6-1  a. A bond is a promissory note issued by a business or a governmental unit. Treasury bonds, sometimes referred to as government bonds, are issued by the Federal government and are not exposed to default risk. Corporate bonds are issued by corporations and are exposed to default risk. Different corporate bonds have different levels of default risk, depending on the issuing company's characteristics and on the terms of the specific bond. Municipal bonds are issued by state and local governments. The interest earned on most municipal bonds is exempt from federal taxes, and also from state taxes if the holder is a resident of the issuing state. Foreign bonds are issued by foreign governments or foreign corporations. These bonds are not only exposed to default risk, but are also exposed to an additional risk if the bonds are denominated in a currency other than that of the investor's home currency.

b. The par value is the nominal or face value of a stock or bond. The par value of a bond generally represents the amount of money that the firm borrows and promises to repay at some future date. The par value of a bond is often $1,000, but can be $5,000 or more. The maturity date is the date when the bond's par value is repaid to the bondholder. Maturity dates generally range from 10 to 40 years from the time of issue. A call provision may be written into a bond contract, giving the issuer the right to redeem the bonds under specific conditions prior to the normal maturity date. A bond's coupon, or coupon payment, is the dollar amount of interest paid to each bondholder on the interest payment dates. The coupon is so named because bonds used to have dated coupons attached to them which investors could tear off and redeem on the interest payment dates. The coupon interest rate is the stated rate of interest on a bond.

c. In some cases, a bond's coupon payment may vary over time. These bonds are called floating rate bonds. Floating rate debt is popular with investors because the market value of the debt is stabilized. It is advantageous to corporations because firms can issue long-term debt without committing themselves to paying a historically high interest rate for the entire life of the loan. Zero coupon bonds pay no coupons at all, but are offered at a substantial discount below their par values and hence provide capital appreciation rather than interest income. In general, any bond originally offered at a price significantly below its par value is called an original issue discount bond (OID).
d. Most bonds contain a call provision, which gives the issuing corporation the right to call the bonds for redemption. The call provision generally states that if the bonds are called, the company must pay the bondholders an amount greater than the par value, a call premium. Redeemable bonds give investors the right to sell the bonds back to the corporation at a price that is usually close to the par value. If interest rates rise, investors can redeem the bonds and reinvest at the higher rates. A sinking fund provision facilitates the orderly retirement of a bond issue. This can be achieved in one of two ways: The company can call in for redemption (at par value) a certain percentage of bonds each year. The company may buy the required amount of bonds on the open market.

e. Convertible bonds are securities that are convertible into shares of common stock, at a fixed price, at the option of the bondholder. Bonds issued with warrants are similar to convertibles. Warrants are options which permit the holder to buy stock for a stated price, thereby providing a capital gain if the stock price rises. Income bonds pay interest only if the interest is earned. These securities cannot bankrupt a company, but from an investor's standpoint they are riskier than "regular" bonds. The interest rate of an indexed, or purchasing power, bond is based on an inflation index such as the consumer price index (CPI), so the interest paid rises automatically when the inflation rate rises, thus protecting the bondholders against inflation.

f. Bond prices and interest rates are inversely related; that is, they tend to move in the opposite direction from one another. A fixed-rate bond will sell at par when its coupon interest rate is equal to the going rate of interest, rd. When the going rate of interest is above the coupon rate, a fixed-rate bond will sell at a "discount" below its par value. If current interest rates are below the coupon rate, a fixed-rate bond will sell at a "premium" above its par value.

g. The current yield on a bond is the annual coupon payment divided by the current market price. YTM, or yield to maturity, is the rate of interest earned on a bond if it is held to maturity. Yield to call (YTC) is the rate of interest earned on a bond if it is called. If current interest rates are well below an outstanding callable bond's coupon rate, the YTC may be a more relevant estimate of expected return than the YTM, since the bond is likely to be called.
h. The shorter the maturity of the bond, the greater the risk of a decrease in interest rates. The risk of a decline in income due to a drop in interest rates is called reinvestment rate risk. Interest rates fluctuate over time, and people or firms who invest in bonds are exposed to risk from changing interest rates, or interest rate risk. The longer the maturity of the bond, the greater the exposure to interest rate risk. Interest rate risk relates to the value of the bonds in a portfolio, while reinvestment rate risk relates to the income the portfolio produces. No fixed-rate bond can be considered totally riskless. Bond portfolio managers try to balance these two risks, but some risk always exists in any bond. Another important risk associated with bonds is default risk. If the issuer defaults, investors receive less than the promised return on the bond. Default risk is influenced by both the financial strength of the issuer and the terms of the bond contract, especially whether collateral has been pledged to secure the bond. The greater the default risk, the higher the bond's yield to maturity.

i. Corporations can influence the default risk of their bonds by changing the type of bonds they issue. Under a mortgage bond, the corporation pledges certain assets as security for the bond. All such bonds are written subject to an indenture, which is a legal document that spells out in detail the rights of both the bondholders and the corporation. A debenture is an unsecured bond, and as such, it provides no lien against specific property as security for the obligation. Debenture holders are, therefore, general creditors whose claims are protected by property not otherwise pledged. Subordinated debentures have claims on assets, in the event of bankruptcy, only after senior debt as named in the subordinated debt's indenture has been paid off. Subordinated debentures may be subordinated to designated notes payable or to all other debt.

j. A development bond is a tax-exempt bond sold by state and local governments whose proceeds are made available to corporations for specific uses deemed (by Congress) to be in the public interest. Municipalities can insure their bonds, in which an insurance company guarantees to pay the coupon and principal payments should the issuer default. This reduces the risk to investors who are willing to accept a lower coupon rate for an insured bond issue vis-a-vis an uninsured issue. Bond issues are normally assigned quality ratings by major rating agencies, such as Moody's Investors Service and Standard & Poor's Corporation. These ratings reflect the probability that a bond will go into default. Aaa (Moody's) and AAA (S&P) are the highest ratings. Rating assignments are based on qualitative and quantitative factors including the firm's debt/assets ratio, current ratio, and coverage ratios. Because a bond's rating is an indicator of its default risk, the rating has a direct, measurable influence on the bond's interest rate and the firm's cost of debt capital. Junk bonds are high-risk, high-yield bonds issued to finance leveraged buyouts, mergers, or troubled companies. Most bonds are purchased by institutional investors rather than individuals, and many institutions are restricted to investment grade bonds, securities with ratings of Baa/BBB or above.
6-2 False. Short-term bond prices are less sensitive than long-term bond prices to interest rate changes because funds invested in short-term bonds can be reinvested at the new interest rate sooner than funds tied up in long-term bonds.

6-3 The price of the bond will fall and its YTM will rise if interest rates rise. If the bond still has a long term to maturity, its YTM will reflect long-term rates. Of course, the bond's price will be less affected by a change in interest rates if it has been outstanding a long time and matures shortly. While this is true, it should be noted that the YTM will increase only for buyers who purchase the bond after the change in interest rates and not for buyers who purchased previous to the change. If the bond is purchased and held to maturity, the bondholder's YTM will not change, regardless of what happens to interest rates.

6-4 If interest rates decline significantly, the values of callable bonds will not rise by as much as those of bonds without the call provision. It is likely that the bonds would be called by the issuer before maturity, so that the issuer can take advantage of the new, lower rates.

6-5 From the corporation's viewpoint, one important factor in establishing a sinking fund is that its own bonds generally have a higher yield than do government bonds; hence, the company saves more interest by retiring its own bonds than it could earn by buying government bonds. This factor causes firms to favor the second procedure. Investors also would prefer the annual retirement procedure if they thought that interest rates were more likely to rise than to fall, but they would prefer the government bond purchases program if they thought rates were likely to fall. In addition, bondholders recognize that, under the government bond purchase scheme, each bondholder would be entitled to a given amount of cash from the liquidation of the sinking fund if the firm should go into default, whereas under the annual retirement plan, some of the holders would receive a cash benefit while others would benefit only indirectly from the fact that there would be fewer bonds outstanding.

On balance, investors seem to have little reason for choosing one method over the other, while the annual retirement method is clearly more beneficial to the firm. The consequence has been a pronounced trend toward annual retirement and away from the accumulation scheme.
6-1 With your financial calculator, enter the following:

\[ N = 10; I = YTM = 9\%; PMT = 0.08 \times 1,000 = 80; FV = 1000; PV = V_B = ? \]

\[ PV = $935.82. \]

Alternatively,

\[ V_B = 80(PVIFA_{9\%,10}) + 1,000(PVIF_{9\%,10}) \]
\[ = 80((1 - 1/1.09^{10})/0.09) + 1,000(1/1.09^{10}) \]
\[ = 80(6.4177) + 1,000(0.4224) \]
\[ = 513.42 + 422.40 = $935.82. \]

6-2 With your financial calculator, enter the following:

\[ N = 12; PV = -850; PMT = 0.10 \times 1,000 = 100; FV = 1000; I = YTM = ? \]

\[ YTM = 12.48\%. \]

6-3 With your financial calculator, enter the following to find YTM:

\[ N = 10 \times 2 = 20; PV = -1100; PMT = 0.08/2 \times 1,000 = 40; FV = 1000; I = YTM = ? \]

\[ YTM = 3.31\% \times 2 = 6.62\%. \]

With your financial calculator, enter the following to find YTC:

\[ N = 5 \times 2 = 10; PV = -1100; PMT = 0.08/2 \times 1,000 = 40; FV = 1050; I = YTC = ? \]

\[ YTC = 3.24\% \times 2 = 6.49\%. \]

6-4 With your financial calculator, enter the following to find the current value of the bonds, so you can then calculate their current yield:

\[ N = 7; I = YTM = 8; PMT = 0.09 \times 1,000 = 90; FV = 1000; PV = V_B = ? \]

\[ PV = $1,052.06. \] Current yield = \[ $90/$1,052.06 = 8.55\%. \]

Alternatively,

\[ V_B = 90(PVIFA_{8\%,7}) + 1,000(PVIF_{8\%,7}) \]
\[ = 90((1 - 1/1.08^{7})/0.08) + 1,000(1/1.08^{7}) \]
\[ = 90(5.2064) + 1,000(0.5835) \]
\[ = 468.58 + 583.50 = $1,052.08. \]

Current yield = \[ $90/$1,052.08 = 8.55\%. \]
6-5 The problem asks you to find the price of a bond, given the following facts:

\[ N = 16; \ I = 8.5/2 = 4.25; \ PMT = 45; \ FV = 1000. \]

With a financial calculator, solve for \( PV = $1,028.60 \)

6-6 a. \( V_B = PMT(PVIFA_{i,n}) + FV(PVIF_{i,n}) \)

\[ = PMT((1- \frac{1}{(1+i)^n})/i) + FV(1/(1+i)^n) \]

1. 5%: Bond L: \( V_B = $100(10.3797) + $1,000(0.4810) = $1,518.97. \)
   Bond S: \( V_B = ($100 + $1,000)(0.9524) = $1,047.64. \)

2. 8%: Bond L: \( V_B = $100(8.5595) + $1,000(0.3152) = $1,171.15. \)
   Bond S: \( V_B = ($100 + $1,000)(0.9259) = $1,018.49. \)

3. 12%: Bond L: \( V_B = $100(6.8109) + $1,000(0.1827) = $863.79. \)
   Bond S: \( V_B = ($100 + $1,000)(0.8929) = $982.19. \)

Calculator solutions:

1. 5%: Bond L: Input \( N = 15, \ I = 5, \ PMT = 100, \ FV = 1000, \ PV = ?, \ PV = $1,518.98. \)
   Bond S: Change \( N = 1, \ PV = ? \ PV = $1,047.62. \)

2. 8%: Bond L: From Bond S inputs, change \( N = 15 \) and \( I = 8, \ PV = ?, \ PV = $1,171.19. \)
   Bond S: Change \( N = 1, \ PV = ? \ PV = $1,018.52. \)

3. 12%: Bond L: From Bond S inputs, change \( N = 15 \) and \( I = 12, \ PV = ?, \ PV = $863.78. \)
   Bond S: Change \( N = 1, \ PV = ? \ PV = $982.14. \)

b. Think about a bond that matures in one month. Its present value is influenced primarily by the maturity value, which will be received in only one month. Even if interest rates double, the price of the bond will still be close to $1,000. A one-year bond's value would fluctuate more than the one-month bond's value because of the difference in the timing of receipts. However, its value would still be fairly close to $1,000 even if interest rates doubled. A long-term bond paying semiannual coupons, on the other hand, will be dominated by distant receipts, receipts which are multiplied by \( 1/(1 + r_d/2)^t \), and if \( r_d \) increases, these multipliers will decrease significantly. Another way to view this problem is from an opportunity point of view. A one-month bond can be reinvested at the new rate very quickly, and hence the opportunity to invest at this new rate is not lost; however, the long-term bond locks in subnormal returns for a long period of time.

Mini Case: 6 - 6
6-7  a. \[ V_B = \sum_{t=1}^{N} \frac{INT}{(1 + r_d)^t} + \frac{M}{(1 + r_d)^N} \]

\[ = \text{PMT}((1 - \frac{1}{(1 + r_d)^4})/r_d) + \text{FV}(1/(1+r_d)^4). \]

\[ M = \$1,000. \ \text{INT} = 0.09(\$1,000) = \$90. \]

1. \[ \$829 = \$90((1 - \frac{1}{(1+r_d)^4})/r_d) + \$1,000(1/(1+r_d)^4). \]

The YTM can be found by trial-and-error. If the YTM was 9 percent, the bond value would be its maturity value. Since the bond sells at a discount, the YTM must be greater than 9 percent. Let's try 10 percent.

At 10%, \[ V_B = \$285.29 + \$683.00 \]
\[ = \$968.29. \]

\$968.29 > \$829.00; therefore, the bond's YTM is greater than 10 percent.

Try 15 percent.

At 15%, \[ V_B = \$256.95 + \$571.80 \]
\[ = \$828.75. \]

Therefore, the bond's YTM is approximately 15 percent.

2. \[ \$1,104 = \$90((1 - \frac{1}{(1+r_d)^4})/r_d) + \$1,000(1/(1+r_d)^4). \]

The bond is selling at a premium; therefore, the YTM must be below 9 percent. Try 6 percent.

At 6%, \[ V_B = \$311.86 + \$792.10 \]
\[ = \$1,103.96. \]

Therefore, when the bond is selling for \$1,104, its YTM is approximately 6 percent.

Calculator solution:

1. Input N = 4, PV = -829, PMT = 90, FV = 1000, I = ? I = 14.99%.

2. Change PV = -1104, I = ? I = 6.00%.

b. Yes. At a price of \$829, the yield to maturity, 15 percent, is greater than your required rate of return of 12 percent. If your required rate of return were 12 percent, you should be willing to buy the bond at any price below \$908.88.
$1,000 = $140((1 - 1/(1+r_d^6))/r_d) + $1,090(1/(1+r_d^6)).

Try 18 percent:

PV_{18\%} = $140(3.4976) + $1,090(0.3704) = $489.66 + $403.74 = $893.40.  
18 percent is too high.

Try 15 percent:

PV_{15\%} = $140(3.7845) + $1,090(0.4323) = $529.83 + $471.21 = $1,001.04.  
15 percent is slightly low.

The rate of return is approximately 15.03 percent, found with a calculator using the following inputs.

N = 6; PV = -1000; PMT = 140; FV = 1090; I = ?  Solve for I = 15.03%.

6-9  a. Using a financial calculator, input the following:

N = 20, PV = -1100, PMT = 60, FV = 1000, and solve for I = 5.1849%.

However, this is a periodic rate. The nominal annual rate = 5.1849%(2) = 10.3699%  
≈ 10.37%.

b. The current yield = $120/$1,100 = 10.91%.

c. YTM = Current Yield + Capital Gains (Loss) Yield

10.37% = 10.91% + Capital Loss Yield

-0.54% = Capital Loss Yield.

d. Using a financial calculator, input the following:

N = 8, PV = -1100, PMT = 60, FV = 1060, and solve for I = 5.0748%.

However, this is a periodic rate. The nominal annual rate = 5.0748%(2) = 10.1495%  
≈ 10.15%.
6-10  The problem asks you to solve for the YTM, given the following facts:

N = 5, PMT = 80, and FV = 1000. In order to solve for I we need PV.

However, you are also given that the current yield is equal to 8.21%. Given this information, we can find PV.

Current yield = Annual interest/Current price
0.0821 = $80/PV
PV = $80/0.0821 = $974.42.

Now, solve for the YTM with a financial calculator:

N = 5, PV = -974.42, PMT = 80, and FV = 1000. Solve for I = YTM = 8.65%.

6-11  The problem asks you to solve for the current yield, given the following facts: N = 14, I = 10.5883/2 = 5.2942, PV = -1020, and FV = 1000. In order to solve for the current yield we need to find PMT. With a financial calculator, we find PMT = $55.00. However, because the bond is a semiannual coupon bond this amount needs to be multiplied by 2 to obtain the annual interest payment: $55.00(2) = $110.00. Finally, find the current yield as follows:

Current yield = Annual interest/Current Price = $110/$1,020 = 10.78%.

6-12  The bond is selling at a large premium, which means that its coupon rate is much higher than the going rate of interest. Therefore, the bond is likely to be called--it is more likely to be called than to remain outstanding until it matures. Thus, it will probably provide a return equal to the YTC rather than the YTM. So, there is no point in calculating the YTM--just calculate the YTC. Enter these values:

N = 10, PV = -1353.54, PMT = 70, FV = 1050, and then solve for I.

The periodic rate is 3.24 percent, so the nominal YTC is 2 x 3.24% = 6.47%. This would be close to the going rate, and it is about what the firm would have to pay on new bonds.
6-13  a. The bonds now have an 8-year, or a 16-semiannual period, maturity, and their value is calculated as follows:

\[
V_B = \sum_{t=1}^{16} \frac{50}{(1.03)^t} + \frac{1,000}{(1.03)^{16}} = 50(12.5611) + 1,000(0.6232)
\]

\[
= 628.06 + 623.20 = 1,251.26.
\]

Calculator solution: Input N = 16, I = 3, PMT = 50, FV = 1000, PV = ? PV = $1,251.22.

b. \[V_B = 50(10.1059) + 1,000(0.3936) = 505.30 + 393.60 = 898.90.\]

Calculator solution: Change inputs from Part a to I = 6, PV = ? PV = $898.94.

c. The price of the bond will decline toward $1,000, hitting $1,000 (plus accrued interest) at the maturity date 8 years (16 six-month periods) hence.

6-14

<table>
<thead>
<tr>
<th>Bond Type</th>
<th>Price at 8%</th>
<th>Price at 7%</th>
<th>Pctge. change</th>
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</thead>
<tbody>
<tr>
<td>10-year, 10% annual coupon</td>
<td>$1,134.20</td>
<td>$1,210.71</td>
<td>6.75%</td>
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<tr>
<td>10-year zero</td>
<td>463.19</td>
<td>508.35</td>
<td>9.75</td>
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<tr>
<td>5-year zero</td>
<td>680.58</td>
<td>712.99</td>
<td>4.76</td>
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<tr>
<td>30-year zero</td>
<td>99.38</td>
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<td>$100 perpetuity</td>
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### a.

<table>
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<th>Price of Bond C</th>
<th>Price of Bond Z</th>
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<tbody>
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<td>$693.04</td>
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<tr>
<td>4</td>
<td>1,000.00</td>
<td>1,000.00</td>
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</tbody>
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### b.

![Graph showing the time path of Bond C and Bond Z](image-url)