

## Lesson 3

### Risk Return Analysis

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#### Objectives of the lesson

After studying this lesson, students will be able to:

- Understand the concept and computation of historic and expected rate of return,
- Describe meaning, components and determinants of risk, and
- Understand various methods of calculating risk.

#### 1.0 Introduction

A return is the ultimate objective for any investor. But, a relationship between return and risk is a key concept in finance. As finance and investments areas are built upon a common set of financial principles, the main characteristics of any investment are investment return and risk. However, to compare various alternatives of investments the precise quantitative measures for both of these characteristics are needed.

#### 2.0 Meaning, Components and Calculation of Return

General definition of return is the benefit associated with an investment. In most cases the investor can estimate his/ her historical return precisely. Many investments have two components of their measurable return, viz., (i) a capital gain or loss, (ii) some form of income.

The rate of return is the percentage increase in returns associated with the holding period.

$$\text{Rate of Return} = \left( \frac{\text{Income} + \text{Capital Gains}}{\text{Purchase Price}} \right) \times 100$$

The rate of return on a stock (share) is estimated as:

$$R = \frac{D + (P_1 - P_0)}{P_0} \times 100$$

Here D = dividends, P<sub>0</sub> = market price of stock at the beginning of holding period, P<sub>1</sub> = market price of stock at the end of the holding period.

The rate of return, calculated by above formulae is called holding period return, because its calculation is independent of the passages of the time. All the investor knows is that there is a beginning of the investment period and an end. The percent calculated using this formula might have been earned over one month or other the year. Investor must be very careful with the interpretation of holding period returns in investment analysis. Investor can't compare the alternative investments using holding period returns, if their holding periods (investment periods) are different.

Statistical data which can be used for the investment analysis and portfolio formation deals with a series of holding period returns. For example, investor knows monthly returns for a year of two stocks. How he/ she can compare these series of returns? In these cases arithmetic average return or sample mean of the returns can be used. But, both holding period returns and sample mean of returns are calculated using historical data. However what happened in the past for the investor is not as important as what happens in the future, because all the investors' decisions are focused to the future, or to expected results from the investments. Of course, no one investor knows the future, but he/ she can use past information and the historical data as well as to use his knowledge and practical experience to make some estimates about it. Analyzing each particular investment vehicle possibilities to earn income in the future investor must think about several scenarios of probable changes in macro economy, industry and company which could influence asset prices and rate of return.

Theoretically it could be a series of discrete possible rates of return in the future for the same asset with the different probabilities of earning the particular rate of return. But, for the same asset the sum of all probabilities of these rates of returns must be equal to 1 or 100 percent. In mathematical statistics it is called simple probability distribution.

The expected rate of return  $E(r)$  of investment is the statistical measure of return, which is the sum of all possible rates of returns for the same investment weighted by probabilities.

$$ExR = \sum P_i R_i$$

Here,  $ExR$  = Expected Rate of Return,  $R_i$  = Return for possible outcome, and  $P_i$  = Probability associated with  $R_i$

In all cases than investor has enough information for modeling of future scenarios of changes in rate of return for investment, the decisions should be based on estimated expected rate of return. But sometimes sample mean of return (arithmetic average return) are a useful proxy for the concept of expected rate of return. Sample mean can give an unbiased estimate of the expected value, but obviously it's not perfectly accurate, because based on the assumption that the returns in the future will be the same as in the past. But this is the only one scenario in estimating expected rate of return. It could be expected, that the accuracy of sample mean will increase, as the size of the sample becomes longer (if  $n$  will be increased). However, the assumption, that the underlying probability distribution does not change its shape for the longer period becomes more and more unrealistic. In general, the sample mean of returns should be taken for as long time, as investor is confident there has not been significant change in the shape of historical rate of return probability distribution.

### 3.0 Meaning and Components of Risk

Risk in finance refers to possible deviations or variations in expected return. There are two major components of risk. These are (i) systematic risk and (ii) unsystematic risk; the combination of two results in total risk.

**3.1 Systematic Risk:** Systematic risk is variation in the returns on securities arising due to macroeconomic factors of business such as social, political or economic factors. Such fluctuations are related to the changes in the return of the entire market. Systematic risk is caused by the changes in government policy, the act of nature such as natural disaster, changes in the nation's economy, international economic components, etc. The risk may result in the fall of the value of investments over a period. It is divided into three categories, viz., interest rate risk, inflation risk, and market risk.

- Interest rate risk is caused by the fluctuation in the rate or interest from time to time and affects interest-bearing securities like bonds and debentures.
- Inflation risk, also known as purchasing power risk (as it adversely affects the purchasing power of an individual) arises due to a rise in the cost of production, the rise in wages etc.
- Similarly, market risk influences the prices of a share, i.e. the prices will rise or fall consistently over a period along with other shares of the market.

**3.2 Unsystematic Risk:** The risk arising due to the fluctuations in returns of a company's security due to the micro-economic factors, i.e. factors existing in the organization, is known as unsystematic risk. The factors that cause such risk relates to a particular security of a company or industry so influences a particular organization only. The risk can be avoided by the organization if necessary actions are taken in this regard. It has been divided into two category, viz., business risk and financial risk.

- Business risk is inherent to the securities, whether companies perform well or not. The risk when a company performs below average is known as a business risk. There are some factors that cause business risks like changes in government policies, the rise in competition, change in consumer taste and preferences, development of substitute products, technological changes etc.
- Financial risk, also known as leveraged risk is associated with changes in capital structure of the company. The debt-equity ratio is the expression of such risk.

The basic differences between systematic and unsystematic risk is provided in the following points:

1. Systematic risk means the possibility of loss associated with the whole market or market segment. Unsystematic risk means risk associated with a particular industry or security.
2. Systematic risk is uncontrollable whereas the unsystematic risk is controllable.

3. Systematic risk arises due to macroeconomic factors. On the other hand, the unsystematic risk arises due to the micro-economic factors.
4. Systematic risk affects a large number of securities in the market. Conversely, unsystematic risk affects securities of a particular company.
5. Systematic risk can be eliminated through several ways like hedging, asset allocation, as opposed to unsystematic risk that can be eliminated through portfolio diversification.
6. Systematic risk is divided into three categories, i.e. interest rate risk, market risk and purchasing power risk. Unlike unsystematic risk is divided into two broad categories business risk and financial risk.

#### **4.0 Computation of Risk**

Risk is associated with the dispersion in the likely outcome. And dispersion refers to variability. So, the total risk of investments can be measured with such common absolute measures used in statistics as (i) variance, and (ii) standard deviation.

Variance can be calculated as a potential deviation of each possible investment rate of return from the expected rate of return.

$$\text{Var or } \sigma^2 = \sum P_i (P_i - (\bar{P}_i))^2$$

To compute the variance in above formula all the rates of returns which were observed in estimating expected rate of return ( $\bar{R}_i$ ) have to be taken together with their probabilities of appearance ( $P_i$ ).

The other an equivalent to variance measure of the total risk is standard deviation which is calculated as the square root of the variance.

$$\sigma = \sqrt{\sum P_i (P_i - (\bar{P}_i))^2}$$

In the cases than the arithmetic average return or sample mean of the returns ( $\bar{R}$ ) is used instead of expected rate of return. Variance and the standard deviation are similar measures of risk and can be used for the same purposes in investment analysis; however, standard deviation in practice is used more often.

Variance and standard deviation are used when investor is focused on estimating total risk that could be expected in the defined period in the future. Sample variance and sample standard deviation are more often used when investor evaluates total risk of his/ her investments during historical period – this is important in investment portfolio management.

The expected rate of return and the variance or standard deviation provide investor with information about the nature of the probability distribution associated with a single asset. However all these numbers are only the characteristics of return and risk of the particular asset. But how does one asset having some specific trade-off between return and risk

influence the other one with the different characteristics of return and risk in the same portfolio? And what could be the influence of this relationship to the investor's portfolio? The answers to these questions are of great importance for the investor when forming his/her diversified portfolio. The statistics that can provide the investor with the information to answer these questions are covariance and correlation coefficient. Covariance and correlation are related and they generally measure the same phenomenon – the relationship between two variables. These concepts are best understood in securities analysis and portfolio management.

### **Summary**

The main characteristics of any investment are investment return and risk. However to compare various alternatives of investments the precise quantitative measures for both of these characteristics are needed. Many investments have two components of their measurable return: (i) a capital gain or loss; (ii) some form of income. The holding period return is the percentage increase in returns associated with the holding period. Investor can't compare the alternative investments using holding period returns, if their holding periods (investment periods) are different. In these cases arithmetic average return or sample mean of the returns can be used.

Risk can be defined as a chance that the actual outcome from an investment will differ from the expected outcome. The circumvention of systematic and unsystematic risk is a big task. As external forces are involved in causing systematic risk, so these are unavoidable as well as uncontrollable. Moreover, it affects the entire market, but can be reduced through hedging and asset allocation. Since unsystematic risk is caused by internal factors so that it can be easily controlled and avoided, up to a great extent through portfolio diversification. The total risk of investments can be measured with such common absolute measures used in statistics as variance and standard deviation. Variance can be calculated as a potential deviation of each possible investment rate of return from the expected rate of return. Standard deviation is calculated as the square root of the variance. The more variable possible outcomes that can occur, the greater will be the risk. In the cases than the arithmetic average return or sample mean of the returns is used instead of expected rate of return, sample variance and sample standard deviation is calculated.

### **Review Questions**

1. Distinguish between historical returns and expected returns. Why methods and tools of the statistics are so important in investment decision making. Comment.
2. Define the components of holding period return. Can any of these components be negative?
3. When should the sample mean of return be used instead of expected rate of return?
4. What do you mean by risk? Discuss its causes and main components.
5. Explain clearly the techniques of measuring risk in investment.