

SFM

STRATEGIC FINANCIAL MANAGEMENT

By CA. Gaurav Jain

PORTFOLIO MANAGEMENT & BOND VALUATION SUMMARY

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Registration Office:

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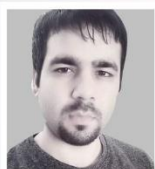
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Portfolio Management

Concept No. 1: Introduction

- **Portfolio** means combination of various underlying assets like bonds, shares, commodities, etc.
- **Portfolio Management** refers to the process of selection of a bundle of securities with an objective of maximization of return & minimization of risk.

Steps in Portfolio Management Process

- Planning
- Execution
- Feedback

Concept No. 2: Major return Measures

(i) Holding Period Return (HPR) :-

HPR is simply the percentage increase in the value of an investment over a given time period.

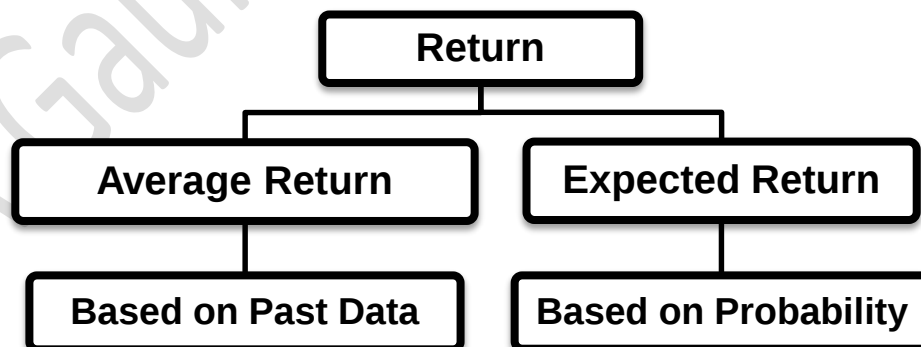
$$\text{HPR} = \frac{\text{Price at the end} - \text{price at the beginning} + \text{Dividend}}{\text{price at the beginning}}$$

(ii) Arithmetic Mean Return :-

It is the simple average of a series of periodic returns.

$$= \frac{R_1 + R_2 + R_3 + R_4 + \dots + R_n}{n}$$

Concept No. 3: Calculation of Return of an individual security



1. Average Return :-

Step 1: Calculate HPR for different years, if it is not directly given in the Question.

Step 2: Calculate Average Return i.e. $\frac{\sum X}{n}$

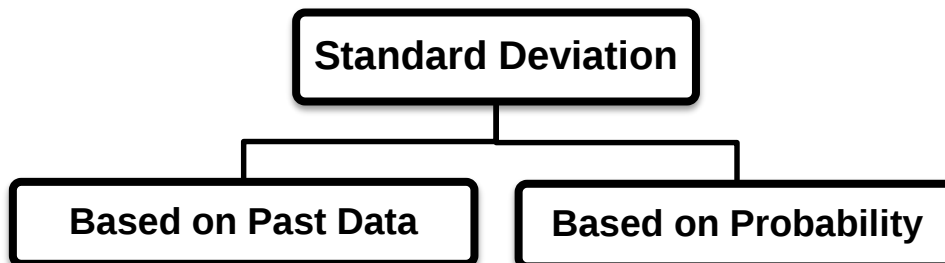
2. Expected Return (Expected Value):-

$$E(x) = \sum P_{X_i} X_i = P_{X_1} X_1 + P_{X_2} X_2 + P_{X_3} X_3 + \dots + P_{X_n} X_n$$

Concept No. 4: Calculation of Risk of an individual security

Risk of an individual security will cover under following heads:

1. **Standard Deviation of Security (S.D)** :- (S.D) or σ (sigma) is a measure of total risk / investment risk.



Based on Past Data:-

Formula

$$(\sigma) = \sqrt{\frac{\sum (X - \bar{X})^2}{n}}$$

Note: For sample data, we may use (n-1) instead of n in some cases.

x = Given Data

$\bar{X}$ = Average Return

n = No. of events/year

Note: $\sum (X - \bar{X})$ will always be Zero

Based on Probability:-

$$\text{S.D } (\sigma) = \sqrt{\sum \text{probability}(X - \bar{X})^2}$$

Where $\bar{x}$ = Expected Return

Note:

- $\sum (X - \bar{X})$ may or may not be Zero in this case.
- S.D can never be negative. It can be zero or greater than zero.
- S.D of risk-free securities or government securities or U.S treasury securities is always assumed to be zero unless, otherwise specified in question.

Decision:

Higher the S.D, Higher the risk and vice versa.

2. **Variance**

Based on Past Data:-

$$\text{Variance} = (\text{S.D})^2 = (\sigma)^2$$

$$\text{Variance} = \frac{\sum (X - \bar{X})^2}{n}$$

Based on Probability:-

$$\text{Variance} = \sum \text{probability}(X - \bar{X})^2$$

Decision:

Higher the Variance, Higher the risk and vice versa.

3. **Co-efficient of Variation (CV) :-**

CV is used to measure the risk (variable) per unit of expected return (mean)

Formula:

$$\text{CV} = \frac{\text{Standard Deviation of X}}{\text{Average/Expected value of X}}$$

Decision:

Higher the C.V, Higher the risk and vice versa.

Concept No. 5: Rules of Dominance in case of an individual Security or when two securities are given

Rule No. 1:

	X Ltd.	Y Ltd
σ	5	5
Return	10	15

Decision:- Select Y. Ltd.

- For a given 2 securities, given same S.D or Risk, select that security which gives higher return.

Rule No. 2:

	X Ltd.	Y Ltd
σ	5	10
Return	15	15

Decision:- Select X. Ltd.

- For a given 2 securities, given same return, select which is having lower risk in comparison to other.

Rule No. 3:

	X Ltd.	Y Ltd
σ	5	10
Return	10	25

Decision:- Based on CV (Co-efficient of Variation).

- When Risk and return are different, decision is based on CV.

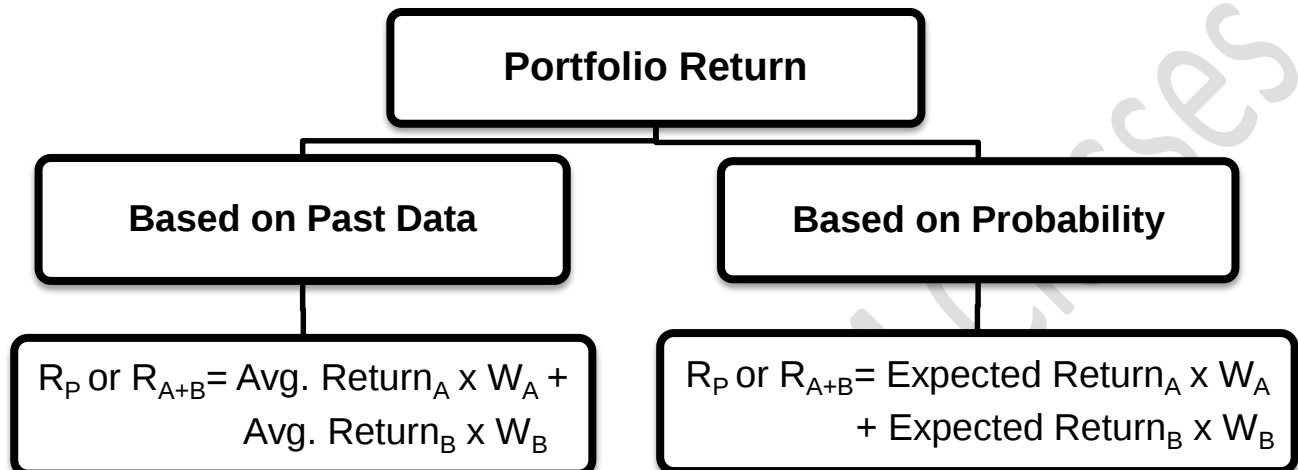
$$CV_x = 5/10 = 0.50$$

$$CV_y = 10/25 = 0.40$$

Decision:- Select Y. Ltd.

Concept No. 6: Calculation of Return of a Portfolio of assets

- It is the weighted average return of the individual assets/securities.



Where, $W_i = \frac{\text{Market Value of investments in asset}}{\text{Market Value of the Portfolio}}$

- Sum of the weights must always =1

i.e. $W_A + W_B = 1$

Concept No. 7: Risk of a Portfolio of Assets

Standard Deviation of a Two-Asset Portfolio

$$\sigma_{1,2} = \sqrt{\sigma_1^2 w_1^2 + \sigma_2^2 w_2^2 + 2\sigma_1 w_1 \sigma_2 w_2 r_{1,2}}$$

where

$r_{1,2}$ = Co-efficient of Co-relation; σ_1 = S.D of Security 1; σ_2 = S.D of Security 2;

w_1 = Weight of Security 1; w_2 = Weight of Security 2

1) Co-efficient of Correlation

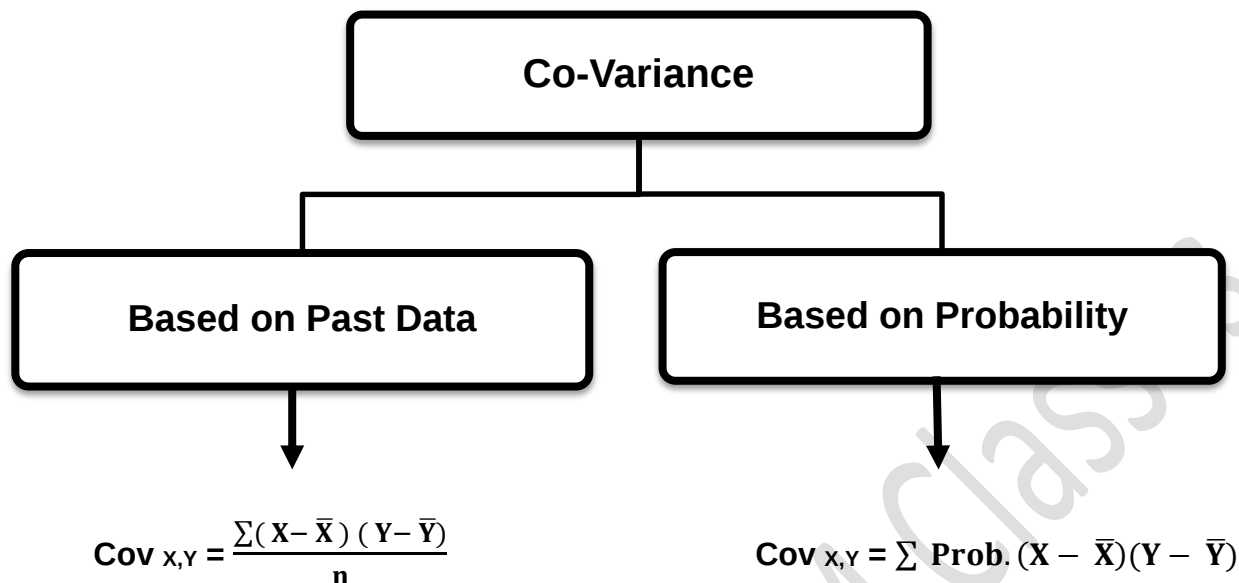
$$r_{1,2} = \frac{\text{Cov}_{1,2}}{\sigma_1 \sigma_2}$$

Or

$$\text{Cov}_{1,2} = r_{1,2} \sigma_1 \sigma_2$$

- The correlation co-efficient has no units. It is a pure measure of co-movement of the two stock's return and is bounded by -1 and +1.

2) Co-Variance



Note:

Co-Variance or Co-efficient of Co-relation between risk-free security & risky security will always be zero.

Concept No. 8: Portfolio risk as Correlation varies

Note:

- The portfolio risk falls as the correlation between the asset's return decreases.
- The lower the correlation of assets return, the greater the risk reduction (diversification) benefit of combining assets in a portfolio.
- If assets return when perfectly negatively correlated, portfolio risk could be minimum.

Portfolio Diversification refers to the strategy of reducing risk by combining many different types of assets into a portfolio. Portfolio risk falls as more assets are added to the portfolio because not all assets prices move in the same direction at the same time. Therefore, portfolio diversification is affected by the:

1. *Correlation between assets*: Lower correlation means greater diversification benefits.
2. *Number of assets included in the portfolio*: More assets means greater diversification benefits.

Concept No. 9: Standard-deviation of a 3-asset Portfolio

$$\sigma_{1,2,3} = \sqrt{\sigma_1^2 W_1^2 + \sigma_2^2 W_2^2 + \sigma_3^2 W_3^2 + 2 \sigma_1 \sigma_2 W_1 W_2 r_{1,2} + 2 \sigma_1 \sigma_3 W_1 W_3 r_{1,3} + 2 \sigma_2 \sigma_3 W_2 W_3 r_{2,3}}$$

Or

$$\sigma_{1,2,3} = \sqrt{\sigma_1^2 W_1^2 + \sigma_2^2 W_2^2 + \sigma_3^2 W_3^2 + 2 W_1 W_2 \text{Cov}_{1,2} + 2 W_1 W_3 \text{Cov}_{1,3} + 2 W_2 W_3 \text{Cov}_{2,3}}$$

Portfolio consisting of 4 securities

$$\sigma_{1,2,3,4} = \sqrt{\sigma_1^2 W_1^2 + \sigma_2^2 W_2^2 + \sigma_3^2 W_3^2 + \sigma_4^2 W_4^2 + 2 \sigma_1 \sigma_2 W_1 W_2 r_{1,2} + 2 \sigma_2 \sigma_3 W_2 W_3 r_{2,3} + 2 \sigma_3 \sigma_4 W_3 W_4 r_{3,4} + 2 \sigma_4 \sigma_1 W_4 W_1 r_{4,1} + 2 \sigma_2 \sigma_4 W_2 W_4 r_{2,4} + 2 \sigma_1 \sigma_3 W_1 W_3 r_{1,3}}$$

Concept No. 10: Standard Deviation of Portfolio consisting of Risk-free security & Risky Security

We know that S.D of Risk-free security is ZERO.

$$\begin{aligned}\sigma_{A,B} &= \sqrt{\sigma_A^2 W_A^2 + \sigma_B^2 W_B^2 + 2 \sigma_A W_A \sigma_B W_B r_{A,B}} \\ &= \sqrt{\sigma_A^2 W_A^2 + 0 + 0} \\ &= \sigma_A W_A\end{aligned}$$

Concept No. 11: Calculation of Portfolio risk and return using Risk-free securities and Market Securities

- Under this we will construct a portfolio using risk-free securities and market securities.

Case 1: Investment 100% in risk-free (RF) & 0% in Market

Risk = 0% [S.D of risk free security is always 0(Zero).]

Return = risk-free return

Case 2: Investment 0% in risk-free (RF) & 100% in Market

$$\text{Risk} = \sigma_m$$

$$\text{Return} = R_m$$

Case 3: Invest part of the money in Market & part of the money in Risk-free

$$\text{Return} = R_m W_m + R_F W_{Rf}$$

$$\text{Risk of the portfolio} = \sigma_m \times W_m \quad (\sigma \text{ of } R_F = 0)$$

Case 4: Invest more than 100% in market portfolio. Addition amount should be borrowed at risk-free rate.

Let the additional amount borrowed weight = x

$$\text{Return of Portfolio} = R_m \times (1+x) - R_F \times x$$

$$\text{Risk of Portfolio} = \sigma_m \times (1 + x)$$

Concept No. 12: Optimum Weights

For Risk minimization, we will calculate optimum weights.

Formula :

$$W_A = \frac{\sigma_B^2 - \text{Covariance (A,B)}}{\sigma_A^2 + \sigma_B^2 - 2 \times \text{Covariance (A,B)}}$$

$$W_B = 1 - W_A \text{ (Since } W_A + W_B = 1 \text{)}$$

We know that

$$\text{Covariance (A,B)} = r_{A,B} \times \sigma_A \times \sigma_B$$

Note:

- When $r = -1$ i.e. two stocks are perfectly (-) correlated, minimum risk portfolio become risk-free portfolio.

$$W_A = \frac{\sigma_B}{\sigma_A + \sigma_B}$$

Concept No. 13: CAPM (Capital Asset Pricing Model)

For Individual Security:

The relationship between Beta (Systematic Risk) and expected return is known as CAPM.
Required return/ Expected Return

$$= \text{Risk-free Return} + \frac{\text{Beta security}}{\text{Beta Market}} (\text{Return Market} - \text{Risk free return})$$

OR

$$= R_F + \beta_s (R_m - R_F)$$

Note:

- **Market Beta is always assumed to be 1.**
- Market Beta is a benchmark against which we can compare beta for different securities and portfolio.
- **Standard Deviation & Beta of risk free security is assumed to be Zero (0) unless otherwise stated.**
- $R_m - R_F = \text{Market Risk Premium}$.
- If Return Market (R_m) is missing in equation, it can be calculated through HPR (Holding Period Return)
- R_m is always calculated on the total basis taking all the securities available in the market.
- $\text{Security Risk Premium} = \beta (R_m - R_F)$

For Portfolio of Securities:

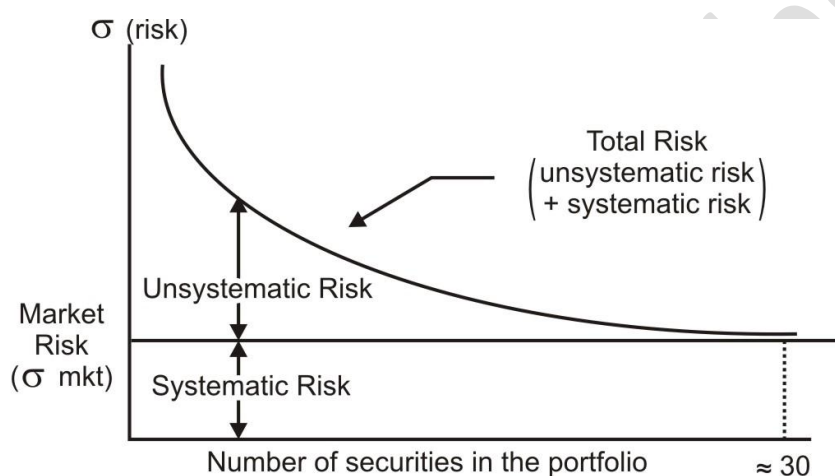
$$\text{Required return/ Expected Return} = R_F + \beta_{\text{Portfolio}} (R_m - R_F)$$

Concept No. 14: Decision Based on CAPM

Case	Decision	Strategy
Estimated Return/ HPR < CAPM Return	Over-Valued	Sell
Estimated Return/ HPR > CAPM Return	Under-Valued	Buy
Estimated Return/ HPR = CAPM Return	Correctly Valued	Buy, Sell or Ignore

- CAPM return need to be calculated by formula, $RF + \beta (R_m - RF)$
- Actual return / Estimated return can be calculated through HPR

Concept No. 15: Systematic Risk, Unsystematic risk & Total Risk



$$\text{Total Risk } (\sigma) = \text{Systematic Risk } (\beta) + \text{Unsystematic Risk}$$

Unsystematic Risk (Controllable Risk):-

- The risk that is eliminated by diversification is called Unsystematic Risk (also called unique, firm-specific risk or diversified risk). They can be controlled by the management of entity. E.g. Strikes, Change in management, etc.

Systematic Risk (Uncontrollable Risk):-

- The risk that remains can't be diversified away is called systematic risk (also called market risk or non-diversifiable risk). This risk affects all companies operating in the market.
- They are beyond the control of management. E.g. Interest rate, Inflation, Taxation, Credit Policy

Concept No. 16: Interpret Beta/ Beta co-efficient / Market sensitivity Index

- The sensitivity of an asset's return to the return on the market index in the context of market return is referred to as its Beta.

Calculation of Beta

1. Beta Calculation with % change Formulae

$$\text{Beta} = \frac{\text{Change in Security Return}}{\text{Change in Market Return}}$$

Note:

- ❖ This equation is normally applicable when two return data is given.
- ❖ In case more than two returns figure are given, we apply other formulas.

2. Beta of a security with co-variance Formulae

$$\begin{aligned}\text{Beta} &= \frac{\text{Co-Variance of Asset's return with Market Return}}{\text{Variance of Market Return}} \\ &= \frac{\text{COV}_{i.m}}{\sigma_m^2}\end{aligned}$$

3. Beta of a security with Correlation Formulae

We know that Correlation Co-efficient (r_{im}) = $\frac{\text{COV}_{i.m}}{\sigma_i \sigma_m}$

to get $\text{Cov}_{im} = r_{im} \sigma_i \sigma_m$

Substitute Cov_{im} in β equation, We get $\beta_i = \frac{r_{im} \sigma_i \sigma_m}{\sigma_m^2}$

$$\beta = r_{im} \frac{\sigma_i}{\sigma_m}$$

Concept No. 17: Beta of a portfolio

It is the weighted average beta of individual security.

Formula:

$$\text{Beta of Portfolio} = \text{Beta}_{X \text{ Ltd.}} \times W_{X \text{ Ltd.}} + \text{Beta}_{Y \text{ Ltd.}} \times W_{Y \text{ Ltd.}}$$

Where, $W_i = \frac{\text{Market Value of investments in asset}}{\text{Market Value of the Portfolio}}$

Concept No. 18: Arbitrage Pricing Theory/ Stephen Ross's Apt Model

Overall Return

$$\begin{aligned}&= \text{Risk free Return} + \{\text{Beta Inflation} \times \text{Inflation differential or factor risk Premium}\} \\ &\quad + \\ &\quad \{\text{Beta GNP} \times \text{GNP differential or Factor Risk Premium}\} \\ &\quad \dots\dots \& \text{ So on.}\end{aligned}$$

Where, Differential or Factor risk Premium = [Actual Values – Expected Values]

Concept No. 19: Evaluation of the performance of a portfolio (Also used in Mutual Fund)

1. Sharpe's Ratio (Reward to Variability Ratio):

- It is excess return over risk-free return per unit of total portfolio risk.

- Higher Sharpe Ratio indicates better risk-adjusted portfolio performance.

Formula:

$$\frac{R_P - R_F}{\sigma_P}$$

Where R_P = Return Portfolio

σ_P = S.D of Portfolio

Note:

- ❖ Sharpe Ratio is useful when Standard Deviation is an appropriate measure of Risk.
- ❖ The value of the Sharpe Ratio is only useful for comparison with the Sharpe Ratio of another Portfolio.

2. Treynor's Ratio (Reward to Volatility Ratio):

- Excess return over risk-free return per unit of Systematic Risk (β)

Formula:

$$\frac{R_P - R_F}{\beta_P}$$

Decision: Higher the ratio, Better the performance.

3. Jensen's Measure/Alpha:

- This is the difference between a fund's actual return & CAPM return

Formula:

$$\alpha_P = R_P - (R_F + \beta (R_m - R_F))$$

Or

$$\text{Alpha} = \text{Actual Return} - \text{CAPM Return}$$

It is excess return over CAPM return.

- If Alpha is +ve, performance is better.
- If Alpha is -ve, performance is not better.

4. Market Risk - return trade – off:

- Excess return of market over risk-free return per unit of total market risk.

Formula:

$$\frac{R_M - R_F}{\sigma_M}$$

Decision: Higher is better.

Concept No. 20: Characteristic Line (CL)

Characteristic Line represents the relationship between Asset excess return and Market Excess return.

Equation of Characteristic Line:

$$Y = \alpha + \beta x$$

Where Y = Average return of Security

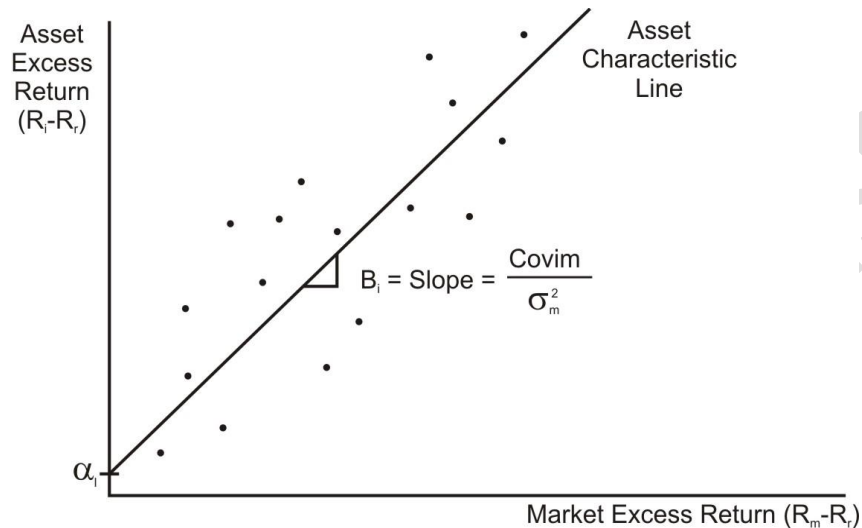
x = Average Return of Market

α = Intercept i.e. expected return of an security when the return from the market portfolio is ZERO, which can be calculated as $Y - \beta \times X = \alpha$

b = Beta of Security

Note:

The slope of a Characteristic Line is $\frac{COV_{i,M}}{\sigma_M^2}$ i.e. Beta



Concept No. 21: New Formula for Co-Variance using Beta

New Formula for Co-Variance between 2 Stocks $(Cov_{A,B}) = \beta_A \times \beta_B \times \sigma^2_m$

Concept No. 22: Co-variance of an Asset with itself is its Variance

$$Cov_{(m,m)} = \text{Variance}_m$$

Co-variance Matrix

In Co-variance matrix, we present the co-variance among various securities with each other.

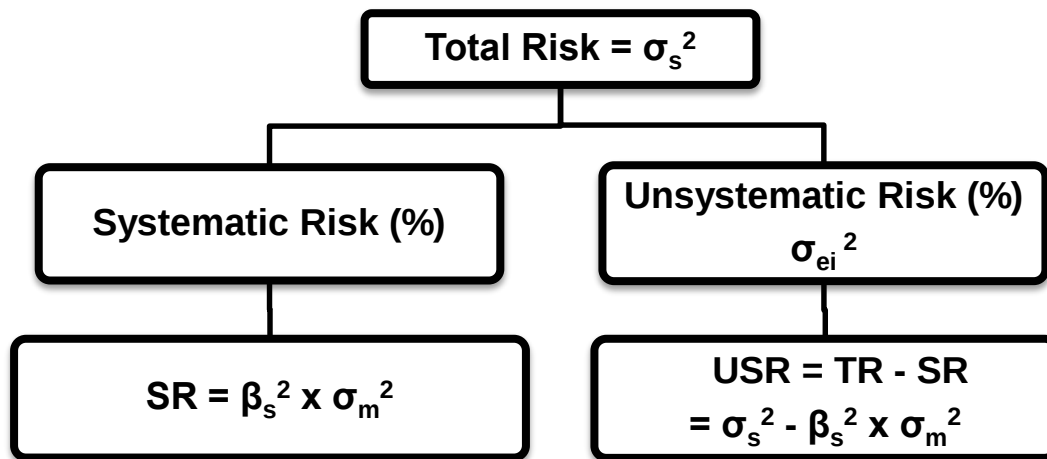
Return Covariance	A	B	C
A	xxx	xxx	xxx
B	xxx	xxx	xxx
C	xxx	xxx	xxx

Concept No. 23: Sharpe Index Model or Calculation of Systematic Risk (SR) & Unsystematic Risk (USR)

➤ Risk is expressed in terms of variance.

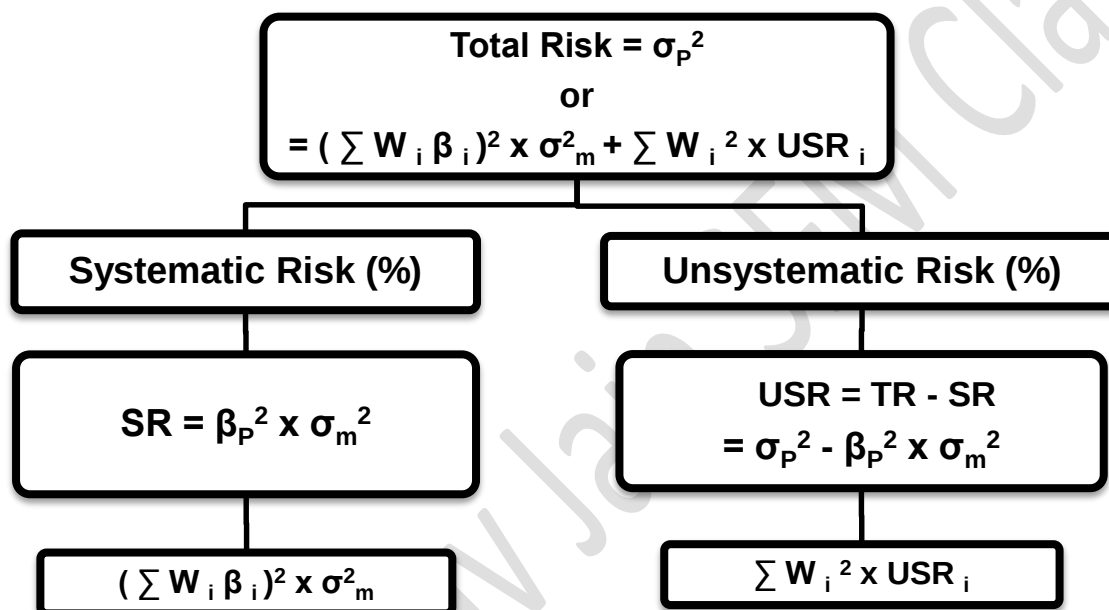
$$\text{Total Risk (TR)} = \text{Systematic Risk (SR)} + \text{Unsystematic Risk (USR)}$$

For an Individual Security:



σ_{ei}^2 = USR/ Standard Error/ Random Error/ Error Term/ Residual Variance.

For A Portfolio of Securities:



Concept No. 24: Co-efficient of Determination

- Co-efficient of Determination = (Co-efficient of co-relation)²
= r^2
- Co-efficient of determination (r^2) gives the percentage of variation in the security's return i.e. explained by the variation of the market index return.

Example:

If $r^2 = 18\%$

- ❖ In the X Company's stock return, 18% of the variation is explained by the variation of the index and 82% is not explained by the index.
- ❖ According to Sharpe, the variance explained by the index is the systematic risk. The unexplained variance or the residual variance is the Unsystematic Risk.

Use of Co-efficient of Determination in Calculating Systematic Risk & Unsystematic Risk:

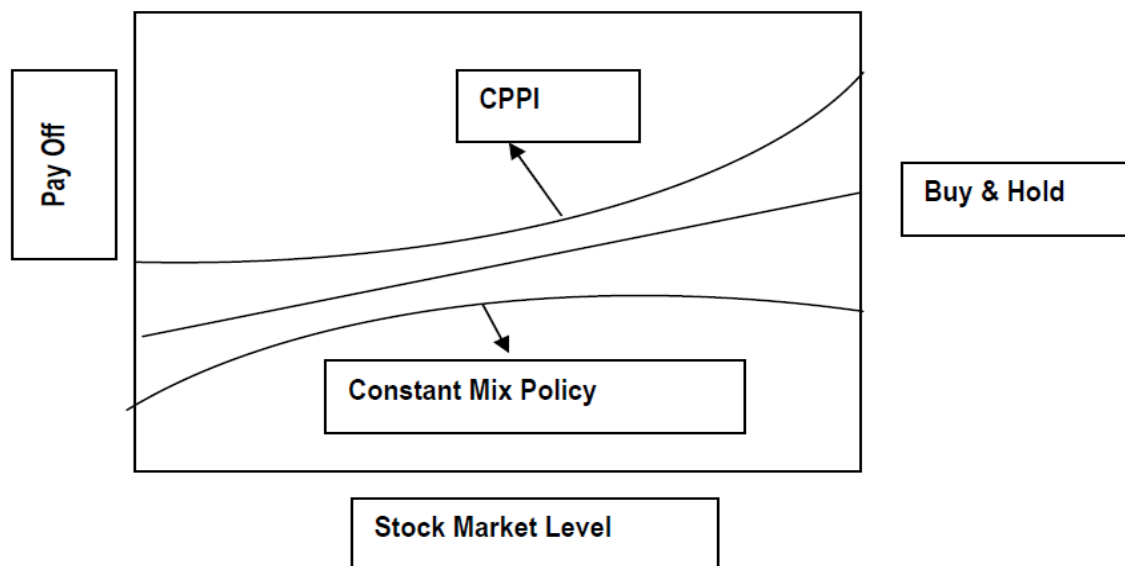
1. Explained by Index [Systematic Risk]

= Variance of Security Return $\times$ Co-efficient of Determination of Security
i.e. $\sigma_1^2 \times r^2$

2. Not Explained by Index [Unsystematic Risk]

= Variance of Security Return $\times (1 - \text{Co-efficient of Determination of Security})$
i.e. $\sigma_1^2 \times (1 - r^2)$

Concept No. 25: Portfolio Rebalancing



- Portfolio re-balancing means balancing the value of portfolio according to the market condition.
- **Three policy of portfolio rebalancing:**

(a) Buy & Hold Policy : ["Do Nothing" Policy]

(b) Constant Mix Policy: ["Do Something" Policy]

(c) Constant Proportion Portfolio Insurance Policy (CPPI): ["Do Something" Policy]

Value of Equity (Stock) = $m \times [\text{Portfolio Value} - \text{Floor Value}]$, Where m = multiplier

- The performance feature of the three policies may be summed up as follows:

(a) Buy and Hold Policy

- (i) Gives rise to a straight line pay off.
- (ii) Provides a definite downside protection.
- (iv) Performance between Constant mix policy and CPPI policy.

(a) Constant Mix Policy

- (i) Gives rise to concave pay off drive.
- (ii) Doesn't provide much downward protection and tends to do relatively poor in the up market.
- (ii) Tends to do very well in flat but fluctuating market.

(a) CPPI Policy

- (i) Gives rise to a convex pay off drive.

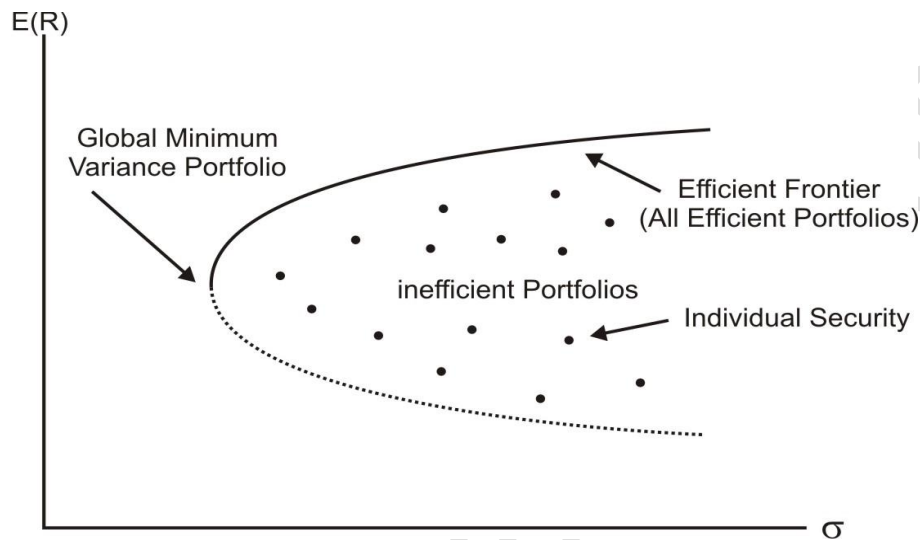
- (ii) Provides good downside protection and performance well in up market.
- (iii) Tends to do very poorly in flat but in fluctuating market.

Note:

- ❖ If Stock market moves only in one direction, then the best policy is CPPI policy and worst policy is Constant Mix Policy and between lies buy & hold policy.
- ❖ If Stock market is fluctuating, constant mix policy sums to be superior to other policies.

Concept No. 26: Modern Portfolio Theory/ Markowitz Portfolio Theory/ Rule of Dominance in case of selection of more than two securities

Under this theory, we will select the best portfolio with the help of efficient frontier.



Efficient Frontier:

- Those portfolios that have the greatest expected return for each level of risk make up the efficient frontier.
- All portfolios which lie on efficient frontier are efficient portfolios.

Efficient Portfolios:

Rule 1: Those Portfolios having same risk but given higher return.

Rule 2: Those Portfolios having same return but having lower risk.

Rule 3: Those Portfolios having lower risk and also given higher returns.

Rule 4: Those Portfolios undertaking higher risk and also given higher return

In-efficient Portfolios:

Which don't lie on efficient frontier.

Solution Criteria:

For selection of best portfolio out of the efficient portfolios, we must consider the risk-return preference of an individual investor.

- If investors want to take risk, invest in the Upper End of efficient frontier portfolios.
- If investors don't want to take risk, invest in the Lower End of efficient frontier portfolios.

Concept No. 27: Capital Market Line (CML)

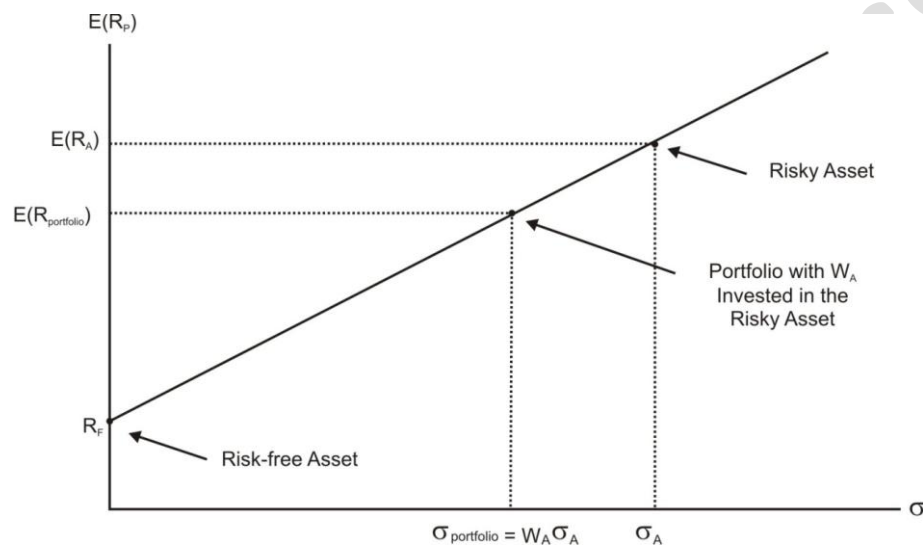
The line of possible portfolio risk and Return combinations given the risk-free rate and the risk and return of a portfolio of risky assets is referred to as the Capital Allocation Line.

- Under the assumption of homogenous expectations (Maximum Return & Minimum Risk), the optimal CAL for investors is termed the Capital Market Line (CML).
- CML reflect the relationship between the expected return & total risk (σ).

Equation of this line:-

$$E(R_p) = R_F + \frac{\sigma_p}{\sigma_m} [E(R_M) - R_F]$$

Where $[E(R_M) - R_F]$ is Market Risk Premium



Concept No. 28: SML (Security Market Line)

- SML reflects the relationship between expected return and systematic risk (β)

Equation:

$$E(R_i) = RFR + \frac{\text{COV}_{i,\text{Market}}}{\sigma_{\text{market}}^2} [E(R_{\text{Market}}) - RFR]$$

↓
Beta

- If $\text{Beta} = 0$

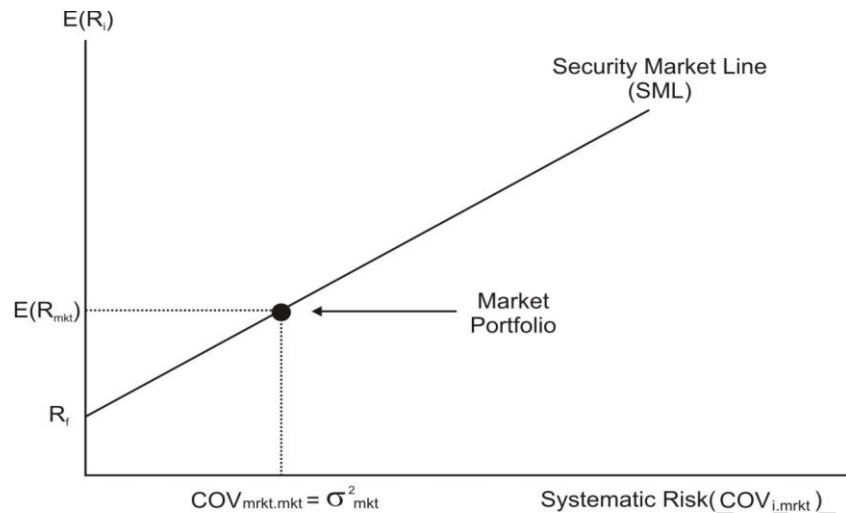
$$\begin{aligned}\text{CAPM Return} &= R_f + \beta (R_m - R_f) \\ &= R_f\end{aligned}$$

- If $\text{Beta} = 1$

$$\begin{aligned}E(R) &= R_f + \beta (R_m - R_f) \\ &= R_f + R_m - R_f \\ &= R_m\end{aligned}$$

Graphical representation of CAPM is SML.

- According to CAPM, all securities and portfolios, diversified or not, will plot on the SML in equilibrium.



Concept No. 29: Cut-Off Point or Sharpe's Optimal Portfolio

Calculate Cut-Off point for determining the optimum portfolio

Steps Involved

Step 1: Calculate Excess Return over Risk Free per unit of Beta i.e. $\frac{R_i - R_f}{\beta_i}$

Step 2: Rank them from highest to lowest.

Step 3: Calculate Optimal Cut-off Rate for each security.

Cut-off Point of each Security

$$C_i = \frac{\sigma_m^2 \sum_{i=1}^N \frac{(R_i - R_f \times \beta)}{\sigma_{ei}^2}}{1 + \sigma_m^2 \sum_{i=1}^N \frac{\beta_i^2}{\sigma_{ei}^2}}$$

Step 4: The Highest Cut-Off Rate is known as "Cut-off Point". Select the securities which lies on or above cut-off point.

Step 5: Calculate weights of selected securities in optimum portfolio.

(a) Calculate Z_i of Selected Security

$$Z_i = \frac{\beta_i}{\sigma_{ei}^2} \left[\frac{(R_i - R_f)}{\beta_i} - \text{Cut off Point} \right]$$

(b) Calculate weight percentage

$$W_i = \frac{Z_i}{\sum Z}$$

BOND VALUATION

Concept No. 1: Introduction (Fixed Income Security)

Bonds are the type of long term obligation which pay periodic interest & repay the principal amount on maturity.

Purpose of Bond's indenture & describe affirmative and negative covenants

- The contract that specifies all the rights and obligations of the issuer and the owners of a fixed income security is called the **Bond indenture**.
- These contract provisions are known as **covenants** and include both negative covenants (prohibitions on the borrower) and affirmative covenants (actions that the borrower promises to perform) sections.

1. Negative Covenants : This Includes

- a) Restriction on asset sales (the company can't sell assets that have been pledged as collateral).
- b) Negative pledge of collateral (the company can't claim that the same assets back several debt issues simultaneously).
- c) Restriction on additional borrowings (the company can't borrow additional money unless certain financial conditions are met).

2. Affirmative Covenants: This Includes

- a) Maintenance of certain financial ratios.
- b) Timely payment of principal and interest.

Common Options embedded in a bond Issue, Options benefit the issuer or the Bondholder

➤ Security owner options:

- a) Conversion option
- b) Put provision
- c) Floors set a minimum on the coupon rate

➤ Security issuer option:

- a) Call provisions
- b) Prepayment options
- c) Caps set a maximum on the coupon rate

Concept No. 2: Terms used in Bond Valuation

- | | |
|---------------------------|------------|
| (i) Face Value | → ₹ 1000 |
| (ii) Maturity Year | → 10 years |
| (iii) Coupon rate | → 10% |

- Coupon Rate is used to calculate Interest Amount.
- Face Value is always used to calculate Interest Amount.

- (iv) **Coupon Amount** → $1000 \times 10\% = ₹ 100 \text{ p.a.}$
- (v) **B₀ / Value of the Bond as on Today/** → ₹ 950
Current Market Price/Issue Price/ Net Proceeds
- (vi) **Yield to Maturity/ K_d / Discount Rate/** → 12%
Required return of investor/ Cost of debt/
Expected Return/ Opportunity Cost/
Market Rate of Interest
- (vii) **Redemption Value/ Maturity Value** → ₹ 1200

Note:

- If Maturity Value is not given, then it is assumed to be equal to Face Value.
- If Face Value is not given, then it is assumed to be ₹ 100 or ₹ 1000 according to the Question.
- If Maturity Year is not given, then it is assumed to be equal to infinity.

Concept No. 3: Valuation of Straight Bond/ Steps in the Bond – Valuation Process

Straight Coupon Bonds are those bonds which pay equal amount of interest and repay principal amount on Maturity.

Step 1: Estimates the cash flows over the Life of the bond.

Two type of Cash Flows:-

- Coupon Payments
- Return of Principal

Step 2: Determine the appropriate discount rate.

Step 3: Calculate the present value of the estimated cash flow using appropriate discount rate.

$$B_0 = \frac{\text{Interest}}{(1+YTM)^1} + \frac{\text{Interest}}{(1+YTM)^2} + \dots + \frac{\text{Interest}}{(1+YTM)^n} + \frac{\text{Maturity value or Par value}}{(1+YTM)^n}$$

Or

$$\text{Interest} \times \text{PVAF (Yield \%, n year)} + \text{Maturity Value} \times \text{PVF (Yield \%, nth year)}$$

n = No. of years to Maturity

Concept No. 4: Coupon Rate Structures

1. Zero – Coupon Bond (Pure Discount Securities)

- They do not pay periodic interest.

- b) They pay the Par value at maturity and the interest results from the fact that Zero – Coupon Bonds are initially sold at a price below Par Value. (i.e. They are sold at a significant discount to Par Value).

2. Step – up Notes

- a) They have coupon rates that increase over – time at a specified rate.
- b) The increase may take place one or more times during the life cycle of the issue.

3. Deferred – Coupon Bonds

- a) They carry coupons, but the initial coupon payments are deferred for some period.
- b) The coupon payments accrue, at a compound rate, over the deferral period and are paid as a lump sum at the end of that period.
- c) After the initial deferment period has passed, these bonds pay regular coupon interest for the rest of the life of the issue (to maturity).

4. Floating – Rate Securities

- a) These are bond for which coupon interest payments over the life of security vary based on a specified **reference rate**.
- b) **Reference Rate** may be **LIBOR** [London Interbank Offered Rate] or **EURIBOR** or any other rate and then adds or subtracts a stated margin to or from that reference rate.

$$\text{New coupon rate} = \text{Reference rate} \pm \text{quoted margin}$$

5. Inflation – indexed Bond (TIPS)

- a) They have coupon formulas based on inflation.

$$\text{E.g.: Coupon rate} = 3\% + \text{annual change in CPI}$$

Concept No. 5: Valuation of Perpetual Bond/ Irredeemable Bond/ Non – Callable Bond

They are infinite bond, never redeemable, non- callable bond.

$$\text{Value of Bond} = \frac{\text{Annual Interest}}{K_d / \text{YTM}}$$

K_d = Cost of debt /Yield to Maturity

Concept No. 6: Valuation of Zero-Coupon Bond

- Zero- coupon Bond has only a single payment at maturity.
- Value of Zero- Coupon Bond is simply the PV of the Par or Face Value.

$$\text{Bond value} = \frac{\text{Maturity Value}}{(1 + \text{YTM})^n}$$

K_d = Discount rate/ Yield to Maturity

n = No. Of years

Concept No. 7: Valuation of Semi – annual Coupon Bonds

Pay interest every six months

$$a) \frac{YTM}{2}$$

$$b) \frac{\text{Coupon rate p.a}}{2}$$

$$c) n \times 2$$

- YTM always given annually unless/otherwise specified in the question.

Note:

- If quarterly use 4 instead of 2
➤ If monthly use 12 instead of 2

Concept No. 8: Valuation of Bond with Changing Coupon Rate

Coupon rate changes from one year to another year as per the terms of bond-indenture.

Concept No. 9: Over – Valued & Under – Valued Bonds

Case	Value	Decision
PV of MP of Bond < Actual MP of Bond	Over – Valued	Sell
PV of MP of Bond > Actual MP of Bond	Under – Valued	Buy
PV of MP of Bond = Actual MP of Bond	Correctly Valued	Either Buy/ Sell

Concept No. 10: Self – Amortization Bond

They make periodic interest and principal payments over the life of the bond. i.e. at regular interval.

Concept No. 11: Holding Period Return (HPR) for Bonds

$$HPR = \frac{B_1 - B_0 + I_1}{B_0}$$

$$= \frac{B_1 - B_0}{B_0}$$

↓

$$+ \frac{I_1}{B_0}$$

↓

(Capital gain Yield/ Return)

(Interest Yield /Current Yield)

Note: HPR is always calculated on p.a basis.

Concept No. 12: Calculation of Current Yield/ Interest Yield

$$\text{Current Yield} = \frac{\text{Annual Cash Coupon Payment}}{\text{Bond Price or Market Price}}$$

Note: Current Yield is always calculated on per annum basis.

- **If existing bond :-**

B_0 = Current Market Price of Bond (1st preference)

Or

Present value Market Price of Bonds (2nd preference)

- **If new bond issued :-**

B_0

= Issue Price

$$\text{Issue Price} = \text{Face value} - \text{Discount} + \text{Premium}$$

➤ Company Point of view :-

$$B_0 = \text{Net Proceeds}$$

$$\text{Net Proceeds} = \text{Face value} - \text{Discount} + \text{Premium} (-) \text{ Floating Cost}$$

Concept No. 13: YTM (Yield to Maturity) / K_d / Cost of debt/ Market rate of Interest/ Market rate of return

- YTM is an annualized overall return on the bond if it is held till maturity.
- It is the annualized rate of return on the investment that the investor expect (on the date of investment) to earn from the date of investment to the date of maturity. It is also referred to as required rate of return.

Alternative 1: By IRR technique.

$$B_0 = \frac{\text{Interest}}{(1+k_d)^1} + \frac{\text{Interest}}{(1+k_d)^2} + \dots + \frac{\text{Interest}}{(1+k_d)^n} + \frac{\text{Maturity value or Par value}}{(1+k_d)^n}$$

- YTM & price contain the same information

- ◆ If YTM given, calculate Price.
- ◆ If Price given, calculate YTM.

$$\text{YTM} = \text{Lower Rate} + \frac{\text{Lower Rate}_{NPV}}{\text{Lower Rate}_{NPV} - \text{Higher Rate}_{NPV}} \times \text{Difference in Rate}$$

Alternative 2: By approximation formula

$$\text{YTM} = \frac{\text{Interest} + \frac{\text{Maturity Value} - B_0}{n}}{\frac{\text{Maturity Value} + B_0}{2}}$$

Concept No. 14: YTM (Yield to Maturity) / K_d of Half – yearly Bond

$$\text{YTM per 6 months} = \frac{\text{Interest for 6 months} + \frac{\text{Maturity Value} - B_0}{n \times 2}}{\frac{\text{Maturity Value} + B_0}{2}}$$

- YTM per annum = YTM of 6 month $\times 2$

Concept No. 15: Treatment of Floating Cost

- Floating Cost is cost associated with issue of new bonds.
e.g. Brokerage, Commission, etc
- We should take Bond value (B_0) Net of Floating Cost.

$$\text{YTM} = \frac{\text{Interest} + \frac{\text{Maturity Value} - \text{Net Proceeds}}{n}}{\frac{\text{Maturity Value} + \text{Net Proceeds}}{2}}$$

Note:

- ◆ Where (f) is floating cost expressed in percentage.

- ◆ If floating cost is given in absolute amount then simply deduct floating cost from Bond Value i.e. $B_0 - f$.

Concept No. 16: Treatment of Tax

- Tax is important part for our analysis, it must be considered if it is given in question.
- Two types of Tax rates are given :-

1. Interest Tax rate/ Normal Tax Rate

We should take Interest Net of Tax i.e. **Interest Amount (1 – Tax)**

2. Capital Gain Tax rate

Take Maturity value after Capital Gain Tax i.e. Maturity Value – Capital Gain Tax Amount

Maturity value – (Maturity value – B_0) × Capital gain tax rate

Formulae:

$$YTM = \frac{\text{Interest}(1 - \text{Tax rate}) + \frac{\text{MV net of CG Tax} - B_0}{n}}{\frac{\text{MV net of CG Tax} + B_0}{2}}$$

Concept No. 17: Yield to call (YTC) & Yield to Put (YTP)

1. Yield to Call

Callable Bond: When company call its bond or Re-purchase its bond prior to the date of Maturity.

Call Price: Price at which Bond will call by the Company.

Call Date: Date on which Bond is called by the Company prior to Maturity.

$$YTC = \frac{\text{Interest} + \frac{\text{Call Price} - B_0}{n}}{\frac{\text{Call Price} + B_0}{2}}$$

n = No. of Years upto Call Date.

2. Yield to Put

Puttable Bond: When investor sell their bonds prior to the date of maturity to the company.

Put Price: Price at which Bond will put/ Sell to the Company.

Put Date: Date on which Bond is sold by the investor prior to Maturity.

$$YTP = \frac{\text{Interest} + \frac{\text{Put Price} - B_0}{n}}{\frac{\text{Put Price} + B_0}{2}}$$

n = No. of years upto Put Date.

Concept No. 18: Yield to worst

- It is the lowest yield between YTM, YTC, YTP, Yield to first call.
- Yield to worst is lowest among all.

Concept No. 19: YTM of a perpetual Bond / Irredeemable Bond

We know that the value of a perpetual bond (B_0) = $\frac{\text{Annual Interest}}{\text{YTM}}$

$$\text{So, YTM} = \frac{\text{Annual Interest}}{B_0}$$

Concept No. 20: Confusion regarding Coupon Rate & YTM

YTM → Required Return / Investor's Expectation / Mkt. Rate of Interest.

Coupon Rate → Rate of Interest paid by the company.

Note 1: YTM is always subjected to change according to Market Conditions.

Note 2: Coupon Rate is always constant throughout the life of the bond and it is not affected by change in market condition.

Note 3: Sometimes interest is expressed in terms of Basis Point
1% = 100 Basis Points

Concept No. 21: Conversion Value/ Stock Value of Bond

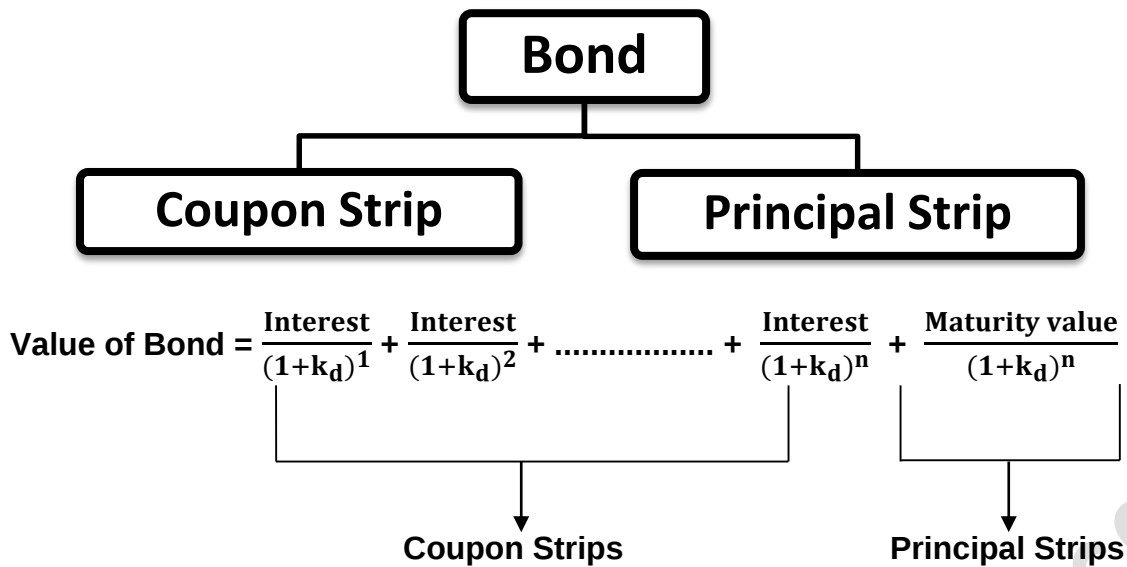
- Converted into equity shares after certain period.
- When **Conversion Value > Bond value**, option can be exercised otherwise not.
- **Conversion Value = $\frac{\text{No. of equity shares issued}}{\text{time of Conversion}} \times \text{Market value at the time of Conversion}$**
- Conversion Ratio = No. of share Received per Convertible Bond

Concept No. 22: Credit Rating Requirement

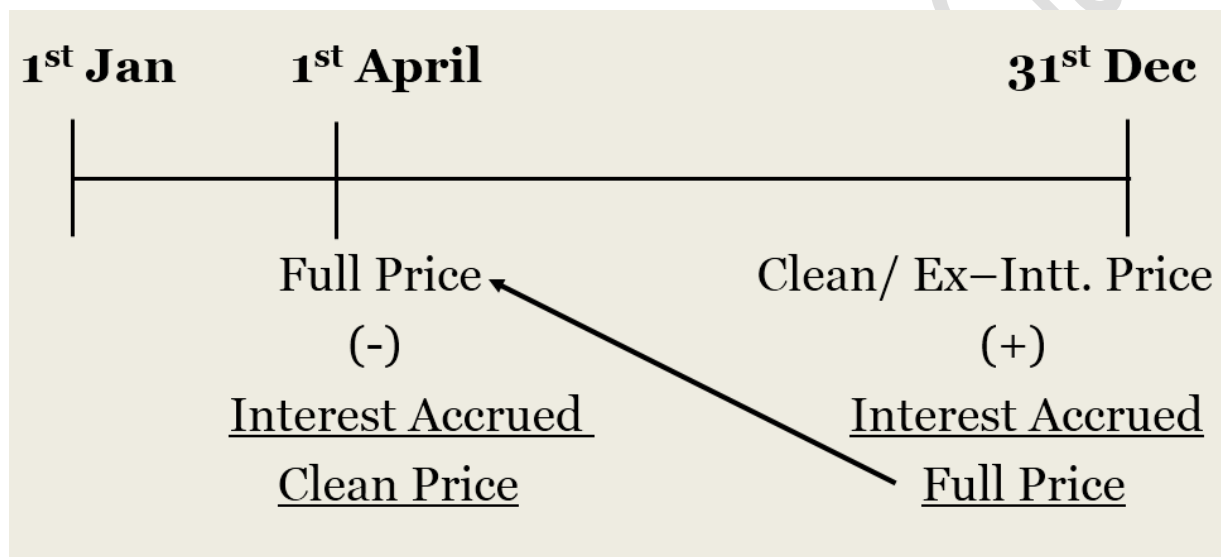
- As per SEBI regulation, no public or right issue of debt/bond instruments shall be made unless credit rating from credit rating agency has been obtained and disclosed in the offer document.
- Rating is based on the track record, financial statement, profitability ratios, debt – servicing capacity ratios, credit worthiness & risk associated with the company.
- Higher rated Bonds means low risk and a lower rated bond means high risk.
- Higher the risk higher will be the expectation and higher will be the discount rate.

Concept No. 23: Strips (Separate Trading of Registered Interest & Principal Securities) Program

Under this, Strip the coupons from the principal, repackage the cash flows and sell them separately as Zero – Coupon Bonds, at discount.



Concept No. 24: Cum Interest & Ex-interest Bond Value



- When Bond value include amount of interest it is known as Cum-Interest Bond Value, other -wise not.
- If question is Silent, we will always assume ex-interest.
- Assume value of Bond (B_0) as ex – interest.
- If it is given Cum-Interest then deduct Interest and proceeds your calculations.

Concept No. 25: Relationship between Coupon Rate & YTM

Bonding Selling At	
Par	Coupon Rate = Yield to Maturity
Discount	Coupon Rate < Yield to Maturity
Premium	Coupon Rate > Yield to Maturity

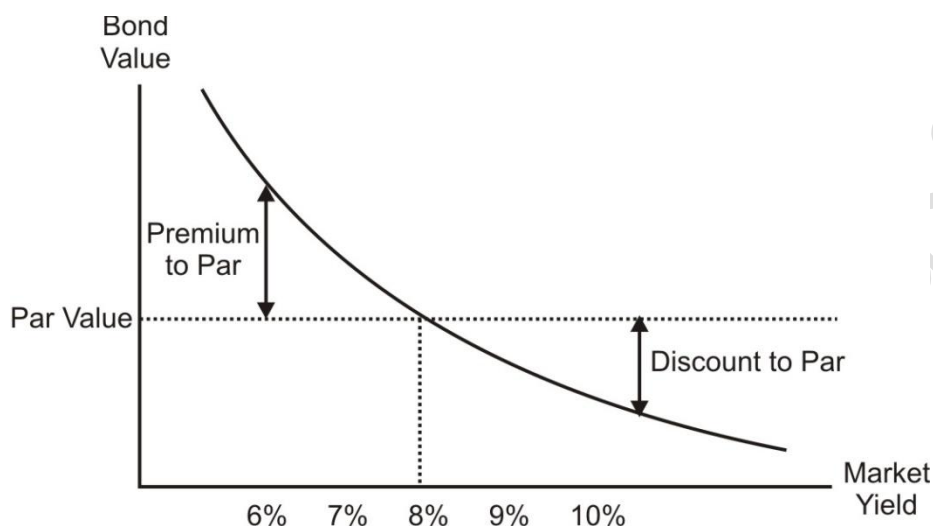
Concept No. 26: Relationship between Bond Value & YTM

- When the coupon rate on a bond is equal to its market yield, the bond will trade at its par value.

- If yield required in the market subsequently rises, the price of the bond will fall & it will trade at a discount.
- If required yield falls, the bond price will increase and bond will trade at a premium.

Crux:

- If YTM increases, bond value decreases & vice-versa, other things remaining same.
- YTM & Bond value have inverse relationship.



Concept No. 27: Value of the Bond at the end of each Year

$$B_0 = \frac{B_1 + I_1}{(1+YTM)^1}$$

$$B_1 = \frac{B_2 + I_2}{(1+YTM)^1}$$

⋮

So on

Concept No. 28: Relationship between Bond Value & Maturity

- Prior to Maturity, a bond can be selling at significant discount or premium to Par value.
- Regardless of its required yield, the price will converge to par value as Maturity approaches.
- Value of premium bond decrease to par value, value of Discount bond increases to Par value.
- Premium and discount vanishes.

Concept No. 29: Floating Rate Bonds

- Floating Rate Bonds are those bonds where coupon rate is decided according to the Reference rate (Market Interest Rate).
- Coupon Rate should be changed with the change in Reference rate (Market Interest Rate).
- In this case **YTM = Coupon Rate**.

Concept No. 30: Duration of a Bond (Macaulay Duration)

- Duration of the bond is a **weighted average of the time (in years) until each cash flow will be received** i.e. our initial investment is fully recovered.
- Duration is a measurement of how long in years it takes for the price of a bond to be repaid by its internal cash flows.
- Duration of bond will always be less than or equal to maturity years.

Formulae :

Duration =

$$\frac{1}{B_0} \left[1 \times \frac{\text{Interest}}{(1 + k_d)^1} + 2 \times \frac{\text{Interest}}{(1 + k_d)^2} + \dots + n \times \frac{\text{Interest}}{(1 + k_d)^n} + n \times \frac{\text{Maturity value}}{(1 + k_d)^n} \right]$$

Concept No. 31: Duration of a Zero - Coupon Bond

Duration of a Zero Coupon Bond will always be equal to its Maturity Years

Concept No. 32: Relationship between Duration of Bond & YTM

- If YTM increases, Bond Value decreases so duration of the bond decreases (recovery is less) & vice versa.
- Higher the YTM, lower will be duration of a bond.
Lower the YTM, higher will be duration of a bond, other things remaining constant.

Concept No. 33: Modified Duration/ Sensitivity/ Volatility/ Effective Duration

- Volatility measures the sensitivity of interest rate to bond prices.
- Duration of a bond can be used to estimate the price sensitivity. It can be calculated through below formula.

Method 1:

$$\text{Modified Duration} = \frac{\text{Macaulay Duration}}{1 + \text{YTM}}$$

- Modified duration will always be lower than Macaulay's Duration.
- Volatility measures the % change in the bond value with 1% change in YTM.

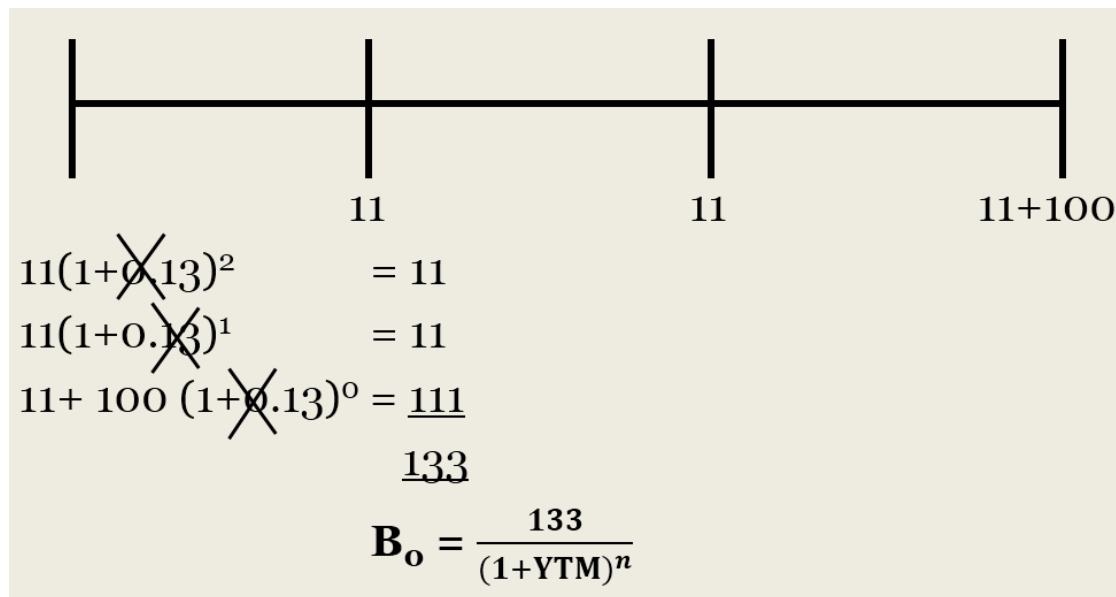
Method 2:

$$\text{Effective Duration} = \frac{BV_{-\Delta Y} - BV_{+\Delta Y}}{2 \times BV_0 \times \Delta Y}$$

Concept No. 34: Return Calculation

When bonds are purchased and sold within time frame.

Concept No. 35: Calculation of yield when Coupon Payment is not available for Re-Investment



Concept No. 36: Downside Risk, Conversion Premium, Conversion Parity Price

1. Downside Risk or Premium over Non-Convertible Bond

Downside Risk reflects the extent of decline in market value of convertible bonds at which conversion option become worthless.

$$\text{Downside Risk} = \frac{\text{Market value of Convertible bond} - \text{Market value of Non-Convertible bond}}{\text{Market value of Non-Convertible bond}}$$

$$\% \text{ Downside Risk / \% Price Decline} = \frac{\text{Downside Risk}}{\text{Market value of Non-convertible bond}}$$

2. Conversion Premium/ Premium over Conversion Value

Conversion Premium shows the percentage increase necessary to reach a parity price relationship between the underlying equity shares and the convertible bond

$$\text{Conversion Premium} = \frac{\text{Market value of Convertible bond} - \text{CV (No. of Shares} \times \text{MPS)}}{\text{CV (No. of Shares} \times \text{MPS)}}$$

(Extent by which Market Value of Convertible Bond exceeds the Conversion Value)

$$\% \text{ Conversion Premium} = \frac{\text{Conversion Premium}}{\text{CV}}$$

$$\text{3. Conversion Premium per share} = \frac{\text{Conversion Premium}}{\text{Conversion Ratio}}$$

$$\text{4. Conversion Parity Price/ No Gain No Loss of Share/ Market Conversion Price} =$$

$$\frac{\text{Market value of Convertible bond}}{\text{No. of equity share issued on Conversion}}$$

When the market value of convertible bond = Conversion Value.

5. Premium Over Investment Value of Non-Convertible bond / MV of NCB :

$$= \frac{\text{Market Price of CB} - \text{Investment Value} / \text{MV of Non-Convertible Bond}}{\text{Investment Value} / \text{MV of Non-Convertible Bond}}$$

6. Premium Pay Back Period or Break Even Period of Convertible Bond

It is a time period, when bond would be converted into equity share so that the loss on conversion would be set-off by income from interest.

$$\text{Break Even Period} = \frac{\text{Loss due to Conversion}}{\text{Extra Income from Bond}}$$

$$\text{OR}$$
$$= \frac{\text{Market Price of Bond} - \text{Conversion Value}}{\text{Interest on Bond} - \text{Dividend on Share}}$$

7. Floor Value: Floor Value is the maximum of :

- a) Market Value of Convertible Bond.
- b) Market Value of Non-Convertible Bond.

Note: Market Value of Convertible Bond (Assume 5 Years)

$$= \frac{\text{Interest}}{(1+YTM)^1} + \frac{\text{Interest}}{(1+YTM)^2} + \dots + \frac{\text{Interest}}{(1+YTM)^5} + \frac{\text{Conversion Value (CV}_5\text{)}}{(1+YTM)^5}$$

CV₅ = MPS at the end of Year 5 × No. of Shares.

Concept No. 37: Callable Bond

Those bonds which can be called before the date of Maturity.

Step 1: Calculate Net Initial Outflow.

Step 2: Calculate Tax Saving on Call Premium & Unamortized Issue Cost.

Step 3: Calculate Annual Saving on Cash Outflow.

Step 4: Calculate Present Value of Total Net Savings by replacing Outstanding Bonds with New Bonds.

Concept No. 38: Spot Rate

- Yield to maturity is a single discount rate that makes the present value of the bond's promised cash flow equal to its Market Price.
- The appropriate discount rates for individual future payments are called Spot Rate.
- Discount each cash flow using a discount rate i.e. specific to the maturity of each cash flow.

Concept No. 39: Relationship between Forward Rate and Spot Rate

Forward Rate is a borrowing/ lending rate for a loan to be made at some future date.

${}_1f_0$ = Spot Rate or Current YTM (rate of 1 year loan)

${}_1f_1$ = Rate for a 1 year loan, one year from now

${}_1f_2$ = Rate for a 1 year loan to be made two years from now

Relationship:

$$(1+S_1)^1 = (1 + {}_1f_0)$$

$$(1+S_2)^2 = (1 + {}_1f_0) (1 + {}_1f_1)$$
$$\text{Or } S_2 = \{(1 + {}_1f_0) (1 + {}_1f_1)\}^{1/2} - 1$$

$$(1 + S_3)^3 = (1+{}_1f_0) (1 + {}_1f_1) (1 + {}_1f_2)$$
$$\text{Or } S_3 = \{(1 + {}_1f_0) (1 + {}_1f_1) (1 + {}_1f_2)\}^{1/3} - 1$$

Concept No. 40: Calculation of After-tax yield of a taxable security & tax-equivalent yield of a tax-exempt security

$$\text{After-tax yield} = \text{taxable yield} \times (1 - \text{marginal tax rate})$$

- Taxable-equivalent yield is the yield a particular investor must earn on a taxable bond to have the same after-tax return they would receive from a particular tax-exempt issue.

$$\text{Taxable-equivalent yield} = \frac{\text{tax-free yield}}{(1 - \text{marginal tax rate})}$$

Concept No. 41: Duration of a Portfolio

It is simply the weighted average of the durations of the individual securities in the Portfolio.

$$\text{Portfolio Duration} = W_1D_1 + W_2D_2 + W_3D_3 + \dots + W_nD_n$$

$$W_i = \frac{\text{Market value of bond } i}{\text{Market value of Portfolio}}$$

D_i = Duration of bond (i)

N = No. Of bonds in the Portfolio

Concept No. 42: Interest Rate anticipation Strategy

