

Unit 4

Calculation of YTM

[BOND VALUATION]

→ Yield till maturity

TOPIC

Bond:- "Debt Instrument" → Normally unsecured

"Normally issued at discount and repaid at Face Value"

→ Written on Bond document

* ZERO Coupon Bond ⇒ "Issued at heavy discount and repaid at Face Value and no Periodic Interest." ⇒ $FV = 100$] ⇒ No Interest
 $IP = 80$

eg:- 12% Bond of ₹10,000 issued at ₹9000 for 5 years and Interest Rate is 10%.

↓
 Coupon Rate
 ↓
 Actual Interest
 ↓
 Always apply on Face Value
 $10000 \times 12\% = 1200$

↓
 Face Value
 ↓
 Redemption Value


↓
 Issue Price

↓
 5 years
 ↓
 Tenure
 ↓
 Maturity

↓
 Interest Rate is 10%
 ↓
 Investor Expectation
 ↓
 Cost of Capital
 ↓
 Discounting Rate

1	1200
2	1200
3	1200
4	1200
5	1200
5	10,000

TERMS ASSOCIATED WITH BONDS

- ✓ Face Value: Also known as the par value  ¹ ⇒ "value written on Bond"
- ✓ Coupon rate: A bond carries a specific rate of interest ⇒ Actual Interest
- ✓ Maturity ⇒ Repay period
- ✓ Redemption Value ⇒ Repay Value [Normally Face value]
- ✓ Interest Rate ⇒ Discounting Rate = Expectation of Investor
- ✓ Market Value ⇒ Stock Exchange Price

TOPIC

TYPES OF BONDS

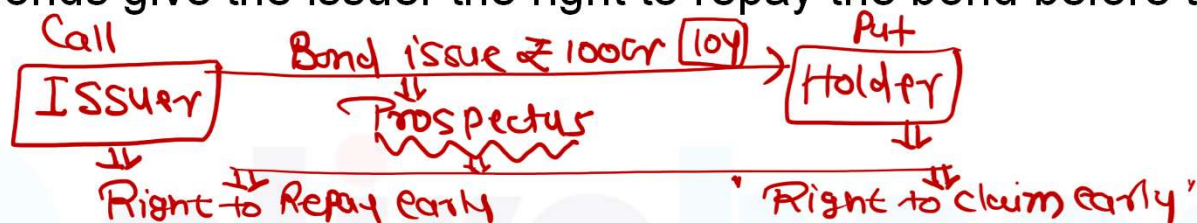
- Fixed rate bonds := Interest fixed
- Floating rate notes = Variable Interest \Rightarrow LIBOR + 4.1.
- Zero-coupon bonds = Issued at heavy disc., Paid at FV (no Periodic Interest)
- High-yield bonds (junk bonds) that are rated below investment grade by the credit rating agencies. As these bonds are riskier than the investment grade bonds, investors expect to earn a higher yield.
- Convertible bonds \Rightarrow 'Can convert into ESC.'
- Inflation-indexed bonds = Interest depends on inflation in market
- Other indexed bonds, for example equity-linked notes \Rightarrow 'Return depends on Shares of company'
- Asset-backed securities are bonds \Rightarrow 'Value depends on Some Asset' = Gold Bond
- Subordinated bonds are those that have a lower priority than other bonds of the issuer in case of Liquidation.
 \hookrightarrow unsecured category

Liquidation

- \rightarrow Worker ✓
- \rightarrow Statutory due ✓
- \rightarrow Secured lender ✓
- \rightarrow Unsecured lender ✓
- \rightarrow ES# ✓

OPTIONALITY IN BONDS

Callability - Some bonds give the issuer the right to repay the bond before the maturity



Putability - Some bonds give the holder the right to force the issuer to repay the bond before the maturity date on the put dates.

TOPIC

Valuation of Bond [Intrinsic Value]

→ Should be Value

⇒ Discounted Cash Flow

eg:- 12% Bond of ₹ 10,000 issued at ₹ 9,000 for 5 years. Interest Rate @ 10%.
 ⇒ Find Value of Bond ⇒ Suggest Buy/Sale @ ₹ 11,000 Disc Rate

Y CF PVF@10%

$$1 \checkmark 1200 \times 0.909 \checkmark = 1090.80 \checkmark$$

$$2 \checkmark 1200 \times 0.826 \checkmark = 991.20 \checkmark$$

$$3 \checkmark 1200 \times 0.751 \checkmark = 901.20 \checkmark$$

$$4 \checkmark 1200 \times 0.683 \checkmark = 819.6 \checkmark$$

$$5 \checkmark 1200 \times 0.621 \checkmark = 745.2 \checkmark$$

$$5 \checkmark 10000 \times 0.621 \checkmark = 6210 \checkmark$$

Intrinsic Value

$$10758 < 11000 \Rightarrow \text{Sale}$$

$$1200 \div 1.10 = m+$$

$$= m+$$

$$= m+$$

$$= m+$$

$$= m+$$

$$10,000 =_{\text{Stime}} m+ \Rightarrow \text{MRC}$$

$$10758$$

$$10000 \times 12\% = 1200$$

$$\text{Disc Factor } \frac{1}{1+r}$$

$$\frac{1}{1.10} \leftarrow \frac{1}{1+0.10}$$

TOPIC

Interest Rate @ 12%

Hw 15% Bond of ₹ 100000 issued at 80000, Tenure = 6 year

⇒ Find Value of Bond

⇒ Suggest Buy/Sale @ 1,10,000.

↓
1,12,334

↓
Buy

$$\Rightarrow \boxed{15000} \div \boxed{1.12} = \underbrace{m+}_{1y} = \underbrace{m+}_{2y} = \underbrace{m+}_{3y} = \underbrace{m+}_{4y} = \underbrace{m+}_{5y} = \underbrace{m+}_{6y}$$

$$\boxed{MRC} \leftarrow m+ = 100000 \text{ 6 times}$$

1,12,334

Hw 12-1. Bond ₹ 100000

Tenure 15 year.

Interest 10-1.

1
1.10

$$\Rightarrow \text{Value} = \boxed{1,15,212}$$

TOPIC

eg:- 12% Bond of ₹10,000, issued @ 8000, Interest Rate @ 10%.
 = $\frac{12\%}{2} = 6\% = 600$

Tenure = 3 years

$$= \boxed{600} \div \boxed{1.05} = \boxed{m+}$$

6 times

$$\boxed{MRC} \leftarrow \boxed{m+} \leftarrow = \leftarrow \boxed{10000}$$

6 times

⇒ $\boxed{10,507} \Rightarrow$ Bond Value

Rate/2

Time X2

Coupon Paid Semi Annually

Coupon Rate

$$\frac{12\%}{2} = \underline{\underline{6\%}}$$

Interest

$$\frac{10\%}{2} = \underline{\underline{5\%}}$$

Tenure X2

$$3 \times 2 = \underline{\underline{6 \text{ years}}}$$

Y	CF	PV @ 5%	
✓ 1	600	0.95	=
✓ 2	600	0.907	=
✓ 3	600	0.863	=
✓ 4	600	0.823	=
✓ 5	600	0.784	=
✓ 6	600	0.746	=
✓ 6	10000	0.746	=
			<u>10,507</u>

$$\frac{1}{1.05} =$$

* Current Yield on Bond :- " 12% Bond of ₹10000

⇒ $\frac{10000 \times 12\%}{12000} \times 100 = \underline{\underline{10\%}}$

Market Price Today = $\boxed{12000}$

Current MP

TOPIC

✓ CURRENT YIELD ON BOND

Current yield = $\frac{\text{Coupon interest}}{\text{current market price}}$

YIELD-TO-MATURITY OF BOND

It is the rate of return earned by an investor, who purchases a bond and holds it until the maturity. The YTM is the discount rate, which equals the present value of promised cash flows to the current market price/ Purchase price.

Example:

Consider a Rs 1000 par value bond, whose current market price is Rs 850/-, The bond carries a coupon rate of 8% and has the maturity period of 9 yrs. What would be the rate of return that an investor earns if he purchase the bond and holds until maturity?

PV of IRR 14.1.

1	1200	x	
2	1200	x	
3	1200	x	
4	1200	x	
5	1200	x	
5	10000	x	

=
=
=
=
=
=
9000

⇒ PVIF = outflow

Internal Rate of Return

"A Rate at which discounted value of Inflow equals to outflow"

PVIF = PV of F ⇒ NPV = 0

⇒ It is also called IRR ⇒
 ↳ Earning till maturity

TOPIC

eg:- 12% Bond of ₹10,000, issued at ₹9000 Find YTM if Tenure is 5 years

$$\Rightarrow \frac{\text{Interest} + \frac{\text{Red. Value} - \text{Issue Price}}{\text{Time}}}{\frac{\text{Red. Value} + \text{Issue Price}}{2}} \times 100 = \frac{I + \frac{RV - IP}{n}}{\frac{RV + IP}{2}} \times 100$$

$$\Rightarrow \frac{1200 + \frac{10,000 - 9000}{5}}{\frac{10000 + 9000}{2}} \times 100 = \frac{1400}{9500} \times 100 = 14.74\%$$

Y	CF	PV @ 14.74%
✓ 1	1200	X
✓ 2	1200	X
✓ 3	1200	X
✓ 4	1200	X
✓ 5	1200	X
✓ 5	10000	X

=
=
=
=
=
=

$$\frac{10000 + 9000}{2}$$

$$1200 \div 1.1474 = \text{mt}$$

$$10000 \div \text{mt} = \text{MRC}$$

* IRR = Rate at which
Your Inflow disc Value
= Your outflow

$$\frac{9000}{2} = 9075$$

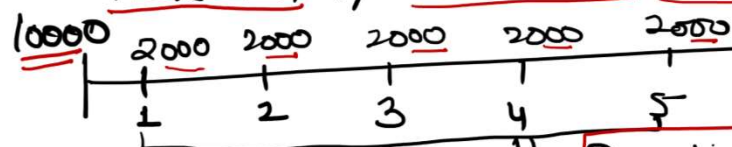
⇒ Interpolation
⇒ Cost of debt

TOPIC

Duration of Bond

⇒ "Maturity and duration are two separate concepts."

⇒ "Time taken to recover the Investment"



Duration = 5y

10y = maturity

⇒ $\left[\begin{array}{l} \text{YTM} (\uparrow) \\ \text{Coupon Rate} (\uparrow) \\ \text{frequency of Coupon} (\uparrow) \end{array} \right] \Rightarrow \text{Duration} (\downarrow)$

"YTM, Coupon Rate, frequency have -ve relation with Duration"

⇒ Duration < Maturity

Duration = maturity → in case of ZERO Coupon Bond b'coz no Period Interest

⇒ Perpetual Bond ⇒ Duration = $\left(\frac{1+r}{r} \right)$ ⇒ eg:- find duration of 12% Perpetual Bond
 To Repaid at winding up. ⇒ $\left(\frac{1+0.12}{0.12} \right) = 9.33 \text{ years}$

TOPIC

PROPERTIES OF DURATION

- ✓ Duration is less than the term to maturity.
- ✓ Bond's duration will be equal to its term to maturity if and only if it is a zero coupon bond.
- ✓ The duration of perpetual bond is equal to $\frac{1+r}{r}$, where r = current yield of the bond. \approx
- ✓ The longer a coupon paying bond's term to maturity, the greater the difference between its term to maturity and duration.
- ✓ Duration and YTM are inversely related.
- ✓ Larger the coupon rate, smaller the duration of a bond.
- ✓ An increase in the frequency of coupon payments decreases the duration, while a decrease in frequency of coupons increases it.
- ✓ Duration of a bond declines as the bond approaches maturity

TOPIC

BOND PRICE VOLATILITY \Rightarrow "Impact of YTM on Bond Price"

$$\Rightarrow \frac{\% \Delta \text{Price}}{\% \Delta \text{YTM}}$$

The sensitivity of the bond price to changes in the interest rates is called "Bond Volatility". Bond prices and YTM are inversely related

$$IE = \frac{\text{Percentage change in price for bond in period } t}{\text{Percentage change in yield to maturity for bond}}$$

$$\Rightarrow \begin{array}{l} \text{Price } \begin{array}{c} \underline{2023} \\ 400 \end{array} \rightarrow \begin{array}{c} \underline{2024} \\ 600 \end{array} \\ \text{YTM } \begin{array}{c} \underline{20\%} \end{array} \rightarrow \begin{array}{c} \underline{25\%} \end{array} \end{array} \quad \left[\begin{array}{l} \frac{200}{400} \times 100 = 50\% \\ \frac{5}{20} \times 100 = 25\% \end{array} \right] \Rightarrow \frac{50\%}{25\%} = \underline{2 \text{ times}}$$

* What if YTM change in 2025 by 20%. Find change in Bond Price = 20% x 2 = 40% \Rightarrow 600 + 40% = 840
New Price

TOPIC

$$\rightarrow 1+r = 1+0.15$$

Q01. Bond 200000 Time 5y. Value? if Disc. Rate is 15%.

Buy/Sale if MP = 2,25,000

$$10,000 \div 1.15 = m+$$

$$= m+$$

$$= m+$$

$$= m+$$

$$= m+$$

$$200000 = m+ MRC$$

Intrinsic Value

$$233522 > 2,25,000 \Rightarrow \text{Buy}$$

TOPIC

Unit 5

Financial Mathematics /Forex Arithmetic

TOPIC

Why? ⇒ "Exchange of Currency" = Banking System

System = {
 ⇒ Before 1991 = Controlled by RBI ⇒ Cap ⇒ \$1 = ₹40
 ⇒ After 1991 = LERMS ⇒ Market driven Rate - [Liberlised Exch. Rate Management System] ⇒ Demand
 ⇒ Supply

Quotation = {
 ⇒ Direct ⇒ \$1 = ₹80 ⇒ 1 unit of Fc is given
 ⇒ Indirect ⇒ ₹1 = \$0.0125 ⇒ 1 unit of Hc is given

Cross Rate ⇒ Finding Value of third Currency by using two diff. Currency

chain Rule ⇒ Process of finding Cross Rate is called chain rule

Value-date ⇒ Date of Accounting of Foreign Exch. trans. in books of A/c

Forward Point =
$$\frac{\text{Spot Rate} \times \text{Interest Rate diff.} \times \text{days}}{100 \times 365}$$

⇒ Forward Point ✓
 ⇒ Spot Rate ✓
 ⇒ Interest Rate diff. ✓
 ⇒ days ✓

\$1 = ₹80
 ₹1 = ₹20
 \$1 = ₹?

TOPIC

Exchange Rates:

Type of Rate	Trans. day	Settlement day	Rate
✓ Cash/Ready Rate (T)	<u>22.7.25</u>	<u>22.7.25</u>	<u>₹80</u> ✓
✓ Tom Rate (T+1)	<u>22.7.25</u>	<u>23.7.25</u>	<u>₹81</u> ✓
✓ Spot Rate (T+2)	<u>22.7.25</u>	<u>24.7.25</u>	<u>₹82</u> ✓
✓ Forward Rate [Beyond T+2]	<u>22.7.25</u>	<u>24.10.25</u>	<u>₹85</u> ✓

⇒ Premium:-

Today
\$1 = ₹80

24.10.25

\$1 = ₹85 =

₹ is expensive
in future

⇒ Discount:-

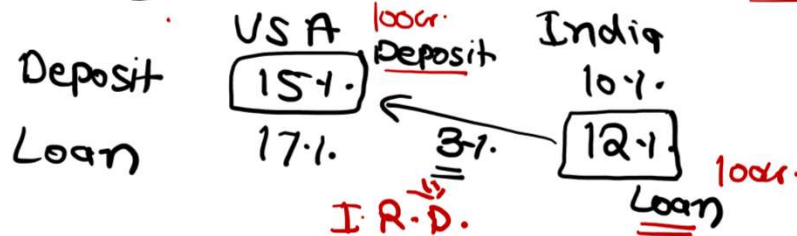
\$1 = ₹80

\$1 = ₹70 =

₹ is cheap.

Arbitrage :-

- ⇒ 0 Invest ✓
- ⇒ 0 Risk ✓
- ⇒ + Return ✓



INTRODUCTION

When we talk of 'Foreign Exchange', we refer to the general mechanism by which a bank converts the currency of one country into that of another.

Three fundamental aspects of this general mechanism

- Almost every country has its own currency
 - Exchange from one currency for another is, mostly, put through by the banks
 - All exchanges of one currency for another are effected with the help of credit instruments.
- Prior to the modified 'Liberalised Exchange Rate Management System' (LERMS), the Reserve Bank fixed the buying and selling rates and the market would remain within the ceiling and the floor, thus fixed by the Reserve Bank.