Chapter 9
Bonds and Their Valuation

Learning Objectives

After reading this chapter, students should be able to:

- Identify the different features of corporate and government bonds.
- Discuss how bond prices are determined in the market, what the relationship is between interest rates and bond prices, and how a bond's price changes over time as it approaches maturity.
- Calculate a bond's yield to maturity, its yield to call if it is callable, and determine the "true" yield.
- Explain the different types of risk that bond investors and issuers face, and discuss how a bond's terms and collateral can be changed to affect its interest rate.

Lecture Suggestions

This chapter serves two purposes. First, it provides important and useful information on bonds per se. Second, it provides a good example of the use of time value concepts, so it reinforces the topics covered in Chapter 5.

We begin our lecture with a discussion of the different types of bonds and their characteristics. Then we move on to how bond values are established, how yields are determined, the effects of changing interest rates on bond prices, and the riskiness inherent in different types of bonds.

What we cover, and the way we cover it, can be seen by scanning the slides and Integrated Case solution for Chapter 9, which appears at the end of this chapter's solutions. For other suggestions about the lecture, please see the "Lecture Suggestions" in Chapter 2, where we describe how we conduct our classes.

DAYS ON CHAPTER: 3 OF 56 DAYS (50-minute periods)

Answers to End-of-Chapter Questions

9-1 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 purchase 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.

9-2 Yes, the statement is true.

9-3 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.

For example, consider two bonds, both with a 10% annual coupon and a $1,000 par value. The only difference between them is their maturity. One bond is a 1-year bond, while the other is a 20-year bond. Consider the values of each at 5%, 10%, 15%, and 20% interest rates.

	1-year	20-year
5%	$1,047.62	$1,623.11
10%	1,000.00	1,000.00
15%	956.52	687.03
20%	916.67	513.04

As you can see, the price of the 20-year bond is much more volatile than the price of the 1-year bond.

9-4 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 soon. 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. For example, consider two bonds with an 8% annual coupon and a $1,000 par value. One bond has a 5-year maturity, while the other has a 20-year maturity. If interest rates rise to 15% immediately after issue the value of the 5-year bond would be $765.35, while the value of the 20-year bond would be $561.85.

9-5 The yield to maturity can be viewed as the bond's *promised* rate of return, which is the return that investors will receive if all of the *promised* payments are made. However, the yield to maturity equals the *expected* rate of return only when (1) the probability of default is zero and (2) the bond cannot be called. If there is some default risk or the bond may be called, there is some chance that the promised payments to maturity will not be received, in which case the calculated yield to maturity will exceed the expected return.

9-6 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.

9-7 As an investor with a short investment horizon, you would view the 20-year Treasury security as being more risky than the 1-year Treasury security. If you bought the 20-year security, you would bear a considerable amount of price risk. Since your investment horizon is only one year, you would have to sell the 20-year security one year from now, and the price you would receive for it would depend on what happened to interest rates during that year. However, if you purchased the 1-year security, you would be assured of receiving your principal at the end of that one year, which is the 1-year Treasury's maturity date.

9-8 **a.** If a bond's price increases, its YTM decreases.

b. If a company's bonds are downgraded by the rating agencies, its YTM increases.

c. If a change in the bankruptcy code made it more difficult for bondholders to receive payments in the event a firm declared bankruptcy, then the bond's YTM would increase.

d. If the economy entered a recession, then the possibility of a firm defaulting on its bond would increase; consequently, its YTM would increase.

e. If a bond were to become subordinated to another debt issue, then the bond's YTM would increase.

9-9 If a company sold bonds when interest rates were relatively high and the issue is callable, then the company could sell a new issue of low-yielding securities if and when interest rates drop. The proceeds of the new issue would be used to retire the high-rate issue, and thus reduce its interest expense. The call privilege is valuable to the firm but detrimental to long-term investors, who will be forced to reinvest the amount they receive at the new and lower rates.

9-10 A sinking fund provision facilitates the orderly retirement of the bond issue. Although sinking funds are designed to protect investors by ensuring that the bonds are retired in an orderly fashion, sinking funds can work to the detriment of bondholders. On balance, however, bonds that have a sinking fund are regarded as being safer than those without such a provision, so at the time they are issued sinking fund bonds have lower coupon rates than otherwise similar bonds without sinking funds.

9-11 A call for sinking fund purposes is quite different from a refunding call. A sinking fund call requires no call premium, and only a small percentage of the issue is normally callable in a given year. A refunding call gives the issuer the right to call all the bond issue for redemption. The call provision generally states that the issuer must pay the bondholders an amount greater than the par value if they are called.

9-12 Convertibles and bonds with warrants are offered with lower coupons than similarly-rated straight bonds because both offer investors the chance for capital gains as compensation for the lower coupon rate. Convertible bonds are exchangeable into shares of common stock, at a fixed price, at the option of the bondholder. On the other hand, bonds issued with warrants are options that permit the holder to buy stock for a stated price, thereby providing a capital gain if the stock's price rises.

9-13 This statement is false. Extremely strong companies can use debentures because they simply do not need to put up property as security for their debt. Debentures are also issued by weak companies that have already pledged most of their assets as collateral for mortgage loans. In this latter case, the debentures are quite risky, and that risk will be reflected in their interest rates.

9-14 The yield spread between a corporate bond over a Treasury bond with the same maturity reflects both investors' risk aversion and their optimism or pessimism regarding the economy and corporate profits. If the economy appeared to be heading into a recession, the spread should widen. The change in spread would be even wider if a firm's credit strength weakened.

9-15 Assuming a bond issue is callable, the YTC is a better estimate of a bond's expected return when interest rates are below an outstanding bond's coupon rate. The YTM is a better estimate of a bond's expected return when interest rates are equal or above an outstanding bond's coupon rate.

9-16 U.S. Treasury securities are risk-free in the sense that they are often assumed to have no default risk. However, Treasury bonds do experience price risk as their prices fall when interest rates increase, with the longer bonds experiencing greater price declines.

9-17 If interest rate goes down after his purchase, he will achieve a return higher than the yield to maturity calculated at the time of his purchase. This is because bond price goes up when interest rate falls, leading to higher capital gains yield.

Solutions to End-of-Chapter Problems

9-1 With your financial calculator, enter the following:

N = 10; I/YR = YTM = 9%; PMT = $0.08 \times 1{,}000 = 80$; FV = 1000; PV = V_B = ?
PV = \$935.82.

9-2 V_B = \$985; M = \$1,000; Int = $0.07 \times \$1{,}000 = \$70$.

a. N = 10; PV = -985; PMT = 70; FV = 1000; YTM = ?
Solve for I/YR = YTM = 7.2157% $\approx$ 7.22%.

b. N = 7; I/YR = 7.2157; PMT = 70; FV = 1000; PV = ?
Solve for V_B = PV = \$988.46.

9-3 The problem asks you to find the price of a bond, given the following facts: N = $2 \times 8 = 16$; I/YR = 8.5/2 = 4.25; PMT = $(0.09/2) \times 1{,}000 = 45$; FV = 1000.

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

9-4 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/YR = 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/YR = YTC = ?
YTC = 3.24% $\times$ 2 = 6.49%.

Since the YTC is less than the YTM, investors would expect the bonds to be called and to earn the YTC.

9-5 Using the financial calculator, we find the bond price today as follows:

V_B = \$1,162.22: Input N = 12 – 2 = 10, PMT = 60, FV = 1000, YTM = I/YR = 4%.

9-6 Using the financial calculator, we find the yield to maturity today as follows:

YTM = I/YR = 6.3835%: Input N = 10, PV = -900, PMT = 50, FV = 1000

Using the calculated YTM, we calculate the bond price three years from today as follows:

V_B = \$923.81: Input N = 10 – 3 = 7, PMT = 50, FV = 1000, YTM = I/YR = 6.3835%.

9-7 **a.** 1. 5%: Bond L: Input N = 15, I/YR = 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/YR = 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/YR = 12, PV = ?, PV = $863.78.

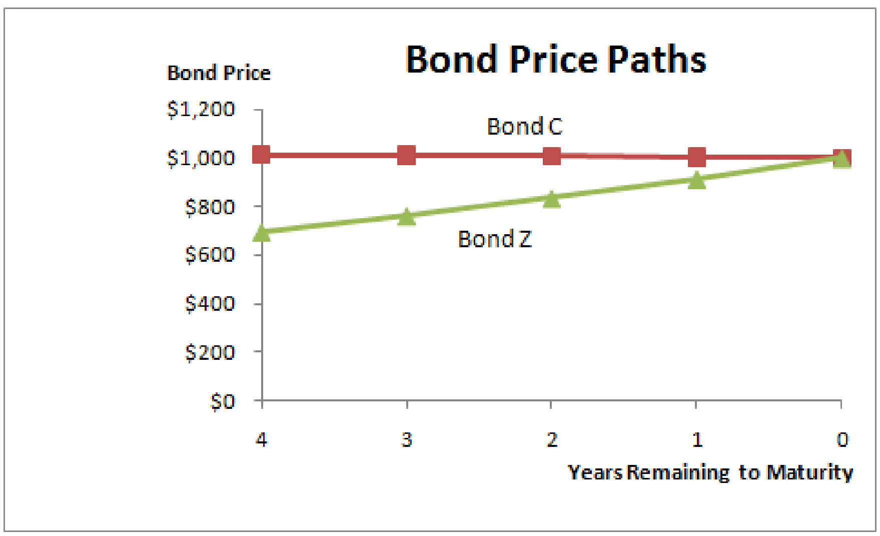
Bond S: Change N = 1, PV = ? PV = $982.14.

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 1-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 that 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 1-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.

9-8 **a.**

Time	Years to Maturity	Price of Bond C	Price of Bond Z
t = 0	4	$1,012.79	$ 693.04
t = 1	3	1,010.02	759.57
t = 2	2	1,006.98	832.49
t = 3	1	1,003.65	912.41
t = 4	0	1,000.00	1,000.00

b.



9-9

	Price at 8%	Price at 7%	Percentage Change
10-year, 10% annual coupon	$1,134.20	$1,210.71	6.75%
10-year zero	463.19	508.35	9.75
5-year zero	680.58	712.99	4.76
30-year zero	99.38	131.37	32.19
$100 perpetuity	1,250.00	1,428.57	14.29

9-10 The rate of return is approximately 15.03%, found with a calculator using the following inputs:

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

Despite a 15% return on the bonds, investors are not likely to be happy that they were called. Because if the bonds have been called, this indicates that interest rates have fallen sufficiently that the YTC is less than the YTM. (Since they were originally sold at par, the YTM at issuance = 14%.) Rates are sufficiently low to justify the call. Now investors must reinvest their funds in a much lower interest rate environment.

9-11 **a.** $V_B = \sum_{t=1}^{N} \frac{INT}{(1+r_d)^t} + \frac{M}{(1+r_d)^N}$

M = $1,000. PMT = 0.09($1,000) = $90.

1. V_B = $829: Input N = 4, PV = -829, PMT = 90, FV = 1000, YTM = I/YR = ? I/YR = 14.99%.

2. V_B = $1,104: Change PV = -1104, YTM = I/YR = ? I/YR = 6.00%.

b. Yes. At a price of $829, the yield to maturity, 15%, is greater than your required rate of return of 12%. If your required rate of return were 12%, you should be willing to buy the bond at any price below $908.88.

9-12 **a.** Solving for YTM:

N = 9, PV = -901.40, PMT = 80, FV = 1000
I/YR = YTM = 9.6911%.

b. The current yield is defined as the annual coupon payment divided by the current price.

CY = $80/$901.40 = 8.875%.

Expected capital gains yield can be found as the difference between YTM and the current yield.

CGY = YTM – CY = 9.691% – 8.875% = 0.816%.

Alternatively, you can solve for the capital gains yield by first finding the expected price next year.
N = 8, I/YR = 9.6911, PMT = 80, FV = 1000
PV = -$908.76. V_B = $908.76.

Hence, the capital gains yield is the percentage price appreciation over the next year.

CGY = $(P_1 – P_0)/P_0$ = ($908.76 – $901.40)/$901.40 = 0.816%.

c. As rates change they will cause the end-of-year price to change and thus the realized capital gains yield to change. As a result, the realized return to investors will differ from the YTM.

9-13 **a.** Using a financial calculator, input the following to solve for YTM:

N = 18, PV = -1100, PMT = 60, FV = 1000, and solve for YTM = I/YR = 5.1355%.

However, this is a periodic rate. The nominal YTM = 5.1355%(2) = 10.2709% $\approx$ 10.27%.

For the YTC, input the following:

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

However, this is a periodic rate. The nominal YTC = 5.0748%(2) = 10.1495% $\approx$ 10.15%.

So the bond is likely to be called, and investors are most likely to earn a 10.15% yield.

b. The current yield = \$120/\$1,100 = 10.91%. The current yield will remain the same; however, if the bond is called the YTC reflects the total return (rather than the YTM) so the capital gains yield will be different.

c.

YTM	= Current yield + Capital gains (loss) yield
10.27%	= 10.91% + Capital loss yield
-0.64%	= Capital loss yield.

This is the capital loss yield if the YTM is expected.

However, based on our calculations in Part a the total return expected would actually be the YTC = 10.15%. So, the expected capital loss yield = 10.15% – 10.91% = -0.76%.

9-14 **a.** Yield to maturity (YTM):

With a financial calculator, input N = 28, PV = -1165.75, PMT = 95, FV = 1000, I/YR = ? I/YR = YTM = 8.00%.

Yield to call (YTC):

With a calculator, input N = 3, PV = -1165.75, PMT = 95, FV = 1090, I/YR = ? I/YR = YTC = 6.11%.

b. Knowledgeable investors would expect the return to be closer to 6.1% than to 8%. If interest rates remain substantially lower than 9.5%, the company can be expected to call the issue at the call date and to refund it with an issue having a coupon rate lower than 9.5%.

c. If the bond had sold at a discount, this would imply that current interest rates are above the coupon rate (i.e., interest rates have risen). Therefore, the company would not call the bonds, so the YTM would be more relevant than the YTC.

9-15 The problem asks you to solve for the YTM and Price, given the following facts:

N = 5 $\times$ 2 = 10, PMT = 80/2 = 40, and FV = 1000. In order to solve for I/YR we need PV.

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

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 = 10, PV = -974.42, PMT = 40, and FV = 1000. Solve for I/YR = YTM = 4.32%. However, this is a periodic rate so the nominal YTM = 4.32%(2) = 8.64%.

9-16 **a.** 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. Therefore, the likely life remaining on these bonds is 5 years (the time to call).

b. Since the bonds are likely to be called, they 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 = 2 × 5 = 10, PV = -1353.54, PMT = 0.14/2 × 1,000 = 70, FV = 1050, and then solve for YTC = I/YR.

The periodic rate is 3.2366%, so the nominal YTC is 2 × 3.2366% = 6.4733% ≈ 6.47%. This would be close to the going rate, and it is about what the firm would have to pay on new bonds.

9-17 First, we must find the amount of money we can expect to sell this bond for in 5 years. This is found using the fact that in five years, there will be 15 years remaining until the bond matures and that the expected YTM for this bond at that time will be 8.5%.

N = 15, I/YR = 8.5, PMT = 90, FV = 1000
PV = -\$1,041.52. V_B = \$1,041.52.

This is the value of the bond in 5 years. Therefore, we can solve for the maximum price we would be willing to pay for this bond today, subject to our required rate of return of 10%.

N = 5, I/YR = 10, PMT = 90, FV = 1041.52
PV = -\$987.87. V_B = \$987.87.

You would be willing to pay up to \$987.87 for this bond today.

9-18 Before you can solve for the price, we must find the appropriate semiannual rate at which to evaluate this bond.

$$EAR = (1 + I_{NOM}/2)^2 - 1$$
$$0.0816 = (1 + I_{NOM}/2)^2 - 1$$
$$I_{NOM} = 0.08.$$

Semiannual interest rate = 0.08/2 = 0.04 = 4%.

Solving for price:

N = 2 × 10 = 20, I/YR = 4, PMT = 0.09/2 × 1,000 = 45, FV = 1000
PV = -\$1,067.95. V_B = \$1,067.95.

9-19 First, we must find the price Chen Xi paid for this bond.

N = 10, I/YR = 9.79, PMT = 110, FV = 1000
PV = -$1,075.02. V_B = $1,075.02.

Then to find the one-period return, we must find the sum of the change in price and the coupon received divided by the starting price.

$$\text{One-period return} = \frac{\text{Ending price} - \text{Beginning price} + \text{Coupon received}}{\text{Beginning price}}$$

One-period return = ($1,060.49 – $1,075.02 + $110)/$1,075.02
One-period return = 8.88%.

9-20 **a.** According to Table 7.5, the yields to maturity for Anadarko Petroleum's and Clear Channel's bonds are 3.743% and 7.330%, respectively. So, Anadarko would need to set a coupon of 3.743% to sell its bonds at par, while Clear Channel would need to set a coupon of 7.330%.

b. Current investments in Anadarko Petroleum and Clear Channel would be expected to earn returns equal to their expected present yields. The return is safer for Anadarko Petroleum, as these are investment-grade bonds. Looking at the table, we see that the Anadarko Petroleum bonds are rated BBB- by S&P, while the Clear Channel bonds have an S&P rating of B.

9-21 **a.** Find the YTM as follows:

N = 10, PV = -1175, PMT = 110, FV = 1000
I/YR = YTM = 8.35%.

b. Find the YTC, if called in Year 5 as follows:

N = 5, PV = -1175, PMT = 110, FV = 1090
I/YR = YTC = 8.13%.

c. The bonds are selling at a premium which indicates that interest rates have fallen since the bonds were originally issued. Assuming that interest rates do not change from the present level, investors would expect to earn the yield to call. (Note that the YTC is less than the YTM.)

d. Similarly from above, YTC can be found, if called in each subsequent year.

If called in Year 6:

N = 6, PV = -1175, PMT = 110, FV = 1080
I/YR = YTC = 8.27%.

If called in Year 7:

N = 7, PV = -1175, PMT = 110, FV = 1070
I/YR = YTC = 8.37%.

If called in Year 8:

N = 8, PV = -1175, PMT = 110, FV = 1060
I/YR = YTC = 8.46%.

If called in Year 9:

N = 9, PV = -1175, PMT = 110, FV = 1050
I/YR = YTC = 8.53%.

According to these calculations, the latest investors might expect a call of the bonds is in Year 6. This is the last year that the expected YTC will be less than the expected YTM. At this time, the firm still finds an advantage to calling the bonds, rather than seeing them to maturity.

Comprehensive/Spreadsheet Problem

Note to Instructors:
The solution to this problem is <u>not</u> provided to students at the back of their text. Instructors can access the *Excel* file on the textbook's website or the Instructor's Resource CD.

9-22 **a.** Bond A is selling at a discount because its coupon rate (7%) is less than the going interest rate (YTM = 9%). Bond B is selling at par because its coupon rate (9%) is equal to the going interest rate (YTM = 9%). Bond C is selling at a premium because its coupon rate (11%) is greater than the going interest rate (YTM = 9%).

b.

Basic Input Data	Bond A	Bond B	Bond C
Years to maturity	12	12	12
Periods per year	1	1	1
Periods to maturity	12	12	12
Coupon rate	7%	9%	11%
Par value	$1,000	$1,000	$1,000
Periodic payment	$70	$90	$110
Yield to maturity	9%	9%	9%
V_{B0} =	$856.79	$1,000.00	$1,143.21

c. Current yield = Annual coupon / Price

	Bond A	Bond B	Bond C
Current yield =	8.17%	9.00%	9.62%

d.

Basic Input Data	Bond A	Bond B	Bond C
Years to maturity	11	11	11
Periods per year	1	1	1
Periods to maturity	11	11	11
Coupon rate	7%	9%	11%
Par value	$1,000	$1,000	$1,000
Periodic payment	$70	$90	$110
Yield to maturity	9%	9%	9%
V_{B1} =	$863.90	$1,000.00	$1,136.10
Expected CG Yield =	0.83%	0.00%	-0.62%
Expected Total Return =	9.00%	9.00%	9.00%

e.

Basic Input Data	Bond D
Years to maturity	9
Periods per year	2
Periods to maturity	18
Coupon rate	8%
Par value	$1,000
Periodic payment	$40
Current price	$1,150
Call price	$1,040
Years until callable	5
Periods until callable	10

YTM =	5.83%
YTC =	5.26%

1. 5.83%

2. 5.26%

3. The bond is selling at a premium, which means that interest rates have declined. If interest rates remain at current levels, then Mr. Tian should expect the bond to be called. Consequently, he would earn the YTC not the YTM.

f.

	9%	10%	% Price Chge
• A 1-year bond with a 9% annual coupon	$1,000.00	$990.91	-0.91%
• A 5-year bond with a 9% annual coupon	$1,000.00	$962.09	-3.79%
• A 5-year bond with a zero coupon	$649.93	$620.92	-4.46%
• A 10-year bond with a 9% annual coupon	$1,000.00	$938.55	-6.14%
• A 10-year bond with a zero coupon	$422.41	$385.54	-8.73%

Price risk is the risk of a decline in a bond's price due to an increase in interest rates. Reinvestment risk is the risk that a decline in interest rates will lead to a decline in income from a bond portfolio.

Ranking the bonds above in order from the most price risk to the least price risk: 10-year bond with a zero coupon, 10-year bond with a 9% annual coupon, 5-year bond with a zero coupon, 5-year bond with a 9% annual coupon, and a 1-year bond with a 9% annual coupon.

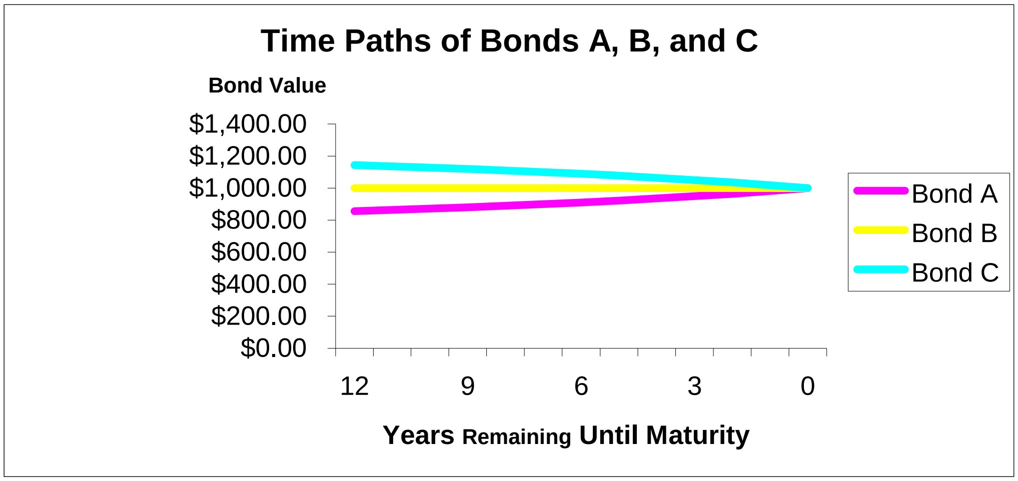
You can double check this ranking by calculating the prices of each bond at 2 different interest rates, and then determining the percentage change in value. (See calculations above.)

Ranking the bonds above in order from the most reinvestment risk to the least reinvestment risk: 1-year bond with a 9% annual coupon, 5-year bond with a 9% annual coupon, 5-year bond with a zero coupon, 10-year bond with a 9% coupon, and 10-year bond with a zero coupon.

Refer to Table 9.2 in text; however, the longer the maturity and the lower the coupon rate of the bond, the lower the reinvestment risk of the bond.

g.

Years Remaining Until Maturity	Bond A	Bond B	Bond C
12	$856.79	$1,000.00	$1,143.21
11	$863.90	$1,000.00	$1,136.10
10	$871.65	$1,000.00	$1,128.35
9	$880.10	$1,000.00	$1,119.90
8	$889.30	$1,000.00	$1,110.70
7	$899.34	$1,000.00	$1,100.66
6	$910.28	$1,000.00	$1,089.72
5	$922.21	$1,000.00	$1,077.79
4	$935.21	$1,000.00	$1,064.79
3	$949.37	$1,000.00	$1,050.63
2	$964.82	$1,000.00	$1,035.18
1	$981.65	$1,000.00	$1,018.35
0	$1,000.00	$1,000.00	$1,000.00



1.

Years Remaining Until Maturity	Bond A	Bond B	Bond C
12	8.17%	9.00%	9.62%
11	8.10%	9.00%	9.68%
10	8.03%	9.00%	9.75%
9	7.95%	9.00%	9.82%
8	7.87%	9.00%	9.90%
7	7.78%	9.00%	9.99%
6	7.69%	9.00%	10.09%
5	7.59%	9.00%	10.21%
4	7.48%	9.00%	10.33%
3	7.37%	9.00%	10.47%
2	7.26%	9.00%	10.63%
1	7.13%	9.00%	10.80%

2.

Years Remaining Until Maturity	Bond A	Bond B	Bond C
12	0.83%	0.00%	-0.62%
11	0.90%	0.00%	-0.68%
10	0.97%	0.00%	-0.75%
9	1.05%	0.00%	-0.82%
8	1.13%	0.00%	-0.90%
7	1.22%	0.00%	-0.99%
6	1.31%	0.00%	-1.09%
5	1.41%	0.00%	-1.21%
4	1.52%	0.00%	-1.33%
3	1.63%	0.00%	-1.47%
2	1.74%	0.00%	-1.63%
1	1.87%	0.00%	-1.80%

3.

Years Remaining Until Maturity	Bond A	Bond B	Bond C
12	9.00%	9.00%	9.00%
11	9.00%	9.00%	9.00%
10	9.00%	9.00%	9.00%
9	9.00%	9.00%	9.00%
8	9.00%	9.00%	9.00%
7	9.00%	9.00%	9.00%
6	9.00%	9.00%	9.00%
5	9.00%	9.00%	9.00%
4	9.00%	9.00%	9.00%
3	9.00%	9.00%	9.00%
2	9.00%	9.00%	9.00%
1	9.00%	9.00%	9.00%

Integrated Case

9-23
Oriental Asset Management Corporation
Bond Valuation

Lee Teng and Hu Feng are vice presidents of Oriental Asset Management and codirectors of the company's pension fund management division. A major new client, the Shandong Network of Cities, has requested that Oriental Asset Management present an investment seminar to the mayors of the represented cities. Lee and Hu, who will make the presentation, have asked you to help them by answering the following questions.

A.	What are a bond's key features?

Answer: [Show S9-1 through S9-4 here.] Here is a list of key features:

1. Par or face value. We generally assume a $1,000 par value, but par can be anything, and often $5,000 or more is used. With registered bonds, which is what are issued today, if you bought $50,000 worth, that amount would appear on the certificate.

2. Coupon rate. The dollar coupon is the "rent" on the money borrowed, which is generally the par value of the bond. The coupon rate is the annual interest payment divided by the par value, and it is generally set at the value of r_d on the day the bond is issued. To illustrate, from Table 9.5 the required rate of return on JP Morgan Chase's 2021 bonds was 4.625% when they were issued, so the coupon rate was set at 4.625%. If the company were to float a new issue today, the coupon rate would be set at the going rate today (June 10, 2011), which would be around 4.574%—the YTM on these outstanding bonds.

3. **__Maturity__. This is the number of years until the bond matures and the issuer must repay the loan (return the par value).**

4. **__Call provision__. Most bonds (except U.S. Treasury bonds) can be called and paid off ahead of schedule after some specified "call protection period." Generally, the call price is above the par value by some "call premium." We will see that companies tend to call bonds if interest rates decline after the bonds were issued, so they can refund the bonds with lower interest bonds. This is just like homeowners refinancing their mortgages if mortgage interest rates decline. The call premium is like the prepayment penalty on a home mortgage.**

5. **__Issue date__. The date when the bond issue was originally sold.**

6. **__Default risk__ is inherent in all bonds except Treasury bonds—will the issuer have the cash to make the promised payments? Bonds are rated from AAA to D, and the lower the rating the riskier the bond, the higher its default risk premium, and, consequently, the higher its required rate of return, r_d.**

7. **__Special features__, such as convertibility and zero coupons, will be discussed later.**

B.	**What are call provisions and sinking fund provisions? Do these provisions make bonds more or less risky?**

Answer: **[Show S9-5 through S9-7 here.] A call provision is a provision in a bond contract that gives the issuing corporation the right to redeem the bonds under specified terms prior to the normal maturity date. The call provision generally states that the company must pay the bondholders an amount greater than the par value if they are called. The additional sum, which is called a call premium, is**

typically set equal to one year's interest if the bonds are called during the first year, and the premium declines at a constant rate of INT/N each year thereafter.

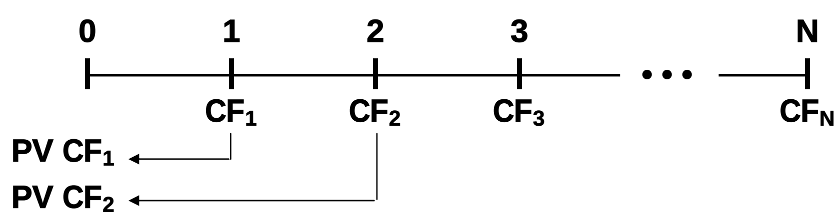
A sinking fund provision is a provision in a bond contract that requires the issuer to retire a portion of the bond issue each year. A sinking fund provision facilitates the orderly retirement of the bond issue.

The call privilege is valuable to the firm but potentially detrimental to the investor, especially if the bonds were issued in a period when interest rates were cyclically high. Therefore, bonds with a call provision are riskier than those without a call provision. Accordingly, the interest rate on a new issue of callable bonds will exceed that on a new issue of noncallable bonds.

Although sinking funds are designed to protect bondholders by ensuring that an issue is retired in an orderly fashion, it must be recognized that sinking funds will at times work to the detriment of bondholders. On balance, however, bonds that provide for a sinking fund are regarded as being safer than those without such a provision, so at the time they are issued, sinking fund bonds have lower coupon rates than otherwise similar bonds without sinking funds.

C.	**How is the value of any asset whose value is based on expected future cash flows determined?**

Answer: [Show S9-8 through S9-10 here.]



The value of an asset is merely the present value of its expected future cash flows:

$$\text{Value} = PV = \frac{CF_1}{(1+r_d)^1} + \frac{CF_2}{(1+r_d)^2} + \frac{CF_3}{(1+r_d)^3} + \ldots + \frac{CF_N}{(1+r_d)^N}$$
$$= \sum_{t=1}^{N} \frac{CF_t}{(1+r_d)^t}.$$

If the cash flows have widely varying risk, or if the yield curve is not horizontal, which signifies that interest rates are expected to change over the life of the cash flows, it would be logical for each period's cash flow to have a different discount rate. However, it is very difficult to make such adjustments; hence it is common practice to use a single discount rate for all cash flows.

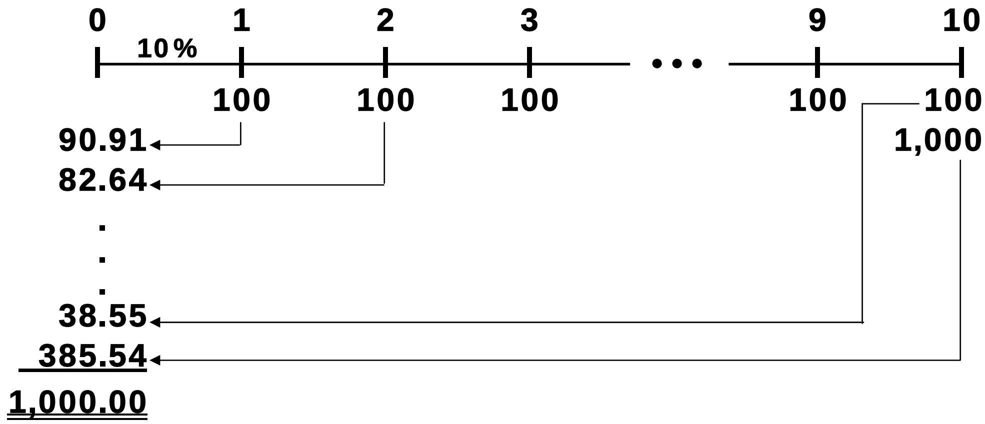
The discount rate is the opportunity cost of capital; that is, it is the rate of return that could be obtained on alternative investments of similar risk. Thus, the discount rate depends primarily on factors discussed in Chapter 9:

$$r_i = r^* + IP + MRP + DRP + LP.$$

D.	How is a bond's value determined? What is the value of a 10-year, $1,000 par value bond with a 10% annual coupon if its required return is 10%?

Answer: [Show S9-11 and S9-12 here.] A bond has a specific cash flow pattern consisting of a stream of constant interest payments plus the return of par at maturity. The annual coupon payment is the cash flow: PMT = (Coupon rate) × (Par value) = 0.1($1,000) = $100.

For a 10-year, 10% annual coupon bond, the bond's value is found as follows:



Expressed as an equation, we have:

$$V_B = \frac{\$100}{(1+r_d)^1} + \ldots + \frac{\$100}{(1+r_d)^{10}} + \frac{\$1,000}{(1+r_d)^{10}}$$
$$= \$90.91 + \ldots + \$38.55 + \$385.54 = \$1,000.$$

The bond consists of a 10-year, 10% annuity of $100 per year plus a $1,000 lump sum payment at t = 10:

PV annuity	**= $ 614.46**
PV maturity value	**= 385.54**
Value of bond	**= $1,000.00**

The mathematics of bond valuation is programmed into financial calculators that do the operation in one step, so the easy way to solve bond valuation problems is with a financial calculator. Input N = 10, r_d = I/YR = 10, PMT = 100, and FV = 1000, and then press PV to find the bond's value, $1,000. Spreadsheets can also be used to find the bond's value.

E. (1) What is the value of a 13% coupon bond that is otherwise identical to the bond described in Part D? Would we now have a discount or a premium bond?

Answer: **[Show S9-13 here.] With a financial calculator, just change the value of PMT from $100 to $130, and press the PV button to determine the value of the bond:**

Price of 13% coupon bond = $1,184.34.

In a situation like this, when the coupon rate <u>exceeds</u> the bond's required rate of return, r_d, the bond's value rises <u>above par</u>, and sells at a <u>premium</u>.

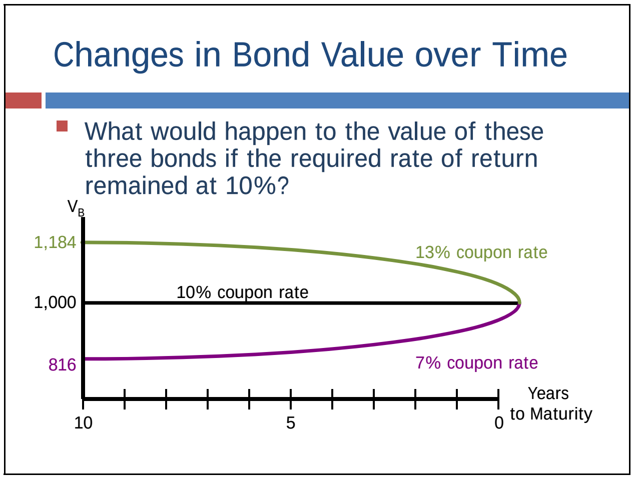
E.	**(2)**	**What is the value of a 7% coupon bond with these characteristics? Would we now have a discount or premium bond?**

Answer: **[Show S9-14 here.] In the second situation, where the coupon rate (7%) is below the bond's required return (10%), the price of the bond falls below par. Just change PMT to $70. We see that the 10-year bond's value falls to $815.66.**

Thus, when the coupon rate is <u>below</u> the required rate of return, the bonds' value falls <u>below par</u>, or sells at a <u>discount</u>. Further, the longer the maturity, the greater the price effect of any given interest rate change.

E.	**(3)**	**What would happen to the values of the 7%, 10%, and 13% coupon bonds over time if the required return remained at 10%? (Hint: With a financial calculator, enter PMT, I/YR, FV, and N; then change (override) N to see what happens to the PV as it approaches maturity.)**

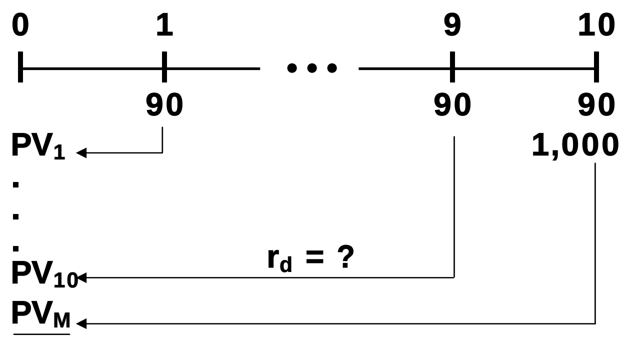
Answer: **[Show S9-15 and S9-16 here.] Assuming that interest rates remain constant (at 10%), we could find the bond's value as time passes, and as the maturity date approaches. If we then plotted the data, we would find the situation shown below:**



At maturity, the value of any bond must equal its par value (plus accrued interest). Therefore, if interest rates, hence the required rate of return, remain constant over time, then a bond's value must move toward its par value as the maturity date approaches, so the value of a premium bond decreases to $1,000, and the value of a discount bond increases to $1,000 (barring default).

F. (1) What is the yield to maturity on a 10-year, 9%, annual coupon, $1,000 par value bond that sells for $887.00? That sells for $1,134.20? What does the fact that it sells at a discount or at a premium tell you about the relationship between r_d and the coupon rate?

Answer: [Show S9-17 through S9-19 here.] The yield to maturity (YTM) is the discount rate that equates the present value of a bond's cash flows to its price. In other words, it is the promised rate of return on the bond. (Note that the expected rate of return is less than the YTM if some probability of default exists.) On a time line, we have the following situation when the bond sells for $887:



Sum = PV = <u>887</u>

We want to find r_d in this equation:

$$V_B = PV = \frac{INT}{(1+r_d)^1} + \ldots + \frac{INT}{(1+r_d)^N} + \frac{M}{(1+r_d)^N}.$$

We know N = 10, PV = -887, PMT = 90, and FV = 1000, so we have an equation with one unknown, r_d. We can solve for r_d by entering the known data into a financial calculator and then pressing the I/YR button. The YTM is found to be 10.91%.

We can tell from the bond's price, even before we begin the calculations, that the YTM must be <u>above</u> the 9% coupon rate. We know this because the bond is selling at a discount, and discount bonds always have r_d > coupon rate.

If the bond were priced at $1,134.20, then it would be selling at a <u>premium</u>. In that case, it must have a YTM that is <u>below</u> the 9% coupon rate, because all premium bonds must have coupons that <u>exceed</u> the going interest rate. Going through the same procedures as before—plugging the appropriate values into a financial calculator and then pressing the I/YR button, we find that at a price of $1,134.20, r_d = YTM = 7.08%.

F.	**(2)**	**What are the total return, the current yield, and the capital gains yield for the discount bond? Assume that it is held to maturity and the company does not default on it. (Hint: Refer to Footnote 7 for the definition of the current yield and to Table 9.1.)**

Answer: **[Show S9-20 through S9-22 here.] The current yield is defined as follows:**

$$\text{Current yield} = \frac{\text{Annual coupon interest payment}}{\text{Current price of the bond}}.$$

The capital gains yield is defined as follows:

$$\text{Capital gains yield} = \frac{\text{Expected change in bond's price}}{\text{Beginning-of-year price}}.$$

The total expected return is the sum of the expected current yield and the expected capital gains yield:

$$\begin{matrix}\text{Expected} \\ \text{total return}\end{matrix} = \begin{matrix}\text{Expected} \\ \text{current yield}\end{matrix} + \begin{matrix}\text{Expected capital} \\ \text{gains yield}\end{matrix}.$$

The term yield to maturity, or YTM, is often used in discussing bonds. It is simply the expected total return (assuming no default risk and the bonds are not called), so $\hat{r}_d$ = expected total return = expected YTM.

Recall also that securities have required returns, r_d, which depend on a number of factors:

$$\text{Required return} = r_d = r^* + IP + LP + MRP + DRP.$$

We know that (1) security markets are normally in equilibrium, and (2) that for equilibrium to exist, the expected return, $\hat{r}_d$ = YTM, as seen by the marginal investor, must be equal to the required return, r_d. If that equality does not hold, then buying and selling will occur

until it does hold, and equilibrium is established. Therefore, for the marginal investor:

$$\hat{r}_d = \text{YTM} = r_d.$$

For our 9% coupon, 10-year bond selling at a price of $887 with a YTM of 10.91%, the current yield is:

$$\text{Current yield} = \frac{\$90}{\$887} = 0.1015 = 10.15\%.$$

Knowing the current yield and the total return, we can find the capital gains yield:

$$\text{YTM} = \text{Current yield} + \text{Capital gains yield}$$

and

$$\begin{aligned}\text{Capital gains yield} &= \text{YTM} - \text{Current yield}\\ &= 10.91\% - 10.15\% = 0.76\%.\end{aligned}$$

The capital gains yield calculation can be checked by asking this question: "What is the expected value of the bond 1 year from now, assuming that interest rates remain at current levels?" This is the same as asking, "What is the value of a 9-year, 9% annual coupon bond if its YTM (its required rate of return) is 10.91%?" The answer, using the bond valuation function of a calculator, is $893.87. With this data, we can now calculate the bond's capital gains yield as follows:

$$\begin{aligned}\text{Capital gains yield} &= (V_{B_1} - V_{B_0})/V_{B_0}\\ &= (\$893.87 - \$887)/\$887 = 0.0077 = 0.77\%,\end{aligned}$$

which agrees with our earlier calculation (except for rounding). When the bond is selling for $1,134.20 and providing a total return of r_d = YTM = 7.08%, we have this situation:

$$\text{Current yield} = \$90/\$1{,}134.20 = 7.94\%$$

and

$$\text{Capital gains yield} = 7.08\% - 7.94\% = -0.86\%.$$

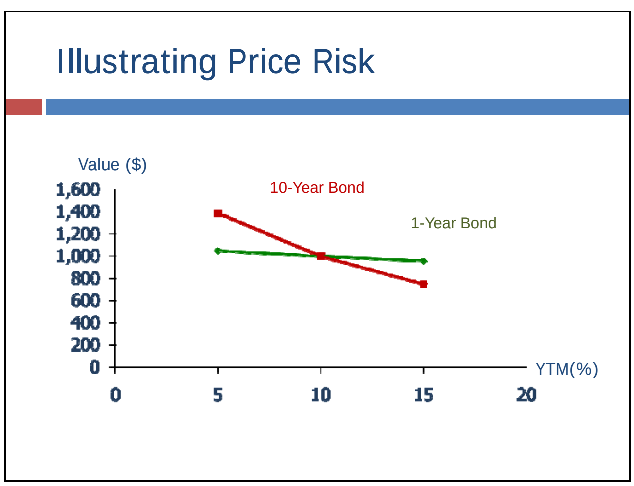
The bond provides a current yield that exceeds the total return, but a purchaser would incur a small capital loss each year, and this loss would exactly offset the excess current yield and force the total return to equal the required rate.

G.	**What is <u>price risk</u>? Which has more price risk, an annual payment 1-year bond or a 10-year bond? Why?**

Answer: **[Show S9-23 and S9-24 here.] <u>Price risk</u> is the risk that a bond will lose value as the result of an increase in interest rates. The table below gives values for a 10%, annual coupon bond at different values of r_d:**

	Maturity			
r_d	1-Year	Change	10-Year	Change
5%	$1,048		$1,386	
		+4.8%		+38.6%
10	1,000		1,000	
		-4.4%		-25.1%
15	956		749	

A 5% increase in r_d causes the value of the 1-year bond to decline by only 4.4%, but the 10-year bond declines in value by more than 25%. Thus, the 10-year bond has more <u>price risk</u>.



The graph above shows the relationship between bond values and interest rates for a 10%, annual coupon bond with different maturities. The longer the maturity, the greater the change in value for a given change in interest rates, r_d.

H.	**What is reinvestment risk? Which has more reinvestment risk, a 1-year bond or a 10-year bond?**

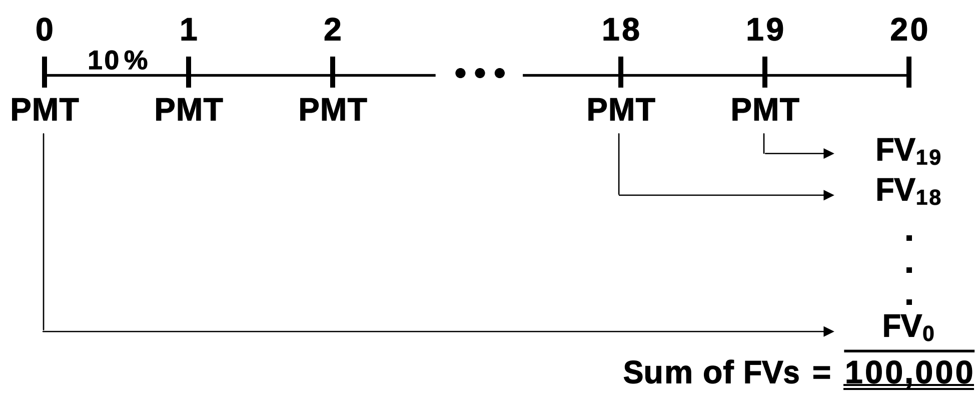
Answer: **[Show S9-25 through S9-27 here.] Reinvestment risk is defined as the risk that cash flows (interest plus principal repayments) will have to be reinvested in the future at rates lower than today's rate. To illustrate, suppose you just won the lottery and now have $500,000. You plan to invest the money and then to live on the income from your investments. Suppose you buy a 1-year bond with a 10% YTM. Your income will be $50,000 during the first year. Then, after 1 year, you will receive your $500,000 when the bond matures, and you will then have to reinvest this amount. If rates have fallen to 3%, then your income will fall from $50,000 to $15,000. On the other hand, had you bought 30-year bonds that yielded 10%, your income would have remained constant at $50,000 per year. Clearly, buying bonds that have short maturities carries reinvestment risk. Note that long-term bonds also have reinvestment risk, but the risk applies only to the coupon payments, and not to the principal amount. Since the coupon payments are significantly less than the principal amount, the reinvestment risk on a long-term bond is significantly less than on a short-term bond.**

Optional Question

Suppose a firm will need \$100,000 20 years from now to replace some equipment. It plans to make 20 equal payments, starting today, into an investment fund. It can buy bonds that mature in 20 years or bonds that mature in 1 year. Both types of bonds currently sell to yield 10%, i.e., r_d = YTM = 10%. The company's best estimate of future interest rates is that they will stay at current levels, i.e., they may rise or they may fall, but the expected r_d is the current r_d.

There is some chance that the equipment will wear out in less than 20 years, in which case the company will need to cash out its investment before 20 years. If this occurs, the company will desperately need the money that has been accumulated—this money could save the business. How much should the firm plan to invest each year?

Answer: Start with a time line:



We have a 20-year annuity due whose FV = 100,000, where r_d = 10%. We could set the calculator to "beginning" or "due," insert the known values (N = 20, r_d = I/YR = 10, PV = 0, FV = 100000), and then press the PMT button to find the payment, PMT = \$1,587.24. Thus, if we save \$1,587.24 per year, starting today, and invest it to earn 10% per year, we would end up with the required \$100,000. Note, though, that this calculation <u>assumes</u> that the company can earn 10% in each future year. If interest rates fall, it could not earn 10% on its additional deposits; hence, it would not end up with the required $100,000.

Optional Question

If the company decides to invest enough right now to produce the future $100,000, how much is its outlay?

Answer: To find the required initial lump sum, we would find the PV of $100,000 discounted back for 20 years at 10%: PV = $14,864.36. If the company invested this amount now and earned 10%, it would end up with the required $100,000. Note again, though, that if interest rates fall, the interest received in each year will have to be reinvested to earn less than 10%, and the $100,000 goal will not be met.

Given the facts as we have developed them, if the company decides on the lump sum payment, should it buy 1-year bonds or 20-year bonds? Neither will be completely safe in the sense of assuring the company that the required $100,000 will be available in 20 years, but is one better than the other? To begin, let's look at this time line:

	0	1	2	•••	18	19	20	
	10%							
	14,864.36						100,000	
1-year		16,351	?		?			Greater uncertainty
20-year		1,486	1,486		?			Less uncertainty

The company will invest $14,864 at t = 0. Then, it would have $1,486.40 of interest to reinvest at t = 1 if it bought a 20-year bond, but it would have $1,486 of interest <u>plus</u> $14,864 of principal = $16,350.80 to reinvest at t = 1 if it bought the 1-year bond. Thus, both bonds are exposed to some reinvestment risk, but the shorter-term bond is more exposed because it would require the reinvestment of more money. Our conclusion is that the shorter the maturity of a bond, other things held constant, the greater its exposure to reinvestment risk.

Optional Question

Can you think of any other type of bond that might be useful for this company's purposes?

Answer: A zero coupon bond is one that pays no interest—it has zero coupons, and its issuer simply promises to pay a stated lump sum at some future date. J.C. Penney was the first major company to issue zeros, and it did so in 1981. There was a demand on the part of pension fund managers, and investment bankers identified this need.

When issuing zeros, the company (or government unit) simply sets a maturity value, say $1,000, and a maturity date, say 20 years from now. There is some value of r_d for bonds of this degree of risk. Assume that our company could buy 20-year zeros to yield 10%. Thus, our company could buy 100 zeros with a total maturity value of 100 $\times$ $1,000 = $100,000. It would have to pay $14,864.36, the PV of $100,000 discounted back 20 years at 10%. Here is the relevant time line:

	0	1	2	•••	19	20
	10%					
Accrued value	= 14,864.36	16,351	17,986		90,909	100,000 = FV

Assuming the zero coupon bond cannot be called for early payment, the company would face no reinvestment risk—there are no intervening cash flows to reinvest, hence no reinvestment risk.

Therefore, the company could be sure of having the required $100,000 if it bought high quality zeros.

Optional Question

What type of bond would you recommend that it actually buy?

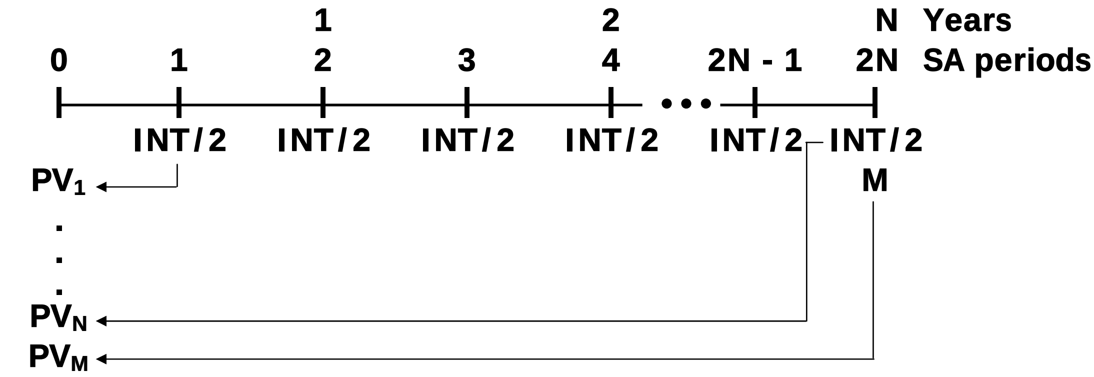
Answer: **It is tempting to say that the best investment for this company would be the zeros, because they have no reinvestment risk. But suppose the company needed to liquidate its bond portfolio in less than 20 years; could that affect the decision? The answer is "yes." If 1-year bonds were purchased, an increase in interest rates would not cause much of a drop in the value of the bonds, but if interest rates rose to 20% the year after the purchase, the value of the zeros would fall from the initial $14,864 to:**

$$PV = \$100{,}000(1.20)^{-19} = \$3{,}130.09.$$

When we reduce reinvestment risk, we increase price risk. Also, since inflation affects reinvestment rates and, often, the future funds needed, this could have a bearing on the decision. The proper decision requires a balancing of all these factors. One can quantify the outcomes to a certain extent, demonstrating what would happen under different conditions, but, in the end, a decision involving judgment must be made.

I. **How does the equation for valuing a bond change if semiannual payments are made? Find the value of a 10-year, semiannual payment, 10% coupon bond if nominal r_d = 13%.**

Answer: **[Show S9-28 and S9-29 here.] In reality, virtually all bonds issued in the U.S. have semiannual coupons and are valued using the setup shown below:**



V_{Bond} = Sum of PVs

We would use this equation to find the bond's value:

$$V_B = \sum_{t=1}^{2N} \frac{INT/2}{(1 + r_d/2)^t} + \frac{M}{(1 + r_d/2)^{2N}}.$$

The payment stream consists of an annuity of 2N payments plus a lump sum equal to the maturity value.

To find the value of the 10-year, semiannual payment bond, Semiannual interest = Annual coupon/2 = \$100/2 = \$50 and N = 2 $\times$ Years to maturity = 2(10) = 20. To find the value of the bond with a financial calculator, enter N = 20, $r_d/2$ = I/YR = 5, PMT = 50, FV = 1000, and then press PV to determine the value of the bond. Its value is \$1,000.

You could then change r_d = I/YR to see what happens to the bond's value as r_d changes, and plot the values.

For example, if r_d rose to 13%, we would input I/YR = 6.5 rather than 5, and find the 10-year bond's value to be \$834.72. If r_d fell to 7%, then input I/YR = 3.5 and press PV to find the bond's new value, \$1,213.19.

J.	Suppose for $1,000 you could buy a 10%, 10-year, annual payment bond or a 10%, 10-year, semiannual payment bond. They are equally risky. Which would you prefer? If $1,000 is the proper price for the semiannual bond, what is the equilibrium price for the annual payment bond?

Answer: **[Show S9-30 and S9-31 here.] The semiannual payment bond would be better. Its EAR would be:**

$$\text{EAR} = \left(1+\frac{r_{NOM}}{M}\right)^{M}-1=\left(1+\frac{0.10}{2}\right)^{2}-1=10.25\%.$$

An EAR of 10.25% is clearly better than one of 10.0%, which is what the annual payment bond offers. You, and everyone else, would prefer it.

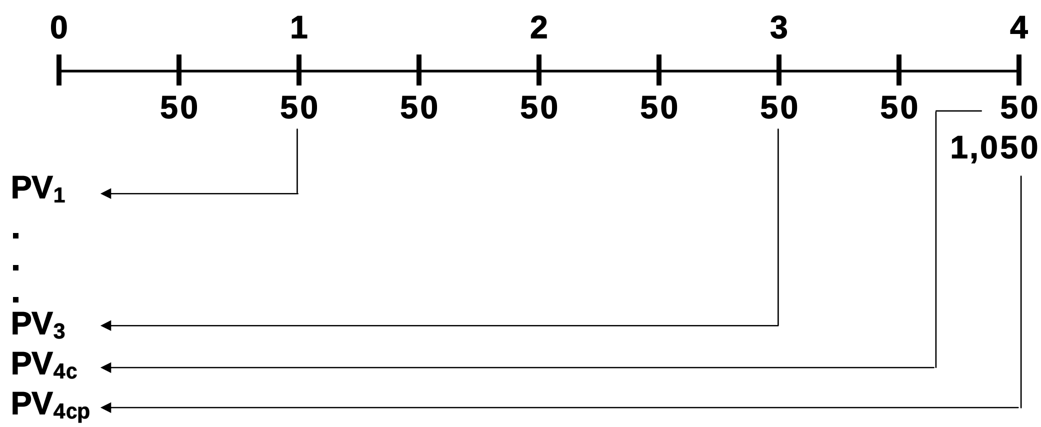
If the going rate of interest on semiannual bonds is r_{NOM} = 10%, with an EAR of 10.25%, then it would not be appropriate to find the value of the annual payment bond using a 10% EAR. If the annual payment bond were traded in the market, its value would be found using 10.25%, because investors would insist on receiving the same EAR on the two bonds, because their risk is the same. Therefore, you could find the value of the annual payment bond, using 10.25%, with your calculator. It would be $984.80 versus $1,000 for the semiannual payment bond.

Note that, if the annual payment bond were selling for $984.80 in the market, its EAR would be 10.25%. This value can be found by entering N = 10, PV = -984.80, PMT = 100, and FV = 1000 into a financial calculator and then pressing the I/YR button to find the answer, 10.25%. With this rate, and the $984.80 price, the annual and semiannual payment bonds would be in equilibrium—investors would receive the same rate of return on either bond, so there

would not be a tendency to sell one and buy the other (as there would be if they were both priced at $1,000.)

K.	**Suppose a 10-year, 10%, semiannual coupon bond with a par value of $1,000 is currently selling for $1,135.90, producing a nominal yield to maturity of 8%. However, it can be called after 4 years for $1,050.**
(1)	**What is the bond's <u>nominal yield to call (YTC)</u>?**

Answer: **[Show S9-32 and S9-33 here.] If the bond were called, bondholders would receive $1,050 at the end of Year 4. Thus, the time line would look like this:**



1,135.90 = Sum of PVs

The easiest way to find the YTC on this bond is to input values into your calculator: N = 8; PV = -1135.90; PMT = 50; and FV = 1050, which is the par value plus a call premium of $50; and then press the I/YR button to find I/YR = 3.568%. However, this is the 6-month rate, so we would find the nominal rate on the bond as follows:

$$r_{NOM} = 2(3.568\%) = 7.137\% \approx 7.1\%.$$

This 7.1% is the rate brokers would quote if you asked about buying the bond.

You could also calculate the EAR on the bond:

$$EAR = (1.03568)^2 - 1 = 7.26\%.$$

Usually, people in the bond business just talk about nominal rates, which is OK so long as all the bonds being compared are on a semiannual payment basis. When you start making comparisons among investments with different payment patterns, though, it is important to convert to EARs.

K. (2) If you bought this bond, would you be more likely to earn the YTM or the YTC? Why?

Answer: [Show S9-34 and S9-35 here.] Since the coupon rate is 10% versus YTC = r_d = 7.137%, it would pay the company to call the bond, to get rid of the obligation of paying $100 per year in interest, and to sell replacement bonds whose interest would be only $71.37 per year. Therefore, if interest rates remain at the current level until the call date, the bond will surely be called, so investors should expect to earn 7.137%. In general, investors should expect to earn the YTC on premium bonds, but to earn the YTM on par and discount bonds. (Bond brokers publish lists of the bonds they have for sale; they quote YTM or YTC depending on whether the bond sells at a premium or a discount.)

L. Does the yield to maturity represent the promised or expected return on the bond? Explain.

Answer: [Show S9-36 here.] The yield to maturity is the rate of return earned on a bond if it is held to maturity. It can be viewed as the bond's promised rate of return, which is the return that investors will receive if all the promised payments are made. The yield to

maturity equals the expected rate of return only if (1) the probability of default is zero and (2) the bond cannot be called. For bonds where there is some default risk, or where the bond may be called, there is some probability that the promised payments to maturity will not be received, in which case, the promised yield to maturity will differ from the expected return.

M.	**These bonds were rated AA- by S&P. Would you consider them investment-grade or junk bonds?**

Answer: [Show S9-37 and S9-38 here.] These bonds would be investment-grade bonds. Triple-A, double-A, single-A, and triple-B bonds are considered investment grade. Double-B and lower-rated bonds are considered speculative, or junk bonds, because they have a significant probability of going into default. Many financial institutions are prohibited from buying junk bonds.

N.	**What factors determine a company's bond rating?**

Answer: [Show S9-39 and S9-40 here.] Bond ratings are based on both qualitative and quantitative factors, some of which are listed below.

1. **Financial performance—determined by ratios such as the debt, TIE, and current ratios.**
2. **Qualitative factors—Bond contract terms:**
    - a. **Secured vs. unsecured debt**
    - b. **Senior vs. subordinated debt**
    - c. **Guarantee provisions**
    - d. **Sinking fund provisions**
    - e. **Debt maturity**

3. Miscellaneous qualitative factors:

a. Earnings stability

b. Regulatory environment

c. Potential product liability

d. Potential antitrust issues

e. Pension liabilities

f. Potential labor problem

O. If this firm were to default on the bonds, would the company be immediately liquidated? Would the bondholders be assured of receiving all of their promised payments? Explain.

Answer: [Show S9-41 through S9-44 here.] When a business becomes insolvent, it does not have enough cash to meet scheduled interest and principal payments. A decision must then be made whether to dissolve the firm through liquidation or to permit it to reorganize and thus stay alive.

The decision to force a firm to liquidate or to permit it to reorganize depends on whether the value of the reorganized firm is likely to be greater than the value of the firm's assets if they were sold off piecemeal. In a reorganization, a committee of unsecured creditors is appointed by the court to negotiate with management on the terms of a potential reorganization. The reorganization plan may call for a restructuring of the firm's debt, in which case the interest rate may be reduced, the term to maturity lengthened, or some of the debt may be exchanged for equity. The point of the restructuring is to reduce the financial charges to a level that the firm's cash flows can support.

If the firm is deemed to be too far gone to be saved, it will be liquidated and the priority of claims (as seen in Web Appendix 9C) would be as follows:

1. **Secured creditors.**
2. **Trustee's costs.**
3. **Expenses incurred after bankruptcy was filed.**
4. **Wages due workers, up to a limit of $2,000 per worker.**
5. **Claims for unpaid contributions to employee benefit plans.**
6. **Unsecured claims for customer deposits up to $900 per customer.**
7. **Federal, state, and local taxes.**
8. **Unfunded pension plan liabilities.**
9. **General unsecured creditors.**
10. **Preferred stockholders, up to the par value of their stock.**
11. **Common stockholders, if anything is left.**

If the firm's assets are worth more "alive" than "dead," the company would be reorganized. Its bondholders, however, would expect to take a "hit." Thus, they would not expect to receive all their promised payments. If the firm is deemed to be too far gone to be saved, it would be liquidated.