FIN 532

Problem Set 5

(1)

$$10{,}000{,}000 = \frac{F}{1.06^{20}}$$

$F = \$32{,}071{,}354.72$

(2) Semi-annual coupon = 35

interest rate = 0.076/2 = 3.8%

N	I/Y	PV	PMT	FV
4	3.8		35	1,000
		-989.06		

Bond Price = \$ 989 06

(3) a.

N	I/Y	PV	PMT	FV
20		-1,034.74	40	1,000
	3.75			

YTM = 2 * 3.75 = 7.50%

b.

N	I/Y	PV	PMT	FV
20	4.5		40	1,000
		- 934.96		

New bond price = $934.96.

4. a. The bond trades at a premium since coupon rate > YTM.

b.

N	I/Y	PV	PMT	FV
14	3.5		40	1,000
		- 1,054.60		

The new bond price is $ 1,054.60.

5. a.

N	I/Y	PV	PMT	FV
10	6		70	1,000
		- 1,073.60		

When it was issued, the price of the bond was $ 1,073.60.

b.

N	I/Y	PV	PMT	FV
9	6		70	1,000
		-1,068.02		

Bond price after coupon = \$1,068.02

⇒ Price before coupon = 1,068.02 + 70

= \$1,138.02

6. You need to set the coupon rate equal to the YTM of the existing bonds.

N	I/Y	PV	PMT	FV
20		-1,078	30	1,000
	2.50			

The YTM = 2.50 × 2 = 5%, which should also be the coupon rate so the new bonds are issued at par.

7 a.

N	I/Y	PV	PMT	FV
60	3		25	1,000
		-861.62		

Bond Price = \$ 861.62.

b.

N	I/Y	PV	PMT	FV
59	2.9		25	1,000
		-887.61		

New bond price = \$ 887.61

c. $HPR = \left(\dfrac{887.61 + 25}{861.62}\right)^2 - 1 = 12.19\%$

I'm squaring the gross return to express the rate per year compounded annually.

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Economy	Prob.	YTM	Price	HPR
Boom	0.2	11%	\$74.05	-17.95%
Normal	0.5	8%	\$100.00	8%
Recession	0.3	7%	\$112.28	20.28%

9 a.

$$r_1 = \frac{1,000}{930} - 1 = 7.53\%$$

$$r_2 = \left(\frac{1,000}{850}\right)^{1/2} - 1 = 8.47\%$$

$$r_3 = \left(\frac{1,000}{770}\right)^{1/3} - 1 = 9.10\%$$

$$r_4 = \left(\frac{1,000}{700}\right)^{1/4} - 1 = 9.33\%$$

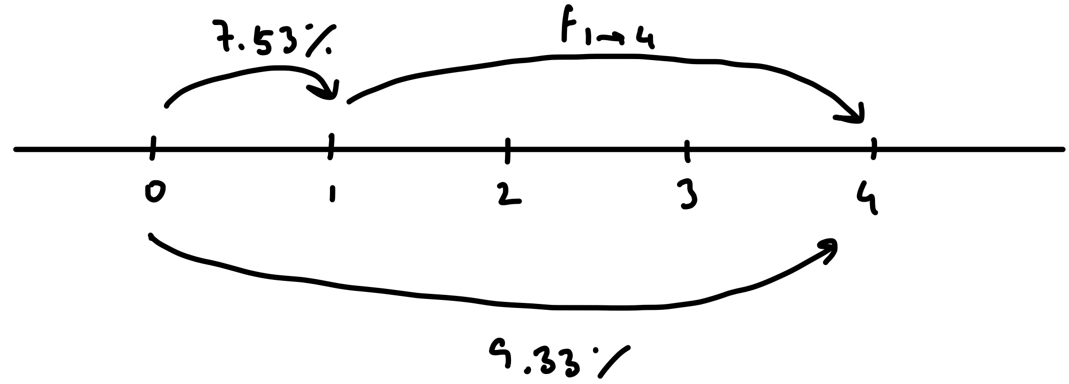
b.

$$B = 0.08 \times 930 + 0.08 \times 850 + 0.08 \times 770 + 1.08 \times 700 = \$960$$

N	I/Y	PV	PMT	FV
4		-960	80	1,000
	9.24			

YTM = 9.24%

c.



$$1.0753 \times (1 + F_{1\to 4})^3 = (1.0933)^4$$

$$F_{1\to 4} = \left(\frac{(1.0933)^4}{1.0753}\right)^{1/3} - 1 = 9.93\%$$

d. The bond trades for \$985, but it's worth \$960. Sell the bond to receive \$985, and buy 8% of Z(1), 8% of Z(2), 8% of Z(3) and 108% of Z(4) which will cost \$960. You make an instant profit of \$25 per trade.

(10) a. $Z(1) = \dfrac{1{,}000}{1.10} = \$909.09$

$Z(2) = \dfrac{1{,}000}{1.09^2} = \$841.68$

$Z(3) = \dfrac{1{,}000}{1.08^3} = \$793.83$

b. $1.10 \times (1 + f_{1\to2}) = 1.09^2$

$f_{1\to2} = \dfrac{1.09^2}{1.10} - 1 = 8.01\%$

$1.09^2\,(1 + f_{2\to3}) = 1.08^3$

$f_{2\to3} = \dfrac{1.08^3}{1.09^2} - 1 = 6.03\%$

$1.10 \times (1 + f_{1\to3})^2 = 1.08^3$

$f_{1\to3} = \left(\dfrac{1.08^3}{1.10}\right)^{1/2} - 1 = 7.01\%$

c.

$B_0 = \dfrac{85}{1.10} + \dfrac{85}{1.09^2} + \dfrac{1{,}085}{1.08^3} = \$1{,}010.12$

d. $B_1 = \dfrac{85}{1.10} + \dfrac{1{,}085}{1.10^2} = \$973.97$

$HPR = \dfrac{973.97 + 85}{1{,}010.12} - 1 = 4.84\%$

e. Yes, there is an arbitrage opportunity.

Sell 0.085 Z(1), 0.085 Z(2) and 1.085 Z(3) and collect \$1,010.12.

Use \$1,000 to purchase the bond

You make \$10.12 per trade.

(11) a.

T	CF	DCF	Weight
5	10	$\frac{10}{1.08^5} = \$6.81$	$\frac{6.81}{9.29} = 73.26\%$
30	25	$\frac{25}{1.08^{30}} = \$2.4$	$\frac{2.4}{9.29} = 26.74\%$

PV = \$9.29

$D = 5 \times 0.7326 + 30 \times 0.2674 = 11.69$ years.

b. Zero-coupon bond with maturity 11.69 years and face value $9.29 \times (1.08)^{11.69} = \$22.84$ million.

c. If rates are 9%, the zero coupon bond is worth

$$\frac{22.84}{1.09^{11.69}} = \$ 8.34 \text{ million}$$

whereas the liability is worth

$$\frac{10}{1.09^5} + \frac{25}{1.09^{30}} = \$8.38 \text{ million}$$

The net position is

$$8.34 - 8.38 = -\$0.04 \text{ million.}$$

12 a.

T	CF	DCF	Weight
10	20	$\frac{20}{1.06^{10}} = \$11.168$	47.24%
20	40	$\frac{40}{1.06^{20}} = \$12.472$	52.76%

$$PV = \$23.640$$

$$D = 0.4724 \times 10 + 0.5276 \times 20 = 15.276 \text{ years.}$$

b. You would buy a zero-coupon bond with maturity 15.276 years and face value $23.64 \times 1.06^{15.276} = \$57.573$ million.

c. $5W_5 + 30W_{30} = 5(1 - W_{30}) + 30W_{30} = 15.276$

$W_{30} = 41.10\%$ and $W_5 = 58.90\%$

Thus, you should invest

$0.5890 \times 23.64 = \$13.924$ in B_5

$0.4110 \times 23.64 = \$9.716$ in B_{30}.