Homework 3

Instructions: please read carefully

- You should show your work how to get the answer for each calculation question to get full credit
- You should make 2 copies. One to turn in for grading purpose, the other to keep to study for the exam.
- The due date is Tuesday, October 6, 2009. Late homework will not be graded.

Name(s): Student ID
Chapter 14

1. A corporate bond has a coupon rate of 8%, payable semiannually, a maturity of 20 years, and a yield to maturity of 9%. How much should you pay for this bond?
   a. $1080
   b. $1000
   c. $966
   d. $908

1. d
PMT = 40, FV = 1000, I/Y = 4.5, n = 40, CPT PV = -908

2. An annual coupon bond issue has a coupon rate of 8% and 10 years maturity. Determine this bond's current yield if its yield to maturity is 7%.
   a. 7.5%
   b. 7.9%
   c. 8.3%
   d. 8.8%

2. a
FV = 1000, PMT = 80, N = 10, I/Y = 7, CPT PV = 1070.23, current yield = 80/1070.23 = 7.5%

3. A semiannual coupon bond is currently selling for $1,142.12. The bond has a maturity of 10 years and a yield to maturity of 7%. Determine the coupon rate of the bond.
   a. 6%
   b. 7%
   c. 8%
   d. 9%

3. d
FV = 1000, I/Y = 3.5, N = 20, PV = -1142.12, CPT PMT = 45, Annual pmt = 90, coupon rate = 90/1000 = 9%.

4. A corporate bond has an annual coupon rate of 8%, payable semiannually, and a maturity of 25 years. Determine the bond's yield to maturity if its current yield is 6.36%.
   a. 3%
   b. 6%
   c. 8%
   d. 9%

4. b
CY = 6.36%, PV (or price) = 80/0.0636 = 1257.86,
FV = 1000, n = 50, PMT = 40, PV = -1257.86, CPT I/Y = 3, YTM = 6%

5. You just purchased an annual coupon bond for $817.84. The bond has a maturity of 15 years, a face value of $1,000, a coupon rate of 5%, and a yield to maturity of 7%. What is the bond's total rate of return for the year if the interest rate increases to 7.5% one year later?
   a. 9.79%
   b. 7.50%
   c. 3.75%
   d. 2.44%
5. d
First, compute price one year from now \( P(1) \)
\[ FV = 1000, \ PMT = 50, \ n = 14, \ I/Y = 7.5, \ CPT \ PV = -787.77 \]
So \( P(1) = 787.77 \)
Total return = \( \frac{50}{817.84} + \frac{(787.77-817.84)}{817.84} = 2.44\% \)

6. You just purchased a semiannual coupon bond for $1,148.77. The bond has a maturity of 10 years, a face value of $1,000, a coupon rate of 8%, and a yield to maturity of 6%. What is the bond's yield to call if the bond is called back 4 years later with a call premium of $80?
   a. 9.79\%
   b. 7.50\%
   c. 3.75\%
   d. 2.44\%
   e. 5.6\%
   
6. e
\[ PV = -1148.77, \ n = 20, \ FV = 1080, \ PTM = 40, \ CPT \ I/Y = 2.8, \ YTC = 5.6\% \]

7. A bond's invoice price is its stated price plus _____________.
   a. the coupon interest
   b. the accrued capital gain
   c. the accrued coupon interest
   d. the accrued capital gain and coupon interest
   
7. c

8. In a period of particularly low interest rates, which of the following bonds is most likely to be called?
   a. Discount coupon bonds with 1 year maturity.
   b. Zero coupon bonds.
   c. Coupon bonds selling at a premium.
   d. Discount coupon bonds with 25 years maturity.
   
8. c (The company will call the bond the YTM < coupon rate, and when YTM < coupon rate, the bond is selling at premium)

9. The current yield of a par bond must be ____________ its coupon rate.
   a. equal to
   b. lower than
   c. higher than
   d. Not enough information to determine.
   
9. a

10. Which of the following bonds is most likely to have the lowest yield to maturity?
    a. Callable mortgage bond.
    b. Callable debenture.
    c. Noncallable debenture.
    d. Noncallable mortgage bond.
    
10. d (since it is most favorable to investors)
11. Which of the following is(are) correct for a discount bond that has a current yield of 8%?
   a. Capital gain yield is positive.
   b. Coupon rate < 8%.
   c. YTM > 8%.
   d. All of the above are correct.

   11. d

For discount bond, we have the followings
   • price < 1000 (par)
   • YTM > coupon rate
   • Therefore, CY = (coupon payment / price) > coupon rate (=coupon payment / par) so coupon rate < 8%
   • For discount bond, the price will go up to par (1000) when time approaching maturity, so if you buy a discount bond today, after 1 year, the bond price will go up (if everything else remains the same), so capital gain yield should be positive
   • We have total return = YTM = current yield + capital gain yield, the current yield = 8%, capital gain yield is positive, so YTM > 8%

12. A debenture is __________.
   A) secured by other securities held by the firm
   B) secured by equipment owned by the firm
   C) secured by property owned by the firm
   D) unsecured

   12. d

13. To earn a high rating from the bond rating agencies, a company would want to have

   __________.
   A) a low times interest earned ratio
   B) a low debt to equity ratio
   C) a low quick ratio
   D) none of the above

   13. b

14. A bond with call feature:
   a. Is attractive because the immediate receipt of principal plus premium produces a high return
   b. Is more apt to be called when interest rates are high because interest saving will be greater
   c. Will usually have a higher yield to maturity than a similar noncallable bond
   d. None of the above

   14. c

The yield on the callable bond must compensate the investor for the risk of call.

   Choice (a) is wrong because, although the owner of a callable bond receives principal plus a premium in the event of a call, the interest rate at which he can subsequently reinvest will be low. The low interest rate that makes it profitable for the issuer to call the bond makes it a bad deal for the bond’s holder.
Choice (b) is wrong because a bond is more apt to be called when interest rates are low. There will be an interest saving for the issuer only if rates are low.

15. Consider a five-year bond with a 10% coupon selling at a yield to maturity of 8%. If the interest rates remain constant, one year from now the price of this bond will be

a. Higher
b. Lower
c. The same
d. Par

15. b

This is a premium bond so the price will go down to par (1000) as time approaches maturity. Therefore the price one year from now should be lower than the price today.

16. Consider two bonds, X and Y. Both bonds presently are selling at their par value of $1,000. Each pays interest of $150 annually. Bond X will mature in 6 years while bond Y will mature in 7 years. If the yields to maturity on the two bonds decrease from 15% to 12%

a. both bonds will increase in value, but bond X will increase more than bond Y.
b. both bonds will decrease in value, but bond X will decrease more than bond Y.
c. both bonds will increase in value, but bond Y will increase more than bond X.
d. both bonds will decrease in value, but bond Y will decrease more than bond X.
e. none of the above

16. c

If the yields to maturity on the two bonds decrease from 15% to 12% both bonds will increase in value, but bond Y will increase more than bond X. It is a general property that, ceteris paribus, the prices of bonds with longer maturities change more as required yields change.

17. Consider a bond paying a coupon rate of 10% per year semiannually when the market interest rate is only 4% per half year (8% per year). The bond has 3 years until maturity

a. Find the bond’s price today and 6 months from now after the next coupon is paid.

The bond pays $50 every six months.

Current price:

\[ N = 6, \ PMT = 50, I/Y = 4, FV = 1000, PV = \$1,052.42 \]

Assuming the market interest rate remains 4% per half year, price six months from now:

\[ N = 5, \ PMT = 50, I/Y = 4, FV = 1000, PV = \$1,044.52 \]
b. What is total rate return of the bond? (i.e. if you sell the bond after 6 months, what is your total rate of return?)

$$\frac{50 + (1,044.52 - 1,052.42)}{1,052.42} = \frac{50 - 7.90}{1,052.42} = 0.0400 = 4.00\% \text{ per six months}$$

18. You purchased a 5-year annual interest coupon bond one year ago. Its coupon interest rate was 6\% and its par value was $1,000. At the time you purchased the bond, the yield to maturity was 4\%. If you sold the bond after receiving the first interest payment and the bond's yield to maturity had changed to 3\%, your annual total rate of return on holding the bond for that year would have been ________.

A) 5.00\%
B) 5.51\%
C) 7.61\%
D) 8.95\%

At the time of purchase

\[ N = 5, \ PMT = 60, \ FV = 1000, \ I/Y = 4, \ PV = 1089.04 \]

After 1 year

\[ N = 4, \ PMT = 60, \ FV = 1000, \ I/Y = 3, \ PV = 1111.51 \]

Current yield = $60/1089.04 = 5.51\%
Capital gain yield = \[\frac{1111.51 - 1089.04}{1089.04} = 2.06\%\]
Total return = 5.51 + 2.06 = 7.57\%

19. A bond with a coupon rate of 7\% makes semiannual coupon payments on January 15 and July 15 of each year. The Wall Street Journal reports the ask price for the bond on January 30 at 100:02. What is the invoice price of the bond if you purchase the bond on January 30? The coupon period has 182 days.

The reported bond price is: 100 2/32 percent of par = $1,000.625

However, 15 days have passed since the last semiannual coupon was paid, so accrued interest equals: $35 x (15/182) = $2.885

The invoice price is the reported price plus accrued interest: $1003.51
20. A zero-coupon bond with a maturity of 4 years has a yield to maturity of 5%. What is the modified duration of the bond?

A) 4.20  
B) 4.00  
C) 3.85  
D) 3.81  

\[ D = \frac{4}{1+0.05} = 3.81 \]

21. Which of the following bonds would have the largest price change when interest rates increase? Assume that the bonds each have the same yield to maturity.

A) 10-year maturity, 8% coupon rate  
B) 10-year maturity, 5% coupon rate  
C) 15-year maturity, 8% coupon rate  
D) 15-year maturity, 5% coupon rate  

21. D (longest time to maturity and lowest coupon rate)

22. A 10-year bond has a yield to maturity of 6.00%. The current price of the bond is $926.40 and the duration is 8.02 years. Use the duration rule to estimate the price of the bond if the yield to maturity decreases to 5.90%.

\[ \frac{\Delta P}{P} = -\frac{D}{1+y} \times \Delta y \]

\[ \frac{\Delta P}{P} = -\frac{8.02}{1+0.06} \times (-0.1) = 0.7566\% \]

\[ \frac{X - 926.40}{926.40} = 0.7566\% \]

\[ X = 933.41 \]
23. An 8% annual-coupon bond has 3 years to maturity, a yield to maturity of 6%, and a par value of $1,000. What is the duration of this bond?

A) 3.00  
B) 2.94  
C) 2.79  
D) 2.46  

23. C

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24. A bond is currently selling for $1,100 with a yield to maturity of 6.0% and a modified duration of 3.02 years. Suppose the yield of the bond changes from 6.0% to 6.5%. Use the modified duration to estimate the percentage change in the price of the bond.

A) -1.42%  
B) 1.42%   
C) -1.51%  
D) 1.51%   

24. C

\[
\Delta P \approx -\frac{D}{1+y} \times \Delta y = -D \times \Delta y = -3.02 \times 0.5\% = -1.51\%
\]

25. An insurance company has liabilities with a duration of 7.2 years. The insurance company wants to immunize its position with 3-year zero-coupon bonds and perpetuities. The market interest rate is 8%. What portion of the company's portfolio should be allocated to the zero-coupon bonds?

A) 40%  
B) 50%   
C) 60%   
D) 70%   

25. C

Duration of perpetuities = \( (1+y)/y = 1.08/0.08 = 13.5 \)

\[3w + (1-w)13.5 = 7.2\]

\[W = 0.6\]
26. The duration of a bond is a function of the bond's

A) coupon rate.
B) time to maturity.
C) yield to maturity.
D) all of the above
E) none of the above

26. d

27. The interest-rate risk of a bond is

A) the risk related to the possibility of bankruptcy of the bond's issuer.
B) the risk that arises from the uncertainty of the bond's return caused by changes in interest rates.
C) the unsystematic risk caused by factors unique in the bond.
D) A and B above.
E) A, B, and C above.

27. b

28. Which of the following two bonds is more price sensitive to changes in interest rates? A par value bond, X, with 10 years-to-maturity and a 10% coupon rate or a zero-coupon bond, Y, with 10 years-to-maturity and a 10% yield-to-maturity.

A) Bond Y because of the longer duration.
B) Bond X because of the longer time to maturity.
C) Bond X because of the higher yield to maturity.
D) Both have the same sensitivity because both have the same yield to maturity.
E) None of the above are true.

28. a

29. Holding other factors constant, which one of the following bonds has the smallest price volatility?

A) 6-year, 0% coupon bond
B) 6-year, 9% coupon bond
C) 6 year, 15% coupon bond
D) 6-year, 10% coupon bond
E) Cannot tell from the information given.

29. c
30. Which of the following is not true?

A) Holding other things constant, the duration of a bond increases with time to maturity.
B) Given time to maturity and yield to maturity, the duration of a bond is higher when the coupon rate is lower.
C) Given time to maturity, the duration of a zero-coupon decreases with yield to maturity.
D) Duration is a better measure of price sensitivity to interest rate changes than is time to maturity.
E) None of the above are true.

30. e

31. You are managing a portfolio of $1 million. Your target duration is 10 years, and you can choose from two bonds: a zero-coupon bond with maturity 5 years, and a perpetuity, each currently yielding 5%.

a. How much of each bond will you hold in your portfolio?

The duration of the perpetuity is: \( \frac{1.05}{0.05} = 21 \) years

Call \( w \) the weight of the zero-coupon bond. Then:

\[
(w \times 5) + [(1 - w) \times 21] = 10 \Rightarrow w = \frac{11}{16} = 0.6875
\]

Therefore, the portfolio weights would be as follows: 11/16 invested in the zero and 5/16 in the perpetuity.

b. How will these fractions change next year if target duration is now nine years?

Next year, the zero-coupon bond will have a duration of 4 years and the perpetuity will still have a 21-year duration. To obtain the target duration of nine years, which is now the duration of the obligation, we again solve for \( w \):

\[
(w \times 4) + [(1 - w) \times 21] = 9 \Rightarrow w = \frac{12}{17} = 0.7059
\]

So, the proportion of the portfolio invested in the zero increases to 12/17 and the proportion invested in the perpetuity falls to 5/17.
32. My pension plan will pay me $10,000 once a year for a 10-year period. The first payment will come in exactly 5 years. The pension fund wants to immunize its position.

a. What is the duration of its obligation to me? The current interest rate is 10% per year

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\[ D = \frac{\sum W \times t}{\sum W} = 8.725461 \]

b. If the plan uses 5-year and 20-year zero-coupon bonds to construct the immunized position, how much money ought to be placed in each bond. What will be the face value of the holdings in each zero?

The present value of the deferred annuity is: 41968.22

Call w the weight of the portfolio invested in the 5-year zero. Then:

\[ (w \times 5) + [(1 - w) \times 20] = 8.7255 \Rightarrow w = 0.7516 \]

The investment in the 5-year zero is equal to:

\[ 0.7516 \times 41968 = 31,543 \]

The investment in the 20-year zeros is equal to:

\[ 0.2484 \times 41968 = 10,425 \]

These are the present or *market* values of each investment. The face values are equal to the respective future values of the investments. The face value of the 5-year zeros is:
\[ 31,543 \times (1.10)^5 = 50,800 \]

Therefore, between 50 and 51 zero-coupon bonds, each of par value $1,000, would be purchased.

Similarly, the face value of the 20-year zeros is:
\[ 10,425 \times (1.10)^{20} = 70,134 \]