	Total variance
D	0.20	0.40	14	0.015
E	0.50	0.50	15	0.025
F	0.30	1.10	21	0.100

Standard Deviation of Market Portfolio Returns = 10%

You are given the following additional data:

$$\text{Covariance (D, E)} = 0.030$$

$$\text{Covariance (D, F)} = 0.020$$

$$\text{Covariance (E, F)} = 0.040$$

Calculate the Portfolio variance considering:

- Correlation between each pair of securities.
- Co-movement between securities due to change in the market index.

(Source: ICAI)

ANSWER:

- i. We can compute the Portfolio variance on the basis of Correlation between each pair of securities as follows:

$$\begin{aligned}
 &= (W_A \times W_A \times \sigma_A^2) + (W_A \times W_B \times \text{COV}_{AB}) + (W_A \times W_C \times \text{COV}_{AC}) + (W_B \times W_A \times \text{COV}_{AB}) + (W_B \times W_B \times \sigma_B^2) + \\
 &(W_B \times W_C \times \text{COV}_{BC}) + (W_C \times W_A \times \text{COV}_{CA}) + (W_C \times W_B \times \text{COV}_{CB}) + (W_C \times W_C \times \sigma_C^2) \\
 &= (0.20 \times 0.20 \times 0.015) + (0.20 \times 0.50 \times 0.030) + (0.20 \times 0.30 \times 0.020) + (0.20 \times 0.50 \times \\
 &0.030) + (0.50 \times 0.50 \times 0.025) + (0.50 \times 0.30 \times 0.040) + (0.30 \times 0.20 \times 0.020) + (0.30 \times 0.50 \\
 &\times 0.040) + (0.30 \times 0.30 \times 0.10) \\
 &= 0.0006 + 0.0030 + 0.0012 + 0.0030 + 0.00625 + 0.0060 + 0.0012 + 0.0060 + 0.0090 \\
 &= 0.0363
 \end{aligned}$$

- ii. To compute the Portfolio variance considering the Co-movement between securities due to change in the market index first we shall compute the Beta of the portfolio is as follows:

$$0.20 \times 0.40 + 0.50 \times 0.50 + 0.30 \times 1.10 = 0.66$$

Then we shall compute the Residual Variance by separating the Systematic Risk from total risk as follows:

Systematic Risk of each security shall be computed as follows:

$$\beta_A^2 \times \sigma_M^2 = (0.40)^2(0.01) = 0.0016$$

$$\beta_B^2 \times \sigma_M^2 = (0.50)^2(0.01) = 0.0025$$

$$\beta_C^2 \times \sigma_M^2 = (1.10)^2(0.01) = 0.0121$$

The Residual Variance of each security

A $0.015 - 0.0016 = 0.0134$

B $0.025 - 0.0025 = 0.0225$

C $0.100 - 0.0121 = 0.0879$

Then Portfolio variance shall be computed using Sharpe Index Model as follows:

Systematic Variance of Portfolio $= (0.66)^2 \times (0.01) = 0.004356$

Unsystematic Variance of Portfolio $= 0.0134 \times (0.20)^2 + 0.0225 \times (0.50)^2 + 0.0879 \times (0.30)^2$
 $= 0.014072$

Total Variance $= 0.004356 + 0.014072$
 $= 0.018428$

Question 43: SSEI CW Book Page No. 59

Following are risk and return estimates for two stocks

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 expected return, standard deviation of expected return of the portfolio?

(Source: ICAI)

ANSWER:

- i. Total Risk = Systematic Risk + Unsystematic Risk

Stock A

$$\text{Systematic Risk} = \beta^2 \sigma_m^2 = (0.8)^2 \times (25)^2 = 400$$

$$\text{Unsystematic Risk} = 35^2$$

$$\text{Total Risk} = \sigma = \sqrt{400 + (35)^2} = \sqrt{1625} = 40.31\%$$

Stock B

$$\text{Systematic Risk} = \beta^2 \sigma_m^2 = (1.2)^2 \times (25)^2 = 900$$

$$\text{Unsystematic Risk} = 45^2$$

$$\text{Total risk} = \sigma = \sqrt{900 + (45)^2} = \sqrt{2925} = 54.08\%$$

- ii. **Expected return of the portfolio**

$$(0.25 \times 14) + (0.40 \times 18) + (0.35 \times 6) = 12.8\%$$

$$\text{Total Risk} = \text{Systematic Risk} + \text{Unsystematic Risk}$$

$$\text{Systematic Risk } \beta p^2 \sigma_m^2$$

$$\beta p = 0.25 (0.8) + 0.4 (1.2) + 0.35 (0) = 0.2 + 0.48 + 0 = 0.68$$

$$\text{Systematic Risk of Portfolio} = \sqrt{(0.68)^2 \times (25)^2} = \sqrt{289}$$

$$\text{Non-systematic Risk of Portfolio}$$

$$= (0.25)^2 (35)^2 + (0.40)^2 (45)^2 + 0 = 76.56 + 324 = \sqrt{400.56}$$

$$\text{Total Risk} = \sqrt{289 + 400.56} = 26.26$$

Question 44: SSEI CW Book Page No. 59

The following details are given for X and Y companies' stocks and the Bombay Sensex for a period of one year. Calculate the systematic and unsystematic risk for the companies' stocks. If equal amount of money is allocated for the stocks what would be the portfolio risk?

	X Stock	Y Stock	Sensex
Average return	0.15	0.25	0.06
Variance of return	6.30	5.86	2.25
β	0.71	0.685	
Correlation Co-efficient	0.424		
Co-efficient of determination (r^2)	0.18		

(Source: ICAI)

ANSWER:

The co-efficient of determination (r^2) i.e. square of Coefficient of Correlation gives the percentage of the variation in the security's return that is explained by the variation of the market index return. In the X company stock return, 18 per cent of variation is explained by the variation of the index and 82 per cent is not explained by the index.

According to Sharpe, the variance explained by the index is the systematic risk. The unexplained variance or the residual variance is the unsystematic risk.

Company X:

$$\begin{aligned} \text{Systematic risk} &= \beta_i^2 \times \text{Variance of market index} \\ &= (0.71)^2 \times 2.25 = 1.134 \end{aligned}$$

$$\begin{aligned} \text{Unsystematic risk}(\epsilon_i^2) &= \text{Total variance of security return} - \text{Systematic Risk} \\ &= 6.30 - 1.134 \\ &= 5.166 \end{aligned}$$

or

$$\begin{aligned} &= \text{Variance of Security Return} (1-r^2) \\ &= 6.30 \times (1-0.18) = 6.3 \times 0.82 = 5.166 \end{aligned}$$

$$\begin{aligned} \text{Total risk} &= \beta_i^2 \times \sigma_m^2 + \epsilon_i^2 \\ &= \text{Systematic Risk} + \text{Unsystematic Risk} \\ &= 1.134 + 5.166 = 6.30 \end{aligned}$$

Company Y:

$$\begin{aligned} \text{Systematic risk} &= \beta_i^2 \times \sigma_m^2 \\ &= (0.685)^2 \times 2.25 = 1.056 \end{aligned}$$

$$\begin{aligned} \text{Unsystematic risk} &= \text{Total variance of the security return} - \text{systematic risk.} \\ &= 5.86 - 1.056 = 4.804 \end{aligned}$$

Portfolio Risk

$$\begin{aligned} \sigma_p^2 &= \left[\left(\sum_{i=1}^N X_i \beta_i \right)^2 \sigma_m^2 \right] + \left[\left(\sum_{i=1}^N X_i^2 \epsilon_i^2 \right) \right] \\ &= [(0.5 \times 0.71 + 0.5 \times 0.685)^2 \times 2.25] + [(0.5)^2(5.166) + (0.5)^2(4.804)] \\ &= [(0.355 + 0.3425)^2 \times 2.25] + [(1.292 + 1.201)] \\ &= 1.0946 + 2.493 = 3.5876 \end{aligned}$$