# Common Stock Analysis and Valuation

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# Chapter - 7

# COMMON STOCK ANALYSIS AND VALUATION

## * Dividend Discount Model (DDM)

There are so many model to calculate intrinsic value of common stock, among them DDM is most popular and widely used method in practise.

According to this model, intrinsic value of common stock is calculated by distributing all the dividends which are expected to received from the given common stock from year 1 to $\infty$ and summarized them.

i.e

$$P_0 = \frac{D_1}{(1+K_s)^1} + \frac{D_2}{(1+K_s)^2} + \frac{D_3}{(1+K_s)^3} + \ldots\ldots + \frac{D_\infty}{(1+K_s)^\infty}$$

where,

$P_0$ = Intrinsic Value of Common stock
$D_1$ = Dividend at the end of year 1
$D_2$ = Dividend at the end of year 2
$K_s$ = Required rate of return

## * Models of DDM :

1. Zero Growth Model
2. Constant Growth Model
3. Supernormal Growth Model

### 1. Zero Growth Model :

This model assumes that earnings and dividend will remain constant each year upto $\infty$ ($g = 0$). According to this model $P_0$ is calculated as follows:

$$P_0 = \frac{D}{K_s}$$

where,

$$D = D_0 = D_1 = D_2 = D_3 = \ldots\ldots = D_\infty$$

### 2. Constant Growth Model :

This model assumes that earnings and dividends will grow at a same constant rate each year forever. According to this model, $P_0$ is calculated as follows:

$$P_0 = \frac{D_1}{K_s - g}, \quad P_1 = \frac{D_2}{K_s - g}, \quad P_2 = \frac{D_3}{K_s - g}$$

where,

$g$ = Constant growth rate

Note: To apply this model, $K_s$ must be greater than $g$.

$D_1 = D_0(1+g)^1$

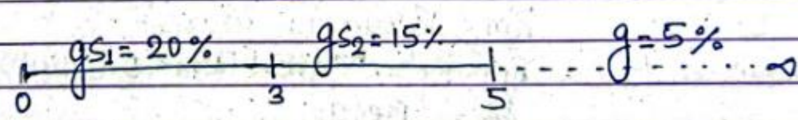
$D_2 = D_1(1+g)^1$ or, $D_2 = D_0(1+g)^2$

$D_3 = D_0(1+g)^3$ or, $D_3 = D_1(1+g)^2$ or, $D_3 = D_2(1+g)^1$

and so on...

## 3. Supernormal Growth Model:

According to this model earnings and dividends will grow at different rate from year 1 to ∞. Under this model, $P_0$ is calculated as follows:




$$P_0 = \frac{D_1}{(1+K_s)^1} + \frac{D_2}{(1+K_s)^2} + \frac{D_3}{(1+K_s)^3} + \frac{D_4}{(1+K_s)^4} + \frac{D_5}{(1+K_s)^5} + \frac{P_5}{(1+K_s)^5}$$

$$P_1 = \frac{D_2}{(1+K_s)^1} + \frac{D_3}{(1+K_s)^2} + \frac{D_4}{(1+K_s)^3} + \frac{D_5}{(1+K_s)^4} + \frac{P_5}{(1+K_s)^4}$$

$$P_2 = \frac{D_3}{(1+K_s)^1} + \frac{D_4}{(1+K_s)^2} + \frac{D_5}{(1+K_s)^3} + \frac{P_5}{(1+K_s)^3}$$

Where,

$D_1 = D_0(1+gs_1)$ $\quad$ $D_4 = D_3(1+gs_2)$ $\quad$ $P_5 = \dfrac{D_6}{K_s - g}$

$D_2 = D_1(1+gs_1)$ $\quad$ $D_5 = D_4(1+gs_2)$

$D_3 = D_2(1+gs_1)$ $\quad$ $D_6 = D_5(1+g)$

Note:

$D_0$ = Current DPS | Present DPS | Dividend just paid | Past year's DPS | Previous year DPS.

$D_1$ = Expected Dividend | Dividend at the year

$K_s = R_f + (R_m - R_f)\beta$ → CAPM

Where,

$R_f$ = Risk free Rate

$R_m$ = Return on market

$R_m - R_f$ = Market Risk premium

$\beta$ = Beta.

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Soln

Given:

Current Dividend ($D_0$) = Rs. 40

a. Constant Growth Model:

constant growth rate (g) = 5%

$$\text{Dividend in Year 10 } (D_{10}) = D_0(1+g)^{10}$$
$$= 40(1+0.05)^{10}$$
$$= \text{Rs. } 65.16$$

b. Required rate of return ($K_s$) = 12%

$$\text{Value of stock } (P_0) = \frac{D_1}{K_s - g} = \frac{D_0(1+g)}{K_s - g}$$

$$= \frac{40(1+0.05)}{0.12-0.05}$$

$$= \text{Rs. } 600$$

c. Dividend at the end of 5 year ($D_5$) = Rs. 50.87

Growth rate ($g$) = ?

$$D_5 = D_0(1+g)^5$$

$$50.87 = 40(1+g)^5$$

$$g = \left(\frac{50.87}{40}\right)^{1/5} - 1$$

$$= 4.93\%$$

d. Supernormal growth rate ($g_{s_1}$) = 5% (Only for 3 Yrs)

Constant growth rate ($g$) = 3%

$$\text{Value of stock } (P_0) = \frac{D_1}{(1+K_s)^1} + \frac{D_2}{(1+K_s)^2} + \frac{D_3}{(1+K_s)^3} + \frac{P_3}{(1+K_s)^3}$$

$$= \frac{42}{(1+0.12)^1} + \frac{44.1}{(1+0.12)^2} + \frac{46.305}{(1+0.12)^3} + \frac{529.89}{(1+0.12)^3}$$

$$= \text{Rs. } 482.79$$

Where,

$D_1 = D_0(1+g_{s1}) = 40(1+0.05) = Rs.\ 42$

$D_2 = D_1(1+g_{s1}) = 42(1+0.05) = Rs.\ 44.1$

$D_3 = D_2(1+g_{s1}) = 44.1(1+0.05) = Rs.\ 46.305$

$D_4 = D_3(1+g) = 46.305(1+0.03) = Rs.\ 47.69$

$$P_3 = \frac{D_4}{K_s - g} = \frac{47.69}{0.12-0.03} = Rs.\ 529.89$$

e. The assumptions of DDM are:

i. The dividend is expected to grow forever at a constant rate g.

ii. The stock price is expected to grow at same rate.

iii. The expected dividend yield is a constant.

iv. The expected rate of return is always greater than g.

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Soln

Given:

Current Dividend $(D_0)$ = Rs. 25

Required rate of return $(K_s)$ = 16 %

a. Zero Growth Model:

$$\text{Value of stock}(P_0) = \frac{D}{K_s} = \frac{25}{0.16} = Rs.\ 156.25$$

b. Constant growth rate (g) = 8 %

Value of stock ($P_0$) = $\frac{D_1}{K_s - g} = \frac{D_0(1+g)}{K_s - g}$

$= \frac{25(1+0.08)}{0.16-0.08}$

$= Rs.\ 337.5$

Since, the stock is underpriced, we would buy the stock if it is selling at Rs. 300 per share.

c. Supernormal growth rate ($g_{s1}$) = 5% (for 3 years)

Constant growth rate (g) = 0

Value of stock ($P_0$) = $\frac{D_1}{(1+K_s)^1} + \frac{D_2}{(1+K_s)^2} + \frac{D_3}{(1+K_s)^3} + \frac{P_3}{(1+K_s)^3}$

$= \frac{26.25}{(1+0.16)^1} + \frac{27.56}{(1+0.16)^2} + \frac{28.94}{(1+0.16)^3} + \frac{\cancel{28.94}\ 180.87}{(1+0.16)^3}$

$= Rs.\ 177.53$

where,

$D_1 = D_0(1+g_{s1}) = 25(1+0.05) = Rs.\ 26.25$

$D_2 = D_1(1+g_{s1}) = 26.25(1+0.05) = Rs.\ 27.56$

$D_3 = D_2(1+g_{s1}) = 27.56(1+0.05) = Rs.\ 28.94$

$D_4 = D_3(1+g) = 28.94(1+0) = Rs.\ 28.94$

$P_3 = \frac{D_4}{K_s - g} = \frac{28.94}{0.16 - 0} = Rs.\ 180.87$

Since the stock is overvalued, we would sell these stock.

d. If the stock is undervalued, we should purchase the stock and if it is overvalued we would sell it.

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Soln

Given:

Risk free Rate ($R_f$) = 5%

Return on market ($R_m$) = 15%

Current Dividend ($D_0$) = Rs. 10

Beta coefficient ($\beta$) = 1

Supernormal growth rate ($gs_1$) = 20% (for 2 years)

Constant growth ~~model~~ rate ($g$) = 5%

a. Required rate of return ($K_s$) $= R_f + (R_m - R_f)\beta$

$= 5\% + (15\% - 5\%) 1$

$= 15\%$

b. Dividend in year 1 ($D_1$) $= D_0(1+gs_1) = 10(1+0.20) =$ Rs. 1.

Dividend in year 2 ($D_2$) $= D_1(1+gs_1) = 12(1+0.20) =$ Rs. 14.4

c. Price at the end of year 2 ($P_2$) $= \frac{D_3}{K_s - g} = \frac{D_2(1+g)}{K_s - g}$

$= \frac{14.4(1+0.05)}{0.15 - 0.05}$

$=$ Rs. 151.2

d. Value of stock today ($P_0$) $= \frac{D_1}{(1+K_s)^1} + \frac{D_2}{(1+K_s)^2} + \frac{P_2}{(1+K_s)^2}$

$= \frac{12}{(1+0.15)^1} + \frac{14.4}{(1+0.15)^2} + \frac{151.2}{(1+0.15)^2}$

$=$ Rs. 135.65

e. If the stock is trading at Rs. 130, it is underpriced. so, we should buy the stock.

2077 Q.N.19

Soln

Given:

Latest dividend ($D_0$) = Rs. 40

Dividend next year ($D_1$) = Rs. 43.2

Dividend in year 2 ($D_2$) = Rs. 46.7

Dividend in year 3 ($D_3$) = Rs. 50.4

Current stock price ($P_0$) = Rs. 565

Price of stock in 3 years ($P_3$) = Rs. 777.50

a. Required rate of return ($K_s$) = 15%

Value of stock ($P_0$) = ?

$$P_0 = \frac{D_1}{(1+K_s)^1} + \frac{D_2}{(1+K_s)^2} + \frac{D_3}{(1+K_s)^3} + \frac{P_3}{(1+K_s)^3}$$

$$= \frac{43.2}{(1+0.15)^1} + \frac{46.7}{(1+0.15)^2} + \frac{50.4}{(1+0.15)^3} + \frac{777.50}{(1+0.15)^3}$$

$=$ Rs. 617.23

b. Calculation of Expected rate of return using IRR approach:

Step-1:

$$P_0 = \frac{D_1}{(1+K_s)^1} + \frac{D_2}{(1+K_s)^2} + \frac{D_3}{(1+K_s)^3} + \frac{P_3}{(1+K_s)^3}$$

$$565 = \frac{43.2}{(1+K_s)^1} + \frac{46.7}{(1+K_s)^2} + \frac{50.4}{(1+K_s)^3} + \frac{777.50}{(1+K_s)^3} \quad \text{--- (1)}$$

Step-2: Try at 20%.

$$TPV_{HR} = \frac{43.2}{(1+0.20)^1} + \frac{46.7}{(1+0.20)^2} + \frac{50.4}{(1+0.20)^3} + \frac{777.50}{(1+0.20)^3}$$

$$= Rs.\ 547.53$$

Step-3: Try at 17%

$$TPV_{LR} = \frac{43.2}{(1+0.17)^1} + \frac{46.7}{(1+0.17)^2} + \frac{50.4}{(1+0.17)^3} + \frac{777.50}{(1+0.17)^3}$$

$$= Rs.\ 587.95$$

Step-4: By Interpolation:

$$\text{Annual Return} = LR\% + \frac{TPV_{LR} - P_0}{TPV_{LR} - TPV_{HR}} \times (HR - LR)$$

$$= 17\% + \frac{587.95 - 565}{587.95 - 547.53} \times (20\% - 17\%)$$

$$= 18.70\%$$

c. Constant growth rate $(g) = 8\%$.
Required rate of return $(K_s) = 15\%$

$$\text{Value of stock } (P_0) = \frac{D_1}{K_s - g} = \frac{D_0(1+g)}{K_s - g} = \frac{40(1+0.08)}{0.15-0.08}$$
$$= \text{Rs. } 617.14$$

d. If $g$ is greater than $K_s$, it implies that dividend yield is negative, which does not hold true in real life.

e. $D_3 = \text{Rs. } 50.4$
$g = 8\%$
$K_s = 15\%$

$$P_3 = \frac{D_4}{K_s - g} = \frac{D_3(1+g)}{K_s - g} = \frac{50.4(1+0.08)}{0.15-0.08} = \text{Rs. } 777.6$$

The value of stock is similar because the valuation of common stock at the end of year 3 is also based on the same expected growth rate of 8%.

## Problem 7.6

a. Given:
Dividend this year $(D_0) = \text{Rs. } 20$
constant growth rate $(g) = 6\%$
Required rate of return $(K_s) = 16\%$

Value of stock ($P_0$) = $\frac{D_1}{K_s - g} = \frac{D_0(1+g)}{K_s - g}$

$= \frac{20(1+0.06)}{0.16-0.06}$

$= Rs. 212$

b.

Dividend Per share (D) = Rs. 12

Required rate of return ($K_s$) = 14 %

Value of stock ($P_0$) = $\frac{D}{K_s} = \frac{12}{0.14} = Rs. 85.71$

c. Expected dividend at the end of the year ($D_1$) = Rs. 8

constant growth rate (g) = 6 %

Required rate of return ($K_s$) = 14 %

Value of stock ($P_0$) = $\frac{D_1}{K_s - g} = \frac{8}{0.14-0.06} = Rs. 100$

d. Expected dividend ($D_1$) = Rs. 12

Market price at end ($P_1$) = Rs. 264

Required rate of return ($K_s$) = 15 %

Value of stock ($P_0$) = $\frac{D_1}{(1+K_s)^1} + \frac{P_1}{(1+K_s)^1}$

$$= \frac{12}{(1+0.15)^1} + \frac{264}{(1+0.15)^2}$$

$= Rs.\ 240$

**Problem 7.7**

Soln

Given:

Dividivid just paid ($D_0$) = Rs. 20

Required rate of return ($k_s$) = 15%

Constant growth rate ($g$) = 5%

a. Value of stock ($P_0$) $= \frac{D_0(1+g)}{k_s - g} = \frac{20(1+0.05)}{0.15-0.05} = Rs.\ 210$

b. Value of stock in 5 years ($P_5$) $= \frac{D_6}{k_s - g} = \frac{D_0(1+g)^6}{k_s - g}$

$= \frac{20(1+0.05)^6}{0.15-0.05}$

$= Rs.\ 268$

c. Supernormal growth rate ($g_{s1}$) = 10% (for 3 years)

Constant growth rate ($g$) = 5%

$$P_0 = \frac{D_1}{(1+k_s)^1} + \frac{D_2}{(1+k_s)^2} + \frac{D_3}{(1+k_s)^3} + \frac{P_3}{(1+k_s)^3}$$

$$= \frac{22}{(1+0.15)^1} + \frac{24.2}{(1+0.15)^2} + \frac{26.62}{(1+0.15)^3} + \frac{279.5}{(1+0.15)^3}$$

$= Rs.\ 238.71$

where

$D_1 = D_0(1+g_{s1}) = 20(1+0.10) = Rs.\ 22$

$D_2 = D_1(1+g_{s1}) = 22(1+0.10) = Rs.\ 24.2$

$D_3 = D_2(1+g_{s1}) = 24.2(1+0.10) = Rs.\ 26.62$

$D_4 = D_3(1+g) = 26.62(1+0.05) = Rs.\ 27.95$

$P_3 = \frac{D_4}{k_s - g} = \frac{27.95}{0.15-0.05} = Rs.\ 279.5$

# Markets and Transaction

# Chapter-2
# Markets and Transactions

## Financial Markets:

Financial market is a place where financial assets are exchanged. It can be defined as a mechanism bringing together buyers and sellers of financial assets in order to facilate trading. Financial market is of two types:

1. On the basis of maturity of claim:

### a. Money Market

Money market are the markets for short-term debt securities. Examples of money market securities are Treasury Bills, Banker's Acceptance, Commercial papers and negotiable certificate of deposit issued by government and financial institutions.

### b. Capital Market

The capital market is the market for long-term debt and equity capital. The capital market includes the stock market, the bond market and the primary market. Company's and government can raise funds for long-term Investment by the capital market.

* Difference between money market and Capital market.

| Basis | Money Market | Capital Market |
|---|---|---|
| Meaning | Market where short term securities are traded. | Market where long term securities are traded. |
| Nature | It is informal market. | It is a formal market. |
| Maturity | Securities having life one year or less than one year are traded. | Securities having life more than one year are traded. |
| Instruments | Treasury bills, Commercial paper, certificate of deposit, etc. | Common stock, corporate bond, preferred stock, governmental bond, etc. |
| Risk | Less Risky | More risky |
| Return | Provide low return | Provide High return |
| liquidity | High liquidity | low liquidity |

2. On the basis of seasoned | security traded:

a. Primary Market

It is the market for new securities. The security market transfer the funds from savers to investors through the primary market. Hence, the transaction of securities issued for the first time takes place in this market.

It can be sub-divided into seasoned and unseasoned issue. Seasoned issue involves the issue of more of an existing security which is already traded in the market whereas unseasoned issue have no track record. They are issue of completely new securities and are often referred to as initial Public offering (IPOs).

b. Secondary Market

It is the market for the existing securities. Second hand securities are bought and sold in this market. It's main function is to provide liquidity to the purchasers of securities. Nepal Stock Exchange (NEPSE) is an expample of secondary market in Nepal.

* Difference between Primary market and secondary market.

| Basis | Primary Market | Secondary Market |
| --- | --- | --- |
| Meaning | Market where first hand securities are traded. | Market where second hand securities are traded. |
| Purpose | Provides funds to the issuing company. | Provide the liquidity of the security. |
| Transaction between | Company and Investor | Between Investors |
| Risky | less risky | More risky |
| Intermediary | Underwriters | Brokers |
| Price | Fixed price | Fluctuates, depends upon the demand and supply. |
| Number of transactions | Less transactions | More transactions |

* Difference between Organized market and Over-The counter (OTC) Market

| Basis | Organized market | OTC Market |
|---|---|---|
| Type of securities | Formal market | Informal market |
| Determination of price | By demand and supply. | By negotiation |
| Commission | Fixed | Negotiated |
| Securities traded | listed securities are traded | Unlisted securities are traded. |
| Location and Timing | Location and timing for trading is fixed. | Physical location and time is not fixed. Anywhere can be traded. |
| Registration | Registered in government agency | Registered in the authorized dealer like NASDAP in America. |
| Specialist | There is specialist for scrutiny of securities. | There is no any specialist. |

Other Markets:

**Broker Markets:** The organized markets where buy and sell orders of investors are executed through the licensed broker is broker market.

**Dealer Markets:** A security market mechanism where in multiple dealers post prices at which they are agreed to buy or sell a specific security is dealear market. eg: OTC Market

**Bull Markets:** A market condition that shows securities prizes are rising and investors are building up confidence in the market is bull market.

**Bear Markets:** A bear market is the opposite to a bull market. A market condition that shows securities prices are falling and investors are pessimistic about the market is bear market.

## * Transactions | Buying and Selling securities:

While buying and selling securities (shares) investors may follow one of the following position:

1. Long position
2. Margin purchase > Buy
3. Short position
4. Short sell > Sell.

## * long position and Margin Purchase:

Purchasing a security today with the expectation that its price will increase in the future is called long position and margin purchase. In long position, investor invest total required amount from his own pocket but in margin purchase he/she uses certain percentage of total required amount as loan from the brokerage firm.

Long Position:

Rate of Return | Holding Period Return (HPR)

$$= \frac{(\text{Ending Price} - \text{Beginning Price}) + \text{Dividend}}{\text{Beginning price}} \times 100$$

$$= \frac{(\text{Selling Price} - \text{Purchase price}) + \text{Dividend}}{\text{Purchase price}} \times 100$$

$$= \frac{(P_1 - P_0) + D_1}{P_0} \times 100$$

$$= \frac{P_1 - P_0}{P_0} \times 100 + \frac{D_1}{P_0} \times 100$$

= Capital Gain Yield + Dividend Yield
= CGY + DY

* Margin purchase:
Example:

ABC. Co
1000 shares
$P_0 = 50$

| | |
|---|---|
| Own pocket money = Rs. 30 | Loan from Brokerage Firm = Rs. 20 |
| Initial Margin (IM) = 60 % | loan = 40 % |
| or | Collateral → Purchased shares |
| Margin Requirement | Interest (i) |
| or | |
| Down Payment | |

1. If $P_0 = 50$

Initial margin (IM) = $\frac{50-20}{50} = 60\%$

2. If stock price rises to Rs. 60

Actual Margin (AM) = $\frac{60-20}{60} = 66.67\%$

3. If stock price decreases to Rs. 30

Actual margin (AM) = $\frac{30-20}{30} = 33.33\%$

$$\boxed{\therefore \text{Actual Margin (AM)} = \frac{P_0 - LPS}{P_0}}$$

where, $P_0$ = market price

LPS = loan per share

OR,

$$\boxed{\text{Actual Margin (AM)} = \frac{\text{Assets} - \text{Debt}}{\text{Assets}}}$$

where,

Assets = $N \times P_0$

Debt/Loan = $N \times P_0 (1 - IM)$

N = Number of shares

## * Maintenance Margin (MM)

It is the minimum actual margin quoted by the brokerage firm. If actual margin decreases due to decrease in stock price and touches or fall below the maintenance margin level, the brokerage firm calls the investor which is called margin call.

∴ Margin Call Price / Trigger Price (TP) = $\frac{1-IM}{1-MM} \times P_0$

where,

IM = Initial Margin

MM = Maintenance Margin

$P_0$ = Beginning Price / Purchase Price

Margin Call Value / Minimum Collateral = $\frac{\text{Debt / Loan}}{1 - \text{Maintenance Margin}}$

Decision:

1. If AM (calculated) > MM (Given) → No Margin Call
2. If AM (calculated) ≤ MM (Given) → Margin Call

OR,

1. If Actual stock price ($P_0$) > Trigger price (TP) → No margin call
2. If Actual stock price ($P_0$) ≤ Trigger price (TP) → Margin call

## * Margin Purchase:

Holding Period Return | Rate of Return (HPR)

$$= \frac{(\text{Ending Price} - \text{Beginning price}) + \text{Dividend} - \text{Interest}}{\text{Beginning price} \times \text{Inital margin}} \times 100$$

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

$$= \frac{P_1 - P_0 + D - I}{BEPS} \times 100$$

Where,

$P_1$ = Selling price per share

$P_0$ = Purchase price per share

$D$ = Dividend

$I$ = Interest

$BEPS$ = Beginning Equity per share

Note:

Return on margin purchase will always be higher than under long position because margin purchase allows the investors to take the advantage of leverage.

Problem 2.1:

Sol$^n$

Given: Long Position:

Number of shares (N) = 1000 share

Beginning price ($P_0$) = Rs.500

Dividend (D) = 0

(a) Ending price ($P_1$) = Rs.600

Rate of Return (HPR) $= \frac{P_1 - P_0 + D}{P_0} \times 100$

$= \frac{600 - 500 + 0}{500} \times 100$

$= 20\%$

(b) Ending price ($P_1$) = Rs.500

Rate of Return (HPR) $= \frac{P_1 - P_0 + D}{P_0} \times 100$

$= \frac{500 - 500 + 0}{500} \times 100$

$= 0$

(c) Ending price ($P_1$) = Rs.400

Rate of Return (HPR) $= \frac{P_1 - P_0 + D}{P_0} \times 100$

$$= \frac{400-500+0}{500} \times 100$$

$$= -20\ \%$$

Problem 2.2

Sol$^n$

Given: Long Position:

Beginning price $(P_0)$ = Rs. 200

Dividend $(D)$ = Rs. 20

Ending Price $(P_1)$ = Rs. 230

Rate of Return (HPR) = ?

We know that,

$$\text{Rate of Return (HPR)} = \frac{P_1 - P_0 + D}{P_0} \times 100$$

$$= \frac{230-200+20}{200} \times 100$$

$$= 25\ \%$$

Problem 2.3

Sol$^n$

Given:

Number of shares (N) = 100 shares

Beginning price $(P_0)$ = Rs. 40

Initial margin (IM) = 70 %

Debt | Loan = $N \times P_0 (1 - IM)$

$= 100 \times 40 (1 - 0.70)$ = Rs. 1200

If stock price moves up to Rs.65

$$\text{Actual Margin (AM)} = \frac{\text{Assets} - \text{loan}}{\text{Assets}}$$

$$= \frac{100 \times 65 - 1200}{100 \times 65}$$

$$= 81.54\%$$

If the stock price decreases to Rs.30

$$\text{Actual Margin (AM)} = \frac{\text{Assets} - \text{loan}}{\text{Assets}}$$

$$= \frac{100 \times 30 - 1200}{100 \times 30}$$

$$= 60\%$$

If stock price decreases, margin also decreases.

Problem 2.4

Soln

Given:

Beginning Price ($P_0$) = Rs.600
Margin Requirement (IM) = 50%
Interest rate (I) = 9%
Maintenance Margin (MM) = 30%

a. Long position without using margin.

Ending price ($P_1$) = Rs.700

$$\text{Rate of Return (HPR)} = \frac{P_1 - P_0 + D}{P_0} \times 100$$

$$= \frac{700 - 600 + 0}{600} \times 100$$

$$= 16.67\ \%$$

b. Long position using Margin:

(i) Trigger Price (TP) $= \frac{1 - IM}{1 - MM} \times P_0$

$$= \frac{1 - 0.50}{1 - 0.30} \times 600$$

$$= \text{Rs. } 428.57$$

If the stock price falls below Rs. 428.57, investor will receive a margin call.

(ii) Ending price ($P_1$) = Rs. 700

$$\text{Rate of Return (HPR)} = \frac{P_1 - P_0 + D - I}{P_0 \times IM} \times 100$$

$$= \frac{700 - 600 + 0 - 27}{600 \times 0.50} \times 100$$

$$= 24.33\%$$

where,

$$I = N \times P_0 (1 - IM) \times i$$
$$= 1 \times 600 (1 - 0.50) \times 0.09$$
$$= 27$$

c. Return on margin purchase is always higher than long position because margin purchase allows the investors to take the advantage of leverage.

Problem 2.5

Solⁿ

Given:

Number of shares (N) = 300 shares

Beginning price ($P_0$) = 400

Loan | Debt = Rs. 40,000

Interest rate (i) = 8%

a. Initial Margin (IM) = $\frac{\text{Assets} - \text{loan}}{\text{Assets}}$

$$= \frac{300 \times 400 - 40{,}000}{300 \times 400}$$
$$= 66.67\%$$

Hence, the margin in her account when she first purchased the stock is 66.67%.

b. If stock price falls to Rs. 300 per share by the end of the year.

$$\text{Actual Margin (AM)} = \frac{\text{Assets} - \text{loan}}{\text{Assets}}$$

$$= \frac{300 \times 300 - 40{,}000}{300 \times 300}$$

$$= 55.56\%$$

Since, the actual margin (55.56%) is higher than the maintenance margin (30%), she will not receive a margin call.

c. Beginning Value (BV) = 300 × 400 = Rs. 120,000
Ending Value (EV) = 300 × 300 = Rs. 90,000
Interest (I) = 8% of 40,000 = Rs. 3200

$$\text{Rate of Return (HPR)} = \frac{(EV - BV) + Div. - Interest}{BV \times IM} \times 100$$

$$= \frac{(90{,}000 - 120{,}000) + 0 - 3200}{120{,}000 \times 0.6667} \times 100$$

$$= -41.50\%$$

## Problem 2.6

Solⁿ

Given:

Number of shares (N) = 200 shares

Beginning price ($P_0$) = Rs.100

Initial Margin (IM) = 50%

Maintenance Margin (MM) = 30%

$$\text{Trigger Price (TP)} = \frac{1 - IM}{1 - MM} \times P_0$$

$$= \frac{1 - 0.50}{1 - 0.30} \times 100$$

$$= \text{Rs. } 71.43$$

Since, the stock price falls to Rs.60 which is lower than trigger price, Mr. Sharma should put an additional Investment of Rs. 2286 [(71.43-60) X 200] to maintain the margin in account.

## Problem 2.7

Solⁿ

Given:

Beginning price ($P_0$) = Rs.500

Own pocket money (Equity) = Rs.50,000

loan / Debt = Rs.50,000

Total Assets = Equity + Debt = 50,000 + 50,000 = 100,000

Interest rate (i) = 8%

Initial Margin (IM) = $\frac{\text{Assets} - \text{loan}}{\text{Assets}} = \frac{100{,}000 - 50{,}000}{100{,}000} = 50\%$

a. If the stock price rises by 10%

Beginning Value (BV) = Rs. 100,000
Ending value (EV) = 100,000 + 10% of 100,000
= Rs. 110,000
Interest (I) = 8% of 50,000 = 4000

$$\text{Rate of Return (HPR)} = \frac{EV - BV + Div. - Interest}{BV \times IM} \times 100$$

$$= \frac{110000 - 100{,}000 + 0 - 4000}{100{,}000 \times 0.50} \times 100$$

$$= 12\%$$

b. Maintenance Margin (MM) = 30%

$$\text{Trigger Price (TP)} = \frac{1 - IM}{1 - MM} \times P_0$$

$$= \frac{1 - 0.50}{1 - 0.30} \times 500$$

$$= Rs.\ 357.14$$

If the stock price falls below Rs. 357.14, the investor will receive a margin call.

## Problem 2.8

Soln

Given:

Number of shares (N) = 5,000 shares

Beginning price ($P_0$) = Rs.300

Initial Margin (IM) = 55 %

Interest rate (i) = 15 %

Dividend per share (D) = Rs.10

a. Ending Price ($P_1$) = Rs.400

$$\text{Rate of Return (HPR)} = \frac{P_1 - P_0 + D - I}{P_0 \times IM} \times 100$$

$$= \frac{400 - 300 + 10 - 20.25}{300 \times 0.55} \times 100$$

$$= 54.39\ \%$$

where,

$$I = N \times P_0 (1 - IM) \times i$$

$$= 1 \times 300 (1 - 0.55) \times 0.15$$

$$= 20.25$$

b. Ending Price ($P_1$) = Rs.200

$$\text{Rate of Return (HPR)} = \frac{P_1 - P_0 + D_1 - I_1}{P_0 \times IM} \times 100$$

$$= \frac{200 - 300 + 10 - 20.25}{300 \times 0.55} \times 100$$

$$= -66.81\%$$

c. Long position:

Ending price ($P_1$) = Rs.400

Rate of Return (HPR) = $\frac{P_1 - P_0 + D_1}{P_0} \times 100$

$= \frac{400 - 300 + 10}{300} \times 100$

$= 36.67\%$

Ending price ($P_1$) = Rs.200

Rate of Return (HPR) = $\frac{P_1 - P_0 + D_1}{P_0} \times 100$

$= \frac{200 - 300 + 10}{300} \times 100$

$= -30\%$

d. $P_0 = 300$

| | Margin purchase | long position |
|---|---|---|
| $P_1 = 400$ | 54.39% | 36.67% |
| $P_1 = 200$ | -66.81% | -30% |

If the stock price increases, margin purchase results higher profit than long position. but if the stock price decreases margin purchase results into higher loss than long position. The margin purchase is more risky than long position or cash purchase.

Problem 2.9

Soln

Given:

Number of shares (N) = 500 shares

Beginning price ($P_0$) = Rs. 100

Initial margin (IM) = 70%

a. Debit Balance (Debt) = $N \times P_0 (1 - IM)$

$= 500 \times 100 (1 - 0.70)$

= Rs. 15,000

b. Equity Capital = Assets − Debt

$= (500 \times 100) - 15000$

$= 50,000 - 15000$

= Rs. 35,000

OR,

Equity = $N \times P_0 \times IM$

$= 500 \times 100 \times 0.70$

= Rs. 35,000

c. Actual Margin (AM) = $\dfrac{\text{Assets} - \text{Debt}}{\text{Assets}}$

$= \dfrac{(500 \times 160) - 15,000}{500 \times 160}$

= 81.25%

Problem 2.10

Soln

Given:

Number of shares (N) = 100 shares

Beginning price ($P_0$) = Rs.100

Ending price ($P_1$) = Rs. 175

i. Initial Margin (IM) = 25 %

$$\text{Rate of Return} = \frac{P_1 - P_0}{P_0 \times IM} \times 100$$

$$= \frac{175 - 100}{100 \times 0.25} \times 100$$

$$= 300\ \%$$

ii. Initial margin (IM) = 50%

$$\text{Rate of Return} = \frac{P_1 - P_0}{P_0 \times IM} \times 100$$

$$= \frac{175 - 100}{100 \times 0.50} \times 100$$

$$= 150\ \%$$

iii. Initial Margin (IM) = 75%

$$\text{Rate of Return} = \frac{P_1 - P_0}{P_0 \times IM} \times 100$$

$$= \frac{175 - 100}{100 \times 0.75} \times 100$$

$$= 100\ \%$$

b. Ending Price ($P_1$) = Rs. 75

i. Initial margin (IM) = 25%

$$\text{Rate of Return} = \frac{P_1 - P_0}{P_0 \times IM} \times 100$$

$$= \frac{75 - 100}{100 \times 0.25} \times 100$$

$$= -100\ \%$$

ii. Initial Margin (IM) = 50%

$$\text{Rate of Return} = \frac{P_1 - P_0}{P_0 \times IM} \times 100$$

$$= \frac{75 - 100}{100 \times 0.50} \times 100$$

$$= -50\ \%$$

iii. Initial margin (IM) = 75 %

$$\text{Rate of Return} = \frac{P_1 - P_0}{P_0 \times IM} \times 100$$

$$= \frac{75-100}{100 \times 0.75} \times 100$$

$$= -33.33\%$$

c.

| | IM = 25% | IM = 50% | IM = 75% |
|---|---|---|---|
| $P_1 = 175$ | 300% | 150% | 100% |
| $P_1 = 75$ | -100% | -50% | -33.33% |

If the stock price is increasing, lower initial margin results higher profit and if the stock price is decreasing lower Initial margin results higher loss.

d. If Investor has to pay commission on margin transaction, the rate of return will decrease. In the same way, dividend income will increase the rate of return and interest expenses will decrease the rate of return.

Problem 2.11

Soln

Given:

Beginning price ($P_0$) = Rs. 100

Number of shares (N) = 500 shares

Beginning value (Assets) = 500X100 = Rs. 50,000

Own pocket money (Initial Equity) = Rs. 37,500

loan/Debt = Assets − Equity = 50000 − 37500 = Rs. 12500

$$\text{Initial Margin (IM)} = \frac{37{,}500}{50{,}000} = 75\%$$

Interest rate (i) = 8%.

Calculation of percentage increase in Net worth (Equity)

| No. of Shares (N) | share Price | Value of Assets | Debt | Equity = Assets - Debt | Initial Equity | Change | % change |
|---|---|---|---|---|---|---|---|
| 500 | Rs. 110 | 55,000 | 12,500 | 42,500 | 37,500 | +5000 | $\frac{5000}{37,500} = 13.3$ |
| 500 | Rs. 100 | 50,000 | 12,500 | 37,500 | 37,500 | 0 | 0 |
| 500 | Rs. 90 | 45,000 | 12,500 | 32,500 | 37,500 | -5000 | -13.33% |

The rate of return on margin is higher when the stock price is higher at end and the decrease in stock price decreases the percentage return.

b. Maintenance Margin (MM) = 25%.

$$\text{Trigger price (TP)} = \frac{1 - IM}{1 - MM} \times P_0$$

$$= \frac{1 - 0.75}{1 - 0.25} \times 100$$

$$= \text{Rs. } 33.33$$

The stock price can fall to Rs. 33.33 to get a margin call.

c. Initial Equity = Rs. 25,000

$$\text{Initial Margin (IM)} = \frac{25,000}{50,000}$$

$$= 50\%$$

Trigger price (TP) = $\frac{1-IM}{1-MM} \times P_0$

$= \frac{1-0.50}{1-0.25} \times 100$

$=$ Rs. 66.67

The stock price can fall to Rs. 66.67 to get a margin call.

d. Interest $= N \times P_0 (1-IM) \times i$

$= 1 \times 100 (1-0.75) \times 0.08 = 2$

Rate of Return $= \frac{P_1 - P_0 - I}{P_0 \times IM} \times 100$

i. If $P_1 = 110$

Rate of Return $= \frac{110-100-2}{100 \times 0.75} \times 100 = 10.67\%$

ii. If $P_1 = 100$

Rate of Return $= \frac{100-100-2}{100 \times 0.75} \times 100 = -2.67\%$

iii. If $P_1 = 90$

Rate of Return $= \frac{90-100-2}{100 \times 0.75} \times 100 = -16\%$

Problem 2.12

Soln

Given:

Number of shares (N) = 200 shares

Beginning price ($P_0$) = Rs. 550

Initial Margin (IM) = 60%

Maintenance Margin (MM) = 30%

If the stock price decrease to Rs. 250 ($P_1$)

Actual Collateral (Assets) = $N \times P_1$ = $200 \times 250$ = Rs. 50,000

Minimum Collateral = $\frac{\text{Debt}}{1 - MM} = \frac{44000}{1 - 0.30}$ = Rs. 62,857.14

where,

Debt = $N \times P_0 (1 - IM)$

= $200 \times 550 (1 - 0.60)$

= Rs. 44,000

Since, the actual collateral is less than minimum collateral, the investor will receive a margin call.

## Problem 2.13

Soln

Given:

Number of shares (N) = 200 shares

Beginning price ($P_0$) = Rs.160

Margin (Initial) (IM) = 60%

Annual Dividend per share (D) = Rs.2

Annual interest rate (i) = 8%.

Rate of Return (6-months) $= \frac{P_1 - P_0 + D - I}{P_0 \times IM} \times 100$

$= \frac{208 - 160 + 1 - 2.56}{160 \times 0.60} \times 100$

$= 48.375\%$

where,

Six-month dividend $= 2 \times 6/12 =$ Rs.1

Six-month Interest (I) $= N \times P_0 (1 - IM) \times i \times 6/12$

$= 1 \times 160 (1 - 0.60) \times 0.08 \times 6/12$

= Rs. 2.56

Annualized Rate of Return = 6-month Return × 2

$= 48.375 \times 2$

$= 96.75\%$

Problem 2.14

Sol$^n$

Given:

Number of shares (N) = 300 shares

Beginning price ($P_0$) = Rs. 550

Initial Margin (IM) = 50%

Four months dividend = Rs. 15

Annual interest rate (i) = 9%

Maintenance Margin (MM) = 25%

a. Initial Value (Assets) = $N \times P_0$ = $300 \times 550$ = Rs. 165,000

Debit Balance (Debt) = $N \times P_0 (1 - IM)$

$= 300 \times 550 (1 - 0.50)$

= Rs. 82,500

Equity = Assets − Debt

= 165000 − 82,500

= Rs. 82,500

OR,

Equity = $N \times P_0 \times IM$

$= 300 \times 550 \times 0.50$

= Rs. 82,500

b. Calculation of Actual Margin:

| No. of Shares (N) | Share Price ($P_1$) | ($N \times P_1$) Assets | Debt | $AM = \frac{\text{Assets} - \text{Debt}}{\text{Assets}}$ | Remarks |
|---|---|---|---|---|---|
| 300 | 450 | 135000 | 82500 | 38.89% | Restricted |
| 300 | 700 | 210,000 | 82,500. | 60.71% | Excess Equity |
| 300 | 350 | 105,000 | 82,500 | 21.43% | margin call |

c.

Total Dividend Received (4-months) = $300 \times 15$ = Rs. 4500

Total Interest paid (4-months) = $82,500 \times 0.09 \times 4/12$ = Rs. 2475

d.

i. Ending Price ($P_1$) = Rs. 500

Ending value = $N \times P_1 = 300 \times 500$ = Rs. 150,000

$$\text{Rate of Return (4-months)} = \frac{\text{Ending Value} - \text{Beginning value} + \text{Div.} - \text{Interest}}{\text{Beginning value} \times IM} \times 100$$

$$= \frac{150000 - 165000 + 4500 - 2475}{165000 \times 0.50} \times 100$$

$$= -15.73\%$$

Annualized Rate of Return = $-15.73\% \times 3 = -47.19\%$

ii. Ending price ($P_1$) = Rs.600

Ending value (EV) = 300 X 600 = Rs.180,000

$$\text{Rate of Return (4-months)} = \frac{EV - BV + Div. - Int.}{BV \times IM} \times 100$$

$$= \frac{180{,}000 - 165000 + 4500 - 2475}{165000 \times 0.50} \times 100$$

$$= 20.64\%$$

Annualized Rate of Return = 20.64% X 3 = 61.92%

iii. Ending price ($P_1$) = Rs.700

Ending value (EV) = 300 X 700 = Rs.210,000

$$\text{Rate of Return} = \frac{(\text{Ending value} - \text{Beginning value}) + \text{Div} - \text{Interest}}{\text{Beginning value} \times IM} \times 100$$

$$= \frac{210{,}000 - 165{,}000 + 4500 - 2475}{165{,}000 \times 0.50} \times 100$$

$$= 57\%$$

Annualized Rate of Return = 57% X 3 = 171%

Problem 2.24

Sol^n

Given:

Beginning price ($P_0$) = Rs. 100

Initial Margin (IM) = 50%

(MM) = 30%

(i) = 10%

(N) = 1000 shares

($P_1$) = Rs. 120

a. Long position without using Margin:

$$\text{Rate of Return} = \frac{P_1 - P_0 + D}{P_0} \times 100$$

$$= \frac{120 - 100 + 0}{100} \times 100$$

$$= 20\%$$

b. Long position Using margin:

$$\text{Rate of Return} = \frac{P_1 - P_0 + D - I}{P_0 \times IM} \times 100$$

$$= \frac{120 - 100 + 0 - 5}{100 \times 0.50} \times 100$$

$$= 30\%$$

where,

$I = N \times P_0 (1 - IM) \times i = 1 \times 100 (1 - 0.50) \times 0.10 = \text{Rs. } 5$

c. Balance sheet (At Beginning)

| | | | |
|---|---|---|---|
| Assets (1000 X 100) | 100,000 | Debt | 50,000 |
| | | Equity (Bal. Fig.) | 50,000 |
| | 100,000 | | 100,000 |

Where,

$$Debt = N \times P_0 (1 - IM)$$

$$= 1000 \times 100 (1 - 0.50)$$

$$= Rs. 50000$$

d(i) If stock price increases to Rs. 110

Balance sheet

| | | | |
|---|---|---|---|
| Assets (1000 X 110) | Rs. 110,000 | Debt | 50,000 |
| | | Equity (Bal. Fig.) | 60,000 |
| | 110,000 | | 110,000 |

(ii) If stock price decreases to Rs. 90

Balance sheet

| | | | |
|---|---|---|---|
| Assets (1000 X 90) | 90,000 | Debt | 50,000 |
| | | Equity (Bal. Fig.) | 40,000 |
| | 90,000 | | 90,000 |

e. If the stock price decreases to Rs. 80.

i. $$\text{Actual Margin (AM)} = \frac{\text{Assets} - \text{Debt}}{\text{Assets}}$$

$$= \frac{(1000 \times 80) - 50{,}000}{1000 \times 80}$$

$$= 37.5\%$$

Since, the actual margin (37.5%) is higher than the minimum maintenance margin (30%), the investor will not receive a margin call.

ii.

$$\text{Trigger Price (TP)} = \frac{1 - IM}{1 - MM} \times P_0$$

$$= \frac{1 - 0.50}{1 - 0.30} \times 100$$

$$= \text{Rs. } 71.43$$

Since, the stock price (Rs. 80) is higher than the trigger price Rs. 71.43, the investor will not receive a margin call.

## * Short position and short selling:

Selling the security today with an expectation that its price will decrease in the future is short position or short sell. Short selling is made due to clamities (आर्थिक मन्दि). "First sell High and buy at lower price."

### * Short position:

$$\text{Rate of Return (HPR)} = \frac{\text{Beginning value} - \text{Ending value} - \text{Dividend}}{\text{Beginning value}} \times 100$$

$$= \frac{(\text{Beginning price} - \text{Ending price}) - \text{Dividend}}{\text{Beginning price}} \times 100$$

$$= \frac{P_0 - P_1 - D}{P_0} \times 100$$

Where,

$P_0$ = Beginning (short sell) price
$P_1$ = Ending (purchase) price
$D_1$ = Dividend paid to brokerage firm.

* Short Selling:

Short selling is the sale of security that is not owned by the seller or that the seller has borrowed. Short selling is motivated by the belief that a security's price will decline enabling it be bought back at a lower price to make profit.

$$\text{Rate of Return (HPR)} = \frac{(\text{Beginning value} - \text{Ending value}) - D_1 + I_1}{\text{Beginning value} \times IM} \times 100$$

$$= \frac{(\text{Beginning price} - \text{Ending price}) - D_1 + I_1}{\text{Beginning price} \times IM} \times 100$$

$$= \frac{P_0 - P_1 - D_1 + I_1}{P_0 \times IM} \times 100$$

$$\text{Actual Margin (AM)} = \frac{\text{Assets} - \text{Debt}}{\text{Debt}}$$

where,

$\text{Debt} = N \times P_1$

$\text{Assets} = N \times P_0 (1 + IM)$

Note:

i. If AM (calculated) > MM (Given) → No margin call

ii. If AM (calculated) ≤ MM (Given) → Margin call

Trigger Price (TP) = $\frac{1+IM}{1+MM} \times P_0$

Decision:

1. If $P_0 < TP$ → No margin call
2. If $P_0 \geq TP$ → Margin call.

Margin call Value | Minimum Collateral = $\frac{Assets}{1+MM}$

* Difference in formula of long position and short position:

| Long position | short position |
| --- | --- |
| $HPR_{LP} = \frac{P_1 - P_0 + D}{P_0} \times 100$ | $HPR_{SP} = \frac{P_0 - P_1 - D}{P_0} \times 100$ |
| $HPR_{MP} = \frac{P_1 - P_0 + D - I}{P_0 \times IM} \times 100$ | $HPR_{SS} = \frac{P_0 - P_1 - D + I}{P_0 \times IM} \times 100$ |
| $AM = \frac{Assets - Debt}{Assets}$ | $AM = \frac{Assets - Debt}{Debt}$ |
| $TP = \frac{1-IM}{1-MM} \times P_0$ | $TP = \frac{1+IM}{1+MM} \times P_0$ |
| Margin call Value (Minimum collateral) = $\frac{Debt}{1-MM}$ | Margin call value = $\frac{Assets}{1+MM}$ |
| Assets = $N \times P_0$ | Assets = $N \times P_0 (1+IM)$ |
| Debt = $N \times P_0 (1-IM)$ | Debt = $N \times P_1$ |

## Problem 2.15

Sol$^n$

Calculation of Rate of Return

| Beginning Price $(P_0)$ | Ending price $(P_1)$ | Rate of Return = $\frac{P_0 - P_1}{P_0} \times 100$ |
|---|---|---|
| 500 | 300 | = 40% |
| 500 | 400 | 20% |
| 500 | 500 | 0 |
| 500 | 600 | -20% |
| 500 | 700 | -40% |

## Problem 2.16

Sol$^n$

Given:

Beginning price $(P_0)$ = Rs.600

Number of shares (N) = 100 shares

a. Repurchase price $(P_1)$ = Rs.700 (Short sell)

Loss = $N \times (P_0 - P_1)$ = 100 (600-700) = - Rs.10,000 (Loss)

b. Long position

Ending price $(P_1)$ = Rs.750

Gain = $N \times (P_1 - P_0)$ = 100 (750-600) = Rs.15,000

c. Short sell:

Repurchase price ($P_1$) = Rs. 450

$$\text{Gain} = N \times (P_0 - P_1) = 100(600-450) = Rs.\ 15{,}000$$

d. Long position:

Ending price ($P_1$) = Rs. 600

$$\text{Gain} = N(P_1 - P_0) = 100(600-600) = 0$$

Problem 2.17

Soln

Beginning Price ($P_0$) = Rs. 450

Number of shares (N) = 200 shares

Initial Margin (IM) = 60%

Balance sheet (Initial)

| | | | |
|---|---|---|---|
| Assets (200 shares @ Rs. 450) | 90,000 | Debt (40%) | 36,000 |
| | | Equity (60%) | 54,000 |
| | 90,000 | | 90,000 |

Balance sheet (If stock price increased to Rs. 600)

| | | | |
|---|---|---|---|
| Assets (200 shares @ 600) | 120,000 | Debt | 36,000 |
| | | Equity → (SF) | 84,000 |
| | 120,000 | | 120,000 |

Equity = Assets − Debt = 120000 − 36000

= 84,000

Balance sheet (Additional 300 shares, IM = 50%)

| | | | |
|---|---|---|---|
| Assets (500 shares @ 600) | 300,000 | Debt | 150,000 |
| | | Equity (50%) | 150,000 |
| | 300,000 | | 300,000 |

∴ Additional Equity = Rs. 150,000 − 84,000
= Rs. 66,000

Problem 2.18

Soln

Given: Short sell

Number of shares (N) = 500 shares

Beginning price ($P_0$) = Rs. 450

Initial Margin (IM) = 55%

Maintenance Margin (MM) = 35%

$$\text{Trigger Price (TP)} = \frac{1+IM}{1+MM} \times P_0$$

$$= \frac{1+0.55}{1+0.35} \times 450$$

$$= \text{Rs. } 516.67$$

Since the stock price (Rs. 500) is less than trigger price Rs. 516.67, the investor will not receive a margin call in short position.

Problem 2.19

Soln

Given: Short sell:

Number of shares (N) = 1000 shares

Beginning price ($P_0$) = Rs. 400

Initial Margin (IM) = 50%

Ending price ($P_1$) = Rs. 500

Dividend ($D_1$) = Rs. 20

a. $\text{Actual Margin} = \dfrac{\text{Assets} - \text{Debt} - \text{Dividend}}{\text{Debt}}$

$= \dfrac{600{,}000 - 500{,}000 - 20{,}000}{500{,}000}$

$= 16\%$

where,

Assets $= N \times P_0 (1 + IM) = 1000 \times 400 (1 + 0.50)$

$=$ Rs. 600,000

Debt $= N \times P_1 = 1000 \times 500 =$ Rs. 500,000

Dividend $= N \times D_1 = 1000 \times 20 =$ Rs. 20,000

b. Since. Actual margin (16%) is lower than maintenance margin (30%), Mr. Sapkota will receive a margin call.

c. Rate of Return = $\frac{P_0 - P_1 - D}{P_0 \times IM} \times 100$

$= \frac{400 - 500 - 20}{400 \times 0.50} \times 100$

$= -60\%$

Problem 2.20

Soln

Given:

Number of shares (N) = 100 shares

Beginning price ($P_0$) = Rs. 500

a. Initial Margin (IM) = 50%

Initial Margin Deposit = $N \times P_0 (1 + IM)$

(Beginning value) $= 100 \times 500 (1 + 0.50)$

= Rs. 75,000

OR,

Initial Margin Deposit = $N \times P_0 \times IM$

$= 100 \times 500 \times 0.50$

= Rs. 25,000

b. Maintenance Margin (MM) = 30%

Trigger price (TP) = $\frac{1 + IM}{1 + MM} \times P_0$

$$= \frac{1+0.50}{1+0.30} \times 500$$

$$= Rs.\ 576.92$$

The stock price can increase to Rs. 576.92 before a margin call.

c. Ending price ($P_1$) = Rs. 400

$$\text{Equity} = \text{Assets} - \text{Debt}$$
$$= N \times P_0 (1 + IM) - N \times P_1$$
$$= 100 \times 500 (1 + 0.50) - 100 \times 400$$
$$= Rs.\ 35,000$$

$$\text{Actual Margin} = \frac{\text{Assets} - \text{Debt}}{\text{Debt}}$$
$$= \frac{75000 - 40,000}{40,000}$$
$$= 87.5\%$$

Since, actual margin (87.5%) is greater than maintenance margin (30%), we will not receive a margin call.

d. $\text{Rate of Return} = \frac{P_0 - P_1 - D}{P_0 \times IM} \times 100$

$$= \frac{500 - 550 - 25}{500 \times 0.50} \times 100$$

$$= -30\%$$

Problem 2.21

Soln

Given: Short sell

Number of shares (N) = 100 shares

Beginning price ($P_0$) = Rs. 500

Initial Margin (IM) = 50%

Maintenance Margin (MM) = 35%

a. Trigger Price (TP) = $\frac{1+IM}{1+MM} \times P_0$

$= \frac{1+0.50}{1+0.35} \times 500$

= Rs. 555.56

If the stock price rises above Rs. 555.56, the investor will get a margin call.

b. Calculation of Rate of Return

| Ending Price ($P_1$) | Beginning price ($P_0$) | Rate of Return (Without Margin) $= \frac{P_0 - P_1}{P_0} \times 100$ | Rate of Return (With Margin) $= \frac{P_0 - P_1}{P_0 \times IM} \times 100$ |
|---|---|---|---|
| 200 | 500 | 60% | 120% |
| 300 | 500 | 40% | 80% |

| | | | |
|---|---|---|---|
| 400 | 500 | 20% | 40% |
| 500 | 500 | 0 | 0 |
| 600 | 500 | -20% | -40% |
| 700 | 500 | -40% | -80% |
| 800 | 500 | -60% | -120% |

**Problem 2.22**

Soln

Given:

Beginning price ($P_0$) = Rs. 250

Margin Requirement (IM) = 50%

Maintenance Margin (MM) = 30%

a. Short position with 100% Initial margin

Ending price ($P_1$) = Rs. 200

$$\text{Rate of Return} = \frac{P_0 - P_1}{P_0} \times 100$$

$$= \frac{250 - 200}{250} \times 100$$

$$= 20\%$$

b.

1. Trigger Price (TP) = $\frac{1+IM}{1+MM} \times P_0$

$= \frac{1+0.50}{1+0.30} \times 250$

$=$ Rs. 288.5

If the stock price rises above Rs. 288.5, the investor will get a margin call.

2. Ending price ($P_1$) = Rs. 200

Rate of Return = $\frac{P_0 - P_1}{P_0 \times IM} \times 100$

$= \frac{250-200}{250 \times 0.50} \times 100$

$= 40\%$

c. The rate of return with 50% initial margin is higher because it can take the advantage of leverage in short selling.

Problem 2.23

Soln.

Given:

Number of shares (N) = 500 shares

Beginning price ($P_0$) = Rs. 120

Initial Margin Deposit = Rs. 45,000

Initial Margin (IM) = $\frac{45000}{500 \times 120} = 75\%$

a. Calculation of Rate of Return

| Ending Price ($P_1$) | Beginning Price ($P_0$) | Rate of Return = $\frac{P_0 - P_1}{P_0 \times IM} \times 100$ |
|---|---|---|
| 132 | 120 | -13.33% |
| 120 | 120 | 0 |
| 108 | 120 | 13.33% |

b. Maintenance Margin (MM) = 25%.

$$\text{Trigger Price (TP)} = \frac{1+IM}{1+MM} \times P_0$$

$$= \frac{1+0.75}{1+0.25} \times 120$$

$$= \text{Rs. } 168$$

If the stock price rises above Rs. 168, the investor will get a margin call.

c. Calculation of Rate of Return

| Ending Price ($P_1$) | Beginning Price ($P_0$) | Dividend ($D_1$) | Rate of Return $\frac{P_0 - P_1 - D_1}{P_0 \times IM} \times 100$ |
|---|---|---|---|
| 132 | 120 | 3 | -16.67% |
| 120 | 120 | 3 | -3.33% |
| 108 | 120 | 3 | 10% |

# Modern Portfolio

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# Chapter - 5
# Modern Portfolio

## * Portfolio:

If we invest our total investment fund in only one asset, the investment is called investment in isolation (single). But if we invest our total investment funds into more than one asset the investment is called diversification and the set or collection of assets in which investment is made is called portfolio. The only one objective of creating a portfolio is risk minimization.

## * Expected Rate of Return of portfolio.

It is the weighted average of expected returns of assets included in the portfolio. i.e

$$E(R_p) = W_A \times E(R_A) + W_B \times E(R_B)$$

where,

$$W_A = \text{Weight of stock } A = \frac{\text{Amt. invested in Stock } A}{\text{Total Amount invested}}$$

$$W_B = \text{Weight of stock } B = \frac{\text{Amt. invested in stock } B}{\text{Total Amount invested}}$$

* Total Risk of portfolio ($\sigma_p$):

For two assets portfolio A and B

$$\sigma_p = \sqrt{W_A^2 \cdot \sigma_A^2 + W_B^2 \cdot \sigma_B^2 + 2 \cdot W_A \cdot W_B \cdot COV_{AB}}$$

$\hookrightarrow \rho_{AB} \times \sigma_A \times \sigma_B$

For three assets portfolio A, B and C

$$\sigma_p = \sqrt{W_A^2 \cdot \sigma_A^2 + W_B^2 \cdot \sigma_B^2 + W_C^2 \cdot \sigma_C^2 + 2 \cdot W_A \cdot W_B \cdot COV_{AB} + 2 \cdot W_B \cdot W_C \cdot COV_{BC} + 2 \cdot W_A \cdot W_C \cdot COV_{AC}}$$

* Calculation of covariance (COV.) and correlation ($\rho$)

Historical Data:

$$COV_{AB} = \frac{\Sigma [R_A - \bar{R}_A][R_B - E(R_B)]}{n-1}$$

Data with probability:

$$COV_{AB} = \Sigma P_j [R_A - E(R_A)][R_B - E(R_B)]$$

$$\text{Correlation } (\rho_{AB}) = \frac{COV_{AB}}{\sigma_A \times \sigma_B}$$

## Problem 5.1

Soln

Given:

Investment in stock A = Rs. 30,000 ] = Rs. 100,000
Investment in stock B = Rs. 70,000

Expected return on stock A, $E(R_A) = 10\%$

Expected return on stock B, $E(R_B) = 15\%$

Expected return on portfolio, $E(R_p) = ?$

We know that,

$$E(R_p) = W_A \times E(R_A) + W_B \times E(R_B)$$
$$= 0.30 \times 10\% + 0.70 \times 15\%$$
$$= 13.5\%$$

where,

Weight of stock A, $(W_A) = \frac{30,000}{100,000} = 0.30$

Weight of stock B, $(W_B) = \frac{70,000}{100,000} = 0.70$

∴ The expected return on the portfolio is 13.5%.

Problem 5.2

Solⁿ

a. Calculation of Average return over the four-year period.

| Year | Beginning value | Ending value | $HPR = \frac{EV - BV}{BV} \times 100$ |
|---|---|---|---|
| 2012 | Rs. 50,000 | Rs. 55,000 | 10% |
| 2013 | 55,000 | 58,000 | 5.45 |
| 2014 | 58,000 | 65,000 | 12.07 |
| 2015 | 65,000 | 70,000 | 7.69 |
| | | | $\Sigma HPR = 35.2$ |

~~b. Calcu~~

Average Return of portfolio, $E(R_p) = \frac{\Sigma HPR}{n} = \frac{35.2}{4}$

$= 8.80\%$

b. Calculation of standard Deviation of portfolio:

| Year | $R_p$ | $R_p - E(R_p)$ | $[R_p - E(R_p)]^2$ |
|---|---|---|---|
| 2012 | 10% | 1.20 | 1.44 |
| 2013 | 5.45 | -3.35 | 11.22 |
| 2014 | 12.07 | 3.27 | 10.69 |
| 2015 | 7.69 | -1.11 | 1.23 |
| | | | $\Sigma [R_p - E(R_p)]^2 = 24.58$ |

$\therefore$ standard deviation, $\sigma_p = \sqrt{\frac{\Sigma [R_p - E(R_p)]^2}{n-1}} = \sqrt{\frac{24.58}{4-1}} = 2.86\%$

Problem 5.3

Soln

a. Calculation of Expected Return:

| Scenario | Prob.($P_j$) | $R_A$ | $R_B$ | $P_j \times R_A$ | $P_j \times R_B$ |
|---|---|---|---|---|---|
| Recission | 0.30 | 10% | 50% | 3% | 15% |
| Normal economy | 0.40 | 20 | 30 | 8 | 12 |
| Boom | 0.30 | 30 | 10 | 9 | 3 |
| | | | | $\Sigma P_j \times R_A = 20\%$ | $\Sigma P_j \times R_B = 30\%$ |

∴ Expected Return of stock A, $E(R_A) = \Sigma P_j \times R_A = 20\%$

Expected Return of stock B, $E(R_B) = \Sigma P_j \times R_B = 30\%$

Weight of stock A, $(W_A) = 50\% = 0.50$

Weight of stock B, $(W_B) = 50\% = 0.50$

Expected Return on portfolio, $E(R_p) = W_A \times E(R_A) + W_B \times E(R_B)$

$= 0.50 \times 20\% + 0.50 \times 30\%$

$= 25\%$

b. Calculation of Standard Deviation:

| Scenario | Prob.($P_j$) | $R_A - E(R_A)$ | $R_B - E(R_B)$ | $P_j[R_A - E(R_A)]^2$ | $P_j[R_B - E(R_B)]^2$ |
|---|---|---|---|---|---|
| Recission | 0.30 | −10 | 20 | 30 | 120 |
| Normal | 0.40 | 0 | 0 | 0 | 0 |
| Boom | 0.30 | 10 | −20 | 30 | 120 |
| | | | | $\Sigma P_j[R_A - E(R_A)]^2 = 60$ | $\Sigma P_j[R_B - E(R_B)]^2 = 240$ |

∴ standard deviation of stock A, $(\sigma_A) = \sqrt{\Sigma P_j [R_A - E(R_A)]^2}$

$= \sqrt{60} = 7.75\%$

∴ standard deviation of stock B, $(\sigma_B) = \sqrt{\Sigma P_j [R_B - E(R_B)]^2}$

$= \sqrt{240} = 15.49\%$

standard deviation of portfolio

$$\sigma_P = \sqrt{W_A^2 \cdot \sigma_A^2 + W_B^2 \cdot \sigma_B^2 + 2 \cdot W_A \cdot W_B \cdot COV_{AB}}$$

$$= \sqrt{(0.50)^2 \times (7.75)^2 + (0.50)^2 \times (15.49)^2 + 2 \times 0.50 \times 0.50 \times (-120)}$$

$= 3.87\%$

where,

Calculation of covariance $(COV_{AB})$

| Scenario | $P_j$ | $R_A - E(R_A)$ | $R_B - E(R_B)$ | $P_j [R_A - E(R_A)][R_B - E(R_B)]$ |
|---|---|---|---|---|
| Recession | 0.30 | −10 | 20 | −60 |
| Normal | 0.40 | 0 | 0 | 0 |
| Boom | 0.30 | 10 | −20 | −60 |
| | | | | $COV_{AB} = -120$ |

Problem 5.4

Soln

Given:

| | KWSC (A) | KEC (B) |
|---|---|---|
| Expected Return | 14 % | 16% |
| Standard deviation | 5 % | 9% |

a. Weight of KWSC $(W_A) = 30\%$

Weight of KEC $(W_B) = 70\%$

Expected Return on portfolio, $E(R_p) = W_A \times E(R_A) + W_B \times E(R_B)$

$= 0.30 \times 14\% + 0.70 \times 16\%$

$= 15.4\%$

b. Calculation of standard deviation:

i. If a perfect positive correlation $(\rho_{AB}) = +1$

$$\sigma_p = \sqrt{W_A^2 \cdot \sigma_A^2 + W_B^2 \cdot \sigma_B^2 + 2 \cdot W_A \cdot W_B \cdot \rho_{AB} \cdot \sigma_A \cdot \sigma_B}$$

$$= \sqrt{(0.30)^2 \times (5)^2 + (0.70)^2 \times (9)^2 + 2 \times 0.30 \times 0.70 \times 1 \times 5 \times 9}$$

$= 7.80\%$

ii. If a slightly negative correlation $(\rho_{AB}) = -0.2$

$$\sigma_p = \sqrt{(0.30)^2 \times (5)^2 + (0.70)^2 \times (9)^2 + 2 \times 0.30 \times 0.70 \times (-0.2) \times 5 \times 9}$$

$= 6.18\%$

Problem 5.7

Soln

Given:

a. If stock M and stock N are perfectly positively correlated $(\rho_{MN}) = +1$

Weight of stock M, $(W_M) = 50\%$.

Weight of stock N, $(W_N) = 50\%$.

Expected Return on portfolio, $E(R_p) = W_M \times E(R_M) + W_N \times E(R_N)$

$= 0.50 \times 8\% + 0.50 \times 13\%$.

$= 10.5\%$

Standard deviation of portfolio

$$\sigma_p = \sqrt{W_M^2 \cdot \sigma_M^2 + W_N^2 \cdot \sigma_N^2 + 2 \cdot W_M \cdot W_N \cdot \rho_{MN} \cdot \sigma_M \cdot \sigma_N}$$

$$= \sqrt{(0.50)^2 \times (5\%)^2 + (0.50)^2 \times (10)^2 + 2 \times 0.50 \times 0.50 \times 1 \times 5 \times 10}$$

$= 7.5\%$

b. If stock M and stock N are uncorrelated $(\rho_{MN} = 0)$

Weight of stock M. $(W_M) = 50\%$

Weight of stock N, $(W_N) = 50\%$.

Expected Return on portfolio, $E(R_p) = W_M \times E(R_M) + W_N \times E(R_N)$

$= 0.50 \times 8\% + 0.50 \times 13\%$.

$= 10.5\%$

$\sigma_p = \sqrt{W_M^2 \cdot \sigma_M^2 + W_N^2 \cdot \sigma_N^2 + 2 \cdot W_M \cdot W_N \cdot \rho_{MN} \cdot \sigma_M \cdot \sigma_N}$

$= \sqrt{(0.50)^2 \times (5)^2 + (0.50)^2 \times (10)^2 + 2 \times 0.50 \times 0.50 \times 0 \times 5 \times 10}$

$= 5.59\ \%$

c. If stock M and stock N are perfectly negatively correlated ($\rho_{MN} = -1$)

Weight of stock M, $(W_M) = 50\%$

Weight of stock N, $(W_N) = 50\ \%$

Expected Return on portfolio, $E(R_p) = W_M \times E(R_M) + W_N \times E(R_N)$

$= 0.50 \times 8\% + 0.50 \times 13\%$

$= 10.5\ \%$

Standard deviation of portfolio:

$\sigma_p = \sqrt{W_M^2 \cdot \sigma_M^2 + W_N^2 \cdot \sigma_N^2 + 2 \cdot W_M \cdot W_N \cdot \rho_{MN} \cdot \sigma_M \cdot \sigma_N}$

$= \sqrt{(0.50)^2 \times (5)^2 + (0.50)^2 \times (10)^2 + 2 \times 0.50 \times 0.50 \times (-1) \times 5 \times 10}$

$= 2.5\ \%$

Problem 5.8

Soln

Given:

Covariance between stock X and stock Y, $(COV_{XY}) = 800$

Correlation between stock X and stock Z, $(\rho_{XZ}) = -0.5$

a. Weight of security x ($W_x$) = 33 %
Weight of security Y ($W_Y$) = 67 %

$E(R_p) = W_X \cdot E(R_X) + W_Y \cdot E(R_Y)$
$= 0.33 \times 5\% + 0.67 \times 15\%$
$= 11.7\%$

$\sigma_p = \sqrt{W_X^2 \cdot \sigma_X^2 + W_Y^2 \cdot \sigma_Y^2 + 2 \times W_X \cdot W_Y \cdot cov_{xy}}$
$= \sqrt{0.33^2 \times 20^2 + 0.67^2 \times 40^2 + 2 \times 0.30 \times 0.67 \times 800}$
$= 33.4\%$

b. Weight of security X ($W_X$) = 33%
Weight of security Z ($W_Z$) = 66%

$E(R_p) = W_X \cdot E(R_X) + W_Z \cdot E(R_Z)$
$= 0.33 \times 5\% + 0.67 \times 15\%$
$= 11.7\%$

$\sigma_p = \sqrt{W_X^2 \cdot \sigma_X^2 + W_Z^2 \cdot \sigma_Z^2 + 2 \times W_X \cdot W_Z \cdot \rho_{XZ} \cdot \sigma_X \cdot \sigma_Z}$
$= \sqrt{0.33^2 \times 20^2 + 0.67^2 \times 40^2 + 2 \times 0.33 \times 0.67 \times (-0.50) \times 20 \times 40}$
$= 24.19\%$

c. Portfolio XZ has lower standard deviation because correlation beetween security X and Z is negative. Diversification is better with portfolio XZ.

Problem 5.5

Sol^n

a. Calculation of Expected Return

| Year | $R_X$ | $R_Y$ | $R_Z$ | $R_{XY} = 0.50 \times R_X + 0.50 \times R_Y$ | $R_{XZ} = 0.50 \times R_X + 0.50 \times R_Z$ |
|---|---|---|---|---|---|
| 2012 | 16% | 17% | 14% | 16.5% | 15% |
| 2013 | 17 | 16 | 15 | 16.5% | 16 |
| 2014 | 18 | 15 | 16 | 16.5 | 17 |
| 2015 | 19 | 14 | 17 | 16.5 | 18 |
| | $\Sigma R_X = 70$ | | | $\Sigma R_{XY} = 66$ | $\Sigma R_{XZ} = 66$ |

$\therefore$ Expected Return of assets X, $E(R_X) = \frac{\Sigma R_X}{n} = \frac{70}{4} = 17.5\%$

$\therefore$ Expected Return of portfolio XY, $E(R_{XY}) = \frac{\Sigma R_{XY}}{n} = \frac{66}{4} = 16.5\%$

$\therefore$ Expected Return of portfolio XZ, $E(R_{XZ}) = \frac{\Sigma R_{XZ}}{n} = \frac{66}{4} = 16.5\%$

b. Calculation of standard Deviation:

| Year | $R_X$ | $R_{XY}$ | $R_{XZ}$ | $[R_X - E(R_X)]^2$ | $[R_{XY} - E(R_{XY})]^2$ | $[R_{XZ} - E(R_{XZ})]^2$ |
|---|---|---|---|---|---|---|
| 2012 | 16% | 16.5% | 15% | 2.25 | 0 | 2.25 |
| 2013 | 17 | 16.5 | 16 | 0.25 | 0 | 0.25 |
| 2014 | 18 | 16.5 | 17 | 0.25 | 0 | 0.25 |
| 2015 | 19 | 16.5 | 18 | 2.25 | 0 | 2.25 |
| | | | | $\Sigma[R_X - E(R_X)]^2 = 5$ | $\Sigma[R_{XY} - E(R_{XY})]^2 = 0$ | $\Sigma[R_{XZ} - E(R_{XZ})]^2 = 5$ |

∴ Standard deviation of stock X

$$\sigma_X = \sqrt{\frac{\Sigma[R_X - E(R_X)]^2}{n-1}} = \sqrt{\frac{5}{4-1}} = 1.29\%$$

∴ Standard deviation of portfolio XY

$$\sigma_{XY} = \sqrt{\frac{\Sigma[R_{XY} - E(R_{XY})]^2}{n-1}} = \sqrt{\frac{0}{4-1}} = 0$$

∴ Standard deviation of portfolio XZ

$$\sigma_{XZ} = \sqrt{\frac{\Sigma[R_{XZ} - E(R_{XZ})]^2}{n-1}} = \sqrt{\frac{5}{4-1}} = 1.29\%$$

c. On the basis of findings in part (a) and (b) we would recommend portfolio XY due to zero risk.

Problem 5.6

Soln

a. Calculation of Expected Return

| Year | $R_A$ | $R_B$ | $R_C$ |
|---|---|---|---|
| 2016 | 12% | 16% | 12% |
| 2017 | 14 | 14 | 14 |
| 2018 | 16 | 12 | 16 |
| | $\Sigma R_A = 42$ | $\Sigma R_B = 42$ | $\Sigma R_C = 42$ |

$\therefore$ Expected Return of stock A, $E(R_A) = \frac{\Sigma R_A}{n} = \frac{42}{3} = 14\%$

$\therefore$ Expected Return of stock B, $E(R_B) = \frac{\Sigma R_B}{n} = \frac{42}{3} = 14\%$

$\therefore$ Expected Return of stock C, $E(R_C) = \frac{\Sigma R_C}{n} = \frac{42}{3} = 14\%$

b. Calculation of standard deviation:

| Year | $[R_A - E(R_A)]^2$ | $[R_B - E(R_B)]^2$ | $[R_C - E(R_C)]^2$ |
|---|---|---|---|
| 2016 | 4 | 4 | 4 |
| 2017 | 0 | 0 | 0 |
| 2018 | 4 | 4 | 4 |
| | $\Sigma[R_A - E(R_A)]^2 = 8$ | $\Sigma[R_B - E(R_B)]^2 = 8$ | $\Sigma[R_C - E(R_C)]^2 = 8$ |

$\therefore$ Standard deviation of Assets A, $\sigma_A = \sqrt{\frac{\Sigma[R_A - E(R_A)]^2}{n-1}} = \sqrt{\frac{8}{3-1}} = 2\%$

$\therefore$ Standard deviation of Assets B, $\sigma_B = \sqrt{\frac{\Sigma[R_B - E(R_B)]^2}{n-1}} = \sqrt{\frac{8}{3-1}} = 2\%$

$\therefore$ Standard deviation of Assets C, $\sigma_C = \sqrt{\frac{\Sigma[R_C - E(R_C)]^2}{n-1}} = \sqrt{\frac{8}{3-1}} = 2\%$

c. Calculation of expected return of each portfolio

| Year | $R_A$ | $R_B$ | $R_C$ | $R_{AB} = 0.5 \times R_A + 0.5 \times R_B$ | $R_{AC} = 0.5 \times R_A + 0.5 \times R_C$ |
|---|---|---|---|---|---|
| 2016 | 12% | 16% | 12% | 14 | 12% |
| 2017 | 14 | 14 | 14 | 14 | 14 |
| 2018 | 16 | 12 | 16 | 14 | 16 |
| | | | | $\Sigma R_{AB} = 42$ | $\Sigma R_{AC} = 42$ |

∴ Expected Return of portfolio AB, $E(R_{AB}) = \frac{\Sigma R_{AB}}{n} = \frac{42}{3} = 14\%$.

∴ Expected Return of portfolio AC, $E(R_{AC}) = \frac{\Sigma R_{AC}}{n} = \frac{42}{3} = 14\%$

d. Assets A and assets B are negatively correlated since their returns are moving in opposite direction but Assets A and assets C are perfectly positively correlated because their returns are moving in same direction.

e. Calculation of standard Deviation of each portfolio:

| Year | $R_{AB}$ | $R_{AC}$ | $R_{AB} - E(R_{AB})$ | $R_{AC} - E(R_{AC})$ | $[R_{AB} - E(R_{AB})]^2$ | $[R_{AC} - E(R_{AC})]^2$ |
|---|---|---|---|---|---|---|
| 2016 | 14% | 12% | 0 | -2 | 0 | 4 |
| 2017 | 14 | 14 | 0 | 0 | 0 | 0 |
| 2018 | 14 | 16 | 0 | 2 | 0 | 4 |
| | | | | | $\Sigma[R_A - E(R_A)]^2 = 0$ | $\Sigma[R_{AC} - E(R_{AC})]^2 = 8$ |

∴ Standard deviation of portfolio AB

$$\sigma_{AB} = \sqrt{\frac{\Sigma[R_{AB} - E(R_{AB})]^2}{n-1}} = \sqrt{\frac{0}{3-1}} = 0$$

∴ standard deviation of portfolio AC

$$\sigma_{AC} = \sqrt{\frac{\Sigma[R_{AC} - E(R_{AC})]^2}{n-1}} = \sqrt{\frac{8}{3-1}} = 2\%$$

f. We would recommend portfolio AB due to zero risk.

g. Calⁿ of Expected Return and standard deviation of portfolio ABC.

| Year | $R_A$ | $R_B$ | $R_C$ | $R_{ABC}$ | $R_{ABC} - E(R_{ABC})$ | $[R_{ABC} - E(R_{ABC})]^2$ |
|---|---|---|---|---|---|---|
| 2016 | 12% | 16% | 12% | 13.33% | −0.67 | 0.4489 |
| 2017 | 14 | 14 | 14 | 14 | 0 | 0 |
| 2018 | 16 | 12 | 16 | 14.67 | 0.67 | 0.4489 |
| | | | | $\Sigma R_{ABC} = 42\%$ | | $\Sigma[R_{ABC} - E(R_{ABC})]^2 = 0.8978$ |

∴ Expected Return of portfolio ABC, $E(R_{ABC}) = \frac{\Sigma R_{ABC}}{n} = \frac{42}{3} = 14\%$

∴ Standard Deviation of portfolio ABC, $\sigma_{ABC} = \sqrt{\frac{\Sigma[R_{ABC} - E(R_{ABC})]^2}{n-1}}$

$$= \sqrt{\frac{0.8978}{3-1}} = 0.67\%$$

forming portfolio of Assets A, B and C the expected returns remains constant but the risk has been reduced than portfolio AC.

Problem 5.9

Soln

a. Calculation of expected return and standard deviation:

| Quarter | $R_1$ | $R_2$ | $R_1-E(R_1)$ | $R_2-E(R_2)$ | $[R_1-E(R_1)]^2$ | $[R_2-E(R_2)]^2$ |
|---|---|---|---|---|---|---|
| 1 | 7.2% | 0.6% | 3.55 | -0.613 | 12.6025 | 0.3758 |
| 2 | 12.9 | 6.0 | 9.25 | 4.787 | 85.5625 | 22.915 |
| 3 | 7.4 | 0.6 | 3.75 | -0.613 | 14.0625 | 0.3758 |
| 4 | -2.1 | 9.7 | -5.75 | 8.487 | 33.0625 | 72.029 |
| 5 | 4.0 | -18.0 | 0.35 | -19.213 | 0.1225 | 369.139 |
| 6 | 6.9 | 6.1 | 3.25 | 4.887 | 10.5625 | 23.883 |
| 7 | -8.4 | -1.8 | -12.05 | -3.013 | 145.2025 | 9.078 |
| 8 | 1.3 | 6.5 | -2.35 | 5.287 | 5.5225 | 27.952 |
| | $\Sigma R_1 = 29.2$ | $\Sigma R_2 = 9.7$ | | | $\Sigma[R_1-E(R_1)]^2 = 306.7$ | $\Sigma[R_2-E(R_2)]^2 = 525.75$ |

∴ Expected Return of stock 1, $E(R_1) = \frac{\Sigma R_1}{n} = \frac{29.2}{8} = 3.65\%$

∴ Expected Return of stock 2, $E(R_2) = \frac{\Sigma R_2}{n} = \frac{9.7}{8} = 1.21\%$

∴ Standard Deviation of stock 1, $\sigma_1 = \sqrt{\frac{\Sigma[R_1-E(R_1)]^2}{n-1}} = \sqrt{\frac{306.7}{8-1}} = 6.62\%$

∴ Standard Deviation of stock 2, $\sigma_2 = \sqrt{\frac{\Sigma[R_2-E(R_2)]^2}{n-1}} = \sqrt{\frac{525.75}{8-1}} = 8.67\%$

b. Calculation of correlation coefficient.

| Quarter | $R_1 - E(R_1)$ | $R_2 - E(R_2)$ | $[R_1 - E(R_1)][R_2 - E(R_2)]$ |
|---|---|---|---|
| 1 | 3.55 | -0.613 | -2.17615 |
| 2 | 9.25 | 4.787 | 44.27975 |
| 3 | 3.75 | -0.613 | -2.29875 |
| 4 | -5.75 | 8.487 | -48.80025 |
| 5 | 0.35 | -19.213 | -6.72455 |
| 6 | 3.25 | 4.887 | 15.88275 |
| 7 | -12.05 | -3.013 | 36.30665 |
| 8 | -2.35 | 5.287 | -12.42445 |
| | | | $\Sigma[R_1 - E(R_1)][R_2 - E(R_2)] = 24.04$ |

Covariance between stock 1 and stock 2

$$COV_{12} = \frac{\Sigma[R_1 - E(R_1)][R_2 - E(R_2)]}{n-1}$$

$$= \frac{24.04}{8-1} = 3.43$$

Correlation coefficient between stock 1 and stock 2

$$\rho_{12} = \frac{COV_{12}}{\sigma_1 \times \sigma_2} = \frac{3.43}{6.62 \times 8.67} = 0.06$$

c. Weight of stock 1, $(W_1) = 50\%$
Weight of stock 2, $(W_2) = 50\%$

Expected Return on portfolio, $E(R_p) = W_1 \times E(R_1) + W_2 \times E(R_2)$

$= 0.50 \times 3.65\% + 0.50 \times 1.21\%$

$= 2.43\%$

Standard deviation of portfolio

$$\sigma_p = \sqrt{W_1^2 \cdot \sigma_1^2 + W_2^2 \cdot \sigma_2^2 + 2 \cdot W_1 \cdot W_2 \cdot COV_{12}}$$

$$= \sqrt{(0.50)^2 \times (6.62)^2 + (0.50)^2 \times (8.67)^2 + 2 \times 0.50 \times 0.50 \times 3.43}$$

$$= 5.61\%$$

The portfolio Risk is lower than individual risk of stock 1 and stock 2.

d. Return on risk free assets $(R_f) = 2\%$
Weight of risk free assets $(W_{RF}) = 10\%$
Weight of portfolio $(W_p) = 90\%$

Expected Return, $E(R_p) = W_{RF} \times R_f + W_p \times R_p$

$= 0.10 \times 2\% + 0.90 \times 2.43$

$= 2.39\%$

Risk of portfolio, $\sigma_p = W_p \times \sigma_p = 0.90 \times 5.61\% = 5.05\%$

Problem 5.10

Sol$^n$

a. Calculation of expected rate of return:

| Prob. ($P_j$) | Return on market ($R_m$) | Return on stock J ($R_j$) | $P_j \times R_m$ | $P_j \times R_j$ |
|---|---|---|---|---|
| 0.3 | 15% | 20% | 4.5 % | 6% |
| 0.4 | 9 | 5 | 3.6 | 2 |
| 0.3 | 18 | 12 | 5.4 | 3.6 |
| | | | $\Sigma P_j \times R_m = 13.5$ | $\Sigma P_j \times R_j = 11.6$ |

∴ Expected Return of market, $E(R_m) = \Sigma P_j \times R_m = 13.5\%$

∴ Expected Return of stock j, $E(R_j) = \Sigma P_j \times R_j = 11.6\%$

b. Calculation of standard deviation:

| Prob. ($P_j$) | $R_m - E(R_m)$ | $R_j - E(R_j)$ | $P_j[R_m - E(R_m)]^2$ | $P_j[R_j - E(R_j)]^2$ |
|---|---|---|---|---|
| 0.3 | 1.5 | 8.4 | 0.675 | 21.168 |
| 0.4 | -4.5 | -6.6 | 8.1 | 17.424 |
| 0.3 | 4.5 | 0.4 | 6.075 | 0.048 |
| | | | $\Sigma P_j[R_m - E(R_m)]^2 = 14.85$ | $\Sigma P_j[R_j - E(R_j)]^2 = 38.64$ |

∴ standard deviation of market, $\sigma_m = \sqrt{\Sigma P_j[R_m - E(R_m)]^2} = \sqrt{14.85} = 3.85\%$

∴ standard deviation of stock j, $\sigma_j = \sqrt{\Sigma P_j[R_j - E(R_j)]^2} = \sqrt{38.64} = 6.22\%$

c.

Beta coefficient of stock j $(\beta_j) = \frac{COV_{jm}}{\sigma_m^2}$

$= \frac{16.2}{(3.85)^2}$

$= 1.091$

where,

Calculation of covariance:

| Prob. ($P_j$) | $R_m - E(R_m)$ | $R_j - E(R_j)$ | $P_j[R_m - E(R_m)][R_j - E(R_j)]$ |
|---|---|---|---|
| 0.3 | 1.5 | 8.4 | 3.78 |
| 0.4 | -4.5 | -6.6 | 11.88 |
| 0.3 | 4.5 | 0.4 | 0.54 |

$\Sigma P_j[R_m - E(R_m)][R_j - E(R_j)] = COV_{jm}$

$= 16.2$

The beta coefficient of stock j is greater than the market beta 1, which indicates that stock j is risky than the market and it is said to be an aggressive stock.

## * Total Risk of Investment | Investment Risk:

Risk can be defined as probability of happening some unfavourable event in the future. Higher the deviations (difference) among investment returns higher will be the total risk of investment and vice-versa.

Standard Deviation is used to measure the total risk of an investment and it is denoted by sigma($\sigma$).

### * Division of Total Risk

Total Risk is measured by standard deviation can be divided into following two types:

1. Diversifiable Risk | Unsystematic Risk | Assets specific Risk
2. Non-Diversifiable Risk | Systematic Risk | Market Risk

### 1. Unsystematic Risk:

It is that portion of total risk which can be diversified away through the creation of portfolio. As this portion of total risk can be diversified away, investors should not require any risk premium (additional return due to risk) for bearing this portion of total risk.

### 2. Systematic Risk

It is that portion of total risk which cannot be diversified away even through the creation of portfolio. As this portion of total risk cannot be diversified away. Investors should require risk premium for bearing this portion of total risk. This risk is represented by Beta coefficient ($\beta$).

Total Risk of Asset j = $\sigma_j$

Systematic Risk of Asset j [$SR_j$]

$$= \frac{COV_{jm}}{\sigma_m}$$

$$= \frac{\rho_{jm} \times \sigma_j \times \cancel{\sigma_m}}{\cancel{\sigma_m}}$$

$$= \rho_{jm} \times \sigma_j$$

Unsystematic Risk of Assets j [$UR_j$]

$$= \sigma_j - SR_j$$

$$= \sigma_j - \frac{COV_{jm}}{\sigma_m}$$

$$= \sigma_j - \rho_{jm} \times \sigma_j$$

$$= \sigma_j (1 - \rho_{jm})$$

* Beta Coefficient of Asset j [$B_j$] = $\frac{\text{Systematic Risk of Assets j}}{\sigma_m}$

$$= \frac{\frac{COV_{jm}}{\sigma_m}}{\sigma_m}$$

$$= \frac{COV_{jm}}{\sigma_m^2}$$

$$= \frac{\rho_{jm} \times \sigma_j \times \cancel{\sigma_m}}{\sigma_m \times \cancel{\sigma_m}}$$

$$= \frac{\rho_{jm} \times \sigma_j}{\sigma_m}$$

## * Interpretation of Beta coefficient ($\beta$):

1. If $\beta_j = 1$ ⇒ This beta is called average beta and the assets having average beta is called average assets.

2. If $\beta_j > 1$ ⇒ This beta is called aggresive beta and the assets having aggressive beta is called aggresive assets.

3. If $\beta_j < 1$ ⇒ This beta is called defensive beta and the assets having defensive beta is called defensive assets.

## * Required Rate of Return [R]:

It is the minimum rate of return required by an investor to invest in the given investment opportunity. It is calculated by using following formula:

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

where,

$R_f$ = Risk free Rate (Treasury)

$R_m$ = Return on market

$(R_m - R_f)$ = Market Risk premium

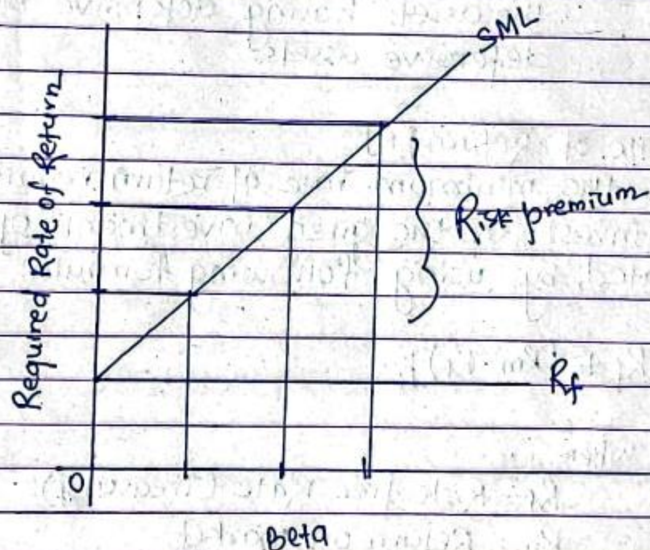
$\beta_j$ = Beta of Asset j.

Decision:

1. If Expected Return > Required Return → Buy or purchase
2. If Expected Return < Required Return → Do not purchase
3. If Expected Return = Required Return → Indifferent

* Security Market Line (SML):

It is a graph which shows the relationship between Beta coefficient and Required rate of return of assets.



Problem 5.11

Soln

a. Calculation of average Return:

| Year | $R_m$ | $R_A$ | $R_B$ |
|---|---|---|---|
| 2006 | 6% | 11% | 16% |
| 2007 | 2 | 8 | 11 |
| 2008 | -13 | -4 | -10 |
| 2009 | -4 | 3 | 3 |
| 2010 | -8 | 0 | -3 |
| 2011 | 16 | 19 | 30 |
| 2012 | 10 | 14 | 22 |
| 2013 | 15 | 18 | 29 |
| 2014 | 8 | 12 | 19 |
| 2015 | 13 | 17 | 26 |
| | $\Sigma R_m = 45\%$ | $\Sigma R_A = 98\%$ | $\Sigma R_B = 143\%$ |

∴ Average Return on market, $E(R_m) = \frac{\Sigma R_m}{n} = \frac{45}{10} = 4.5\%$

∴ Average Return on stock A, $E(R_A) = \frac{\Sigma R_A}{n} = \frac{98}{10} = 9.8\%$

∴ Average Return on stock B, $E(R_B) = \frac{\Sigma R_B}{n} = \frac{143}{10} = 14.3\%$

b. Calculation of variance and standard deviation:

| Year | $R_m - E(R_m)$ | $R_A - E(R_A)$ | $R_B - E(R_B)$ | $[R_m - E(R_m)]^2$ | $[R_A - E(R_A)]^2$ | $[R_B - E(R_B)]^2$ |
|---|---|---|---|---|---|---|
| 2006 | 1.5 | 1.2 | 1.7 | 2.25 | 1.44 | 2.89 |
| 2007 | -2.5 | -1.8 | -3.3 | 6.25 | 3.24 | 10.89 |
| 2008 | -17.5 | -13.8 | -24.3 | 306.25 | 190.44 | 590.49 |
| 2009 | -8.5 | -6.8 | -11.3 | 72.25 | 46.24 | 127.69 |
| 2010 | -12.5 | -9.8 | -17.3 | 156.25 | 96.04 | 299.29 |
| 2011 | 11.5 | 9.2 | 15.7 | 132.25 | 86.64 | 246.49 |
| 2012 | 5.5 | 4.2 | 7.7 | 30.25 | 17.64 | 59.29 |
| 2013 | 10.5 | 8.2 | 14.7 | 110.25 | 67.24 | 216.09 |
| 2014 | 3.5 | 2.2 | 4.7 | 12.25 | 4.84 | 22.09 |
| 2015 | 8.5 | 7.2 | 11.7 | 72.25 | 51.84 | 136.89 |
| | | | | $\Sigma[R_m - E(R_m)]^2 = 900.5$ | $\Sigma[R_A - E(R_A)]^2 = 563.60$ | $\Sigma[R_B - E(R_B)]^2 = 1712.10$ |

∴ Variance of market, $\sigma_m^2 = \frac{\Sigma[R_m - E(R_m)]^2}{n-1} = \frac{900.5}{10-1} = 100.06$

∴ Standard deviation of market, $\sigma_m = \sqrt{100.06} = 10\%$

∴ Variance of investment A, $\sigma_A^2 = \frac{\Sigma[R_A - E(R_A)]^2}{n-1} = \frac{563.60}{10-1} = 62.62$

∴ Standard deviation of investment A, $\sigma_A = \sqrt{62.62} = 7.91\%$

∴ Variance of Investment B, $\sigma_B^2 = \frac{\Sigma[R_B - E(R_B)]^2}{n-1} = \frac{1712.10}{10-1} = 190.23$

∴ Standard deviation of stock B, $\sigma_B = \sqrt{190.23} = 13.79\%$

c. Calculation of Covariance ($COV_{AM}$)

| Year | $[R_M - E(R_m)][R_A - E(R_A)]$ | $[R_m - E(R_m)][R_B - E(R_B)]$ |
|---|---|---|
| 2006 | 1.80 | 2.55 |
| 2007 | 4.50 | 8.25 |
| 2008 | 241.50 | 425.25 |
| 2009 | 57.80 | 96.05 |
| 2010 | 122.50 | 216.25 |
| 2011 | 105.80 | 180.55 |
| 2012 | 23.10 | 42.35 |
| 2013 | 86.10 | 154.35 |
| 2014 | 7.70 | 16.45 |
| 2015 | 61.20 | 99.45 |
| | $\Sigma[R_m - E(R_m)][R_A - E(R_A)] = 712$ | $\Sigma[R_m - E(R_m)][R_B - E(R_B)] = 1241.5$ |

Covariance between market return and investment A

$$COV_{AM} = \frac{\Sigma[R_m - E(R_m)][R_A - E(R_A)]}{n-1} = \frac{712}{10-1} = 79.1$$

Covariance between market return and investment B

$$COV_{Bm} = \frac{\Sigma[R_m - E(R_m)][R_B - E(R_B)]}{n-1} = \frac{1241.5}{10-1} = 137.9$$

d. Calculation of correlation:

Correlation between market and Investment A

$$\rho_{AM} = \frac{COV_{AM}}{\sigma_A \times \sigma_m} = \frac{79.1}{7.91 \times 10} = 1$$

Correlation between market and Investment B

$$\rho_{BM} = \frac{COV_{BM}}{\sigma_B \times \sigma_m} = \frac{137.9}{13.79 \times 10} = 1$$

e. Calculation of Beta Coefficient:

Beta coefficient of investment A, $(\beta_A) = \frac{COV_{Am}}{\sigma_m^2} = \frac{79.1}{100.06} = 0.79$

Beta coefficient of Investment B, $(\beta_B) = \frac{COV_{BM}}{\sigma_m^2} = \frac{137.9}{100.06} = 1.38$

f. Since, Investment A has Beta coefficient less than 1, it is less risky than the market whereas investment B has beta coefficent more than 1, so it is more risky than the market.

Problem 5.12

Sol^n

Calculation of Required Rate of Return using CAPM

| Security | Risk free Rate ($R_f$) | Market Return ($R_m$) | Beta ($\beta$) | Required Rate of Return $R = R_f + (R_m - R_f)\beta$ |
|---|---|---|---|---|
| A | 5% | 8% | 1.30 | $= 5\% + (8\% - 5\%)1.30 = 8.9\%$ |
| B | 8 | 13 | 0.90 | $= 8\% + (13\% - 8\%)0.90 = 12.5\%$ |
| C | 9 | 12 | −0.20 | $= 9\% + (12\% - 9\%)(-0.20) = 8.4\%$ |
| D | 10 | 15 | 1.00 | $= 10\% + (15\% - 10\%)1.00 = 15\%$ |
| E | 6 | 10 | 0.60 | $= 6\% + (10\% - 6\%)0.60 = 8.4\%$ |

Problem 5.13

Sol^n

Given:

Risk free Rate ($R_f$) = 3%

Beta ($\beta$) = 1.25

Expected Return, $E(R)$ = 14%

Market Return ($R_m$) = 13%

Required Rate of Return ($R$) $= R_f + (R_m - R_f)\beta$

$= 3\% + (13\% - 3\%)1.25$

$= 15.5\%$

Jagar should leave his funds in the T-bill because its expected return (14%) is lower than required rate of return (15.5%).

Problem 5.14

Soln

Given:

Risk free Rate ($R_f$) = 6%

Return on market ($R_m$) = 14%

Beta of Company A ($\beta_A$) = 1.55

Beta of Company B ($\beta_B$) = 0.75

Price of stock A = Rs. 38

Price of stock B = Rs. 23

$\rightarrow$ Total = 38 + 23 = Rs. 61

a. Required Rate of Return for common stock A

$$E(R_A) = R_f + (R_m - R_f)\beta_A$$

$$= 6\% + (14\% - 6\%)\,1.55$$

$$= 18.4\%$$

b. Required Rate of Return for common stock B

$$E(R_B) = R_f + (R_m - R_f)\beta_B$$

$$= 6\% + (14\% - 6\%)\,0.75$$

$$= 12\%$$

c. Weight of stock A ($W_A$) $= \frac{38}{61} = 0.63$

Weight of stock B ($W_B$) $= \frac{23}{61} = 0.37$

Required Rate of Return for portfolio $= W_A \times E(R_A) + W_B \times E(R_B)$

$$= 0.63 \times 18.4\% + 0.37 \times 12\%$$

$$= 16.03\%$$

OR,

$\beta_p = W_A \times \beta_A + W_B \times \beta_B$

$= 0.63 \times 1.55 + 0.37 \times 0.75$

$= 1.254$

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

$= 6\% + (14\% - 6\%) 1.254$

$= 16.03\%$

Problem 5.15

Soln

Given:

- Risk free rate ($R_f$) = 6 %
- Expected Return on market portfolio, $E(R_m)$ = 11 %
- Standard Deviation of the market portfolio, ($\sigma_m$) = 11 %
- Correlation Coefficient of Asset A and market ($\rho_{AM}$) = + 0.80
- Standard deviation of the return of Asset A ($\sigma_A$) = 9 %

a. Beta coefficient for Asset A

$$\beta_A = \frac{\rho_{Am} \times \sigma_A \times \sigma_m}{\sigma_m^2}$$

$$= \frac{0.80 \times 9 \times 11}{11 \times 11}$$

$$= 0.65$$

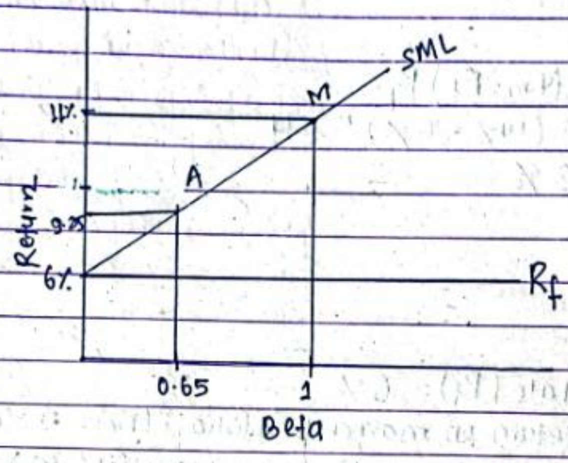
Since, Beta of Asset A is less than 1, It is a defensive asset.

b. Expected Return for Asset A, $E(R_A) = R_f + (R_m - R_f)\beta_A$

$$= 6\% + (11\% - 6\%)\, 0.65$$

$$= 9.25\%$$

c.




d. Systematic Risk for Asset A $= \dfrac{COV_{Am}}{\sigma_m} = \dfrac{\rho_{Am} \times \sigma_A \times \sigma_m}{\sigma_m}$

$$= \frac{0.80 \times 9 \times 11}{11}$$

$$= 7.2\%$$

Unsystematic Risk $= \sigma_A (1 - \rho_{Am})$

$$= 9\% (1 - 0.80) = 1.8\%$$

Total risk of asset A is 9% where 7.2% is systematic and 1.8% is unsystematic.

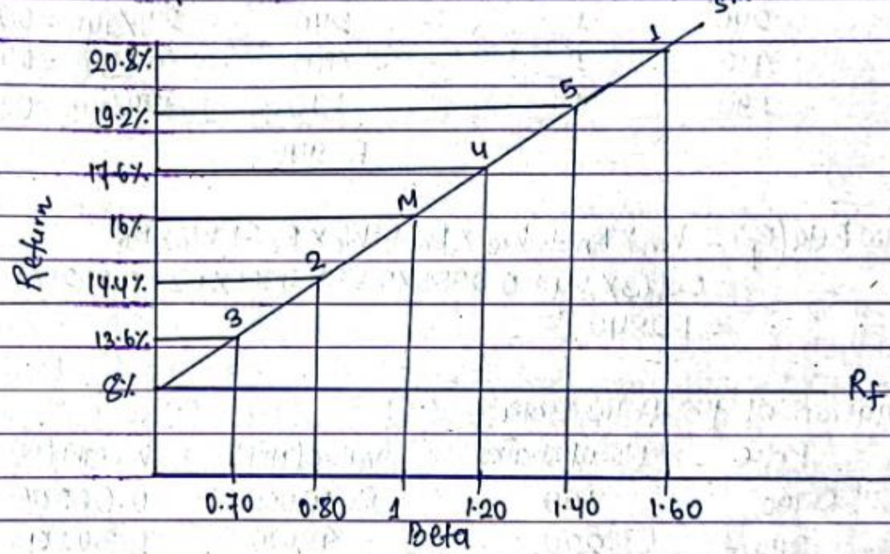
Problem 5.16

Soln

Given:

Risk free Rate ($R_f$) = 8%

Return on market ($R_m$) = 16%




Caln of Required Rate of Return:

$R = R_f + (R_m - R_f)\,\beta$

$R_1 = 8\% + (16\% - 8\%)\,1.60 = 20.8\%$

$R_2 = 8\% + (16\% - 8\%)\,0.80 = 14.4\%$

$R_3 = 8\% + (16\% - 8\%)\,0.70 = 13.6\%$

$R_4 = 8\% + (16\% - 8\%)\,1.20 = 17.6\%$

$R_5 = 8\% + (16\% - 8\%)\,1.40 = 19.2\%$

Problem 5.17

Sol$^n$

a. Calculation of portfolio Beta:

| Stock | Price | No. of shares | Value(NXP) | Weight(W) |
|---|---|---|---|---|
| A | Rs.100 | 1 | 100 | 100/940 = 0.1063 |
| B | 240 | 1 | 240 | 240/940 = 0.2553 |
| C | 410 | 1 | 410 | 410/940 = 0.4361 |
| D | 190 | 1 | 190 | 190/940 = 0.2021 |
| | | | Rs.940 | |

$$\text{Portfolio Beta}(\beta_P) = W_A \times \beta_A + W_B \times \beta_B + W_C \times \beta_C + W_D \times \beta_D$$
$$= 0.1063 \times 1.4 + 0.2553 \times 0.8 + 0.4361 \times 1.3 + 0.2021 \times 1.8$$
$$= 1.2840$$

b. Calculation of portfolio Beta:

| Stock | Price | No. of shares | Value(NXP) | Weight(W) |
|---|---|---|---|---|
| A | Rs.100 | 100 | Rs.10,000 | 0.0629 |
| B | 240 | 200 | 48,000 | 0.3019 |
| C | 410 | 200 | 82,000 | 0.5157 |
| D | 190 | 100 | 19,000 | 0.1195 |
| | | | 159,000 | |

$$\text{Portfolio Beta}(\beta_P) = W_A \times \beta_A + W_B \times \beta_B + W_C \times \beta_C + W_D \times \beta_D$$
$$= 0.0629 \times 1.4 + 0.3019 \times 0.8 + 0.5157 \times 1.3 + 0.1195 \times 1.8$$
$$= 1.2151$$

c. Calculation of Required rate of return on each stock:

$$E(R) = R_f + (R_m - R_f)\beta$$

$$E(R_A) = 8\% + (12\% - 8\%)\,1.2 = 12.8\%$$

$$E(R_B) = 8\% + (12\% - 8\%)\,0.8 = 11.2\%$$

$$E(R_C) = 8\% + (12\% - 8\%)\,1.5 = 14\%$$

$$E(R_D) = 8\% + (12\% - 8\%)\,2 = 16\%$$

Problem 5.18

Soln

a. Ranking of stocks from most risky to least risky

| Stock | Beta | Rank | Remarks |
|---|---|---|---|
| A | 0.80 | 2 | |
| B | 1.40 | 1 | most risky |
| C | -0.30 | 3 | least risky |

b. If market increases by 12%, the change in stock's return is given by:

| Stock | Beta($\beta$) | Increase in market return($\Delta R_m$) | $\beta \times \Delta R_m$ |
|---|---|---|---|
| A | 0.80 | 12% | 9.6% |
| B | 1.40 | 12% | 16.8% |
| C | -0.30 | 12% | -3.6% |

c. If the market return declines by 5%.

| Stock | Beta ($\beta$) | $\Delta R_m$ | $\beta \times \Delta R_m$ |
|---|---|---|---|
| A | 0.8 | −5% | −4% |
| B | 1.4 | −5% | −7% |
| C | −0.3 | −5% | +1.5% |

d. If we felt the stock market was about to experience a significant decline, we would be most likely to add to stock C because it has negative beta means that when market declines it increases.

e. If we anticipated a major stock market increases, we would be most likly to add stock B to our portfolio because its beta is the highest and highest beta results highest return.

Problem 5.19

Soln

Given:

$\beta_1 = 1.2$ $\beta_2 = 0.9$

$W_1 = 50\%$ $W_2 = 50\%$

a. Beta of portfolio ($\beta_p$) $= W_1 \times \beta_1 + W_2 \times \beta_2$

$= 0.50 \times 1.2 + 0.50 \times 0.9$

$= 1.05$

b. Portfolio Beta ($\beta_p$) = 1.1 , $W_1$ = ? , $W_2$ = ?

We have,

$$\beta_p = W_1 \times \beta_1 + W_2 \times \beta_2$$

$$\left[ \begin{array}{l} W_1 + W_2 = 1 \\ W_2 = 1 - W_1 \end{array} \right]$$

$$1.1 = W_1 \times 1.2 + (1 - W_1)\, 0.9$$

$$1.1 = 1.2\, W_1 + 0.9 - 0.9\, W_1$$

$$1.1 - 0.9 = 0.3\, W_1$$

$$W_1 = \frac{0.2}{0.3} = 0.6667 \text{ or } 66.67\%$$

$$W_2 = 1 - W_1 = 1 - 0.6667 = 0.3333 \text{ or } 33.33\%$$

Problem 5.20

Soln

a. Calculation of Beta for Portfolio A and B

| Asset | Asset Beta | $W_A$ | $W_B$ | Beta x $W_A$ | Beta x $W_B$ |
|---|---|---|---|---|---|
| 1 | 1.3 | 0.10 | 0.30 | 0.13 | 0.39 |
| 2 | 0.7 | 0.30 | 0.10 | 0.21 | 0.07 |
| 3 | 1.25 | 0.10 | 0.20 | 0.125 | 0.25 |
| 4 | 1.1 | 0.10 | 0.20 | 0.11 | 0.22 |
| 5 | 0.9 | 0.40 | 0.20 | 0.36 | 0.18 |
| | | | | $\beta_A$ = 0.935 | $\beta_B$ = 1.11 |

b. Portfolio A has beta less than 1, so it is less risky than market whereas Portfolio B has beta more than 1, so it is more risky than market. Since, beta of stock B is higher than the beta of stock A. stock B portfolio is more risky.

c.

Risk free Rate ($R_f$) = 2%
Market Return ($R_m$) = 12%

Required Rate of Return, $E(R) = R_f + (R_m - R_f) \times \beta$

Portfolio A, $E(R_A) = 2\% + (12\% - 2\%) \times 0.935 = 11.35\%$

Portfolio B, $E(R_B) = 2\% + (12\% - 2\%) \times 1.11 = 13.1\%$

d. Calculation of Expected Return of portfolio A and B.

| Assets | $R_j$ | $W_A$ | $W_B$ | $W_A \times R_j$ | $W_B \times R_j$ |
|---|---|---|---|---|---|
| 1 | 16.5% | 0.10 | 0.30 | 1.65% | 4.95% |
| 2 | 12% | 0.30 | 0.10 | 3.6 | 1.2 |
| 3 | 15% | 0.10 | 0.20 | 1.5 | 3 |
| 4 | 13% | 0.10 | 0.20 | 1.3 | 2.6 |
| 5 | 7% | 0.40 | 0.20 | 2.8 | 1.4 |
| | | | | $E(R_A)$ = 10.85% | $E(R_B)$ = 13.15% |

We would choose portfolio B because its average return (13.15%) is greater than the required return (13.1%).

Problem 5.21

Solⁿ

a. Calculation of Expected Return

| State of Economy | Probability ($P_j$) | $R_{MF}$ | $R_{CS}$ | $R_{CD}$ | $P_j \times R_{MF}$ | $P_j \times R_{CS}$ | $P_j \times R_{CD}$ |
|---|---|---|---|---|---|---|---|
| Weak growth | 0.3333 | 8% | 6% | 7% | 2.6664 | 1.9998 | 2.3331 |
| Moderate | 0.3333 | 10 | 12 | 7 | 3.333 | 3.9996 | 2.3331 |
| Strong | 0.3333 | 12 | 15 | 7 | 3.9996 | 4.9995 | 2.3331 |
| | | | | | = 10% | = 11% | = 7% |

∴ The expected return on Mutual fund, $E(R_{MF}) = \Sigma P_j \times R_{MF} = 10\%$

∴ The expected return on common stock, $E(R_{CS}) = \Sigma P_j \times R_{CS} = 11\%$

∴ The expected return on certificate of Deposit, $E(R_{CD}) = \Sigma P_j \times R_{CD} = 7\%$

Hence, Common stock provides highest expected Return.

b. Calculation of Standard Deviation:

| State of Economy | $P_j$ | $R_{MF} - E(R_{MF})$ | $R_{CS} - E(R_{CS})$ | $R_{CD} - E(R_{CD})$ | $P_j [R_{MF} - E(R_{MF})]^2$ |
|---|---|---|---|---|---|
| Weak growth | 0.3333 | −2 | −5 | 0 | 1.3332 |
| Moderate | 0.3333 | 0 | 1 | 0 | 0 |
| Strong | 0.3333 | 2 | 4 | 0 | 1.3332 |
| | | | | | = 2.6664 |

| $P_j [R_{CS} - E(R_{CS})]^2$ | $P_j [R_{CD} - E(R_{CD})]^2$ |
|---|---|
| 8.3325 | 0 |
| 0.3333 | 0 |
| 5.3328 | 0 |
| = 13.9986 | = 0 |

∴ Standard deviation of Mutual fund ($\sigma_{MF}$) $= \sqrt{\Sigma P_j [R_{MF} - E(R_{MF})]^2}$

$= \sqrt{2.6664} = 1.6329\%$

∴ Standard deviation of common stock ($\sigma_{CS}$) $= \sqrt{\Sigma P_j [R_{CS} - E(R_{CS})]^2}$

$= \sqrt{13.9986} = 3.7415\%$

∴ Standard deviation of certificate of Deposit ($\sigma_{CD}$) $= \sqrt{\Sigma P_j [R_{CD} - E(R_{CD})]^2}$

$= \sqrt{0} = 0$

Certificate of Deposit is least risky in terms of standard deviation because it has zero risk.

Common stock is the most risky in terms of beta because it has higher beta than mutual fund and certificate of deposit.

c. Portfolio 'X' | Portfolio Y

Weight of Mutual fund ($W_{MF}$) = 75%. Weight of Common stock ($W_{CS}$) = 50%.
Weight of Common stock ($W_{CS}$) = 25%. Wight of certificate of Deposit ($W_{CD}$) = 50%.

Standard Deviation of portfolio X

$$\sigma_X = \sqrt{W_{MF}^2 \cdot \sigma_{MF}^2 + W_{CS}^2 \cdot \sigma_{CS}^2 + 2 \cdot W_{MF} \cdot W_{CS} \cdot COV_{MF,CS}}$$

$= \sqrt{(0.75)^2 \times (1.6329)^2 + (0.25)^2 \times (3.7415)^2 + 2 \times 0.75 \times 0.25 \times 6}$

$= 2.150\%$

Working Note:

Calculation of covariance between MF and CS ($COV_{MF,CS}$)

| State | $R_{MF} - E(R_{MF})$ | $R_{CS} - E(R_{CS})$ | $P_j$ | $P_j [R_{MF} - E(R_{MF})][R_{CS} - E(R_{CS})]$ |
|---|---|---|---|---|
| Weak | -2 | -5 | 0.3333 | 3.333 |
| Moderate | 0 | 1 | 0.3333 | 0 |
| Strong | 2 | 4 | 0.3333 | 2.666 |
| | | | | 6% |

∴ Covariance between MF and CS ($COV_{MF,CS}$) $= \Sigma P_j [R_{MF} - E(R_{MF})](R_{CS} - E(R_{CS})]$

$= 6\%$

Standard deviation of portfolio Y

$\sigma_Y = \sqrt{W_{CS}^2 \times \sigma_{CS}^2 + W_{CD}^2 \times \sigma_{CD}^2 + 2 \cdot W_{CS} \cdot W_{CD} \cdot COV_{CS,CD}}$

$= \sqrt{(0.50)^2 \times (3.7415)^2 + (0.50)^2 \times (0)^2 + 2 \times 0.50 \times 0.50 \times 0}$

$= 1.870\%$

Portfolio Y is less risky in terms of standard deviation due to lower standard deviation.

Beta of portfolio X

$$\beta_X = W_{MF} \times \beta_{MF} + W_{CS} \times \beta_{CS}$$
$$= 0.75 \times 1 + 0.25 \times 1.2$$
$$= 1.05$$

Beta of portfolio Y

$$\beta_Y = W_{CS} \times \beta_{CS} + W_{CD} \times \beta_{CD}$$
$$= 0.50 \times 1.2 + 0.50 \times 0$$
$$= 0.6$$

Portfolio Y is least risky in terms of beta due to lower beta.

d. The standard deviation measures the total risk. Total risk has two components: systematic risk and unsystematic risk. Beta is a measure of systematic risk. In a well diversified portfolio only the systematic risk is relevant because of that we calculate beta.

# Bond Valuation

## Chapter-9
## BOND VALUATION

**Bond:**

- It is a legal written promisory note.
- It is a agreement between issuers and investors.
- It is a long term debt whose life is more than a year.
- Maturity period is fixed. (Generally 5 Yrs, 10 Yrs, 20 Yrs, 30 Yrs).
- Interest is a income received from bond.
- Bond can be called before its maturity period which is also known as callable bond.

**Terms:**

1. Maturity value (M) / Par value / Face value
2. Term to Maturity (n) / Maturity period
3. Coupon rate (c) / interest rate (i)
4. Required rate of return ($K_d$) / Yield to Maturity (YTM) / Market rate / discount rate.
5. Call period ($n_c$) for callable bond
6. Call price (CP) (par value + premium)

## * Types of Bond:

Bond

Redeemable Bond (whose life is fixed)

- Coupon Bond ($V = I_{1-n} + M$)
- Zero coupon Bond ($V = M$)

Irredemable Bond (whose life is not fixed) or Perpetual Bond or Consol Bond ($V = I_{1-\infty}$)

## * Valuation of Bond:

- If Interest is paid annually:

1. Coupon Bond:

Intrinsic Value of Bond ($V_0$) = $I \times PVIFA_{kd\%, n} + M \times PVIF_{kd\%, n}$

OR, $$V_0 = I\left[\frac{1 - \frac{1}{(1+K_d)^n}}{K_d}\right] + \frac{M}{(1+K_d)^n}$$

2. Zero Coupon Bond:

Intrinsic Value of Bond ($V_0$) = $M \times PVIF_{kd\%, n}$

OR,

$$V_0 = \frac{M}{(1+K_d)^n}$$

3. Perpetual Bond:

Intrinsic Value of Bond ($V_0$) = $I/K_d$

• If Interest is paid semi-annually:

Changes:

$I \longrightarrow I/2$

$K_d \longrightarrow K_d/2$

$n \longrightarrow n \times 2$

* Relationship between coupon rate (C), Required rate of return ($K_d$/YTM) and Value of Bond ($V_0$).

| | | |
|---|---|---|
| If, | $C = K_d$ | $V_0$ = Rs. 1000 (Par) |
| If, | $C > K_d$ | $V_0$ = more than 1000 |
| If, | $C < K_d$ | $V_0$ = less than 1000 |

Conclusion:

· Coupon rate and value of bond has direct relation i.e increase in coupon rate increases the value of bond and vice-versa.

· Required Rate of Return or Yield to Maturity and value of bond has inverse relation i.e increase in YTM decreases the value of bond and vice versa.

- Higher the maturity period higher will be the value of bond and vice-versa.

Decision:

1. If Market price (given) = Intrinsic value (calculated) ⇒ Correctly valued (Equilibrium) ⇒ Indifference

2. If Market price (given) < Intrinsic value (calculated) ⇒ Undervalued → Buy / Purchase

3. If Market price (given) > Intrinsic value (calculated) ⇒ Overvalued → Not purchase (sell)

* Bond Yields:

1. Rate of Return (HPR) $= \frac{\text{Ending price} - \text{Beginning price} + \text{Interest}}{\text{Beginning price}} \times 100$

$$= \frac{\text{Selling price} - \text{Purchase price} + \text{Interest}}{\text{Purchase price}} \times 100$$

$\boxed{P_0 = V_0}$

$$= \frac{P_1 - P_0 + I_1}{P_0} \times 100$$

$$= \frac{P_1 - P_0}{P_0} \times 100 + \frac{I}{P_0} \times 100$$

HPR / YTM = Capital Gain Yield + Current Yield

2. Coupon Yield = $\frac{\text{Interest}}{\text{Face value}} \times 100$

3. Current Yield = $\frac{\text{Interest}}{\text{Current Market price}} \times 100$

$= \frac{I}{V_0} \times 100$

## * Yield To Maturity (YTM):

Yield to Maturity is the annualized rate of return that an investor can realize if the bond is held until the maturity.

Assumptions of YTM:

1. The bond should be held until the maturity.
2. The bond should pay all promised cash flows.
3. The bond should not be called by the issuer before maturity.
4. All intermediates cash flows in terms of coupon Interest from bonds are assumed to reinvest at the rate of return equal to YTM.

Formula:

a. Perpetual Bond:

$V_0 = I/K_d \longrightarrow \text{YTM}$

$$\boxed{\therefore \text{YTM} = I/V_0}$$

b. Zero coupon Bond:

$$V_0 = \frac{M}{(1+\underbrace{K_d}_{\to YTM})^n}$$

$$(1+YTM)^n = \frac{M}{V_0}$$

$$\therefore \boxed{YTM = \left[\frac{M}{V_0}\right]^{1/n} - 1}$$

c. Coupon Bond

- If interest is paid annually

Step-1: Approximate YTM $= \dfrac{I + \dfrac{M - V_0}{n}}{\dfrac{M + 2V_0}{3}} \times 100$

Step-2: Try at low rate

$TPV_{LR} = I \times PVIFA_{LR\%, n} + M \times PVIF_{LR\%, n}$

(Ans = $V_0$ থেকে বেশি)

Step-3: Try at High rate

$TPV_{HR} = I \times PVIFA_{HR\%, n} + M \times PVIF_{HR\%, n}$

(Ans = $V_0$ থেকে কম)

Step-4 : By Interpolation:

$$\text{Annual YTM} = LR + \frac{TPV_{LR} - V_0}{TPV_{LR} - TPV_{HR}} \times (HR - LR)$$

· If interest is paid semi-annually

Changes:

$YTM \longrightarrow YTM/2$

$I \longrightarrow I/2$

$n \longrightarrow n \times 2$

Step-5: Nominal YTM = Semi-annual YTM × 2

Step-6: Effective Annual YTM = $(1 + \text{Semi-annual YTM})^2 - 1$

* Yield To Call (YTC):

An Yield to call is the annualized rate of return that bondholders will realize if the bond is called at the stated date before the maturity.

Assumptions of YTC:

1. The given bond must be hold until its call period.
2. The issuer should not default to pay the promised amount at promised date.
3. The coupons from the given bond must be reinvested at the rate of YTC of the given bond.

Formula: Same as YTM

Changes

YTM $\longrightarrow$ YTC

$n \longrightarrow n_c$ (call Period)

$M \longrightarrow CP$ (call price)

* Duration:

It can be defined as average time required to recover the incomes from the given bond or it can simply be defined as average life or maturity of the bond. It is propounded by Frederick Macaulay so it is called Macaulay Duration.

Note:

1. The duration of Coupon Bond is always less than its life.
2. The duration of Zero Coupon Bond is always equals to its life.

Formula:

$$\text{Duration (D)} = \frac{1+Y}{Y} - \frac{(1+Y) + n(C-Y)}{C[(1+Y)^n - 1] + Y}$$

$$\text{Modified Duration (MD)} = \frac{D}{1+Y}$$

$$\text{Change in price } (\Delta P) = -1 \times MD \times \Delta I$$

Where,

$Y$ = Yield To Maturity

$C$ = Coupon rate

$n$ = number of payments

$MD$ = Modified Duration

$\Delta I$ = Change in Interest Rate

100 Basis points = 1 %

In case of semi-annual payment

Changes.

$Y \rightarrow Y/2$

$C \rightarrow C/2$

$n \rightarrow 2n$

Annual Duration = $D/2$

* Why duration is calculated ?

It indicates the weighted average number of years that cash flows occur from the bond. Duration is a better measure of time structure of bonds than years to maturity because duration reflects the amount and timing of every cash flow rather than merely the length of time until the final payment occurs. Moreover, duration is a measure of bond's interest rate risk. So duration is calculated.

Problem 9.1

Soln

Given:

a. Perpetual Bond:

Par value (M) = Rs. 1000

Coupon rate (C) = 7 %

Interest Amount (I) = M×C = 1000×0.07 = Rs. 70

Required rate of return (Kd) = 9 %

Value of Bond ($V_0$) = ?

We know that,

$$V_0 = \frac{I}{Kd} = \frac{70}{0.09} = Rs.\ 777.77$$

b. Zero Coupon Bond:

Maturity period (n) = 10 Yrs

Par value (M) = Rs. 1000

Required rate of return (Kd) = 12 %

Value of bond ($V_0$) = ?

We know that,

$$V_0 = M \times PVIF_{Kd\%, n}$$
$$= 1000 \times PVIF_{12\%, 10}$$
$$= 1000 \times 0.3220$$
$$= Rs.\ 322$$

OR,

$$V_0 = \frac{M}{(1+Kd)^n} = \frac{1000}{(1+0.12)^{10}} = Rs.\ 322$$

c. Coupon Bond:

Par value (M) = Rs. 1000

Maturity period (n) = 8 Yrs

Coupon rate (c) = 7.5 %

Interest Amount (I) = M X C = 1000 X 0.075 = Rs. 75

Yield To Maturity (Kd) = 12 %

Value of Bond ($V_0$) = ?

We know that,

$$V_0 = I \times PVIFA_{kd\%,n} + M \times PVIF_{kd\%,n}$$

$$= 75 \times PVIFA_{12\%,8} + 1000 \times PVIF_{12\%,8}$$

$$= 75 \times 4.9676 + 1000 \times 0.4039$$

$$= \text{Rs. } 776.47$$

OR,

$$V_0 = I \left[ \frac{1 - \frac{1}{(1+Kd)^n}}{Kd} \right] + \frac{M}{(1+Kd)^n}$$

$$= 75 \left[ \frac{1 - \frac{1}{(1+0.12)^8}}{0.12} \right] + \frac{1000}{(1+0.12)^8}$$

$$= \text{Rs. } 776.47$$

Problem 9.2

Soln

Given: Coupon Bond:

Face Value (M) = Rs.1000

Coupon rate (c) = 8 % (semi-annually)

Maturity period (n) = 5 years

Interest Amount (I) = M×C = 1000×0.08 = Rs.80

(a) Required rate of return (Kd) = 6 %

Value of Bond ($V_0$) = ?

We know that,

$$V_0 = \frac{I}{2} \times PVIFA_{\frac{kd}{2}\%,\, n\times 2} + M \times PVIF_{\frac{kd}{2}\%,\, n\times 2}$$

$$= \frac{80}{2} \times PVIFA_{\frac{6}{2}\%,\, 5\times 2} + 1000 \times PVIF_{\frac{6}{2}\%,\, 5\times 2}$$

$$= 40 \times PVIFA_{3\%,10} + 1000 \times PVIF_{3\%,10}$$

$$= 40 \times 8.5302 + 1000 \times 0.7441$$

$$= Rs.\ 1085.31$$

(b) Required rate of return (Kd) = 8%

Value of Bond ($V_0$) = ?

$$V_0 = \frac{I}{2} \times PVIFA_{\frac{kd}{2}\%,\, n\times 2} + M \times PVIF_{\frac{kd}{2}\%,\, n\times 2}$$

$$= \frac{80}{2} \times PVIFA_{\frac{8}{2}\%,\, 5\times 2} + 1000 \times PVIF_{\frac{8}{2}\%,\, 5\times 2}$$

$$= 40 \times PVIFA_{4\%,10} + 1000 \times PVIF_{4\%,10}$$

$= 40 \times 8.1109 + 1000 \times 0.6756$

$= Rs.\ 1000$

c. Required rate of return ($K_d$) = 10%

$V_0 = \frac{I}{2} \times PVIFA_{\frac{kd}{2}\%, n\times 2} + M \times PVIF_{\frac{kd}{2}\%, n\times 2}$

$= \frac{80}{2} \times PVIFA_{\frac{10}{2}\%, 5\times 2} + 1000 \times PVIF_{\frac{10}{2}\%, 5\times 2}$

$= 40 \times PVIFA_{5\%,10} + 1000 \times PVIF_{5\%,10}$

$= 40 \times 7.7217 + 1000 \times 0.6139$

$= Rs.\ 922.78$

Problem 9.3

Soln

Given: Coupon Bond:

Coupon Rate (c) = 8.5 % , $I = 1000 \times 0.085 = Rs. 85$

Face Value (M) = Rs. 1000

Maturity period (n) = 5 years

Required rate of Return ($K_d$) = 12%

Value of Bond ($V_0$) = ?

$V_0 = I \times PVIFA_{kd\%, n} + M \times PVIF_{kd\%, n}$

$= 85 \times PVIFA_{12\%, 5} + 1000 \times PVIF_{12\%, 5}$

$= 85 \times 3.6048 + 1000 \times 0.5674$

$= Rs.\ 873.81$

If interest is paid semi-annually:

$V_0 = \frac{I}{2} \times PVIFA_{\frac{kd}{2}\%, n\times2} + M \times PVIF_{\frac{kd}{2}\%, n\times2}$

$= \frac{85}{2} \times PVIFA_{\frac{12}{2}\%, 5\times2} + 1000 \times PVIF_{\frac{12}{2}\%, 5\times2}$

$= 42.5 \times PVIFA_{6\%,10} + 1000 \times PVIF_{6\%,10}$

$= 42.5 \times 7.3601 + 1000 \times 0.5584$

= Rs. 871.2

Problem 9.4

Soln

Given: Coupon

Interest (I) = Rs. 90

Par value (M) = Rs. 1000

Maturity period (n) = 20 years

Required rate of return (Kd) = 8%

a. Value of Bond ($V_0$) = $I \times PVIFA_{kd\%,n} + M \times PVIF_{kd\%,n}$

$= 90 \times PVIFA_{8\%,20} + 1000 \times PVIF_{8\%,20}$

$= 90 \times 9.8181 + 1000 \times 0.2145$

= Rs. 1098.13

b. Required rate of return (Kd) = 10%

ii. Required rate of return ($K_d$) = 6%

Problem 9.5

Sol$^n$

Given: Coupon

| | Bond A | Bond B |
|---|---|---|
| Annual Interest (I) | Rs. 80 | Rs. 80 |
| Maturity value (M) | Rs. 1000 | Rs. 1000 |
| Maturity period (n) | 15 years | 1 year |

a. i. Required Rate of Return ($K_d$) = 4%

Bond A

$V_0 = I \times PVIFA_{kd\%,n} + M \times PVIF_{kd\%,n}$

$= 80 \times PVIFA_{4\%,15} + 1000 \times PVIF_{4\%,15}$

$= 80 \times 11.1184 + 1000 \times 0.5553$

$=$ Rs. 1444.78

Bond B

$V_0 = I \times PVIFA_{kd\%,n} + M \times PVIF_{kd\%,n}$

=

=

ii. Required Rate of Return ($K_d$) = 8%.

Bond A

Bond B

iii. Required Rate of Return ($K_d$) = 12%

Bond A

Bond B

b. The value of longer term bond fluctuates more in compare to shorter term bond because, the longer term bonds are more exposed to maturity risk or price risk.

## Problem 9.6

Soln

Given: Coupon Bond:

Annual coupon Rate (c) = 6.5 %

Interest Amount (I) = M X C = 1000 X 0.065 = Rs. 65

Maturity period (n) = 10 yrs

Yield to Maturity (YTM/Kd) = 7 %

a. The bondholders will receive interest of Rs. 65 each year.

b. $$\text{Current Yield} = \frac{I}{V_0} \times 100$$

$$= \frac{65}{964.83} \times 100$$

$$= 6.74\%$$

Working Note:

$$V_0 = I \times PVIFA_{kd\%, n} + M \times PVIF_{kd\%, n}$$

$$= 65 \times PVIFA_{7\%, 10} + 1000 \times PVIF_{7\%, 10}$$

$$= 65 \times 7.0236 + 1000 \times 0.5083$$

$$= \text{Rs. } 964.83$$

b. The bond sells at Rs. 964.83

c. Yield To Maturity (YTM|Kd) = 6 %

Value of Bond ($V_0$) = $I \times PVIFA_{kd\%,n} + M \times PVIF_{kd\%,n}$

$= 65 \times PVIFA_{6\%,10} + 1000 \times PVIF_{6\%,10}$

$= 65 \times 7.3601 + 1000 \times 0.5584$

= Rs. 1036.8

d. The Coupon rate and value of bond has positive relation i.e increase in coupon rate increases the value of bond and vice-versa.

The yield to maturity and value of bond has inverse relation i.e increase in yield to maturity decreases the value of bond and vice-versa.

Problem 9.7

Soln

Given: Coupon Bond

Coupon Interest (I) = Rs. 90

Par value (M) = Rs. 1000

Maturity period (n) = 10 years

Required rate of return (Kd) = 10%

Value of Bond today ($V_0$) = $I \times PVIFA_{kd\%,n} + M \times PVIF_{kd\%,n}$

$= 90 \times PVIFA_{10\%,10} + 1000 \times PVIF_{10\%,10}$

$= 90 \times 6.1446 + 1000 \times 0.3855$

= Rs. 938.514

After 2 Years:

Remaining life (n) = 10 - 2 = 8 Yrs

Value of Bond ($V_2$) = $I \times PVIFA_{kd\%,n} + M \times PVIF_{kd\%,n}$

$= 90 \times PVIFA_{10\%,8} + 1000 \times PVIF_{10\%,8}$

$= 90 \times 5.3349 + 1000 \times 0.4665$

= Rs. 946.64

After 6 Years:

Remaining life (n) = 10 - 6 = 4 Yrs

Value of bond ($V_6$) = $I \times PVIFA_{kd\%,n} + M \times PVIF_{kd\%,n}$

$= 90 \times PVIFA_{10\%,4} + 1000 \times PVIF_{10\%,4}$

$= 90 \times 3.1699 + 1000 \times 0.6830$

= Rs. 968.29

## Problem 9.8

Soln

Given: Coupon Bond:

Coupon rate (c) = 8 %

Maturity period (n) = 18 Yrs

Yield (Kd) = 10 %

After a Year

Yield (Kd) = 9%

Remaining life (n) = 18 - 1 = 17 Yrs

Interest (I) = M X C = 1000 X 0.08

= Rs. 80

Value of bond today ($V_0$) = $I \times PVIFA_{kd\%,n} + M \times PVIF_{kd\%,n}$

$= 80 \times PVIFA_{10\%,18} + 1000 \times PVIF_{10\%,18}$

$= 80 \times 8.2014 + 1000 \times 0.1799$

$=$ Rs. 836.01

Value of bond in 1 year ($V_1$) = $I \times PVIFA_{kd\%,n} + M \times PVIF_{kd\%,n}$

$= 80 \times PVIFA_{9\%,17} + 1000 \times PVIF_{9\%,17}$

$= 80 \times 8.5436 + 1000 \times 0.2311$

$=$ Rs. 914.59

Holding Period Return (HPR) = $\frac{V_1 - V_0 + I_1}{V_0} \times 100$

$= \frac{914.59 - 836.01 + 80}{836.01} \times 100$

$= 18.97\%$

Problem 9.9

Soln

Given: Coupon Bond

Coupon rate (c) = 10%

Maturity period (n) = 25 Yrs

Selling price ($V_0$) = Rs. 1200

Interest (I) = M×C = 1000×0.10 = Rs. 100

Current Yield (CY) = $\frac{I}{V_0} \times 100 = \frac{100}{1200} \times 100 = 8.33\%$

Calculation of Yield To Maturity (YTM):

- If Interest is paid annually

Step-1: Approximat YTM = $\dfrac{I + \dfrac{M-V_0}{n}}{\dfrac{M+2V_0}{3}} \times 100$

$= \dfrac{100 + \dfrac{1000-1200}{25}}{\dfrac{1000+2\times1200}{3}} \times 100.$

$= 8.12\%.$

Step-2: Try at low rate i.e 8%

$TPV_{LR} = I \times PVIFA_{YTM\%,n} + M \times PVIF_{YTM\%,n}$
$= 100 \times PVIFA_{8\%,25} + 1000 \times PVIF_{8\%,25}$
$= 100 \times 10.6748 + 1000 \times 0.1460$
$=$ Rs. 1213.48

Step-3: Try at High rate i.e 9%

$TPV_{HR} = I \times PVIFA_{YTM\%,n} + M \times PVIF_{YTM\%,n}$
$= 100 \times PVIFA_{9\%,25} + 1000 \times PVIF_{9\%,25}$
$= 100 \times 9.8226 + 1000 \times 0.1160$
$=$ Rs. 1098.26

Step-4: By interpolation:

$$\text{Annual YTM} = LR + \frac{TPV_{LR} - V_0}{TPV_{LR} - TPV_{HR}} \times (HR - LR)$$

$$= 8\% + \frac{1213.48 - 1200}{1213.48 - 1098.26} \times (9\% - 8\%)$$

$$= 8.12\ \%$$

• If interest is paid semi-annually:

Step-1: $$\text{Approximate } \frac{YTM}{2} = \frac{\frac{I}{2} + \frac{M - V_0}{n \times 2}}{\frac{M + 2V_0}{3}} \times 100$$

$$= \frac{\frac{100}{2} + \frac{1000 - 1200}{25 \times 2}}{\frac{1000 + 2 \times 1200}{3}} \times 100$$

$$= 4.05\ \%$$

Step-2: Try at low rate i.e 4%

$$TPV_{LR} = \frac{I}{2} \times PVIFA_{\frac{YTM}{2}\%,\, n\times 2} + M \times PVIF_{\frac{YTM}{2}\%,\, n\times 2}$$

$$= \frac{100}{2} \times PVIFA_{4\%,\, 25\times 2} + 1000 \times PVIF_{4\%,\, 25\times 2}$$

$$= 50 \times PVIFA_{4\%,\, 50} + 1000 \times PVIF_{4\%,\, 50}$$

$= 50 \times 21.4822 + 1000 \times 0.1407$

$= Rs.\ 1214.81$

Step-3: Try at High Rate i.e 5%

$$TPV_{HR} = \frac{I}{2} \times PVIFA_{\frac{YTM}{2}, n\times 2} + M \times PVIF_{\frac{YTM}{2}, n\times 2}$$

$$= \frac{100}{2} \times PVIFA_{5\%, 25\times 2} + 1000 \times PVIF_{5\%, 25\times 2}$$

$$= 50 \times PVIFA_{5\%, 50} + 1000 \times PVIF_{5\%, 50}$$

$$= 50 \times 18.2559 + 1000 \times 0.0872$$

$$= Rs.\ 1000$$

Step-4: By Interpolation:

$$\text{Semi-annual } YTM = LR\% + \frac{TPV_{LR} - V_0}{TPV_{LR} - TPV_{HR}} \times (HR - LR)$$

$$= 4\% + \frac{1214.81 - 1200}{1214.81 - 1000} \times (5\% - 4\%)$$

$$= 4.07\ \%$$

Step-5: Nominal / Annual YTM = Semi-annual YTM × 2

$$= 4.07 \times 2 = 8.14\%$$

Step-6: Effective Annual YTM = $(1 + \text{semi annual } YTM)^2 - 1$

$$= (1 + 0.0407)^2 - 1$$

$$= 8.31\%$$

Problem 9.10

Sol^n

Given:

Coupon rate (C) = 12% (semi-annual payment)

Maturity period (n) = 10 Yrs

Maturity value (M) = Rs. 1000

Interest Amount (I) = M × C = 1000 × 0.12 = Rs. 120

Selling price ($V_0$) = 95% of 1000 = Rs. 950

$$\text{Current Yield} = \frac{I}{V_0} \times 100 = \frac{120}{950} \times 100 = 12.63\,\%$$

Calculation of YTM:

Step-1: $$\text{Approximate } \frac{YTM}{2} = \frac{\frac{I}{2} + \frac{M - V_0}{n \times 2}}{\frac{M + 2V_0}{3}} \times 100$$

$$= \frac{\frac{120}{2} + \frac{1000 - 950}{10 \times 2}}{\frac{1000 + 2 \times 950}{3}} \times 100$$

$$= 6.47\,\%$$

Step-2: Try at low rate i.e 6%

$$TPV_{LR} = \frac{I}{2} \times PVIFA_{\frac{YTM}{2}\%,\, n\times 2} + M \times PVIF_{\frac{YTM}{2}\%,\, n\times 2}$$

$= \frac{120}{2} \times PVIFA_{6\%, 10\times2} + 1000 \times PVIF_{6\%, 10\times2}$

$= 60 \times PVIFA_{6\%, 20} + 1000 \times PVIF_{6\%, 20}$

$= 60 \times 11.4699 + 1000 \times 0.3118$

$= Rs.\ 1000$

Step-3: Try at High Rate i.e 7%

$TPV_{HR} = \frac{I}{2} \times PVIFA_{\frac{YTM}{2}\%, n\times2} + M \times PVIF_{\frac{YTM}{2}\%, n\times2}$

$= \frac{120}{2} \times PVIFA_{7\%, 10\times2} + 1000 \times PVIF_{7\%, 10\times2}$

$= 60 \times PVIFA_{7\%, 20} + 1000 \times PVIF_{7\%, 20}$

$= 60 \times 10.5940 + 1000 \times 0.2584$

$= Rs.\ 894.04$

Step-4: Semi-Annual $YTM = LR + \frac{TPV_{LR} - V_0}{TPV_{LR} - TPV_{HR}} \times (HR - LR)$

$= 6\% + \frac{1000 - 950}{1000 - 894.04} \times (7\% - 6\%)$

$= 6.47\%$

Step-5: Annual. YTM = Semi-annual YTM × 2

$= 6.47\% \times 2 = 12.94\%$

Step-6: Effective Annual $YTM = (1 + \text{semiannual YTM})^2 - 1$

$= (1 + 0.0647)^2 - 1$

$= 13.36\%$

Problem 9.11

Sol$^n$

Given:

a. Market price ($V_0$) = Rs. 850

Maturity period (n) = 10 years

Maturity value (M) = Rs. 1000

Coupon rate (C) = 12%

Interest (I) = M×C = 1000×0.12 = Rs. 120

Yield to Maturity (YTM) = ?

Step-1: Approximate YTM = $\dfrac{I + \dfrac{M - V_0}{n}}{\dfrac{M + 2V_0}{3}} \times 100$

$= \dfrac{120 + \dfrac{1000 - 850}{10}}{\dfrac{1000 + 2 \times 850}{3}} \times 100$

$= 15\%$

Step-2: Try at 15%

$TPV_{HR} = I \times PVIFA_{YTM\%, n} + M \times PVIF_{YTM\%, n}$

$= 120 \times PVIFA_{15\%, 10} + 1000 \times PVIF_{15\%, 10}$

$= 120 \times 5.0188 + 1000 \times 0.2472$

= Rs. 849.46

Step-3: Try at 14%

$TPV_{LR} = I \times PVIFA_{YTM\%,n} + M \times PVIF_{YTM\%,n}$

$= 120 \times PVIFA_{14\%,10} + 1000 \times PVIF_{14\%,10}$

$= 120 \times 5.2161 + 1000 \times 0.2697$

$=$ Rs. 895.63

Step-4: By Interpolation:

$$\text{Annual YTM} = LR + \frac{TPV_{LR} - V_0}{TPV_{LR} - TPV_{HR}} \times (HR - LR)$$

$$= 14\% + \frac{895.63 - 850}{895.63 - 849.46} \times (15\% - 14\%)$$

$$= 14.99\%$$

b. Zero Coupon Bond:

Selling price ($V_0$) = Rs. 321

Maturity value (M) = Rs. 1000

Maturity period (n) = 10 years

Yield to Maturity (YTM) = ?

$$YTM = \left[\frac{M}{V_0}\right]^{1/n} - 1$$

$$= \left[\frac{1000}{321}\right]^{1/10} - 1$$

$$= 12\%$$

c. Perpetual Bond:

Selling price ($V_0$) = Rs.800

Coupon rate (c) = 10%

Par value (M) = Rs.1000

Interest (I) = M×C = 1000×0.10 = Rs.100

Yield To Maturity (YTM) = ?

$$YTM = I/V_0 = \frac{100}{800} = 12.5\%$$

Problem 9.12

Soln

Given: Coupon Bond:

Maturity period (n) = 10 years

Selling price ($V_0$) = Rs. 985

Face value (M) = Rs. 1000

Coupon rate (c) = 7%

Interest Amount (I) = M×C = 1000×0.07 = Rs.70

a. $\text{Current Yield} = \frac{I}{V_0} \times 100 = \frac{70}{985} \times 100 = 7.11\%$

b. Yield To Maturity (YTM) = ?

Note: Solve yourself (step 1 - step 4)

Ans = 7.22%

c. Remaining life = 10 - 3 = 7 Yrs , YTM = 7.22 %
Value of bond ($V_3$) = ?

$$V_3 = I \times PVIFA_{YTM\%,n} + M \times PVIF_{YTM\%,n}$$

$$= I\left[\frac{1 - \frac{1}{(1+YTM)^n}}{YTM}\right] + \frac{M}{(1+YTM)^n}$$

$$= 70\left[\frac{1 - \frac{1}{(1+0.0722)^7}}{0.0722}\right] + \frac{1000}{(1+0.0722)^7}$$

= Rs. 988.23

Problem 9.13

Soln

Given: Coupon:

Maturity period (n) = 9 Years

Coupon rate (c) = 8 %

Selling price ($V_0$) = Rs. 901.40

Interest (I) = M×C = 1000 × 0.08 = Rs. 80

a. Current Yield = $\frac{I}{V_0} \times 100 = \frac{80}{901.40} \times 100$ = 8.88 %

b. Yield To Maturity (YTM) = ?

Do Yourself (Step 1 - Step 4) Ans = 9.67 %

c. Capital Gain Yield = YTM - Current Yield
= 9.67 - 8.88
= 0.79 %

Problem 9.14

Soln

Given: Coupon:

Maturity period (n) = 5 Years

Face value (M) = Rs. 1000

Annual coupon rate (c) = 8%

Current yield (CY) = 8.21 %

Yield To Maturity (YTM) = ?

Interest (I) = M X C = 1000 X 0.08 = Rs. 80

Current yield = $\frac{I}{V_0} \times 100$

$\frac{8.21}{100} = \frac{80}{V_0}$

$\therefore V_0$ = Rs. 974.42

YTM : Do yourself (Step 1 - Step 4)

The coupon rate and the value of bond have direct relation i.e increase in coupon rate increases the value of bond and vice-versa.

YTM and value of bond have inverse relation i.e increase in ~~value~~ YTM decreases the value of bond and vice-versa.

Problem 9.15

$Sol^n$

Given: Coupon Bond:

Face value (M) = Rs. 1000

Maturity period (n) = 10 Years

Coupon rate (c) = 11 %

Interest (I) = M × C = 1000 × 0.11 = Rs. 110

Current price ($V_0$) = Rs. 1175

Call period ($n_c$) = 5 years

Call price (CP) = 109 % of 1000 = Rs. 1090

a. Calculation of Yield To Maturity (YTM) = ?

Step-1: $\text{Approximate YTM} = \dfrac{I + \dfrac{M - V_0}{n}}{\dfrac{M + 2V_0}{3}} \times 100$

$= \dfrac{110 + \dfrac{1000 - 1175}{10}}{\dfrac{1000 + 2 \times 1175}{3}} \times 100$

$= 8.28\%$

Step-2: Try at low rate i.e 8%

$TPV_{LR} = I \times PVIFA_{YTM\%, n} + M \times PVIF_{YTM\%, n}$

$= 110 \times PVIFA_{8\%, 10} + 1000 \times PVIF_{8\%, 10}$

$= 110 \times 6.7101 + 1000 \times 0.4632$

$= Rs.\ 1201.31$

Step-3: Try at High rate i.e 9%

$TPV_{HR} = I \times PVIFA_{YTM\%,n} + M \times PVIF_{YTM\%,n}$

$= 110 \times PVIFA_{9\%,10} + 1000 \times PVIF_{9\%,10}$

$= 110 \times 6.4177 + 1000 \times 0.4224$

$=$ Rs. 1128.34

Step-4: By Interpolation:

$$\text{Annual YTM} = LR + \frac{TPV_{LR} - V_0}{TPV_{LR} - TPV_{HR}} \times (HR - LR)$$

$$= 8\% + \frac{1201.31 - 1175}{1201.31 - 1128.34} \times (9\% - 8\%)$$

$$= 8.36\%$$

b. Calculation of Yield To call (YTC): (Same as YTM → changes

YTM → YTC

n → $n_c$

M → CP

Step-1: Approximate YTC $= \dfrac{I + \dfrac{CP - V_0}{n_c}}{\dfrac{CP + 2V_0}{3}} \times 100$

$$= \frac{110 + \dfrac{1090 - 1175}{5}}{\dfrac{1090 + 2 \times 1175}{3}} \times 100$$

$$= 8.11\%$$

Step-2: Try at low rate i.e 8%.

$TPV_{LR} = I \times PVIFA_{YTC\%, n_c} + CP \times PVIF_{YTC\%, n_c}$

$= 110 \times PVIFA_{8\%, 5} + 1090 \times PVIF_{8\%, 5}$

$= 110 \times 3.9927 + 1090 \times 0.6806$

$=$ Rs. 1181.05

Step-3: Try at High rate i.e 9%

$TPV_{HR} = I \times PVIFA_{YTC\%, n_c} + CP \times PVIF_{YTC\%, n_c}$

Step-4: By Interpolation:

$$\text{Annual YTC} = LR\% + \frac{TPV_{LR} - V_0}{TPV_{LR} - TPV_{HR}} \times (HR - LR)$$

$=$

$= 8.13\%$

C. Investor of this bond might expect to earn 8.13% i.e yield to call. Because yeald to call is less than yield to maturity and company always try to reduce cost of debt. Hence, bond yield is expected to be called in 5 years and investor will earn only 8.13% i.e YTC.

Problem 9.16

Sol$^n$

Given:

| | Bond A | Bond B |
|---|---|---|
| Maturity period (n) | 20 Yrs | 20 Yrs |
| Coupon rate (c) | 9 % (semi) | 8% (annual) |
| Yield (Kd) | 10.5 % | 7.5 % |
| Interest (I) | Rs. 90 | Rs. 80 |

Bond A:

$$V_0 = \frac{I}{2} \times \left[ \frac{1 - \frac{1}{(1+Kd/2)^{n\times2}}}{Kd/2} \right] + \frac{M}{\left(1+\frac{Kd}{2}\right)^{n\times 2}}$$

$$= \frac{90}{2} \left[ \frac{1 - \frac{1}{\left(1+\frac{0.105}{2}\right)^{20\times2}}}{0.105/2} \right] + \frac{1000}{\left(1+\frac{0.105}{2}\right)^{20\times2}}$$

$$= 45 \times 746.43 + \cancel{1000}\ 129.156$$

$$= Rs.\ 876$$

Current Yield $= \frac{I}{V_0} \times 100 = \frac{90}{876} \times 100 = 10.27\%$

Bond B:

$$V_0 = I\left[\frac{1 - \frac{1}{(1+K_d)^n}}{K_d}\right] + \frac{M}{(1+K_d)^n}$$

$$= 80\left[\frac{1 - \frac{1}{(1+0.075)^{20}}}{0.075}\right] + \frac{1000}{(1+0.075)^{20}}$$

$$= 815.56 + 235.41$$

$$= Rs.\ 1050.97$$

Current Yield $= \frac{I}{V_0} \times 100 = \frac{80}{1050.97} \times 100 = 7.61\%$

b. Bond A has higher YTM.

Problem 9.17

Soln

Given: Zero Coupon Bond

Maturity period (n) = 25 yrs

Selling price ($V_0$) = 11.625% of 1000 = Rs. 116.25

Maturity value (M) = Rs. 1000

Current Yield $= \frac{I}{V_0} \times 100 = \frac{0}{116.25} \times 100 = 0$

Promised Yield (YTM) $= \left[\frac{M}{V_0}\right]^{1/n} - 1$

$= \left[\frac{1000}{116.25}\right]^{1/25} - 1$

$= 8.99\%$

If Yield (Kd) = 12% (semi-annual)

Value of bond ($V_0$) = $M \times PVIF_{\frac{Kd}{2}\%, n\times2}$

$= 1000 \times PVIF_{\frac{12}{2}\%, 25\times2}$

$= 1000 \times PVIF_{6\%, 50}$

$= 1000 \times 0.0543$

$=$ Rs. 54.3

Problem 9.18

solⁿ

Given:

Current price ($V_0$) = Rs. 800

coupon rate (c) = 8%

Interest (I) = M×C = 1000×0.08 = Rs. 80

Holding period (n) = 3 Yrs

Selling price in 3 Yrs ($V_3$) = Rs. 950

Realized yield (YTM) = ?

Do Yourself: (step 1 - step 4) Changes → $M \to V_3$

$$\text{Holding period Return (HPR)} = \frac{SP - PP + I}{PP} \times 100$$

$$= \frac{950 - 800 + 80 \times 9/12}{800} \times 100$$

$$= \frac{150 + 60}{800} \times 100$$

$$= 26.25\%$$

Problem 9.19

Soln

Given: Coupon Bond

Maturity period (n) = 10.5 Yrs

YTM = 10 %

Current price ($V_0$) = Rs. 860

Coupon rate (C) = ?

$$V_0 = I\left[\frac{1 - \frac{1}{(1+YTM)^n}}{YTM}\right] + \frac{M}{(1+YTM)^n}$$

$$860 = I\left[\frac{1 - \frac{1}{(1+0.10)^{10.5}}}{0.10}\right] + \frac{1000}{(1+0.10)^{10.5}}$$

$$860 = I \times 6.3239 + 367.60$$

$$860 - 367.60 = I \times 6.3239$$

$$\therefore I = 77.86$$

Now,

$I = M \times C$

$77.86 = 1000 \times C$

$\therefore C = \frac{77.86}{1000} = 7.78\%$

Problem 9.20

Soln

Bond A: (Coupon Bond)

Coupon rate (c) = 10% , I = Rs. 100

Maturity period (n) = 7 years

Market interest rate (Kd) = 8%

Value of Bond ($V_0$) = ?

$V_0 = I \times PVIFA_{kd\%,n} + M \times PVIF_{kd\%,n}$

$= 100 \times PVIFA_{8\%,7} + 1000 \times PVIF_{8\%,7}$

$= 100 \times 5.2064 + 1000 \times 0.5835$

= Rs. 1104.14

Bond B:

Current price ($V_0$) = Rs. 887

Maturity (n) = 10 years

Market interest rate (Kd) = 12%

Coupon rate (c) = ?

Do Yourself (see Q.N. 19)

Bond I Coupon Bond:

Price ($V_0$) = Rs. 920

Coupon Rate (c) = 12%

Interest Amt (I) = 1000 X 0.12 = Rs. 120

Maturity (n) = 10 Yrs

Market Interest Rate (YTM) = ?

Do Yourself (step 1 – step 4)

Bond D Coupon:

Price ($V_0$) = Rs. 1060

Coupon Rate (C) = 8%

Interest Amount (I) = 1000X0.08 = Rs. 80

Market Interest Rate (Kd) = 7.2% (YTM)

Maturity (n) = ?

$$\text{Approximate YTM} = \frac{I + \frac{M - V_0}{n}}{\frac{M + 2V_0}{3}}$$

$$0.072 = \frac{80 + \frac{1000 - 1060}{n}}{\frac{1000 + 2 \times 1060}{3}}$$

$n$ = 11 Yrs

Bond E Zero Coupon Bond

Price ($V_0$) = Rs. 500

Maturity (n) = 5 Yrs

Market Interest Rate (YTM) = ?

$$YTM = \left[\frac{M}{V_0}\right]^{1/n} - 1$$

$$= \left[\frac{1000}{500}\right]^{1/5} - 1$$

$$= 14.86\ \%$$

Problem 9.21

Soln

Given:

Selling price ($V_0$) = Rs. 1000

Maturity period (n) = 3 years

Coupon rate (c) = 7%

Yield To Maturity (Y) = 7% [$\because V_0 = 1000$]

a. Bond's Duration (D) = $\frac{1+Y}{Y} - \frac{(1+Y)+n(c-Y)}{c[(1+Y)^n-1]+Y}$

$$= \frac{1+0.07}{0.07} - \frac{(1+0.07)+3(0.07-0.07)}{0.07[(1+0.07)^3-1]+0.07}$$

$$= 2.81 \text{ years}$$

b. Modified Duration (MD) = $\frac{D}{1+Y} = \frac{2.81}{1+0.07} = 2.63$ Years

Problem 9.22

Soln

Given:

Face value (M) = Rs. 1000

Annual coupon rate (c) = 12%

Term (n) = 5 years

Yield to Maturity (Y) = 15%

$$\text{Bond Duration } (D) = \frac{1+Y}{Y} - \frac{(1+Y) + n(c-Y)}{c[(1+Y)^n - 1] + Y}$$

$$= \frac{1+0.15}{0.15} - \frac{(1+0.15) + 5(0.12-0.15)}{0.12[(1+0.15)^5 - 1] + 0.15}$$

$$= 7.67 - 3.68$$

$$= 3.99 \text{ years}$$

Problem 9.25

Soln

Given:

Yield To Maturity (Y) = 10%

Face Value (M) = Rs. 1000

Coupon rate (c) = 8%. (semi-annually)

Maturity (n) = 3 Yrs

$$D = \frac{1+Y/2}{Y/2} - \frac{(1+Y/2) + 2n(c/2 - Y/2)}{c/2[(1+Y/2)^{2n} - 1] + Y/2}$$

$$= \frac{1+0.10/2}{0.10/2} - \frac{(1+0.10/2) + 2\times3(0.08/2 - 0.10/2)}{0.08/2[(1+0.10/2)^{2\times3} - 1] + 0.10/2}$$

$$= \frac{1+0.05}{0.05} - \frac{(1+0.05) + 2\times3\,(0.04-0.05)}{0.04\left[(1+0.05)^6-1\right]+0.05}$$

$$= 21 - 15.56$$

$$= 5.434 \text{ periods}$$

Annual Duration $= \frac{D}{2} = \frac{5.434}{2} = 2.72$ Years

Problem 9.23

Sol^n

Given: 100 basis points = 1%

Change in interest rate ($\Delta i$) = 50 basis point = -0.5%

a. Duration (D) = 8.46 Years

Yield (Y) = 7.5%

Change in price ($\Delta p$) $= -1 \times MD \times \Delta i$

$= -1 \times 7.87 \times (-0.5\%)$

$= 3.935\%$

where,

$$MD = \frac{D}{1+Y} = \frac{8.46}{1+0.075} = 7.87 \text{ Yrs}$$

b. Duration (D) = 9.30 Yrs

Yield (Y) = 10%

Change in price ($\Delta p$) = $-1 \times MD \times \Delta i$

$= -1 \times 8.45 \times (-0.5\%)$

$= 4.225\ \%$

where,

$$MD = \frac{D}{1+Y} = \frac{9.30}{1+0.10} = 8.45 \text{ Yrs.}$$

c. Duration (D) = 8.75 Yrs

Yield (Y) = 5.75 %

Change in price ($\Delta p$) = $-1 \times MD \times \Delta i$

$= -1 \times 8.27 \times (-0.5\%)$

$= 4.135\%$

where,

$$MD = \frac{D}{1+Y} = \frac{8.75 \text{ Yrs}}{1+0.0575} = 8.27 \text{ Yrs}$$

A bond with a Macaulay duration of 9.30 years that is priced to yield 10% should be selected because this bond have higher percentage change in price.

Problem 9.26

Soln

Portfolio Duration ($D_p$) = $W_A \times D_A + W_B \times D_B + W_I \times D_I + W_D \times D_D$

$= 0.20 \times 4.5 + 0.25 \times 3.0 + 0.25 \times 3.5 + 0.30 \times 2.8$

$= 3.365$ Years.

# Fixed Income Securities

# Chapter- 8
# Fixed Income Securities

**Concept:**

Those securities whose income is fixed at the time of issue are called fixed income securities. Fixed income securities can be classified into following two types according to their life or maturity.

1. Short term fixed income securities (Money market Instruments)
2. Long term fixed income securities (Capital market Instruments)

**Examples of short term fixed income securities:**

1. Treasury Bill (T-Bill)
2. Commercial paper
3. Certificate of Deposit (CD)
4. Banker's Acceptance (BA)
5. Repurchase Agreement (Repo)

*** Treasury Bill:**

→ Issued at discount and Redeemed at par.

→ Discount Yield (D) / Bank Discount Yield (BDY) / Bank Discount Rate

$$D = \frac{\text{Face Value} - \text{purchase price}}{\text{Face value}} \times \frac{360}{t}$$

Where,

Discount Rs. = FV − PP

t = Term to maturity

→ Bond Equivalent Yield (BEY) / Coupon Equivalent Yield / Annual Equivalent Yield

$$BEY = \frac{\text{Face value} - \text{purchase price}}{\text{purchace price}} \times \frac{365}{t}$$

→ Maturity of T-Bill:

13 weeks → 90 days

26 weeks → 180 days

52 weeks → 360 days

→ T-Bill Quotation:

Dealers

| Bid | Ask |
|---|---|
| Purchasing price of Dealear or (selling price of Investor) | Selling price of Dealear or (Purchase price of Investor) |

- Maturity (11|14|91) ⇒ It indicates that the given T-Bill will be matured on 14th November 1991.

- Days to maturity (170 days) ⇒ It indicates that remaining life of T-Bill from the day of quotation is 170 days.

- Bid (5.57) ⇒ It is the annualized discount percentage at which the dealer is willing to purchase the given T-bill on the day of quotation.

Calculation of Rs. price of Bid

suppose FV = Rs. 1000

We have,

$$D = \frac{FV - P}{FV} \times \frac{360}{t}$$

$$0.0557 = \frac{1000 - P}{1000} \times \frac{360}{170}$$

$\therefore P =$ Rs. 973.69 (Purchasing price of dealer or selling price of investor)

- Ask (5.55) ⇒ It is the annualized discount percentage at which the dealer is willing to sell the given T-bill on the day of quotation.

Calculation of Ask price.

Suppose $FV = Rs.\ 1000$

$$D = \frac{FV - P}{FV} \times \frac{360}{t}$$

$$0.0555 = \frac{1000 - P}{1000} \times \frac{360}{170}$$

$\therefore P = Rs.\ 973.79$ (selling price of dealer or purchase price of investor)

$\therefore$ Dealer's spread = Rs. price of Ask − Rs. price of Bid

$= 973.79 - 973.69$

$= Rs.\ 0.10$

- Change (−0.03) ⇒ It indicates the difference between the given bid and previous day's bid.

$\therefore$ previous day's Bid = Given bid − change

$= 5.57 - (-0.03)$

$= 5.57 + 0.03 = 5.60$

- Ask Yield (5.79) ⇒ It is the annualized rate of return to be earned from the given T-bill of one would purchase the given T-bill on given ask price and hold it until maturity. It is also called Bond Equivalent Yield (BEY).

Calculation of Ask Yield:

$\therefore$ Ask Yield = $\frac{FV-P}{P} \times \frac{365}{t}$

$= \frac{1000-973.79}{973.79} \times \frac{365}{170}$

$= 5.79\%$

Problem 8.1

Soln

Given:

Face value = Rs. 100,000

Price = Rs. 96,000

Days to maturity = 180 days

a. 180-days Discount rate = $\frac{\text{Face value} - \text{Price}}{\text{Face value}}$

$= \frac{100,000 - 96,000}{100,000} = 4\%$

b. Annual Discount rate = $\frac{\text{Face value} - \text{Price}}{\text{Face value}} \times \frac{360}{t}$

$= \frac{100,000 - 96,000}{100,000} \times \frac{360}{180}$

$= 8\%$

c. 180-days Yield or HPR = $\frac{\text{Face value} - \text{Price}}{\text{Price}}$

$= \frac{100{,}000 - 96{,}000}{96{,}000} = 4.17\%$

d. Annual Equivalent Yield = $\frac{\text{Face value} - \text{Price}}{\text{Price}} \times \frac{365}{t}$

$= \frac{100{,}000 - 96{,}000}{96{,}000} \times \frac{365}{180}$

$= 8.45\%$

Problem 8.2

Soln

Given:

Face Value = Rs. 25,000

Maturity period(t) = 91 days

Bank Discount Yield (D) = 6%

a. Price of T-bill = ?

$D = \frac{\text{Face value} - \text{price}}{\text{Face value}} \times \frac{360}{t}$

$0.06 = \frac{25{,}000 - \text{Price}}{25{,}000} \times \frac{360}{91}$

$\therefore$ Price = Rs. 24620.83

b. 91-days HPR = $\frac{\text{Face value} - \text{price}}{\text{Price}}$

$$= \frac{25000 - 24620.83}{24620.83}$$

$$= 1.54\ \%$$

c. Bond equivalent Yield = $\frac{\text{Face value} - \text{Price}}{\text{Price}} \times \frac{365}{t}$

$$= \frac{25000 - 24620.83}{24620.83} \times \frac{365}{91}$$

$$= 6.17\ \%$$

d. Effective annual yield = $[1 + HPR]^{\frac{365}{t}} - 1$

$$= [1 + 0.0154]^{\frac{365}{91}} - 1$$

$$= 6.32\ \%$$

Problem 8.3

Soln

a. Bid is an annualized discount percentage at which the dealer is willing to purchase the given T-bill on the day of quotation whereas ask is the annualized discount percentage at which the dealer is willing to sell the given T-bill on the day of quotation.

b. The change of - 0.03 means the current days price has been declined by 0.03% in comparision of previou's day's pri

c. 5.78 % is the annualized yield.

Problem 8.4

Soln

a. Coupon Interest Rate = 9 3/8 = 9.375 %

Annual Interest = 1000 X 0.09375 = Rs. 93.75

semi-annual Interest = $\frac{I}{2} = \frac{93.75}{2}$ = Rs. 46.875

b. The term-to-maturity of the bond from February 2006 is 10 years. (2016 - 2006)

c. Ask = 106:30 → Points

no.

32 points = 1 no.

Rs. price of Ask = $\left(106 + \frac{30}{32}\right)$ % of face Value

= 106.9375 % of 1000

= Rs. 1069.375

d. Dealer's spread = Rs. price of Ask − Rs. price of Bid

= 1069.375 − 1068.125

= Rs. 1.25

Working Note:

Rs. price of Bid = $\left(106 + \frac{26}{32}\right)$ % of Face value

= 106.8125 % of 1000

= Rs. 1068.125

2076 Q.No. 13

Sol^n

NIBL 9 S 20 → 2020

S → semi-annualy

9 → Coupon rate

NIBL → Abbriviate form of Name

a. The coupon rate is 9%. The coupon rate is paid twice in a year i.e semi-annualy.

b. The bond matures in 2020. 1200 bonds were traded on that day.

c. Close = $101\frac{6}{8}$

Rs. price of close = $101\frac{6}{8}$ % of Face value

= 101.75 % of 1000

= Rs. 1017.5

The current yield is calculated as follows:

$$\text{Current Yield} = \frac{\text{Interest}}{\text{close price}} \times 100$$

$$= \frac{1000 \times 0.09}{1017.5} \times 100$$

$$= 8.85\ \%$$

d. The net change $-1/8$ means that the closing price on the day of quotation has been declined by $1/8$ (0.125 %) percentage of Rs. 1000 as compared to previous day's closing price.

e. Previous Day's close price = close price − net change

$$= 1017.5 - (-0.125\% \text{ of } 1000)$$

$$= 1017.5 + 1.25$$

$$= \text{Rs. } 1018.75$$

2058 Func.

Sol$^n$

IBM 9s98 → 1998

IBM → Short form name

9 → Coupon rate

s → semi annually

a. Interest on April 1 = $1000 \times 0.09 \times 3/12$ = Rs. 22.5

b. Close = 101.5

Rs. price of close = 101.5 % of face value
= 101.5% of 1000
= Rs. 1015

c. The bond matures in 1998

Practice Yourself
2068 Q.N.7
2065 Q.N.79
2063 Q.NO.7

2068 Q.NO.7

soln

a. Annual Interest = $1000 \times 0.08125$ = Rs. 81.25

Total Interest for 10 bonds = $10 \times 81.25$ = Rs. 812.5

b. The bond matures in 2022.

c. The current yield 7.9 means that annual coupon amout of Rs. 81.25 is the divisible of close price Rs. 1030.

Current yield is calculated as follows:

$$\text{Current Yield} = \frac{\text{Interest}}{\text{close price}}$$

$$= \frac{81.25}{103\% \text{ of } 1000}$$

$$= \frac{81.25}{1030}$$

$$= 7.9\%$$

d. close = 103

∴ close price = 103% of 1000 = Rs. 1030

e. The net change of + 1/2 indicates that the today closing price has been increased by 1/2 (0.5%) than the previous day close price.

# Returns and Risk

## Chapter-4
# RETURN AND RISK

### * Investment Return

It is the additional income generated by the investment. It is generally expressed in the form of percentage and measured on after tax basis. Return expressed in the form of percentage is called Rate of Return (r) or Holding period Return (HPR).

### * Measurement of Investment Return

Generally following three types of investment returns are measured.

1. Realized Rate of Return
2. Expected Rate of Return
3. Required Rate of Return

### * Realized Rate of Return

It is that return which had already been achieved or earned. It is also called past return or historical return or ex-post return and calculated by using following formula:

$$HPR = \frac{\text{Selling price} - \text{purchase price} + \text{Dividend/interest}}{\text{Purchase price}} \times 100$$

$$= \frac{\text{Ending value} - \text{Beginning value} + \text{Dividend}}{\text{Beginning value}} \times 100$$

where,

Ending value - Beginning value = Capital Gain.

Alternatively,

$$HPR = \frac{\text{Capital Gain} + \text{Dividend}}{\text{Beginning value}} \times 100$$

$$= \frac{\text{Capital Gain}}{\text{Beginning value}} \times 100 + \frac{\text{Dividend}}{\text{Beginning value}} \times 100$$

$$= \text{Capital Gain Yield} + \text{Dividend Yield}$$

$$= CGY + DY$$

## * Total Return

Total Return is the total of current income and capital Gain or loss from an investment. It is calculated as follows:

Total Rupee Return = Current income + Capital Gain (or loss)

$$\text{Percentage Return / Rate of Return} = \frac{\text{Total Rupee Return}}{\text{Beginning value of Investment}}$$

**Problem 4.1**

Soln

Beginning value = Rs. 9500
Ending value = Rs. 10,000
Interest for six months = Rs. 300
Maturity period = 18 months

a. Income = 300 × 3 = Rs. 900

b. Capital Gain = Ending Value − Beginning value
= Rs. 10,000 − Rs. 9500
= Rs. 500

c. Total Return in Rupee = Income + Capital Gain
= 900 + 500
= Rs. 1400

$$\text{Percentage Return} = \frac{\text{Total Return in Rupee}}{\text{Beginning value}}$$

$$= \frac{1400}{9500}$$

$$= 14.74\%$$

Problem 4.2

$Sol^n$

a. Calculation of total Rupee Return and percentage Return

| Year | $P_1$ | $P_0$ | D | $CG = P_1 - P_0$ | Total Rupee Return = D + CG | Percentage Return = Total Rs. Return/$P_0$ |
|---|---|---|---|---|---|---|
| 2012 | 220 | 200 | 10 | 20 | 30 | 15 % |
| 2013 | 230 | 220 | 20 | 10 | 30 | 13.64 % |
| 2014 | 250 | 230 | 25 | 20 | 45 | 19.57 % |
| 2015 | 280 | 250 | 40 | 30 | 70 | 28 % |
| 2016 | 350 | 280 | 20 | 70 | 90 | 32.14 % |

b. Average Rate of Return over the period 2012 - 2016

$$= \frac{15\% + 13.64\% + 19.57\% + 28\% + 32.14\%}{5}$$

$$= 21.67\%$$

c. We would expect the same average rate of return of 21.67% in 2017 if all others things remain constant.

d.

Beginning value = 150 shares X 200 = Rs. 30,000
Ending value = 150 shares X 250 = Rs. 37,500
Dividend Income (2012-2014) = (10+20+25) X 150 shares = 8250

Total Return in Rupee = (Ending Value - Beginning value) + Dividend
= (37500 - 30,000) + 8250
= Rs. 15,750

Rate of Return = $\frac{\text{Total Rupee Return}}{\text{Beginning value}}$

$= \frac{15,750}{30,000}$

$= 52.5\%$

Problem 4.3

Sol$^n$

Given:

Real Rate of Return ($K^*$) = 3%

Inflation premium (IP) = 5%

Risk premium of A ($RP_A$) = 3%

Risk premium of B ($RP_B$) = 5%

a. Risk free Rate of Return ($R_f$) = $K^* + IP$

$= 3\% + 5\%$

$= 8\%$

b. Required Rate of Return (R) = $R_f + RP$

$R_A = R_f + RP_A = 8\% + 3\% = 11\%$

$R_B = R_f + RP_B = 8\% + 5\% = 13\%$

c. Investment B, is riskier due to higher risk premium.

Problem 4.4

Soln

a.

| | Bond A | Bond B |
|---|---|---|
| Interest Received: | | |
| First quarter | Rs.100 | Rs.75 |
| Second quarter | 100 | 125 |
| Third quarter | 100 | 125 |
| Fourth quarter | 100 | 275 |
| Total interest Received | 400 | 600 |
| Investment Value: | | |
| End of the year | Rs.5100 | Rs.4400 |
| Beginning of the year | 5000 | 4500 |
| Capital Gain or loss | 100 | (100) |
| Total Rupee Return | 500 | 500 |

Holding period Return

$$HPR = \frac{\text{Total Rupee Return}}{\text{Beginning value}} \qquad \frac{500}{5000} = 10\% \qquad \frac{500}{4500} = 11.11\%$$

. Capital Gain or loss is not likely to be realized if we continue to hold each of the bonds beyond one year because capital Gain or loss is only realized if we sell the investment.

c. Assuming both the bonds are of equal risk, we would prefer Bond B because it has higher Holding period Return than Bond A.

## Problem 4.5

Soln

Given:

Number of shares (N) = 100 shares

Beginning price ($P_0$) = Rs. 20

Dividend per share ($D_1$) = Rs. 2

Ending price ($P_1$) = Rs. 21

a. Total Rupee Return $= [(P_1 - P_0) + D_1] \times N$

$= [(21-20) + 2] \times 100$ shares

$=$ Rs. 300

b. $HPR = \dfrac{\text{Total Rupee Return}}{\text{Beginning value}} \times 100$

$= \dfrac{300}{100 \times 20} \times 100$

$= 15\%$

OR,

$$HPR = \frac{P_1 - P_0 + D_1}{P_0} \times 100$$

$$= \frac{21 - 20 + 2}{20} \times 100 = 15\%$$

c. Dividend Yield $= \frac{D_1}{P_0} \times 100$

$= \frac{2}{20} \times 100$

$= 10\%$

Capital Gain Yield $= \frac{P_1 - P_0}{P_0} \times 100$

$= \frac{21-20}{20} \times 100$

$= 5\%$

Problem 4.6

Soln

| | ABC | XYZ |
|---|---|---|
| Beginning value | Rs. 120,000 | Rs. 155,000 |
| Cash Flow (Income) | Rs. 15,000 | Rs. 16,800 |
| Ending value | Rs. 130,000 | Rs. 185,000 |

a. Calculation of Holding Period Return (HPR)

$$HPR = \frac{(\text{Ending value} - \text{Beginning value}) + \text{cash flow}}{\text{Beginning value}} \times 100$$

$$HPR_{ABC} = \frac{(130,000 - 120,000) + 15,000}{120,000} \times 100 = 20.83\%$$

$$HPR_{XYZ} = \frac{(185{,}000 - 155{,}000) + 16{,}800}{155{,}000} \times 100 = 30.19\%$$

b. If the two investments are equally risky, Mr. Thapa should recommend Investment XYZ because of higher return.

## Problem 4.7

Sol<sup></sup>

| | Stock 1st | Stock 2nd |
|---|---|---|
| **Dividend Received** | | |
| First quarter | Rs.5 | Rs.6 |
| Second quarter | Rs.5 | Rs.6 |
| Third quarter | – | Rs.6 |
| Fourth quarter | – | Rs.6 |
| Total Dividend (A) | Rs.10 | Rs. 24 |
| **Investment Value** | | |
| Beginning price | Rs. 250 | Rs. 270 |
| Ending price | Rs. 270 | Rs. 300 |
| Capital Gain (B) | Rs. 20 | Rs. 30 |
| Total Rupee Return (A+B) | Rs. 30 | Rs. 54 |
| Percentage Return (HPR) $= \frac{\text{Total Rupee Return}}{\text{Beginning price}}$ | $\frac{30}{250} = 12\%$ | $\frac{54}{270} = 20\%$ |
| Annualized HPR | $12 \times 2 = 24\%$ | – |

First stock P will provide better annualized holding period return.

Problem 4.8

Soln

| | Nepal Bank LTD. | Nabil Bank LTD. | Total |
|---|---|---|---|
| Beginning value | 1000 X 200 = Rs.200,000 | 500 X 700 = Rs.350,000 | Rs.550,000 |
| Dividend in 2014 | – | 500 X 20 = Rs.10,000 | Rs.10,000 |
| Dividend in 2015 | – | 500 X 30 = Rs. 15,000 | Rs.15,000 |
| Ending value | 1000 X 190 = Rs.190,000 | 500 X 800 = Rs.400,000 | Rs. 590,000 |

1. Calculation of Two-Year Holding period Return on total Investment assuming that the dividend received in 2014 was not reinvested.

$$\text{Two-Year HPR} = \frac{\text{Ending value} - \text{Beginning value} + Div_{2014} + Div_{2015}}{\text{Beginning value}} \times 100$$

$$= \frac{590,000 - 550,000 + 10,000 + 15,000}{550,000} \times 100$$

$$= 11.8\%$$

b. Calculation of Two-year holding period return, assuming that the dividend received in 2014 was reinvested at 10%.

$$\text{Two-Year HPR} = \frac{\text{Ending value} - \text{Beginning value} + Div_{2014}(1+i) + Div_{2015}}{\text{Beginning value}} \times 100$$

$$= \frac{590000 - 550{,}000 + 10{,}000(1+0.10)^{1} + 15{,}000}{550{,}000} \times 100$$

$$= 12\%$$

## * Internal Rate of Return (IRR)

The annualized rate of return from an investment with more than one year of holding period, is Internal Rate of Return. IRR or Yield is a return that recogzines the concept of Time value of money.

The internal rate of return is compared against the required rate of return to conclude on the performance of investment. If IRR is greater than or equal to the required return, the investment performance is said to be satisfactory. If IRR is lower than the required rate of return we do not accept such investment as it reduce investment wealth.

- IRR for Single cash Flow

$$FV = PV(1+IRR)^{n}$$

Where,

PV = Present Value or Beginning Investment

FV = Future value or Ending value

n = Time period

Problem 4.9

Soln

Given:

a. Present value (PV) = Rs. 20,000

Future value (FV) = Rs. 40,000

Maturity period (n) = 5 years

Internal Rate of Return (IRR) = ?

We know that,

$$FV = PV(1+IRR)^n$$

$$40{,}000 = 20{,}000(1+IRR)^5$$

$$IRR = \left[\frac{40{,}000}{20{,}000}\right]^{1/5} - 1$$

$$= 14.87\%$$

b. Since, the Internal Rate of return 14.87% is higher than the required rate of return of 12%, so we would accept this offer.

Problem 4.10

Soln

Given:

a. Present value (PV) = Rs. 2500

Future value (FV) = Rs. 6000

Maturity period (n) = 8 years

Internal Rate of Return (IRR) = ?

We know that,

$$FV = PV(1+IRR)^n$$

$$6000 = 2500(1+IRR)^8$$

$$\frac{6000}{2500} = (1+IRR)^8$$

$$\left[\frac{6000}{2500}\right]^{1/8} = 1+IRR$$

$$\therefore IRR = \left[\frac{6000}{2500}\right]^{1/8} - 1$$

$$= 11.56\%$$

b. Since, the Internal Rate of Return 11.56% is higher than the required rate of return of 10%, we should make the proposed investment.

Problem 4.11

Sol^n

Given:

Beginning value ($CF_0$) = Rs. 7000

Dividend in year 1 = Rs. 65

Dividend in year 2 = Rs. 70

Dividend in year 3 = Rs. 70

Dividend in year 4 = Rs. 65

Ending value = Rs. 7900

Step-1:

Total Return = Capital Gain + Dividend

$= (7900-7000) + (65+70+70+65)$

$= 900 + 270$

= Rs. 1170

Step-2:

Average Annual Return in Rupee $= \frac{\text{Total Return}}{\text{No. of Years}} = \frac{1170}{4}$

= Rs. 292.5

Step-3:

Average percentage Return (Approximate Return) $= \frac{292.5}{7000} = 4.17\%$

Step-4:

Calculation of Net present Value (NPV)

| Year | Cash flow | PVIF@4% | PV | PVIF@3% | PV |
|---|---|---|---|---|---|
| 1 | 65 | 0.9615 | 62.50 | 0.9709 | 63.11 |
| 2 | 70 | 0.9246 | 64.71 | 0.9426 | 65.98 |
| 3 | 70 | 0.8890 | 62.23 | 0.9151 | 64.06 |
| 4 | 65+7900=7965 | 0.8548 | 6808.52 | 0.8885 | 7076.80 |
| | | | TPV = 6997.96 | | TPV = 7269.95 |
| | | | – CFo = 7000 | | – CFo = 7000 |
| | | | NPV = (2.04) | | NPV = 269.95 |

Step-5:

By Interpolation:

Low Rate (LR) = 3%

High Rate (HR) = 4%

$NPV_{LR} = 269.95$

$NPV_{HR} = (2.04)$

$$IRR = LR + \frac{NPV_{LR}}{NPV_{LR} - NPV_{HR}} \times (HR - LR)$$

$$= 3\% + \frac{269.95}{269.95 + 2.04} \times (4\% - 3\%)$$

$$= 3.99\%$$

Since, the Internal Rate of Return 3.99% is lower than the required rate of return of 5%, the Investment is not better.

Problem 4.12

Soln

Given:

Initial Investment ($CF_0$) = Rs. 25,000

Cash flow in Year 1 ($CF_1$) = 0

Cash flow in Year 2 ($CF_2$) = 0

Cash flow in Year 3 ($CF_3$) = Rs. 5000

Cash flow in Year 4 ($CF_4$) = Rs. 35,000

Step-1:

Total Rupee Return = (35000 − 25,000) + 5000

= Rs. 15,000

Step-2:

Average rupee Return = $\frac{15000}{4}$ = Rs. 3750

Step-3:

Approximate average percentage Return = $\frac{3750}{25,000}$

= 15 %

Step-4:

Calculation of NPV

| Year | cashflows | PVIF@15% | PV | PVIF@12% | PV |
|---|---|---|---|---|---|
| 1 | 0 | 0.8696 | 0 | 0.8929 | 0 |
| 2 | 0 | 0.7561 | 0 | 0.7972 | 0 |

| | | | | | |
|---|---|---|---|---|---|
| 3 | 5000 | 0.6575 | 3287.5 | 0.7118 | 3558.9 |
| 4 | 35000 | 0.5718 | 20013 | 0.6355 | 22243.13 |
| | | TPV | 23300.5 | TPV | 25802.03 |
| | | − CFo | 25000 | − CFo | 25000 |
| | | NPV | (1699.5) | NPV | 802.03 |

Step-5:

By Interpolation:

Low Rate (LR) = 12%

High Rate (HR) = 15%

$NPV_{LR} = 802.03$

$NPV_{HR} = (1699.5)$

$$IRR = LR + \frac{NPV_{LR}}{NPV_{LR} - NPV_{HR}} \times (HR - LR)$$

$$= 12\% + \frac{802.03}{802.03 + 1699.5} \times (15 - 12)$$

$$= 12.96\%$$

Since, the Internal Rate of Return is higher than the required rate of return, we would invest in the project.

Problem 4.13

Sol$^n$

Stock 'X'

$$DiV_{2015} = DiV_{2009}(1+g)^6$$

$$5.25 = 4.21(1+g)^6$$

$$\left(\frac{5.25}{4.21}\right)^{1/6} = 1+g$$

$$\therefore g = \left(\frac{5.25}{4.21}\right)^{1/6} - 1$$

$$= 3.75\%$$

Stock 'Y'

$$DiV_{2015} = DiV_{2011}(1+g)^4$$

$$3.20 = 2.69(1+g)^4$$

$$\left(\frac{3.20}{2.69}\right)^{1/4} = 1+g$$

$$g = \left(\frac{3.20}{2.69}\right)^{1/4} - 1$$

$$= 4.43\%$$

Stock Y has higher annual compound rate of growth in dividend.

## * Expected Rate of Return:

This is the return which is expected to be earned from the given investment in the future. It is largely affected by the change in economic conditions.

Data

Historical Data | Data with probability

| Year | Return | Probability | Return |
|---|---|---|---|
| 1 | 10% | 0.3 | 10% |
| 2 | 5 | 0.4 | 5 |
| 3 | 15 | 0.1 | 15 |
| 4 | -5 | 0.2 | -5 |

Requirements:

1. Expected Rate of Return E(R) / Average Return ($\bar{R}$)
2. Standard Deviation ($\sigma$)
3. Variance ($\sigma^2$)
4. Coefficient of Variation (CV)
5. Covariance between stock A and stock B ($COV_{AB}$)
6. Correlation between stock A and stock B ($\rho_{AB}$)
7. Portfolio
   i. Portfolio Return
   ii. Portfolio Risk

## Problem 4.14

Soln

Calculation of average return and standard Deviation:

| Year | $R_H$ | $R_B$ | $R_H - \bar{R}_H$ | $R_B - \bar{R}_B$ | $[R_H - \bar{R}_H]^2$ | $[R_B - \bar{R}_B]^2$ |
|---|---|---|---|---|---|---|
| 1 | 10% | 14% | -1 | +2.67 | 1 | 7.13 |
| 2 | 15 | -10 | 4 | -21.33 | 16 | 454.96 |
| 3 | 8 | 30 | -3 | 18.67 | 9 | 348.57 |
| | $\Sigma R_H = 33$ | $\Sigma R_B = 34$ | | | $\Sigma[R_H - \bar{R}_H]^2 = 26$ | $\Sigma[R_B - \bar{R}_B]^2 = 810.64$ |

a. Average Return of HBL stock $(\bar{R}_H) = \frac{\Sigma R_H}{n} = \frac{33}{3} = 11\%$

Average Return of BOK stock $(\bar{R}_B) = \frac{\Sigma R_B}{n} = \frac{34}{3} = 11.33\%$

b. Standard Deviation of HBL stock $(\sigma_H) = \sqrt{\frac{\Sigma[R_H - \bar{R}_H]^2}{n-1}}$

$$= \sqrt{\frac{26}{3-1}} = \sqrt{13} = 3.60\%$$

Variance of HBL stock $= (\sigma_H)^2 = (3.60)^2 = 13$

Standard Deviation of BOK stock $(\sigma_B) = \sqrt{\frac{\Sigma[R_B - \bar{R}_B]^2}{n-1}}$

$$= \sqrt{\frac{810.64}{3-1}} = 20.13\%$$

Variance of BOK stock $= (\sigma_B)^2 = (20.13)^2 = 405.34$

Stock BOK has higher variance and standard deviation

c. Calculation of Coefficient of variation (cv)

$$CV_H = \frac{\sigma_H}{\bar{R}_H} = \frac{3.60}{11} = 0.32$$

$$CV_B = \frac{\sigma_B}{\bar{R}_B} = \frac{20.13}{11.33} = 1.77$$

Stock BOK is more riskier due to higher cv.

## Problem 4.15

Soln

a. On the basis of a review of the return data, stock A appears to be more risky due to higher fluctuation in return.

b. Calculation of Average Return and standard Deviation:

| Year | $R_A$ | $R_B$ | $R_A-\bar{R}_A$ | $R_B-\bar{R}_B$ | $[R_A-\bar{R}_A]^2$ | $[R_B-\bar{R}_B]^2$ |
|---|---|---|---|---|---|---|
| 2011 | 19% | 8% | 7% | -4 | 49 | 16 |
| 2012 | 1 | 10 | -11 | -2 | 121 | 4 |
| 2013 | 10 | 12 | -2 | 0 | 4 | 0 |
| 2014 | 26 | 14 | 14 | 2 | 196 | 4 |
| 2015 | 4 | 16 | -8 | 4 | 64 | 16 |
| | $\Sigma R_A = 60$ | $\Sigma R_B = 60$ | | | $\Sigma[R_A-\bar{R}_A]^2 = 434$ | $\Sigma[R_B-\bar{R}_B]^2 = 40$ |

Average Return of investment A $[\bar{R}_A] = \frac{\Sigma R_A}{n} = \frac{60}{5} = 12\%$

Average Return of investment B $[\bar{R}_B] = \frac{\Sigma R_B}{n} = \frac{60}{5} = 12\%$

c. Calculation of Standard Deviation:

Standard Deviation of investment A

$$\sigma_A = \sqrt{\frac{\Sigma[R_A - \bar{R}_A]^2}{n-1}} = \sqrt{\frac{434}{5-1}} = 10.42\%$$

Standard Deviation of Investment B

$$\sigma_B = \sqrt{\frac{\Sigma[R_B - \bar{R}_B]^2}{n-1}} = \sqrt{\frac{40}{5-1}} = 3.16\%$$

d. On the basis of our calculation in part 'c', Investment A is more risky due to higher standard deviation. The result in part 'a' is same as in part 'c' because higher fluctuation in returs results higher risk.

Problem 4.16

Soln

a. Calculation of expected Return and standard deviation

| State of economy | Prob. ($P_j$) | R | $P_j \times R$ | R-E(R) | $P_j[R-E(R)]^2$ |
|---|---|---|---|---|---|
| Strong growth | 0.10 | 25% | 2.5 | 13.7 | 18.769 |
| Moderate growth | 0.40 | 15 | 6 | 3.7 | 5.476 |
| Weak growth | 0.40 | 10 | 4 | -1.3 | 0.676 |
| Recession | 0.10 | -12 | -1.2 | -23.3 | 54.289 |
| | | | $\Sigma P_j \times R$ = 11.3 | | $\Sigma P_j[R-E(R)]^2$ = 79.21 |

∴ Expected Rate of Return, $E(R) = \Sigma P_j \times R = 11.3\%$

b. Variance $= \Sigma P_j [R - E(R)]^2 = 79.21$

c. Standard Deviation $(\sigma) = \sqrt{\Sigma P_j [R-E(R)]^2} = \sqrt{79.21} = 8.9\%$

d. Coefficient of Variation (CV) $= \frac{\sigma}{E(R)} = \frac{8.9}{11.3} = 0.7876$

e. The coefficient of variation is a relative measure of risk. It relates investment risk to the return. It measures risk per unit of return.

Problem 4.17

Sol$^n$

Calculation of expected Return and standard deviation:

| Prob.($P_j$) | $R_X$ | $R_Y$ | $P_j \times R_X$ | $P_j \times R_Y$ | $R_X - E(R_X)$ | $R_Y - E(R_Y)$ | $P_j[R_X - E(R_X)]^2$ |
|---|---|---|---|---|---|---|---|
| 0.2 | 5% | 50% | 1 | 10 | -7.5 | 30 | 11.25 |
| 0.3 | 10 | 30 | 3 | 9 | -2.5 | 10 | 1.875 |
| 0.3 | 15 | 10 | 4.5 | 3 | 2.5 | -10 | 1.875 |
| 0.2 | 20 | -10 | 4 | -2 | 7.5 | -30 | 11.25 |
| | | | $\Sigma P_j \times R_X$ = 12.5% | $\Sigma P_j \times R_Y$ = 20% | | | $\Sigma P_j[R_X - E(R_X)]^2$ = 26.25 |

a. Expected Return of stock X, $E(R_X) = \Sigma P_j \times R_X$
$= 12.5\%$

Expected Return of stock Y, $E(R_Y) = \Sigma P_j \times R_Y$
$= 20\%$

| $P_j[R_Y - E(R_Y)]^2$ |
|---|
| 180 |
| 30 |
| 30 |
| 180 |
| $\Sigma P_j[R_Y - E(R_Y)]^2 = 420$ |

b. Standard Deviation of stock X

$$\sigma_X = \sqrt{P_j[R_X - E(R_X)]^2} = \sqrt{26.25} = 5.12\%$$

Standard Deviation of stock Y

$$\sigma_Y = \sqrt{\Sigma P_j[R_Y - E(R_Y)]^2} = \sqrt{420} = 20.49$$

c. Calculation of coefficient of variation (cv)

$$CV_X = \frac{\sigma_X}{E(R_X)} = \frac{5.12}{12.5} = 0.4096$$

$$CV_Y = \frac{\sigma_Y}{E(R_Y)} = \frac{20.49}{20} = 1.0245$$

Stock Y is more riskier due to higher cv. so, we should prefer stock X with lower cv.

Problem 4.18

Soln

a. Calculation of Expected Return and standard deviation of stock X

| Prob. ($P_j$) | $R_X$ | $P_j \times R_X$ | $R_X - E(R_X)$ | $P_j[R_X - E(R_X)]^2$ |
|---|---|---|---|---|
| 0.1 | -10% | -1 | -22% | 48.4 |
| 0.2 | 2 | 0.4 | -10% | 20 |
| 0.4 | 12 | 4.8 | 0 | 0 |
| 0.2 | 20 | 4 | 8 | 12.8 |
| 0.1 | 38 | 3.8 | 26 | 67.6 |
| | | $\Sigma P_j \times R_X = 12$ | | $\Sigma P_j[R_X - E(R_X)]^2 = 148.8$ |

∴ The expected return of stock X, $E(R_X) = \Sigma P_j \times R_X = 12\%$

∴ Standard Deviation of stock X, $\sigma_X = \sqrt{\Sigma P_j[R_X - E(R_X)]^2}$

$= \sqrt{148.8} = 12.20\%$

b. Calculation of Expected Return and standard deviation of stock Y.

| Prob.($P_j$) | $R_Y$ | $P_j \times R_Y$ | $R_Y - E(R_Y)$ | $P_j(R_Y - E(R_Y))^2$ |
|---|---|---|---|---|
| 0.1 | -35% | -3.5 | -49% | 240.1 |
| 0.2 | 0 | 0 | -14 | 39.2 |
| 0.4 | 20 | 8 | 6 | 14.4 |
| 0.2 | 25 | 5 | 11 | 24.2 |
| 0.1 | 45 | 4.5 | 31 | 96.1 |
| | | $\Sigma P_j \times R_Y = 14\%$ | | $\Sigma P_j[R_Y - E(R_Y)]^2 = 414$ |

∴ The expected return of stock Y, $E(R_Y) = \Sigma P_j \times R_Y = 14\%$

∴ Standard deviation of stock Y, $\sigma_Y = \sqrt{\Sigma P_j [R_Y - E(R_Y)]^2}$

$= \sqrt{414} = 20.35\%$

c. Coefficient of variation, $CV_X = \frac{\sigma_X}{E(R_X)} = \frac{12.20}{12} = 1.02$

Coefficient of variation, $CV_Y = \frac{\sigma_Y}{E(R_Y)} = \frac{20.35}{14} = 1.45$

d. No, it is not possible that most of the investors might regard stock Y as being less risky than stock X because stock Y has higher standard deviation and coefficient of variation than stock X.

Problem 4.19

Soln

a. Calculation of Holding Period Return and expected Return (stock A)

| Year | $D_1$ | $P_0$ | $P_1$ | $HPR = P_1 - P_0 + D_1 / P_0 \times 100$ |
|---|---|---|---|---|
| 2011 | 1.6 | 23 | 26 | 20% |
| 2012 | 1.7 | 26 | 25 | 2.69% |
| 2013 | 2.0 | 25 | 24 | 4% |
| 2014 | 2.1 | 24 | 27 | 21.25% |
| 2015 | 2.2 | 27 | 30 | 19.26% |
| | | | | $\Sigma HPR = 67.2\%$ |

$\therefore$ Expected Return, $E(R_A) = \frac{\Sigma HPR_A}{n} = \frac{67.2}{5} = 13.44\%$

For stock B:

| Year | $D_1$ | $P_0$ | $P_1$ | $HPR = \frac{P_1 - P_0 + D_1}{P_0} \times 100$ |
|---|---|---|---|---|
| 2011 | 2.0 | 22 | 23 | 13.64% |
| 2012 | 2.1 | 23 | 23 | 9.13 |
| 2013 | 2.2 | 23 | 24 | 13.91 |
| 2014 | 2.3 | 24 | 25 | 13.75 |
| 2015 | 2.4 | 25 | 25 | 9.6 |
| | | | | $\Sigma HPR = 60.03\%$ |

$\therefore$ Expected Return, $E(R_B) = \frac{\Sigma HPR_B}{n} = \frac{60.03\%}{5} = 12.01\%$

b. Calcution of standard deviation and CV (Stock X)

| Year | $R_X$ | $R_X - E(R_X)$ | $[R_X - E(R_X)]^2$ |
|---|---|---|---|
| 2011 | 20 % | 6.56 % | 43.03 |
| 2012 | 2.69 | −10.75 | 115.56 |
| 2013 | 4 | −9.44 | 89.11 |
| 2014 | 21.25 | 7.81 | 61 |
| 2015 | 19.26 | 5.82 | 33.87 |
| | | | $\Sigma[R_A - E(R_A)]^2 = 342.57$ |

$\therefore$ Standard deviation $(\sigma_A) = \sqrt{\dfrac{\Sigma[R_A - E(R_A)]^2}{n-1}} = \sqrt{\dfrac{342.57}{5-1}} = 9.25\%$

$\therefore$ Coefficient of Variation, $(CV_A) = \dfrac{\sigma_A}{E(R_A)} = \dfrac{9.25}{13.44} = 0.69$

Stock 'B'

| Year | $R_B$ | $R_B - E(R_B)$ | $[R_B - E(R_B)]^2$ |
|---|---|---|---|
| 2011 | 13.64 | 1.63 | 2.65 |
| 2012 | 9.13 | −2.88 | 8.29 |
| 2013 | 13.91 | 1.9 | 3.61 |
| 2014 | 13.75 | 1.74 | 3.03 |
| 2015 | 9.6 | −2.41 | 5.81 |
| | | | $\Sigma[R_B - E(R_B)]^2 = 23.39$ |

$\therefore$ Standard Deviation, $(\sigma_B) = \sqrt{\dfrac{\Sigma[R_B - E(R_B)]^2}{n-1}} = \sqrt{\dfrac{23.39}{5-1}} = 2.41\%$

$\therefore$ coefficient of Variation, $(CV_B) = \dfrac{\sigma_B}{E(R_B)} = \dfrac{2.41}{12.01} = 0.20$

c. The expected return of stock A is greater than that of stock B where is standard deviation of stock B is less than stock A. Considering ~~st~~ Rate of return stock A is preferable due to higher return but stock B is also preferable due to lower standard deviation. So there is a conflict between return and risk. Finally we should use the relative measure i.e coefficient of variation to make the conclusion. Therefore, stock B is preferable due to lower CV.

d. We would recommend Nilima to invest in stock B due to lower coefficient of variation.

# Managing Portfolio

Chapter-11

# MANAGING PORTFOLIO

A portfolio of investment means combining investment into more than one assets. The basic idea behind forming a portfolio is to reduce investment risk. A portfolio can reduce risk sometimes even without sacrisfying the return.

The portfolio policy and objectives play an important role in asset allocation while forming the portfolios.

## * Measurement of the performance of Investment vehicles:

The return performance of each individual investment is measured in terms of holding period Return (HPR). A holding period return is a total rate of return realized from investment over a period of time, usually one year or less. The holding period return contains two types of returns:

i. Cash Income
ii. Capital Gain

- HPR for Stocks and Bonds:

The holding period return from common stock contains both cash income received in the form of dividend and capital gain or loss resulted from the change in stock price at the end of period as compared to the beginning.

$$\therefore HPR = \frac{V_1 - V_0 + C}{V_0} \times 100$$

where,

$V_1$ = Ending value of investment
$V_0$ = Beginning value of investment
$V_1 - V_0$ = Capital Gain or loss
$C$ = Current income (Dividend on stock or Interest on bond)

- HPR Again.

After tax HPR = HPR $(1-t)$

where,
$t$ = tax rate

• HPR for Mutual Funds:

The holding period return on mutual fund contains investment income dividend and capital gain dividend. Note that investment income dividend and capital gain dividend distributed to investors are treated as current cash income since they are paid in cash.

$$\therefore HPR = \frac{NAV_1 - NAV_0 + ID_1 + CG_1}{NAV_0} \times 100$$

Where,

$NAV_1$ = Net Assets value at the end of the year.
$NAV_0$ = Net Assets value at the beginning of the year
$ID_1$ = Income dividend at the end of the year
$CG_1$ = Capital Gain at the end of the year.

• HPR for Options and Futures:

The only income that an options and futures holder realizes is the capital gain which results from the change in options or futures value at the end of period as compared to the beginning.

$$\therefore HPR = \frac{\text{Ending value} - \text{Beginning value}}{\text{Beginning value}}$$

• HPR for portfolio.

The holding period return on portfolio contains two types of income: ordinary or current income and capital gain. The current income comes from dividends and interest on the stocks and bonds respectively whereas capital gain comes from the change in market value of securities.

$$\therefore \text{HPR for portfolio} = \frac{RCG + UCG + C}{E_0 + \left(NF \times \frac{ip}{12}\right) - \left(WF \times \frac{wp}{12}\right)}$$

where,

RCG = Realized capital Gain
UCG = Unrealized Capital Gain
C = Dividend and Interest received
$E_0$ = Initial Equity investment
NF = New Fund
ip = number of months in portfolio
WF = withdrawn funds
wp = number of months withdrawn from portfolio.

## * Comparison of portfolio Return with overall Market Measures:

After measuring portfolio return it is compared with the broad market measure like NEPSE, S & P500 to conclude whether the portfolio is doing better than the market as a whole. Note that such comparison only takes into account the return but does not consider the risk.

So, we should use risk-adjusted measure of rate of return to compare the portfolio performance such as Sharpe's measure, Treynor's measure and Jensen's measure.

### • Sharpe's Measure of portfolio performance:

Sharpe's measure of portfolio performance is developed by William F. Sharpe. This measure provides a portfolio performance index that compares a portfolio's risk premium to the total risk associated with the portfolio. The portfolio's total risk is measured by the standard deviation of portfolio's return.

$$\therefore S_P = \frac{R_P - R_F}{\sigma_P}$$

Where,

$S_P$ = Sharpe's index of portfolio performance measure

$R_P$ = Total rate of return on portfolio

$R_f$ = The risk free rate of return
$\sigma_p$ = The standard deviation of portfolio return

**For Market:**

Sharpe's measure for market portfolio:

$$S_m = \frac{R_m - R_f}{\sigma_m}$$

Where,

$R_m$ = Return on market
$R_f$ = Risk free rate
$\sigma_m$ = Standard deviation of markets

- **Treynor's Measure of portfolio performance.**

Treynor's measure of portfolio performance is developed by Jack L. Treynor. This measure provides a portfolio performance index that compares a portfolio's risk premium to the systematic risk. It is measured by an index of systematic risk called beta.

$$\therefore T_p = \frac{R_p - R_f}{\beta_p}$$

Where,

$\beta_p$ = The beta coefficient of the portfolio

For market:

$$T_m = \frac{R_m - R_f}{\beta_m}$$

Where,

$T_m$ = Treynor's index of market performance measure

$R_m$ = Return on market

$R_f$ = Risk free Rate

$\beta_m$ = Beta coefficient of market = 1

- Jensen's measure of portfolio performance:

Jensen's measure of portfolio performance is developed by Michel C. Jensen. Jensen's measure of portfolio performance calculates the Jensen's Alpha which is the excess of portfolio return above the required rate of return on the portfolio measured by CAPM.

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

Where,

$A_p$ = Jensen's Alpha

$R_p$ = Portfolio Return

$R_f$ = Risk free rate

$R_m$ = market return

$\beta_p$ = Portfolio Beta

* Why sharpe's and Treynor's measure are different?

Sharpe's and Treynor's measure of portfolio performance differs with each other in terms of methodology and assumptions. Sharpe's measure takes into account total risk measured by standard deviation of portfolio while treynor's measure considers systematic risk measured by beta.

Problem 11.7

Soln

Given:

Return on portfolio ($R_p$) = 11.8%

Standard deviation on portfolio ($\sigma_p$) = 14.1%

Risk free Rate ($R_f$) = 6.2%

Return on market ($R_m$) = 9%

Standard deviation on market ($\sigma_m$) = 9.4%

a. Sharpe's measure for Yamuna's portfolio:

$$S_p = \frac{R_p - R_f}{\sigma_p} = \frac{11.8\% - 6.2\%}{14.1\%}$$

$$= 0.3972$$

b. The sharpe's measure for Yamuna's portfolio is 0.3972 where as of Rabina's portfolio is 0.43. Lower value of sharpe's measure for Yamuna's portfolio implies that it offered lower risk premium per unit of total risk as compared to that of Ravina's portfolio. So, Ravina's portfolio performed better.

c. Sharpe's measure for market portfolio:

$$S_m = \frac{R_m - R_f}{\sigma_m} = \frac{9\% - 6.2\%}{9.4\%} = 0.2979$$

d. The sharpe's measure for Yamuna's portfolio is 0.3972 where as of market portfolio is 0.2979. Higher value of Sharpe's measure for Yamuna's portfolio implies that it offered higher risk premium per unit of total risk as compared to the market. Yamuna's portfolio has outperformed the market during the year just ended.

Problem 11.8

Soln

Given:

Portfolio Beta ($\beta_p$) = 0.90

Return on portfolio ($R_p$) = 8.6%

Risk free Rate ($R_f$) = 7.3%

Return on market ($R_m$) = 9.2%

a. Treynor's measure for Ashish's portfolio

$$T_p = \frac{R_p - R_f}{\beta_p} = \frac{8.6\% - 7.3\%}{0.90} = 1.44$$

b. The Treynor's measure for Ashish's portfolio is 1.44 and for Bishai's portfolio is 1.25. Higher value of Treynor's measure for Ashish's portfolio implies that it offered higher risk premium per unit of systematic risk as compared to that of Bishai's portfolio. Thus, Ashish's portfolio showed superior performance.

c. Treynor's measure for market portfolio,

$$T_m = \frac{R_m - R_f}{\beta_m} = \frac{9.2\% - 7.3\%}{1} = 1.9$$

d. The Treynor's measure for Ashish's portfolio is 1.44. which is lower than that of market portfolo 1.9. Lower value of Treynor's measure for Ashish's portfolio implies that it offered lower risk premium per unit of systematic risk as compared to the market. Thus, market portfolio has outperformed Ashish's portfolio during the year just ended.

Problem 11.9

Soln

Given:

Return on portfolio ($R_p$) = 17.60 %
Standard deviation of portfolio ($\sigma_p$) = 15.20 %
Beta of portfolio ($\beta_p$) = 1.2
Return on market ($R_m$) = 18.40 %
Standard deviation of market ($\sigma_m$) = 20.40 %.
Risk free Rate ($R_f$) = 5 %

a. Treynor's measure of the portfolio:

$$T_p = \frac{R_p - R_f}{\beta_p} = \frac{17.60\% - 5\%}{1.2} = 10.5$$

Treynor's measure for market:

$$T_m = \frac{R_m - R_f}{\beta_m} = \frac{18.40\% - 5\%}{1} = 13.4$$

According to Treynor's measure the portfolio performance is inferior than the market since its risk premium per unit of systematic risk is lower than that of the market.

b. Sharpe's measure of the portfolio:

$$S_p = \frac{R_p - R_f}{\sigma_p} = \frac{17.60\% - 5\%}{15.20\%} = 0.83$$

Sharpe's measure for market

$$S_m = \frac{R_m - R_f}{\sigma_m} = \frac{18.40\% - 5\%}{20.40\%} = 0.66$$

According to Sharpe's measure the portfolio has outperformed the market since its risk premium per unit of total risk is higher than that of market.

Problem 11.10

Soln

Given:

Return on portfolio ($R_p$) = 16.8 %

Beta of portfolio ($\beta_p$) = 1.10

Risk Free Rate ($R_f$) = 7.4 %

Return on market ($R_m$) = 15.2 %

Jensen's alpha of portfolio:

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

$$= 16.8\% - [7.4\% + (15.2\% - 7.4\%)\,1.10]$$

$$= 0.82\%$$

Using Jensen's measure, portfolio has outperformed the market because it offers the positive excess rate of return above the CAPM required rate of return.

Problem 11.11

Soln

Given:

Beta of portfolio ($\beta_p$) = 1.3

Return on portfolio ($R_p$) = 12.9 %

Risk free rate ($R_f$) = 7.8%

Return on market ($R_m$) = 11 %

a. Jensen's measure for Indu's portfolio:

$$A_p = R_p - [R_f + (R_m - R_f)\beta_p]$$
$$= 12.9\% - [7.8\% + (11\% - 7.8\%)\,1.3]$$
$$= 0.94\,\%$$

b. The Jensen's measure for Indu's portfolio (0.94%) is greater than that of Bindu's portfolio (−0.24). So, Indu's portfolio performed better.

c. Indu's portfolio has positive Jensen's alpha. It implies that Indu's portfolio has earned positive excess return during the year above the rate of return required on her portfolio.

Problem 11.12

Sol^n

a. Calculation of Sharpe's measure of five portfolios: ($S_p$)

| Portfolios | Return on Portfolio ($R_p$) | Risk-free Rate ($R_f$) | Standard Deviation of portfolio ($\sigma_p$) | $S_p = \frac{R_p - R_f}{\sigma_p}$ | Rank |
|---|---|---|---|---|---|
| M | 7% | 3% | 3% | $\frac{7\% - 3\%}{3\%} = 1.3333$ | 2 |
| N | 10% | 3% | 8% | $\frac{10\% - 3\%}{8\%} = 0.875$ | 5 |

| | | | | | |
|---|---|---|---|---|---|
| O | 13% | 3% | 6% | $= \frac{13\% - 3\%}{6\%} = 1.67$ | 1 |
| P | 15% | 3% | 13% | $= \frac{15\% - 3\%}{13\%} = 0.923$ | 4 |
| Q | 18% | 3% | 15% | $= \frac{18\% - 3\%}{15\%} = 1$ | 3 |

Portfolio O performed the best according to sharpe's measure because its risk premium per unit of total risk is highest among all.

b. Calculation of Treynor's measure of five portfolio ($T_p$):

| Portfolios | Average Return ($R_p$) | Risk free Rate ($R_f$) | Beta ($\beta$) | $T_p = \frac{R_p - R_f}{\beta_p}$ | Rank |
|---|---|---|---|---|---|
| M | 7% | 3% | 0.4 | $= \frac{7\% - 3\%}{0.4} = 10$ | 2 |
| N | 10% | 3% | 1.0 | $= \frac{10\% - 3\%}{1.0} = 7$ | 4 |

| | | | | | |
|---|---|---|---|---|---|
| O | 13% | 3% | 1.1 | $= \frac{13\% - 3\%}{1.1}$ $= 9.09$ | 3 |
| P | 15% | 3% | 1.2 | $= \frac{15\% - 3\%}{1.2}$ $= 10$ | 2 |
| Q | 18% | 3% | 1.4 | $= \frac{18\% - 3\%}{1.4}$ $= 10.71$ | 1 |

Portfolio Q performed the best according to Treynor's measure because its risk premium per unit of systematic risk is highest among all.

c. Sharpe's and Treynor's measure of portfolio performance differs with each other in terms of methodology and assumptions. Sharpe's measure takes into account total risk measured by standard deviation of portfolio while Treynor's measure consider systematic risk measured by beta.

Problem 11.13

Sol^n

Given:

| | Portfolio X | Market |
|---|---|---|
| Average Return | $R_p = 20\%$ | $R_m = 15\%$ |
| Beta | $\beta_p = 1.20$ | $\beta_m = 1.00$ |
| Standard deviation | $\sigma_p = 22\%$ | $\sigma_m = 20\%$ |

Risk free Rate ($R_f$) = 6%

Calculation of Sharpe's measure for portfolio X:

$$S_p = \frac{R_p - R_f}{\sigma_p} = \frac{20\% - 6\%}{22\%} = 0.64$$

Sharpe's measure for market

$$S_m = \frac{R_m - R_f}{\sigma_m} = \frac{15\% - 6\%}{20\%} = 0.45$$

Calculation of Treynor's measure for portfolio X

$$T_p = \frac{R_p - R_f}{\beta_p} = \frac{20\% - 6\%}{1.20} = 11.67$$

Treynor's measure for market

$$T_m = \frac{R_m - R_f}{\beta_m} = \frac{15\% - 6\%}{1} = 9$$

Both Sharpe's and Treynor's measure of portfolio X has outperformed the market because its risk premium are higher than that of market.

Calculation of Jensen's measure for portfolio X

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

$$= 20\% - [6\% + (15\% - 6\%)\,1.20]$$

$$= 3.2\%$$

Jensen's measure of portfolio X has also outperformed because it has positive excess return over its CAPM required return.

Hence, all the portfolio measures shows the superior performance of portfolio X over the market.

Problem 11.14

Soln

Given:

Risk free Rate ($R_f$) = 8.1%

| | GEM's portfolio | Market portfolio |
|---|---|---|
| Rate of Return | $R_p = 12.8\%$ | $R_m = 11.2\%$ |
| Standard Deviation | $\sigma_p = 13.5\%$ | $\sigma_m = 9.6\%$ |
| Beta | $\beta_p = 1.10$ | $\beta_m = 1.00$ |

a. Calculation of sharpe's measure of portfolio:

$$S_p = \frac{R_p - R_f}{\sigma_p} = \frac{12.8\% - 8.1\%}{13.5\%} = 0.3481$$

Sharpe's measure for market portfolio:

$$S_m = \frac{R_m - R_f}{\sigma_m} = \frac{11.2\% - 8.1\%}{9.6\%} = 0.3229$$

Gem's portfolio of sharpe's measure has outperformed the market because it offers larger risk premium per unit of total risk as compared to the market.

b. Calculation of Treynor's measure of GEM's portfolio:

$$T_p = \frac{R_p - R_f}{\beta_p} = \frac{12.8\% - 8.1\%}{1.10} = 4.27$$

Treynor's measure for market portfolio:

$$T_m = \frac{R_m - R_f}{\beta_m} = \frac{11.2\% - 8.1\%}{1.0} = 3.1$$

Treynor's measure of GEM's portfolio has outperformed the market because it offers larger risk premium per unit of systematic risk as compared to the market.

c. Calculation of Jensen's measure of portfolio:

$$A_p = R_p - [R_f + (R_m - R_f)\beta_p]$$
$$= 12.8\% - [8.1\% + (11.2\% - 8.1\%)1.10]$$
$$= 1.29\%$$

The portfolio has positive Jensen's alpha. It implies that the portfolio has 1.29% excess return above the CAPM required return. Thus portfolio has earned excess return on both risk-adjusted and market adjusted basis.

Problem 11.15

Sol$^n$

Given:

T-bills Rate ($R_f$) = 6%

Average return of portfolio ($R_p$) = 10%

Standard deviation of portfolio ($\sigma_p$) = 18%

Beta of portfolio ($\beta_p$) = 0.6

Average return of market ($R_m$) = 12%

Standard deviation of market ($\sigma_m$) = 13%

Beta of market ($\beta_m$) = 1.0

a. Calculation of sharpe's measure for portfolio:

$$S_p = \frac{R_p - R_f}{\sigma_p} = \frac{10\% - 6\%}{18\%} = 0.2222$$

Sharpe's measure for market

$$S_m = \frac{R_m - R_f}{\sigma_m} = \frac{12\% - 6\%}{13\%} = 0.4615$$

Calculation of Treynor's measure for portfolio:

$$T_p = \frac{R_p - R_f}{\beta_p} = \frac{10\% - 6\%}{0.6} = 6.6667$$

Treynor's measure for market:

$$T_m = \frac{R_m - R_f}{\beta_m} = \frac{12\% - 6\%}{1} = 6$$

Calculation of Jensen's measure of portfolio:

$$A_p = R_p - [R_f + (R_m - R_f)\beta_p]$$
$$= 10\% - [6\% + (10\% - 6\%)\,0.6]$$
$$= 0.4\%$$

Jensen's measure for market:

$$A_m = R_m - [R_f + (R_m - R_f)\beta_m]$$
$$= 12\% - [6\% + (12\% - 6\%)\,1]$$
$$= 12\% - 12\%$$
$$= 0$$

b. According to Treynor's and Jensen's measure the portfolio X has outperformed the market because these values of the portfolio are higher than the market.

c. Sharpe's measure, Treynor's measure and Jensen's measure of portfolio performance differs with each other in terms of methodology and assumption.

Sharpe's measure takes into account total risk measured by standard deviation of portfolio while Treynor's measure and Jensen's measure consider systematic risk measured by beta.

# Common Stock Fundamentals

Chapter-6

# COMMON STOCK FUNDAMENTALS

Common stock:

→ Common stock is a major source of long term capital. By selling common stock to the investors, company receives capital permanently.

→ The life of common stock will not be fixed. (i.e upto ∞)

→ The dividend of common stock will not be fixed at the time of issue.

→ Income of the common stock holder from the investment in the common stock are expected dividends and capital gain, that will be realized from the increase in market value of common stock.

→ From investor's view point, common stock is more riskier than bond due to residual claim on income and assets (at the time of liquation.)

→ From company's view point, Common stock is less risky than bond because like bond common stock holders do not have right to liquidate the company if company failed to pay dividend in common stock.

→ Common stock has limited liabilities.

Formula:

$$\text{Dividend Yield} = \frac{\text{Dividend}}{\text{close price}} \times 100$$

$$\text{Price-Earning ratio (PE Ratio)} = \frac{\text{Price}}{\text{Earnings}}$$

* Stock split:

It is simply increase in number of shares outstanding through appropriate decrease in par value per share of stock. It is done to decrease market value per share of common stock.

After stock split:

1. Number of shares outstanding increases
2. Market value per share decreases
3. Book value per share decreases
4. Par value per share decreases

Formula:

1. No. of shares after stock split = No. of shares before stock split x stock split ratio

2. $$\text{MVPS} | \text{BVPS} | \text{PV after stock split} = \frac{\text{MVPS} | \text{BVPS} | \text{PV before stock split}}{\text{Stock split ratio}}$$

## * Stock dividend:

If the company distributes its earnings to its share holders in the form of shares rather than cash, is called Stock dividend or bonus shares. It is done to raise the capital by the firm.

After stock dividend:

1. Number of shares Increases
2. Market value per share Decreases
3. Book value per share Decreases
4. Par value → No Change

Formula:

1. No. of shares after stock dividend = No. of shares before stock dividend (1+SDR)

2. Bvps/Mvps after stock dividend = $\frac{\text{Bvps/Mvps before stock dividend}}{1+SDR}$

where,

SDR = Stock Dividend Rate

Problem 6.1

Soln

a. The trading activity occured on a day before the day of quotation. The day of quotation is Monday, June 5 so, the trading occured on sunday June 4.

b. The close quote is 299, which implies that the stock sold at price of Rs. 299 at the end of the day on Sunday June 4.

c. The firm's price-earnings ratio is 14.95 times. It indicates that closing market price Rs. 299 of sunday June 4 is 14.95 times of the recent annual earnings per share.

d. The last price at which stock traded on the date quoted is the closing price Rs. 299.

e. The dividend of Rs. 10.50 per share is expected in the current year.

f. During the latest 52-weeks period stock traded at the highest price of Rs. 352 and the lowest price of Rs. 290 per share.

g. 432 round lots or 43,200 shares (432x100) were traded on the day quoted.

h. The stock price declined by Rs. 1 per share on the day quoted as compared to the immediately preceding day. The preceding day's close price was Rs. 300.

Preceding day's close price = close price - net change

$= 299 - (-1)$

$= 299 + 1 = \text{Rs. } 300.$

Problem 6.2

Soln

a. The 52-weeks high and low price indicates the highest and the lowest stock price over the recent 52-weeks period. During the period, maximum stock price was Rs. 77.5625 and minimum price was Rs. 40.0625.

b. Dividend Yield is calculated by dividing dividend by closing price. Yes, it is an annualized yield.

$$\text{Dividend Yield} = \frac{\text{DPS}}{\text{Closing price}} = \frac{1.44}{45.50} = 3.2\%$$

c. PE indicates the willingness of the investor to pay for the stock for every rupee of the earnings. It is calculated as follows:

$$\text{PE Ratio} = \frac{\text{Close price}}{\text{EPS}}$$

d. 103 round lots or 10,300 shares were traded on the trading day.

Problem 6.3

Soln

a. Price of Everest Bank shares is more volatile than the price of life Insurance corporation Nepal because EBL price fluctuated in the range of Rs. 6 (522 - 516) while that of life Insurance only fluctuated in the range of Rs. 1 (125-124). Larger price movement of the Everest Bank share implies that it has more price risk.

b. The NEPSE Index of 208.82 means it increased by 108.82 from the base price of 100 and +0.07 means the NEPSE is increased by 0.07 points from the previous day's closing price.

Problem 6.11.

Soln

Given:

Stock split ratio = 3 for 2

Stock price before split = Rs. 300

Stock price after split = stock price before split X stock split ratio

$= 300 \times \frac{2}{3}$ OR, $\frac{300}{3/2}$

$=$ Rs. 200 $\quad = 300 \times \frac{2}{3} =$ Rs. 200

Number of shares before split = 200 shares

Number of shares after split = No. of shares before split X stock split ratio

$= 200 \times \frac{3}{2}$

$= 300$ shares

Problem 6.12

Sol$^n$

Stock dividend rate = 25%.

Price before stock dividend = Rs. 49.75

a. Number of shares before stock dividend = 100 shares

Number of shares after stock dividend = No. of shares before stock dividend (1+SDR)

$= 100\,(1+0.25)$

$= 125$ shares

b. Price after stock dividend = $\frac{\text{Price before stock dividend}}{1+SDR}$

$= \frac{49.75}{1+0.25} =$ Rs. 39.8

c. Stock dividends are non-taxable income whereas cash dividends are taxable income, so investors might choose stock dividends.

# Mutual Fund

# Chapter-10
# MUTUAL FUNDS

## * Investment Companies:

Investment companies are those companies who raise funds by issuing their own shares and use these funds to invest in the securities of other companies. There are generally following two types of investment companies:

1. Closed End Companies | closed End Fund
2. Open End Companies | Open End Fund

## * Features of closed End Companies:

a. These companies have fixed number of shares outstanding as these companies do not stand ready to issue or redeem their shares at any point of time.

b. Shares of these companies are traded in organized stock exchanges, like Nepal stock Exchange (NEPSE) through the help of brokers. Broker charges commission while buying and selling the shares of these companies.

c. The market price of shares of these companies are determined by the interaction of demand and supply in the market which may be above or below NAV per share.

* Features of Open End companies:

a. These companies do not have fixed number of shares outstanding as these companies stand ready to sell or redeem their own shares at any point of time.

b. The shares of these companies are sold through the agents generally. Agent charges fee for his involvement which is called load fee.

c. Shares of these companies are traded in NAV per share.

d. Mutual Fund is a well known example of open end companies.

Mutual Fund

No Load Fund | Load Fund

. No Load Fund: It is that type of mutual fund in which there occurs no load fee either at the time of purchase or sell or both.

- **Load Fund:** It is that type of mutual fund in which there occurs load fee either at the time of purchase or sell or both.

Load Fund
- Front End Load Fund
- Back End Load Fund

- **Front End Load fund:** It is that type of load fund in which load fee occurs only at the time of purchase of fund.

- **Back End Load Fund:** It is that type of load fund in which load fee occurs at the time of sell of bond.

Load Fee
- Front End Load Fee
- Back End Load Fee

- **Front End Load fee/Load fee:** It occurs one at the time of purchase of mutual fund and reduces the amount of initial investment.

  Example:

  Amount available for Investment = Rs.1000

  Front end load fee = 10%

$\therefore$ Net amount invested = Amount available for investment (1 − % of front end load fee)

$= 1000\,(1 - 0.10)$

$= Rs.\,900$

Let. NAV per share (NAV) = Rs. 10

$\therefore$ Number of shares to be purchased

$$(N) = \frac{\text{Net Amount invested}}{\text{NAV per share}}$$

$$= \frac{900}{10} = 90 \text{ shares}$$

Alternatively,

$$\text{Offering price} = \frac{\text{NAV per share}}{1 - \text{load fee}}$$

$$= \frac{10}{1 - 0.10}$$

$= Rs.\,11.11$

$$\therefore \text{Number of shares } (N) = \frac{\text{Amount available for Investment}}{\text{Offering price}}$$

$$= \frac{1000}{11.11}$$

$= 90$ shares

Back End Load fee:

It occurs once at the time of sale of fund. It reduces the amount of sales from the investment.

Example:

Amount invested in fund = Rs. 1000

Annual HPR = 10%

Back end Fee = 2%

Net amount received from sales = ?

Here,

Net amount received from sales = Amount of investment $(1+HPR)^n$ (1 - Back end load fee)

$= 1000(1+0.10)^1(1-0.02)$

$=$ Rs. 1078

Annual 12(b)-1 Charge/Management and Administrative fee:

It occurs annually and reduces the HPR to be received from the fund.

Example:

Annual HPR = 12%

Annual 12(b)-1 charge = 1%

Net Annual HPR = Annual HPR - Annual 12(b)-1 charge

$= 12\% - 1\%$

$= 11\%$

## * Net Assets Value per share [NAV per share]

Investors $\xrightarrow{\text{Fund}}$ Mutual Fund

Mutual Fund $\xrightarrow{\text{1000 shares}}$ Investors

| Stock | No. of shares | $P_0$ | Total |
|---|---|---|---|
| A | 1000 shares | Rs.100 | Rs.100,000 |
| B | 2000 " | Rs.50 | Rs.100,000 |
| C | 500 " | Rs.200 | Rs.100,000 |

| | |
|---|---|
| Total Market value of Assets (MVA) | Rs.300,000 |
| – liabilities | Rs.100,000 |
| Net Assets value (Total) | Rs. 200,000 |

$$\text{NAV per share} = \frac{\text{Total NAV}}{\text{No. of shares}} = \frac{200000}{1000}$$

$$= \text{Rs. } 200 \text{ per share}$$

Conclusion:

$$\text{NAV per share} = \frac{MVA_t - \text{liabilities}_t}{N_t}$$

where,

$MVA_t$ = Market value of Assets of mutual fund at time 't'.

$liab._t$ = liabilities of mutual fund at time 't'

$N_t$ = Number of shares outstanding at time 't'.

* Calculation of Rate of Return on Mutual fund:

Sources of Return:

1. Capital Gain $(NAV_1 - NAV_0)$
2. Dividend or Interest.

Formula:

For No load fund:

$$HPR = \frac{(NAV_1 - NAV_0) + CG + ID}{NAV_0} \times 100$$

For Load fee

$$HPR = \frac{(NAV_1 - \text{Offering price}) + CG + ID}{\text{Offering price}} \times 100$$

Where,

$$\text{Offering price} = \frac{NAV}{1 - \text{load fee}}$$

$$\text{Market Based } HPR = \frac{\text{Ending price} - \text{Beginning price} + \text{Div.}}{\text{Beginning price}} \times 100$$

* Concept of premium or discount on close-end fund:

As we know that, the price of close-end fund depends on demand and supply in the stock market. Thus, in most of the cases, the price of close end fund will be greater or lower than its NAV.

Then,

1. If current market price > NAV → Premium
2. If current market price < NAV → Discount
3. If current market price = NAV → par

$$\therefore \text{premium \%} = \frac{\text{Current MPS} - \text{NAV}}{\text{NAV}}$$

$$\therefore \text{Discount \%} = \frac{\text{NAV} - \text{Current MPS}}{\text{NAV}}$$

Remarks:

The percentage of premium or discount is based on NAV.

$$\therefore \text{Current MPS} = \text{NAV}\,(1 + \text{premium} - \text{Discount})$$

## * Portfolio Turnover Rate/Ratio [PTR]

→ It shows the level of activity in the fund.

→ It measures how actively and efficiently the fund managers involves in buying and selling securities.

→ It is calculated as follows:

Formula:

1. Operating expenses Ratio/Expenses Ratio

$$= \frac{\text{Annual operating expenses}}{\text{Beginning NAV}}$$

2. Portfolio Turnover Ratio (PTR)

$$= \frac{\text{Minimum of the value of securities purchased or sold}}{\text{Average NAV}}$$

where,

$$\text{Average NAV} = \frac{\text{Beginning NAV} + \text{Ending NAV}}{2}$$

Note:

Average NAV is also called Average daily total assets.

* Difference between open-end fund and close-end fund:

| Basis of Difference | Open-End fund | Close-End fund |
|---|---|---|
| 1. Maturity period | NO | Fixed |
| 2. Buy/sell | Directly through Fund | Through stock exchange |
| 3. Selling price | NAV | Market price |
| 4. No. of shares | Variable | fixed |
| 5. Redeemable | Yes | NO |
| 6. Popularity | More popular | less popular |
| 7. Liquidity | More liquid | less liquid. |

Problem 10.1

Soln

Given:

Total Assets (MVA) = Rs. 420 million

liabilities (liab.) = Rs. 6 million

Number of shares (N) = 20 million shares

Discount rate = 10%

a. Net Assets Value (NAV) = $\frac{\text{MVA} - \text{liab.}}{\text{N}}$

$= \frac{420\text{ m} - 6\text{ m}}{20\text{ m}}$ = Rs. 20.7 per share

b. Current price of the fund = NAV (1 − discount)

= 20.7 (1 − 0.10)

= Rs. 18.63 per share

Problem 10.2

Soln

Given:

Number of shares (N) = 150,000 shares

Management fee obligations (liab.) = Rs. 50,000

Market value of Assets (MVA) = (5000×100) + (2000×70) + (3500×300)

= Rs. 16,90,000

Net Assets Value (NAV) = $\frac{\text{MVA} - \text{liab.}}{\text{N}} = \frac{16{,}90000 - 50{,}000}{150{,}000}$ = Rs. 10.93 per share

Problem 10.3

Soln

Given:

Market value of Assets (MVA) = (1000 X 150) + (2000 X 140)

= Rs. 430,000

Number of shares (N) = 10,000 shares

liabilities (liab.) = 0

a. $NAV = \frac{MVA - liab.}{N} = \frac{430{,}000 - 0}{10{,}000}$ = Rs. 43 per share

b. Market Value of Assets (MVA) = (1000 X 180) + (2000 X 110)

= Rs. 400,000

Expected $NAV = \frac{MVA - liab.}{N} = \frac{400{,}000 - 0}{10{,}000}$ = Rs. 40 per share

c. Let the price of ABC should be $x$ to get NAV calculated in part a.

$$NAV = \frac{MVA - liab.}{N}$$

$$43 = \frac{[(1000 \times 180) + (2000 \times x)] - 0}{10{,}000}$$

$$430{,}000 = 180{,}000 + 2000x$$

$$2000x = 250{,}000$$

$$x = \frac{250{,}000}{2000} = \text{Rs. } 125$$

Therefore, the price of ABC Co. should decline by Rs.15 (140-125) to maintain the NAV as estimated in (a).

Problem 10.4

Soln

Given:

a. $HPR_{2014} = \frac{NAV_{2015} - NAV_{2014} + D_{2014} + CG_{2014}}{NAV_{2014}} \times 100$

$= \frac{150 - 100 + 7.55 + 30}{100} \times 100$

$= 87.55\ \%$

b. $HPR_{2015} = \frac{NAV_{2016} - NAV_{2015} + D_{2015} + CG_{2015}}{NAV_{2015}} \times 100$

$= \frac{120 - 150 + 6 + 10}{150} \times 100$

$= -9.33\ \%$

Problem 10.5

Soln

Given:

Amount of investment = Rs.10,000

Beginning price = Rs.120 (Purchase price)

Commission = 3 %

Dividend = Rs. 10 per share

Ending price / selling price = Rs. 125

a. HPR considering Brokerage commission

$$= \frac{\text{Net Selling price} - \text{Net purchase price} + \text{Dividend}}{\text{Net purchase price}} \times 100$$

$$= \frac{121.25 - 123.6 + 10}{123.6} \times 100$$

$$= 6.19\%$$

where

Net pp = 120(1+0.03) = Rs. 123.6

Net sp = 125 (1-0.03) = Rs. 121.25

b. HPR without Considering Brokerage Commission

$$= \frac{\text{Selling price} - \text{purchase price} + \text{Dividend}}{\text{purchase price}} \times 100$$

$$= \frac{125 - 120 + 10}{120} \times 100$$

$$= 12.5\%$$

Problem 10.6

Soln

Given:

Amount invested = Rs. 10,000

Beginning NAV ($NAV_0$) = Rs. 120

Offering price = Rs. 124

Dividend per share = Rs. 1

Ending NAV ($NAV_1$) = Rs. 125

a. HPR (with load fee) = $\frac{NAV_1 - \text{Offering price} + Div.}{\text{Offering price}} \times 100$

$= \frac{125 - 124 + 1}{124} \times 100$

$= 1.6129\ \%$

b. HPR (no load fee) = $\frac{NAV_1 - NAV_0 + Div.}{NAV_0} \times 100$

$= \frac{125 - 120 + 1}{120} \times 100$

$= 5\ \%$

Problem 10.7.

Soln

Given:

Beginning no. of shares (N) = 200 shares

Beginning NAV ($NAV_0$) = Rs. 8.50

Dividend (Div.) = Rs. 0.90

Capital Gain (CG) = Rs. 0.75

a. Ending NAV ($NAV_1$) = Rs. 9.10

HPR = $\frac{NAV_1 - NAV_0 + Div. + CG}{NAV_0} \times 100$

$= \frac{9.10 - 8.50 + 0.90 + 0.75}{8.50} \times 100$

$= 26.47\ \%$

b. Total amount from dividend and capital gain

$= (0.90 + 0.75) \times 200$ shares

$=$ Rs. 330

Additional shares $= \frac{330}{8.75} = 37.71$ shares

Ending shares $= 237.71$ shares $(200 + 37.71)$

$$HPR = \frac{\text{Ending value} - \text{Beginning value}}{\text{Beginning value}} \times 100$$

$$= \frac{(237.71 \times 9.10) - (200 \times 8.50)}{200 \times 8.50} \times 100$$

$= 27.24\ \%$

Problem 10.8

Soln

Given:

Beginning NAV ($NAV_0$) = Rs. 21.50

Beginning Offering price = Rs. 23.35

Ending NAV ($NAV_1$) = Rs. 23.04

Ending offering price = Rs. 25.04

Dividend and capital gain = Rs. 1.05

$$\text{Holding Period Return} = \frac{NAV_1 - \text{offering price} + \text{Div.} \& \text{CG}}{\text{Offering price}} \times 100$$

$$= \frac{23.04 - 23.35 + 1.05}{23.35} \times 100 = 3.17\ \%$$

Problem 10.9

Soln

$$HPR = \frac{NAV_1 - \text{Offering price} + \text{Div.} + CG}{\text{Offering price}} \times 100$$

$$HPR_{2013} = \frac{43.20 - 55 + 2.10 + 1.83}{55} \times 100 = -14.31\%$$

$$HPR_{2014} = \frac{60.47 - 46.20 + 2.84 + 6.26}{46.20} \times 100 = 50.58\%$$

$$HPR_{2015} = \frac{54.75 - 64.68 + 2.61 + 4.32}{64.68} \times 100 = -4.64\%$$

Calculation of Average annual compound rate of return over the 3-year period, 2013-2015.

| Year | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| Purchase price | (55) | | | |
| Dividend | | 2.10 | 2.84 | 2.61 |
| Capital Gain | | 1.83 | 6.26 | 4.32 |
| Selling price | | | | 54.75 |
| Total Cash flow | (55) | 3.93 | 9.10 | 61.68 |

Calculation of compound rate of return using IRR approach

$$CF_0 = \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \frac{CF_3}{(1+r)^3}$$

$$55 = \frac{3.93}{(1+r)^1} + \frac{9.10}{(1+r)^2} + \frac{61.68}{(1+r)^3} \longrightarrow (1)$$

Now,

$$\text{Required Factor} = \frac{CF_0}{\text{Average CFAT}} = \frac{55}{24.9033} = 2.2088$$

$$\text{Average CFAT} = \frac{3.93 + 9.10 + 61.68}{3} = 24.9033$$

Looking at PVIFA table at 3rd year, the required factor lies between 17% and 18%. Since, the initial years cash flow is lower than the final year's cash flow, actual return will be less than 17%. So, let's try at 10%.

$$TPV_{LR} = \frac{3.93}{(1+0.10)^1} + \frac{9.10}{(1+0.10)^2} + \frac{61.68}{(1+0.10)^3}$$

$$= 57.43$$

Try at 13%

$$TPV_{HR} = \frac{3.93}{(1+0.13)^1} + \frac{9.10}{(1+0.13)^2} + \frac{61.68}{(1+0.13)^3}$$

$$= \text{Rs. } 53.48$$

By Interpolation,

$$\text{Annual Return} = LR + \frac{TPV_{LR} - CF_0}{TPV_{LR} - TPV_{HR}} \times (HR - LR)$$

$$= 10\% + \frac{57.43 - 55}{57.43 - 53.48} \times (13 - 10)$$

$$= 11.84\%$$

Problem 10.10

Soln

Given:

Beginning NAV ($NAV_0$) = Rs. 10.40

Discount = 18%

Market price at beginning = NAV (1 - discount)

= 10.40 (1 - 0.18)

= Rs. 8.53

Ending NAV ($NAV_1$) = Rs. 11.69

premium = 4%

Market price at end = NAV (1 + premium)

= 11.69 (1 + 0.04)

= Rs. 12.16

Dividend (Div.) = Rs. 0.40

Capital Gain (CG) = Rs. 0.95

a. $\text{NAV based HPR} = \frac{NAV_1 - NAV_0 + Div. + CG}{NAV_0} \times 100$

$$= \frac{11.69 - 10.40 + 0.40 + 0.95}{10.40} \times 100$$

$$= 25.38\%$$

b. Market based HPR = $\frac{\text{Ending price} - \text{Beginning price} + \text{Div.} + \text{CG}}{\text{Beginning price}} \times 100$

$$= \frac{12.16 - 8.53 + 0.40 + 0.95}{8.53} \times 100$$

$$= 58.38\%$$

The market premium/ discount added value to the investor's return because market based HPR is higher than the NAV based HPR.

c. Beginning Market price = $NAV_0 (1 + \text{premium})$

$= 10.40 (1 + 0.18) = \text{Rs. } 12.27$

Ending Market price = $NAV_1 (1 - \text{discount})$

$= 11.69 (1 - 0.04) = \text{Rs. } 11.22$

Market based HPR = $\frac{\text{Ending price} - \text{Beginning price} + \text{Div.} + \text{CG}}{\text{Beginning price}} \times 100$

$$= \frac{11.22 - 12.27 + 0.40 + 0.95}{12.27} \times 100$$

$$= 2.45\%$$

There is a huge change in rate of return due to the change in discount and premium.

Problem 10.11

Sol$^n$

a. NAV based HPR $= \dfrac{NAV_1 - NAV_0 + Div. + CG}{NAV_0} \times 100$

$= \dfrac{9.25 - 7.50 + 1.20 + 0.90}{7.50} \times 100$

$= 51.33\%$

b. Beginning of the Year: (MPS > NAV)

Premium % $= \dfrac{MPS - NAV}{NAV} \times 100$

$= \dfrac{7.75 - 7.50}{7.50} \times 100$

$= 3.33\%$

End of the year: (MPS < NAV)

Discount % $= \dfrac{NAV - MPS}{NAV} \times 100$

$= \dfrac{9.25 - 9.00}{9.25} \times 100$

$= 2.7\%$

c. Market Based HPR = $\frac{\text{Ending price} - \text{Beginning price} + \text{Div.} + \text{CG}}{\text{Beginning price}} \times 100$

$= \frac{9.00 - 7.75 + 1.20 + 0.90}{7.75} \times 100$

$= 43.23\%$

Premium/discount hurt the HPR. Investor purchased the share at premium and sold them at discount as a result HPR decreased.

Problem 10.12

Soln

Given:

Beginning no. of shares = 1000 shares

Beginning NAV = Rs. 20

Beginning value = 1000 X 20 = Rs. 20,000 (PV)

Ending no. of shares = 1100 shares

Ending NAV = 22.91

Ending value = 1100 X 22.91 = Rs. 25201 (FV)

Holding period (n) = 3 years

a. $FV = PV(1+r)^n$

$25201 = 20,000(1+r)^3$

$\frac{25201}{20,000} = (1+r)^3$

$r = \left[\frac{25201}{20,000}\right]^{1/3} - 1 = 8\%$

b. Offering price $= \dfrac{NAV}{1-\text{load fee}} = \dfrac{20}{1-0.03} = Rs.\ 20.62$

Beginning value $= 1000 \times 20.62 = Rs.\ 20,620$

$$FV = PV(1+r)^n$$

$$25201 = 20,620\,(1+r)^3$$

$$\therefore r = \left[\frac{25201}{20620}\right]^{1/3} - 1 = \cancel{6.92} \; 6.92\%$$

Problem 10.13

soln

Portfolio Turnover Rate $= \dfrac{\text{Minimum value of buying or selling securities}}{\text{Average NAV}}$

$$= \frac{15,000,000}{1500,000 \times 28}$$

$$= 0.357 \text{ times}$$

Where,

Purchase Value $= 200,000 \times 50 + 200,000 \times 25 = Rs.\ 15000,000$

Selling value $= 600,000 \times 25 = Rs.\ 15\,000,000$

NAV $= \dfrac{\text{Total assets} - \text{liab.}}{\text{Number of shares}}$

$$= \frac{(200000 \times 35 + 300000 \times 40 + 400,000 \times 20 + 600,000 \times 25) - 0}{15,00,000}$$

$= Rs.\ 28$

Problem 10.14

Soln

Given:

HPR = 12 %

Amount invested = Rs. 10,000

a. Holding period (n) = 3 years

Anticipated Rupee value(FV) = $PV(1 + HPR)^n (1 - \text{load fee})$

Fund X:

$FV = 10{,}000(1 + 0.11)^3 (1 - 0) = \text{Rs. } 13{,}676.31$

Fund Y:

$FV = 10{,}000(1 + 0.12)^3 (1 - 0.04) = \text{Rs. } 13{,}487.31$

Fund X seems to be a better alternative due to higher anticipated value.

b. Holding period (n) = 6 years

Fund X:

$FV = 10{,}000(1 + 0.11)^6 (1 - 0) = \text{Rs. } 18{,}704.15$

Fund Y:

$FV = 10{,}000(1 + 0.12)^6 (1 - 0.04) = \text{Rs. } 18{,}948.69$

c. For Indifference Holding Period Return

$$\text{FV of Fund X} = \text{FV of Fund Y}$$

$$10,000(1+0.11)^n(1-0) = 10000(1+0.12)^n(1-0.04)$$

$$(1.11)^n = (1.12)^n \times 0.96$$

$$\frac{(1.11)^n}{(1.12)^n} = 0.96$$

$$\left(\frac{1.11}{1.12}\right)^n = 0.96$$

$$(0.99107)^n = 0.96$$

Taking log on both side

$$n \log 0.99107 = \log 0.96$$

$$n = \frac{\log 0.96}{\log 0.99107} = 4.55 \text{ Years}$$

d. The length of the anticipated holding period should be considered in comparing load fees with annual expenses such as 12b-1 charge because load fee is charged only once at the time of purchase whereas Annual 12b-1 charge is charged annually.

Problem 10.15

Soln

Given:

Amount Invested = Rs. 1000

load fee = 8.5 %

Management and other fees (Annual 12b-1 charge) = 1.10%

Holding period (n) = 5 Yrs

Interest in saving account (i) = 5%

Holding period return (HPR) = ?

Fund from investing in Mutual fund = Amount from Saving account

$$1000\,(1 + HPR - 0.011)^5\,(1 - 0.085) = 1000\,(1 + 0.05)^5$$

$$1000\,(0.989 + HPR)^5 \times 0.915 = 1000 \times (1.05)^5$$

$$(0.989 + HPR)^5 = \frac{(1.05)^5}{0.915}$$

$$(0.989 + HPR)^5 = 1.3945$$

$$HPR = (1.3945)^{1/5} - 0.989$$

$$= 7.98\%$$

Problem 10.16

Soln

Given:

| | Fund E | Fund D | Fund N | Fund L |
|---|---|---|---|---|
| Amount Invested | Rs.1000 | Rs.1000 | Rs.1000 | Rs.1000 |
| NAV | Rs.10 | Rs.10 | Rs.10 | Rs.10 |
| Market price | Rs.10 | Rs.8 | – | – |
| Commission | 2% | 2% | – | – |
| Load fee | – | – | – | 8.5% |

$$\text{Number of shares (N)} = \frac{\text{Amount invested}}{\text{Cost per share}}$$

Fund E :

$$\text{Number of shares (N)} = \frac{\text{Rs.}1000}{10 + 2\% \text{ of } 10} = 98.04 \text{ shares}$$

Fund D:

$$\text{Number of shares (N)} = \frac{\text{Rs.}1000}{8 + 2\% \text{ of } 8} = 122.55 \text{ shares}$$

Fund N :

$$\text{Number of shares (N)} = \frac{\text{Rs.}1000}{\text{Rs.}10} = 100 \text{ shares}$$

Fund L

$$\text{Number of shares (N)} = \frac{\text{Rs.}1000}{\text{Rs.}10.93} = 91.49 \text{ shares}$$

where,

$$\text{Offering price} = \frac{\text{NAV}}{1 - \text{load fee}} = \frac{10}{1 - 0.085} = \text{Rs. } 10.93$$

Problem 10.17

Soln

a. $\text{NAV per share} = \dfrac{\text{Total net assets}}{\text{Number of shares}}$

Fund A

$\text{NAV at beginning} = \dfrac{10{,}00{,}000}{100{,}000} = \text{Rs.}10$

$\text{NAV at end} = \dfrac{11{,}00{,}000}{110{,}000} = \text{Rs.}10$

Fund B

$\text{NAV at beginning} = \dfrac{10{,}00{,}000}{100{,}000} = \text{Rs.}10$

$\text{NAV at end} = \dfrac{1200{,}000}{100{,}000} = \text{Rs.}12$

b. $\text{Expenses Ratio} = \dfrac{\text{Operating expenses}}{\text{Beginning Net assets}}$

$\text{Fund A} = \dfrac{\text{Rs.}10{,}000}{\text{Rs.}10{,}00{,}000} = 0.01 = 1\%$

$$\text{Fund B} = \frac{12,000}{10,00,000} = 0.012 = 1.2\%$$

c. Portfolio Turnover Ratio = $\frac{\text{Minimum Value of sold or purchase}}{\text{Average Net Assets value}}$

$$\text{Fund A} = \frac{400,000}{(10,00,000 + 11,00,000)/2} = 0.3809$$

$$\text{Fund B} = \frac{800,000}{(10,00,000 + 12,00,000)/2} = 0.7272$$

d. The higher operating expenses for Fund B are justified because it has higher value of securities purchased and sold during the year.

e. The higher portfolio turnover ratio and brokerage fees for Fund B are justified because it has higher value of securities purchased and sold during the year.

# Derivative Securities

# Chapter - 12
## DERIVATIVE SECURITIES

Concept:
Derivatives are the securities that derive their value from the underlying assets. Undering assets are those assets on which derivatives are written on. The value of derivaties depends on the value of derivative assets.

Option:
An option is a contract that gives its holder the right to buy or sell an assets at some predetermined price within a specified period of time.

One party (option writer) writes the option and sells it to another (option buyer/holder). The seller or writer has an obligation to sell or buy the underlying assets at predetermined price on the exercise of the option. But buyer or holder of the option has a choice for the exercise of option.

There are two types of options:

1. Call option (Right to Buy)

Buyer of the call option has a right to buy the underlying assets at specified price within or at the expiration date of option.

2. Put option (Right to sell)

Buyer of the put option has right to sell option writer the underlying assets at specified price before or on the expiration of the options.

* Strike price | Exercise price:

Strike price is the price at which optioned securities are bought or sold. In the case of call options, strike price specifies the price at which each of the 100 shares can be purchased.

Similarly, in the case of put option, it specifies the price at which each of the 100 shares stock can be sold to option writer. Strike price of listed option are standardized.

* Expiration Date:

Expiration date is the contract between the writer and buyer of the stock option regarding the life of the option.

For example, if the option is written on the January 1st and it expires on March 31st, then the life of the option at the time of contract is 3 months.

## * Intrinsic value:

Intrinsic value is called theoritical value and fair value. Intrinsic value is just difference between stock market price and options strike price. when stock's market price is below the option stock price, the intrinsic value is zero.

### • Intrinsic Value of Call Option:

~~the t~~ Call option gives the right to the holders of the option to buy an underlying assets at specified price. The intrinsic value is ~~cal~~ also called fundamental value of the call option before the expiration date is given by:

$$V_c = Max\,[0,\ (S-X)\,100]$$

where,

$V_c$ = Intrinsic Value of call option
Max. = Maximum of $(S-X)100$ and 0.
S = Current price of the stock
X = Exercise | ~~stit~~ strike price

Note: We multiply by 100, it indicates that call is exercised in a 100 share lot.

- Intrinsic value of put option:

Put option gives the right to the holders of the option to sell an underlying assets at specified price. The intrinsic value of put option is determined by using following equation:

$$V_p = \text{Max}\,[0, (X-S)100]$$

Where,

$V_p$ = Intrinsic value of a put option
Max. = Maximum of $(X-S)100$ and 0
S = Current price of the stock
X = Exercise | strike price

* Time premium:

Time premium on call = $C - V_c$
Time premium on put = $P - V_p$

Where, C = Market price of call
P = market price of put

* Rate of Return = $\dfrac{\text{Profit}}{\text{Investment}}$

where,

profit = Value of call or put − Cost (Investment)

Problem 12.1

Soln

Given: Call option

Selling price | stock price (S) = Rs. 190

Exercise price | Strike price (x) = Rs. 180

Market price of call (C) = Rs. 25

Value of call option ($V_c$) = Max [0, (S-X)]

= Max [0, (190 - 180)]

= Max [0, 10]

= Rs. 10

Time premium = $C - V_c$ = 25 - 10 = Rs. 15

Problem 12.2

Soln

Given: Put option:

Stock price (S) = Rs. 360

Strike price (X) = Rs. 275

Market price of put (P) = Rs. 8.50

Value of put option ($V_p$) = Max [0, (X-S)]

= Max [0, (275 - 360)]

= Max [0, -85]

= 0

Time premium = $P - V_p$ = 8.50 - 0 = Rs. 8.50

## Problem 12.3

Soln

Given: Put option

Number of shares (N) = 100 shares

Exercise price(X) = Rs. 340

Current market price (S) = Rs. 330

Theoretical value of put option ($V_p$) = Max [0, (X − S) 100]

= Max [0, (340 − 330) 100]

= Max [0, 1000]

= Rs. 1000

## Problem 12.4

Soln

Given: Call option:

Number of shares (N) = 100 shares

Exercise price (X) = Rs. 2310

Option premium (cost) = Rs. 5 × 100 = Rs. 500

Market price | Stock price (S) = Rs. 2375

Value of call option ($V_c$) = Max [0, (S − X) 100]

= Max [0, (2375 − 2310) 100]

= Max [0, 6500]

= Rs. 6500

Profit = Value of call − cost

= 6500 − 500 = Rs. 6000

## Problem 12.3

Soln

Given: Put option

Number of shares (N) = 100 shares

Exercise price (X) = Rs. 340

Current market price (S) = Rs. 330

Theoretical value of put option ($V_p$) = Max [0, (X − S) 100]

= Max [0, (340 − 330) 100]

= Max [0, 1000]

= Rs. 1000

## Problem 12.4

Soln

Given: Call option:

Number of shares (N) = 100 shares

Exercise price (X) = Rs. 2310

Option premium (cost) = Rs. 5 × 100 = Rs. 500

Market price / Stock price (S) = Rs. 2375

Value of call option ($V_c$) = Max [0, (S − X) 100]

= Max [0, (2375 − 2310) 100]

= Max [0, 6500]

= Rs. 6500

Profit = Value of call − cost

= 6500 − 500 = Rs. 6000

$$\text{Rate of Return} = \frac{\text{Profit}}{\text{Investment}}$$

$$= \frac{6000}{500}$$

$$= 1200\ \%$$

Problem 12.5

Soln

Given:

Purchase price = Rs. 2310

Selling price = Rs. 2375

a. Investment = 100 X 2310 = Rs. 231,000

b. Sales proceed = 100 X 2375 = Rs. 237,500

c. Profit = Sales proceed - Investment = 237500 - 231000 = Rs. 6500

d. $\text{Rate of Return} = \frac{\text{Profit}}{\text{Investment}} = \frac{6500}{231{,}000} = 2.81\ \%$

e. Leverage of option is very high. So, investor can earn much more by investing a small amount of investment in option. This feature of options attracts the investors to invest in options.

Problem 12.6

Solⁿ

Given: Put option

No. of shares = 100 shares

Exercise price (X) = Rs. 1108

Option premium (cost) = 100 × 5 = Rs. 500

Current stock price (S) = Rs. 1100

a. Value of put option ($V_p$) = Max [0, (X−S) 100]

= Max [0, (1108−1100) 100]

= Max [0, 800]

= Rs. 800

Profit = Value of put − cost

= Rs. 800 − 500

= Rs. 300

b. Rate of Return = $\frac{\text{Profit}}{\text{Investment (cost)}}$

= $\frac{300}{500}$

= 60 %

c. The option is out-of-money. So she did not exercise the option.

d. The maximum limit of loss on option is Rs. 500 i.e her investment.

Problem 12.7

Soln

Given: Call option

Strike price $(X)$ = Rs. 60

Cost = Rs. 600

Current stock price $(S)$ = Rs. 75

Value of call option $(V_c)$ = $Max[0, (S-X)100]$

= $Max[0, (75-60)100]$

= $Max[0, 1500]$

= Rs. 1500

Profit = Value of call - cost

= 1500 - 600

= Rs. 900

$$HPR = \frac{Profit}{Investment} = \frac{900}{600} = 150\%$$

Problem 12.8

Soln

Given: Put option

strike price $(X)$ = Rs. 690

cost = $4.50 \times 100$ = Rs. 450

current stock price $(S)$ = 686.45 X

New stock price $(S)$ = Rs. 665

a. Value of put ($V_p$) = Max [0, (X-S) 100]
= Max [0, (690 - 665) 100]
= Max [0, 2500]
= Rs. 2500

Profit = value of put - cost
= 2500 - 450
= Rs. 2050

Holding period Return (HPR) = $\frac{\text{Profit}}{\text{Investment}}$

= $\frac{2050}{450}$ = 455.56 %

~~Problem~~

b. If the stock price increases to Rs. 715 she will lose the cost of put investment i.e Rs. 450.

Problem 12.9

Soln.

Given: Call option

Number of shares (N) = 100 shares

Call price (cost) = 100X10 = Rs. 1000

Exercise price (X) = Rs. 1000

Current stock price (S) = Rs. 1150

a. Value of Call option ($V_c$) = Max [ 0, (S-x) 100]

= Max [0, (1150 - 1000) 100]

= Max [ 0; 15000]

= Rs. 15,000

b. If the stock price drops to Rs. 975

Value of Call option ($V_c$) = Max [0, (S-x) 100]

= Max [ 0, (975 - 1000) 100]

= Max [ 0, - 2500]

= 0

c. Her maximum loss in her investment is Rs. 1000.

d. Break even point = Exercise price + option premium

= 1000 + 10

= Rs. 1010

e. If it is a option to buy she should exercise the option even when market price of shares is in between the exercise price and break-even price, because it reduces her loss.

Problem 12.10

Soln

Given: Call option:

Strike price $(X)$ = 1484.04

Current price of option $(S)$ = 1522.25

Cost of option = 40.21

1 point = Rs.100

a. Value of Call option $(V_c)$ = Max $[0, (S-X)]$

$= Max[0, (1522.25 - 1484.04)]$

$= Max[0, 38.21]$

$= 38.21$ points

$= 38.21 \times 100 =$ Rs. 3821

b. Time premium = Cost $- V_c$

$= (40.21 \times 100) - 3821$

= Rs. 200

Problem 12.11

Soln

Given: Euro Contracts

a. Value of contract = $2 \times 30{,}000 \times 119.45$ = Rs. 7167000

b. Total investment = $2 \times 7000$ = Rs. 14000

c. Value of contract after appreciation = $2 \times 30{,}000 \times 120.12$ = Rs. 7207200

d. Profit = 7207,200 − 7167,000 = Rs. 40,200

e. Rate of Return = $\frac{\text{Profit}}{\text{Investment}} = \frac{40,200}{14,000}$ = 287.14%

Problem 12.12

Soln

a. Amount received from short sell = $2 \times 5000,000 \times \frac{110}{100}$

= Rs. 11,000,000

b. Amount paid for future contract = $2 \times 5000,000 \times \frac{108}{100}$

= Rs. 10,800,000

c. profit = 11,000,000 − 10,800,000 = Rs. 200,000

d. Rate of Return = $\frac{\text{Profit}}{\text{Investment}} = \frac{200,000}{2 \times 12,000}$ = 833.33%

Problem 12.13

Soln

a. profit = (1102.84 − 1022.77) × Rs. 200 = Rs. 16,014

b. Rate of Return = $\frac{\text{Profit}}{\text{Investment}} = \frac{16,014}{8500}$ = 188.4 %

# Investment Environment

# Chapter - 1

## Investment Environment

**Concept:**

Simply, Investment refers to the sacrifice of present financial resources with the view to get additional financial benefit in future. The best use of the saving can be defined as the investment or purchase of financial assets or real assets is investment.

In other words, Investment can be defined as the process of bearing risk on his saving by satisfying today in another sector in order to get the more extra in future. It involves the commitment of resources that have been saved or put away from current consumption in hope that some benefit will produce in future.

The sacrify takes place in the present and is certain while the reward comes later and is uncertain. Today numerous alternatives of investment are available such as:

- Common stock
- Preferred stock
- Debt securities
- Hybrid securities
- Real assets, mutual fund, etc.

* key points:

- Sacrify of present financial resources.
- Alternative or the best use of the saving.
- Process of bearing risk
- Purchase of financial assets | Real assets

* Reasons for Investment:

- To get future financial benefit
- To increase the value of wealth
- To save the money from inflation or to maintain the purchasing power of money.

* Major elements of Investment:

1. Risk: Bearing uncertain
2. Time: Holding Period or certain duration
3. Return: Comes in future or expectation of the benefit.

* Difference between Investment and Speculation:

| Basis | Investment | Speculation |
|---|---|---|
| 1. Objective | Stable Return / Series of Return | Buy low and sell High / Capital Gain |
| 2. Risk | It is low risky. | It is high risky. |
| 3. Return | Moderate Rate of Return | High Rate of Return |

| | | |
|---|---|---|
| 4. Time | Long-term | Short-term |
| 5. Decision | Individual usually make decision with amount of Information available. | Individual make decision based on limited - Information. |
| 6. Planning | longer planning horizon | Short-term planning horizon. |
| 7. Investor | Generally Risk averse. | Generally risk seeker. |

## * Investment Environment:

There are various factors that may be internal or external qualitative or quantitative which may affect the investment decision directly or indirectly is considered as the Investment environment. The overall investment environment is categorized into three parts which are:

1. Securities or financial assets:
   - Ownership Securities / Common stock
   - Hybrid securities / Preferred stock
   - Debt securities / bond or debenture
   - Derivative instruments / Option or futures
   - Money Market Instruments i.e short term in nature
   - Capital Market Instruments i.e long term in nature

2. Securities markets

a. On the basis of security based

- Primary market
- Secondary market

b. On the basis of time or life span of securities

- Money market
- Capital market

3. Financial Intermediaries or Financial Institutions

- Bridge between savers and users

Investment
- → Real Assets (Land, Building, plant, etc)
- → Financial Assets (stock, Bond, debt, etc)

- **Short Term Securities (Money Market Instrument)**
  - **Corporate Security**
    - → Commercial Paper
    - → Banker's Acceptance (BA)
    - → Certificate of Deposit (CD)
    - → Euro-Dollars, etc.
  - **Government Security**
    - ↓ Treasury Bill (T-Bill)
    - ↓ (Issued at Discount and Redeemable at Par)
- **Long Term Securities (Capital Market Instrument)**
  - **Corporate Security**
    - → Common Stock
    - → Preferred Stock
    - → Bond / Debt
  - **Government Security**
    - → Treasury Note
    - → Governmental Bond

1. Short Term Securities:

The securities which have less than one year life are called short-term securities. They are also called money market instruments. The return on short term securities are higher. Most of the short term securities are issued at discount.

a. Corporate Securities:

The securities issued by corporation / Company is called corporate securities.

i. Certificate of Deposit (CD)
ii. Commercial Paper
iii. Euro, dollars, etc.

b. Government Securities:

The securities issued by government to raise the funds is called government securities. Government securities are risk free security that's why return on government securities are lower than corporate securities. Treasury Bill (T-Bill) is the example of government securities..

2. Long Term Securities:

The securities which have more than one year life is called long term securities. They are also called capital market instrument. The risk and return associated with long term securities are higher than short term.

a. Corporate securities
   1. Common stock
   2. Preferred stock
   3. Bond

b. Government Securities
   1. Treasury Note
   2. Governmental Bond

* Investment Alternatives:
   1. Short Term Securities (T-Bill, Commercial Paper, etc)
   2. Common stock
   3. Fixed Income Securities
   4. Mutual funds
   5. Derivative Securities
   6. Other Investment alternatives (gold, silver, real estate, etc)

* Factors to be considered in choosing Investment alternatives:
  1. Investment goal
  2. Risk and Rate of Return
  3. Tax consideration
  4. Investment horizon
  5. Investment strategy.

* Process of Investment
  1. Determining Investment objectives
  2. Developing Investment plan.
  3. Evaluating and selecting investment alternatives
  4. Constructing a portfolio
  5. Evaluating and Revising the portfolio.