

**Midterm Exam #1**  
 ADM 3351 M  
**Fixed Income Securities**  
 Winter 2009  
 (1 Hour and 20 minutes)  
 Prof. C. Guo

*Closed-book exam. No material of any kind is allowed. A calculator is required.  
 The formula page can be detached and need not submit.*

Name (print legibly) \_\_\_\_\_

Student Number \_\_\_\_\_

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**Statement to be signed by the student:**

I have read the text on academic integrity and I pledge not to have committed or attempted to commit academic fraud in this examination.

Signed: \_\_\_\_\_

Note: an examination copy or booklet without that signed statement will not be graded and will receive a final exam grade of zero.

Question	Credit	Mark
<b>n</b>		
<b>1</b>	15	
<b>2</b>	15	
<b>3</b>	20	
<b>4</b>	25	
<b>5</b>	25	
<b>Total</b>	100	

Apr 15 \$ 0015

**Question 1** (15 points)

A 6.5% U.S. Treasury bond will mature on April 15, 2020. Today is Feb. 10, 2009. For simplicity, assume that the bond trading can be settled on the same day. If the yield-to-maturity of the bond is 3.00%, how should the bond price be quoted? Assume that this bond is fairly priced, i.e., the present value of the cash flows of the bond is equal to the invoice (dirty) price of the bond. Draw a time line to clearly indicate the cash flows of the bond. Explicit calculations are required regardless what kind of calculator you use.

(Hint: (i) U.S. Treasury securities pay semiannual coupon interests; (ii) bond price is “clean price”, i.e., net of accrued interest).

**Solution:**

$$u = 118/182 = 0.648$$

$$AI = (6.5/2) * 0.648 = 2.11$$

$$F = 100$$

$$n = 23 \text{ cash flows}$$

$$PVIFA(1.5\%, 23) = 19.33$$

$$P_{\text{standard}} = 3.25 * PVIFA(0.015, 23) + 100 / (1.015)^{23} = 133.829$$

$$P_{\text{invoice}} = (1.015)^{0.648} P_{\text{standard}} = 135.127$$

$$P_{\text{quote}} = P_{\text{invoice}} - AI = 135.127 - 2.11 = 133.02$$

Settle Day	Last Coup	# since last	Next coup	# of days	u	AI
10/02/2009	15/10/2008	118.0	15/04/2009	182	0.648351648	2.10714286
P_Quote	Coupon	Maturity	Term	# of CF	r-semi	YTM
133.019979	6.5	15/04/2020	22.367123	23	0.015	0.03
Invoice P	P_Standard					
135.127122	133.8290075					

**Question 2** (15 points)

A floater of \$100 million face value pays semiannual floating rate coupon at LIBOR + 1%. It was last coupon reset date was November 15, 2008 when LIBOR=4.5%. Today is Feb 10, 2009, and the current LIBOR=3.5% (the six-month LIBOR in this question is quoted as APR with semiannual compounding).

- (1) What is the current market value of the floater? (10 points)
- (2) What will be the value of the floater at the next coupon reset date after the current coupon has been paid? (5 points)

To find the next value after the next coupon reset we need to find the coupon value, the discount rate, the  $v$  and then calculate with  $(\text{floater value} + \text{coupon rate}) / (1 + \text{the discount rate})^v$ . Answer the PV

**Answer:**

(1)

Floater F	100					
Old LIBOR	Current LIBOR	Spread	Coupon	Discount r	$u$	$v$
0.045	0.035	0.01	2.75	0.0225	0.4807	0.5193
Last reset	Current date	Next reset	Days since	Days to next	Days btwn	
15/11/2008	10/02/2009	15/05/2009	87	94	181	
PV==>	101.569500					

(2) Face value, i.e., \$100 million.

100  $C = r = \text{par value}$

**Question 3 (20 points)**

Assume that the yield curve is always flat. The current interest rate level is at 2% (BEY). Concerned with increasing inflation risk, you have estimated that the interest rate will rise at the pace of 25 basis points every 6 months for the next 2 years. You have a two-year investment horizon. You are considering an outstanding U.S. Treasury bond with 7.5% annual coupon rate, which will mature in 7 years. What annualized return (in BEY) can you realize over two years if you invest in this bond?

**Answer:**

If investing in the 7.5% 7-year bond,

Year	R(BEY)	r(semiannual)	# of years	# of periods	Coupon	Price	Interest	Cum Int
0.0	0.0200	0.0100	7.0	14	7.5	135.760	0	
0.5	0.0225	0.0113	6.5	13	7.5	131.582	3.750	3.750
1.0	0.0250	0.0125	6.0	12	7.5	127.698	3.750	7.500
1.5	0.0275	0.0138	5.5	11	7.5	124.092	3.750	11.250
2.0	0.0300	0.0150	5.0	10	7.5	120.750	3.750	15.000

Horizon Return =  $[(120.75 + 15.293) / 135.76]^{1/4} - 1 = 0.0005$  per half-year, and in BEY,  $2 * 0.0005 = 0.001$ .

$$\begin{aligned}
 & 3.8927 \quad 3.75 (1.0113)(1.0125)(1.0138) \\
 & 3.8442 \quad 3.75 (1.0125)(1.0138) \\
 & 3.8017 \quad 3.75 (1.0138) \\
 & 3.75 \quad 3.75
 \end{aligned}$$

**Question 4 (25 points)**

A 7% Treasury bond with 12-year remaining maturity currently sells to yield 8% (BEY). Calculate the duration and convexity and use them to approximate the percentage price change of the bond for 1% immediate increase in yield.

**Solution:**

R(BEY)	r(semiannual)	# of years	# of periods	upon(% p.	Price	Modified Duration	Convexity	Macauley Duration
0.080	0.0400	12.0	24	7	92.377	7.83031	81.2536813	16.286715
0.081	0.0405	12.0	24	7	91.657			
0.079	0.0395	12.0	24	7	93.104			
0.090	0.0450	12.0	24	7	85.505			
App %P=	-0.074240404							
Actual	-0.074391165							

Approximating Duration = 7.83 years

Approximating Convexity = 81.25

Percentage change in bond price with respect to 1% increase in yield is:

$$\begin{aligned} \Delta P / P &= -(\text{Modified D}) \times dy + \frac{1}{2}(\text{Convexity}) \times (dy)^2 \\ &= -7.83 \times 0.01 + 0.5 \times 81.25 \times (0.01)^2 = -0.07424 \approx -7.42\% \end{aligned}$$

**Question 5** (25 points)

The current term structure of interest rate is given below, where the YTM on bonds with maturities less than or equal to one year are zero-coupon yields, and the rest are par-yields, i.e., YTM on par valued coupon bonds. All of the quotes are expressed as BEY, i.e., APR with semiannual compounding.

- (a) Find the missing spot rates (15 points)  
 (b) Find the price of a 6% coupon bond with 5 years to maturity by the spot rate yield curve (10 points).

Year	YTM	Spot Rate	<i>D, 3 cent</i>	<i>Cash Flow</i>	<i>PV<sub>t</sub></i>
0.5	2.300				
1.0	2.800	<i>2.3</i>			
1.5	3.100	<i>2.8</i>			
2.0	3.400				
2.5	3.600	3.619			
3.0	3.800	3.827			
3.5	4.000	4.037			
4.0	4.150	4.195			
4.5	4.300	4.355			
5.0	4.400	4.462			

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Answer:

			100.000	100.000	100.000	100.000	100.000	100.00
			3.100	3.400	3.600	3.800	4.000	4.15
			1.5	2.0	2.5	3.0	3.5	4.
Year	YTM	Spot Rate	1.550	1.700	1.800	1.900	2.000	2.07
0.5	2.300	2.300	1.532	1.681	1.780	1.878	1.977	2.05
1.0	2.800	2.800	1.507	1.653	1.751	1.848	1.945	2.01
1.5	3.100	3.107	96.961	1.623	1.719	1.814	1.910	1.98
2.0	3.400	3.414	0.000	95.042	1.682	1.776	1.869	1.93
2.5	3.600	3.619	0.000	0.000	93.069	1.737	1.828	1.89
3.0	3.800	3.827	0.000	0.000	0.000	90.947	1.785	1.85
3.5	4.000	4.037	0.000	0.000	0.000	0.000	88.686	1.80
4.0	4.150	4.195	0.000	0.000	0.000	0.000	0.000	86.45
4.5	4.300	4.355	0.000	0.000	0.000	0.000	0.000	0.00
5.0	4.400	4.462	0.000	0.000	0.000	0.000	0.000	0.00

(b)

coupon	6.000				
maturity	5.000		Discount	Cash	
Year	YTM	Spot Rate	Factor	Flow	PV
0.5	2.300	2.300	0.989	3.00	2.966
1.0	2.800	2.800	0.973	3.00	2.918
1.5	3.100	3.107	0.955	3.00	2.864
2.0	3.400	3.414	0.935	3.00	2.804
2.5	3.600	3.619	0.914	3.00	2.743
3.0	3.800	3.827	0.893	3.00	2.678
3.5	4.000	4.037	0.869	3.00	2.608
4.0	4.150	4.195	0.847	3.00	2.541
4.5	4.300	4.355	0.824	3.00	2.471
5.0	4.400	4.462	0.802	103.00	82.608
				P=	107.200