

## Security Analysis

### Notes for 1-10 sessions

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Topic	Total No of Sessions Covered
Investment Scenario	2
Sources of Financial Information	1
Securities Markets	2
Risk and Return	3
Valuation of Fixed Income Investments	2

**Investment Scenario – Concept of Investment – Investment Objectives and Constraints  
Security and Non-security Forms of Investment (including Investing in Life Insurance  
Schemes, Small Saving Schemes and Bank Deposits, real assets and real estate investments).**

**Total Number of Sessions Allotted: 2 : Total Number of Sessions covered : 2**

Security in broader sense implies different financial instruments where investor can put their hard-earned money by sacrificing their conspicuous consumption in the short run in order to enjoy higher rate of return in the long run. Different attributes of financial assets are provided below.

**Return** = {Annual Income+ (Ending – Beginning Price)} / Beginning Price

Return from a stock can defined as follows =  $\{(P_t - P_{t-1}) + D_t\} / P_{t-1}$

$$= (P_t - P_{t-1}) / P_{t-1} + D_t / P_{t-1}$$

= Capital gain + Dividend gain

$P_t$  = Selling price at the end of t th period

$P_{t-1}$  = Purchase price at the end of t-1 th period  $D_t$  = Dividend received at the end of t th period

**Risk** = Rate of return from investments like equity shares, real estate, silver and gold vary rather widely. The risk of an investment refers to the variability of its rate of return: How much do individual outcomes deviate from the expected value? The different measures of the risk are variance, standard deviation and beta.

**Marketability:** An asset is called marketable if it can be transacted quickly, transaction cost is low and price changes between two successive transactions are negligible. Liquidity of an asset can be judged in terms of its depth, breadth and resilience. Depth implies existence of buy and sells order around current market price. Breadth implies presence of such orders in large volume. Resilience means that new orders emerge in response to the price changes. Generally, equity shares of large and well-established companies enjoy high marketability and equity shares of small companies in their formative years have low marketability.

Now question arises that whether securities traded in the secondary market only have liquidity?

How does marketability of an investment like a provident fund deposit will be judged which is non-marketable by nature? Such an investment may be regarded as highly marketable if any one of the following conditions is satisfied:

- a) A substantial portion of the accumulated balance can be withdrawn without significant penalty
- b) A loan (representing a significant portion of the accumulated balance) can be raised at a rate of interest that is slightly higher than the rate of interest earned on the investment itself.

Public Provident fund (PPF) can be used for ready example. Though the period of a PPF account is stated to be 15 years, the number of contributions has to be 16. This is because the 15-year period is calculated from the financial year following the date on which the account is opened. The subscriber to a PPF account is required to make a minimum deposit of Rs100 per year. The maximum permissible deposit per year is Rs 1,50,000 . PPF deposits currently earn a compound interest rate of 7.1 percent per annum which is totally exempted from tax. The interest is accumulated in the PPF account and not paid annually to the subscriber. The subscriber to a PPF account is eligible to take loan from the third year to the sixth year after opening the PPF account. The amount of loan cannot exceed 25 percent of the balance standing to the credit of the PPF account at the end of the second preceding financial year. The interest rate payable on loan is 1 percent higher than the PPF account interest rate. The subscriber to a PPF account can make one withdrawal every year from the sixth year to the fifteenth year. The amount of withdrawal cannot exceed 50 percent of the balance at the end of the fourth preceding year or the year immediately preceding the year of withdrawal, whichever is lower, less the amount of loan if any. The withdrawal can be put to any use and is not required to be refunded. On maturity, the credit balance in a PPF account can be withdrawn. However, at the option of subscriber, the account can be continued for two successive block periods of five years each with or without deposits.

### **Tax Shelter**

Some instruments provide tax benefits; others don't. Tax benefits are categorized into three groups.

**Initial Tax benefit:** An initial tax benefit refers to the tax relief enjoyed at the time of making investment

**Continuing Tax benefit:** A continuing tax benefit represents the tax shield associated with periodic returns from the investment. For example- dividend income and income from other sources are tax exempted.

**Terminal Tax benefit:** A terminal tax benefit refers to relief from taxation when an investment is realized or liquidated.

### **Convenience**

Convenience refers to the ease with which investment can be made and looked after. Two factors should be judged.

- a) Can the investment be made readily?
- b) Can the investment be looked after easily?

Security incorporates small saving schemes, life insurance products, mutual funds, equity share etc.

**Sources of Financial Information - Sources of Economic Data- Sources of Market Data  
Sources of Company Data- Sources of International Economic Data.**

**Total Number of Sessions Allotted: 1 : Total Number of Sessions covered : 1**

Different databases of financial information are provided as below.

- 1) Data base of Indian Economy (<https://dbie.rbi.org.in/DBIE/dbie.rbi?site=home>)
- 2) Yahoo Finance(<https://in.finance.yahoo.com/>)
- 3) Money Control (<http://www.moneycontrol.com>)
- 4) Screener (<https://www.screener.in>)
- 5) Investing (<https://in.investing.com>)
- 6) ET Market (<http://economictimes.indiatimes.com/markets>)
- 7) LiveMint (<http://www.livemint.com>)
- 8) NSE India (<https://www.nseindia.com>)
- 9) BSE India (<http://www.bseindia.com>)

**Securities Markets - Markets and their Functions- Methods of Raising Capital-Book building Development of Stock Market in India Dematerialization of Shares-Listing of Securities- Membership of Stock Exchange Trading and Settlement Procedure- Stock Market Indices- Regulation of Securities Markets.**

**Total Number of Sessions Allotted: 2 : Total Number of Sessions covered : 2**

Capital market is a mechanism through which funds can be borrowed and lent for long term period. Capital market instruments are categorized into three groups- debt capital, share capital and derivatives. Investors can be categorized into three groups- retail investors, High Net worth Individuals (HNIs) and Qualified Institutional Buyers (QIBs). At a particular time at a particular scheme if the amount of investment is less than Rs 2 lakh, the investor is known as retail investor for that scheme as per the SEBI guideline. At a particular time at a particular scheme if the amount of investment is more than Rs 2 lakh, the investor is known as High Net worth Individuals for that scheme. QIB means a) Public financial institution b) A scheduled commercial bank c) A mutual fund registered with the Board d) A foreign institutional investor and sub-account registered with SEBI, other than a sub-account which is a foreign corporate or foreign individual e) A multilateral and bilateral development financial institution f) A venture capital fund registered with SEBI g) Foreign venture capital investor registered with SEBI h) A state industrial development corporation i) An insurance company registered with the Insurance Regulatory and Development Authority (IRDA) j) A provident fund with minimum corpus of Rs. 25 crores k) A pension fund with minimum corpus of Rs. 25 crores.

Market can be categorized into two parts -Primary market and Secondary market. Primary market is the mechanism through which fund is raised for the long term from the market. Primary market includes IPO (Initial Public Offer), FPO (Follow on Public Offer), Right issue. IPO implies when the company wants to raise the fund from the market by issuing equity shares for the first time. Follow on Public Offer indicates when the company wants to raise the additional fund from market by issuing more equity shares but the company's shares are already being traded in the market. Right issue implies when the company wants to raise the additional fund from market by issuing more equity shares to the existing shareholders. Secondary market implies where already issued shares are being traded. Examples of the secondary market are stock exchanges such as Bombay Stock Exchange and National Stock Exchange. No company shall make public or rights issue or an offer for sale of securities, unless it conforms with any one entry norm out of three entry norms as per the SEBI DIP (Depositor and Investor Protection) guidelines.

### **Book Building Process**

To become eligible for IPO, Public companies have to conform to any one out of the three entry norms mentioned in the SEBI DIP Guideline. Book building process is used in IPO and FPO where issue price is not disclosed earlier. When a company is going for a public issue, first it has to file a draft prospectus to SEBI with the help of Merchant Banker 21 days prior of filing Red herring's prospectus with the Registrar of the Companies provided company is going for 100% book building process. In the red herring prospectus, only the information such as total number of shares issued by the company, the face value of the share and total number of shares available for Net Public Offer are given. Just before five days of opening the bidding process, cap and floor price is provided. The cap should not be more than 120% of floor price. Floor price is the minimum price which an investor can bid and cap is the

maximum price for which investor can bid in order to get the allotment of the share. After the bidding process is over, issue price is determined depending on the demand pattern for the stock. In a book building offer, issue price reflects revealed demand and contemporary market conditions. In book building process, if the company wants to revise the price band they can do so but they have to disseminate the necessary information about change by a press release, as well as information should be available in the company's website, in the website of all merchant bankers who are managing the issue and in all print as well as electronic media. After the revision of price band, bidding should be open at least for three days. In book Building process, issue price is determined at a price at which company can generate maximum sale proceed as well as company will be able to offload its target volume of shares.

### **Different methods of fund raising for the long term**

**Initial Public Offer** - Company wants to raise the fund from the market by issuing equity shares for the first time

**Follow on Public Offer** -Company wants to raise the additional fund from market by issuing more equity shares but the company's shares are already being traded in the market

**Right Issue** - Company wants to raise the additional fund from market by issuing more equity shares to the existing shareholders

**Depository Receipt** - A depository receipt is a negotiable certificate that usually presents a company's publicly traded equity or debt. Depository receipts are created when a broker purchases the company's share on the home stock market and deliver those to the depository's local custodian bank which then instructs the depository bank to issue a depository receipt. Depository receipts are quoted and traded in the country in which they trade and are governed by trading and settlement procedure of the market. All the depository receipts including GDR are essentially equity instrument created or issued abroad, not by the companies but by the oversea depository's bank which are authorized by the company in say India to issue them to non-resident investors against their shares. These shares are physically held by domestic custodian banks nominated or appointed by Overseas Depositories Banks (ODB). In the company's book the ODBs' name appear as the holder of their shares When an Indian company is willing to raise the fund from USA without being listed in the New York Stock Exchange, the company can do so by issuing ADR. On the other hand, if an Indian company is willing to raise the fund from rest of the globe apart from USA, it can do so by issuing GDR. When a foreign company is willing to raise fund from Indian market without being listed in the Indian stock exchanges, the company can go for issuing IDR.

### **Dematerialization of Shares**

Any individual wants to buy equity or mutual fund, has to open mandatorily a demat account. All the holdings of equity, debt, mutual fund, ETF etc of account holder will be kept in electronic format. Prior to demat account, individual had to carry physical certificates of shares. They used to buy and sell shares in lot size. Now after dematerialisation, investors can buy or sell any quantities of share they want.

In national level there are two depositories – one is NSDL (National Securities Depository Limited) and another is CDSL (Central Depository Services Limited).

All the depository participants (brokerage houses) are registered with them. Once an investor prefers to convert its physical certificate in electronic format, it will make an application to the depository participant. Depository participant will forward the application to the NSDL or CDSL wherever they are registered. After getting the instruction from the central depository level, registrar of the company will destroy the physical certificate of the shareholder and

shares will be kept in the dematerialized account of the client in electronic format. Each share will be provided a unique International Securities Identification Number (ISIN).

### **Trading and Settlement Procedure**

Screen based trading system is followed in India. A large number of participants, geographically separated can trade simultaneously at high speed through the computer network. There can be two types of order in online trading such as market and limit. Market order implies buying and selling order will be executed at the prevailing market price. Limit order pre specifies the price limit. The order matching is done on price time priority. A buy order at higher limit price will be given more priority over a buy order at a lower limit price. A sell order at a lower limit price will be given higher importance. If two limit orders are placed at the same price, the limit order placed earlier is given more priority.

Indian capital market follows rolling settlement. The settlement of all trades is on a T+2 basis. T is the trade day and T+1 is the day of custodial confirmation and final obligation. Pay in and pay out of fund and securities take place in T+2 days.

### **Stock Market Indices**

Sensex, Nifty, BSE100, BSE 500 are examples of market indices. Sensex is the weighted average of 30 stocks listed in the Bombay Stock Exchange. The Sensex for any trading day reflects the average aggregate market value of 30 securities on that day in relation to the average aggregate market value of those shares in the base year 1978-79. From 2003, Sensex is constructed on the basis of free float market capitalisation. Free float market capitalisation= free float factor X total number of shares outstanding of a company x market price per share. Free float factor implies proportion of total number of shares of company available for trading in the secondary market. Nifty is the weighted average of 50 stocks listed in the National Stock Exchange. The base period is closing price of 3<sup>rd</sup> November,1995 and base value is 100 for nifty.

### **Regulation of Securities Markets**

ICDR implies Issue of Capital and Disclosure Requirement, a norm designed by the SEBI. According to this norm, if company prefers to go for public issue, it has to offer at least 35% to the Retail Investors, 15% to the High Net worth Individuals and 50% to the Qualified Institutional Buyers when company is going for 100% book building process. Initially ICDR instructs to all the issuer companies to make minimum application size in such a way so that minimum application value will fall in between Rs 5000-Rs 7000. In the year 2012, ICDR has been revised where minimum application value has been increased from Rs 10000 to Rs 15000. The share allotment system in IPOs will be modified to ensure that every retail applicant, irrespective of the application size, gets allotted a minimum bid lot, subject to availability of shares in aggregate. Investors are able to apply for shares offered in a public issue online through their stock broker. Electronic issuance of initial public offerings, or e-IPOs as the name suggests, can be done online to save time and reduce the paperwork involved. It has extended the facility of ASBA (application supported by blocked amount) through this mode. Suitable incentive structures to issuers/brokers/banks are in place to encourage use of ASBA by retail individual investors. The regulator has also increased the QIB participation of 75% against the existing 50% in case of compulsory book-building route if the issuer does not have more than Rs. 15 crores average pre-tax operating profit. For companies coming out with IPOs, they would now have to disclose the price band at least five working days before the opening of the bidding, as against the current norm of two days. According to ICDR Guideline, 2014, 60% of QIB offer has to be mandatorily allotted to the anchor investor.

**Risk and Return - Total Risk and its Factors Concept and Components of Total Risk  
Security Returns: Measuring Historical and Ex Ante (Expected) Returns- Systematic  
and Unsystematic Risk- Quantifying Portfolio Risk and Return- Benefits of  
Diversification Characteristic Regression Line -Capital Assets Pricing Model.**

**Total Number of Sessions Allotted: 3 : Total Number of Sessions covered : 3**

**Return** = {Annual Income+ (Ending – Beginning Price)} / Beginning Price

Return from a stock can defined as follows =  $\{(P_t - P_{t-1}) + D_t\} / P_{t-1} = (P_t - P_{t-1}) / P_{t-1} + D_t / P_{t-1}$   
= Capital gain + Dividend gain

$P_t$  = Selling price at the end of t th period,  $P_{t-1}$  = Purchase price at the end of t-1 th period,  $D_t$   
= Dividend received at the end of t th period

**Risk** = Rate of return from investments like equity shares, real estate, silver and gold vary rather widely. The risk of an investment refers to the variability of its rate of return: How much do individual outcomes deviate from the expected value? The total risk is measured by standard deviation.

Classification of data

Ex post : It takes into account historical data.

Ex-Ante: It is all about forecasting the future. Since future is full of risk and uncertainty, probability theory has to be used to forecast the future.

**Risk and return of Ex- post data**

**Ex post** Return:  $\bar{x}$  or  $\mu = \sum X_i / n$

**Ex post risk:** Variance =  $\sigma^2 = 1/n \sum (x - \bar{x})^2$  Or S D =  $\sigma = \sqrt{[1/n \sum (x - \bar{x})^2]}$

Probability Distributions

Investors cannot predict security returns with certainty. They can list the potential outcomes and have a sense for the likelihood that each of these outcomes will occur. Probabilities represent the relative likelihood each outcome will occur. The probabilities for the full range of outcomes must sum to one. Individual probabilities cannot be negative.

Expected Return - the return that an investor expects to earn on an asset, given its price, growth potential, etc.

## Expected Return of a Probability Distribution

$$R_i = \sum_{j=1}^M p_j R_j$$

Where  $R_j$  = the  $j^{\text{th}}$  investment outcome,  $M$  = the number of possible investment outcomes,  $p_j$  = the likelihood that the  $j^{\text{th}}$  outcome will occur

### Risk

$$\text{Var}(x) = E\{X - E(X)\}^2 = E[X^2 - 2X E(X) + \{E(X)\}^2] = E(X^2) - 2E(X)E(X) + \{E(X)\}^2 = E(X^2) - \{E(X)\}^2 = \sum P X^2 - (\sum P X)^2$$

$$\text{Or Var}(x) = E\{X - E(X)\}^2 = \sum P \{X - E(X)\}^2$$

### Portfolio Expected Returns

$$E(R_p) = \sum_{i=1}^N w_i E(R_i)$$

$E(R_p)$  = the expected return on the portfolio,  $E(R_i)$  = the expected return on asset  $i$ ,  $n$  = the number of assets in the portfolio,  $w_i$  = the fraction of the portfolio placed in the asset

### Portfolio Risk

$$\sigma^2 = w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2 w_1 w_2 \sigma_1 \sigma_2 r_{12}$$

### Where:

$w_1$  = the proportion of wealth placed in assets 1,  $w_2$  = the proportion of wealth placed in assets 2,  $\sigma_1$  = the standard deviation of returns for securities 1

$\sigma_2$  = the standard deviation of returns for securities 2,  $r_{12}$  = the correlation coefficient

### Return of Two Security Portfolio

$$R_p = w_1 R_1 + w_2 R_2$$

$R_p$  = Portfolio return,  $w_1$  = fraction of  $R_{s1}$  invested in security 1,  $w_2$  = fraction of  $R_{s1}$  invested in security 2,  $R_1$  = Return from security 1

$R_2$  = Return from security 2

## Risk of Two Security Portfolio

$$R_P = w_1 R_1 + w_2 R_2, E(R_P) = w_1 E(R_1) + w_2 E(R_2)$$

$$\text{Var}(R_P) = E\{R_P - E(R_P)\}^2 = E\{w_1 R_1 + w_2 R_2 - w_1 E(R_1) - w_2 E(R_2)\}^2 = E\{w_1 \{R_1 - E(R_1)\} + w_2 \{R_2 - E(R_2)\}\}^2$$

$$\begin{aligned} &= E\{w_1^2 \{R_1 - E(R_1)\}^2 + w_2^2 \{R_2 - E(R_2)\}^2 + 2 w_1 w_2 \{R_1 - E(R_1)\} \{R_2 - E(R_2)\}\} \\ &= w_1^2 E\{R_1 - E(R_1)\}^2 + w_2^2 E\{R_2 - E(R_2)\}^2 + 2 w_1 w_2 E[\{R_1 - E(R_1)\} \{R_2 - E(R_2)\}] \\ &= w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2 w_1 w_2 \text{COV}(1,2) \\ &= w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2 w_1 w_2 \sigma_1 \sigma_2 r_{12} \end{aligned}$$

### Systematic versus Unsystematic Risk

Total Risk = Market Risk + Unique Risk

Market Risk = Systematic Risk, Unique Risk = Unsystematic, or Diversifiable Risk

The correlation coefficient measures the extent to which security returns relate to one another. Positive correlation means that security returns move together, i.e. if one goes up, so does the other. Negative correlation means that security returns move in the opposite direction. Zero correlation means that security returns are unrelated to one another. In general, the less positive the correlation among securities in a portfolio, the more the risk-reducing benefit of diversification will be. Conversely, a portfolio containing highly positive-correlated securities will do little to reduce risk. The relationship depends on correlation coefficient.  $-1.0 \leq r \leq +1.0$ . The smaller the correlation is, the greater the risk reduction potential. If  $r = +1.0$ , no risk reduction is possible. Investing in more than one security is expected to reduce risk. If two stocks are perfectly positively correlated, diversification has no effect on risk. If two stocks are perfectly negatively correlated, the portfolio is perfectly diversified. Some risk can be diversified away and some cannot. Market risk (systematic risk) is non diversifiable. This type of risk cannot be diversified away. Company-unique risk (unsystematic risk) is diversifiable. This type of risk can be reduced through diversification. Examples of market risk are expected changes in interest rates, unexpected changes in cash flows due to tax rate changes, foreign competition, and the overall business cycle. Examples of company-unique risk are strike, lockout, corporate governance risk, inadequate succession planning etc.

### Markowitz model

#### Assumptions

- 1) Investors are risk averse
- 2) Investors prefer to invest in security where the risk is less.

Markowitz model discusses how to calculate return and risk of standalone security as well as for portfolio.

Formation of Efficient Frontier

Step- I identify two different securities and calculate their standalone return and risk.

Step-II Calculate the correlation coefficient between the return of the two securities

Step -III Take different possible combination of two securities. Each combination is considered as one portfolio.

Step-IV Calculate risk and return of all portfolios

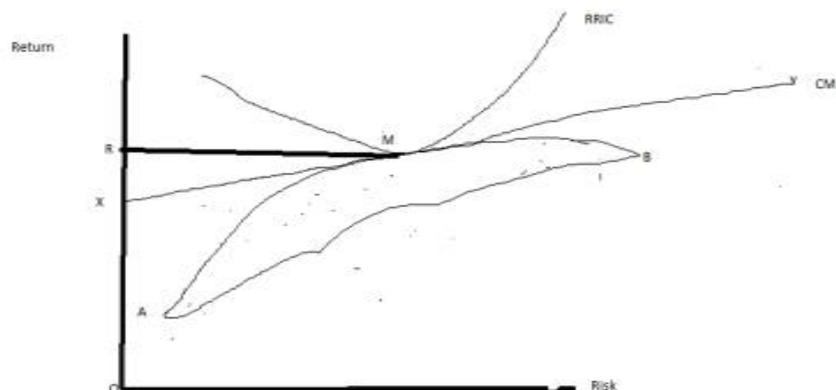
Step-V When return and risk of the portfolios are plotted in a graph measuring return along the vertical axis and risk along the horizontal axis, an umbrella shape curve will be obtained.

Step-VI Efficient frontier incorporates all the portfolios which are giving maximum return subject to a given risk and minimum risk subject to a given return.

Step-VII AMB is the efficient frontier. Risk return indifference curve is tangent to the efficient frontier at M. M is known as market portfolio . If a portfolio is created after incorporating all stocks of an market index and exactly in the same proportion in which they are listed in the index, it is known as market portfolio. The tangency point between efficient frontier and risk return indifference curve is market portfolio.

Step-VIII Risk return indifference curve shows different possible combinations of risk and return which are providing same level of satisfaction to the investor . RRIC is upward sloping as in order to enjoy higher return, investor has to undertake additional risk.

## Formation of efficient frontier



If investor invests 100% in risky asset, efficient frontier will be AMB. But in reality, investors don't invest entirely on risky asset, it prefers to diversify between risky and risk-free asset. When diversification is done between risky and risk-free asset, new efficient frontier will be an upward sloping straight line XMY. This is known as Capital Market Line. If investors are willing to accept market rate of return (OR) or less than that return, it will lend its fund. No borrowing is required. They will stay MX portion of CML. This is known as lending portfolio. If investors are willing to beat the market rate of return (OR), they have to borrow at risk free rate and invest the entire amount that is sum total of own and borrowed fund in risky securities. It will stay MY portion of CML. This is known as borrowing portfolio. Capital Market line is divided by market portfolio into borrowing and lending portfolio. This is known as Tobin's Separation Theorem.

## Capital Market Line

$$\mu = x \mu_1 + (1-x) \mu_2 \quad (1)$$

$$\sigma^2 = x^2 \sigma_1^2 + (1-x)^2 \sigma_2^2 + 2x(1-x)\sigma_1 \sigma_2 r_{12} \quad (2)$$

$x$  = fraction of Rupee one invested in asset 1,  $1-x$  = fraction of Rupee one invested in asset 2

$\mu_1$  = Return of asset 1,  $\mu_2$  = Return of asset 2,  $\sigma_1$  = Risk of asset 1,  $\sigma_2$  = Risk of asset 2,  $r_{12}$  = correlation coefficient between return of asset 1 and asset 2

Asset 1 is risk free asset.  $\sigma_1 = 0$ , Putting  $\sigma_1 = 0$  in equation (2)

$$\sigma^2 = (1-x)^2 \sigma_2^2 \quad \text{Or } \sigma = (1-x) \sigma_2, \text{ Or } (1-x) = \sigma / \sigma_2, \text{ Or } x = 1 - (\sigma / \sigma_2)$$

$$\mu = x \mu_1 + (1-x) \mu_2, \text{ or } \mu = \{1 - (\sigma / \sigma_2)\} \mu_1 + (\sigma / \sigma_2) \mu_2$$

$$\text{or } \mu = \mu_1 - (\sigma / \sigma_2) \mu_1 + (\sigma / \sigma_2) \mu_2, \text{ or } \mu = \mu_1 + \sigma (\mu_2 - \mu_1) / \sigma_2$$

$$\text{If } m = (\mu_2 - \mu_1) / \sigma_2 \text{ or } \mu = \mu_1 + m \sigma$$

Capital market line shows linear relationship between portfolio risk and return

## Limitation of Markowitz model

1) It requires huge database as it is information sensitive. If there are  $n$  securities, database will incorporate  $n$  means,  $n$  variances and  $n(n-1)/2$  covariances.

2) Market risk is not taken into consideration.

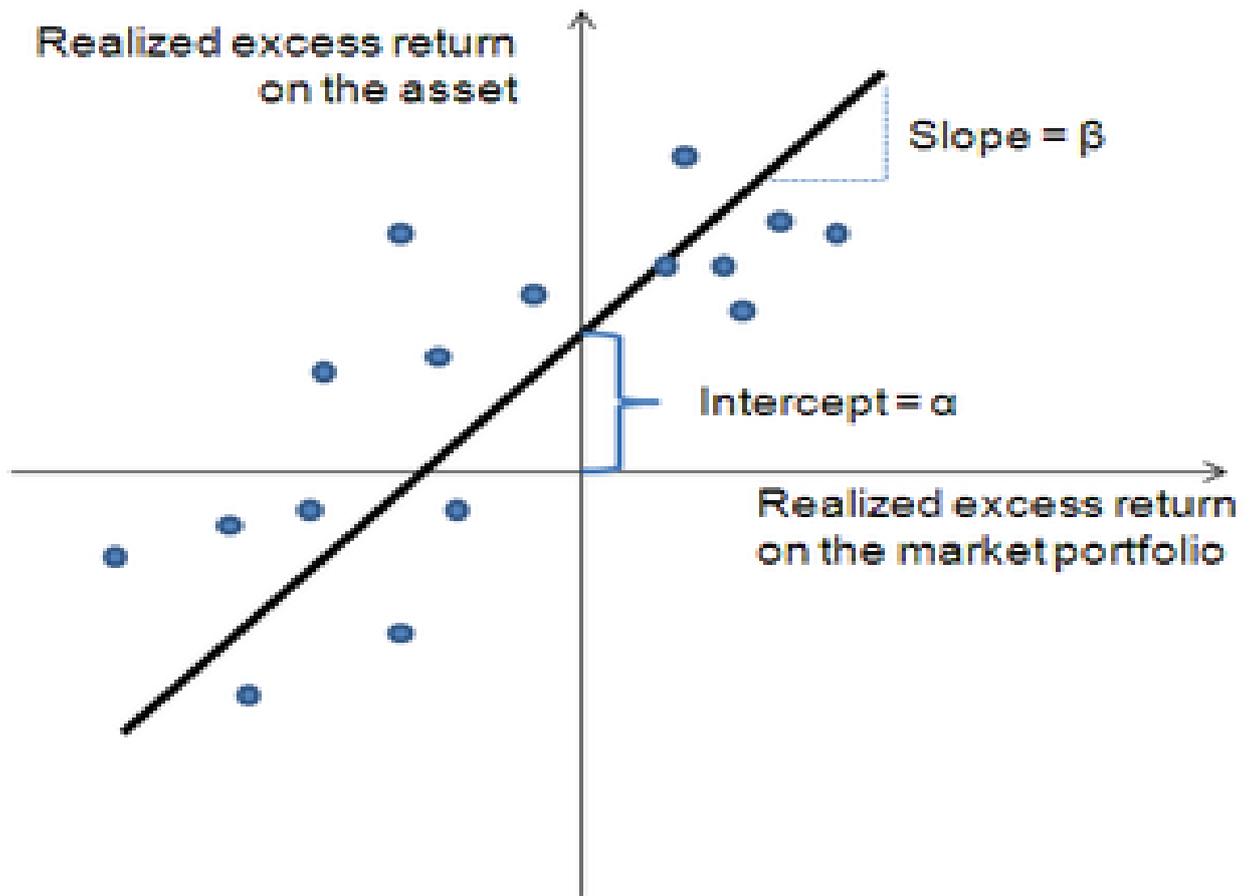
## Sharpe Single Index Model

Markowitz had suggested an index, to which securities are related, may be used for the purpose of generating the covariance terms. Taking a cue from Markowitz, William Sharpe developed the Single Index Model which expresses the returns on each security as a function of the returns on a broad market index.

$$R_i = a_i + b_i R_m + e_i$$

$R_i$  = return on security  $i$ ,  $R_m$  = Return on market index,  $a_i$  = constant term,  $b_i$  = measure of security  $i$ 's return to the return on the market index,  $e_i$  = error term

The estimates of  $a_i$  (constant term) and  $b_i$  (the slope term of the single index model) may be obtained by regressing the return on security  $i$  on the corresponding return on market index. This is based on the following assumptions. 1) The error term ( $e_i$ ) has an expected value of zero and a finite variance 2) The error term is not related with the return on market portfolio.  $\text{Cov}(e_i, R_m) = 0$  3) Securities are related only through their common response to the return on market index. This implies that the error term of the  $i$ th security is not correlated with error term for any other security.  $\text{Cov}(e_i, e_j) = 0$



## Capital Asset Pricing Model

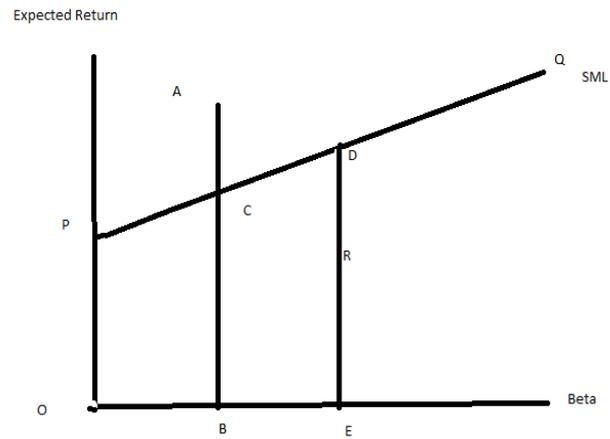
### Assumptions

- 1) Individuals are risk averse
- 2) Individuals seek to maximise the expected utility of their portfolio over a single period planning horizon.
- 3) Individuals have homogeneous expectations- they have identical subjective estimates of the means, variances and covariances among return.
- 4) Individuals can borrow and lend freely at risk free interest rate
- 5) The market is perfect, there are no taxes, there are no transaction costs, securities are perfectly divisible, the market is competitive.
- 6) The quantity of risky securities in the market is given.

$$R_j = R_f + \beta_j (R_m - R_f)$$

$R_j$  = required rate of return of jth asset,  $R_f$  = Risk free rate of return  $\beta_j$  = beta value of jth security,  $R_m$  = Market rate of return

If expected rate of return is greater than the required rate of return, asset is considered to be under-priced or vice versa. Diagrammatic representation of CAPM is known as Security Market Line.



For Security A, expected return = AB, required rate of return = BC,  $AB > BC$ , Hence A is under-priced. For Security R, expected return = RE, required rate of Return = DE,  $DE > RE$ , Hence R is overpriced. Assets plotted above the SML is under-priced and below SML are overpriced in nature.

Valuation of Fixed Income Investments - The Strategic Role of Bonds- Bond Returns and Prices- Systematic and Unsystematic Risk involved in Fixed Income Securities- Present Value Model and Bond Valuation- valuation of Tax- Sheltered Investments- Hedging for Duration Shifts- Convexity- Bond Price Volatility- term Structure of Interest Rates, Warrants – Convertible Securities- Valuation of Convertible Bonds.

Total Number of Sessions Allotted: 4: Total Number of Sessions covered: 2

## Valuation

$$\text{Value of a bond } V = \sum C / (1+r)^t + M/(1+r)^n$$

$$= C \times \text{PVIFA}(r\%, n \text{ years}) + M \times \text{PVIF}(r\%, n \text{ years})$$

V = value of bond, C= coupon income from bond (coupon payments are made annually, M= redemption price, n= life of the bond

t= 1,2,3.....n ,r=periodic rate of return

$$\text{Value of a bond } V = \sum (C/2) / (1+r/2)^t + M/(1+r/2)^{2n}$$

When interest is compounded half yearly,

V = value of bond, C/2= Semiannual coupon income from bond, r/2= required rate of return half yearly

M= redemption price, 2n= life of the bond expressed in half yearly periods, t= 1,2,3.....2n

## Yield of bond

Yield = coupon/ market price. Yield is measurement of return from bond. If price goes down, yield goes up and vice versa.

Let us assume there are three bonds A, B and C

A is Rs 100 face value bond offering 10% coupon and currently traded at Rs 110

B is Rs 100 face value bond offering 10% coupon and currently traded at Rs 100

C is Rs 100 face value bond offering 10% coupon and currently traded at Rs 90

Yield of bond A =  $10/110 = 9.09\%$ , Yield of bond B =  $10/100 = 10\%$ , Yield of bond C =  $10/90 = 11.1\%$

Coupon > Yield for a premium bond, Coupon=Yield for a par value bond, Coupon < Yield for a discount bond

## Yield to Maturity

Yield to Maturity (YTM) of bond is the discounting rate for which sum total of the present value of future inflows from the bond (from the investor's perspective) is equal to the current market price of the bond. YTM is based on two assumptions-1) Investors will hold the bond till the maturity 2) coupons will be reinvested at YTM rate.

$$P = \sum C / (1+r)^t + M / (1+r)^n$$

$$= C \times PVIFA(r\%, n \text{ years}) + M \times PVIF(r\%, n \text{ years})$$

P = Market price of bond, C= coupon income from bond, M= redemption price, n= life of the bond, t= 1,2,3.....n ,r=YTM of bond

Short cut method for Yield to Maturity (YTM)

$$= \frac{C+(M-P)/n}{0.6P+0.4M}$$

P = Market price of bond, C= coupon income from bond, M= redemption price, n= life of the bond

### Relaxation of first assumption

If the first assumption is relaxed (Investors will hold the bond till the maturity), investor can sell the bond any time before the maturity period.

Investor will realize coupon, interest on interest and capital gain.

### Relaxation of second assumption

If the second assumption is relaxed (coupons will be reinvested at YTM rate), this is known as realized YTM.

### Risks of Fixed Income Security

Investor of fixed income security mainly faces two types of risk- interest rate risk and reinvestment risk. Interest rate and bond price are inversely related. If there is anticipation that interest rate will go up in near future, bond price will go down. Hence bondholder has to suffer capital loss. This is known as interest rate risk. If there is anticipation that interest rate will go down in near future, bond price will go up. Hence bondholder will enjoy capital gain. But the accumulated sales proceed of bond has to be reinvested at a lower rate of interest. This is known as reinvestment risk.

The interest rate risk and reinvestment risk are moving in the opposite direction. Investor cannot avoid both the risk simultaneously. If there is anticipation that interest rate will go up in near future, bond price will go down. Hence bondholder has to suffer capital loss. But bondholder is able to reinvest the sales proceed at a higher rate which is known as reinvestment gain. On the other hand, if there is anticipation that interest rate will go down in near future, bond price will go up. Hence bondholder will enjoy capital gain. But the accumulated sales proceed of bond has to be reinvested at a lower rate of interest. The sum total of interest rate risk and reinvestment risk can be minimized if investor is holding the bond till its duration rather than its maturity period.

## Duration

Duration (D) is a measure of the weighted average life of bond which considers the size and timing of each cash flow. The weight assigned to each time period is the present value of the cash flow paid at the time as a proportion of the price of the bond.

$$D = [PV(C_1)X1+PV(C_2)X2+PV(C_3)X3+.....PV(C_n)X n]/V$$

$PV(C_t)$  = Present value of the cash flow receivable at the end of year t

t= 1,2,3.....n , V= value of bond

Duration is a point at which all the weighted coupon payments on the left exactly balance all the weighted coupon payments and principal at the right.

$$\text{Modified Duration } (D^*) = D / (1+y)$$

y= the bond's yield to maturity

$$\text{Percentage change in bond price} = -D^* \times \text{change in yield}$$

## Immunization Strategy

Banks and financial institutions such as provident fund, pension fund have huge number of payables in future. Due to volatility in market interest rate, the present value of future payables varies. In order to immunize the future payables from the interest rate volatility, banks and financial institutions have to create a bond portfolio in such a way so that duration of the liability becomes equal to the duration of the bond portfolio. This is known as immunization strategy.

## Convexity

Convexity is a desirable feature of the bond. A bond is called convex if for a proportionate rise in interest rate, there is a less than proportionate fall in bond price but for a proportionate fall in interest rate, there is a more than proportionate rise in bond price.

Convexity

$$= 1/(1+r)^2 \{ \sum CF_t (t^2 + t)/(1+r)^t \}$$

P

$CF_t$  = Cash flow generated at the end of time period t, P= Market price of the bond, r=Yield to Maturity, t=1,2, ---n, n=maturity period of bond

## Percentage change in bond price

$$= \frac{1}{2} \times \text{convexity} \times \text{Price} \times (\text{change in yield})^2$$

## Expectation Hypothesis

The long-term rate is the geometric mean of spot rate and future one-year rates expected by the market participants.

$$(1+r_n) = \{ (1+r_1) (1+f_2) \dots (1+f_n) \}^{1/n}$$

$r_n$  = long term rate (rate offered by bond of maturity one year)

$r_1$  = spot rate

$f_2$  = forward rate at the end of 2<sup>nd</sup> year or expected one spot rate at the 2<sup>nd</sup> year

$f_n$  = forward rate at the end of nth year or expected one spot rate at the nth year

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