

current yield  
 premium bonds  
 discount bonds  
 realized compound return  
 horizon analysis  
 reinvestment rate risk

• credit risk  
 investment-grade bonds  
 speculative-grade or junk  
 bonds  
 sinking fund  
 subordination clauses

collateral  
 debenture  
 default premium  
 credit default swap (CDS)  
 collateralized debt obligations  
 (CDOs)

**KEY EQUATIONS** Price of a coupon bond:

$$\begin{aligned} \text{Price} &= \text{Coupon} \times \frac{1}{r} \left[ 1 - \frac{1}{(1+r)^T} \right] + \text{Par value} \times \frac{1}{(1+r)^T} \\ &= \text{Coupon} \times \text{Annuity factor}(r, T) + \text{Par value} \times \text{PV factor}(r, T) \end{aligned}$$

**PROBLEM SETS**

1. Define the following types of bonds:
  - a. Catastrophe bond.
  - b. Eurobond.
  - c. Zero-coupon bond.
  - d. Samurai bond.
  - e. Junk bond.
  - f. Convertible bond.
  - g. Serial bond.
  - h. Equipment obligation bond.
  - i. Original issue discount bond.
  - j. Indexed bond.
  - k. Callable bond.
  - l. Puttable bond.

Basic

2. Two bonds have identical times to maturity and coupon rates. One is callable at 105, the other at 110. Which should have the higher yield to maturity? Why?
3. The stated yield to maturity and realized compound yield to maturity of a (default-free) zero-coupon bond will always be equal. Why?

Intermediate

4. Why do bond prices go down when interest rates go up? Don't lenders like high interest rates?
5. A bond with an annual coupon rate of 4.8% sells for \$970. What is the bond's current yield?
6. Which security has a higher *effective* annual interest rate?
  - a. A 3-month T-bill selling at \$97,645 with par value \$100,000.
  - b. A coupon bond selling at par and paying a 10% coupon semiannually.
7. 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 they paid their coupons *annually*? (Hint: What is the effective annual yield on the bond?)
8. Consider a bond with a 10% coupon and with yield to maturity = 8%. If the bond's yield to maturity remains constant, then in 1 year, will the bond price be higher, lower, or unchanged? Why?
9. Consider an 8% coupon bond selling for \$953.10 with 3 years until maturity making *annual* coupon payments. The interest rates in the next 3 years will be, with certainty,  $r_1 = 8\%$ ,  $r_2 = 10\%$ , and  $r_3 = 12\%$ . Calculate the yield to maturity and realized compound yield on the bond.

Suppose you have a 1-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 is a zero-coupon bond that pays \$1,000 at maturity. The second has an 8% coupon rate and pays the \$80 coupon once per year. The third has a 10% coupon rate and pays the \$100 coupon once per year.

(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? 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?

(c) Recalculate your answer to (b) under the assumption that you expect the yields to maturity on each bond to be 7% at the beginning of next year.

11. A 20-year maturity bond with par value of \$1,000 makes semiannual coupon payments at a coupon rate of 8%. Find the bond equivalent and effective annual yield to maturity of the bond if the bond price is:

- a. \$950.
- b. \$1,000.
- c. \$1,050.

Repeat Problem 11 using the same data, but assuming that the bond makes its coupon payments annually. Why are the yields you compute lower in this case?

12. Fill in the table below for the following zero-coupon bonds, all of which have par values of \$1,000.

Price	Maturity (years)	Bond-Equivalent Yield to Maturity
\$400	20	—
\$500	20	—
\$500	10	—
—	10	10%
—	10	8%
\$400	—	8%

14. Consider a bond paying a coupon rate of 10% per year semiannually when the market interest rate is only 4% per half-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.
  - b. What is the total (6-month) rate of return on the bond?
15. 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 100.125. What is the invoice price of the bond? The coupon period has 182 days.
16. A bond has a current yield of 9% and a yield to maturity of 10%. Is the bond selling above or below par value? Explain.
17. Is the coupon rate of the bond in Problem 16 more or less than 9%?
18. Return to Table 14.1 and calculate both the real and nominal rates of return on the TIPS bond in the second and third years.
19. A newly issued 20-year maturity, zero-coupon bond is issued with a yield to maturity of 8% and face value \$1,000. Find the imputed interest income in the first, second, and last year of the bond's life.
20. A newly issued 10-year maturity, 4% coupon bond making *annual* coupon payments is sold to the public at a price of \$800. What will be an investor's taxable income from the bond over the coming year? The bond will not be sold at the end of the year. The bond is treated as an original-issue discount bond.

21. A 30-year maturity, 8% coupon bond paying coupons semiannually is callable in 5 years at a call price of \$1,100. The bond currently sells at a yield to maturity of 7% (3.5% per half-year).
- What is the yield to call?
  - What is the yield to call if the call price is only \$1,050?
  - What is the yield to call if the call price is \$1,100, but the bond can be called in 2 years instead of 5 years?
22. A 10-year bond of a firm in severe financial distress has a coupon rate of 14% and sells for \$900. The firm is currently renegotiating the debt, and it appears that the lenders will allow the firm to reduce coupon payments on the bond to one-half the originally contracted amount. The firm can handle these lower payments. What is the stated and expected yield to maturity of the bonds? The bond makes its coupon payments annually.
23. A 2-year bond with par value \$1,000 making annual coupon payments of \$100 is priced at \$1,000. What is the yield to maturity of the bond? What will be the realized compound yield to maturity if the 1-year interest rate next year turns out to be (a) 8%, (b) 10%, (c) 12%?
24. Suppose that today's date is April 15. A bond with a 10% coupon paid semiannually every January 15 and July 15 is listed in *The Wall Street Journal* as selling at an ask price of 101.25. If you buy the bond from a dealer today, what price will you pay for it?
25. Assume that two firms issue bonds with the following characteristics. Both bonds are issued at par.

	ABC Bonds	XYZ Bonds
Issue size	\$1.2 billion	\$150 million
Maturity	10 years*	20 years
Coupon	9%	10%
Collateral	First mortgage	General debenture
Callable	Not callable	In 10 years
Call price	None	110
Sinking fund	None	Starting in 5 years

\*Bond is extendible at the discretion of the bondholder for an additional 10 years.

Ignoring credit quality, identify four features of these issues that might account for the lower coupon on the ABC debt. Explain.

26. An investor believes that a bond may temporarily increase in credit risk. Which of the following would be the most liquid method of exploiting this?
- The purchase of a credit default swap.
  - The sale of a credit default swap.
  - The short sale of the bond.
27. Which of the following *most accurately* describes the behavior of credit default swaps?
- When credit risk increases, swap premiums increase.
  - When credit and interest rate risk increases, swap premiums increase.
  - When credit risk increases, swap premiums increase, but when interest rate risk increases, swap premiums decrease.
28. What would be the likely effect on the yield to maturity of a bond resulting from:
- An increase in the issuing firm's times-interest-earned ratio.
  - An increase in the issuing firm's debt-to-equity ratio.
  - An increase in the issuing firm's quick ratio.

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10. The term structure for zero-coupon bonds is currently:

Maturity (Years)	YTM (%)
1	4%
2	5
3	6

Next year at this time, you expect it to be:

Maturity (Years)	YTM (%)
1	5%
2	6
3	7

- What do you expect the rate of return to be over the coming year on a 3-year zero-coupon bond?
- Under the expectations theory, what yields to maturity does the market expect to observe on 1- and 2-year zeros at the end of the year? Is the market's expectation of the return on the 3-year bond greater or less than yours?

11. The yield to maturity on 1-year zero-coupon bonds is currently 7%; the YTM on 2-year zeros is 8%. The Treasury plans to issue a 2-year maturity coupon bond, paying coupons once per year with a coupon rate of 9%. The face value of the bond is \$100.

- At what price will the bond sell?
- What will the yield to maturity on the bond be?
- 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?
- Recalculate your answer to (c) if you believe in the liquidity preference theory and you believe that the liquidity premium is 1%.

12. Below is a list of prices for zero-coupon bonds of various maturities.

Maturity (Years)	Price of \$1,000 Par Bond (Zero-Coupon)
1	\$943.40
2	873.52
3	816.37

- An 8.5% coupon \$1,000 par bond pays an annual coupon and will mature in 3 years. What should the yield to maturity on the bond be?
- If at the end of the first year the yield curve flattens out at 8%, what will be the 1-year holding-period return on the coupon bond?

13. Prices of zero-coupon bonds reveal the following pattern of forward rates:

Year	Forward Rate
1	5%
2	7
3	8

In addition to the zero-coupon bond, investors also may purchase a 3-year bond making annual payments of \$60 with par value \$1,000.

- What is the price of the coupon bond?
- What is the yield to maturity of the coupon bond?
- Under the expectations hypothesis, what is the expected realized compound yield of the coupon bond?
- If you forecast that the yield curve in 1 year will be flat at 7%, what is your forecast for the expected rate of return on the coupon bond for the 1-year holding period?

CFA

8. The shape of the U.S. Treasury yield curve appears to reflect two expected Federal Reserve reductions in the federal funds rate. The current short-term interest rate is 5%. The first reduction of approximately 50 basis points (bp) is expected 6 months from now and the second reduction of approximately 50 bp is expected 1 year from now. The current U.S. Treasury term premiums are 10 bp per year for each of the next 3 years (out through the 3-year benchmark).

However, the market also believes that the Federal Reserve reductions will be reversed in a single 100-bp increase in the federal funds rate 2½ years from now. You expect liquidity premiums to remain 10 bp per year for each of the next 3 years (out through the 3-year benchmark).

Describe or draw the shape of the Treasury yield curve out through the 3-year benchmark. Which term structure theory supports the shape of the U.S. Treasury yield curve you've described?

9. U.S. Treasuries represent a significant holding in many pension portfolios. You decide to analyze the yield curve for U.S. Treasury notes.
- Using the data in the table below, calculate the 5-year spot and forward rates assuming annual compounding. Show your calculations.

U.S. Treasury Note Yield Curve Data

Years to Maturity	Par Coupon Yield to Maturity	Calculated Spot Rates	Calculated Forward Rates
1	5.00	5.00	5.00
2	5.20	5.21	5.42
3	6.00	6.05	7.75
4	7.00	7.16	10.56
5	7.00	?	?

- Define and describe each of the following three concepts:

- Short rate
- Spot rate
- Forward rate

Explain how these concepts are related.

- You are considering the purchase of a zero-coupon U.S. Treasury note with 4 years to maturity. On the basis of the above yield-curve analysis, calculate both the expected yield to maturity and the price for the security. Show your calculations.

10. The spot rates of interest for five U.S. Treasury securities are shown in the following exhibit. Assume all securities pay interest annually.

Spot Rates of Interest

Term to Maturity	Spot Rate of Interest
1 year	13.00%
2	12.00
3	11.00
4	10.00
5	9.00

- Compute the 2-year implied forward rate for a deferred loan beginning in 3 years.
- Compute the price of a 5-year annual-pay Treasury security with a coupon rate of 9% by using the information in the exhibit.

**PROBLEM SETS**

1. We said that options can be used either to scale up or reduce overall portfolio risk. What are some examples of risk-increasing and risk-reducing options strategies? Explain each.
2. What are the trade-offs facing an investor who is considering buying a put option on an existing portfolio?
3. What are the trade-offs facing an investor who is considering writing a call option on an existing portfolio?
4. Why do you think the most actively traded options tend to be the ones that are near the money?
5. Turn back to Figure 20.1, which lists prices of various IBM options. Use the data in the figure to calculate the payoff and the profits for investments in each of the following February expiration options, assuming that the stock price on the expiration date is \$195.
  - a. Call option,  $X = \$190$ .
  - b. Put option,  $X = \$190$ .
  - c. Call option,  $X = \$195$ .
  - d. Put option,  $X = \$195$ .
  - e. Call option,  $X = \$200$ .
  - f. Put option,  $X = \$200$ .

Basic

Intermediate

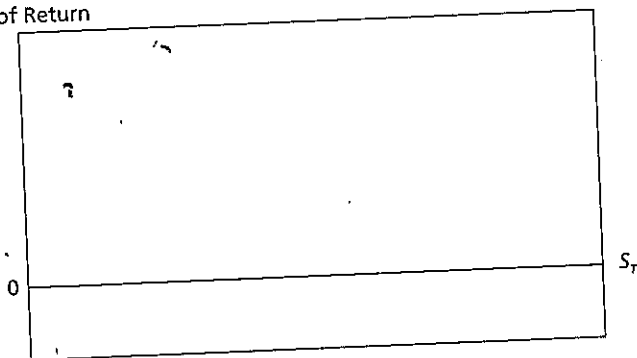
6. Suppose you think FedEx stock is going to appreciate substantially in value in the next 6 months. Say the stock's current price,  $S_0$ , is \$100, and the call option expiring in 6 months has an exercise price,  $X$ , of \$100 and is selling at a price,  $C$ , of \$10. With \$10,000 to invest, you are considering three alternatives.
  - a. Invest all \$10,000 in the stock, buying 100 shares.
  - b. Invest all \$10,000 in 1,000 options (10 contracts).
  - c. Buy 100 options (one contract) for \$1,000, and invest the remaining \$9,000 in a money market fund paying 4% in interest over 6 months (8% per year).

What is your rate of return for each alternative for the following four stock prices 6 months from now? Summarize your results in the table and diagram below.

Price of Stock 6 Months from Now			
\$80	\$100	\$110	\$120

- a. All stocks (100 shares)
- b. All options (1,000 shares)
- c. Bills + 100 options

Rate of Return



7. The common stock of the P.U.T.T. Corporation has been trading in a narrow price range for the past month, and you are convinced it is going to break far out of that range in the next 3 months. You do not know whether it will go up or down, however. The current price of the stock is \$100 per share, and the price of a 3-month call option at an exercise price of \$100 is \$10.
  - a. If the risk-free interest rate is 10% per year, what must be the price of a 3-month put option on P.U.T.T. stock at an exercise price of \$100? (The stock pays no dividends.)

3. Suresh Singh, CFA, is analyzing a convertible bond. The characteristics of the bond and the underlying common stock are given in the following exhibit:

Convertible Bond Characteristics	
Par value	\$1,000
Annual coupon rate (annual pay)	6.5%
Conversion ratio	22
Market price	105% of par value
Straight value	99% of par value
Underlying Stock Characteristics	
Current market price	\$40 per share
Annual cash dividend	\$1.20 per share

Compute the bond's:

- a. Conversion value.
  - b. Market conversion price.
4. Rich McDonald, CFA, is evaluating his investment alternatives in Ytel Incorporated by analyzing a Ytel convertible bond and Ytel common equity. Characteristics of the two securities are given in the following exhibit:

Characteristics	Convertible Bond	Common Equity
Par value	\$1,000	—
Coupon (annual payment)	4%	—
Current market price	\$980	\$35 per share
Straight bond value	\$925	—
Conversion ratio	25	—
Conversion option	At any time	—
Dividend	—	\$0
Expected market price in 1 year	\$1,125	\$45 per share

- a. Calculate, based on the exhibit, the:
    - i. Current market conversion price for the Ytel convertible bond.
    - ii. Expected 1-year rate of return for the Ytel convertible bond.
    - iii. Expected 1-year rate of return for the Ytel common equity.

One year has passed and Ytel's common equity price has increased to \$51 per share. Also, over the year, the interest rate on Ytel's nonconvertible bonds of the same maturity increased, while credit spreads remained unchanged.
  - b. Name the two components of the convertible bond's value. Indicate whether the value of each component should decrease, stay the same, or increase in response to the:
    - i. Increase in Ytel's common equity price.
    - ii. Increase in interest rates.
5. a. Consider a bullish spread option strategy using a call option with a \$25 exercise price priced at \$4 and a call option with a \$40 exercise price priced at \$2.50. If the price of the stock increases to \$50 at expiration and each option is exercised on the expiration date, the net profit per share at expiration (ignoring transaction costs) is:
- i. \$8.50
  - ii. \$13.50
  - iii. \$16.50
  - iv. \$23.50