- When the yield curve is not flat, bonds with the same maturity but different coupon rates will have different yields to maturity.

6.4 Corporate Bonds

- When a bond issuer does not make a bond payment in full, the issuer has defaulted.
  - The risk that default can occur is called default or credit risk.
  - U.S. Treasury securities are generally considered free of default risk.
- The expected return of a corporate bond, which is the firm's debt cost of capital, equals the risk-free rate of interest plus a risk premium. The expected return is less than the bond's yield to maturity because the yield to maturity of a bond is calculated using the promised cash flows, not the expected cash flows.
- Bond ratings summarize the creditworthiness of bonds for investors.
- The difference between yields on Treasury securities and yields on corporate bonds is called the credit spread or default spread. The credit spread compensates investors for the difference between promised and expected cash flows and for the risk of default.

6.5 Sovereign Bonds

- Sovereign bonds are issued by national governments.
- Sovereign bond yields reflect investor expectations of inflation, currency, and default risk.
- Countries may repay their debt by printing additional currency, which generally leads to a rise in inflation and a sharp currency devaluation.
- When "inflating away" the debt is infeasible or politically unattractive, countries may choose to default on their debt.

Key Terms

bond certificate *p. 170*
clean price *p. 179*
corporate bonds *p. 184*
coupon bonds *p. 173*
coupon-paying yield curve *p. 184*
coupon rate *p. 170*
coupons *p. 170*
credit risk *p. 185*
debt ceiling *p. 185*
default (credit) spread *p. 188*
dirty price *p. 179*
discount *p. 170*
duration *p. 179*
face value *p. 170*
high-yield bonds *p. 188*
investment-grade bonds *p. 188*
invoice price *p. 179*
junk bonds *p. 188*
maturity date *p. 170*
on-the-run bonds *p. 184*
par *p. 175*
premium *p. 175*
pure discount bond *p. 170*
sovereign bonds *p. 188*
speculative bonds *p. 188*
spot interest rates *p. 172*
term *p. 170*
Treasury bills *p. 170*
Treasury bonds *p. 173*
Treasury notes *p. 173*
yield to maturity (YTM) *p. 171*
zero-coupon bond *p. 170*
zero-coupon yield curve *p. 172*

Further Reading

For readers interested in more details about the bond market, the following texts will prove useful: Z. Bodie, A. Kane, and A. Marcus, *Investments* (McGraw-Hill/Irwin, 2004); F. Fabozzi, *The Handbook of Fixed Income Securities* (McGraw-Hill, 2005); W. Sharpe, G. Alexander, and J. Bailey, *Investments* (Prentice-Hall, 1998); and B. Tuckman, *Fixed Income Securities: Tools for Today's Markets* (John Wiley & Sons, Inc., 2002). C. Reinhart and K. Rogoff, *This Time Is Different* (Princeton University Press, 2010), provides a historical perspective and an excellent discussion of the risk of sovereign debt.

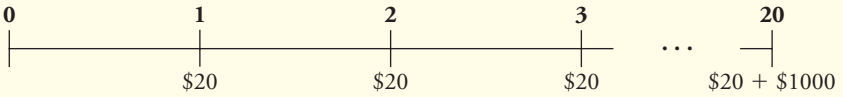
Problems

All problems are available in MyFinanceLab. An asterisk (*) indicates problems with a higher level of difficulty.

Bond Cash Flows, Prices, and Yields

1. A 30-year bond with a face value of $1000 has a coupon rate of 5.5%, with semiannual payments.
   a. What is the coupon payment for this bond?
   b. Draw the cash flows for the bond on a timeline.

2. Assume that a bond will make payments every six months as shown on the following timeline (using six-month periods):



   a. What is the maturity of the bond (in years)?
   b. What is the coupon rate (in percent)?
   c. What is the face value?

3. The following table summarizes prices of various default-free, zero-coupon bonds (expressed as a percentage of face value):

Maturity (years)	1	2	3	4	5
Price (per $100 face value)	$95.51	$91.05	$86.38	$81.65	$76.51

   a. Compute the yield to maturity for each bond.
   b. Plot the zero-coupon yield curve (for the first five years).
   c. Is the yield curve upward sloping, downward sloping, or flat?

4. Suppose the current zero-coupon yield curve for risk-free bonds is as follows:

Maturity (years)	1	2	3	4	5
YTM	5.00%	5.50%	5.75%	5.95%	6.05%

   a. What is the price per $100 face value of a two-year, zero-coupon, risk-free bond?
   b. What is the price per $100 face value of a four-year, zero-coupon, risk-free bond?
   c. What is the risk-free interest rate for a five-year maturity?

5. In the Global Financial Crisis box in Section 6.1, Bloomberg.com reported that the three-month Treasury bill sold for a price of $100.002556 per $100 face value. What is the yield to maturity of this bond, expressed as an EAR?

6. Suppose a 10-year, $1000 bond with an 8% coupon rate and semiannual coupons is trading for a price of $1034.74.
   a. What is the bond's yield to maturity (expressed as an APR with semiannual compounding)?
   b. If the bond's yield to maturity changes to 9% APR, what will the bond's price be?

7. Suppose a five-year, $1000 bond with annual coupons has a price of $900 and a yield to maturity of 6%. What is the bond's coupon rate?

Dynamic Behavior of Bond Prices

8. The prices of several bonds with face values of $1000 are summarized in the following table:

Bond	A	B	C	D
Price	$972.50	$1040.75	$1150.00	$1000.00

For each bond, state whether it trades at a discount, at par, or at a premium.

9. Explain why the yield of a bond that trades at a discount exceeds the bond's coupon rate.

10. Suppose a seven-year, $1000 bond with an 8% coupon rate and semiannual coupons is trading with a yield to maturity of 6.75%.
a. Is this bond currently trading at a discount, at par, or at a premium? Explain.
b. If the yield to maturity of the bond rises to 7% (APR with semiannual compounding), what price will the bond trade for?

11. Suppose that General Motors Acceptance Corporation issued a bond with 10 years until maturity, a face value of $1000, and a coupon rate of 7% (annual payments). The yield to maturity on this bond when it was issued was 6%.
a. What was the price of this bond when it was issued?
b. Assuming the yield to maturity remains constant, what is the price of the bond immediately before it makes its first coupon payment?
c. Assuming the yield to maturity remains constant, what is the price of the bond immediately after it makes its first coupon payment?

12. Suppose you purchase a 10-year bond with 6% annual coupons. You hold the bond for four years, and sell it immediately after receiving the fourth coupon. If the bond's yield to maturity was 5% when you purchased and sold the bond,
a. What cash flows will you pay and receive from your investment in the bond per $100 face value?
b. What is the internal rate of return of your investment?

13. Consider the following bonds:

Bond	Coupon Rate (annual payments)	Maturity (years)
A	0%	15
B	0%	10
C	4%	15
D	8%	10

a. What is the percentage change in the price of each bond if its yield to maturity falls from 6% to 5%?
b. Which of the bonds A–D is most sensitive to a 1% drop in interest rates from 6% to 5% and why? Which bond is least sensitive? Provide an intuitive explanation for your answer.

14. Suppose you purchase a 30-year, zero-coupon bond with a yield to maturity of 6%. You hold the bond for five years before selling it.
a. If the bond's yield to maturity is 6% when you sell it, what is the internal rate of return of your investment?
b. If the bond's yield to maturity is 7% when you sell it, what is the internal rate of return of your investment?
c. If the bond's yield to maturity is 5% when you sell it, what is the internal rate of return of your investment?
d. Even if a bond has no chance of default, is your investment risk free if you plan to sell it before it matures? Explain.

15. Suppose you purchase a 30-year Treasury bond with a 5% annual coupon, initially trading at par. In 10 years' time, the bond's yield to maturity has risen to 7% (EAR).
a. If you sell the bond now, what internal rate of return will you have earned on your investment in the bond?
b. If instead you hold the bond to maturity, what internal rate of return will you earn on your investment in the bond?
c. Is comparing the IRRs in (a) versus (b) a useful way to evaluate the decision to sell the bond? Explain.

16. Suppose the current yield on a one-year, zero coupon bond is 3%, while the yield on a five-year, zero coupon bond is 5%. Neither bond has any risk of default. Suppose you plan to invest for

one year. You will earn more over the year by investing in the five-year bond as long as its yield does not rise above what level?

The Yield Curve and Bond Arbitrage

For Problems 17–22, assume zero-coupon yields on default-free securities are as summarized in the following table:

Maturity (years)	1	2	3	4	5
Zero-coupon YTM	4.00%	4.30%	4.50%	4.70%	4.80%

17. What is the price today of a two-year, default-free security with a face value of $1000 and an annual coupon rate of 6%? Does this bond trade at a discount, at par, or at a premium?

18. What is the price of a five-year, zero-coupon, default-free security with a face value of $1000?

19. What is the price of a three-year, default-free security with a face value of $1000 and an annual coupon rate of 4%? What is the yield to maturity for this bond?

20. What is the maturity of a default-free security with annual coupon payments and a yield to maturity of 4%? Why?

***21.** Consider a four-year, default-free security with annual coupon payments and a face value of $1000 that is issued at par. What is the coupon rate of this bond?

22. Consider a five-year, default-free bond with annual coupons of 5% and a face value of $1000.
a. Without doing any calculations, determine whether this bond is trading at a premium or at a discount. Explain.
b. What is the yield to maturity on this bond?
c. If the yield to maturity on this bond increased to 5.2%, what would the new price be?

***23.** Prices of zero-coupon, default-free securities with face values of $1000 are summarized in the following table:

Maturity (years)	1	2	3
Price (per $1000 face value)	$970.87	$938.95	$904.56

Suppose you observe that a three-year, default-free security with an annual coupon rate of 10% and a face value of $1000 has a price today of $1183.50. Is there an arbitrage opportunity? If so, show specifically how you would take advantage of this opportunity. If not, why not?

***24.** Assume there are four default-free bonds with the following prices and future cash flows:

		Cash Flows		
Bond	Price Today	Year 1	Year 2	Year 3
A	$934.58	1000	0	0
B	881.66	0	1000	0
C	1,118.21	100	100	1100
D	839.62	0	0	1000

Do these bonds present an arbitrage opportunity? If so, how would you take advantage of this opportunity? If not, why not?

***25.** Suppose you are given the following information about the default-free, coupon-paying yield curve:

Maturity (years)	1	2	3	4
Coupon rate (annual payments)	0.00%	10.00%	6.00%	12.00%
YTM	2.000%	3.908%	5.840%	5.783%

a. Use arbitrage to determine the yield to maturity of a two-year, zero-coupon bond.
b. What is the zero-coupon yield curve for years 1 through 4?

Corporate Bonds

26. Explain why the expected return of a corporate bond does not equal its yield to maturity.

27. Grummon Corporation has issued zero-coupon corporate bonds with a five-year maturity. Investors believe there is a 20% chance that Grummon will default on these bonds. If Grummon does default, investors expect to receive only 50 cents per dollar they are owed. If investors require a 6% expected return on their investment in these bonds, what will be the price and yield to maturity on these bonds?

28. The following table summarizes the yields to maturity on several one-year, zero-coupon securities:

Security	Yield (%)
Treasury	3.1
AAA corporate	3.2
BBB corporate	4.2
B corporate	4.9

a. What is the price (expressed as a percentage of the face value) of a one-year, zero-coupon corporate bond with a AAA rating?
b. What is the credit spread on AAA-rated corporate bonds?
c. What is the credit spread on B-rated corporate bonds?
d. How does the credit spread change with the bond rating? Why?

29. Andrew Industries is contemplating issuing a 30-year bond with a coupon rate of 7% (annual coupon payments) and a face value of $1000. Andrew believes it can get a rating of A from Standard and Poor's. However, due to recent financial difficulties at the company, Standard and Poor's is warning that it may downgrade Andrew Industries bonds to BBB. Yields on A-rated, long-term bonds are currently 6.5%, and yields on BBB-rated bonds are 6.9%.
a. What is the price of the bond if Andrew maintains the A rating for the bond issue?
b. What will the price of the bond be if it is downgraded?

30. HMK Enterprises would like to raise $10 million to invest in capital expenditures. The company plans to issue five-year bonds with a face value of $1000 and a coupon rate of 6.5% (annual payments). The following table summarizes the yield to maturity for five-year (annual-pay) coupon corporate bonds of various ratings:

Rating	AAA	AA	A	BBB	BB
YTM	6.20%	6.30%	6.50%	6.90%	7.50%

a. Assuming the bonds will be rated AA, what will the price of the bonds be?
b. How much total principal amount of these bonds must HMK issue to raise $10 million today, assuming the bonds are AA rated? (Because HMK cannot issue a fraction of a bond, assume that all fractions are rounded to the nearest whole number.)
c. What must the rating of the bonds be for them to sell at par?
d. Suppose that when the bonds are issued, the price of each bond is $959.54. What is the likely rating of the bonds? Are they junk bonds?

31. A BBB-rated corporate bond has a yield to maturity of 8.2%. A U.S. Treasury security has a yield to maturity of 6.5%. These yields are quoted as APRs with semiannual compounding. Both bonds pay semiannual coupons at a rate of 7% and have five years to maturity.
a. What is the price (expressed as a percentage of the face value) of the Treasury bond?
b. What is the price (expressed as a percentage of the face value) of the BBB-rated corporate bond?
c. What is the credit spread on the BBB bonds?

32. The Isabelle Corporation rents prom dresses in its stores across the southern United States. It has just issued a five-year, zero-coupon corporate bond at a price of $74. You have purchased this bond and intend to hold it until maturity.
   a. What is the yield to maturity of the bond?
   b. What is the expected return on your investment (expressed as an EAR) if there is no chance of default?
   c. What is the expected return (expressed as an EAR) if there is a 100% probability of default and you will recover 90% of the face value?
   d. What is the expected return (expressed as an EAR) if the probability of default is 50%, the likelihood of default is higher in bad times than good times, and, in the case of default, you will recover 90% of the face value?
   e. For parts (b–d), what can you say about the five-year, risk-free interest rate in each case?

Sovereign Debt

33. What does it mean for a country to "inflate away" its debt? Why might this be costly for investors even if the country does not default?

34. Suppose the yield on German government bonds is 1%, while the yield on Spanish government bonds is 6%. Both bonds are denominated in euros. Which country do investors believe is more likely to default? Why?

Data Case

You are an intern with Sirius Satellite Radio in their corporate finance division. The firm is planning to issue $50 million of 12% annual coupon bonds with a 10-year maturity. The firm anticipates an increase in its bond rating. Your boss wants you to determine the gain in the proceeds of the new issue if the issue is rated above the firm's current bond rating. To prepare this information, you will have to determine Sirius' current debt rating and the yield curve for their particular rating.

1. Begin by finding the current U.S. Treasury yield curve. At the Treasury Web site (www.treas.gov), search using the term "yield curve" and select "Historic Yield Data." Click on "View Text Version of Treasury Yield Curve." The correct link is likely to be the first link on the page. Download that table into Excel by right clicking with the cursor in the table and selecting "Export to Microsoft Excel."

2. Find the current yield spreads for the various bond ratings. Unfortunately, the current spreads are available only for a fee, so you will use old ones. Go to BondsOnline (www.bondsonline.com) and click "Today's Market." Next, click "Corporate Bond Spreads." Download this table to Excel and copy and paste it to the same file as the Treasury yields.

3. Find the current bond rating for Sirius. Go to Standard & Poor's Web site (www.standardandpoors.com). Select "Find a Rating" from the list at the left of the page, then select "Credit Ratings Search." At this point, you will have to register (it's free) or enter the username and password provided by your instructor. Next, you will be able to search by Organization Name—enter Sirius and select Sirius Satellite Radio. Use the credit rating for the organization, not the specific issue ratings.

4. Return to Excel and create a timeline with the cash flows and discount rates you will need to value the new bond issue.
   a. To create the required spot rates for Sirius' issue, add the appropriate spread to the Treasury yield of the same maturity.
   b. The yield curve and spread rates you have found do not cover every year that you will need for the new bonds. Specifically, you do not have yields or spreads for four-, six-, eight-, and nine-year maturities. Fill these in by linearly interpolating the given yields and spreads. For example, the four-year spot rate and spread will be the average of the three- and five-year rates. The six-year rate and spread will be the average of the five- and seven-year rates. For years 8 and 9 you will have to spread the difference between years 7 and 10 across the two years.