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RISK

Every investment is characterised by return and risk. The concept of risk is intuitively understood by investors. In general, it refers to the possibility of incurring a loss in a financial transaction. But risk involves much more than that. The word 'risk' has a definite financial meaning.

MEANING OF RISK

A person making an investment expects to get some return from the investment in the future. But, as future is uncertain, so is the future expected return. It is this uncertainty associated with the returns from an investment that introduces risk into an investment.

We can distinguish between the expected return and the realised return from an investment. The *expected return* is the uncertain future return that an investor expects to get from his investment. The *realised return*, on the contrary, is the certain return that an investor has actually obtained from his investment at the end of the holding period. The investor makes the investment decision based on the expected return from the investment. The actual return realised from the investment may not correspond to the expected return. This possibility of variation of the actual return from the expected return is termed risk. Where realisations correspond to expectations exactly, there would be no risk. Risk arises where there is a possibility of variation between expectations and realisations with regard to an investment.

Thus, risk can be defined in terms of variability of returns. "Risk is the potential for variability in returns."[1] An investment whose returns are fairly stable is considered to be a low-risk investment, whereas an investment whose returns fluctuate significantly is considered to be a high-risk investment. Equity shares whose returns are likely to fluctuate widely are considered risky investments. Government securities whose returns are fairly stable are considered to possess low risk.

ELEMENTS OF RISK

The essence of risk in an investment is the variation in its returns. This variation in returns is caused by a number of factors. These factors which produce variations in the returns from an investment constitute the elements of risk.

Let us consider the risk in holding securities, such as shares, debentures, etc. The elements of risk may be broadly classified into two groups. The first group comprises factors that are external to a company and affect a large number of securities simultaneously. These are mostly uncontrollable in nature. The second group includes those factors which are internal to companies and affect only those particular companies. These are controllable to a great extent. The risk produced by the first group of factors is known as systematic risk, and that produced by the second group is known as unsystematic risk.

The total variability in returns of a security represents the total risk of that security. Systematic risk and unsystematic risk are the two components of total risk. Thus,

Total risk = Systematic risk + Unsystematic risk

Systematic Risk

As the society is dynamic, changes occur in the economic, political and social systems constantly. These changes have an influence on the performance of companies and thereby on their stock prices. But these changes affect all companies and all securities in varying degrees. For example, economic and political instability adversely affects all industries and companies. When an economy moves into recession, corporate profits will shift downwards and stock prices of most companies may decline. Thus, the impact of economic, political and social changes is system-wide and that portion of total variability in security returns caused by such system-wide factors is referred to as **systematic risk**. Systematic risk is further subdivided into interest rate risk, market risk, and purchasing power risk.

Interest Rate Risk

Interest rate risk is a type of systematic risk that particularly affects debt securities like bonds and debentures. A bond or debenture normally has a fixed coupon rate of interest. The issuing company pays interest to the bond holder at this coupon rate. A bond is normally issued with a coupon rate which is equal to the interest rate prevailing in the market at the time of issue. Subsequent to the issue, the market interest rate may change but the coupon rate remains constant till the maturity of the instrument. The change in market interest rate relative to the coupon rate of a bond causes changes in its market price.

A bond having a face value of Rs. 100 issued with a coupon rate of ten per cent when the market interest rate is also ten per cent will have a market price of Rs. 100. If, subsequent to the issue, the market interest rate moves up to 12.5 per cent, no investor will buy the bond with ten per cent coupon interest rate unless the holder of the bond reduces the price to Rs. 80. When the price is reduced to Rs. 80, the purchaser of the bond gets interest of

Rs. ten on an investment of Rs. 80 which is equivalent to a return of 12.5 per cent which is the same as the prevailing market interest rate.

Thus, we see that as the market interest rate moves up in relation to the coupon interest rate, the market price of the bond declines. Similarly, the market price of the bond would move up when there is a drop in market interest rate compared to the coupon rate. In other words, the market price of bonds and debentures is inversely related to the market interest rates. As a result, the market price of debt securities fluctuates in response to variations in the market interest rates. This variation in bond prices caused due to the variations in interest rates is known as **interest rate risk.**

The interest rate variations have an indirect impact on stock prices also. Speculators often resort to margin trading, i.e. purchasing stock on margin using borrowed funds. As interest rates increase, margin trading becomes less attractive. The lower demand by speculators may push down stock prices. The opposite happens when interest rates fall.

Many companies use borrowed funds to finance their operation. When interest rates move up, companies using borrowed funds have to make higher interest payments. This leads to lower earnings, dividends and share prices. On the contrary, lower interest rates may push up earnings and prices. Thus, we see that variations in interest rates may indirectly influence stock prices. Interest rate risk is a systematic risk which affects bonds directly and shares indirectly.

Market Risk

Market risk is a type of systematic risk that affects shares. Market prices of shares move up or down consistently for some time periods. A general rise in share prices is referred to as a bullish trend, whereas a general fall in share prices is referred to as a bearish trend. In other words, the share market alternates between the bullish phase and the bearish phase. The alternating movements can be easily seen in the movement of share price indices such as the BSE Sensitive Index, BSE National Index, NSE Index, etc.

Business cycles are considered to be a major determinant of the timing and extent of the bull and bear phases of the market. This would suggest that the ups and downs in share markets would follow the expansion and recession phase of the economy. This may be true in the long run, but it does not sufficiently explain the short-term movements in the market.

The short-term volatility in the stock market is caused by sweeping changes in investor expectations which are the result of investor reactions to certain tangible as well as intangible events. The basis of the reaction may be a set of real tangible events, political, economic or social, such as the fall of a government, drastic change in monetary policy, etc. The change in investor expectations is usually initiated by the reaction to real events. But the reaction is often aggravated by the intangible factor of emotional instability of investors. They tend to act collectively and irrationally, leading to an overreaction.

The stock market is seen to be volatile. This volatility leads to variations in the returns of investors in shares. The variation in returns caused by the volatility of the stock market is referred to as the **market risk.**

Purchasing Power Risk

Another type of systematic risk is the purchasing power risk. It refers to the variation in investor returns caused by inflation.

Inflation results in lowering of the purchasing power of money. When an investor purchases a security, he foregoes the opportunity to buy some goods or services. In other words, he is postponing his consumption. Meanwhile, if there is inflation in the economy, the prices of goods and services would increase and thereby the investor actually experiences a decline in the purchasing power of his investments and the return from the investment. Let us consider a simple example. Suppose a person lends Rs. 100 today at ten per cent interest. He would get back Rs. 110 after one year. If during the year, the prices have increased by eight per cent, Rs. 110 received at the end of the year will have a purchasing power of only Rs. 101.20, i.e. 92 per cent of Rs. 110. Thus, inflation causes a variation in the purchasing power of the returns from an investment. This is known as purchasing power risk and its impact is uniformly felt on all securities in the market and as such, is a systematic risk.

The two important sources of inflation are rising costs of production and excess demand for goods and services in relation to their supply. They are known as cost-push and demand-pull inflation respectively. When demand is increasing but supply cannot be increased, price of the goods increases thereby forcing out some of the excess demand and bringing the demand and supply into equilibrium. This phenomenon is known as **demand pull inflation**. **Cost push inflation** occurs when the cost of production increases and this increase in cost is passed on to the consumers by the producers through higher prices of goods.

In an inflationary economy, rational investors would include an allowance for the purchasing power risk in their estimate of the expected rate of return from an investment. In other words, the expected rate of return would be adjusted upwards by the estimated annual rate of inflation.

Unsystematic Risk

The returns from a security may sometimes vary because of certain factors affecting only the company issuing such security. Examples are raw material scarcity, labour strike, management inefficiency. When variability of returns occurs because of such firm—specific factors, it is known as **unsystematic risk**. This risk is unique or peculiar to a company or industry and affects it in addition to the systematic risk affecting all securities.

The unsystematic or unique risk affecting specific securities arises from two sources: (a) the operating environment of the company, and (b) the financing pattern adopted by the company. These two types of unsystematic risk are referred to as **business risk** and **financial risk** respectively.

Business Risk

Every company operates within a particular operating environment. This operating environment comprises both internal environment within the firm and external environment outside the firm. The impact of these operating conditions is reflected in the operating

costs of the company. The operating costs can be segregated into fixed costs and variable costs. A larger proportion of fixed costs is disadvantageous to a company. If the total revenue of such a company declines due to some reason or the other, there would be a more than proportionate decline in its operaing profits because it would be unable to reduce its fixed costs. Such a firm is said to face a larger business risk.

Business risk is thus a function of the operating conditions faced by a company and is the variability in operating income caused by the operating conditions of the company.

Financial Risk

Financial risk is a function of financial leverage which is the use of debt in the capital structure. The presence of debt in the capital structure creates fixed payments in the form of interest which is a compulsory payment to be made whether the company makes profit or loss. This fixed interest payment creates more variability in the earnings per share (EPS) available to equity share holders. For example, if the rate of return or operating profit ratio is higher than the interest rate payable on the debt, EPS would increase. On the contrary, if the operating profit ratio is lower than the interest rate, EPS would be depressed. The increase or decrease in EPS in response to changes in operating profit would be much wider in the case of a levered firm (a company having debt in its capital structure) than in the case of an unlevered firm.

This variability in EPS due to the presence of debt in the capital structure of a company is referred to as financial risk. This is specific to each company and forms part of its unsystematic risk. Financial risk is an avoidable risk in so far as a company is free to finance its activities without resorting to debt.

MEASUREMENT OF RISK

An intelligent investor would attempt to anticipate the kind of risk that he is likely to face. He would also attempt to estimate the extent of risk associated with different investment proposals. In other words, he tries to measure or quantify the risk of each investment that he considers before making the final selection. The quantification of risk is thus necessary for investment analysis.

Risk in investment is associated with return. The risk of an investment cannot be measured without reference to return. The return, in turn, depends on the cash inflows to be received from the investment. Let us consider the purchase of a share. While purchasing an equity share, an investor expects to receive future dividends declared by the company. In addition, he expects to receive the selling price when the share is finally sold.

Suppose a share is currently selling at Rs. 120. An investor who is interested in the share anticipates that the company will pay a dividend of Rs. 5 in the next year. Moreover, he expects to sell the share at Rs. 175 after one year. The expected return from this investment can be calculated as follows:

$$R = \frac{\text{Forecasted dividend} + \text{Forecasted end of the period stock price}}{\text{Initial investment}} - 1$$

$$R = \frac{\text{Rs. 5} + \text{Rs. 175}}{\text{Rs. 120}} - 1 = 0.5 \text{ or } 50 \text{ per cent}$$

In this case the investor expects to get a return of 50 per cent in the future. But the future is uncertain. The dividend declared by the company may turn out to be either more or less than the figure anticipated by the investor. Similarly, the selling price of the stock may be less than the price anticipated by the investor at the time of investment. It may sometimes be even more. Thus, there is a possibility that the future return may be more than 50 per cent or less than 50 per cent. Since the future is uncertain the investor has to consider the probability of several other possible returns. The expected returns may be 30 per cent, 40 per cent, 50 per cent, 60 per cent or 70 per cent. The investor now has to assign the probability of occurrence of these possible alternative returns. An example is given below:

Possible returns (in per cent) X_i	*Probability of occurrence* $p(X_i)$
30	0.10
40	0.30
50	0.40
60	0.10
70	0.10

This table gives the probability distribution of possible returns from an investment in shares. Such a distribution can be developed by the investor by studying the past data and modifying it appropriately for the changes he expects to occur in the future.

The information contained in the probability distribution has to be reduced to two simple statistical measures in order to aid investment decision-making. These measures are *summary statistics*. One measure would indicate the expected return from the investment and the other measure would indicate the risk of the investment.

Expected Return

The expected return of the investment is the probability weighted average of all the possible returns. If the possible returns are denoted by X_i and the related probabilities are $p(X_i)$, the expected return may be represented as $\bar{X}$ and can be calculated as:

$$\bar{X} = \sum_{i=1}^{n} X_i p(X_i)$$

It is the sum of the products of possible returns with their respective probabilities.

The expected return of the share in the example given above can be calculated as follows:

Calculation of Expected Return

Possible returns X_i	*Probability* $p(X_i)$	$X_i\ p(X_i)$
30	0.10	3.0
40	0.30	12.0
50	0.40	20.0
60	0.10	6.0
70	0.10	7.0
		$\sum_{i=1}^{n} X_i p(X_i) = 48.0$

Here, the expected return is 48 per cent.

Risk

Expected returns are insufficient for decision-making. The risk aspect should also be considered. The most popular measure of risk is the variance or standard deviation of the probability distribution of possible returns.

Variance is usually denoted by σ^2 and is calculated by the following formula:

$$\sigma^2 = \sum_{i=1}^{n} [(X_i - \bar{X})^2\ p(X_i)]$$

The table below provides the required calculations in the case of our example.

Possible return X_i	*Probability* $p(X_i)$	*Deviation* $(X_i - \bar{X})$	*Deviation squared* $(X_i - \bar{X})^2$	*Product* $(X_i - \bar{X})^2 p(X_i)$
30	0.10	−18	324	32.4
40	0.30	−8	64	19.2
50	0.40	2	4	1.6
60	0.10	12	144	14.4
70	0.10	22	484	48.4
				$\sigma^2 = 116.0$

Variance = 116 per cent

Standard deviation is the square root of the variance and is represented as σ. The standard deviation in our example is $\sqrt{116} = 10.77$ per cent.

The variance and standard deviation measure the extent of variability of possible returns from the expected return. Several other measures such as range, semi-variance and mean absolute deviation have been used to measure risk, but standard deviation has been the most popularly accepted measure.

In the method described above, the probability distribution of possible returns from an investment proposal is used to estimate the expected return from the investment and its variability. The mean gives the expected value and the variance or standard deviation gives the variability. This widely used procedure for assessing risk is known as the **mean-variance approach.**

The standard deviation or variance, however, provides a measure of the total risk associated with a security. Total risk comprises of two components, namely systematic risk and unsystematic risk. Unsystematic risk is risk which is specific or unique to a company. Unsystematic risk associated with the security of a particular company can be reduced by combining it with another security having opposite characteristics. This process is known as **diversification of investment**. As a result of diversification, the investment is spread over a group of securities with different characteristics. This group of securities is called a portfolio.

As far as an investor is concerned, the unsystematic risk is not very important as it can be reduced or eliminated through diversification. It is an irrelevant risk. The risk that is relevant in investment decision-making is the systematic risk because it is undiversifiable. Hence, the investor seeks to measure the systematic risk of a security.

Measurement of Systematic Risk

Systematic risk is the variability in security returns caused by changes in the economy or the market. All securities are affected by such changes to some extent, but some securities exhibit greater variability in response to market changes. Such securities are said to have higher systematic risk. The average effect of a change in the economy can be represented by the change in the stock market index. The systematic risk of a security can be measured by relating that security's variability with the variability in the stock market index. A higher variability would indicate higher systematic risk and vice versa.

The systematic risk of a security is measured by a statistical measure called **Beta**. The input data required for the calculation of beta are the historical data of returns of the individual security as well as the returns of a representative stock market index. Two statistical methods may be used for the calculation of Beta, namely the **correlation method** or the **regression method.**

Using the *correlation method*, beta can be calculated from the historical data of returns by the following formula:

$$\beta_i = \frac{r_{im}\sigma_i\sigma_m}{\sigma_m^2}$$

where

r_{im} = Correlation coefficient between the returns of stock i and the returns of the market index.
σ_i = Standard deviation of returns of stock i.
σ_m = Standard deviation of returns of the market index.
σ_m^2 = Variance of the market returns.

The second method of calculating beta is by using the *regression method*. The regression model postulates a linear relationship between a dependent variable and an independent

variable. The model helps to calculate the values of two constants, namely α and β. β measures the change in the dependent variable in response to unit change in the independent variable, while α measures the value of the dependent variable even when the independent variable has zero value. The form of the regression equation is as follows:

$$Y = \alpha + \beta X$$

where

Y = Dependent variable.
X = Independent variable.
α and β are constants.

The formula used for the calculation of α and β are given below.

$$\alpha = \bar{Y} - \beta \bar{X}$$

$$\beta = \frac{n\Sigma XY - (\Sigma X)(\Sigma Y)}{n\Sigma X^2 - (\Sigma X)^2}$$

where

n = Number of items.
$\bar{Y}$ = Mean value of the dependent variable scores.
$\bar{X}$ = Mean value of independent variable scores.
Y = Dependent variable scores.
X = Independent variable scores.

For the calculation of beta, the return of the individual security is taken as the dependent variable, and the return of the market index is taken as the independent variable. The regression equation is represented as follows:

$$R_i = \alpha + \beta R_m$$

where

R_i = Return of the individual security.
R_m = Return of the market index.
α = Estimated return of the security when the market is stationary.
β_i = Change in the return of the individual security in response to unit change in the return of the market index. It is, thus, the measure of systematic risk of a security.

A security can have betas that are positive, negative or zero.

"The beta of an asset, β_i, is a measure of the variability of that asset relative to the variability of the market as a whole. Beta is an index of the systematic risk of an asset."[2]

As beta measures the volatility of a security's returns relative to the market, the larger the beta, the more volatile the security. A beta of 1.0 indicates a security of average risk. A stock with beta greater than 1.0 has above average risk. Its returns would be more volatile than the market returns. For example, when market returns move up by five per cent, a stock with beta of 1.5 would find its returns moving up by 7.5 per cent (i.e. 5×1.5). Similarly, decline in market returns by five per cent would produce a decline of 7.5 per cent in the return of the individual security.

A stock with beta less than 1.0 would have below average risk. Variability in its returns would be comparatively lesser than the market variability. Beta can also be negative, implying that the stock returns move in a direction opposite to that of the market returns.

Beta is calculated from historical data of returns to measure the systematic risk of a security. It is a historical measure of systematic risk. In using this beta for investment decision-making, the investor is assuming that the relationship between the security variability and market variability will continue to remain the same in future also.

To conclude, risk is the possibility of variation in returns from an investment. Many factors contribute to this variability in returns. Some of these factors are system-wide and affect all securities, while some are unique and affect only specific securities. Total variability or risk of a security can be measured by calculating the standard deviation or variance of the security's returns. Beta measures the systematic risk of a security.

Example 1 A share is currently selling at Rs. 50. It is expected that a dividend of Rs. 2 per share would be paid during the year and the share could be sold at Rs. 54 at the end of the year. Calculate the expected return from the share.

Solution

$$R = \frac{\text{Forecasted dividend} + \text{Forecasted end of the period stock price}}{\text{Initial investment}} - 1$$

$$R = \frac{2 + 54}{50} - 1 = 0.12 \quad \text{or} \quad 12 \text{ per cent}$$

Alternatively,

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

where

D = Dividend.
P_1 = End of period stock price.
P_0 = Initial strick price.

$$R = \frac{2}{50} + \frac{54 - 50}{50} = 0.04 + 0.08 = 0.12 \quad \text{or} \quad 12 \text{ per cent.}$$

Example 2 Calculate the expected return and the standard deviation of returns for a stock having the following probability distribution of returns.

Possible returns (in per cent)	*Probability of occurrence*
−25	0.05
−10	0.10
0	0.10
15	0.15
20	0.25
30	0.20
35	0.15

Solution

Calculation of Expected Return

Possible returns X_i	*Probability* $p(X_i)$	*Product* $X_i.p\ (Xi)$
−25	0.05	−1.25
−10	0.10	−1.00
0	0.10	0.00
15	0.15	2.25
20	0.25	5.00
30	0.20	6.00
35	0.15	5.25
		16.25

$$\bar{X} = \sum_{i=1}^{n} X_i p(X_i) = 16.25 \text{ per cent}$$

Calculation of Standard Deviation of Return

Possible returns X_i	*Probability* $p(X_i)$	*Deviation* $(X_i - \bar{X})$	*Deviation squared* $(X_i - \bar{X})^2$	*Product* $(X_i - \bar{X})^2 p(X_i)$
−25	0.05	−41.25	1701.56	85.08
−10	0.10	−26.25	689.06	68.91
0	0.10	−16.25	264.06	26.41
15	0.15	−1.25	1.56	0.23
20	0.25	3.75	14.06	3.52
30	0.20	13.75	189.06	37.81
35	0.15	18.75	351.56	52.73
				$\sigma^2 = 274.69$

$$\text{Variance, } \sigma^2 = \sum_{i=1}^{n} [(X_i - \bar{X})^2 p(X_i)] = 274.69 \text{ per cent}$$

$$\text{Standard deviation, } \sigma = \sqrt{274.69} = 16.57 \text{ per cent}$$

Example 3 A stock costing Rs. 120 pays no dividends. The possible prices that the stock might sell for at the end of the year with the respective probabilities as follows:

Price (Rs.)	Probability
115	0.1
120	0.1
125	0.2
130	0.3
135	0.2
140	0.1

1. Calculate the expected return.
2. Calculate the standard deviation of returns.

Solution 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) Rs.	$P_1 - P_0$ Rs.	$[(P_1 - P_0)/P_0] \times 100$ 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 Return

Probable 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
		$\bar{X}$ = 7.083

Expected return, $\bar{X}$ = 7.08 per cent

Calculation of Standard Deviation of Returns

Probable return X_i	*Probability* $p(X_i)$	*Deviation* $(X_i - \bar{X})$	*Deviation squared* $(X_i - \bar{X})^2$	*Product* $(X_i - \bar{X})^2 p(X_i)$
−4.17	0.1	−11.25	126.56	12.66
0.00	0.1	−7.08	50.13	5.01
4.17	0.2	−2.91	8.47	1.69
8.33	0.3	1.25	1.56	0.47
12.50	0.2	5.42	29.38	5.88
16.67	0.1	9.59	91.97	9.20
				$\sigma^2 = 34.91$

Variance, $\sigma^2 = 34.91$ per cent

Standard deviation, $\sigma = \sqrt{34.91} = 5.91$ per cent

Example 4 An investor has analysed a share for a one-year holding period. The share is currently selling for Rs. 43 but pays no dividends and there is a fifty-fifty chance that the share will sell for either Rs. 55 or Rs. 60 by the year end. What is the expected return and risk if 250 shares are acquired with 80 per cent borrowed funds? Assume the cost of borrowed funds to be 12 per cent. (Ignore commissions and taxes).

Solution

Calculation of Probable Returns

Year-end prices (P_1) *(Rs.)*	$(P_1 - P_0)$ *(Rs.)*	*Return (per cent)* $[(P_1 - P_0)/P_0] \times 100$
55	12	27.91
60	17	39.53

Calculation of Expected Return

Probable return (per cent) (X_i)	*Probability* $p(X_i)$	*Product* $X_i p(X_i)$
27.91	0.50	13.955
39.53	0.50	19.765
		$\bar{X} = 33.720$

Calculation of Standard Deviation

Probable return X_i	*Probability* $p(X_i)$	*Deviation* $(X_i - \bar{X})$	*Deviation squared* $(X_i - \bar{X})^2$	*Product* $(X_i - \bar{X})^2 p(X_i)$
27.91	0.5	−5.81	33.76	16.88
39.53	0.5	5.81	33.76	16.88
				$\sigma^2 = 33.76$

Variance, $\sigma^2 = 33.76$
Standard deviation, $\sigma = 5.81$

Return and risk of buying 250 shares

Investment in 250 shares = 250 × Rs. 43
= Rs. 10,750

Borrowed funds (80 per cent) = Rs. 8,600

Expected return from 250 shares:

$$\text{Gross return} = \frac{10{,}750 \times 33.72}{100} = 3{,}624.90$$

Less: Interest at the rate of 12 per cent on borrowed funds

$$= \frac{8600 \times 12}{100} = 1{,}032.00$$

Net returns = 2,592.90

Risk in investing in 250 shares

$$= \frac{10{,}750 \times 5.81}{100} = \text{Rs. } 624.58$$

Example 5 Monthly return data (in per cent) are presented below for ITC stock and BSE National Index for a 12 month period.

Month	*ITC*	*BSE National Index*
1	9.43	7.41
2	0.00	−5.33
3	−4.31	−7.35
4	−18.92	−14.64
5	−6.67	1.58
6	26.57	15.19
7	20.00	5.11
8	2.93	0.76
9	5.25	−0.97
10	21.45	10.44
11	23.13	17.47
12	32.83	20.15

Calculate beta of ITC stock.

Solution Correlation coefficient is calculated with the following formula:

$$r = \frac{n\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{n\Sigma X^2 - (\Sigma X)^2} \cdot \sqrt{n\Sigma Y^2 - (\Sigma Y)^2}}$$

where

X = One data series (R_m).
Y = Other data series (R_i).
n = Number of items.

Calculation of Correlation Coefficient

ITC returns $Y(R_i)$	*BSE Index return* $X(R_m)$	Y^2	X^2	XY
9.43	7.41	88.92	54.91	69.88
0.00	−5.33	00.00	28.41	00.00
−4.31	−7.35	18.58	54.02	31.68
−18.92	−14.64	357.97	214.33	276.99
−6.67	1.58	44.49	2.50	−10.54
26.57	15.19	705.96	230.74	403.60
20.00	5.11	400.00	26.11	102.20
2.93	0.76	8.58	0.58	2.23
5.25	−0.97	27.56	0.94	−5.09
21.45	10.44	460.10	108.99	223.94
23.13	17.47	535.00	305.20	404.08
32.83	20.15	1077.81	406.02	661.52
111.69	49.82	3724.97	1432.75	2160.49

$$r = \frac{(12 \times 2160.49) - (49.82 \times 111.69)}{\sqrt{(12 \times 1432.75) - (49.82)^2}\sqrt{(12 \times 3724.97) - (111.69)^2}}$$

$$r = \frac{25,925.88 - 5564.40}{\sqrt{17193 - 2482.03}\sqrt{44,699.64 - 12,474.66}}$$

$$= \frac{20,361.48}{\sqrt{14,710.97 \times 32,224.98}} = \frac{20,361.48}{21,772.94}$$

$$r = 0.935$$

Standard deviation and variance can be calculated by using the following formula:

$$\text{Variance, } \sigma^2 = \frac{N\Sigma X^2 - (\Sigma X)^2}{N^2}$$

$$\text{Standard deviation, } \sigma = \sqrt{\frac{N\Sigma X^2 - (\Sigma X)^2}{N^2}}$$

where
X = Original data.
N = Number of items.

Standard deviation of ITC returns From the above table, the following data are available:

$$\Sigma R_i = 111.69 \qquad \Sigma R_i^2 = 3724.97 \qquad N = 12$$

$$\sigma_i = \sqrt{\frac{(12 \times 3724.97) - (111.69)^2}{12 \times 12}} = \sqrt{\frac{44,699.64 - 12,474.66}{144}}$$

$$= \sqrt{223.78} = 14.96$$

Variance and standard deviation of BSE Index returns From the above table, the following data are available:

$$\Sigma R_m = 49.82 \qquad \Sigma R_m^2 = 1432.75 \qquad N = 12$$

$$\sigma_m^2 = \frac{(12 \times 1432.75) - (49.82)^2}{12 \times 12}$$

$$= \frac{17,193 - 2482.03}{144} = \frac{14,710.97}{144} = 102.16$$

$$\sigma_m = \sqrt{102.16} = 10.11$$

Beta

$$\beta_i = \frac{r_{im}\sigma_i\sigma_m}{\sigma_m^2}$$

$$= \frac{(0.935)(14.96 \times 10.11)}{102.16} = \frac{141.41}{102.16}$$

$$\beta_i = 1.384$$

Example 6 With the data given in example 5, calculate beta of ITC stock, using the regression model.

Solution

Dependent variable $Y = R_i$

Independent variable $X = R_m$

From the table prepared for solving the problem in example 5, we have the following values:

$$\Sigma XY = 2160.49 \qquad \Sigma X = 49.82 \qquad \Sigma Y = 111.69$$

$$\Sigma X^2 = 1432.75 \qquad n = 12$$

$$\bar{Y} = \frac{\Sigma Y}{n} = \frac{111.69}{12} = 9.31$$

$$\bar{X} = \frac{\Sigma X}{n} = \frac{49.82}{12} = 4.15$$

$$\beta = \frac{n\Sigma XY - (\Sigma X)(\Sigma Y)}{n\Sigma X^2 - (\Sigma X)^2}$$

$$= \frac{(12 \times 2160.49) - (49.82 \times 111.69)}{(12 \times 1432.75) - (49.82)^2}$$

$$= \frac{25,925.88 - 5564.40}{17,193 - 2482.03}$$

$$= \frac{20,361.48}{14,710.97}$$

$$\beta = 1.384$$

$$\alpha = \bar{Y} - \beta\bar{X} = 9.31 - (1.384 \times 4.15)$$

$$= 9.31 - 5.74 = 3.57$$

Example 7 Monthly return data (in per cent) for ONGC stock and the NSE index for a 12 month period are presented below:

Month	*ONGC*	*NSE Index*
1	−0.75	−0.35
2	5.45	−0.49
3	−3.05	−1.03
4	3.41	1.64
5	9.13	6.67
6	2.36	1.13
7	−0.42	0.72
8	5.51	0.84
9	6.80	4.05
10	2.60	1.21
11	−3.81	0.29
12	−1.91	−1.96

1. Calculate alpha and beta for the ONGC stock.
2. Suppose NSE index is expected to move up by 15 per cent next month. How much return would you expect from ONGC?

Solution Since alpha and beta of the stock are to be calculated, the regression model may be used.

Calculation of α and β of stock

ONGC returns $Y(R_i)$	*NSE Index return* $X(R_m)$	X^2	XY
−0.75	−0.35	0.12	0.26
5.45	−0.49	0.24	−2.67
−3.05	−1.03	1.06	3.14
3.41	1.64	2.69	5.59
9.13	6.67	44.49	60.90
2.36	1.13	1.28	2.67
−0.42	0.72	0.52	−0.30
5.51	0.84	0.71	4.63
6.80	4.05	16.40	27.54
2.60	1.21	1.46	3.15
−3.81	0.29	0.08	−1.10
−1.91	−1.96	3.84	3.74
25.32	12.72	72.89	107.55

$$\beta = \frac{n\Sigma XY - (\Sigma X)(\Sigma Y)}{n\Sigma X^2 - (\Sigma X)^2}$$

$$= \frac{(12 \times 107.55) - (12.72 \times 25.32)}{(12 \times 72.89) - (12.72)^2}$$

$$= \frac{1290.60 - 322.07}{874.68 - 161.80} = \frac{968.53}{712.88}$$

$$\beta = 1.359$$

$$\alpha = \bar{Y} - \beta\bar{X}$$

$$= \frac{25.32}{12} - (1.359)\frac{12.72}{12}$$

$$= 2.11 - (1.359)\ (1.06) = 2.11 - 1.44 = 0.67$$

The expected return from ONGC stock when NSE index moves up by 15 per cent can be calculated from the regression equation which is

$$R_i = 0.67 + 1.359\ R_m$$

Substituting the value of R_m as 15 in the equation, we get

$$R_i = 0.67 + 1.359\ (15) = 0.67 + 20.385 = 21.055$$

UNIT 3 RISK AND RETURN

Objectives

The objectives of this Unit are to:

- Explain the concepts of Risk and Return
- Describe the genesis of total Investment Risk.
- Distinguish between 'Systematic' and 'Unsystematic' Risk.
- Identify the factors that affect Risk in Investment in Equity Shares.

Structure

3.1 CONCEPT OF INVESTMENT RISK

The term 'risk' is commonly used in the investment sector. In everyday life, the word risk frequently connotes an unexpected negative outcome. When you say it is risk to drive on a certain route, you are implying that driving on that route could result in an accident. The term risk in the context of investments, on the other hand, has a different meaning. It not only denotes the possibility of a negative outcome but also the likelihood of a less positive outcome.

As you are aware risk and return are interrelated. A person purchases a financial asset with the intent of receiving a profit. The investment decision would be based on an 'anticipated return,' which may be realized or not. The risk associated with an investment decision is the possibility of an "unexpected" negative or "adverse" return.

Almost every decision involves some level of risk. When a manufacturing manager chooses equipment, a marketing manager creates an ad campaign, or a finance manager manages a portfolio of assets, they are all dealing with uncertain cash flows. The financial analysis includes assessing risks and incorporating their likely effect into financial decisions. The variability in return from security is described as a risk in theory. On the other hand, security that generates consistent returns over time and the returns are assured

based on some type of guarantee usually sovereign guarantee is referred t a "risk-less security" or "risk-free security," whereas security that generat inconsistent returns over time is referred to as a "risky asset." Take a look at the following options, for example:

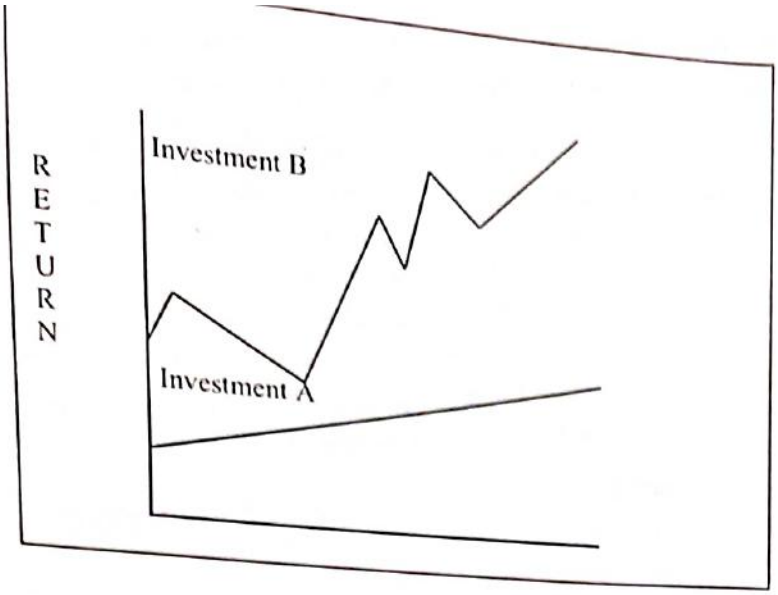
- Rs.1000, 12% 2020 Government of India Loan.
- Rs.100, 14.5% 2005 TISCO Non-Convertible Debentures.

The Government Loan would have zero risk because the government system does not collapse, and interest and principal repayments are guaranteed. In the case of TISCO debentures, here are protective covers in the shape of corporate assets and sustained solid financial performance, but there is a risk of poor performance and default.

For many investors, investment risk is a major source of anxiety. When a secondary market fails to respond to rational expectations, the risk component of such markets is rather large, and most investors are unaware of the true risk involved in the investment process. Risk aversion is a characteristic that many small investors have in the secondary market. Small investors, in particular, look to the market for a certain return, and when their expectations are not satisfied, it has a detrimental impact on their morale. As a result, these investors prefer to put their money into assets that will give them a small return on average rather than securities that may give them a large return on average but fluctuate wildly.

There are also risk-taking investors in the financial system. Speculators are risk-takers who choose to invest in securities that provide large returns even though the certainty of such returns is relatively low. In the market, they are also known as risk-takers. A secondary market requires both risk-takers and risk-averse investors.

In figure-3.1(i), an investor given the following investment options would surely pick investment 'B' over investment 'A'. Whereas in figure 3.1(ii), Investment 'A' provides a predictable income stream. Comparing Figures 3.1 (i) and 3.1 (ii), we find Investment 'B' is predictable in the figure 3.1(i) but variable in figure 3.1 (ii). The risk of a security is defined as the volatility in the flow of income to investors. Despite the danger in the second case, the investor's preference would still be for investment 'B' because it provides a better return almost every time. This can be interpreted as the investor is associated with higher return for taking greater risk.



3.1 (ii) Fluctuating Return

Activity 3.1

a) Define risk.

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b) Can the risk of investment be considered without reference to return?

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3.2 EVOLUTION OF RISK CONNOTATIONS

In the twenty-first century, analysts would utilize financial statement data to assess the risk of a company's securities. They utilized the quantity of debt held by the company as a broad indication. Their rule was that the bigger the amount of debt, the riskier the securities. In the 1962 edition of their seminal work titled "Security Analysis," Graham Dodd and Cottle, who are considered pioneers of "security analysis" as a field, emphasized "margin of safety" as a measure of risk. They believed that security analysis should compute a security's "intrinsic worth," which is independent of its market price. 'The intrinsic worth of an asset would be the security analyst's own opinion based on its earning power and financial attributes, without reference to its market price,' they claim. The margin of safety was defined as the

difference between "intrinsic value" and "market price," and the assessment criterion was "the bigger the margin of safety, the lower the risk.

Other than the standard deviation, measurements such as range, semi-variance, and mean absolute deviation have been employed to assess risk. However, the standard deviation is widely accepted since it allows probability statements for a wide range of distributions. This 'total' is decomposed into multiple components by the investment risk, which can be done in two ways. The first is to divide total risk into systematic and unsystematic risk, and the second is to divide total risk into components, each of which has a causal force as its source.

Inflation, interest rates, market sentiment, and other pervasive risks can be divided into two categories: those that affect all securities to varying degrees, such as inflation, interest rates, and market sentiment, and those that are specific to a particular security, such as financial risk and business risk.

When return variability moves with the market, it is known as 'systematic risk'. Such a risk is impossible to eradicate, and it is a big source of anxiety for investors. When prices rise, for example, all enterprises are affected in terms of their expenses and realizations, which affect return variability. This will be a market phenomenon and would tend to stay for all. In calculating his projected rate of return, the investor would seek compensation for this risk factor.

Non-systematic risk, on the other hand, occurs when returns vary due to firm-specific factors such as failure to get a prestigious foreign contract or a higher exposure to the risk of default in payment of interest charges and debt obligations. This type of risk is not taken into account when calculating the expected or needed rate of return because it can be mitigated with a diverse portfolio.

3.3 SOURCES OF RISK

The risk associated with an investment is always a concern for an investor. He is confronted with several inquiries. To comprehend risk, S/he needs to be aware of the following:

i) What makes investment risky?

ii) What are the various elements or sources of risk that the investments are exposed to?

Variations in investment return can be attributed to a variety of factors. Each of these sources carries a certain amount of danger. We have mentioned above that there are various causes for future returns differing from predicted returns. Now, let us focus on understanding distinct risk sources. The following are the several sources of risk in investments:

i) Market Risk

Even though the company's earnings do not change, market prices of investments, particularly equity shares, may fluctuate in a short period.

The causes for this pricing change could be several. Investors' attitudes toward equities may change as a result of one or more factors, leading to a change in market price. The return on investment varies depending on the market price. This is referred to as market risk. Market risk is the variation in return caused by changes in the market price of an investment and arises as a result of investors' reactions to various key occurrences. The market prices of equity shares are affected by a variety of social, political, economic, and firm-specific events. Another aspect that influences market prices is market psychology. Market prices for all shares tend to rise during bull periods, while prices tend to fall during bear phases.

Business cycles have been discovered to be a primary driver of the timing and extent of bull and bear market periods. This would imply that the ups and downs in the stock market correspond to the economy's expansion and contraction cycles. Pessimism is triggered by a bear market, and prices plummet on a large scale. Although there may be exceptions, empirical evidence suggests that it is difficult for investors to avoid losing money in down markets. As stated earlier, market risk can be characterized as systematic or non-systematic. When a number of systematic forces cause the majority of stocks to rise during a bull market and decrease during a bear market, it is said to be a market situation called systematic market risk.

As is stated earlier, a small percentage of securities would be negatively associated with the current market trend. For example firms which have been granted a valuable patent for gaining a profitable additional market share, may see their share prices rise despite the market's general gloom. Such unsystematic price swings are diversifiable, and the securities that are exposed to them can be managed with other shares, resulting in a diversified portfolio.

ii) Interest-Rate Risk.

The interest rate influences the return on securities in a variety of ways. Because investors always compare risk-free return with expected return on investment, it has an impact on the expected or required rate of return. When the interest rate rises, the expected or needed rate of return on other assets rises as well. Thus, the interest rates on risk-free (government) securities and the general rate of interest are linked. The rate of interest on other bond securities rises or falls in tune with the risk-free rate of interest. Interest rate risk refers to the variation in return induced by market price changes in fixed income products, such as bonds and debentures. The price of a security (bonds and debentures) is inversely proportional to the level of interest rates. Existing securities' prices decline when the interest rate rises, and vice versa. Changes in interest rates have a direct impact on bond and debenture prices, as well as an indirect impact on equity share values.

i) **Inflation Risk.**

Inflation risk is the variability in the total purchasing power of an asset. It arises from the rising general price level. Thus, it refers to the unpredictability of the buying power of cash flows expected from an investment. It depicts how inflation or deflation affects an investment. Interest rates on bonds and debentures, as well as dividend rates on stock and preference shares, are expressed in money terms, and if the general price level rises in the future, the purchasing power of cash interest/dividend income will certainly drop. If the money rate of return is equal to the rate of inflation, the investor obtains a zero rate of return.

Many investors feel that, despite inflation, they will be better off if the market prices of their financial assets rise. After all, money is increasing, they argue. This is nothing more than a monetary delusion. Take, for example, a circumstance in which the market price of security you own doubles and the overall price level quadruples. Would you consider yourself to be wealthier just because your control over money has doubled as a result of selling the security? True, you get more money than before, but you can only buy so much with it. You cannot deny that, as a result of a four-fold increase in pricing in general, your control over goods and services (which is the ultimate goal of all investment decisions) has eroded. Thus, the risk of inflation originates from the uncertainty of the purchasing power of the money to be gained from future investments.

iv) **Business Risk.**

Business enterprises work in a constantly changing environment, which makes expected income to fluctuate. A change in government policy on fertilizer subsidies, for example, could harm a group of fertilizer companies. Similarly, a competitor's conduct, whether domestic or foreign, might have an impact on other businesses. While the aforementioned changes in the environment are the result of specific entities, several other elements alter the operational environment but can not be traced to a particular sources. For example, many businesses are affected by the business cycle, and their earnings fluctuate dramatically from one year to the next.

Steel, auto, and transportation companies are all affected by these business cycles. It might be difficult to determine if a company's risk is systematic or not. A diverse portfolio of assets from several industries can help to mitigate such company specific risk to a large extent. Portfolios with a few firms or companies from a few industries, on the other hand, would be vulnerable to such business risk if all sectors of the portfolio are affected by environmental changes.

v) **Financial Risk.**

When the company capital structure includes debt, financial risk occurs. Debt creates a fixed liability, which increases the income variability available to equity stockholders and it is not always a negative thing. It

will boost profitability when the company performs well, and stock investors receive a higher return than would otherwise be available. Because of the fixed liability, debt causes problems in poor times. If the company fails to satisfy its debt obligations, the managers will have to spend a significant amount of time convincing lenders to accept a delayed payment, wasting valuable managerial time in the process.

The default easily spreads negative information about the organization, and the corporation is plagued by problems on multiple fronts. It may be unable to obtain financing from suppliers, and some of its best employees may depart. Customers will also favor organizations with strong financials to minimize supply disruptions. However, until the loan is completely secured, too much debt causes challenges for even current debt security holders. Even in such circumstances, due to the lengthy legal process, seizing assets and selling them to fulfill their liabilities is challenging.

vi) Management Risk:

Management risk is the portion of total return variability caused by managerial actions in companies where the owners are not the managers. Regardless of how experienced the Management team is, there is always the risk of making a mistake or making the wrong decision. Owners-investors are rightfully enraged when executives are paid large salaries and bonuses and are given ego-boosting non-income spendings such as fancy automobiles and lavishly equipped offices, but their poor decisions put the company in serious trouble.

Management errors are the primary causes of the management risk component of overall investor risk. There are so many of them that it is difficult to keep track of them all, let alone classify them. Nonetheless, certain potential managerial blunders can be identified. Ignoring product obsolescence is one of the biggest mistakes that management can make. In reality, adequate R&D expenditures must be made, and alternative products must be promoted before the old ones' life cycle ends. Firms with a single product line will be more vulnerable to this risk than those with a diverse product range.

A company's reliance on a single large customer also may cause this risk. Many software firms are now dealing with this issue and are attempting to diversify their customer base as well as their geographic exposure. Another example of management mistakes could be how a correct choice is handled when it is unfairly criticized and even litigated in court. For example, a vehicle company produces a fuel-efficient tiny car well ahead of its time. Some zealous consumer advocacy group files a lawsuit because they perceive that user safety is being jeopardized. The company then announces the product's discontinuation, leaving investors to endure the loss of their capital as well as future revenue losses. Please keep in mind that these examples are merely examples, and the list might go on indefinitely.

3.4 TYPES OF RISK

The first three types of risk in investments, namely market risk, interest rate risk, and inflation risk, are external to the firm and therefore cannot be managed. These are all pervasive and have an impact on all businesses. The business and financial risk, on the other hand, are controlled and internal to a certain corporation. Based on this analysis, the risk may be classified into systematic and unsystematic risk.

i) Systematic Risk.

The portion of return variability induced by factors impacting all enterprises is referred to as systematic risk. Diversification will not be able to mitigate such a risk. The following are some examples of systemic risk:

- The government changes the interest rate policy.
- The corporate tax rate is increased.
- The government resorts to massive deficit financing.
- The inflation rate increased.
- The Central Bank of the Country promulgates a restrictive credit policy.
- Government fails to attract FIIs.

ii) Unsystematic Risk.

The unsystematic risk is the variation in the return of an investment owing to factors that are specific to the firm and not to the market as a whole. Unsystematic, or unique risk, is a type of risk that can be completely mitigated through diversification. The following are some examples of unsystematic risk:

- Workers declare a strike in a company.
- The R&D expert of the company leaves.
- A formidable competitor enters the market.
- The company loses a big contract in a bid.
- The company makes a breakthrough in process of innovation.
- The government increases custom duty on the material used by the company.
- The company is not able to obtain an adequate quantity of raw material used by the company.

Total risk is equal to systematic risk + non-systematic risk because the two components are additive. In most cases, systemic risk is calculated by comparing the stock's performance to the market's performance under various scenarios. For example, if the stock appreciates more than other stocks in the market during a good period and depreciates more than other stocks in the

market during a poor period, the stock's systematic risk is more than the market risk.

The market's systematic risk is one, and systematic risk of all stocks is stated in terms of the market index's systematic risk. This is accomplished by measuring a value known as beta. When stock returns are regressed on market-index returns, the beta of the stock equals the beta of the regression coefficient. If a stock's beta is 1.50, it is likely to see a price increase of 1.5 times as compared to market return of 1. At the same time, if the market falls by a certain percentage in a terrible period, the stock is predicted to fall 1.5 times as much as the market.

Risk Vs. Uncertainty:

Although the terms risk and uncertainty are sometimes used interchangeably, their perceptions differ. Risk implies that a decision-maker is aware of the probable outcomes of a decision and its associated probabilities. Uncertainty refers to a scenario in which the likelihood of a particular occurrence is unknown. Investors strive to maximize Expected Returns while staying within their risk tolerance. The degree of risk depends upon the basis of the features of assets, investment instruments, and the mode of investment.

Causes of Risk:

Some factors, which can be stated to cause risk in the investment arena, are given below:

- Wrong method of investment,
- Wrong period of investment,
- Wrong quantity of investment,
- Interest rate risk,
- Nature of investment instruments,
- Nature of industry,
- Nature of business in which investment is made,
- National and international factors,
- Nature calamities etc.

3.5 MEASURING HISTORICAL RETURN

The total return on investment for a given period is:

$$\text{Total return} = \frac{\text{Cash Payment received during period} + \text{Price change over the period.}}{\text{Price of the investment at the beginning}}$$

The amount received throughout the period could be positive or negative. The difference between the ending price and the initial price is the rupee price change over time. This might be positive (the ending price is higher

than the beginning price), zero (the ending price is the same as the beginning price), or negative (the ending price is lower than the beginning price).

$$R = \frac{C+(P_E - P_B)}{P_B}$$

Where R= total return over the period

C= cash payment received during the period

P_E = ending price of the investment

P_B = beginning price

To illustrate, consider the following information for an equity stock:

- Price at the beginning of the year: Rs.70.00
- Dividend paid at the end of this year: Rs.5.00
- Price at the end of the year: Rs.80.00

The total return on this stock is calculated as follows:

$$\frac{5.00 + (80-70)}{70} = 0.214 \text{ or } 21.4\%$$

3.6 MEASURING HISTORICAL RISK

Risk refers to the possibility that the actual outcome of an investment will differ from the expected outcome. Alternatively, risk refers to variability or dispersion. If an asset's return has no variability, it is riskless. Suppose you are analyzing the total return of an equity stock over some time. Apart from knowing the mean return, you would also like to know about the variability in returns.

Variance and Standard Deviation:

The most commonly used measures of risk in finance are the Variance or its square root; the Standard Deviation. The variance and the standard deviation of a historical risk are defined as follows:

Standard deviation = $\sqrt{Varience}$

$$\sigma = \sqrt{\sigma^2}$$

$$\sigma^2 = \frac{1}{n-1}\sum_{i=1}^{n}\left(R_i - \overline{R}\right)^2$$

Where, σ^2 = Variance of Return

R_i = return from the stock in period I(I=1,….,n)

$\overline{R}$ = average rate of return or mean of the returns

n = number of periods

σ = standard deviation

To illustrate, consider initial rate of return is 16% and the returns from a stock over 6 years period are:

R_1=16%, R_2=12%, R_3=20%, R_4 = -13%, R_5 =15%, R_6 = 10%

The variance and standard deviation of returns are calculated as below:

Period	Return	Deviation $(R_i - R)$	Square of deviation $(R_i - \bar{R})^2$
1	16	16-10= 6	36
2	12	12-10= 2	4
3	20	20-10= 10	100
4	-13	-13-10= -23	529
5	15	15-10 = 5	25
6	10	10-10= 0	0
	$\sum R_i = 60$		$\Sigma\left(R_i - \bar{R}\right)^2$ 694

$$\sigma^2 = \frac{694}{6-1} = 138.8$$

$$\sigma = \sqrt{138.8} = 11.78$$

Variance = 138.8 and Standard deviation = $\sqrt{138.8} = 11.78$

Looking at the above calculations, we find that:

- The squared difference between the distinct values and the mean values. This means that values that are distant from the mean have a significantly greater impact on standard deviation than those that are near to it.
- The square root of the average of squared variances yields the standard deviation. This means that the standard deviation and the mean are both expressed in the same units, allowing them to be compared directly.

3.7 MEASURING EXPECTED RETURN AND RISK

We have just looked at historical (ex facto) return and risk so far. Now we will discuss the predicted (ex-ante) return and risk.

i) Probability Distribution:

When you buy a stock, you understand that the return on your investment might be anything. For example, it could be 5%, 15%, or even 35%. Furthermore, the probability of these possible returns varies. As a result, you should consider probability distributions.

The likelihood of an event's occurrence is represented by its probability. Assume there is 80% possibility that the market price of stock A will climb in the following two weeks. This means that there is 80% likelihood that the price of stock A will raise in the next two weeks, and a 20% chance that it will remain unchanged.

Outcome	Probability
Stock price will rise	0.80
Stock price will not rise	0.20

Another illustration of the concept of probability distribution could be presented.

Consider the stock of Bharat Foods and the stock of Oriental Shipping. Based on the status of the economy, Bharat Foods stock could produce a return of 16%, 11%, or 06%, with certain probability associated with each. Based on the status of the economy, the second stock, Oriental Shipping stock, which is more volatile, might achieve a return of 40%, 10%, or -20% with the same odds. The following Exhibit shows the probability distributions of the returns for these two stocks:

State of Economy	Probability of Occurrence	Rate of Return (%)	
		Bharat Foods Shipping	Oriental
Boom	0.30	16	40
Normal	0.50	11	10
Recession	0.20	06	-20

You can compute two crucial parameters, the expected rate of return and the standard deviation of the rate of return, using the probability distribution of the rate of return.

ii) Expected Rate of Return:

The expected rate of return is the weighted average of all possible returns multiplied by their respective probabilities. In symbols:

$$E(R) = \sum_{i=1}^{n} R_i P_i$$

Where,

E (R) = expected return from the stock
R_i = return from stock under state i
P_i = probability that the state i occurs
n = number of possible states of the world

From the above equation, E(R) is the weighted average of possible outcomes – each outcome is weighted by the probability associated with it. The expected rate of return on Bharat Foods stock is:

$E(R_B) = (0.30)\ (.16\%) + (0.50)\ (.11\%) + (0.20)\ (6\%) = 11.5\%$

$E(R_B) = .048 + .055 + .012 = 0.115 = 11.5\%$

Similarly, the expected rate of return on Oriental Shipping stock is:

$E(R_O) = (0.30)\ (40\%) + (0.50)\ (10\%) + (0.20)\ (-20\%) = 13.0\%$

$= .12 + .05 + (-.04) = .13 = 13\%$

iii) Standard Deviation of Return:

The dispersion of a variable is referred to as risk. The variance or standard deviation are usually used to calculate it. The sum of the squares of the deviations of actual returns from the expected return, weighted by the related probabilities, is the variance of a probability distribution. In terms of symbols,

$$\sigma^2 = \sum P_i \times [R_i - E(R)]^2$$

Where,

σ^2 = Variance

R_i =return for the ith possible outcome

P_i = Probability associated with the ith possible outcome

E (R) = Expected return

Since variance is expressed as squared returns it is somewhat difficult to grasp. So, its square root, the standard deviation, is employed as an equivalent measure.

$$\sigma = \sqrt{\sigma^2}$$

Solution:

Taking expected return as 11.5%, we calculate:

Bharat Foods Stock						
State of the Economy	P_i	R_i	$R_i - E(R)$	$[(R_i - E(R))]^2$	$P_i [R_i - E(R)]^2$	$R_i P_i$
Boom	0.30	16	4.5	20.25	6.075	4.8
Normal	0.50	11	-0.5	0.25	0.125	5.5
Recession	0.20	6	-5.5	30.25	6.050	1.2
					$\sum = 12.25$	$\sum = 11.5$

$$E(R) = \sum_{i=1}^{n} R_i P_i = 11.5$$

$\sigma^2 = \sum P_i (R_i - E(R))^2 = 12.25$

$\sigma = (\sum P_i (R_i - E(R))^2)^{1/2} = 3.5\%$

Taking expected return as 13%, we calculate:

Oriental Shipping Stock						
State of the Economy	P_i	R_i	$R_i - E(R)$	$[(R_i - E(R))]^2$	$P_i [R_i - E(R)]^2$	$R_i P_i$
Boom	0.30	40	27.0	729.0	218.7	12
Normal	0.50	10	-3.0	9	4.5	5
Recession	0.20	-20	-33.0	1089.0	217.8	–4
					$\sum$=441	$\sum$=13

$$E(R) = \sum_{i=1}^{n} R_i P_i = 13.0$$

$$\sigma^2 = \sum P_i (R_i - E(R))^2 = 441.0$$

$$\sigma = (\sum P_i (R_i - E(R))^2)^{1/2} = 21.0\%$$

3.8 SUMMARY

The majority of investors are risk-averse and want to get the most out of their money while taking the fewest risks possible. The greater the risk that a person is willing to face, the greater is the potential reward. The investor analyses prior experience to estimate risk adapts it properly for projected future changes and then produces a subjective probability distribution of prospective returns from the proposed investment.

The expected value of the return and its variability are then estimated using this probability distribution. The expected value is given by the mean, while the variability, or standard deviation, is given by the variance or risk measure. The mean-variance technique is a commonly used method for measuring risk. The variance, often known as the standard deviation, is a measure of risk. It calculates overall risk and several factors that contribute to the total risk. To understand the impact of these components individually, a decomposition of total risk would be required.

When it comes to defining the elements that influence total risk, there are two major categories to consider; factors that produce non-diversifiable or systematic risk and factors that induce non-diversifiable or unsystematic risk. The first group includes factors such as interest rate fluctuations, inflation, and market mood (or bull-bear market), all of which have an impact on all businesses and can be measured to help determine the required rate of return. The causes such as the business environment, financial leverage, management quality, liquidity, and the risk of default would fall under the latter category. They have an impact on certain businesses but not on all. These sources of risk are unlikely to have a significant influence on a well-diversified portfolio, therefore, they are not worth worrying about.

3.9 KEY WORDS

Agency Theory: The documents, believe that managers are motivated to consume rather than work hard, as opposed to owners who are motivated to work hard. Delegation of authority to executives who manage on behalf of owners is the foundation of the objective decision-making process. The non-owner managers, according to agency theory are more prone to management errors.

Agency Cost: The difference in value between a firm controlled by executive delegates and one managed by owners, with the latter having a higher worth.

Coupon Rate Risk: The probability of the coupon rate of interest printed on the face of a debt security as a percentage of its face value being changed in successive short periods.

Diversifiable Risk: Variability of a return caused by factors that are unique to one or a few securities. Such variability is averaged out to zero in a diversified portfolio and can, therefore, be eliminated.

Default Risk: The variability of returns to investors caused by changes in the probability that the company issuing securities might default. Also known as financial risk and/or bankruptcy risk.

Liquidity Risk: The probability that securities will not be sold out for cash without price discounts and/or commission.

Non-Diversifiable Risk: Variability in the investor's rates of return arising out of common and macro-level factors like an economic downturn, general rise in prices. Increase in interest rates, and bull/bear phases of the securities market. All returns of securities are systematically affected by these factors. Hence, the risk is also known as 'systematic risk'.

Recession: A period when overall company activity drops during several months or even years.

3.10 SELF ASSESSMENT QUESTIONS

1. Differentiate between Expected Return and Realized Return.
2. What do you mean by risk? How is it different from uncertainty?
3. What are the sources of risk in an investment? Explain.
4. How the return of an investment can be measured? What are the elements of risk?
5. Explain the following terms:

   a) Diversifiable interest rate risk b) Liquidity risk c) Market risk
6. Distinguish between

   a) Financial risk and business risk

   b) Diversifiable risk and non-diversifiable risk

   c) Market interest rate risk and coupon rate risk
7. Prashanth is considering investing in a security that has the following distribution of possible one-year returns:

Probability of occurrence	.10	.20	.30	.30	.10
Possible return	-.10	.00	.10	.20	.30

   a) What is the expected return and standard deviation associated with the investment?

   b) Is there much "downside" risk? How can you tell?