

Answers to Sample Questions in Spiral Bound Book  
Lecture Topics 1-5

Lecture 1:

1. The Fisher equation tells us that the nominal rate on a debt instrument is set by the adding expected inflation to the required real rate of return. We can rewrite the Fisher equation to get the required real rate from expected inflation and the nominal contract rate. In this example, the contract rate is 5.75 and expected inflation is 3, so the required real rate is  $5.75 - 3$  or 2.75%.
2. If your parents hold a 9% TVA bond now, it must be selling at a premium because these trade at yields very close to those of Treasuries, which have much lower yields. So 9% is quite a nice coupon to be receiving these days. If you don't quite see this, write down the cash flows on a 9% bond (pick a short one with annual coupons to save work) and start out with a price of par (discount rate of 9%). Now make the interest rate lower (say 5%) and look at the new price of the bond. You should get a number that is larger than \$1000. If the TVA bonds are worth a premium over face value, your parents would not choose to cash them in for their face value (if they needed the money for your education they could take them to a bond dealer and get a better price).
3. The expectations theory of the yield curve says that the rate on a long term instrument is a geometric average of the yields on one year instruments between now and the end of the maturity of the long term debt. (A geometric average is calculated by multiplying the various expected rates (using  $1+r$ , not  $r$ ) and then taking the  $n$ th root of the product.) If we are talking about a two year note, we take today's one year rate, multiply it by next year's one year rate (the rate that is expected), and then take the square root. With a thirty year bond, we need to multiply out all those future rates, which in this case are nearly identical, and then raise the product of the rates to the power  $1/30$ . In this question, you could actually calculate the rate that people expect the one-year bill to change to, but were not asked such detail. All you need to know for the answer is that if the long bond has a higher rate than today's, then it must be (according to the expectations theory) that there is an increase in one year rates.
4. (c). The FF rate would increase in the near future. The expectations theory of the yield curve states that longer maturity bonds' yields are based on expectations of future one year rates. So a two year bond yield should be a geometric average of today's one year rate and what people expect the one year rate to be in a year. If the yield curve is steep, people are expecting rates to go up in the future, either because of higher inflation or higher real rates from the Fed tightening. Answers (a) and (b) are wrong because both would imply lower future rates, which gives a flat or inverted yield curve. Answer (d) suggests future rates would be lower because of supply and demand factors, again giving the wrong shape to the yield curve.

Lecture 2:

1. Duration is 1.44 years. This is obtained by taking the present values of the cash flows and using them as weights in a weighted average of the coupon dates. In a few steps below you can see the PV of the bond and see that the weights for times .5, 1 and 1.5 are .03846, .03698 and .9259. Except for rounding, these weights should add up to 1. Multiply .5 by the first weight, 1 by the second and 1.5 by the third to get the duration. Because this is a semi-annual coupon, the duration formula is slightly different (the divisor is  $1 + .5R$ , not  $1+R$ ). Using the duration approximation, the bond price change would be

$$1.44 (.002/1.04) = .277\% \text{ or nearly 28 basis points}$$

Given that the bond was initially selling at par, the new price would be \$99.72 for every \$100 face value of bonds ( a decline of 28 cents per each \$100 face value).

Just for completeness, compare that answer to the one you would get by discounting the cash flows:

The discounted value of the semiannual coupon bond at the old interest rate (8.0%) was:

$$\frac{4}{1.04} + \frac{4}{1.04^2} + \frac{100 + 4}{1.04^3} = 100$$

Now, with rates at 8.2%, the discounted cash flow is:

$$\frac{4}{1.041} + \frac{4}{1.041^2} + \frac{100 + 4}{1.041^3} = 99.723$$

2. % change in  $P = -MD * \text{change in rates}$ , so the bond price declines by 6.5%

3. Duration is about 2.82. Because of the change in inflation expectations, rates rise by 50 bp, so the % change in rates is  $50\text{bp}/(1 + 5/2)$ . [Remember Treasury coupons are paid semi-annually, so assume semi-annual unless you are told annual.]  $D * \% \text{ change in } R$  is  $2.82 * .00487 = -1.38\%$ . As it started out at par, the new price ought to be about \$98.62 for each face of \$100 owed.

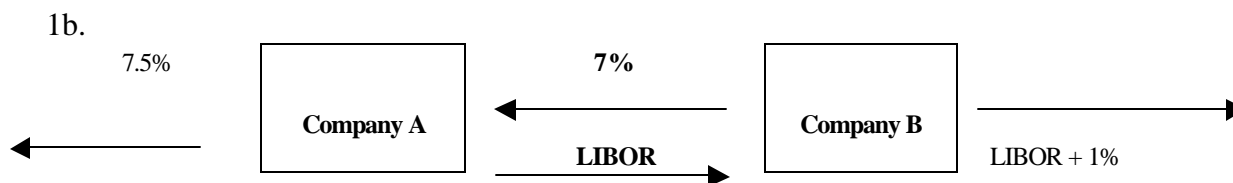
4. Since the bonds have the same duration, their interest rate sensitivity should be about the same.

5. The zero coupon bond will be more sensitive to interest rates because it has no intermediate cash flows. An amortizing bond pays out principal and interest on a regular (usually monthly) basis, and therefore, the more frequent cash flows of the amortizing bond cause it to have less interest rate sensitivity. Consistent with this explanation, its duration will also be shorter.

Lecture 3:

1a. Cash Flows for Company B:

Date	LIBOR	Floating CF Received	Fixed CF Paid	Net Cash Flow
Beginning Date	6.6%	NONE	NONE	NONE
End of Year 1	6.7%	\$66 million	\$70 million	-\$4 million
End of Year 2	6.8%	\$67 million	\$70 million	-\$3 million
End of Year 3	7%	\$68 million	\$70 million	-\$2 million
End of Year 4	7.4%	\$70 million	\$70 million	\$0



1c. Cash flows for Company A:

Pay: -LIBOR  
 Receive: 7%  
Pay: -7.5%  
 Net Pay:  $-(\text{LIBOR} + .5\%)$  or  $-\text{LIBOR} - .5\%$

1d. Cash flows for Company B:

Pay: -7%  
 Receive: LIBOR  
Pay:  $-(\text{LIBOR} + 1\%)$  or  $-\text{LIBOR} - 1\%$   
 Net Pay: -8%

- 1e. A has transformed a fixed rate liability to a floating rate liability  
 B has transformed a floating rate liability to a fixed rate liability

2. Modified duration is:  $\text{Duration}/(1+\text{rate}) = 6/1.07 = 5.61$   
 The capital loss would be:  $2 * 5.61 = 11.215\% * \$1,900,000 = \$213,085$

b. The manager could sell a forward contract to lock in the 7% rate. The contract would obligate him to sell 10-year bonds at today's rate of 7% (bond value is \$1,900,000) in 3 months.

c. If rates go to 9%, the value of the bond will go down by \$213,085 to \$1,686,915. However, the forward contract would gain an equal amount, which would offset the loss on the balance sheet. Technically, the gain in the forward is equivalent to the manager buying the bond in the open market for \$1,686,915, and then selling it to his counterparty for \$1,900,000, for a gain of \$213,085. If the forward is cash-settled, the counterparty would just pay \$213,085. The net effect on the financial position of the bank is \$0.

d. If rates drop to 6%, the balance sheet asset will gain:  $5.61 \times 1 = 5.61\% \times 1,900,000 = 106,590$ . However, the forward position will lose the same amount, since the bank now must buy the bond on the open market at market value  $(1,900,000 + 106,590) = 2,006,590$ , and then sell it to the counterparty for \$106,590. If it is cash-settled, the bank will simply pay the counterparty \$106,590. So, the net position is again zero.

e. The manager has perfectly immunized his asset against interest rate risk for the next three months. He is guaranteed to make a profit of zero on this asset, regardless of the direction of rates. He would not implement perfect hedges like this one all the time since he is in business to make profits.

Lecture 4:

1.

$$\begin{aligned}
 E(R) = 1.06 &= p(1.1) + 1-p(.5) \\
 1.06 &= 1.1p + .5 - .5p \\
 1.06 - .5 &= 1.1p - .5p \\
 .56 &= .6p \\
 p &= .56/.6 = .93333
 \end{aligned}$$

probability of default =  $1 - p = 6 \frac{2}{3}\%$

2. (To make this question a little more sensible, assume the interest is due next July, rather than 1999.) Harvard Industries does not appear to have the cash available to make its interest payment on July 1 - its cash on hand now and what it expects to add to the cash holdings totals only \$10 and the company needs to come up with \$15 million by then. The two events that are most likely are:

1. Technical default on the bond (declare bankruptcy or simply announce that it will not pay)

or

2. Offer to exchange the bonds for a lesser valued bond and see if bondholders accept.

A third possibility is that they get some extra cash somewhere - sell off assets, borrow more money to pay the bondholders, or do an equity offering. These seem much less likely to occur.

3. Kroger is BBB-rated and Penn Traffic is B-rated, so Kroger has a lower probability of default. If the bonds were sold at par (most new offerings are), the Penn Traffic bond should have the higher coupon to reflect the higher risk (it carries a higher spread). The fact that Penn Traffic is selling sub debt means the coupon would be higher, even if the firm were also rated BBB, so that feature merely makes it more likely to carry a higher coupon. If Kroger were also selling sub debt, their higher rating would still mean a lower coupon for their debt.

Lecture 5.

1. This is very hard to do in your head, so it's a good idea to make a table. Below is a table for the years that are relevant to the questions.

Year	0	.5	1	1.5	2	2.5	3	3.5	4	5	6
LIBOR6	7	8	9	10	11	12	13	14	16	18 ...	
This ARM	8	9	9.5	11	11	12.5	12.5	14	14	15	15 ...
Fixed	9.5	10	10.5	10.75	11	11.25	11.5	11.75	12	12.5	12.5

I made the assumption that rates could not go up more than by 1.5% in a calendar year. You might have thought that the limits referred to any 12 month period, but that is not very likely in a real ARM.

By examining the table, we see that the answer to (a) is 14% and the answer to (b) is year 2.

2. With a 5% mortgage downpayment, your sister and her husband started out with a balance of \$475,000 on their mortgage and equity of \$25,000. Without even knowing the exact interest rate on their mortgage, it is safe to assume that they have not increased their equity in the house by much more than \$20,000 since they bought the house. With a total equity of \$45,000 at the most, this couple now faces a cost of \$75,000, which they would be hard pressed to pay for in cash. Does it make sense spend \$75,000 to gain equity of \$45,000 in the house, which may again suffer from this mysterious problem? Once the \$75K is spent, the couple has assets of \$45K and the option value of the house (it may do ok and appreciate). Since both figures are in today's dollars, it is hard to see the value of spending \$75K to get \$45K. They should default on the mortgage and go find a rental unit. If the mortgage is held by your grandparents, the money saved by your sister and her husband is money lost by your grandparents. In that case, if your grandparents matter to them at all, they should try to borrow the \$75K and fix the house, as exercising the option to default means a dollar loss to your grandparents for every dollar your sister and her husband gain.

3. Banks generally hate real estate owned. They have to maintain the property (mow the lawn, etc.) and then try to get the thing sold in a reasonable amount of time. A bank with lots of REO probably has a pretty lousy screening process for credit applications. REO cannot be compared to mortgage loans because: a. it does not amortize b. it does not earn interest c. though it is listed as an asset, it is effectively a liability for a bank due to maintenance costs, etc.

4. I might prepay some of my mortgage early (like paying an extra \$100 a month) if:

a. my rate is very high, and alternative investments for my \$100/month are not going to earn me more than I'm saving on my mortgage.

b. I put down a small amount, so I am paying PMI (private mortgage insurance) on my loan. Once my LTV is higher, I can discontinue paying PMI, so it is to my benefit to pay down some of the loan

c. I just won the lottery and I don't want to be bothered with the piddly mortgage payments anymore.

5. Prepayment risk is bad for banks. If the bank has mortgage loans as a significant asset, and many of them begin to prepay by customers refinancing, the loans could go to another financial institution, which means the income stream would be gone completely. Even if the customer refinances with the existing bank, the rate will be lower, reducing the bank's interest income. Finally, when customers prepay their mortgages, banks face reinvestment risk and usually must invest this cash into a falling interest rate environment, thus reducing their interest income. The effects are basically the same if the bank's balance sheet contains a good deal of mortgage-backed (or other asset-backed) securities – they face reinvestment risk at a bad time.