

Portfolio Theory

Question 1

- (a) *What sort of investor normally views the variance (or Standard Deviation) of an individual security's return as the security's proper measure of risk?*
- (b) *What sort of investor rationally views the beta of a security as the security's proper measure of risk? In answering the question, explain the concept of beta.*

(3 + 7 Marks) (May 2004)

Answer

- (a) A rational risk-averse investor views the variance (or standard deviation) of her portfolio's return as the proper risk of her portfolio. If for some reason or another the investor can hold only one security, the variance of that security's return becomes the variance of the portfolio's return. Hence, the variance of the security's return is the security's proper measure of risk.

While risk is broken into diversifiable and non-diversifiable segments, the market generally does not reward for diversifiable risk since the investor himself is expected to diversify the risk himself. However, if the investor does not diversify he cannot be considered to be an efficient investor. The market, therefore, rewards an investor only for the non-diversifiable risk. Hence, the investor needs to know how much non-diversifiable risk he is taking. This is measured in terms of beta.

An investor therefore, views the beta of a security as a proper measure of risk, in evaluating how much the market reward him for the non-diversifiable risk that he is assuming in relation to a security. An investor who is evaluating the non-diversifiable element of risk, that is, extent of deviation of returns viz-a-viz the market therefore consider beta as a proper measure of risk.

- (b) If an individual holds a diversified portfolio, she still views the variance (or standard deviation) of her portfolios return as the proper measure of the risk of her portfolio. However, she is no longer interested in the variance of each individual security's return. Rather she is interested in the contribution of each individual security to the variance of the portfolio.

Under the assumption of homogeneous expectations, all individuals hold the market

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portfolio. Thus, we measure risk as the contribution of an individual security to the variance of the market portfolio. The contribution when standardized properly is the beta of the security. While a very few investors hold the market portfolio exactly, many hold reasonably diversified portfolio. These portfolios are close enough to the market portfolio so that the beta of a security is likely to be a reasonable measure of its risk.

In other words, beta of a stock measures the sensitivity of the stock with reference to a broad based market index like BSE sensex. For example, a beta of 1.3 for a stock would indicate that this stock is 30 per cent riskier than the sensex. Similarly, a beta of a 0.8 would indicate that the stock is 20 per cent (100 – 80) less risky than the sensex. However, a beta of one would indicate that the stock is as risky as the stock market index.

Question 2

Distinguish between 'Systematic risk' and 'Unsystematic risk'. (4 Marks)(November 2004)

Answer

Systematic risk refers to the variability of return on stocks or portfolio associated with changes in return on the market as a whole. It arises due to risk factors that affect the overall market such as changes in the nations' economy, tax reform by the Government or a change in the world energy situation. These are risks that affect securities overall and, consequently, cannot be diversified away. This is the risk which is common to an entire class of assets or liabilities. The value of investments may decline over a given time period simply because of economic changes or other events that impact large portions of the market. Asset allocation and diversification can protect against systematic risk because different portions of the market tend to underperform at different times. This is also called market risk.

Unsystematic risk however, refers to risk unique to a particular company or industry. It is avoidable through diversification. This is the risk of price change due to the unique circumstances of a specific security as opposed to the overall market. This risk can be virtually eliminated from a portfolio through diversification.

Question 3

Briefly explain the objectives of "Portfolio Management". (6 Marks) (May 2006)

Answer

Objectives of Portfolio Management

Portfolio management is concerned with efficient management of portfolio investment in financial assets, including shares and debentures of companies. The management may be by professionals or others or by individuals themselves. A portfolio of an individual or a corporate unit is the holding of securities and investment in financial assets. These holdings are the result of individual preferences and decisions regarding risk and return.

The investors would like to have the following objectives of portfolio management:

- (a) Capital appreciation.
- (b) Safety or security of an investment.
- (c) Income by way of dividends and interest.
- (d) Marketability.
- (e) Liquidity.
- (f) Tax Planning - Capital Gains Tax, Income tax and Wealth Tax.
- (g) Risk avoidance or minimization of risk.
- (h) Diversification, i.e. combining securities in a way which will reduce risk.

It is necessary that all investment proposals should be assessed in terms of income, capital appreciation, liquidity, safety, tax implication, maturity and marketability i.e., saleability (i.e., saleability of securities in the market). The investment strategy should be based on the above objectives after a thorough study of goals of the investor, market situation, credit policy and economic environment affecting the financial market.

The portfolio management is a complex task. Investment matrix is one of the many approaches which may be used in this connection. The various considerations involved in investment decisions are liquidity, safety and yield of the investment. Image of the organization is also to be taken into account. These considerations may be taken into account and an overall view obtained through a matrix approach by allotting marks for each consideration and totaling them.

Question 4

Discuss the various kinds of Systematic and Unsystematic risk? (6 Marks) (November 2006)

Answer

There are two types of Risk - Systematic (or non-diversifiable) and unsystematic (or diversifiable) relevant for investment - also, called as general and specific risk.

Types of Systematic Risk

- (i) *Market risk:* Even if the earning power of the corporate sector and the interest rate structure remain more or less unchanged prices of securities, equity shares in particular, tend to fluctuate. Major cause appears to be the changing psychology of the investors. The irrationality in the security markets may cause losses unrelated to the basic risks. These losses are the result of changes in the general tenor of the market and are called market risks.
- (ii) *Interest Rate Risk:* The change in the interest rate has a bearing on the welfare of the investors. As the interest rate goes up, the market price of existing fixed income securities falls and vice versa. This happens because the buyer of a fixed income security would not buy it at its par value or face value if its fixed interest rate is lower than the prevailing interest rate on a similar security.

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- (iii) *Social or Regulatory Risk*: The social or regulatory risk arises, where an otherwise profitable investment is impaired as a result of adverse legislation, harsh regulatory climate, or in extreme instance nationalization by a socialistic government.
- (iv) *Purchasing Power Risk*: Inflation or rise in prices lead to rise in costs of production, lower margins, wage rises and profit squeezing etc. The return expected by investors will change due to change in real value of returns.

Classification of Unsystematic Risk

- (i) *Business Risk*: As a holder of corporate securities (equity shares or debentures) one is exposed to the risk of poor business performance. This may be caused by a variety of factors like heightened competition, emergence of new technologies, development of substitute products, shifts in consumer preferences, inadequate supply of essential inputs, changes in governmental policies and so on. Often of course the principal factor may be inept and incompetent management.
- (ii) *Financial Risk*: This relates to the method of financing, adopted by the company, high leverage leading to larger debt servicing problem or short term liquidity problems due to bad debts, delayed receivables and fall in current assets or rise in current liabilities.
- (iii) *Default Risk*: Default risk refers to the risk accruing from the fact that a borrower may not pay interest and/or principal on time. Except in the case of highly risky debt instrument, investors seem to be more concerned with the perceived risk of default rather than the actual occurrence of default. Even though the actual default may be highly unlikely, they believe that a change in the perceived default risk of a bond would have an immediate impact on its market price.

Question 5

Discuss the Capital Asset Pricing Model (CAPM) and its relevant assumptions.

(5 Marks) (November 2008) (M)

or Write a short note on assumptions of CAPM.

(3 Marks) (May 2006)

Answer

Capital Asset Pricing Model: The mechanical complexity of the Markowitz's portfolio model kept both practitioners and academics away from adopting the concept for practical use. Its intuitive logic, however, spurred the creativity of a number of researchers who began examining the stock market implications that would arise if all investors used this model. As a result what is referred to as the Capital Asset Pricing Model (CAPM), was developed.

The Capital Asset Pricing Model was developed by Sharpe, Mossin and Linter in 1960. The model explains the relationship between the expected return, non diversifiable risk and the valuation of securities. It considers the required rate of return of a security on the basis of its contribution to the total risk. It is based on the premises that the diversifiable risk of a security is eliminated when more and more securities are added to the portfolio. However, the systematic risk cannot be diversified and

is or related with that of the market portfolio. All securities do not have same level of systematic risk. The systematic risk can be measured by beta, β under CAPM, the expected return from a security can be expressed as:

$$\text{Expected return on security} = R_f + \text{Beta} (R_m - R_f)$$

The model shows that the expected return of a security consists of the risk-free rate of interest and the risk premium. The CAPM, when plotted on the graph paper is known as the Security Market Line (SML). A major implication of CAPM is that not only every security but all portfolios too must plot on SML. This implies that in an efficient market, all securities are expected returns commensurate with their riskiness, measured by β .

Relevant Assumptions of CAPM

- (i) The investor's objective is to maximize the utility of terminal wealth;
- (ii) Investors make choices on the basis of risk and return;
- (iii) Investors have identical time horizon;
- (iv) Investors have homogeneous expectations of risk and return;
- (v) Information is freely and simultaneously available to investors;
- (vi) There is risk-free asset, and investor can borrow and lend unlimited amounts at the risk-free rate;
- (vii) There are no taxes, transaction costs, restrictions on short rates or other market imperfections;
- (viii) Total asset quantity is fixed, and all assets are marketable and divisible.

Thus, CAPM provides a conceptual frame work for evaluating any investment decision where capital is committed with a goal of producing future returns. However, there are certain limitations of the theory. Some of these limitations are as follows:

- (i) **Reliability of Beta:** Statistically reliable Beta might not exist for shares of many firms. It may not be possible to determine the cost of equity of all firms using CAPM. All shortcomings that apply to Beta value apply to CAPM too.
- (ii) **Other Risks:** It emphasis only on systematic risk while unsystematic risks are also important to share holders who do not possess a diversified portfolio.
- (iii) **Information Available:** It is extremely difficult to obtain important information on risk-free interest rate and expected return on market portfolio as there are multiple risk-free rates for one while for another, markets being volatile it varies over time period.

Question 6

Explain briefly the capital Asset pricing model used in the context of valuation of securities.
(5 Marks) (November 2008) (M)

Answer

Portfolio theories have undergone major changes over the years. The current standard in

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valuation theory is found in the CAPM. It is an economic model that describes how securities are priced in the market. Its major merit lies in recognizing the difference or distinction between risk of holding a single asset and holding a portfolio.

The CAPM formula:

$$E(R_p) = R_f + \beta_p [E(R_m) - R_f]$$

Where:

$E(R_p)$ = Expected return of portfolio

R_f = Risk free rate of Return

β_p = Portfolio Beta

$E(R_m)$ = Expected return on Market portfolio

The CAPM formula is based on certain assumptions regarding rationality and homogeneity of investors etc. and is subjected to criticism on this score.

Question 7

Discuss how the risk associated with securities is effected by Government policy.

(4 Marks) (May 2011)

Answer

The risk from Government policy to securities can be impacted by any of the following factors.

- (i) Licensing Policy
- (ii) Restrictions on commodity and stock trading in exchanges
- (iii) Changes in FDI and FII rules.
- (iv) Export and import restrictions
- (v) Restrictions on shareholding in different industry sectors
- (vi) Changes in tax laws and corporate and Securities laws.

Question 8

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.

(8 Marks) (November 2009) (M)

Answer

Here, the probable returns have to be calculated using the formula

$$R = \frac{D}{P_0} + \frac{P_1 - P_0}{P_0}$$

Calculation of Probable Returns

Possible prices (P ₁) ₹	P ₁ -P ₀ ₹	[(P ₁ -P ₀)/ P ₀] x 100 Return (per cent)
115	-5	-4.17
120	0	0.00
125	5	4.17
130	10	8.33
135	15	12.50
140	20	16.67

Calculation of Expected Returns

Possible return X _i	Probability p(X _i)	Product X _i -p(X _i)
-4.17	0.1	-0.417
0.00	0.1	0.000
4.17	0.2	0.834
8.33	0.3	2.499
12.50	0.2	2.500
16.67	0.1	1.667
		<u>1.667</u>
		X = <u>7.083</u>

Expected return X = 7.083 per

Calculation of Standard Deviation of Returns

Probable return X _i	Probability p(X _i)	Deviation (X _i - X)	Deviation squared (X _i - X) ²	Product (X _i - X) ² p(X _i)
-4.17	0.1	-11.253	126.63	12.66
0.00	0.1	-7.083	50.17	5.017
4.17	0.2	-2.913	8.49	1.698
8.33	0.3	1.247	1.56	0.467

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12.50	0.2	5.417	29.34	5.869
16.67	0.1	9.587	91.91	<u>9.191</u>
				$\sigma^2 = \underline{34.902}$

Variance, $\sigma^2 = 34.902$ per cent

Standard deviation, $\sigma = \sqrt{34.902} = 5.908$ per cent

Question 9

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.

- 100 percent investment in B only;
- 50 percent of the fund in B and the rest 50 percent in D;
- 75 percent of the fund in B and the rest 25 percent in D; and
- 100 percent investment in D only.

Also indicate that which portfolio is best for him from risk as well as return point of view?

(6 Marks) (November 2008) (M)

Answer

We have $E_p = W_1E_1 + W_2E_2 + \dots + W_nE_n$

and for standard deviation $\sigma_p^2 = \sum_{i=1}^n \sum_{j=1}^n w_i w_j \sigma_{ij}$

$$\sigma_p^2 = \sum_{i=1}^n \sum_{j=1}^n w_i w_j \rho_{ij} \sigma_i \sigma_j$$

Two asset portfolio

$$\sigma_p^2 = w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2 w_1 w_2 \sigma_1 \sigma_2 \rho_{12}$$

Substituting the respective values we get,

- (i) All funds invested in B

$$E_p = 12\%$$

$$\sigma_p = 10\%$$

- (ii) 50% of funds in each of B & D

$$E_p = 0.50 \times 12\% + 0.50 \times 20\% = 16\%$$

$$\sigma_p^2 = (0.50)^2(10\%)^2 + (0.50)^2(18\%)^2 + 2(0.50)(0.50)(0.15)(10\%)(18\%)$$

$$\sigma_p^2 = 25 + 81 + 13.5 = 119.50$$

$$\sigma_p = 10.93\%$$

- (iii) 75% in B and 25% in D

$$E_p = 0.75 \times 12\% + 0.25 \times 20\% = 14\%$$

$$\sigma_p^2 = (0.75)^2(10\%)^2 + (0.25)^2(18\%)^2 + 2(0.75)(0.25)(0.15)(10\%)(18\%)$$

$$\sigma_p^2 = 56.25 + 20.25 + 10.125 = 86.625$$

$$\sigma_p = 9.31\%$$

- (iv) All funds in D

$$E_p = 20\%$$

$$\sigma_p = 18.0\%$$

Portfolio	(i)	(ii)	(iii)	(iv)
Return	12	16	14	20
σ	10	10.93	9.31	18

In the terms of return, we see that portfolio (iv) is the best portfolio. In terms of risk we see that portfolio (iii) is the best portfolio.

Question 10

Consider the following information on two stocks, A and B :

Year	Return on A (%)	Return on B (%)
2006	10	12
2007	16	18

You are required to determine:

- The expected return on a portfolio containing A and B in the proportion of 40% and 60% respectively.
- The Standard Deviation of return from each of the two stocks.
- The covariance of returns from the two stocks.

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- (iv) Correlation coefficient between the returns of the two stocks.
(v) The risk of a portfolio containing A and B in the proportion of 40% and 60%.

(5 Marks) (November 2008) (S), (8 Marks) (November 2010) (S)

Answer

- (i) Expected return of the portfolio A and B

$$E(A) = (10 + 16) / 2 = 13\%$$

$$E(B) = (12 + 18) / 2 = 15\%$$

$$R_p = \sum_{i=1}^N X_i R_i = 0.4(13) + 0.6(15) = 14.2\%$$

- (ii) Stock A:

$$\text{Variance} = 0.5 (10 - 13)^2 + 0.5 (16 - 13)^2 = 9$$

$$\text{Standard deviation} = \sqrt{9} = 3\%$$

Stock B:

$$\text{Variance} = 0.5 (12 - 15)^2 + 0.5 (18 - 15)^2 = 9$$

$$\text{Standard deviation} = 3\%$$

- (iii) Covariance of stocks A and B

$$\text{Cov}_{AB} = 0.5 (10 - 13) (12 - 15) + 0.5 (16 - 13) (18 - 15) = 9$$

- (iv) Correlation of coefficient

$$r_{AB} = \frac{\text{Cov}_{AB}}{\sigma_A \sigma_B} = \frac{9}{3 \times 3} = 1$$

- (v) Portfolio Risk

$$\begin{aligned} \sigma_P &= \sqrt{X_A^2 \sigma_A^2 + X_B^2 \sigma_B^2 + 2X_A X_B (\sigma_A \sigma_B \sigma_{AB})} \\ &= \sqrt{(0.4)^2 (3)^2 + (0.6)^2 (3)^2 + 2(0.4)(0.6)(3)(3)(1)} \\ &= \sqrt{1.44 + 3.24 + 4.32} = 3\% \end{aligned}$$

Question 11

Consider the following information on two stocks X and Y:

Year	Return on X (%)	Return on Y (%)
2008	12	10
2009	18	16

You are required to determine:

- (i) The expected return on a portfolio containing X and Y in the proportion of 60% and 40% respectively.
- (ii) The standard deviation of return from each of the two stocks.
- (iii) The covariance of returns from the two stocks.
- (iv) Correlation co-efficient between the returns of the two stocks.
- (v) The risk of portfolio containing X and Y in the proportion of 60% and 40%.

(8 Marks) (November 2010) (S)

Answer

- (i) Expected return of the portfolio X and Y

$$E(X) = (12 + 18)/2 = 15\%$$

$$E(Y) = (10 + 16)/2 = 13\%$$

$$R_P = 0.6(15) + 0.4(13) = 14.2\%$$

- (ii) Stock X

$$\text{Variance} = \frac{\sum_{t=1}^n (X_t - \bar{X})^2}{N}$$

$$\text{Variance} = 0.5(12 - 15)^2 + 0.5(18 - 15)^2 = 9$$

$$\text{Standard deviation} = \sqrt{9} = 3\%$$

Stock Y

$$\text{Variance} = \frac{\sum_{t=1}^n (Y_t - \bar{Y})^2}{N}$$

$$\text{Variance} = 0.5(10 - 13)^2 + 0.5(16 - 13)^2 = 9$$

$$\text{Standard deviation} = \sqrt{9} = 3\%$$

- (iii) Covariance of Stocks X and Y

$$\text{Covariance} = \frac{\sum_{t=1}^n (X_t - \bar{X})(Y_t - \bar{Y})}{N}$$

$$\text{Cov}_{XY} = 0.5(12 - 15)(10 - 13) + 0.5(18 - 15)(16 - 13) = 9$$

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(iv) Correlation of Coefficient

$$\gamma_{XY} = \frac{\text{COV}_{XY}}{\sigma_X \sigma_Y} = \frac{9}{3 \times 3} = 1$$

(v) Portfolio Risk

$$\begin{aligned}\sigma_P &= \sqrt{(0.6)^2 (3)^2 + (0.4)^2 (3)^2 + 2(0.6)(0.4)(3)(3)(1)} \\ &= \sqrt{3.24 + 1.44 + 4.32} = \sqrt{9} = 3\%\end{aligned}$$

Question 12

The Investment portfolio of a bank is as follows:

Government Bond	Coupon Rate	Purchase rate (F.V. ₹ 100 per Bond)	Duration (Years)
G.O.I. 2006	11.68	106.50	3.50
G.O.I. 2010	7.55	105.00	6.50
G.O.I. 2015	7.38	105.00	7.50
G.O.I. 2022	8.35	110.00	8.75
G.O.I. 2032	7.95	101.00	13.00

Face value of total Investment is ₹ 5 crores in each Government Bond.

Calculate actual Investment in portfolio.

What is a suitable action to churn out investment portfolio in the following scenario?

1. Interest rates are expected to lower by 25 basis points.
2. Interest rates are expected to raise by 75 basis points.

Also calculate the revised duration of investment portfolio in each scenario.

(8 Marks) (November 2005)

Answer**Calculation of Actual investment of Portfolio**

Security	Purchase price	Investment (₹ in lakhs)
GOI 2006	106.50	532.50*
GOI 2010	105.00	525.00
GOI 2015	105.00	525.00
GOI 2022	110.00	550.00
GOI 2032	101.00	505.00
Total		2,637.50

$$* \frac{₹ 5 \text{ crores}}{₹ 100 \times 1,00,000} \times ₹ 106.50$$

$$\text{Average Duration} = \frac{3.5 + 6.5 + 7.5 + 8.75 + 13.00}{5} = \frac{39.25}{5} = 7.85$$

Suitable action to churn out investment portfolio in following scenario is to reduce risk and to maximize profit or minimize losses.

- (1) Interest rates are expected to be lower by 25 basis points in such case increase the average duration by purchasing GOI 2032 and Disposing of GOI 2006.

$$\text{Revised average duration shall be} = \frac{39.25 - 3.5 + 13}{5} = \frac{48.75}{5} = 9.75 \text{ years}$$

- (2) Interest rates are expected to rise by 75 basis points in such case reduce the average duration by (*) Purchasing GOI 2010 and disposing of GOI 2032.

$$\text{Revised average duration shall be} = \frac{39.25 - 13 + 6.5}{5} = \frac{32.75}{5} = 6.55 \text{ years}$$

(*) Purchasing of GOI 2006 is not beneficial as maturity period is very short and 75 basis points is comparatively higher change.

Question 13

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

(10 Marks) (May 2007)

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Answer

Calculation of Covariance

Year	R_1	Deviation ($R_1 - \bar{R}_1$)	Deviation ($R_1 - \bar{R}_1$) ²	R_2	Deviation ($R_2 - \bar{R}_2$)	Deviation ($R_2 - \bar{R}_2$) ²	Product of deviations
1	12	-2.8	7.84	20	-1	1	2.8
2	8	-6.8	46.24	22	1	1	-6.8
3	7	-7.8	60.84	24	3	9	-23.4
4	14	-0.8	0.64	18	-3	9	2.4
5	16	1.2	1.44	15	-6	36	-7.2
6	15	0.2	0.04	20	-1	1	-0.2
7	18	3.2	10.24	24	3	9	9.6
8	20	5.2	27.04	25	4	16	20.8
9	16	1.2	1.44	22	1	1	1.2
10	22	7.2	51.84	20	-1	1	-7.2
$R_1 = \frac{148}{10} = 14.8$		$\Sigma = 207.60$		$R_2 = \frac{210}{10} = 21$		$\Sigma = 84.00$	

$$\text{Covariance} = \frac{\sum_{i=1}^N [R_1 - \bar{R}_1][R_2 - \bar{R}_2]}{N} = -8/10 = -0.8$$

Standard Deviation of Security 1

$$\sigma_1 = \sqrt{\frac{(R_1 - \bar{R}_1)^2}{N}}$$

$$\sigma_1 = \sqrt{\frac{207.60}{10}} = \sqrt{20.76}$$

$$\sigma_1 = 4.56$$

Standard Deviation of Security 2

$$\sigma_2 = \sqrt{\frac{(R_2 - \bar{R}_2)^2}{N}}$$

$$\sigma_2 = \sqrt{\frac{84}{10}} = \sqrt{8.40}$$

$$\sigma_2 = 2.90$$

Alternatively, Standard Deviation of securities can also be calculated as follows:.

Calculation of Standard Deviation

Year	R ₁	R ₁ ²	R ₂	R ₂ ²
1	12	144	20	400
2	8	64	22	484
3	7	49	24	576
4	14	196	18	324
5	16	256	15	225
6	15	225	20	400
7	18	324	24	576
8	20	400	25	625
9	16	256	22	484
10	22	484	20	400
	148	2398	210	4494

Standard deviation of security 1:

$$\begin{aligned}\sigma_1 &= \sqrt{\frac{N \sum R_1^2 - (\sum R_1)^2}{N^2}} \\ &= \sqrt{\frac{(10 \times 2398) - (148)^2}{10 \times 10}} = \sqrt{\frac{23980 - 21904}{100}} \\ &= \sqrt{20.76} = 4.56\end{aligned}$$

Standard deviation of security 2:

$$\begin{aligned}\sigma_2 &= \sqrt{\frac{N \sum R_2^2 - (\sum R_2)^2}{N^2}} \\ &= \sqrt{\frac{(10 \times 4494) - (210)^2}{10 \times 10}} = \sqrt{\frac{44940 - 44100}{100}} \\ &= \sqrt{\frac{840}{100}} = \sqrt{8.4} = 2.90\end{aligned}$$

Correlation Coefficient

$$r_{12} = \frac{\text{Cov}}{\sigma_1 \sigma_2} = \frac{-0.8}{4.56 \times 2.90} = \frac{-0.8}{13.22} = -0.0605$$

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Question 14

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

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

You are required to

- Comment on return and risk of investment in individual shares.
- Compare the risk and return of these two shares with a Portfolio of these shares in equal proportions.
- Find out the proportion of each of the above shares to formulate a minimum risk portfolio.

(16 Marks) (November 2010) (M)

Answer

(i)

Probability	ABC (%)	XYZ (%)	1X2 (%)	1X3 (%)
(1)	(2)	(3)	(4)	(5)
0.20	12	16	2.40	3.2
0.25	14	10	3.50	2.5
0.25	-7	28	-1.75	7.0
0.30	28	-2	<u>8.40</u>	<u>-0.6</u>
Average return			<u>12.55</u>	<u>12.1</u>

Hence the expected return from ABC = 12.55% and XYZ is 12.1%

Probability	(ABC- ABC)	(ABC- ABC) ²	1X3	(XYZ- XYZ)	(XYZ- XYZ) ²	(1)X(6)
(1)	(2)	(3)	(4)	(5)	(6)	
0.20	-0.55	0.3025	0.06	3.9	15.21	3.04
0.25	1.45	2.1025	0.53	-2.1	4.41	1.10
0.25	-19.55	382.2025	95.55	15.9	252.81	63.20
0.30	15.45	238.7025	<u>71.61</u>	-14.1	198.81	<u>59.64</u>
			<u>167.75</u>			<u>126.98</u>

$$\sigma^2_{ABC} = 167.75(\%)^2 ; \sigma_{ABC} = 12.95\%$$

$$\sigma^2_{XYZ} = 126.98(\%)^2 ; \sigma_{XYZ} = 11.27\%$$

- (ii) In order to find risk of portfolio of two shares, the covariance between the two is necessary here.

Probability	(ABC- $\overline{ABC}$)	(XYZ- $\overline{XYZ}$)	2X3	1X4
(1)	(2)	(3)	(4)	(5)
0.20	-0.55	3.9	-2.145	-0.429
0.25	1.45	-2.1	-3.045	-0.761
0.25	-19.55	15.9	-310.845	-77.71
0.30	15.45	-14.1	-217.845	-65.35
				<u>-144.25</u>

$$\sigma^2_P = (0.5^2 \times 167.75) + (0.5^2 \times 126.98) + 2 \times (-144.25) \times 0.5 \times 0.5$$

$$\sigma^2_P = 41.9375 + 31.745 - 72.125$$

$$\sigma^2_P = 1.5575 \text{ or } 1.56(\%)$$

$$\sigma_P = \sqrt{1.56} = 1.25\%$$

$$E(R_p) = (0.5 \times 12.55) + (0.5 \times 12.1) = 12.325\%$$

Hence, the return is 12.325% with the risk of 1.25% for the portfolio. Thus the portfolio results in the reduction of risk by the combination of two shares.

- (iii) For constructing the minimum risk portfolio the condition to be satisfied is

$$X_{ABC} = \frac{\sigma_X^2 - r_{AX}\sigma_A\sigma_X}{\sigma_A^2 + \sigma_X^2 - 2r_{AX}\sigma_A\sigma_X} \text{ or } = \frac{\sigma_X^2 - \text{Cov.}_{AX}}{\sigma_A^2 + \sigma_X^2 - 2\text{Cov.}_{AX}}$$

σ_X = Std. Deviation of XYZ

σ_A = Std. Deviation of ABC

r_{AX} = Coefficient of Correlation between XYZ and ABC

Cov._{AX} = Covariance between XYZ and ABC.

Therefore,

$$\% \text{ ABC} = \frac{126.98 - (-144.25)}{126.98 + 167.75 - [2 \times (-144.25)]} = \frac{271.23}{583.23} = 0.46 \text{ or } 46\%$$

$$\% \text{ ABC} = 46\%, \text{ XYZ} = 54\%$$

$$(1 - 0.46) = 0.54$$

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Question 15

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

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

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.

(8 Marks) (May 2006)

Answer

Security F

Prob(P)	R _f	PxR _f	Deviations of F (R _f – ER _f)	(Deviation) ² of F	(Deviations) ² P _x
0.3	30	9	13	169	50.7
0.4	20	8	3	9	3.6
0.3	0	0	-17	289	86.7
		ER _f =17			Var _f =141

$$\text{STDEV } \sigma_f = \sqrt{141} = 11.87$$

Market Portfolio, P

R _M %	P _M	Exp. Return R _M x P _M	Dev. of P (R _M -ER _M)	(Dev. of P) ²	(Dev. of P) ² P _M	(Deviation of F) x (Deviation of P)	Dev. of F x Dev. of P) x P
-10	0.3	-3	-24	576	172.8	-312	-93.6
20	0.4	8	6	36	14.4	18	7.2
30	0.3	9	16	256	76.8	-272	-81.6
		ER _M =14			Var _M =264 σ _M =16.25		=Co Var P _M =- 168

$$\text{Beta} = \frac{\text{Co Var P}_M}{\sigma_M^2} = \frac{-168}{264} = -.636$$

Question 16

Given below is information of market rates of Returns and Data from two Companies A and B:

	Year 2002	Year 2003	Year 2004
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.
(4 Marks) (November 2004)

Answer**Company A:**

Year	Return % (Ra)	Market return % (Rm)	Deviation R(a)	Deviation Rm	D Ra × DRm	Rm ²
1	13.0	12.0	1.57	1.33	2.09	1.77
2	11.5	11.0	0.07	0.33	0.02	0.11
3	<u>9.8</u>	<u>9.0</u>	-1.63	-1.67	<u>2.72</u>	<u>2.79</u>
	<u>34.3</u>	<u>32.0</u>			<u>4.83</u>	<u>4.67</u>

Average Ra = 11.43

Average Rm = 10.67

$$\text{Covariance} = \frac{\sum (R_m - \bar{R}_m)(R_a - \bar{R}_a)}{N}$$

$$\text{Covariance} = \frac{4.83}{3} = 1.61$$

$$\text{Variance } (\sigma_m^2) = \frac{\sum (R_m - \bar{R}_m)^2}{N}$$

$$= \frac{4.67}{3} = 1.557$$

$$\beta = \frac{1.61}{1.557} = 1.03$$

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Company B:

Year	Return % (R _b)	Market return % (R _m)	Deviation R(b)	Deviation R _m	D R _b × D R _m	R _m ²
1	11.0	12.0	0.67	1.33	0.89	1.77
2	10.5	11.0	0.17	0.33	0.06	0.11
3	<u>9.5</u>	<u>9.0</u>	-0.83	-1.67	<u>1.39</u>	<u>2.79</u>
	<u>31.0</u>	<u>32.0</u>			<u>2.34</u>	<u>4.67</u>

Average R_b = 10.33

Average R_m = 10.67

$$\text{Covariance} = \frac{\sum (R_m - \bar{R}_m)(R_b - \bar{R}_b)}{N}$$

$$\text{Covariance} = \frac{2.34}{3} = 0.78$$

$$\text{Variance } (\sigma_m^2) = \frac{\sum (R_m - \bar{R}_m)^2}{N}$$

$$= \frac{4.67}{3} = 1.557$$

$$\beta = \frac{0.78}{1.557} = 0.50$$

Question 17

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

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:

- Characteristic line for stock A
- The systematic and unsystematic risk of stock A.

(8 Marks) (June 2009) (S)

Answer

Characteristic line is given by

$$\alpha + \beta R_m$$

$$\beta_i = \frac{\sum xy - n \bar{x} \bar{y}}{\sum x^2 - n(\bar{x})^2}$$

$$\alpha_i = \bar{y} - \beta \bar{x}$$

Return on A (Y)	Return on market (X)	xy	x ²	(x - $\bar{x}$)	(x - $\bar{x}$) ²	(y - $\bar{y}$)	(y - $\bar{y}$) ²
12	8	96	64	2.25	5.06	5.67	32.15
15	12	180	144	6.25	39.06	8.67	75.17
11	11	121	121	5.25	27.56	4.67	21.81
2	-4	-8	16	-9.75	95.06	-4.33	18.75
10	9.5	95	90.25	3.75	14.06	3.67	13.47
<u>-12</u>	<u>-2</u>	<u>24</u>	<u>4</u>	<u>-7.75</u>	<u>60.06</u>	<u>-18.33</u>	<u>335.99</u>
38	34.5	508	439.25		240.86		497.34

$$\bar{y} = \frac{38}{6} = 6.33$$

$$\bar{x} = \frac{34.5}{6} = 5.75$$

$$\begin{aligned} \beta &= \frac{\sum xy - n \bar{x} \bar{y}}{\sum x^2 - n(\bar{x})^2} = \frac{508 - 6(5.75)(6.33)}{439.25 - 6(5.75)^2} = \frac{508 - 218.385}{439.25 - 198.375} \\ &= \frac{289.615}{240.875} = 1.202 \end{aligned}$$

$$\alpha = \bar{y} - \beta \bar{x} = 6.33 - 1.202(5.75) = -0.58$$

Hence the characteristic line is $-0.58 + 1.202(R_m)$

$$\text{Total Risk of Market} = \sigma_{m^2} = \frac{\sum (x - \bar{x})^2}{n} = \frac{240.86}{6} = 40.14(\%)$$

$$\text{Total Risk of Stock} = \frac{497.34}{6} = 82.89(\%)$$

$$\text{Systematic Risk} = \beta_i^2 \sigma_2 = (1.202)^2 \times 40.14 = 57.99(\%)$$

$$\begin{aligned} \text{Unsystematic Risk is} &= \text{Total Risk} - \text{Systematic Risk} \\ &= 82.89 - 57.99 = 24.90(\%) \end{aligned}$$

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Question 18

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? **(10 Marks) (November 2003)**

Answer

(i)

Period	R_X	R_M	$R_X - \bar{R}_X$	$R_M - \bar{R}_M$	$(R_X - \bar{R}_X)(R_M - \bar{R}_M)$	$(R_M - \bar{R}_M)^2$
1	20	22	5	10	50	100
2	22	20	7	8	56	64
3	25	18	10	6	60	36
4	21	16	6	4	24	16
5	18	20	3	8	24	64
6	-5	8	-20	-4	80	16
7	17	-6	2	-18	-36	324
8	19	5	4	-7	-28	49
9	-7	6	-22	-6	132	36
10	<u>20</u>	<u>11</u>	5	-1	<u>-5</u>	<u>1</u>
	150	120			357	706
	ΣR_X	ΣR_M			$\Sigma (R_X - \bar{R}_X)(R_M - \bar{R}_M)$	$\Sigma (R_M - \bar{R}_M)^2$

$$\bar{R}_X = 15 \quad \bar{R}_M = 12$$

$$\sigma^2_M = \frac{\sum (R_M - \bar{R}_M)^2}{n} = \frac{706}{10} = 70.60$$

$$\text{Cov}_{XM} = \frac{\sum (R_X - \bar{R}_X)(R_M - \bar{R}_M)}{n} = \frac{357}{10} = 35.70$$

$$\text{Beta}_X = \frac{\text{Cov}_{XM}}{\sigma^2_M} = \frac{35.70}{70.60} = 0.505$$

(ii) $\bar{R}_X = 15$ $\bar{R}_M = 12$

$$y = \alpha + \beta x$$

$$15 = \alpha + 0.505 \times 12$$

$$\begin{aligned} \text{Alpha } (\alpha) &= 15 - (0.505 \times 12) \\ &= 8.94\% \end{aligned}$$

Characteristic line for security X = $\alpha + \beta \times R_M$

Where, R_M = Expected return on Market Index

$\therefore$ Characteristic line for security X = $8.94 + 0.505 R_M$

Question 19

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) Which of three securities will be selected?
- (ii) Assuming perfect correlation, analyse whether it is preferable to invest 80% in security U and 20% in security W or to invest 100% in Y. **(6 Marks) (May 2004)**

Answer

- (i) When we make risk-return analysis of different securities from U to Z, we can observe that security U gives a return of 10% at risk level of 5%. Simultaneously securities V and Z give the same return of 10% as of security U, but their risk levels are 6% and 7% respectively. Security X is giving only 5% return for the risk rate of 5%. Hence, security U dominates securities V, X and Z.

Securities W and Y offer more return but it carries higher level of risk.

Hence securities U, W and Y can be selected based on individual preferences.

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- (ii) In a situation where the perfect positive correlation exists between two securities, their risk and return can be averaged with the proportion.

Assuming the perfect correlation exists between the securities U and W, average risk and return of U and W together for proportion 4 : 1 is calculated as follows:

$$\text{Risk} = (4 \times 5\% + 1 \times 13\%) \div 5 = 6.6\%$$

$$\text{Return} = (4 \times 10\% + 1 \times 15\%) \div 5 = 11\%$$

Therefore:	80% U	100% Y
	20% V	—
Risk	6.6%	6%
Return	11%	11%

When we compare risk of 6.6% and return of 11% with security Y with 6% risk and 11% return, security Y is preferable over the portfolio of securities U and W in proportion of 4 : 1

Question 20

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%

You are required to calculate:

- The Betas of the two stocks.
- Expected return of each stock, if the market return is equally likely to be 7% or 25%.
- The Security Market Line (SML), if the risk free rate is 7.5% and market return is equally likely to be 7% or 25%.
- The Alphas of the two stocks.

(8 Marks) (May 2007)

Answer

- (a) The Betas of two stocks:

$$\text{Aggressive stock} \quad - \quad 40\% - 4\% / 25\% - 7\% = 2$$

$$\text{Defensive stock} \quad - \quad 18\% - 9\% / 25\% - 7\% = 0.50$$

- (b) Expected returns of the two stocks:-

$$\text{Aggressive stock} \quad - \quad 0.5 \times 4\% + 0.5 \times 40\% = 22\%$$

$$\text{Defensive stock} \quad - \quad 0.5 \times 9\% + 0.5 \times 18\% = 13.5\%$$

- (c) Expected return of market portfolio = $0.5 \times 7\% + 0.5 \times 25\% = 16\%$

$\therefore$ Market risk prem. = $16\% - 7.5\% = 8.5\%$

$\therefore$ SML is, required return = $7.5\% + \beta_i 8.5\%$

(d) $R_s = \alpha + \beta R_m$

Where

α = Alpha

β = Beta

R_m = Market Return

For Aggressive Stock

$22\% = \alpha_A + 2(16\%)$

$\alpha_A = -10\%$

For Defensive Stock

$13.5\% = \alpha_D + 0.50(16\%)$

$\alpha_D = 5.5\%$

Question 21

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) ?

(8 Marks) (November 2009) (S)

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 = σ_i / σ_m

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

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

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

(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 $\beta_p^2 \sigma_m^2 = (0.8467)^2 (15)^2 = 161.302$

Unsystematic Risk = Total Risk – Systematic Risk
 $= 200.244 - 161.302 = 38.942$

Question 22

Mr. X owns a portfolio with the following characteristics:

	Security A	Security B	Risk Free security
Factor 1 sensitivity	0.80	1.50	0
Factor 2 sensitivity	0.60	1.20	0
Expected Return	15%	20%	10%

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

- If Mr. X has ₹ 1,00,000 to invest and sells short ₹ 50,000 of security B and purchases ₹ 1,50,000 of security A what is the sensitivity of Mr. X's portfolio to the two factors?
- If Mr. X 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 A and B in the same proportion as described in part (i), what is the sensitivity of the portfolio to the two factors?
- What is the expected return premium of factor 2? **(8 Marks) (June 2009) (S)**

Answer

- Mr. X's position in the two securities are +1.50 in security A and -0.5 in security B. Hence

the portfolio sensitivities to the two factors:-

$$b \text{ prop. 1} = 1.50 \times 0.80 + (-0.50 \times 1.50) = 0.45$$

$$b \text{ prop. 2} = 1.50 \times 0.60 + (-0.50 \times 1.20) = 0.30$$

(ii) Mr. X's current position:-

$$\text{Security A} \quad ₹ 3,00,000 / ₹ 1,00,000 = 3$$

$$\text{Security B} \quad -₹ 1,00,000 / ₹ 1,00,000 = -1$$

$$\text{Risk free asset} \quad -₹ 100,000 / ₹ 100,000 = -1$$

$$b \text{ prop. 1} = 3.0 \times 0.80 + (-1 \times 1.50) + (-1 \times 0) = 0.90$$

$$b \text{ prop. 2} = 3.0 \times 0.60 + (-1 \times 1.20) + (-1 \times 0) = 0.60$$

(iii) The portfolio created in part (ii) is a pure factor 2 portfolio.

Expected return on the portfolio in part (b) is:

$$R_p = 3 \times 0.15 + (-1) \times 0.20 + (-1) \times 0.10$$

$$= 0.15 \text{ i.e. } 15\%$$

$$\therefore \text{Expected return premium} = 15\% - 10\% = 5\%$$

Question 23

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.

(5 Marks) (May 2011)

Answer

$$\text{Market Risk Premium (A)} = 14\% - 7\% = 7\%$$

Share	Beta	Risk Premium (Beta x A) %	Risk Free Return %	Return %	Return ₹
Oxy Rin Ltd.	0.45	3.15	7	10.15	8,120
Boxed Ltd.	0.35	2.45	7	9.45	14,175

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Square Ltd.	1.15	8.05	7	15.05	33,863
Ellipse Ltd.	1.85	12.95	7	19.95	89,775
Total Return					<u>1,45,933</u>

Total Investment ₹ 9,05,000

$$(i) \text{ Portfolio Return} = \frac{\text{₹ } 1,45,933}{\text{₹ } 9,05,000} \times 100 = 16.13\%$$

(ii) Portfolio Beta

Portfolio Return = Risk Free Rate + Risk Premium $\times \beta = 16.13\%$

$$7\% + 7\beta = 16.13\%$$

$$\beta = 1.30$$

Alternative Approach

First we shall compute Portfolio Beta using the weighted average method as follows:

$$\begin{aligned} \text{Beta}_P &= 0.45 \times \frac{0.80}{9.05} + 0.35 \times \frac{1.50}{9.05} + 1.15 \times \frac{2.25}{9.05} + 1.85 \times \frac{4.50}{9.05} \\ &= 0.45 \times 0.0884 + 0.35 \times 0.1657 + 1.15 \times 0.2486 + 1.85 \times 0.4972 = 0.0398 + 0.058 + 0.2859 + 0.9198 = 1.3035 \end{aligned}$$

Accordingly,

(i) Portfolio Return using CAPM formula will be as follows:

$$\begin{aligned} R_P &= R_F + \text{Beta}_P(R_M - R_F) \\ &= 7\% + 1.3035(14\% - 7\%) = 7\% + 1.3035(7\%) \\ &= 7\% + 9.1245\% = 16.1245\% \end{aligned}$$

(ii) Portfolio Beta

As calculated above 1.3035

Question 24

Amal Ltd. has been maintaining a growth rate of 12% in dividends. The company has paid dividend @ ₹ 3 per share. The rate of return on market portfolio is 15% and the risk-free rate of return in the market has been observed as 10%. The beta co-efficient of the company's share is 1.2.

You are required to calculate the expected rate of return on the company's shares as per CAPM model and the equilibrium price per share by dividend growth model.

(5 Marks) (November 2010) (S)

Answer

Capital Asset Pricing Model (CAPM) formula for calculation of expected rate of return is

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

E_R = Expected Return

β = Beta of Security

R_m = Market Return

R_f = Risk free Rate

$$= 10 + [1.2 (15 - 10)]$$

$$= 10 + 1.2 (5)$$

$$= 10 + 6 = 16\% \text{ or } 0.16$$

Applying dividend growth mode for the calculation of per share equilibrium price:-

$$E_R = \frac{D_1}{P_0} + g$$

$$\text{or } 0.16 = \frac{3(1.12)}{P_0} + 0.12 \quad \text{or} \quad 0.16 - 0.12 = \frac{3.36}{P_0}$$

$$\text{or } 0.04 P_0 = 3.36 \quad \text{or} \quad P_0 = \frac{3.36}{0.04} = ₹ 84$$

Therefore, equilibrium price per share will be ₹ 84.

Question 25

The risk free rate of return R_f is 9 percent. The expected rate of return on the market portfolio R_m is 13 percent. The expected rate of growth for the dividend of Platinum Ltd. is 7 percent. The last dividend paid on the equity stock of firm A was ₹ 2.00. The beta of Platinum Ltd. equity stock is 1.2.

(i) What is the equilibrium price of the equity stock of Platinum Ltd.?

(ii) How would the equilibrium price change when

- The inflation premium increases by 2 percent?
- The expected growth rate increases by 3 percent?
- The beta of Platinum Ltd. equity rises to 1.3?

(8 Marks) (November 2014)

Answer

(i) Equilibrium price of Equity using CAPM

$$= 9\% + 1.2(13\% - 9\%)$$

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$$= 9\% + 4.8\% = 13.8\%$$

$$P = \frac{D_1}{k_e - g} = \frac{2.00(1.07)}{0.138 - 0.07} = \frac{2.14}{0.068} = ₹ 31.47$$

(ii) New Equilibrium price of Equity using CAPM

$$= 9.18\% + 1.3(13\% - 9.18\%)$$

$$= 9.18\% + 4.966\% = 14.146\%$$

$$P = \frac{D_1}{k_e - g} = \frac{2.00(1.10)}{0.14146 - 0.10} = \frac{2.20}{0.04146} = ₹ 53.06$$

Question 26

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:

	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.

(6 Marks) (November 2014)

Answer

On the basis of existing and revised factors, rate of return and price of share is to be calculated.

Existing rate of return

$$= R_f + \text{Beta} (R_m - R_f)$$

$$= 12\% + 1.3 (5\%) = 18.5\%$$

Revised rate of return

$$= 10\% + 1.4 (4\%) = 15.60\%$$

Price of share (original)

$$P_o = \frac{D (1 + g)}{K_e - g} = \frac{3 (1.09)}{0.185 - 0.09} = \frac{3.27}{0.095} = ₹ 34.42$$

Price of share (Revised)

$$P_o = \frac{2.50 (1.07)}{0.156 - 0.07} = \frac{2.675}{0.086} = ₹ 31.10$$

Market price of share of ₹40 is higher in comparison to current equilibrium price of ₹ 34.42 and revised equity price of ₹31.10. Under this situation investor should sell the share.

Question 27

XYZ Ltd. has substantial cash flow and until the surplus funds are utilised 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	3.14	26.00%

The current market return is 19% and the risk free rate is 11%.

Required to:

- Calculate the risk of XYZ's short-term investment portfolio relative to that of the market;
- Whether XYZ should change the composition of its portfolio. (8 Marks) (November 2007)

Answer

(i) Computation of Beta of Portfolio

Investment	No. of shares	Market Price	Market Value	Dividend Yield	Dividend	Composition	β	Weighted β
I.	60,000	4.29	2,57,400	19.50%	50,193	0.2339	1.16	0.27
II.	80,000	2.92	2,33,600	24.00%	56,064	0.2123	2.28	0.48
III.	1,00,000	2.17	2,17,000	17.50%	37,975	0.1972	0.90	0.18
IV.	1,25,000	3.14	3,92,500	26.00%	1,02,050	0.3566	1.50	0.53
			11,00,500		2,46,282	1.0000		1.46

$$\text{Return of the Port Folio} = \frac{2,46,282}{11,00,500} = 0.2238$$

$$\text{Beta of Port Folio} = 1.46$$

7.32 Strategic Financial Management

Market Risk implicit

$$0.2238 = 0.11 + \beta \times (0.19 - 0.11)$$

$$\text{Or, } 0.08 \beta + 0.11 = 0.2238$$

$$\beta = \frac{0.2238 - 0.11}{0.08} = 1.42$$

Market β implicit is 1.42 while the portfolio β is 1.46. Thus the portfolio is marginally risky compared to the market.

- (ii) The decision regarding change of composition may be taken by comparing the dividend yield (given) and the expected return as per CAPM as follows:

Expected return

R_s as per CAPM is:

$$R_s = I_{RF} + (R_M - I_{RF}) \beta$$

$$\begin{aligned} \text{For investment I } R_s &= I_{RF} + (R_M - I_{RF}) \beta \\ &= .11 + (.19 - .11) 1.16 \\ &= 20.28\% \end{aligned}$$

$$\text{For investment II, } R_s = .11 + (.19 - .11) 2.28 = 29.24\%$$

$$\begin{aligned} \text{For investment III, } R_s &= .11 + (.19 - .11) .90 \\ &= 18.20\% \end{aligned}$$

$$\begin{aligned} \text{For investment IV, } R_s &= .11 + (.19 - .11) 1.50 \\ &= 23\% \end{aligned}$$

Comparison of dividend yield with the expected return R_s shows that the dividend yields of investment I, II and III are less than the corresponding R_s . So, these investments are over-priced and should be sold by the investor. However, in case of investment IV, the dividend yield is more than the corresponding R_s , so, XYZ Ltd. should increase its proportion.

Question 28

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
B	1.0
C	0.9

D	2.0
E	0.6

Required:

- (i) If the company invests 20% of its investment in 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? **(10 Marks) (May 2008)**

Answer

With 20% investment in each MF Portfolio Beta is the weighted average of the Betas of various securities calculated as below:

(i)

Investment	Beta (β)	Investment (₹ Lacs)	Weighted Investment
A	1.6	20	32
B	1.0	20	20
C	0.9	20	18
D	2.0	20	40
E	0.6	<u>20</u>	<u>12</u>
		<u>100</u>	<u>122</u>
Weighted Beta (β) = 1.22			

(ii) With varied percentages of investments portfolio beta is calculated as follows:

Investment	Beta (β)	Investment (₹ Lacs)	Weighted Investment
A	1.6	15	24
B	1.0	30	30
C	0.9	15	13.5
D	2.0	30	60
E	0.6	<u>10</u>	<u>6</u>
		<u>100</u>	<u>133.5</u>
Weighted Beta (β) = 1.335			

7.34 Strategic Financial Management

(iii) Expected return of the portfolio with pattern of investment as in case (i)

$$= 12\% \times 1.22 \text{ i.e. } 14.64\%$$

Expected Return with pattern of investment as in case (ii) = $12\% \times 1.335$ i.e., 16.02%.

Question 29

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:

- Expected return on the portfolio, if the Government Securities are at 8% and the NIFTY is yielding 10%.
- Advisability of replacing Security 'Better' with NIFTY. **(8 Marks) (November 2012)**

Answer

(i) Computation of Expected Return from Portfolio

Security	Beta (β)	Expected Return (r) as per CAPM	Amount (₹ Lakhs)	Weights (w)	wr
Moderate	0.50	$8\% + 0.50(10\% - 8\%) = 9\%$	60	0.115	1.035
Better	1.00	$8\% + 1.00(10\% - 8\%) = 10\%$	80	0.154	1.540
Good	0.80	$8\% + 0.80(10\% - 8\%) = 9.60\%$	100	0.192	1.843
Very Good	1.20	$8\% + 1.20(10\% - 8\%) = 10.40\%$	120	0.231	2.402
Best	1.50	$8\% + 1.50(10\% - 8\%) = 11\%$	<u>160</u>	<u>0.308</u>	<u>3.388</u>
Total			<u>520</u>	<u>1</u>	<u>10.208</u>

Thus Expected Return from Portfolio 10.208% say 10.21%

- 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 30

Your client is holding the following securities:

Particulars of Securities	Cost	Dividends/Interest	Market price	Beta
	₹	₹	₹	

<i>Equity Shares:</i>				
<i>Gold Ltd.</i>	10,000	1,725	9,800	0.6
<i>Silver Ltd.</i>	15,000	1,000	16,200	0.8
<i>Bronze Ltd.</i>	14,000	700	20,000	0.6
<i>GOI Bonds</i>	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. (8 Marks) (November 2005)

* In examination it was printed as 1.

Answer

<i>Particulars of Securities</i>	<i>Cost ₹</i>	<i>Dividend</i>	<i>Capital gain</i>
Gold Ltd.	10,000	1,725	–200
Silver Ltd.	15,000	1,000	1,200
Bronz Ltd.	14,000	700	6,000
GOI Bonds	<u>36,000</u>	<u>3,600</u>	<u>–1,500</u>
Total	<u>75,000</u>	<u>7,025</u>	<u>5,500</u>

Expected rate of return on market portfolio

$$\frac{\text{Dividend Earned} + \text{Capital appreciation}}{\text{Initial investment}} \times 100$$

$$= \frac{\text{₹ } 7,025 + \text{₹ } 5,500}{\text{₹ } 75,000} \times 100 = 16.7\%$$

Risk free return

$$\text{Average of Betas} = \frac{0.6 + 0.8 + 0.6 + 0.01}{4}$$

$$\text{Average of Betas} = 0.50$$

$$\text{Average return} = \text{Risk free return} + \text{Average Betas} (\text{Expected return} - \text{Risk free return})$$

$$15.7 = \text{Risk free return} + 0.50 (16.7 - \text{Risk free return})$$

$$\text{Risk free return} = 14.7\%$$

Expected Rate of Return for each security is

$$\text{Rate of Return} = R_f + B (R_m - R_f)$$

$$\text{Gold Ltd.} = 14.7 + 0.6 (16.7 - 14.7) = 15.90\%$$

7.36 Strategic Financial Management

Silver Ltd. $= 14.7 + 0.8 (16.7 - 14.7) = 16.30\%$

Bronz Ltd. $= 14.7 + 0.6 (16.7 - 14.7) = 15.90\%$

GOI Bonds $= 14.7 + 0.01 (16.7 - 14.7) = 16.70\%$

Question 31

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 on his portfolio using Capital Asset Pricing Method (CAPM)

(ii) The average return of his portfolio.

Risk-free return is 14%.

(10 Marks) (May 2008)

* In examination it was printed as 0.99.

Answer

(i) Expected rate of return

	Total Investments	Dividends	Capital Gains
Epsilon Ltd.	25	2	25
Sigma Ltd.	35	2	25
Omega Ltd.	45	2	90
GOI Bonds	<u>1,000</u>	<u>140</u>	<u>5</u>
	<u>1,105</u>	<u>146</u>	<u>145</u>

Expected Return on market portfolio = $\frac{146 + 145}{1105} = 26.33\%$

CAPM $E(R_p) = R_F + \beta [E(R_M) - R_F]$

Epsilon Ltd	$14 + 0.8 [26.33 - 14] =$	$14 + 9.86$	$=$	23.86%
Sigma Ltd.	$14 + 0.7 [26.33 - 14] =$	$14 + 8.63$	$=$	22.63%
Omega Ltd.	$14 + 0.5 [26.33 - 14] =$	$14 + 6.17$	$=$	20.17%
GOI Bonds	$14 + 0.01 [26.33 - 14] =$	$14 + 0.12$	$=$	14.12%

(ii) Average Return of Portfolio

$$\frac{23.86 + 22.63 + 20.17 + 14.12}{4} = \frac{80.87}{4} = 20.20\%$$

$$\text{Alternatively } \frac{0.8 + 0.7 + 0.5 + 0.01}{4} = \frac{2.01}{4} = 0.5025$$

$$14 + 0.5025(26.33 - 14)$$

$$14 + 6.20 = 20.20\%$$

Question 32

Mr. Ram is holding the following securities:

Particulars of Securities	Cost ₹	Dividends	Market Price	Beta
Equity Shares:				
Gold Ltd.	11,000	1,800	12,000	0.6
Silver Ltd.	16,000	1,000	17,200	0.8
Bronze Ltd.	12,000	800	18,000	0.6
GOI Bonds	40,000	4,000	37,500	1.0

Calculate:

- (i) Expected rate of return in each case, using the Capital Asset Pricing Model (CAPM).
 (ii) Average rate of return, if risk free rate of return is 14%. **(8 Marks) (November 2013)**

Answer

- (i) Expected rate of return

	Total Investments	Dividends	Capital Gains
Gold Ltd.	11,000	1,800	1,000
Silver Ltd.	16,000	1,000	1,200
Bronze Ltd.	12,000	800	6,000
GOI Bonds	<u>40,000</u>	<u>4,000</u>	<u>(2,500)</u>
	<u>79,000</u>	<u>7,600</u>	<u>5,700</u>

$$\text{Expected Return on market portfolio} = \frac{7,600 + 5,700}{79,000} = 16.84\%$$

$$\text{CAPM } E(R_p) = R_F + \beta [E(R_M) - R_F]$$

Gold Ltd.	14 + 0.6 [16.84 - 14] =	14 + 1.70	= 15.70%
Silver Ltd.	14 + 0.8 [16.84 - 14] =	14 + 2.27	= 16.27%

7.38 Strategic Financial Management

Bronze Ltd.	$14 + 0.6 [16.84 - 14] =$	$14 + 1.70$	$=$	15.70%
GOI Bonds	$14 + 1 [16.84 - 14] =$	$14 + 2.84$	$=$	16.84%

(ii) Average Return of Portfolio

$$\frac{15.70 + 16.27 + 15.70 + 16.84}{4} = \frac{64.51}{4} = 16.13\%$$

$$\text{Alternatively } \frac{0.6 + 0.8 + 0.6 + 1}{4} = \frac{3}{4} = 0.75$$

$$14\% + 0.75(16.84\% - 14\%) = 14\% + 2.13\% = 16.13\%$$

Question 33

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:

	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.

- 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?
- 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?

(6 Marks) (June 2009) (S)

Answer

(i) Investment committed to each security would be:-

	<u>A</u> (₹)	<u>B</u> (₹)	<u>C</u> (₹)	<u>Total</u> (₹)
Portfolio X	1,500	2,000	1,500	5,000
Portfolio Y	<u>600</u>	<u>1,500</u>	<u>900</u>	<u>3,000</u>
Combined Portfolio	<u>2,100</u>	<u>3,500</u>	<u>2,400</u>	<u>8,000</u>
∴ Stock weights	0.26	0.44	0.30	

(ii) The equation of critical line takes the following form:-

$$WB = a + bWA$$

Substituting the values of WA & WB from portfolio X and Y in above equation, we get

$$0.40 = a + 0.30b, \text{ and}$$

$$0.50 = a + 0.20b$$

Solving above equation we obtain the slope and intercept, $a = 0.70$ and $b = -1$ and thus, the critical line is

$$WB = 0.70 - WA$$

If half of the funds is invested in security A then,

$$WB = 0.70 - 0.50 = 0.20$$

Since $WA + WB + WC = 1$

$$WC = 1 - 0.50 - 0.20 = 0.30$$

$\therefore$ Allocation of funds to security B	$= 0.20 \times 8,000$	$= ₹ 1,600$, and
Security C	$= 0.30 \times 8,000$	$= ₹ 2,400$

Question 34

X Co., Ltd., invested on 1.4.2006 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, 2006, 10% dividend was paid out by M Ltd. and in October, 2006, 30% dividend paid out by N Ltd. On 31.3.2007 market quotations showed a value of ₹220 and ₹290 per share for M Ltd. and N Ltd. respectively.

On 1.4.2007, investment advisors indicate (a) that the dividends from M Ltd. and N Ltd. for the year ending 31.3.2008 are likely to be 20% and 35%, respectively and (b) that the probabilities of market quotations on 31.3.2008 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:

- Calculate the average return from the portfolio for the year ended 31.3.2007;
- Calculate the expected average return from the portfolio for the year 2007-08; and
- Advise X Co. Ltd., of the comparative risk in the two investments by calculating the standard deviation in each case. **(8 Marks) (May 2008), (8 Marks) (November 2006)**

Answer

Calculation of return on portfolio for 2006-07	(Calculation in ₹ / share)		
	M	N	
Dividend received during the year	10	3	
Capital gain/loss by 31.03.2007			

7.40 Strategic Financial Management

Market value by 31.03.2007	220	290	
Cost of investment	200	300	
Gain/loss	20	(-)10	
Yield	30	(-)7	
Cost	200	300	
% return	15%	(-)2.33%	
Weight in the portfolio	57	43	
Weighted average return			7.55%
Calculation of estimated return for 2007-08			
Expected dividend	20	3.5	
Capital gain by 31.03.2008			
(220x0.2)+ (250x0.5)+(280x0.3) – 220=(253-220)	33	-	
(290x0.2)+(310x0.5)+(330x0.3) – 290= (312 – 290)	-	22	
Yield	53	25.5	
*Market Value 01.04.2007	220	290	
% return	24.09%	8.79%	
*Weight in portfolio (1,000x220): (500x290)	60.3	39.7	
Weighted average (Expected) return			18.02%
(*The market value on 31.03.2007 is used as the base for calculating yield for 2007-08)			

Calculation of Standard Deviation

M Ltd.

Exp. market value	Exp. gain	Exp. div.	Exp Yield (1)	Prob. Factor (2)	(1) X (2)	Dev. $(P_M - \bar{P}_M)$	Square of dev. (3)	(2) X (3)
220	0	20	20	0.2	4	-33	1089	217.80
250	30	20	50	0.5	25	-3	9	4.50
280	60	20	80	0.3	24	27	729	218.70
					53			$\sigma^2_M = 441.00$

Standard Deviation (σ_M)

21

N Ltd.

Exp. market value	Exp. gain	Exp. div.	Exp Yield (1)	Prob. Factor (2)	(1) X(2)	Dev. $(P_N - \bar{P}_N)$	Square of dev. (3)	(2) X (3)
290	0	3.5	3.5	0.2	0.7	-22	484	96.80
310	20	3.5	23.5	0.5	11.75	-2	4	2.00
330	40	3.5	43.5	0.3	13.05	18	324	97.20
					25.5			$\sigma^2_N = 196.00$

Standard Deviation (σ_N)

14

Share of company M Ltd. is more risky as the S.D. is more than company N Ltd.

Question 35

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:

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

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. **(10 Marks) (November 2009) (S)**

Answer

$$\text{Expected Return on stock A} = E(A) = \sum_{i=G,S,R} P_i A_i$$

(G,S & R, denotes Growth, Stagnation and Recession)

$$(0.40)(25) + 0.30(10) + 0.30(-5) = 11.5\%$$

Expected Return on 'B'

$$(0.40 \times 20) + (0.30 \times 15) + 0.30 \times (-8) = 10.1\%$$

Expected Return on Market index

$$(0.40 \times 18) + (0.30 \times 13) + 0.30 \times (-3) = 10.2\%$$

Variance of Market index

$$(18 - 10.2)^2 (0.40) + (13 - 10.2)^2 (0.30) + (-3 - 10.2)^2 (0.30) \\ = 24.34 + 2.35 + 52.27 = 78.96\%$$

Covariance of stock A and Market Index M

$$\text{Cov. (AM)} = \sum_{i=G,S,R} (A_i - E(A)) [M_i - E(M)] P_i$$

$$(25 - 11.5) (18 - 10.2) (0.40) + (10 - 11.5) (13 - 10.2) (0.30) + (-5 - 11.5) (-3 - 10.2) (0.30) \\ = 42.12 + (-1.26) + 65.34 = 106.20$$

Covariance of stock B and Market index M

7.42 Strategic Financial Management

$$(20-10.1)(18-10.2)(0.40) + (15-10.1)(13-10.2)(0.30) + (-8-10.1)(-3-10.2)(0.30) = 30.89 + 4.12 + 71.67 = 106.68$$

$$\text{Beta for stock A} = \frac{\text{CoV(AM)}}{\text{VAR(M)}} = \frac{106.20}{78.96} = 1.345$$

$$\text{Beta for Stock B} = \frac{\text{CoV(BM)}}{\text{VarM}} = \frac{106.68}{78.96} = 1.351$$

Required Return for A

$$R(A) = R_f + \beta(M - R_f)$$

$$11\% + 1.345(10.2 - 11)\% = 9.924\%$$

Required Return for B

$$11\% + 1.351(10.2 - 11)\% = 9.92\%$$

Alpha for Stock A

$$E(A) - R(A) \text{ i.e. } 11.5\% - 9.924\% = 1.576\%$$

Alpha for Stock B

$$E(B) - R(B) \text{ i.e. } 10.1\% - 9.92\% = 0.18\%$$

Since stock A and B both have positive Alpha, therefore, they are UNDERPRICED. The investor should make fresh investment in them.

Question 36

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

Security	Expected Return	Beta	σ^2_{ci}
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? (10 Marks) (May 2010) (M)

Answer

Securities need to be ranked on the basis of excess return to beta ratio from highest to the lowest.

Security	R_i	β_i	$R_i - R_f$	$\frac{R_i - R_f}{\beta_i}$
A	15	1.5	8	5.33
B	12	2	5	2.5
C	10	2.5	3	1.2
D	9	1	2	2
E	8	1.2	1	0.83
F	14	1.5	7	4.67

Ranked Table:

Security	$R_i - R_f$	β_i	σ^2_{ei}	$\frac{(R_i - R_f) \times \beta_i}{\sigma^2_{ei}}$	$\sum_{e=i}^N \frac{(R_i - R_f) \times \beta_i}{\sigma^2_{ei}}$	$\frac{\beta_i^2}{\sigma^2_{ei}}$	$\sum_{e=i}^N \frac{\beta_i^2}{\sigma^2_{ei}}$	C_i
A	8	1.5	40	0.30	0.30	0.056	0.056	1.923
F	7	1.5	30	0.35	0.65	0.075	0.131	2.814
B	5	2	20	0.50	1.15	0.20	0.331	2.668
D	2	1	10	0.20	1.35	0.10	0.431	2.542
C	3	2.5	30	0.25	1.60	0.208	0.639	2.165
E	1	1.2	20	0.06	1.66	0.072	0.711	2.047

$$CA = 10 \times 0.30 / [1 + (10 \times 0.056)] = 1.923$$

$$CF = 10 \times 0.65 / [1 + (10 \times 0.131)] = 2.814$$

$$CB = 10 \times 1.15 / [1 + (10 \times 0.331)] = 2.668$$

$$CD = 10 \times 1.35 / [1 + (10 \times 0.431)] = 2.542$$

$$CC = 10 \times 1.60 / [1 + (10 \times 0.639)] = 2.165$$

$$CE = 10 \times 1.66 / [1 + (10 \times 0.711)] = 2.047$$

Cut off point is 2.814

$$Z_i = \frac{\beta_i}{\sigma^2_{ei}} \left[\frac{(R_i - R_f)}{\beta_i} - C \right]$$

$$Z_A = \frac{1.5}{40} (5.33 - 2.814) = 0.09435$$

7.44 Strategic Financial Management

$$Z_F = \frac{1.5}{30} (4.67 - 2.814) = 0.0928$$

$$X_A = 0.09435 / [0.09435 + 0.0928] = 50.41\%$$

$$X_F = 0.0928 / [0.09435 + 0.0928] = 49.59\%$$

Funds to be invested in security A & F are 50.41% and 49.59% respectively.

Question 37

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:

- Portfolio beta.
 - If the PM seeks to reduce the beta to 0.8, how much risk free investment should he bring in?
 - If the PM seeks to increase the beta to 1.2, how much risk free investment should he bring in?
- (8 Marks) (November 2011)**

Answer

Security	No. of shares (1)	Market Price of Per Share (2)	(1) × (2)	% to total (w)	β (x)	wx
VSL	10000	50	500000	0.4167	0.9	0.375
CSL	5000	20	100000	0.0833	1	0.083
SML	8000	25	200000	0.1667	1.5	0.250
APL	2000	200	400000	0.3333	1.2	0.400
			<u>1200000</u>	1		<u>1.108</u>

Portfolio beta

1.108

(i) Required Beta

0.8

It should become (0.8 / 1.108)

72.2 % of present portfolio

If ₹ 12,00,000 is 72.20%, the total portfolio should be

₹ 12,00,000 × 100/72.20 or

₹ 16,62,050

Additional investment in zero risk should be (₹ 16,62,050 – ₹ 12,00,000) = ₹ 4,62,050

Revised Portfolio will be

Security	No. of shares (1)	Market Price of Per Share (2)	(1) × (2)	% to total (w)	β (x)	wx
VSL	10000	50	500000	0.3008	0.9	0.271
CSL	5000	20	100000	0.0602	1	0.060
SML	8000	25	200000	0.1203	1.5	0.180
APL	2000	200	400000	0.2407	1.2	0.289
Risk free asset	46205	10	462050	0.2780	0	0
			1662050	1		0.800

(ii) To increase Beta to 1.2

Required beta

1.2

It should become $1.2 / 1.108$

108.30% of present beta

If 1200000 is 108.30%, the total portfolio should be

$1200000 \times 100/108.30$ or

1108033 say 1108030

Additional investment should be (-) 91967 i.e. Divest ₹ 91970 of Risk Free Asset

(iii) Revised Portfolio will be

Security	No. of shares (1)	Market Price of Per Share (2)	(1) × (2)	% to total (w)	β (x)	wx
VSL	10000	50	500000	0.4513	0.9	0.406
CSL	5000	20	100000	0.0903	1	0.090
SML	8000	25	200000	0.1805	1.5	0.271
APL	2000	200	400000	0.3610	1.2	0.433
Risk free asset	-9197	10	-91970	-0.0830	0	0
			1108030	1		1.20

Portfolio beta

1.20

Question 38

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

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index (σ_m) is 18%.

(8 Marks) (May 2012)

Answer

$$\begin{aligned}\beta_p &= \sum_{i=1}^4 x_i \beta_i \\ &= 1.60 \times 0.25 + 1.15 \times 0.30 + 1.40 \times 0.25 + 1.00 \times 0.20 \\ &= 0.4 + 0.345 + 0.35 + 0.20 = 1.295 \\ \text{The Standard Deviation (Risk) of the portfolio is} \\ &= [(1.295)^2(18)^2 + (0.25)^2(7)^2 + (0.30)^2(11)^2 + (0.25)^2(3)^2 + (0.20)^2(9)^2] \\ &= [543.36 + 3.0625 + 10.89 + 0.5625 + 3.24] = [561.115]^{1/2} = 23.69\%\end{aligned}$$

Alternative Answer

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)	$\sigma^2 X w$
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				626.47

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

Question 39

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?

(5 Marks) (May 2011)

Answer**Return of the stock under APT**

Factor	Actual value in %	Expected value in %	Difference	Beta	Diff. x Beta
GNP	7.70	7.70	0.00	1.20	0.00
Inflation	7.00	5.50	1.50	1.75	2.63
Interest rate	9.00	7.75	1.25	1.30	1.63
Stock index	12.00	10.00	2.00	1.70	3.40
Ind. Production	7.50	7.00	0.50	1.00	<u>0.50</u>
					8.16
Risk free rate in %					<u>9.25</u>
Return under APT					<u>17.41</u>