CHAPTER 5
INTEREST RATES AND BOND VALUATION

Answers to Concept Questions

1. No. As interest rates fluctuate, the value of a Treasury security will fluctuate. Long-term Treasury securities have substantial interest rate risk.

2. All else the same, the Treasury security will have lower coupons because of its lower default risk, so it will have greater interest rate risk.

3. No. If the bid were higher than the ask, the implication would be that a dealer was willing to sell a bond and immediately buy it back at a higher price. How many such transactions would you like to do?

4. Prices and yields move in opposite directions. Since the bid price must be lower, the bid yield must be higher.

5. There are two benefits. First, the company can take advantage of interest rate declines by calling in an issue and replacing it with a lower coupon issue. Second, a company might wish to eliminate a covenant for some reason. Calling the issue does this. The cost to the company is a higher coupon. A put provision is desirable from an investor’s standpoint, so it helps the company by reducing the coupon rate on the bond. The cost to the company is that it may have to buy back the bond at an unattractive price.

6. Bond issuers look at outstanding bonds of similar maturity and risk. The yields on such bonds are used to establish the coupon rate necessary for a particular issue to initially sell for par value. Bond issuers also simply ask potential purchasers what coupon rate would be necessary to attract them. The coupon rate is fixed and simply determines what the bond’s coupon payments will be. The required return is what investors actually demand on the issue, and it will fluctuate through time. The coupon rate and required return are equal only if the bond sells for exactly at par.

7. Yes. Some investors have obligations that are denominated in dollars; i.e., they are nominal. Their primary concern is that an investment provides the needed nominal dollar amounts. Pension funds, for example, often must plan for pension payments many years in the future. If those payments are fixed in dollar terms, then it is the nominal return on an investment that is important.

8. Companies pay to have their bonds rated simply because unrated bonds can be difficult to sell; many large investors are prohibited from investing in unrated issues.

9. Junk bonds often are not rated because there would be no point in an issuer paying a rating agency to assign its bonds a low rating (it’s like paying someone to kick you!).
10. The term structure is based on pure discount bonds. The yield curve is based on coupon-bearing issues.

11. Bond ratings have a subjective factor to them. Split ratings reflect a difference of opinion among credit agencies.

12. As a general constitutional principle, the federal government cannot tax the states without their consent if doing so would interfere with state government functions. At one time, this principle was thought to provide for the tax-exempt status of municipal interest payments. However, modern court rulings make it clear that Congress can revoke the municipal exemption, so the only basis now appears to be historical precedent. The fact that the states and the federal government do not tax each other’s securities is referred to as “reciprocal immunity.”

13. Lack of transparency means that a buyer or seller can’t see recent transactions, so it is much harder to determine what the best bid and ask prices are at any point in time.

14. When the bonds are initially issued, the coupon rate is set at auction so that the bonds sell at par value. The wide range coupon of coupon rates shows the interest rate when the bond was issued. Notice that interest rates have evidently declined. Why?

15. Companies charge that bond rating agencies are pressuring them to pay for bond ratings. When a company pays for a rating, it has the opportunity to make its case for a particular rating. With an unsolicited rating, the company has no input.

16. A 100-year bond looks like a share of preferred stock. In particular, it is a loan with a life that almost certainly exceeds the life of the lender, assuming that the lender is an individual. With a junk bond, the credit risk can be so high that the borrower is almost certain to default, meaning that the creditors are very likely to end up as part owners of the business. In both cases, the “equity in disguise” has a significant tax advantage.

17. \(a\). The bond price is the present value of the cash flows from a bond. The YTM is the interest rate used in valuing the cash flows from a bond.

\(b\). If the coupon rate is higher than the required return on a bond, the bond will sell at a premium, since it provides periodic income in the form of coupon payments in excess of that required by investors on other similar bonds. If the coupon rate is lower than the required return on a bond, the bond will sell at a discount since it provides insufficient coupon payments compared to that required by investors on other similar bonds. For premium bonds, the coupon rate exceeds the YTM; for discount bonds, the YTM exceeds the coupon rate, and for bonds selling at par, the YTM is equal to the coupon rate.

\(c\). Current yield is defined as the annual coupon payment divided by the current bond price. For premium bonds, the current yield exceeds the YTM, for discount bonds the current yield is less than the YTM, and for bonds selling at par value, the current yield is equal to the YTM. In all cases, the current yield plus the expected one-period capital gains yield of the bond must be equal to the required return.
18. A long-term bond has more interest rate risk compared to a short-term bond, all else the same. A low coupon bond has more interest rate risk than a high coupon bond, all else the same. When comparing a high coupon, long-term bond to a low coupon, short-term bond, we are unsure which has more interest rate risk. Generally, the maturity of a bond is a more important determinant of the interest rate risk, so the long-term, high coupon bond probably has more interest rate risk. The exception would be if the maturities are close, and the coupon rates are vastly different.

Solutions to Questions and Problems

NOTE: All end-of-chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.

NOTE: Most problems do not explicitly list a par value for bonds. Even though a bond can have any par value, in general, corporate bonds in the United States will have a par value of $1,000. We will use this par value in all problems unless a different par value is explicitly stated.

Basic

1. The price of a pure discount (zero coupon) bond is the present value of the par. Remember, even though there are no coupon payments, the periods are semiannual to stay consistent with coupon bond payments. So, the price of the bond for each YTM is:

   a. \( P = \frac{1,000}{(1 + .05/2)^{40}} = 372.43 \)

   b. \( P = \frac{1,000}{(1 + .10/2)^{40}} = 142.05 \)

   c. \( P = \frac{1,000}{(1 + .15/2)^{40}} = 55.42 \)

2. The price of any bond is the PV of the interest payments, plus the PV of the par value. Notice this problem assumes a semiannual coupon. The price of the bond at each YTM will be:

   a. \( P = \frac{35 \times \left( 1 - \frac{1}{(1 + .035)^{50}} \right)}{.035} + \frac{1,000}{(1 + .035)^{50}} \)

      \( P = 1,000.00 \)

      When the YTM and the coupon rate are equal, the bond will sell at par.

   b. \( P = \frac{35 \times \left( 1 - \frac{1}{(1 + .045)^{50}} \right)}{.045} + \frac{1,000}{(1 + .045)^{50}} \)

      \( P = 802.38 \)

      When the YTM is greater than the coupon rate, the bond will sell at a discount.

   c. \( P = \frac{35 \times \left( 1 - \frac{1}{(1 + .025)^{50}} \right)}{.025} + \frac{1,000}{(1 + .025)^{50}} \)

      \( P = 1,283.62 \)

      When the YTM is less than the coupon rate, the bond will sell at a premium.
We would like to introduce shorthand notation here. Rather than write (or type, as the case may be) the entire equation for the PV of a lump sum, or the PVA equation, it is common to abbreviate the equations as:

\[ PVIF_{R,t} = \frac{1}{(1 + R)^t} \]

which stands for Present Value Interest Factor

\[ PVIFA_{R,t} = \frac{\left(1 - \frac{1}{(1 + R)^t}\right)}{R} \]

which stands for Present Value Interest Factor of an Annuity

These abbreviations are short hand notation for the equations in which the interest rate and the number of periods are substituted into the equation and solved. We will use this shorthand notation in the remainder of the solutions key.

3. Here we are finding the YTM of a semiannual coupon bond. The bond price equation is:

\[ P = 1,050 = 34(PVIFA_{R\%,26}) + 1,000(PVIF_{R\%,26}) \]

Since we cannot solve the equation directly for \( R \), using a spreadsheet, a financial calculator, or trial and error, we find:

\[ R = 3.117\% \]

Since the coupon payments are semiannual, this is the semiannual interest rate. The YTM is the APR of the bond, so:

\[ YTM = 2 \times 3.117\% = 6.23\% \]

4. Here we need to find the coupon rate of the bond. We need to set up the bond pricing equation and solve for the coupon payment as follows:

\[ P = 1,040 = C(PVIFA_{3.65\%,25}) + 1,000(PVIF_{3.65\%,25}) \]

Solving for the coupon payment, we get:

\[ C = 38.97 \]

Since this is the semiannual payment, the annual coupon payment is:

\[ 2 \times 38.97 = 77.93 \]

And the coupon rate is the annual coupon payment divided by par value, so:

\[ \text{Coupon rate} = \frac{77.93}{1,000} = .0779, \text{ or } 7.79\% \]
5. The price of any bond is the PV of the interest payment, plus the PV of the par value. The fact that the bond is denominated in euros is irrelevant. Notice this problem assumes an annual coupon. The price of the bond will be:

\[ P = \text{€}58\left(1 - \frac{1}{(1 + .069)^{23}}\right) / .069 + \text{€}1,000\left(1 / (1 + .069)^{23}\right) \]

\[ P = \text{€}874.94 \]

6. Here we are finding the YTM of an annual coupon bond. The fact that the bond is denominated in yen is irrelevant. The bond price equation is:

\[ P = \text{¥}89,000 = \text{¥}4,900(PVIFA_{R\%,18}) + \text{¥}100,000(PVIF_{R\%,18}) \]

Since we cannot solve the equation directly for \( R \), using a spreadsheet, a financial calculator, or trial and error, we find:

\[ R = 5.91\% \]

Since the coupon payments are annual, this is the yield to maturity.

7. The approximate relationship between nominal interest rates (\( R \)), real interest rates (\( r \)), and inflation (\( h \)) is:

\[ R = r + h \]

Approximate \( r = .041 - .027 = .014 \), or 1.40\%

The Fisher equation, which shows the exact relationship between nominal interest rates, real interest rates, and inflation is:

\[ (1 + R) = (1 + r)(1 + h) \]

\[ (1 + .041) = (1 + r)(1 + .027) \]

Exact \( r = [(1 + .041) / (1 + .027)] - 1 = .0136 \), or 1.36\%

8. The Fisher equation, which shows the exact relationship between nominal interest rates, real interest rates, and inflation, is:

\[ (1 + R) = (1 + r)(1 + h) \]

\[ R = (1 + .025)(1 + .034) - 1 = .0599 \), or 5.99\%

9. The Fisher equation, which shows the exact relationship between nominal interest rates, real interest rates, and inflation, is:

\[ (1 + R) = (1 + r)(1 + h) \]

\[ h = [(1 + .115) / (1 + .079)] - 1 = .0334 \), or 3.34\% \]
10. The Fisher equation, which shows the exact relationship between nominal interest rates, real interest rates, and inflation, is:

\[ (1 + R) = (1 + r)(1 + h) \]

\[ r = \left( \frac{1 + .127}{1.042} \right) - 1 = .0816, \text{ or } 8.16\% \]

11. The coupon rate, located in the second column of the quote is 5.500%. The bid price is:

\[
\begin{align*}
\text{Bid price} &= 141.4375\% \times 1,000 \\
\text{Bid price} &= 1,414.375
\end{align*}
\]

The previous day’s ask price is found by:

\[
\begin{align*}
\text{Previous day’s asked price} &= \text{Today’s asked price} - \text{Change} \\
\text{Previous day’s asked price} &= 141.5156 - 1.1563 \\
\text{Previous day’s asked price} &= 140.3593
\end{align*}
\]

The previous day’s price in dollars was:

\[
\begin{align*}
\text{Previous day’s dollar price} &= \left( \frac{140.3593}{100} \right) \times 1,000 \\
\text{Previous day’s dollar price} &= 1,403.593
\end{align*}
\]

12. This is a premium bond because it sells for more than 100 percent of face value. The current yield is based on the asked price, so the current yield is:

\[
\text{Current yield} = \frac{\text{Annual coupon payment}}{\text{Price}} \\
\text{Current yield} = \frac{42.50}{1,276.328} \\
\text{Current yield} = .0333, \text{ or } 3.33\%
\]

The YTM is located under the “Asked Yield” column, so the YTM is 2.772%.

The bid-ask spread is the difference between the bid price and the ask price, so:

\[
\begin{align*}
\text{Bid-Ask spread} &= 127.6328 - 127.5547 \\
\text{Bid-Ask spread} &= .0781\% \times 1,000 \\
\text{Bid-Ask spread} &= .781
\end{align*}
\]
Intermediate

13. Here we are finding the YTM of semiannual coupon bonds for various maturity lengths. The bond price equation is:

\[ P = C \left( \text{PVIFA}_{R\%,t} \right) + \$1,000 \left( \text{PVIF}_{R\%,t} \right) \]

Miller Corporation bond:
- \( P_0 = 90(\text{PVIFA}_{3.5\%,26}) + 1,000(\text{PVIF}_{3.5\%,26}) = \$1,168.90 \)
- \( P_1 = 90(\text{PVIFA}_{3.5\%,24}) + 1,000(\text{PVIF}_{3.5\%,24}) = \$1,160.58 \)
- \( P_3 = 90(\text{PVIFA}_{3.5\%,20}) + 1,000(\text{PVIF}_{3.5\%,20}) = \$1,142.12 \)
- \( P_8 = 90(\text{PVIFA}_{3.5\%,10}) + 1,000(\text{PVIF}_{3.5\%,10}) = \$1,083.17 \)
- \( P_{12} = 90(\text{PVIFA}_{3.5\%,2}) + 1,000(\text{PVIF}_{3.5\%,2}) = \$1,019.00 \)
- \( P_{13} = \$1,000 \)

Modigliani Company bond:
- \( P_0 = 70(\text{PVIFA}_{4.5\%,26}) + 1,000(\text{PVIF}_{4.5\%,26}) = \$848.53 \)
- \( P_1 = 70(\text{PVIFA}_{4.5\%,24}) + 1,000(\text{PVIF}_{4.5\%,24}) = \$855.05 \)
- \( P_3 = 70(\text{PVIFA}_{4.5\%,20}) + 1,000(\text{PVIF}_{4.5\%,20}) = \$869.92 \)
- \( P_8 = 70(\text{PVIFA}_{4.5\%,10}) + 1,000(\text{PVIF}_{4.5\%,10}) = \$920.87 \)
- \( P_{12} = 70(\text{PVIFA}_{4.5\%,2}) + 1,000(\text{PVIF}_{4.5\%,2}) = \$981.27 \)
- \( P_{13} = \$1,000 \)

All else held constant, the premium over par value for a premium bond declines as maturity approaches, and the discount from par value for a discount bond declines as maturity approaches. This is called “pull to par.” In both cases, the largest percentage price changes occur at the shortest maturity lengths.

Also, notice that the price of each bond when no time is left to maturity is the par value, even though the purchaser would receive the par value plus the coupon payment immediately. This is because we calculate the clean price of the bond.
14. Any bond that sells at par has a YTM equal to the coupon rate. Both bonds sell at par, so the initial YTM on both bonds is the coupon rate, 6.5 percent. If the YTM suddenly rises to 8.5 percent:

\[ P_{\text{Laurel}} = 32.50 \times (PVIFA_{4.25\%,6}) + 1,000 \times (PVIF_{4.25\%,6}) = 948.00 \]

\[ P_{\text{Hardy}} = 32.50 \times (PVIFA_{4.25\%,40}) + 1,000 \times (PVIF_{4.25\%,40}) = 809.23 \]

The percentage change in price is calculated as:

Percentage change in price = (New price – Original price) / Original price

\[ \Delta P_{\text{Laurel}}\% = (948.00 - 1,000) / 1,000 = -0.0520, \text{ or } -5.20\% \]

\[ \Delta P_{\text{Hardy}}\% = (809.23 - 1,000) / 1,000 = -0.1908, \text{ or } -19.08\% \]
If the YTM suddenly falls to 4.5 percent:

\[ P_{\text{Laurel}} = 32.50(PVIFA_{2.25\%,6}) + 1,000(PVIF_{2.25\%,6}) = 1,055.54 \]

\[ P_{\text{Hardy}} = 32.50(PVIFA_{2.25\%,40}) + 1,000(PVIF_{2.25\%,40}) = 1,261.94 \]

\[ \Delta P_{\text{Laurel}}\% = \frac{(1,055.54 - 1,000)}{1,000} = +.0555, \text{ or } 5.55\% \]

\[ \Delta P_{\text{Hardy}}\% = \frac{(1,261.94 - 1,000)}{1,000} = +.2619, \text{ or } 26.19\% \]

All else the same, the longer the maturity of a bond, the greater is its price sensitivity to changes in interest rates. Notice also that for the same interest rate change, the gain from a decline in interest rates is larger than the loss from the same magnitude change. For a plain vanilla bond, this is always true.

15. Initially, at a YTM of 9 percent, the prices of the two bonds are:

\[ P_{\text{Faulk}} = 30(PVIFA_{4.5\%,28}) + 1,000(PVIF_{4.5\%,28}) = 763.86 \]

\[ P_{\text{Gonax}} = 60(PVIFA_{4.5\%,28}) + 1,000(PVIF_{4.5\%,28}) = 1,236.14 \]
If the YTM rises from 9 percent to 11 percent:

\[ P_{\text{Faulk}} = 30 \times (PVIFA_{5.5\%,28}) + 1,000 \times (PVIF_{5.5\%,28}) = 646.96 \]

\[ P_{\text{Gonas}} = 60 \times (PVIFA_{5.5\%,28}) + 1,000 \times (PVIF_{5.5\%,28}) = 1,070.61 \]

The percentage change in price is calculated as:

\[ \Delta P_{\text{Faulk}}\% = \frac{(\text{New price} - \text{Original price})}{\text{Original price}} \cdot 100 \]

\[ \Delta P_{\text{Gonas}}\% = \frac{(\text{New price} - \text{Original price})}{\text{Original price}} \cdot 100 \]

If the YTM declines from 9 percent to 7 percent:

\[ P_{\text{Faulk}} = 30 \times (PVIFA_{3.5\%,28}) + 1,000 \times (PVIF_{3.5\%,28}) = 911.66 \]

\[ P_{\text{Gonas}} = 60 \times (PVIFA_{3.5\%,28}) + 1,000 \times (PVIF_{3.5\%,28}) = 1,441.68 \]

\[ \Delta P_{\text{Faulk}}\% = \frac{(\text{New price} - \text{Original price})}{\text{Original price}} \cdot 100 \]

\[ \Delta P_{\text{Gonas}}\% = \frac{(\text{New price} - \text{Original price})}{\text{Original price}} \cdot 100 \]

All else the same, the lower the coupon rate on a bond, the greater is its price sensitivity to changes in interest rates.

16. The current yield is:

Current yield = Annual coupon payment / Price = $71 / $1,080 = .0657, or 6.57%

The bond price equation for this bond is:

\[ P = 1,080 = 35.50 \times (PVIFA_{R\%,18}) + 1,000 \times (PVIF_{R\%,18}) \]

Using a spreadsheet, financial calculator, or trial and error we find:

\[ R = 2.970\% \]

This is the semiannual interest rate, so the YTM is:

\[ \text{YTM} = 2 \times 2.970\% = 5.94\% \]

The effective annual yield is the same as the EAR, so using the EAR equation from the previous chapter:

Effective annual yield = \((1 + .02970)^2 - 1 = .0603, or 6.03\% \)
17. The company should set the coupon rate on its new bonds equal to the required return. The required return can be observed in the market by finding the YTM on outstanding bonds of the company. So, the YTM on the bonds currently sold in the market is:

\[ P = $1,101.50 = 35(PVIFA_{R\%,40}) + 1,000(PVIF_{R\%,40}) \]

Using a spreadsheet, financial calculator, or trial and error we find:

\[ R = 3.057\% \]

This is the semiannual interest rate, so the YTM is:

\[ YTM = 2 \times 3.057\% = 6.11\% \]

18. Accrued interest is the coupon payment for the period times the fraction of the period that has passed since the last coupon payment. Since we have a semiannual coupon bond, the coupon payment per six months is one-half of the annual coupon payment. There are two months until the next coupon payment, so four months have passed since the last coupon payment. The accrued interest for the bond is:

Accrued interest = $76/2 \times 4/6 = $25.33

And we calculate the clean price as:

Clean price = Dirty price – Accrued interest = $945 – 25.33 = $919.67

19. Accrued interest is the coupon payment for the period times the fraction of the period that has passed since the last coupon payment. Since we have a semiannual coupon bond, the coupon payment per six months is one-half of the annual coupon payment. There are four months until the next coupon payment, so two months have passed since the last coupon payment. The accrued interest for the bond is:

Accrued interest = $82/2 \times 2/6 = $13.67

And we calculate the dirty price as:

Dirty price = Clean price + Accrued interest = $1,060 + 13.67 = $1,073.67

20. To find the number of years to maturity for the bond, we need to find the price of the bond. Since we already have the coupon rate, we can use the bond price equation, and solve for the number of years to maturity. We are given the current yield of the bond, so we can calculate the price as:

Current yield = .0695 = $63/P_0
\[ P_0 = $63/.0695 = $906.47 \]

Now that we have the price of the bond, the bond price equation is:

\[ P = $906.47 = $63\{[(1 - (1/1.0714)') / .0714} + $1,000/1.0714' \]
We can solve this equation for \( t \) as follows:

\[
906.47(1.0714)^t = 882.35(1.0714)^t - 882.35 + 1,000 \\
117.65 = 24.12(1.0714)^t \\
4.878 = 1.0714^t \\
t = \log 4.878 / \log 1.0714 = 22.976 \approx 23 \text{ years}
\]

The bond has about 23 years to maturity.

21. The bond has 13 years to maturity, so the bond price equation is:

\[
P = \$943.50 = 34(\text{PVIFA}_{R\%,26}) + 1,000(\text{PVIF}_{R\%,26})
\]

Using a spreadsheet, financial calculator, or trial and error we find:

\[
R = 3.744\%
\]

This is the semiannual interest rate, so the YTM is:

\[
\text{YTM} = 2 \times 3.744\% = 7.49\% 
\]

The current yield is the annual coupon payment divided by the bond price, so:

\[
\text{Current yield} = \$68 / \$943.50 = .0721, \text{ or } 7.21\%
\]

22. We found the maturity of a bond in Problem 20. However, in this case, the maturity is indeterminate. A bond selling at par can have any length of maturity. In other words, when we solve the bond pricing equation as we did in Problem 20, the number of periods can be any positive number.

**Challenge**

23. To find the capital gains yield and the current yield, we need to find the price of the bond. The current price of Bond P and the price of Bond P in one year is:

\[
P_0 = 80(\text{PVIFA}_{7\%,8}) + 1,000(\text{PVIF}_{7\%,8}) = 1,059.71 \\
P_1 = 80(\text{PVIFA}_{7\%,7}) + 1,000(\text{PVIF}_{7\%,7}) = 1,053.89
\]

Current yield = $80 / 1,059.71 = .0755, \text{ or } 7.55\%

The capital gains yield is:

Capital gains yield = (New price – Original price) / Original price

Capital gains yield = ($1,053.89 – 1,059.71) / $1,059.71 = -.0055 or -.55%
The current price of Bond D and the price of Bond D in one year is:

\[ D: \quad P_0 = 60(PVIFA_{7\%,8}) + 1,000(PVIF_{7\%,8}) = 940.29 \]

\[ P_1 = 60(PVIFA_{7\%,7}) + 1,000(PVIF_{7\%,7}) = 946.11 \]

Current yield = $60 / $940.29 = .0638, or 6.38%

Capital gains yield = ($946.11 – 940.29) / $940.29 = .0062, or .62%

All else held constant, premium bonds pay a high current income while having price depreciation as maturity nears; discount bonds pay a lower current income but have price appreciation as maturity nears. For either bond, the total return is still 7 percent, but this return is distributed differently between current income and capital gains.

24. a. The rate of return you expect to earn if you purchase a bond and hold it until maturity is the YTM. The bond price equation for this bond is:

\[ P_0 = 835 = 62(PVIFA_{R\%,21}) + 1,000(PVIF_{R\%,21}) \]

Using a spreadsheet, financial calculator, or trial and error we find:

\[ R = YTM = 7.83\% \]

b. To find our HPY, we need to find the price of the bond in two years. The price of the bond in two years, at the new interest rate, will be:

\[ P_2 = 62(PVIFA_{6.83\%,19}) + 1,000(PVIF_{6.83\%,19}) = 934.53 \]

To calculate the HPY, we need to find the interest rate that equates the price we paid for the bond with the cash flows we received. The cash flows we received were $62 each year for two years, and the price of the bond when we sold it. The equation to find our HPY is:

\[ P_0 = 835 = 62(PVIFA_{R\%,2}) + 934.53(PVIF_{R\%,2}) \]

Solving for \( R \), we get:

\[ R = HPY = 13.02\% \]

The realized HPY is greater than the expected YTM when the bond was bought because interest rates dropped by 1 percent; bond prices rise when yields fall.

25. The price of any bond (or financial instrument) is the PV of the future cash flows. Even though Bond M makes different coupon payments, to find the price of the bond, we just find the PV of the cash flows. The PV of the cash flows for Bond M is:

\[ P_M = 800(PVIFA_{3.25\%,16})(PVIF_{3.25\%,12}) + 1,000(PVIFA_{3.25\%,12})(PVIF_{3.25\%,28}) + 20,000(PVIF_{3.25\%,40}) \]

\[ P_M = 16,286.63 \]

Notice that for the coupon payments of $800, we found the PVA for the coupon payments, and then discounted the lump sum back to today.
Bond N is a zero coupon bond with a $20,000 par value; therefore, the price of the bond is the PV of the par, or:

\[ P_N = 20,000(PVIF_{3.25\%,40}) = 5,564.52 \]

26. To calculate this, we need to set up an equation with the callable bond equal to a weighted average of the noncallable bonds. We will invest X percent of our money in the first noncallable bond, which means our investment in Bond 3 (the other noncallable bond) will be \((1 - X)\). The equation is:

\[ C_2 = C_1X + C_3(1 - X) \]
\[ 7.60 = 5.50X + 8.40(1 - X) \]
\[ 7.60 = 5.50X + 8.40 - 8.40X \]
\[ X = 0.27586 \]

So, we invest about 28 percent of our money in Bond 1, and about 72 percent in Bond 3. This combination of bonds should have the same value as the callable bond, excluding the value of the call. So:

\[ P_2 = 0.27586P_1 + 0.72414P_3 \]
\[ P_2 = 0.27586(106.375) + 0.72414(108.21875) \]
\[ P_2 = 107.71 \]

The call value is the difference between this implied bond value and the actual bond price. So, the call value is:

\[ \text{Call value} = 107.71 - 103.50 = 4.210 \]

Assuming a $1,000 par value, the call value is $42.10.

27. In general, this is not likely to happen, although it can (and did). The reason that this bond has a negative YTM is that it is a callable U.S. Treasury bond. Market participants know this. Given the high coupon rate of the bond, it is extremely likely to be called, which means the bondholder will not receive all the cash flows promised. A better measure of the return on a callable bond is the yield to call (YTC). The YTC calculation is the basically the same as the YTM calculation, but the number of periods is the number of periods until the call date. If the YTC were calculated on this bond, it would be positive.

28. To find the present value, we need to find the real weekly interest rate. To find the real return, we need to use the effective annual rates in the Fisher equation. So, we find the real EAR is:

\[ (1 + R) = (1 + r)(1 + h) \]
\[ 1 + .072 = (1 + r)(1 + .035) \]
\[ r = .0357, \text{ or } 3.57\% \]
Now, to find the weekly interest rate, we need to find the APR. Using the equation for discrete compounding:

$$\text{EAR} = \left[1 + \left(\frac{\text{APR}}{m}\right)\right]^m - 1$$

We can solve for the APR. Doing so, we get:

$$\text{APR} = m \left[ \left(1 + \text{EAR} \right) \right]^{1/m} - 1$$

$$\text{APR} = 52 \left[ \left(1 + \frac{.0357}{52}\right) \right]^{1/52} - 1$$

$$\text{APR} = .0351, \text{ or } 3.51\%$$

So, the weekly interest rate is:

Weekly rate = APR / 52
Weekly rate = .0351 / 52
Weekly rate = .0007, or .07\%

Now we can find the present value of the cost of the roses. The real cash flows are an ordinary annuity, discounted at the real interest rate. So, the present value of the cost of the roses is:

$$\text{PVA} = C \left[ \frac{1 - \left[1/(1 + r)\right]^t}{r} \right]$$

$$\text{PVA} = 5 \left[ 1 - \left[1/(1 + .0007)\right]^{30(52)} \right] / .0007$$

$$\text{PVA} = 5,819.94$$

29. To answer this question, we need to find the monthly interest rate, which is the APR divided by 12. We also must be careful to use the real interest rate. The Fisher equation uses the effective annual rate, so, the real effective annual interest rates, and the monthly interest rates for each account are:

Stock account:

(1 + R) = (1 + r)(1 + h)
1 + .12 = (1 + r)(1 + .04)
\(r = .0769, \text{ or } 7.69\%\)

$$\text{APR} = m \left[ \left(1 + \text{EAR} \right) \right]^{1/m} - 1$$

$$\text{APR} = 12 \left[ \left(1 + \frac{.0769}{12}\right) \right]^{1/12} - 1$$

$$\text{APR} = .0743, \text{ or } 7.43\%$$

Monthly rate = APR / 12
Monthly rate = .0743 / 12
Monthly rate = .0062, or .62\%

Bond account:

(1 + R) = (1 + r)(1 + h)
1 + .07 = (1 + r)(1 + .04)
\(r = .0288, \text{ or } 2.88\%\)

$$\text{APR} = m \left[ \left(1 + \text{EAR} \right) \right]^{1/m} - 1$$

$$\text{APR} = 12 \left[ \left(1 + \frac{.0288}{12}\right) \right]^{1/12} - 1$$

$$\text{APR} = .0285, \text{ or } 2.85\%$$
Monthly rate = APR / 12
Monthly rate = .0285 / 12
Monthly rate = .0024, or .24%

Now we can find the future value of the retirement account in real terms. The future value of each account will be:

Stock account:
FVA = C \{ (1 + r)^t - 1 \} / r
FVA = $900\{ (1 + .0062)^{360} - 1 \} / .0062\}
FVA = $1,196,731.96

Bond account:
FVA = C \{ (1 + r)^t - 1 \} / r
FVA = $400\{ (1 + .0024)^{360} - 1 \} / .0024\}
FVA = $227,089.04

The total future value of the retirement account will be the sum of the two accounts, or:

Account value = $1,196,731.96 + 227,089.04
Account value = $1,423,821.00

Now we need to find the monthly interest rate in retirement. We can use the same procedure that we used to find the monthly interest rates for the stock and bond accounts, so:

\[(1 + R) = (1 + r)(1 + h)\]
\[1 + .08 = (1 + r)(1 + .04)\]
\[r = .0385, \text{ or } 3.85\%\]

\[APR = m\{ (1 + EAR)^{1/m} - 1 \}\]
\[APR = 12\{ (1 + .0385)^{1/12} - 1 \}\]
\[APR = .0378, \text{ or } 3.78\%\]

Monthly rate = APR / 12
Monthly rate = .0378 / 12
Monthly rate = .0031, or .31%

Now we can find the real monthly withdrawal in retirement. Using the present value of an annuity equation and solving for the payment, we find:

\[PVA = C\{ 1 - [1/(1 + r)]^t \} / r \]
\[PVA = C\{ 1 - [1/(1 + .0031)]^{300} \} / .0031\]
\[C = $7,343.56\]
This is the real dollar amount of the monthly withdrawals. The nominal monthly withdrawals will increase by the inflation rate each month. To find the nominal dollar amount of the last withdrawal, we can increase the real dollar withdrawal by the inflation rate. We can increase the real withdrawal by the effective annual inflation rate since we are only interested in the nominal amount of the last withdrawal. So, the last withdrawal in nominal terms will be:

$$FV = PV(1 + r)^t$$

$$FV = \$7,343.56(1 + .04)^{30+25}$$

$$FV = \$63,495.09$$

30. In this problem, we need to calculate the future value of the annual savings after the five years of operations. The savings are the revenues minus the costs, or:

Savings = Revenue – Costs

Since the annual fee and the number of members are increasing, we need to calculate the effective growth rate for revenues, which is:

Effective growth rate = \((1 + .06)(1 + .03) - 1\)

Effective growth rate = .0918, or 9.18%

The revenue for the current year is the number of members times the annual fee, or:

Current revenue = 550($700)

Current revenue = $385,000

The revenue will grow at 9.18 percent, and the costs will grow at 2 percent, so the savings each year for the next five years will be:

<table>
<thead>
<tr>
<th>Year</th>
<th>Revenue</th>
<th>Costs</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$420,343.00</td>
<td>$81,600.00</td>
<td>$338,743.00</td>
</tr>
<tr>
<td>2</td>
<td>458,930.49</td>
<td>83,232.00</td>
<td>375,698.49</td>
</tr>
<tr>
<td>3</td>
<td>501,060.31</td>
<td>84,896.64</td>
<td>416,163.67</td>
</tr>
<tr>
<td>4</td>
<td>547,057.64</td>
<td>86,594.57</td>
<td>460,463.07</td>
</tr>
<tr>
<td>5</td>
<td>597,277.53</td>
<td>88,326.46</td>
<td>508,951.07</td>
</tr>
</tbody>
</table>

Now we can find the value of each year’s savings using the future value of a lump sum equation, so:

$$FV = PV(1 + r)^t$$

<table>
<thead>
<tr>
<th>Year</th>
<th>Future Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$478,163.39</td>
</tr>
<tr>
<td>2</td>
<td>486,540.44</td>
</tr>
<tr>
<td>3</td>
<td>494,444.05</td>
</tr>
<tr>
<td>4</td>
<td>501,904.75</td>
</tr>
<tr>
<td>5</td>
<td>508,951.07</td>
</tr>
</tbody>
</table>

Total future value of savings = $2,470,003.69
He will spend $400,000 on a luxury boat, so the value of his account will be:

Value of account = $2,470,003.69 – 400,000
Value of account = $2,070,003.69

Now we can use the present value of an annuity equation to find the payment. Doing so, we find:

PVA = C(\{1 – [1/(1 + r)]^t \} / r)
$2,070,003.69 = C(\{1 – [1/(1 + .09)]^{25} \} / .09)
C = $210,739.31
Calculator Solutions

1. 
   a. 
Enter  
   \[ \begin{array}{cccc} 
   \text{N} & \text{I/Y} & \text{PV} & \text{PMT} & \text{FV} \\
   40 & 2.5\% & \text{PV} & \text{PMT} & \text{FV} \\
   \end{array} \] 
   Solve for \$1,000 
   \text{PV} = \$372.43 

   b. 
Enter  
   \[ \begin{array}{cccc} 
   \text{N} & \text{I/Y} & \text{PV} & \text{PMT} & \text{FV} \\
   40 & 5\% & \text{PV} & \text{PMT} & \text{FV} \\
   \end{array} \] 
   Solve for \$1,000 
   \text{PV} = \$142.05 

   c. 
Enter  
   \[ \begin{array}{cccc} 
   \text{N} & \text{I/Y} & \text{PV} & \text{PMT} & \text{FV} \\
   40 & 7.5\% & \text{PV} & \text{PMT} & \text{FV} \\
   \end{array} \] 
   Solve for \$1,000 
   \text{PV} = \$55.42 

2. 
   a. 
Enter  
   \[ \begin{array}{cccc} 
   \text{N} & \text{I/Y} & \text{PV} & \text{PMT} & \text{FV} \\
   50 & 3.5\% & \text{PV} & \text{PMT} & \text{FV} \\
   \end{array} \] 
   Solve for \$1,000 
   \text{PV} = \$1,000.00 

   b. 
Enter  
   \[ \begin{array}{cccc} 
   \text{N} & \text{I/Y} & \text{PV} & \text{PMT} & \text{FV} \\
   50 & 4.5\% & \text{PV} & \text{PMT} & \text{FV} \\
   \end{array} \] 
   Solve for \$1,000 
   \text{PV} = \$802.38 

   c. 
Enter  
   \[ \begin{array}{cccc} 
   \text{N} & \text{I/Y} & \text{PV} & \text{PMT} & \text{FV} \\
   50 & 2.5\% & \text{PV} & \text{PMT} & \text{FV} \\
   \end{array} \] 
   Solve for \$1,000 
   \text{PV} = \$1,283.62 

3. 
Enter  
   \[ \begin{array}{cccc} 
   \text{N} & \text{I/Y} & \text{PV} & \text{PMT} & \text{FV} \\
   26 & \pm1,050 & \text{PV} & \text{PMT} & \text{FV} \\
   \end{array} \] 
   Solve for \$1,000 
   \text{PV} = 3.117\% 
   \text{PV} \times 2 = 6.23\% 

4. 
Enter  
   \[ \begin{array}{cccc} 
   \text{N} & \text{I/Y} & \text{PV} & \text{PMT} & \text{FV} \\
   25 & 3.65\% & \text{PV} & \text{PMT} & \text{FV} \\
   \end{array} \] 
   Solve for \$1,000 
   \text{PV} = \$38.97 
   \$38.97 \times 2 = 77.93 
   \$77.93 / \$1,000 = 7.79\%
5. Enter 23 6.90% PV $58 FV €1,000
Solve for N I/Y 874.94 PMT

6. Enter 18 ±¥89,000 PV ¥4,900 PMT ¥100,000
Solve for N I/Y 5.91% FV

13. Miller Corporation

P_0 Enter 26 3.5% PV $45 PMT $1,000
Solve for N I/Y 1,168.90 FV

P_1 Enter 24 3.5% PV $45 PMT $1,000
Solve for N I/Y 1,160.58 FV

P_3 Enter 20 3.5% PV $45 PMT $1,000
Solve for N I/Y 1,142.12 FV

P_8 Enter 10 3.5% PV $45 PMT $1,000
Solve for N I/Y 1,083.17 FV

P_{12} Enter 2 3.5% PV $45 PMT $1,000
Solve for N I/Y 1,019.00 FV

Modigliani Company

P_0 Enter 26 4.5% PV $35 PMT $1,000
Solve for N I/Y 848.53 FV

P_1 Enter 24 4.5% PV $35 PMT $1,000
Solve for N I/Y 855.05 FV
P_3
Enter 20 4.5% $35 $1,000
Solve for $869.92 $35 $1,000

P_8
Enter 10 4.5% $35 $1,000
Solve for $920.87 $35 $1,000

P_{12}
Enter 2 4.5% $35 $1,000
Solve for $981.27 $35 $1,000

14. If both bonds sell at par, the initial YTM on both bonds is the coupon rate, 6.5 percent. If the YTM suddenly rises to 8.5 percent:

P_{Laurel}
Enter 6 4.25% $32.50 $1,000
Solve for $948.00 $948.00
\Delta P_{Laurel} \% = \frac{($948.00 - 1,000)}{1,000} = -5.20\%

P_{Hardy}
Enter 40 4.25% $32.50 $1,000
Solve for $809.23 $809.23
\Delta P_{Hardy} \% = \frac{($809.23 - 1,000)}{1,000} = -19.08\%

If the YTM suddenly falls to 4.5 percent:

P_{Laurel}
Enter 6 2.25% $32.50 $1,000
Solve for $1,055.54 $1,055.54
\Delta P_{Laurel} \% = \frac{($1,055.54 - 1,000)}{1,000} = +5.55\%

P_{Hardy}
Enter 40 2.25% $32.50 $1,000
Solve for $1,261.94 $1,261.94
\Delta P_{Hardy} \% = \frac{($1,261.94 - 1,000)}{1,000} = +26.19\%

All else the same, the longer the maturity of a bond, the greater is its price sensitivity to changes in interest rates.
15. Initially, at a YTM of 9 percent, the prices of the two bonds are:

<table>
<thead>
<tr>
<th>Bond</th>
<th>N</th>
<th>I/Y</th>
<th>PV</th>
<th>PMT</th>
<th>FV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faulk</td>
<td>28</td>
<td>4.5%</td>
<td>$30</td>
<td></td>
<td>$1,000</td>
</tr>
<tr>
<td>Solve for</td>
<td>$763.86</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gonas</td>
<td>28</td>
<td>4.5%</td>
<td>$60</td>
<td></td>
<td>$1,000</td>
</tr>
<tr>
<td>Solve for</td>
<td>$1,236.14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If the YTM rises from 9 percent to 11 percent:

<table>
<thead>
<tr>
<th>Bond</th>
<th>N</th>
<th>I/Y</th>
<th>PV</th>
<th>PMT</th>
<th>FV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faulk</td>
<td>28</td>
<td>5.5%</td>
<td>$30</td>
<td></td>
<td>$1,000</td>
</tr>
<tr>
<td>Solve for</td>
<td>$646.96</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[
\Delta P_{\text{Faulk}}\% = \left(\frac{646.96 - 763.86}{763.86}\right) = -15.30\%
\]

<table>
<thead>
<tr>
<th>Bond</th>
<th>N</th>
<th>I/Y</th>
<th>PV</th>
<th>PMT</th>
<th>FV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gonas</td>
<td>28</td>
<td>5.5%</td>
<td>$60</td>
<td></td>
<td>$1,000</td>
</tr>
<tr>
<td>Solve for</td>
<td>$1,070.61</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[
\Delta P_{\text{Gonas}}\% = \left(\frac{1,070.61 - 1,236.14}{1,236.14}\right) = -13.39\%
\]

If the YTM declines from 9 percent to 7 percent:

<table>
<thead>
<tr>
<th>Bond</th>
<th>N</th>
<th>I/Y</th>
<th>PV</th>
<th>PMT</th>
<th>FV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faulk</td>
<td>28</td>
<td>3.5%</td>
<td>$30</td>
<td></td>
<td>$1,000</td>
</tr>
<tr>
<td>Solve for</td>
<td>$911.66</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[
\Delta P_{\text{Faulk}}\% = \left(\frac{911.66 - 763.86}{763.86}\right) = +19.35\%
\]

<table>
<thead>
<tr>
<th>Bond</th>
<th>N</th>
<th>I/Y</th>
<th>PV</th>
<th>PMT</th>
<th>FV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gonas</td>
<td>28</td>
<td>3.5%</td>
<td>$60</td>
<td></td>
<td>$1,000</td>
</tr>
<tr>
<td>Solve for</td>
<td>$1,441.68</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[
\Delta P_{\text{Gonas}}\% = \left(\frac{1,441.68 - 1,236.14}{1,236.14}\right) = +16.63\%
\]

All else the same, the lower the coupon rate on a bond, the greater is its price sensitivity to changes in interest rates.

16. Enter 18  

\[
\text{N:} \quad 18 \\
\text{I/Y:} \quad \pm$1,080 \\
\text{PV:} \quad $35.50 \\
\text{FV:} \quad $1,000
\]

Solve for 2.970%

\[
\text{YTM} = 2.970\% \times 2 = 5.94\%
\]
17. The company should set the coupon rate on its new bonds equal to the required return; the required return can be observed in the market by finding the YTM on outstanding bonds of the company.

Enter
\begin{tabular}{cccc}
40 & N & \multicolumn{1}{|c|}{+$1,101.50} & \multicolumn{1}{|c|}{$35} & \multicolumn{1}{|c|}{$1,000} \\
\end{tabular}
Solve for
\begin{tabular}{c}
3.057% \\
\end{tabular}
\begin{center}
3.057\% \times 2 = 6.11\%
\end{center}

20. Current yield = .0695 = $63/P_0$ ; $P_0 = $906.47

Enter
\begin{tabular}{cccc}
7.14\% & I/Y & \multicolumn{1}{|c|}{$+$906.47} & \multicolumn{1}{|c|}{$63} & \multicolumn{1}{|c|}{$1,000} \\
\end{tabular}
Solve for
\begin{tabular}{c}
22.9760 \\
\end{tabular}

21. Enter
\begin{tabular}{cccc}
26 & N & \multicolumn{1}{|c|}{$+$943.50} & \multicolumn{1}{|c|}{$34} & \multicolumn{1}{|c|}{$1,000} \\
\end{tabular}
Solve for
\begin{tabular}{c}
3.744\% \\
\end{tabular}
\begin{center}
3.744\% \times 2 = 7.49\%
\end{center}

23. Bond P

$P_0$

Enter
\begin{tabular}{cccc}
8 & N & \multicolumn{1}{|c|}{7\%} & \multicolumn{1}{|c|}{$80} & \multicolumn{1}{|c|}{$1,000} \\
\end{tabular}
Solve for
\begin{tabular}{c}
$1,059.71 \\
\end{tabular}

$P_1$

Enter
\begin{tabular}{cccc}
7 & N & \multicolumn{1}{|c|}{7\%} & \multicolumn{1}{|c|}{$80} & \multicolumn{1}{|c|}{$1,000} \\
\end{tabular}
Solve for
\begin{tabular}{c}
$1,053.89 \\
\end{tabular}
\begin{center}
Current yield = $80 / $1,059.71 = 7.55\%
Capital gains yield = ($1,053.89 – 1,059.71) / $1,059.71 = -.55\%
\end{center}

Bond D

$P_0$

Enter
\begin{tabular}{cccc}
8 & N & \multicolumn{1}{|c|}{7\%} & \multicolumn{1}{|c|}{$60} & \multicolumn{1}{|c|}{$1,000} \\
\end{tabular}
Solve for
\begin{tabular}{c}
$940.29 \\
\end{tabular}

$P_1$

Enter
\begin{tabular}{cccc}
7 & N & \multicolumn{1}{|c|}{7\%} & \multicolumn{1}{|c|}{$60} & \multicolumn{1}{|c|}{$1,000} \\
\end{tabular}
Solve for
\begin{tabular}{c}
$946.11 \\
\end{tabular}
\begin{center}
Current yield = $60 / $940.29 = 6.38\%
Capital gains yield = ($946.11 – 940.29) / $940.29 = .62\%
\end{center}

All else held constant, premium bonds pay a higher current income while having price depreciation as maturity nears; discount bonds pay a lower current income but have price appreciation as maturity nears. For either bond, the total return is still 7 percent, but this return is distributed differently between current income and capital gains.
24.

a. Enter

$$\begin{array}{cccc}
N & I/Y & PV & PMT & FV \\
21 & \pm$835 & $62 & $1,000
\end{array}$$

Solve for

7.83%

This is the rate of return you expect to earn on your investment when you purchase the bond.

b. Enter

$$\begin{array}{cccc}
N & I/Y & PV & PMT & FV \\
19 & 6.83\% & $62 & $1,000
\end{array}$$

Solve for

$934.53

The HPY is:

Enter

$$\begin{array}{cccc}
N & I/Y & PV & PMT & FV \\
2 & \pm$835 & $62 & $934.53
\end{array}$$

Solve for

13.02%

The realized HPY is greater than the expected YTM when the bond was bought because interest rates dropped by 1 percent; bond prices rise when yields fall.

25.

\[ CF_{\text{M}} \]

\[
\begin{array}{|c|c|}
\hline
C_{\text{F0}} & $0 \\
C_{\text{F01}} & $0 \\
F_{\text{F01}} & 12 \\
C_{\text{F02}} & $800 \\
F_{\text{F02}} & 16 \\
C_{\text{F03}} & $1,000 \\
F_{\text{F03}} & 11 \\
C_{\text{F04}} & $21,000 \\
F_{\text{F04}} & 1 \\
\hline
\end{array}
\]

\[ I = 3.25\% \]

NPV CPT

$16,286.63

\[ CF_{\text{N}} \]

Enter

$$\begin{array}{cccc}
N & I/Y & PV & PMT & FV \\
40 & 3.25\% & \text{NPV CPT} & $20,000
\end{array}$$

Solve for

$5,564.52

28.

Real return: \[ 1 + .072 = (1 + r)(1 + .035); \ r = 3.57\% \]

Enter

\[ \text{NOM}, 3.57\%, 12 \]

Solve for

3.51\%

Enter

$$\begin{array}{cccc}
N & I/Y & PV & PMT & FV \\
52 \times 30 & 3.51\% / 52 & $5
\end{array}$$

Solve for

$4,819.94
29.
Real return for stock account: \( 1 + .12 = (1 + r)(1 + .04); \ r = 7.6923\% \)
Enter \[ \text{NOM} \quad 7.6923\% \quad 12 \]
Solve for \[ \text{EFF} \quad C/Y \quad 7.4337\% \]

Real return for bond account: \( 1 + .07 = (1 + r)(1 + .04); \ r = 2.8846\% \)
Enter \[ \text{NOM} \quad 2.8846\% \quad 12 \]
Solve for \[ \text{EFF} \quad C/Y \quad 2.8472\% \]

Real return post-retirement: \( 1 + .08 = (1 + r)(1 + .04); \ r = 3.8462\% \)
Enter \[ \text{NOM} \quad 3.8462\% \quad 12 \]
Solve for \[ \text{EFF} \quad C/Y \quad 3.7800\% \]

Stock portfolio value:
Enter \[ 12 \times 30 \quad \frac{7.4337\%}{12} \quad \$900 \]
Solve for \[ \text{N} \quad \text{I/Y} \quad \text{PV} \quad \text{PMT} \quad \text{FV} \quad \$1,196,731.96 \]

Bond portfolio value:
Enter \[ 12 \times 30 \quad \frac{2.8472\%}{12} \quad \$400 \]
Solve for \[ \text{N} \quad \text{I/Y} \quad \text{PV} \quad \text{PMT} \quad \text{FV} \quad \$227,089.04 \]

Retirement value = $1,196,7931.96 + 227,089.04 = $1,423,821.00

Retirement withdrawal:
Enter \[ 25 \times 12 \quad \frac{3.7800\%}{12} \quad \$1,423,821.00 \]
Solve for \[ \text{N} \quad \text{I/Y} \quad \text{PV} \quad \text{PMT} \quad \text{FV} \quad \$7,343.56 \]

The last withdrawal in real terms is:
Enter \[ 30 + 25 \quad 4\% \quad \$7,343.56 \]
Solve for \[ \text{N} \quad \text{I/Y} \quad \text{PV} \quad \text{PMT} \quad \text{FV} \quad \$63,495.09 \]

30.
Future value of savings:
Year 1:
Enter \[ 4 \quad 9\% \quad \$338,743 \]
Solve for \[ \text{N} \quad \text{I/Y} \quad \text{PV} \quad \text{PMT} \quad \text{FV} \quad \$478,163.39 \]

Year 2:
Enter \[ 3 \quad 9\% \quad \$375,698.49 \]
Solve for \[ \text{N} \quad \text{I/Y} \quad \text{PV} \quad \text{PMT} \quad \text{FV} \quad \$486,540.44 \]
Chapter 5 B-140

Year 3:
Enter 2 9% $416,163.67
Solve for $494,444.05

Year 4:
Enter 1 9% $460,463.07
Solve for $501,904.75

Future value = $478,163.39 + 486,540.44 + 494,444.05 + 501,904.75 + 508,951.07
Future value = $2,470,003.69

He will spend $400,000 on a luxury boat, so the value of his account will be:

Value of account = $2,470,003.69 – 400,000
Value of account = $2,070,003.69

Enter 25 9% $2,070,003.69
Solve for $210,739.31