4. Two bonds are available for purchase in the financial markets. The first bond is a two-year, $1,000 bond that pays an annual coupon of 10 percent. The second bond is a two-year, $1,000, zero-coupon bond.

    a. What is the duration of the coupon bond if the current yield-to-maturity (R) is 8 percent?10 percent? 12 percent? (*Hint*: You may wish to create a spreadsheet program to assist in the calculations.)
    b. How does the change in the yield to maturity affect the duration of this coupon bond?
    c. Calculate the duration of the zero-coupon bond with a yield to maturity of 8 percent, 10 percent, and 12 percent.
    d. How does the change in the yield to maturity affect the duration of the zero-coupon bond?
    e. Why does the change in the yield to maturity affect the coupon bond differently than it affects the zero-coupon bond?

5. What is the duration of a five-year, $1,000 Treasury bond with a 10 percent semiannual coupon selling at par? Selling with a yield to maturity of 12 percent? 14 percent? What can you conclude about the relationship between duration and yield to maturity? Plot the relationship. Why does this relationship exist?
6. Consider three Treasury bonds each of which has a 10 percent semiannual coupon and trades at par.
    a. Calculate the duration for a bond that has a maturity of four years, three years, and two years?
    b. What conclusions can you reach about the relationship of duration and the time to maturity? Plot the relationship.
7. A six-year, $10,000 CD pays 6 percent interest annually and has a 6 percent yield to maturity. What is the duration of the CD? What would be the duration if interest were paid semiannually? What is the relationship of duration to the relative frequency of interest payments?
9. Maximum Pension Fund is attempting to manage one of the bond portfolios under its management. The fund has identified three bonds which have five year maturities and trade at a yield to maturity of 9 percent. The bonds differ only in that the coupons are 7 percent, 9 percent, and 11 percent.
    a. What is the duration for each bond?
    b. What is the relationship between duration and the amount of coupon interest that is paid? Plot the relationship.
10. An insurance company is analyzing three bonds and is using duration as the measure of interest rate risk. All three bonds trade at a yield to maturity of 10 percent, have $10,000 par values, and have five years to maturity. The bonds differ only in the amount of annual coupon interest that they pay: 8, 10, and 12 percent.
    a. What is the duration for each five-year bond?
    b. What is the relationship between duration and the amount of coupon interest that is paid?

13. You have discovered that the price of a bond rose from $975 to $995 when the yield to maturity fell from 9.75 percent to 9.25 percent. What is the duration of the bond?

16. Calculate the duration of a two-year, $1,000 bond that pays an annual coupon of 10 percent and trades at a yield of 14 percent. What is the expected change in the price of the bond if interest rates fall by 0.50 percent (50 basis points)?

18. Suppose you purchase a six-year, 8 percent coupon bond (paid annually) that is priced to yield 9 percent. The face value of the bond is $1,000.
    a. Show that the duration of this bond is equal to five years.
    b. Show that if interest rates rise to 10 percent within the next year and your investment horizon is five years from today, you will still earn a 9 percent yield on your investment.
    c. Show that a 9 percent yield also will be earned if interest rates fall next year to 8 percent.

19. Suppose you purchase a five-year, 15 percent coupon bond (paid annually) that is priced to yield 9 percent. The face value of the bond is $1,000.
    a. Show that the duration of this bond is equal to four years.
    b. Show that if interest rates rise to 10 percent within the next year and your investment horizon is four years from today, you will still earn a 9 percent yield on your investment.
    c. Show that a 9 percent yield also will be earned if interest rates fall next year to 8 percent.