

BOND VALUATION

IMPORTANT QUESTIONS

CLASS WORK QUESTIONS

Question 7:

- i. Rate used for discounting shall be yield. Accordingly ZCB shall fetch:

$$1000 \text{ df}(8.5\%, 10) = 442.28$$

- ii. The day count basis is actual number days / 365. Accordingly annualized yield shall be:

$$\text{Yield} = \frac{10000 - 982}{9820} \times 100 \times \frac{365}{81} = 8.26\%$$

Note: Alternatively, it can also be computed on 360 days a year.

- iii. Price GOI 2033 would fetch

$$\begin{aligned} &= ₹ 108.2 \text{ PVAF}(8.5\%, 10) + ₹ 1000 \text{ PVF}(8.5\%, 10) \\ &= ₹ 108.2 \times 6.561 + ₹ 1000 \times 0.442 \\ &= ₹ 709.91 + ₹ 442 = ₹ 1151.91 \end{aligned}$$

- iv. Price GOI 2028 Bond would fetch:

$$\begin{aligned} &= ₹ 60 \text{ PVAF}(5\%, 10) + ₹ 1000 \text{ PVF}(5\%, 10) \\ &= ₹ 60 \times 7.7183 + ₹ 1000 \times 0.6139 \\ &= 463.1 + 613.9 = 1077 \end{aligned}$$

Question 12:

The current market prices of the two bonds may be estimated to be:

$$\text{Zero coupon} = \$41.73 \frac{\$100}{(1.06)^{15}} = \$ 41.73$$

12% gilt with a semi-annual coupon

$$\text{Present value of an annuity for 30 periods at 3\% is } \frac{1 - (1.03)^{-30}}{0.03} = 9.6004$$

\$

$$\text{Present value of interest payments } \$6 \times 9.6004 = 117.60$$

$$\text{Present value of redemption using PVF}(3\%, 30) [\$100 \times 0.4120] = \underline{41.20}$$

$$\underline{158.80}$$

- i. If interest rates increase by 1%

$$\text{Zero coupon } \frac{\$100}{(1.07)^{15}} = \$36.25, \text{ a decrease of } \$5.48 \text{ or } 13.1\%$$

12% gilt

Present value of an annuity for 30 periods at 3.5% is $\frac{1 - (1.035)^{-30}}{0.035} = 18.3920$

\$

Present value of interest payments $\$6 \times 18.3920 = 110.35$

Present value of redemption using PVF(3.5%, 30) [$\$100 \times 0.3563$] = 35.63

145.98

This is a decrease of \$12.82 or 8.1%

ii. If interest rates decrease by 1%:

Zero coupon $\frac{\$100}{(1.05)^{15}} = \48.10 , an increase of \$6.37 or 15.3%

12% gilt with a semi-annual coupon

Present value of an annuity for 30 periods at 2.5% is $\frac{1 - (1.025)^{-30}}{0.025} = 20.9303$

\$

Present value of interest payments $\$6 \times 20.9303 = 125.58$

Present value of redemption using PVF (2.5%, 30) [$\$100 \times 0.4767$] = 47.67

173.25

This is an increase of \$14.45 or 9.1%

Question 15:

BOB Bank sells 16.5% GOI Securities of face value of Rs. 800 crore at current market price of Rs. 830 crore.

Cash Outflow to CB Bank on 30.04.2015 (Amount of Borrowing)

Value of Security	Rs.830.00 crore
Interest for the period 30.09 to 30.01 ($\frac{122}{360} \times 0.165 \times 800$)	Rs. 44.73 crore
	Rs. 874.73cr

Buyback Price of Securities

Amount of Loan	Rs. 874.73 crore
Add: Interest for 12 days @ 14% ($0.12 \times 874.73 \times 12/360$)	Rs. 3.50 crore
	Rs. 878.23 crore
Less: Interest for 134 days ($800 \times 0.165 \times 134/360$)	Rs. 48.77 crore
	Rs. 829.46 crore

Question 17:

Effective Interest Rate = $\left[\frac{F - P}{P} \right] \times \frac{12}{m} \times 100$

$$= \frac{1,00,000 - 97,800}{97,800} \times \frac{12}{5} \times 100$$

$$= 0.02249 \times 2.4 \times 100$$

$$= 5.3976$$

$$\text{Effective Interest Rate} = \left(1 + \frac{5.3976}{2.4}\right)^{2.4} - 1 = 5.4841\%$$

Cost of Funds to the Company

Effective Interest	5.4841%
Brokerage(0.10*2.4)	0.24%
Rating Charges	0.60%
Stamp Duty (0.15*2.4)	0.36%
Cost of funds	6.6841%

Note: In the question it has not been clearly mentioned whether issue expenses pertain to a year or 4 months. Although above solution is based on the assumption that these expenses pertain to 5 months, but students can also consider them as expenses for year and solve the question accordingly.

Question 29:

i. **10 year bond:**

Fv = 1000 , CR= 10% , PRICE = 1000 YTM=10%

YIELD	PV OF COUPON	PV OF PRINCIPAL	PRICE
10%	614.46	385.54	1000
8%	671.01	463.19	1134.2
INCREASE	56.55	77.65	134.2

Hence increase in price = 134.2

% increase in price that comes from pv of principal amount = $(77.65/134.2) \times 100 = 57.86\%$

% increase in price that comes from pv of coupon amount = 42.14%

25 year bond: do on your own

ii. Since the bond is selling at par ytm= coupon rate = 9%

$$D = \frac{1.09}{0.09} - \frac{1.09 + 8(0.09 - 0.09)}{0.09[(1.09)^8 - 1] + 0.09} = 6.031 \text{ years}$$

iii. YTM changes to 12% CR=9%

$$\text{New duration} = \frac{1.12}{0.12} - \frac{1.02 + 8(0.09 - 0.12)}{0.09[(1.12)^8 - 1] + 0.12} = 5.85 \text{ years}$$

So as YTM increases duration decreases

REASON: As YTM increases pv of all cashflows fall. However the distant years Pv of cashflows falls proportionately more. Hence duration falls

Question 37:

NPV for bond refunding

	₹
PV of annual cash flow savings (W.N. 2) (3,49,600 × PVIFA 8%,25) i.e. 10.675	37,31,980
Less: Initial investment (W.N. 1)	31,15,000
NPV	6,16,980

Recommendation: Refunding of bonds is recommended as NPV is positive.

Working Notes:

1. Initial investment:

a. Call premium		
Before tax $(1,150 - 1,000) \times 30,000$	45,00,000	
Less tax @ 40%	18,00,000	
After tax cost of call prem.		27,00,000
b. Floatation cost		4,25,000
c. Overlapping interest		
Before tax $(0.14 \times 2/12 \times 3 \text{ crores})$	7,00,000	
Less tax @ 40%	2,80,000	4,20,000
d. Tax saving on unamortised discount on old bond $(25/30 \times 9,00,000 \times 0.4)$		(3,00,000)
e. Tax savings from unamortised floatation Cost of old bond $25/30 \times 3,90,000 \times 0.4$		(1,30,000)
		31,15,000

2. Annual cash flow savings:

Old bond

(i) Interest cost $(0.14 \times 3 \text{ crores})$	42,00,000	
Less tax @ 40%	<u>16,80,000</u>	25,20,000
(ii) Tax savings from amortisation of discount $(9,00,000/30 \times 0.4)$		(12,000)
(iii) Tax savings from amortisation of floatation cost $(3,90,000/30 \times 0.4)$		<u>(5,200)</u>
Annual after tax cost payment under old Bond (A)		<u>25,02,800</u>

(b) New bond		
(i)	Interest cost before tax (0.12×3 crores)	36,00,000
	Less tax @ 40%	<u>14,40,000</u>
	After tax interest	21,60,000
(ii)	Tax savings from amortisation of floatation cost ($0.4 \times 4,25,000/25$)	<u>(6,800)</u>
	Annual after tax payment under new Bond (B)	<u>21,53,200</u>
	Annual Cash Flow Saving (A) – (B)	<u>3,49,600</u>

Question 38:

i. If the current interest rate is 10%, the company will not extent the duration of Bond and the maximum amount the investor would ready to pay will be:

$$= 12,000 \text{ PVIAF } (10\%, 5) + 1,00,000 \text{ PVIF } (10\%, 5)$$

$$= 1,07,581$$

ii. If the current interest rate is 14%, the company will extent the duration of Bond. After 5 years the value of Bond will be

$$= 12,000 \text{ PVIAF } (14\%, 5) + 100,000 \text{ PVIF } (14\%, 5)$$

$$= 93,133$$

Thus, potential loss will be $1,07,581 - 93,133 = 14,448$

Question 39:

Here we shall compare two bonds, one with fixed copoun rate and another as per with prevailing interest rate.

i. **After 3 Years passed (5 years remaining) Value of Bond Series – A**

$$= \text{Rs. } 10000 \text{ PVIAF } (12\% ,5) + \text{Rs.} 1,00,000 \text{ PVIF } (12\%, 5)$$

$$= 92,790$$

Since Bond-Series BPrice = FV =1,00,000

After 2 additional years at the yield rate of 9%, the value of Bond shall be as follows:

Bond-Series A

$$= \text{Rs.} 10,000 \text{ PVIAF } (9\%, 2) + \text{Rs.} 1,00,000 \text{ PVIF } (9\%, 2)$$

$$= \text{Rs. } 1,01,759.11$$

Bond-Series B

$$\text{PRICE} = \text{FV} = 1,00,000$$

- ii. From above prices it can be concluded that price of Bond-Series A moves inversely with change in interest rate. Whereas, the price of Bond Series B does not fluctuate, reason being its interest (coupon) adjusted according to change in interest rates.

Question 40:

i. Calculation of Forward Rates

Maturity	YTM (%)	PVIF	Face value	Price	Forward rate	
1	11	0.9009	10,000	9009		
2	12	0.7972	10,000	7972	0.1301 i.e.	13.01%
3	13	0.6930	10,000	6930	0.1503 i.e.	15.03%

ii. Calculation of Expected Prices and YTM

Maturity	Forward rate	Face value	Price	YTM	
2	0.1301	10,000	$10000/1.1301 = 8848.78$	0.1301 i.e.	13.01%
3	0.1503	10,000	$10000/1.1401^2 = 7693.32$	0.1401* i.e.	14.01%

*F13

Question 42:

i. Conversion Value of Debenture

$$= \text{Market Price of one Equity Share} \times \text{Conversion Ratio}$$

$$= ₹ 25 \times 30 = ₹ 750$$

ii. Market Conversion Price

$$\frac{\text{Market Price of Convertible Debenture}}{\text{Conversion Ratio}}$$

$$= \frac{₹ 900}{30} = ₹ 30$$

iii. Conversion Premium per share

$$\text{Market Conversion Price} - \text{Market Price of Equity Share}$$

$$= ₹ 30 - ₹ 25 = ₹ 5$$

iv. Ratio of Conversion Premium

$$\frac{\text{Conversion premium per share}}{\text{Market Price of Equity Share}} = \frac{₹ 5}{₹ 25} = 20\%$$

v. Premium over Straight Value of Debenture

$$\frac{\text{Market Price of Convertible Bond}}{\text{Straight Value of Bond}} - 1 = \frac{₹ 900}{₹ 700} - 1 = 28.6\%$$

vi. Favourable income differential per share

$$\frac{\text{Coupon Interest from Debenture} - \text{Conversion Ratio} \times \text{Dividend Per Share}}{\text{Conversion Ratio}}$$

$$\frac{\text{₹ } 85 - 30 \times \text{₹ } 1}{30} = \text{₹ } 1.833$$

vii. Premium pay back period

$$\frac{\text{Conversion premium per share}}{\text{Favourable Income Differential Per Share}} = \frac{\text{₹ } 5}{\text{₹ } 1.833} = 2.73 \text{ Years}$$

Question 45:

Working Notes:

i. Conversion Value of Debenture

$$\begin{aligned} &= \text{Market Price of one Equity Share} \times \text{Conversion Ratio} \\ &= \text{₹ } 30 \times 25 = \text{₹ } 750 \end{aligned}$$

ii. Market Conversion Price

$$\begin{aligned} &\text{Market Price of Convertible Debenture} / \text{Conversion Ratio} \\ &1000 / 25 = \text{₹ } 40 \end{aligned}$$

iii. Conversion Premium per share

$$\begin{aligned} &\text{Market Conversion Price} - \text{Market Price of Equity Share} \\ &= \text{₹ } 40 - \text{₹ } 30 \\ &= \text{₹ } 10 \end{aligned}$$

iv. Favourable income differential per share

$$= \frac{\text{Coupon Interest from Debenture} - \text{Conversion Ratio} \times \text{Dividend Per Share}}{\text{Conversion Ratio}}$$

$$= \frac{90 - 25 \times 1}{25} = \text{₹ } 2.6$$

v. Premium pay back period

$$\begin{aligned} &= \text{Conversion premium per share} / \text{Favourable Income Differential Per Share} \\ &= 10 / 2.6 = 3.85 \text{ years} \end{aligned}$$

Analysis: Thus from above it can be analysed that:

- The Conversion Value of Debenture is less than the Market Value of Debenture because the Coupon Interest Rate is higher than Yield as Straight Value is somewhat near about the conversion value.
- If the investor adopts the route of Convertible Debenture for acquiring shares he/ she will have to pay premium over the market price.

- So far as the recovery of the premium paid for acquiring one share is concerned approximate it will take about 4 years.
- However, in case if the market price of the share is increased then of course the premium will be reduced and hence the payback period. Reverse will happen in case if the prices of the share goes below ₹ 30 per share.

Question 53:

- i. For finding expected market price first we shall calculate Intrinsic Value of Bond as follows:**

PV of Interest + PV of Maturity Value of Bond

Forward rate of interests

- 1st Year 13%
- 2nd Year 12.62%
- 3rd Year 12.33%
- 4th Year 12.06%

YEARS	INT RATE	CF	PV
1	13	10	8.85
2	12.62	10	7.88
3	12.33	10	7.06
4	12.06	110	69.76
			93.55

Expected Price = Intrinsic Value x Beta Value
 = Rs. 93.55 x 1.05
 = Rs. 98.23

- ii. The given yield curve is inverted yield curve.**

The main reason for this shape of curve is expectation for forthcoming recession when investors are more interested in Short-term rates over the long term.

Question 59:

GOVT BOND	PURCHASE RATE	MARKET VALUE FOR 7CR F.V.
2026	106	7.42
2030	104	7.28
2035	105.50	7.385
2042	109	7.63
2052	102	7.14
	Actual investment in portfolio	36.855

Existing duration of portfolio = $[7.42 \times 3 + 7.28 \times 6 + 7.385 \times 7 + 7.63 \times 8 + 7.14 \times 12] / 36.855$
 = 7.1728 years

i. Interest rates are expected to lower by 75 basis points

We should increase portfolio duration by shifting from short term bonds to long term bonds. So we may sell GOI 2026 and buy GOI 2052

$$\begin{aligned}\text{Revised duration} &= [0 \times 3 + 7.28 \times 6 + 7.385 \times 7 + 7.63 \times 8 + 14.56 \times 12] / 36.855 \\ &= 8.9848 \text{ years}\end{aligned}$$

ii. Interest rates are expected to raise by 25 basis points.

We should decrease portfolio duration by shifting from long term bonds to short term bonds. So we may sell GOI 2052 and buy GOI 2026

$$\begin{aligned}\text{Revised duration} &= [14.56 \times 3 + 7.28 \times 6 + 7.385 \times 7 + 7.63 \times 8 + 0 \times 12] / 36.855 \\ &= 5.429 \text{ years}\end{aligned}$$