What to do with this practice set?

To help MBA students prepare for the assignment and the exams, practice sets with solutions will be handed out. These sets contain select worked-out end-of-chapter problems from BKM4 through BKM6. These sets will not be graded, but students are strongly encouraged to try hard to solve them and to use office hours to discuss any problems they may have doing so. One of the best self-tests for a student of his or her command of the material before a case or the exam is whether he or she can handle the questions of the relevant practice sets. The questions on the exam will cover the reading material, and will be very similar to those in the practice sets.

Question 1:

Treasury bonds paying an 8% coupon rate with semiannual payments currently sell at par value. What coupon rate would they have to pay in order to sell at par if these bonds instead paid their coupons annually?

Question 2:

Two bonds have identical times to maturity and coupons rates. One is callable at 105, the other at 110. Which should have the higher yield to maturity? Why?

Question 3:

Consider a newly issued bond that pays its coupon once annually, and whose coupon rate is 5%; the maturity is 20 years, and yield to maturity is 8%.

(a) Assuming there are no taxes, find the holding period return for a one-year investment period if the bond is selling at a yield to maturity of 7% by the end of the year.
(b) (NOT EXAM MATERIAL) If you sell the bond after one year, what taxes will you owe if the tax rate on interest income is 40% and the tax rate on capital gains income is 30%? The bond is subject to original-issue discount tax treatment.
(c) (NOT EXAM MATERIAL) What is the after-tax holding period return on the bond?

Question 4:

Assume you have a one-year investment horizon and are trying to choose among three bonds. All have the same degree of default risk and mature in 10 years. The first bond is a zero-coupon bond that pays $1,000 at maturity. The second one has an 8% coupon rate and pays the $80 coupon once per year. The third bond has a 10% coupon rate and pays the $100 coupon once per year. For parts (a) and (b), assume that there are no taxes.
(a) If all three bonds are now priced to yield 8% to maturity, what are their prices?
(b) If you expect their yields to maturity to be 8% at the beginning of next year, what will their prices be then? What is your before-tax holding period return on each bond?
(c) (NOT EXAM MATERIAL) If your tax bracket is 30% on ordinary income and 20% on capital gains income, what will your after-tax rate of return be on each bond?

Hint: In computing taxes, assume that the 10% coupon bond was issued at par and that the drop in price, when the bond is sold at year-end, is treated as a capital loss (and not as an offset to ordinary income).

**Question 5:**

You have the following information about a convertible bond issue:

**Burroughs Corporation**

7 ¼% Due 8-1-2010

| Agency rating (Moody’s/S&P) | A3/A- |
| Conversion ratio            | 12.882 |
| Market price of convertible | 102  |
| Market price of common stock | $66.00 |
| Dividend per share-common   | $2.60 |
| Call price (first call: 8-1-2000) | 106 |
| Estimated floor price        | $66.50 |

Using the information above, calculate the following values and show calculations:

(a) Market conversion value.
(b) Conversion premium per common share.
(c) Current yield-convertible.
(d) Dividend yield-common.

**Question 6:**

The yield to maturity on one-year zero-coupon bonds is currently 7%, and the yield to maturity on two-year zeros is 8%. The Treasury plans to issue a two-year maturity coupon bond, paying coupons once per year with a coupon rate of 9%. The face value of the bond is $100.

(a) At what price will the bond sell?
(b) What will the yield to maturity on the bond be?
(c) If the expectations theory of the yield curve is correct, what is the market expectation of the price that the bond will sell for next year?
(d) Recalculate your answer to (c) if you believe in the liquidity preference theory, and that the liquidity premium is 1%.
**Question 7:**

U.S. Treasuries represent a significant holding in many pension portfolios. You decide to analyze the yield curve for U.S. Treasury Notes.

(a) Using the data in the table below, calculate the five-year spot and forward rates assuming annual compounding. Show your calculations.

(Hint: the spot rates are yields to maturity for zero-coupon bonds; yields to maturity for coupon bonds selling at par will typically differ).

<table>
<thead>
<tr>
<th>Years to Maturity</th>
<th>Par Coupon Yield-to-Maturity</th>
<th>Calculated Spot Rates</th>
<th>Calculated Forward Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
</tr>
<tr>
<td>2</td>
<td>5.20</td>
<td>5.21</td>
<td>5.42</td>
</tr>
<tr>
<td>3</td>
<td>6.00</td>
<td>6.05</td>
<td>7.75</td>
</tr>
<tr>
<td>4</td>
<td>7.00</td>
<td>7.16</td>
<td>10.56</td>
</tr>
<tr>
<td>5</td>
<td>7.00</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

(b) Based on the above yield curve analysis, calculate both the expected yield to maturity and the price of a 4-year zero. Show your calculations.

**Question 8:**

The yield to maturity on one-year-maturity zero coupon bonds is 5% and the yield to maturity on two-year-maturity zero coupon bonds is 6%. The yield to maturity on two-year-maturity coupon bonds with coupon rates of 12% (paid annually) is 5.8%. What arbitrage opportunity is available for an investment banking firm? What is the profit on the activity?
Practice Set #2: Solutions.

Question 1:
The effective annual yield on the semiannual coupon bonds is \( 8.16\% = (1+8%/2)^2 - 1 \). If the annual coupon bonds are to sell at par, then they must offer the same yield, which will require an annual coupon rate of 8.16%.

Question 2:
The bond callable at 105 (110) requires the issuing firm to pay bondholders 105% (110%) of the bond’s face value if the firm decides to call the bond. The first bond should therefore sell for a lower price because the call provision is more valuable to the firm that issued it. Therefore, that bond’s yield to maturity should be higher than that of the bond callable at 110.

Question 3:
(a) You can use Excel or a financial calculator to compute the following:

The initial price is: \( P_0 = $705.46 \), for \([n = 20; PMT = 50; FV = 1000; i = 8]\)

The next year’s price is: \( P_1 = $793.29 \), for \([n = 19; PMT = 50; FV = 1000; i = 7]\)

Thus, the holding period return (HPR) is given by:

\[
HPR = \frac{$50 + ($793.29 - $705.46)}{$705.46} \Rightarrow HPR = 0.195 = 19.5\%
\]

(b) Using OID tax rules, the price path of the bond under the constant yield method is obtained by discounting at an 8% yield, and reducing maturity by one year at a time:

Constant yield prices:

\( P_0 = $705.46 \)
\( P_1 = $711.89 \) (implies implicit interest over first year = $6.43)
\( P_2 = $718.84 \) (implies implicit interest over second year = $6.95)

- Tax on explicit plus implicit interest in the first year = \( 0.40 \times ($50 + $6.43) = $22.57 \)
- Capital gain in the first year = actual price – constant yield price
  \[= $793.29 - 711.89 = $81.40 \]
- Tax on capital gain = \( 0.30 \times $81.40 = $24.42 \)
- Total taxes = $22.57 + $24.42 = $46.99

(d) The after-tax HPR = \[\frac{$50 + ($793.29 - $705.46) - $46.99}{$705.46} \]
\[= 0.129 = 12.9\% \]
Question 4:
(a) Using Excel (for example) we get:

<table>
<thead>
<tr>
<th></th>
<th>Zero coupon</th>
<th>8% coupon</th>
<th>10% coupon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current prices</td>
<td>$463.19</td>
<td>$1,000.00</td>
<td>$1,134.20</td>
</tr>
</tbody>
</table>

(b)

<table>
<thead>
<tr>
<th></th>
<th>Zero coupon</th>
<th>8% coupon</th>
<th>10% coupon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price one year from now</td>
<td>$500.25</td>
<td>$1,000.00</td>
<td>$1,124.94</td>
</tr>
<tr>
<td>Price increase</td>
<td>$37.06</td>
<td>$0.00</td>
<td>-$9.26</td>
</tr>
<tr>
<td>Coupon income</td>
<td>$0.00</td>
<td>$80.00</td>
<td>$100.00</td>
</tr>
<tr>
<td>Pre-tax income</td>
<td>$37.06</td>
<td>$80.00</td>
<td>$90.74</td>
</tr>
<tr>
<td>Pre-tax rate of return</td>
<td>8.00%</td>
<td>8.00%</td>
<td>8.00%</td>
</tr>
<tr>
<td>Taxes*</td>
<td>$11.12</td>
<td>$24.00</td>
<td>$28.15</td>
</tr>
<tr>
<td>After-tax income</td>
<td>$25.94</td>
<td>$56.00</td>
<td>$62.59</td>
</tr>
<tr>
<td>After-tax return</td>
<td>5.60%</td>
<td>5.60%</td>
<td>5.52%</td>
</tr>
</tbody>
</table>

* In computing taxes, we have assumed that the 10% coupon bond was issued at par and that the drop in price, when the bond is sold at year-end, is treated as a capital loss (tax rate = 20%) and not as an offset to ordinary income (tax rate = 30%).

Question 5:
(a) Market conversion price = value if converted into stock
   = market price of common stock x conversion ratio
   = 12.882 x $66 = $850.21

(b) Conversion premium = Bond price – value if converted into stock
   = $1020 – (12.882 x $66) = $1020 - $850.21 = $169.79

   Thus, the conversion premium per share = ($169.79/12.882) = $13.18

(c) Current yield = (coupon/price) = ($72.50/$1020) = 0.0711 = 7.11%

(d) Dividend yield on common = (dividend per share/price) = ($2.60/$66) = 3.94%

Question 6:
(a) \[ P = \left( \frac{9}{1.07} + \frac{109}{1.08^2} \right) = 101.86 \]

(b) YTM = 7.958%, which is the solution to: 9 PA(y,2) + 100 PF(y,2) = 101.86
(c) The forward rate for next year, derived from the zero-coupon yield curve, is approximately 9%:

\[ 1 + f_2 = \frac{1.08^2}{1.07} = 1.0901, \text{ which implies } f_2 = 9.01\%. \text{ Therefore, using an expected rate for next year of } r_2 = 9\%, \text{ we can find that the forecast bond price is} \]

\[ P = \frac{109}{1.09} = $100 \]

(d) If the liquidity premium is 1%, then the forecast interest rate is:

\[ E[r_2] = f_2 - \text{liquidity premium} = 9\% - 1\% = 8\%, \text{ and you forecast the bond to sell at:} \]

\[ (109/1.08) = $100.93. \]

**Question 7:**

(a) • Final spot rate:

\[
1000 = \frac{70}{(1 + y_1)} + \frac{70}{(1 + y_2)^2} + \frac{70}{(1 + y_3)^3} + \frac{70}{(1 + y_4)^4} + \frac{1070}{(1 + y_5)^5}
\]

\[
\Rightarrow \quad 1000 = \frac{70}{1.05} + \frac{70}{1.0521^2} + \frac{70}{1.0605^3} + \frac{70}{1.0716^4} + \frac{1070}{(1 + y_5)^5}
\]

\[
\Rightarrow \quad 1000 = $66.67 + $63.24 + $58.69 + $53.08 + [$1070/(1 + y_5)^5]
\]

\[
\Rightarrow \quad $1000 - $241.68 = [$1070/(1 + y_5)^5] \quad \Rightarrow \quad $758.32 = [$1070/(1 + y_5)^5]
\]

\[
\Rightarrow \quad (1 + y_5)^5 = $1070/$758.32 \quad \Rightarrow \quad (1 + y_5) = (1.411)^{1/5}
\]

\[
\Rightarrow \quad y_5 = 1.0713 - 1 = 7.13\%.
\]

• Final forward rate:

\[
\]

(b) The spot rate at 4 years is 7.16%. Therefore, 7.16% is the theoretical yield to maturity for the zero coupon U.S. Treasury note. The price of the zero coupon at 7.16% is the present value of $1000 to be received in 4 years.

• Annual compounding: \( PV = \frac{1000}{1.0716^4} = $758.35 \)

• With semi-annual compounding, we would have: \( PV = \frac{1000}{(1 + (0.0716/2))^{8}} = $754.73 \)

**Question 8:**

The price of the coupon bond, based on its yield to maturity, is:

\[
120 \text{ PA}(5.8\%, 2) + 1000 \text{ PF}(5.8\%, 2) = $1,113.99.
\]
If the coupons were stripped and sold separately as zeros, then based on the yield to maturity of zeros with maturities of one and two years, the coupon payments could be sold separately for

\[
\frac{120}{1.05} + \frac{1,120}{1.06^2} = \$1,111.08.
\]

The arbitrage strategy is to buy zeros with face values of $120 and $1,120 and respective maturities of one and two years, and simultaneously sell the coupon bond. The profit equals $2.91 on each bond.