Assignment

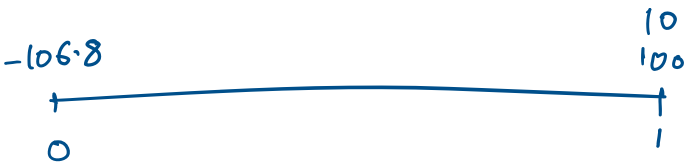
16 March 2022 12:53

Q2- Solution

Given data :-

a]

A :-

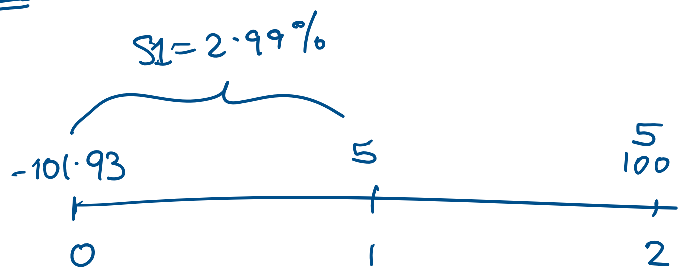


$$\text{Spot Rate} = 110(1+x)^{-1} - 106.8$$

$$0 = 110(1.0299)^{-1} - 106.8$$

$$\therefore \boxed{S1 = 2.99\%}$$

B :-

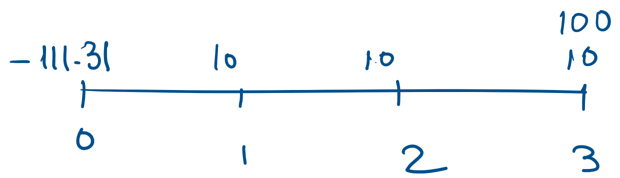


$\boxed{S2 = 3.98\%}$ [Spot Rate]

Eq :- [Table f^n]

$$5\left[\frac{1-(1+x)^{-2}}{x}\right] - 101.93 + 100(1+x)^{-2}$$

C :-



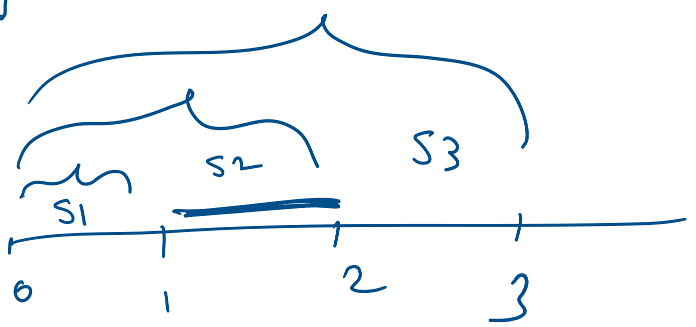
eg:-

$$10\left[\frac{1-(1+x)^{-3}}{x}\right] - 111.31 + 100(1+x)^{-3}$$

$x = 5.786\%$

$\boxed{S3 = 5.786\%}$

b)



$1y1y = ?$

$(1+S2)^2 = (1+S1)(1y1y)$

$(1.0398)^2 = (1.0299)(1y1y)$

$$1y1y = \frac{1.0398^2}{1.0299} - 1$$

$$= \boxed{4.9795\%}$$

Q3 Sol^n :-

Given data :-

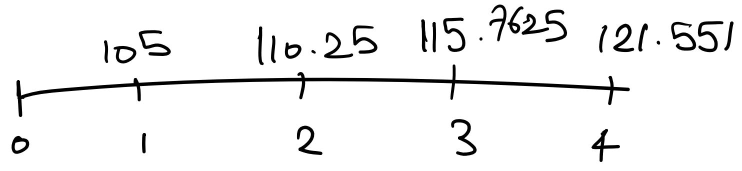
Year 1 = $100(1+0.05)$

Year 2 = $100(1.05)^2$

Int Rate = 5% p.a for all maturities

a.

Time Line



$$\text{Current Price} = \frac{105}{1.05} + \frac{110.25}{1.05^2} + \frac{115.7625}{1.05^3} + \frac{121.551}{1.05^4}$$

$$= \boxed{\$400}$$

b. [Assuming Macaulay Dur^n is asked]

Macaulay Dur^n :-

$$\frac{1+r}{r} - \frac{1+r+[n \times (c-r)]}{c \times [(1+r)^n - 1] + r}$$

$$\frac{\Sigma Pv \times t}{\Sigma Pv}$$

$$\frac{(100\times1)+(100\times2)+(100\times3)+(100\times4)}{400}$$

$$= \boxed{2.5} \text{ years}$$

Modified Dur^n :-

$$-\frac{Mac \cdot d}{1+YTM}$$

$$= \frac{-2.5}{1+0.05}$$

$$= \boxed{2.38095} \text{ years}$$

Q.4 Sol^n

Basis Point Change = ± 0.005

Largest
to
Least

We know that Low Coupon, Long Maturity & low YTM are more sensitive to price change.

The sequence is :-

b. Ignoring maturity → b : being ZCB, it has highest
c. volatility.

b. c. d. a.

Ignoring maturity → b: being ZCB, it has highest volatility.
c & d are second most volatile followed by a being least volatile.

Q.1

Given:-

Half-yearly effective rate: 8%

$$(1+i) = \left(1+\frac{i^{(p)}}{p}\right)^p \rightarrow 8\%$$

$$1+i = \left(1+\frac{0.08}{2}\right)^2$$

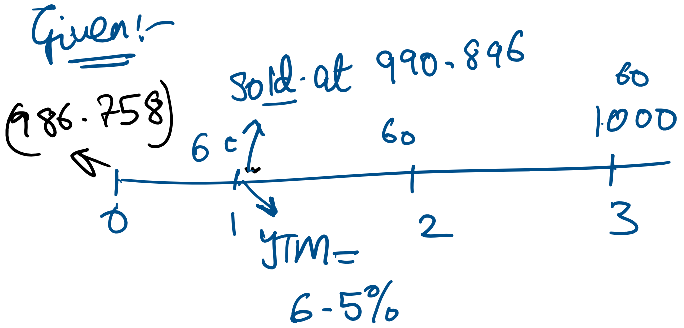
$$i = (1+0.04)^2 - 1$$

$\boxed{i = 8.16}$ effective rate p.a.

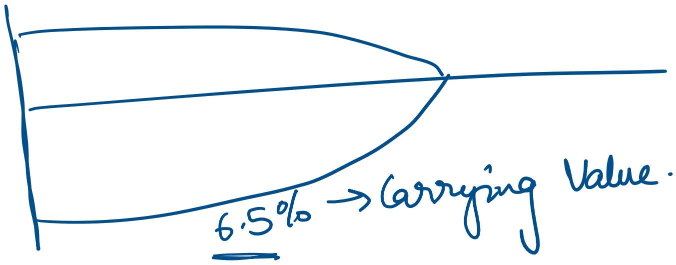
⇒ They will have to pay 8.16% coupon rate annually in order to sell at par.

Q.5

Given:-



a. So:-



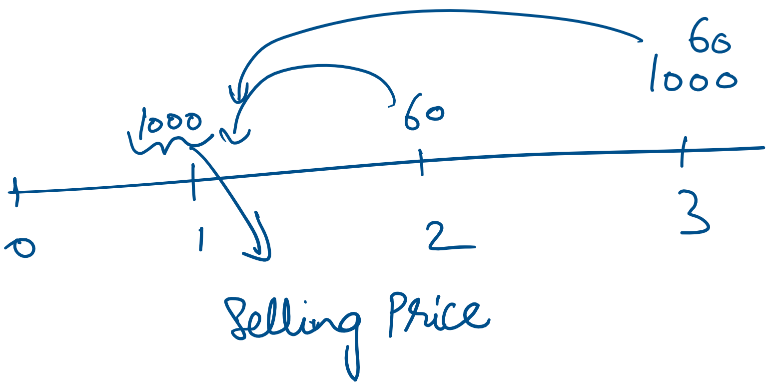
⇒ Since when the Bond is sold the YTM is 6.5% which lies on the price-yield trajectory, the rate of return will also be 6.5%.

b. $60\left(\frac{1-(1+6.5\%)^{-3}}{6.5\%}\right)+1000(1.065)^{-3}$

$= \underline{986.758}$ [Purchasing Price $|_{t=0}$]

$986.758\,(1.065)$

Selling $|_{t=1}$



$RoR = \frac{1060}{986.758} - 1 = \boxed{7.422\%}$

Q.6)

If the underwriter purchases the bonds from the corporate client, then it assumes
the full risk of being unable to resell the bonds at the

stipulated offering price. In other words, the underwriter bears the risk of interest rate movement between the time of purchase and the time of resale. For long maturity bonds, it is generally true that its duration is also long. Thus, bonds with long maturities are more exposed to interest rate movement risk. Therefore, the underwriter demands a larger spread (higher underwriting fees) between the purchase price and stipulated offering price.

Q-8)

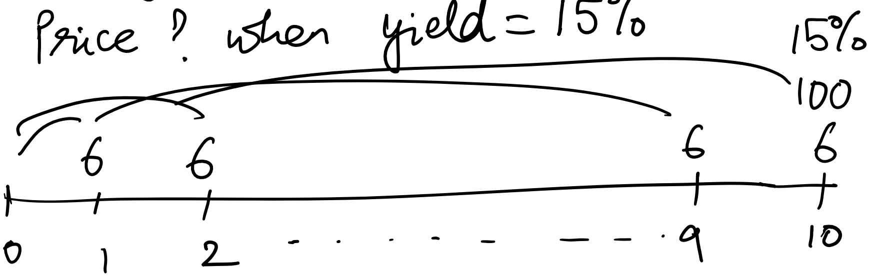
Given:-

Price = \$100

Coupon = 6%

T = 10yrs

a. Price? when yield = 15%



$$\therefore = 6\left[\frac{1-(1.15)^{-10}}{0.15}\right] + 100(1.15)^{-10}$$

$$= \boxed{54.831}$$

b. 15% → 16% yield increase

Price = ?

$$6\left[\frac{1-(1.16)^{-10}}{0.16}\right] + 100(1.16)^{-10}$$

$= \boxed{51.668}$ {price at 16% YTM}

-5.768635% change

c. Price when yield is 5% = ?

Price = $\boxed{107.723}$

d. Since yield increases from 5% to 6% [same as coupon rate], the Price is 100.

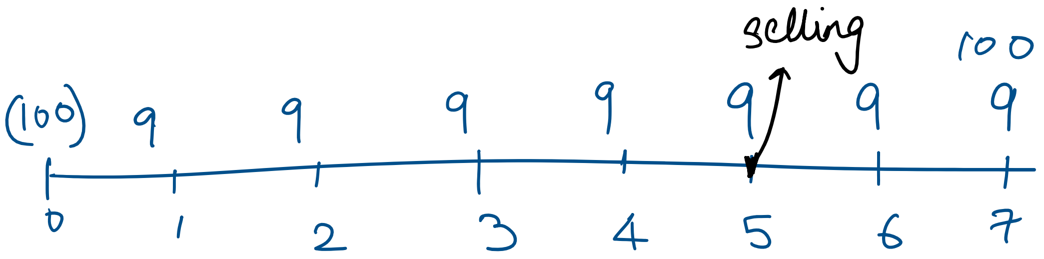
$$\frac{107.723 - 100}{107.723}$$

$= \boxed{7.1693\%}$

e. From answers in part b. and d, we can understand that as the yield decreases the volatility increases and vice versa.

Q.9

The timeline here will be :-



Price at time 5:

$$\underbrace{9\left(\frac{(1.094)^5-1}{0.094}\right)}_{\text{acc.}} + \underbrace{9(1.112)^{-1} + 109(1.112)^{-2}}_{\text{disc.}}$$

$$= 54.2933 + 96.2424$$

$$= \boxed{150.5357}$$

∴ The total return =

$$100(1+i)^5 = 150.5357$$

$$= 8.524527\%$$

Q.10

Given:-

T = 20yr

YTM = 8%

ZCB

Since we know that a ZCB has zero reinvestment risk if held to maturity, it's return isn't dependent on the interest component.

Thus, int earned on ZCB held to maturity is same as promised YTM i.e 8% in this case.

Q. 11

Yes, the ZCB rates will change over time since Convexity relⁿ holds true for a zero coupon Bond as well.

Also, the price responsiveness of a ZCB is diff as yields change. As the maturity gets higher, the price responsiveness of ZCBs increase with resp. to lower int. rates as compared to higher int. rates. Moreover, for a given yield & maturity, ZCBs have higher convexity & thus price responsiveness to movements in yields.

Q. 13

While 2 portfolios can have the same duration, their convexities may differ so that even for a parallel shift in the yield curve, the % change in price may differ.

For non-parallel shift in the yield curve, portfolio of differing convexities may perform very differently even if they have the same duration!

Q. 14

a. Given

Bond	Market Value	Duration
W	13	2
X	27	7
Y	60	8
Z	40	14

Total $\underline{\underline{140}}$

(i)

Since Sum of MV = 140

$\therefore$ Duration of Bond = Σ weights X dur^n

$$\frac{13\times2}{140} + \frac{27\times7}{140} + \frac{60\times8}{140} + \frac{40\times14}{140}$$

$$= \boxed{8.964}$$

(ii)

Duration X Σ MV X Basis Point Change.

$= 8.964 \times 140 \times 0.005$

$$= \frac{6.2748}{140} \times 100$$

$$= \boxed{4.482\%}$$

(iii) For:

$W \rightarrow 2 \times \frac{13}{70} = 0.18571$

$X \rightarrow 7 \times \frac{27}{140} = 1.35$

$Y \rightarrow 8 \times \frac{60}{140} = 3.4286$

$2 \rightarrow \frac{14 \times 40}{140} = 4$

Q.15

(i) What is Yield Curve?

→ The graphical depiction of relⁿ betⁿ yield on bonds of same credit quality but diff maturities. More often, constructed from observations of prices & yields in treasury market.

(ii) Treasury Securities are free from default risk. The Treasury markets are largest and most active bonds market offering the fewest obstacles in terms of illiquidity & infrequent trading