Chapter 11: Corporate Bond Investments, Analysis, and Valuation

This chapter will give an overview of the secondary bond market and how investors trade bonds. It will repeat a few of the concepts introduced in chapter 1 regarding return analysis and the time value of money to analyze and value various investments in bonds and securitized bond vehicles. Entailed in the analysis includes a risk evaluation of the present factors including impacts of interest rate fluctuations, credit rating upgrades and downgrades, and refinancing risk. It will also cover various scenario analyses to determine factors such as duration and convexity.

Learning Objectives

After reading this chapter, students will be able to do the following:

- Understand how the secondary bond markets work and how these securities are traded
- Understand various type of corporate bonds and how they are structured
- Understand all the risks involved investing in corporate bonds
- Analyze various yield results including current yield (CY), yield to maturity (YTM), yield to call (YTC), and yield to worse (YTW)
- Calculate the market price, invoice price, duration, and convexity of a corporate bond

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Author's notes:

When I was a junior analyst in the late 1980s working for Bank of America's leveraged finance department I was fascinated by how deals could be strategically structured and priced, no matter how much risk the company and transaction carried. My manager at the time always used to say, "Any deal can get done as long as you can price it right." For many of the transactions, the odds were that of pulling an ace of hearts out of a deck of 52 cards. However, if people believe they can get paid $52 for a $1 bet; there will always be a game—no matter the odds of losing being 51 out of 52. I remember specifically the investment bank Drexel Burnham Lambert and one of their most successful managers, Michael Milken, being able to get some of the toughest deals I had ever seen financed and executed. I reviewed many of these deals and was stunned by how they would always manage to find a structure that worked. If the company could not pay interest, no problem: The deal was engineered to include deferred interest bonds, ironically called paid-in-kind (PIK) bonds. I remember, as a young analyst, I was so fascinated by Drexel, Michael Milken, and their famous annual convention held at the Beverly Hilton Hotel in Los Angeles. The event was later tokened the Predator's Ball, featuring speakers categorized as some of the nation's most prominent corporate raiders, private equity firm managers, and financiers such as Ron Perelman, Carl Icahn, and Henry Kravis with KKR—all Drexel's clients. These conventions became the place to go if an analyst or investor wanted to learn how to financially engineer leveraged buyouts and hostile takeovers using this new innovative financing, at the time called high-yield bonds or "junk" bonds. The convention also attracted major banks and institutional investors in high-yield bonds as well as management teams from companies involved in leveraged buyouts. This famous convention became the title of the book, The Predators' Ball: The Inside Story of Drexel Burnham and the Rise of the Junk Bond Raiders. *Since then a lot of similar conventions are organized by many major investment banks called high-yield and leveraged finance conferences that I attended in places like Miami Beach, Las Vegas, and the Bahamas—all the high-energy places where you are comfortable signing risky deals over a margarita drink. Despite the bad publicity, high volatility, and high risk, these high-yield bonds will always dominate the corporate bond market. Issuers continue to turn to high-yield bonds, which investors are happy to actively purchase and trade.*

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Key takeaways:

- The risk characteristics of investing in bonds are much different than investing in stocks. Initial bond investors don't have much upside and primarily seek stability on both ends: high and low. If the company does very well, the stock holders get the benefit and the bond holders will most likely be refinanced out. If the company does very badly, then the bond holders will get stuck holding a security that will be valued at a discount.
- Where stock investors focus on volatility as the main risk, bond investor focus on interest rates and duration as the main risk.
- Bonds are referred to as fixed-income securities because of the interest payment or coupon payments they receive. It is important to factor in that these payments could be cut short of the intended duration (bought out). The analysis therefore needs to incorporate the possibility of early retirement or redemption and how it can affect the expected returns.
- Yield to maturity (YTM) is not the only return measurement of a bond. If the company redeems or calls the bonds early, the return measurement will be yield to call (YTC). In any case, the analyst needs to run all the scenarios including YTM and YTC and report the worst-case scenario: yield to worse (YTW).
- Given the sensitivity to interest rate fluctuations, especially holding a fixed-rate security, the analyst will also need to run and asses other performance measurements such as duration and convexity.

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Secondary Bond Markets: An Overview

In the United States, the secondary market for publicly traded bonds takes place in over-the-counter transactions. Like stocks, brokers and dealers of bonds need to register with the SEC and report all secondary trading activities in a centralized reporting platform called TRACE, which stands for trade reporting and compliance engine. Specifically, it requires that all brokers and dealers who are member firms of the Financial Integrity Regulatory Authority (FINRA) report transactions in corporate bonds to TRACE including the volume and price, advances and declines, and the 10 most active investment-grade, high-yield, and convertible bonds.

Bonds that are privately placed are exempt from registration with the SEC. Many private placements and other 144A bonds trade in the secondary markets among institutional investors. The secondary market's bond prices are not publicized but rather shared between institutions, similar to bank loans, discussed in the next chapter.

As it was discussed in detail in the primary market section of this text book, the bonds are rated, as required by the SEC, by two independent rating agencies before they are issued. As a precaution, they continue to be monitored for upgrades or downgrades, a very important factor for valuing the bonds in the secondary market. The rating that is assigned to the bond security is an estimation on the probability of default. **The rating agencies' sole objective when measuring the risk of default for bonds is to protect the public investor who is not sophisticated enough to analyze the risk of the company, raise debt, nor measure the probability of default.** The rating agencies such as Standard & Poor's (S&P), Moody's, and Fitch assign two to three separate ratings: One rating is for the company that is specifically issuing the bonds, one is for the bonds themselves, and in many cases the rating agency will issue a rate for large syndicated bank loans that are being bought by an array of funds.

Figure 11.1 shows the corporate bond rating system and the symbols assigned and is broken down into five categories of risk, described in chapter 7, including AAA risk-free grade, investment grade, non-investment grade, and distress and default grades.

CORPORATE BOND RATING AGENCIES' SCALES

Description		Standard & Poor's	Moody's	Fitch
Highest Quality (Risk Free)	INVESTMENT GRADE	AAA	Aaa	AAA
High Quality		AA+ AA+ AA-	Aa1 Aa2 Aa3	AA+ AA+ AA-
Strong Payment Capacity		A+ A+ A-	A1 A2 A3	A+ A+ A-
Adequate Payment Capacity		BBB+ BBB BBB-	Baa1 Baa2 Baa3	BBB+ BBB BBB-
Likely to fullfill Obligations	NON-INVESTMENT GRADE (HIGH YEILD)	BB+ BB BB-	Ba1 Ba2 Ba3	BB+ BB BB-
High-risk Obligations		B+ B B-	B1 B2 B3	B+ B B-
Current Vulnarable to Default	DISTRESS	CCC+ CCC CCC- CC C	Caa	CCC
Default	**DEFAULT**	D	D	DDD,DD,D

Figure 11.1

[Insert Figure 11.1]

Bonds are basically traded in two separate markets: investment grade and non-investment grade (high yield). Investment and commercial banks are organized to have two separate departments ranging from corporate finance to trading activities. Investment-grade bonds are rated from BBB up to AA. Non-investment-grade bonds are rated from BB down to CCC (speculative grade). A summary review, taken out of chapter 7's discussion on bonds, is described next.

Investment Grade Bonds (BBB to AA)

A bond is considered investment grade (IG) if the rating is BBB- or Baa3 and higher by S&P and Moody's, respectively. The designation of IG is sometimes a very important intended outcome for the companies that are in the process of raising bonds in the bond markets. Not only can the issuer's interest rate or coupon rate be substantially lower with an investment grade rating, but also certain capital structures become available. In addition, these structures have less restrictive terms and conditions integrated in the bond indenture. Typical IG bonds tend to have more flexibility in terms of refinancing these bonds with no penalties, as exampled by various non-investment grade bonds that include call prices. These call prices (discussed later in the chapter) are designed to discourage the issuer from early repayment of the bonds. The high price and redemption level are often set to be significantly higher than the par value in the case of non-investment grade versus investment grade. For example, a call price or redemption price of 105 suggests that the issuer desires to repay or call the bonds; the repayment is set at 105% of par or 5% penalty—a very steep arrangement. Most IG bonds are not structured that way, giving flexibility to the issuer to refinance earlier if, for example, the rates drop or the issuer gets upgraded and can get a better coupon rate with a new bond. Another benefit an IG issuer can enjoy is a more flexible covenant package where there are less restrictions on business actions such as paying dividends to shareholders or structuring the bonds as unsecured (no pledge of collateral).

Typical IG bond structures include a "make-whole" call premium provision to address a situation where the issuer repays the bonds earlier than maturity. This feature allows an issuer to entirely avoid the call structure issue (which is typically included in non-investment grade structures; discussed in the next section). The make-whole premium is made up of penalty fees that the issuer pays over the market value of the bonds.

Non-Investment-Grade Bonds or High-Yield Bonds (CCC to BB+)

Non-investment-grade high-yield bonds are debt securities issued by corporations with ratings of BB- and Ba1 or lower by S&P and Moody's, respectively. The primary purpose of a high-yield bond is to finance companies that are seeking money for growth (i.e., M&A or LBO), working capital, recapitalization, refinancing existing debt, or other cash flow purposes.

Since these issuers are viewed as riskier given their low ratings and methods for financing, as compensation these bonds offer a higher interest rate and, in most cases, have additional investor-friendly structural features. The high-yield market was originally developed in the late 80s by Michael Milken, also referred to as the "junk bond king," while he was at Drexel Lambert, an investment bank. This type of corporate bond was developed to finance the mega leveraged buyout (LBO) deals in the 80s such as the KKR buyout of RJR Nabisco, illustrated in the satiric book and movie *Barbarians at the Gate*. Though these bonds are sometimes called junk bonds (typical B, B-, and CCC+ rated bonds) and have given the asset class some negative connotation over the years, this asset class has matured into a solid 25% of the overall corporate bond market, according to Bond Market Association estimates.

High-yield bond indentures typically include call protection limits or provisions. This gives the issuer the ability to call the bond for redemption. Typically, it is at the half term of the bonds. For example, 10-year bonds will carry 5 years of call protection. Using the 10-year example, the call prices or redemptions could be set at 105, 104, 103, 102, and 101 for years 1, 2, 3, 4, and 5 from issuance, respectively. That means if the issuer decides to call (refinance) the bonds by the third anniversary from the issuance, he or she needs to repay the bonds at 103% of par, representing a 3% penalty for early termination. Some high-yield bonds are structured as 7-year (non-call 3) paper or 8-year (non-call 5) bonds. These bonds are not callable, which means that if the issuer for some reason needs to terminate the bonds during the non-call period, he or she will have to pay all the future interest for the non-callable period. In this case, the repayment amount is calculated by the present value of all future coupons that would have been paid through the non-call period.

Bond Investment Concepts: Reintroduced

The following concepts will be used to explain the secondary trading of bonds and the various factors bond research analysts focus on when evaluating bonds. Since bonds are debt instruments, as discussed in earlier chapters, there are four important **money terms** that are relevant in every bond contract: initial and secondary price values, interest rates and pricing, days, and contractual payments.

Bond Value Concepts

1. **Face value (par value)**: The face value, or par value, of a bond is the amount the issuer pays at maturity and the starting point for calculating the coupon rate (e.g., 5% coupon rate pays 5% of $1,000 or $50 per year). Each bond is basically valued at $1,000 or par (100% of $1,000), and this is the basis for what the issuer receives as initial proceeds per bond before any fee adjustments are netted out in a form of original issue discount (OID), which represents the below-par original issue price. However, the face value of $1,000 still represents what the issuer will pay to holders at maturity.

2. **Market value/market price (clean price)**: Secondary pricing starts on the day of issuance until the bonds are refinanced. When they say that the market price of a bond is trading at either a discount, at par, or at a premium, it indicates the bond can be bought below a percentage of $1,000, at $1,000, or above $1,000 per bond, respectively. For example, a bond that is trading at 98 means that you can trade it in the secondary market at 98% of a $1,000 or $980. This bond is considered to be trading at a discount. If a bond is trading at 103, then the secondary market value is 103% of $1,000, or $1,030 market price. This is sometimes referred to as the clean price, as compared to the dirty price, discussed later, that includes accrued interest. The other possibility is for the stock to be trading at par or 100% of $1,000; in such case the secondary market price would be $1,000. If the investor is expecting a higher yield on the bond, then the market value of the bond will decrease to a discount level that meets the expected yield. The formula for calculating the market value and price when the yield to maturity is known can be calculated as follows:

$$\text{MV} = \sum_1^n \frac{\text{CP}}{(1+\text{YTM})^n} + \frac{\$1{,}000}{(1+\text{YTM})^n} \text{ and } \text{MV}/10 = \text{MP}$$

where MV is the market value of the bond, CP is the coupon payment, YTM is the yield to maturity, and n is the number of years remaining until maturity. The market price (MP) or the trading price can be calculated by dividing the market value of the bonds by a factor of 10, considering that we are analyzing 10-year bonds. Using the information shown in figure 11.2, the market value of the bond is calculated as follows:

$$\text{MV} = \sum_1^{10} \frac{21.25}{(1+0.0474/2)^{10}} + \frac{\$1{,}000}{(1+.0474)^{10}} = 170.42 + 807.99 = 978.41$$

$$\text{MP} = \frac{978.41}{10} = 97.841$$

Figure 11.2 shows that the coupon rate is 4.25% and the trading yield or yield to maturity (YTM) is at 4.74%. The calculated market price of 97.841 or market value of $978.41 per bond is calculated using both Excel formulas and the present value of the semi-annual coupon payments using the yield as a discount rate.

	B	C	D	E	F	G	H	I	J
2	**MARKET PRICE**								
3	**USING EXCEL FORMULAS**				**USING PRESENT VALUE CALCULATIONS**				
4									
5	Settlement Date=		1/15/2019		**# Pmts**	**Coupon Dates**	**Coupon Payment (CP)**	**Present Value of (CP)**	
6	Maturity Date=		1/15/2024		0	1/15/2019			
7	Coupon Rate=		4.250%		1	7/15/2019	21.25	20.76	=+H7/((1+$D$8/2)^F7)
8	**Yield to Maturity=**		**4.740%**		2	1/15/2020	21.25	20.28	
9	Redemption value %=		100		3	7/15/2020	21.25	19.81	
10	Coupon Pmts per year=		2		4	1/15/2021	21.25	19.35	
11					5	7/15/2021	21.25	18.90	
12	**Market Price (% Par)**		**97.841**		6	1/15/2022	21.25	18.46	
13					7	7/15/2022	21.25	18.04	
14			=PRICE(D5,D6,D7,D8,D9,D10)		8	1/15/2023	21.25	17.62	
15			=PRICE(SD,MD,CR,YTM,R,F)		9	7/15/2023	21.25	17.21	
16					**10**	**1/15/2024**	**1,021.25**	**807.99**	
17									
18				=+$D$7/2*1000+1000			Market Value =	978.41	=SUM(I7:I16)
19							**Market Price =**	**97.841**	
20									

Figure 11.2

[Insert Figure 11.2]

The reasons bond prices move up or down in the secondary market after the original issuance could be based on the following:

Change of risk-free rate: Movement of the risk-free rate such as the treasury rate after the federal government increases or decreases the fed funds rate can affect bonds' secondary market value. If the risk-free rate moves up as a result of the increasing rates, the risk premium between the risk-free rate and the fixed rate squeezes. As a result, if someone is looking to buy a bond, the rate hike/discount will be priced into the bond's bid price to get the same premium. He or she will therefore be buying at a discount to make up for the shortfall. All new issuances are priced off the treasury rate and set until maturity. The sensitivity of interest rates is one of the most important tools used by analysts to value bonds (discussed in detail later). **Rating downgrade/upgrade**: Any rating agency action (upgrade or downgrade) will almost always affect the bond's price. The downgrade of a bond's rating by an agency, let's assume from BB to BB-, will also negatively affect the bond's price. The market prices on bonds shift from that of BB to BB- and thus demand a higher coupon rate. The discount price of such a bond is calculated so that the rate of return or yield expectation of the buyer will be in line with a BB- rating bond. The relationship between yield and market price will be discussed in the valuation section of this chapter. **Refinancing**: The market price of bonds will be affected up or down, if for example the company announces an early retirement or early redemption of bonds prior to maturity. A few relevant scenarios include a merger and acquisition announcement that will trigger the refinancing of the existing bonds. Another example is an unexpected upgrade of bonds' rating, attracting the company to refinance the debt securities with a lower coupon payment. Also, if the bonds are cleared to be refinanced after the bond call period is over, which means they come with an "early repayment penalty," it will be enticing for the company to take advantage of favorable markets and replace the bonds with newer, cheaper ones.

3. **Invoice price (dirty price)**: The invoice price or "dirty price" is the total price of the bond including the market price and accrued interest. This is the amount that you would pay or receive if you purchase or sell the bond. Basically, the invoice price is equal to the market price (discussed previously) plus the accrued interest (discussed later). An example shown in figure 11.3 shows the calculation of the invoice price. Corporate bonds (and municipal bonds) are based on a 360-day year when calculating the accrued

interest. In other words, every month has 30 days (day-count basis)—even February has 30 days when calculating the accrued interest. Figure 11.3 shows that the market price of the bond is 98.50 or $985.00. The 7.5% F&A corporate bond will pay $37.50 (7.5%/2 x $1,000) in interest on February 28 and August 31 every year. Another important input item that is needed for calculating the days since the last coupon payment is the settlement date—the date that the investor settles or owns the bond. The "regular way trade" (per SEC definition) is T+3 business days (trade day + 3 days) to calculate the settlement day. In this example in figure 11.3, since the trade was executed on Thursday, January 17, the settlement day will be on the following Tuesday, January 22 (T+3 business days + 2 weekend days). The days since the last coupon payment is calculated at 142 days (30 days in September + 30 days is October + 30 days in November + 30 days in December + 17 days in January through the trade days + 5 days = 142 days). This means that the investor who bought the bonds on January 17 and owned them on January 22 needs to pay back accrued interest of $29.50 representing 142 days that he/she did not own. That is 142 days out of 180 days between two coupon payments of $37.50. The $29.50 accrued interest is calculated as 142/180 x $40 = $29.50. The invoice price is calculated $1,042.58, calculated as $985.00 + $29.50 = $1,014.58.

MARKET PRICE / INVOICE PRICE

Manual Example:

Bought (Traded) F&A the 7.50% Corporate Bond at 98.50 on Thursday, January 17, 2019

INPUT

Trading Date	Thursday, January 17, 2019
Settlement Date (T+3 Business Days)	Tuesday, January 22, 2019
Market Price	98.50
Coupon Rate	7.500%
Coupon Dates	F&A (Feb 28 and Aug 31)
Semi-Annual Coupon Payment	$37.50
Face Value	$1,000
Accrued Basis	360 Days

OUTPUT

Market Price Paid	$985.00	$98.50 x 10
Accrued Expenses	$29.58	37.50 x (142 / 180) = $29.58
Invoice Price	$1,014.58	

Total Days	142

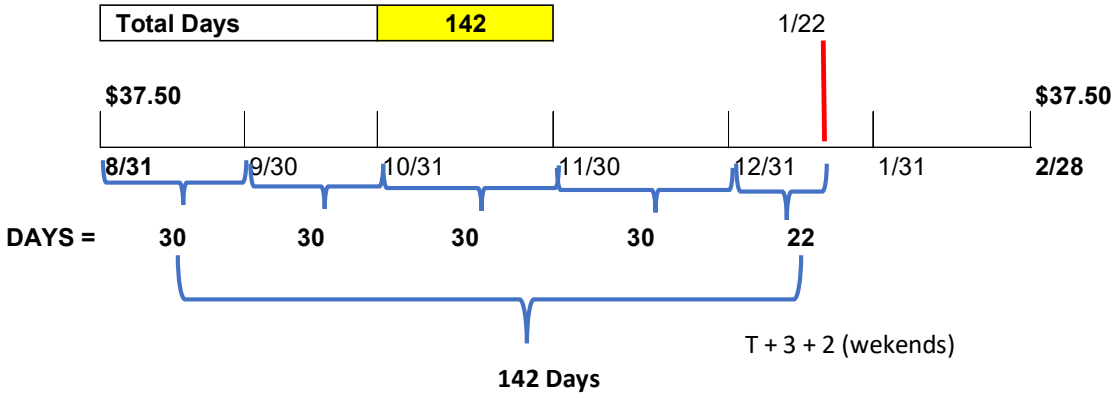

Figure 11.3

[Insert Figure 11.3]

Accrued interest can also be calculated using Excel formulas, shown in Figure 11.4.

	B	C	D		
2	**MARKET PRICE & INVOICE PRICE CALCULATION**				
3					
4	**CALCULATING THE PRICE**				
5	Settlement Date=		3/15/2015		
6	Maturity Date=		1/15/2025		
7	Coupon Rate=		4.250%		
8	**Yield to Maturity=**		**4.740%**		
9	Redemption value %=		100		
10	Coupon Pmts per year=		2		
11					
12	**Market Price =**		**96.179**		=PRICE(D5,D6,D7,D8,D9,D10
13					
14	**Market Value =**		**$ 961.79**		=+D12*10
15					
16	Day since last coupon=		60		=COUPDAYBS(D5,D6,D10,0)
17	Days in coupon period=		180		=COUPDAYS(D5,D6,D10,0)
18	Accrued Interest=		$ 7.08		=(D16/D17)*D7*1000/2
19					
20	**Invoice Price=**		**$ 968.87**		=+D18+D14
21					
					Figure 11.4

[Insert Figure 11.4]

4. **Redemption price**: The redemption price represents the bond repayment that the issuer gives to the investor on, usually, the date of maturity. The redemption is expressed as percentage of the face value of the bond. Most term bonds have a redemption price of 100 at maturity, which means that the issuer pays 100% of $1,000 for each bond. If the issuer decides to pay the bond early, assuming there are no early repayment penalties (call provisions), the redemption price is 100 or 100% of $1,000 bond. Zero-coupon bonds (explained later) carry no coupon payments and are structured so that the initial price starts priced at a discount, depending on the deferred coupon rate, and reaches a redemption of 100.

5. **Call price/call premium**: Some indentures (bond agreements) are structured to have call provisions. These provisions allow the issuer to demand the bondholder sell the bonds back to the issuer usually for its face value, plus a set percentage as a "penalty" for early retirement. For example, for an indenture with a call price of 105 if the bonds are repaid or "called" within 2 years from issuance, the redemption price will then be 105% of face value, or $1,050 for each bond**. Depending on how the terms are structured, that premium may decrease as the bond matures.** A typical high-yield bond is structured to have 105, 104, 103,1 02, 101, and 100 call prices if the issuer repays the bonds in the first, second, third, fourth, fifth, and sixth year from issuance, respectively. These arrangements are made either by design by the investor to discourage the issuer from early repayment because of hefty "penalties" or pushed by the issuer to have more flexibility of repayment on the debt. Some bonds are non-callable for a period of time, meaning the issuer cannot refinance the bonds for a certain duration unless he or she pays for all the future interest owed (make-whole provision). Once a bond has been called, the issuer has no legal obligation to make any interest payments after the call date.

6. **Original issuance discount (OID)**: An original issue discount (OID) is the percentage discount from par value on the issuance date, hence the original issue discount. **It is the difference between the stated**

redemption price of 100 and the actual issue price, basically representing the upfront fee. For example, if the OID is set at 98, the difference of 2 points from the face value (100 - 98) represents 2% of fees or $20 per bond to the investor as he or she will receive a redemption price of 100 or $1,000 plus the paid coupon rate (interest) that is set based on the $1,000. The OID going to the secondary market sets the secondary price 1 day before it trades up or down from there. A typical press announcement will say that "on day one the bond is trading above the OID level." The OID that is set in the primary market is part of the overall pricing of the bond. A bond that has an OID below a 100 when issued, by definition, will come with a bond yield higher than the coupon or nominal rate. For example, an 8% bond issued with a 98 OID will have an opening yield of 8.163% (annual coupon payment/market price = $80 / 980 = 0.08163 = 8.163%). Current yield is discussed later in the chapter.

Bond Interest and Yields Concepts

1. **Nominal yield (coupon rate)**: **This is the contractual interest rate (typically a fixed rate) that the issuer needs to pay the bond holder until the bonds mature or gets repaid.** For example, an 8% bond pays $80 per year (8% x $1,000) per bond or $40 every 6 months (typically, bonds pay on a semi-annual basis).

2. **Accrued interest**: **This is the interest payment owed by the buyer and earned by the seller if the settlement day (the day the investor owns the bond) is between coupon.** Figure 11.2 shows the calculation of the accrued interest of $29.50. In Figure 11.2 shows an example of a 7.5% F&A corporate bond that pays $37.50 (7.5%/2 x $1,000) on February 28 and August 31 every year. Another important input item that is needed for calculating the days since the last coupon payment is the settlement date—the date that the investor settles or owns the bond. The "regular way trade" (per SEC definition) is T+3 business days (trade day + 3 days) to calculate the settlement day. In this example, in figure 11.2 since the trade was executed on Thursday, January 17, the settlement day will be on the following Tuesday, January 22 (T+3 business days + 2 weekend days). The days since the last coupon payment is calculated to be 142 days (30 days in September + 30 days is October + 30 days in November + 30 days in December + 17 days in January through the trade days + 5 days = 142 days). This means that the investor who bought the bonds on January 17 and owns them on January 22 needs to pay back accrued interest of $29.50, representing 142 days that he or she did not own the bond. Therefore, with 142 days out of 180 days being the accrued period between two coupon payments of $37.50, the $29.50 of accrued interest is calculated as 142/180 x $40 = $29.50. Accrued interest can also be calculated using Excel formulas. Figure 11.4 shows the formulas for calculating the accrued interest on a different example.

3. **Yield to maturity (YTM)**: This is the interest rate that is equal to the present value of a bond's cash flow to its current price. YTM assumes that the bond will be held until maturity and that all coupon payments representing the cash flows of the bond investment will be reinvested at a rate equal to the yield to maturity, though the formula for YTM is complicated to measure and therefore most analysts use Excel (shown in figure 11.5); however, the following is the rule of thumb method used in the FINRA license exams:

$$\frac{\text{Annual coupon or interest payment } \pm \left[\frac{\text{Discount or premium}}{\text{Years to maturity}}\right]}{\text{Average price of bonds}}$$

For example, using Figure 11.5 input numbers, the annual coupon payment is $42.50 (4.25% x $1000); the discount is $38.21 (1,000 – 961.79); estimated years to maturity is 7 years (1/15/2018 today and 1/15/2025 is maturity); and the average price of the bonds is between $1,000 and $961.79 since issuance. Then, the rule of thumb yield to maturity is calculated as follows:

$$\frac{42.50 + \left[\frac{38.21}{7}\right]}{(961.79 + 1{,}000)/2} = \frac{42.50 + 5.46}{980.90} = 0.04889 = 4.9\%$$

Please note that the discount price amount (1,000 – 961.79) is added to the coupon payment on the numerator. If the bond is trading at a premium, then premium price amount is subtracted from the coupon payment.

Figure 11.5 shows an example of calculating the yield given the market price by using both bond yield Excel formulas and the internal rate of return methods.

	B	C	D	E	F	G	H	I
2								
3	**Yield to Maturity Calculation**							
4								
5	**CALCULATING THE YTM**					**# pmts**	**Remaining Dates**	**Cash Flow**
6	Settlement Date (SD) =		**1/15/2018**					
7	Maturity Date (MD) =		1/15/2025			0		(961.79)
8	Coupon Rate (CR) =		4.250%			1	7/15/2018	21.25
9	**Market Price (MP) =**		**96.179**			2	1/15/2019	21.25
10	Redemption value % (R) =		100			3	7/15/2019	21.25
11	Coupon Pmts per year (Frequency (F) =		2			4	1/15/2020	21.25
12						5	7/15/2020	21.25
13	**Yield to Maturity (YTM) =**		**4.902%**	**=YIELD(D6,D7,D8,D9,D10,D11)**		6	1/15/2021	21.25
14				**= YIELD (SD,MD,CR,MP,R,F)**		7	7/15/2021	21.25
15						8	1/15/2022	21.25
16						9	7/15/2022	21.25
17						10	1/15/2023	21.25
18						11	7/15/2023	21.25
19						12	1/15/2024	21.25
20						13	7/15/2024	21.25
21						14	1/15/2025	1,021.25
22								
23							**IRR =**	**4.902%**
24								**=IRR(I7:I21)*2**
25								
26								Figure 11.5
27								

[Insert Figure 11.5]

4. **Yield to call (YTC)**: **This is the yield on a bond assuming the bond is redeemed by the issuer at the first call date.** Yield to call differs from yield to maturity in that yield to call uses a bond's call date as the final maturity date (most often, the first call date). Figure 11.6 shows a yield to call calculation using both the Excel formulas and internal rate of return method (IRR). The call redemption prices shown are 105,104, 103, 102, 101 for repayment of 1, 2, 3, 4, and 5 years from maturity.

	B	C	D	E	F	G	H	I	J	K	L
2	**YIELD TO MAURITY (YTM), YIELD TO CALL (YTC), YIELD TO WORSE (YTW) and CURRENT YIELD (CY)**										
3	**EXCEL FORMULAS**										
4				**YTM**			**YTC1**	**YTC2**	**YTC3**	**YTC4**	**YTC5**
5	Issuance Date =			1/16/2017			1/16/2017	1/16/2017	1/16/2017	1/16/2017	1/16/2017
6	Trading Date =			Wednesday, July 11, 2018			7/11/2018	7/11/2018	7/11/2018	7/11/2018	7/11/2018
7											
8	**Settlement Date (T+3) (SD)**			Monday, July 16, 2018			**7/16/2018**	**7/16/2018**	**7/16/2018**	**7/16/2018**	**7/16/2018**
9	**Maturity Date / Call Date (MD)**			**1/16/2027**			**1/16/2018**	**1/16/2019**	**1/16/2020**	**1/16/2021**	**1/16/2022**
10	**Coupon Rate (CR)**			**8.00%**			**8.00%**	**8.00%**	**8.00%**	**8.00%**	**8.00%**
11	**Market Price (MP)**			**98.50**			**98.50**	**98.50**	**98.50**	**98.50**	**98.50**
12	**Redemption (Final payment % of Par) (R)**			**100.00**			**105.00**	**104.00**	**103.00**	**102.00**	**101.00**
13	**Frequency (payments per year) (F)**			**2**			**2**	**2**	**2**	**2**	**2**
14											
15	**Call Provision**						105.00	104.00	103.00	102.00	101.00
16											
17			**YTM=**	**8.249%**		**YTC=**	**NA**	**19.289%**	**11.006%**	**9.415%**	**8.757%**
18											
19			**YTW=**	**8.249%**		**CY=**	**8.1218%**				
20									**=YIELD(J9,J9,J11,J12,J13)**		
21	**Face Value**			**$1,000**					**=YIELD(SD,MD,CR,MP,R,F)**		
22	**Coupon Payment $**			**$40**							
23	**Years (Term)**			**10**	**Years**						
24											
25	**INTERNAL RATE OR RETURN METHOD**										
26											
27		**# Pmts**	**Coupon Dates**	**YTM**			**YTC1**	**YTC2**	**YTC3**	**YTC4**	**YTC5**
28				**(985.00)**				**(985.00)**	**(985.00)**	**(985.00)**	**(985.00)**
29		1	**1/16/2019**	40.00				**1,080.00**	40.00	40.00	40.00
30		2	7/16/2019	40.00					40.00	40.00	40.00
31		3	1/16/2020	40.00					**1,070.00**	40.00	40.00
32		4	7/16/2020	40.00						40.00	40.00
33		5	1/16/2021	40.00						40.00	40.00
34		6	7/16/2021	40.00						**1,060.00**	40.00
35		7	1/16/2022	40.00							40.00
36		8	7/16/2022	40.00			**=+$E$10/$E$13*$E$21+K12*10**				**1,050.00**
37		9	1/16/2023	40.00							
38		10	7/16/2023	40.00				**Payment $40**			
39		11	1/16/2024	40.00				**Redemption $1020**			
40		12	7/16/2024	40.00							
41		13	1/16/2025	40.00							
42		14	7/16/2025	40.00							
43		15	1/16/2026	40.00							
44		16	7/16/2026	40.00							
45		17	1/16/2027	1,040.00							
46	**IRR =**			**8.249%**			**N/A**	**19.289%**	**11.006%**	**9.177%**	**8.666%**
47				**=IRR(E28:E45)*2**					**=IRR(I28:I45)*2**		

Figure 11.6

[Insert Figure 11.6]

5. **Yield to worst (YTW)**: After calculating the YTM and YTC, the YTW represents the lowest yield generated between the YTM and the YTC. Figure 11.6 shows that the yield to worse is 8.249%, representing the lowest possible yield. (Please note that the current yield of 8.1218% should not be included)

6. **Current yield (CY): This measures a quick annual rate of return for the investor who is planning to buy the bond in the secondary market**. The calculation is same as the holding period return (HPR), discussed in earlier chapters, which equals the expected cash flows from the investment divided by the initial investment (CF/I). The current yield (CY) formula is as follows:

$$\text{Current bond yield} = \frac{\text{Annual coupon or interest payment}}{\text{Market price}}$$

Figure 11.6 shows a $1,000 bond that is selling for $985 and paying an 8% coupon rate. The current yield is calculated as follows:

$$\text{Current bond yield} = \frac{\$80.00}{\$985.00} = 0.08122 = 8.122\%$$

Bond Dates and General Timing Concepts

1. **Issuance date**: This is the day the bonds get issued in the primary market and set the coupon payment dates on a semi-annul basis thereafter. Using the example in Figure 11.6, showing that the issuance date is January 16, 2017, the coupon payments are paid on January 16 and July 16 every year until maturity. The maturity day is also set. In this example, this a 10-year bond, so it matures exactly 10 years from January 16, 2017 with the maturity date shown in figure 11.4 of January 16, 2027. On issuance day, the company receives the money from the investors (net of fees or OID) and the bonds are free to trade in the secondary market.

2. **Maturity date**: This is the last day, contractually, that the bonds come due. If the bond is structured as a term bond (all of the principal payment is paid on the last day) paid on maturity day, the issuer pays the last coupon payment and the redemption price—typically the face value of $1,000 per bond or redemption of 100.

3. **Coupon dates**: Coupon payments are the dates that the issuer, contractually, needs to make the coupon payments. Typical corporate bonds are paid semi-annually, and the first coupon date is set at exactly 6 months from date of issuance. All future payments are set to be every 6 months thereafter until maturity. In Figure 11.6 the coupon dates are January 16 and July 16. Most bond desks will use the abbreviation J&J16 to indicate that the coupon payments are paid on January 16 and July 16. Coupon payment abbreviations are J&J for January and July, F&A for February and August, M&S for March and September, A&O for April and October, M&N for May and November, and J&D for June and December.

4. **Call dates**: These dates that are set contractually are the optional "maturity dates" that the issuer can call the bonds or repay at a set call price. Figure 11.6 shows that the five call dates are set 1 year to 5 years from the issuance at 1/16/2018, 1/16/2019, 1/16/2020, 1/16/2021, 1/16/2022. If the company calls the bonds on or before those dates the redemption prices are 105, 104, 103, 102, and 101, respectively.

5. **Trading day**: This is the day the investor buys or sells the bonds at the market price.

6. **Settlement day**: This is the day that the investor officially owns the bonds after he or she purchases them, typically 3 days before settlement. Typically, the "regular way" settlement is T+3, which means the investor buys or sells the bonds on trade day (T) and settles in 3 business days. Please note for a trade that happens on a Wednesday, Thursday, or Friday, the settlement is 3 business day later or 5 calender days. Also, it is important to know the holidays before calculating the settlement day. As mentioned, the settlement day is the day the investor takes possession of the bond (the bonds are delivered) and is therefore entitled to receive the next coupon payment as well as the principal repayment on the date of maturity. The coupon repayment portion since the last coupon date that is paid back to the previous owner is calculated by number of days during the period at a pro-rated amount for these days, called accrued interest.

7. **Day-count basis**: These are the number of days since the last coupon payment, and they are used as the basis to calculate the accrued interest, which will be part of the invoice price. Figure 11.3 shows that there are 142 days since the last coupon that the new investor needs to pay accrued interest on back to the previous investor.

Bond Payment Concepts

1. **Coupon payments**: These are the contractual payments that the issuer must pay to the investor, typically every 6 months. The annual coupon payment is calculated by taking the interest rate times the face value of the bond ($1,000). For example, an 8% bond pays $80 per year (8% x $1,000) or $40 every 6 months.

2. **Frequency of payments**: This is the number of times the coupon payment is paid per year. Most bond coupons are paid on a semi-annual basis with a frequency (F) of 2. For annually the F is 1, quarterly is 4, monthly is 12, and so on.

3. **Principal payments**: This refers to the face value of the bond, which is typically $1,000 per bond. The principal payment, which is different than the coupon or interest payment, can be paid back based on the structure of the bond as follows:

    - Term bond, the most popular, refers to the bond that pays all its principal amount at maturity. For example, for a 5-year bond the principal payments for years 1–5 are 0, 0, 0, 0, 1000.
    - Serial bond refers to the bond that pays all its principal amount equally across maturity. For example, for a 5-year bond the principal payments for years 1–5 are 200, 200, 200, 200, 200.
    - Bullet bond refers to the bond that pays a partial amount of the principal upfront and the balance at maturity. For example, for a 5-year bond the principal payments for years 1–5 are 50, 50, 50, 50, 800.

Bond Investment Valuation Concepts

Bond analysis lives by the fundamental concept that the value of the bonds in the secondary market go up and down based on the return expectation for the investor looking to buy these bonds. The investor knows that this type of security includes a contractual payment that the issuer needs to make every 6 months. The question for an investor who is looking to buy such a bond is to assess if the fixed payment (coupon payment) is enough to justify the risk. If it's not, then investors will be bidding for the bond at a discount to make up that shortfall expectation. Therefore, the expected return or yield affects the value of the bonds. Figure 11.7 shows the inverse relationship between bond values and yield.

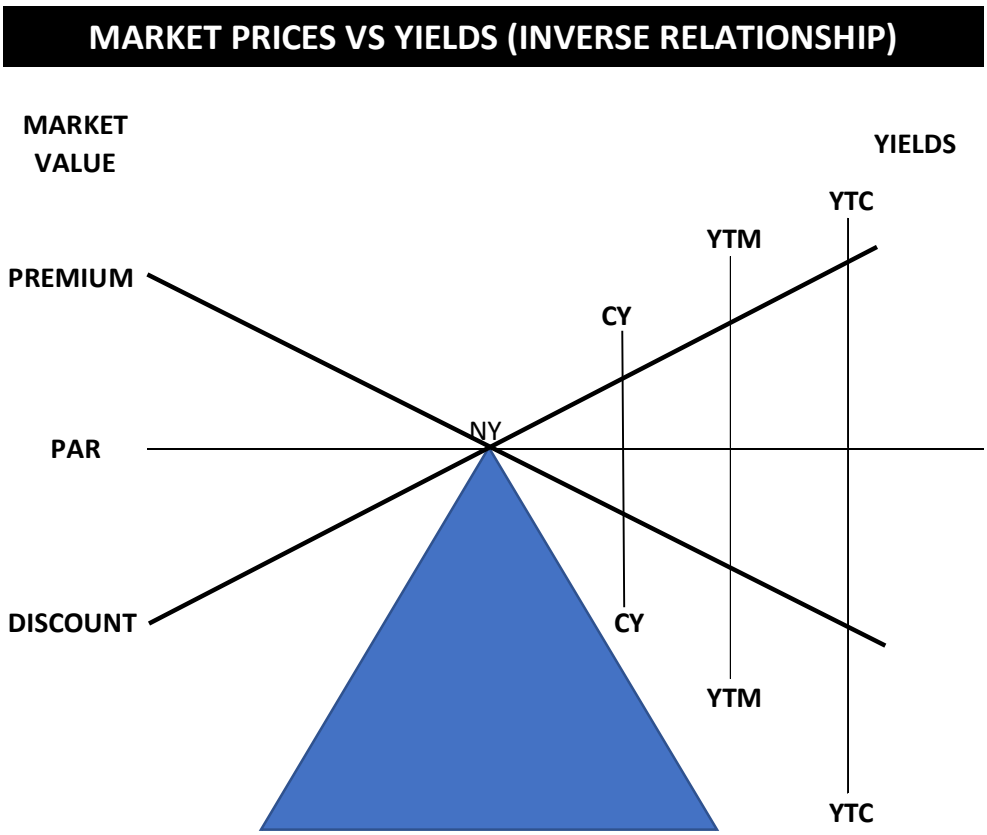

Figure 11.7

[Insert Figure 11.7]

Bond price calculation: See the description of the **market value** and how is derived. The bond price or market price is the quoted trading price expressed as percentage of market value. In Figure 11.4 the market price is calculated at 96.179, representing 96.179% of the face value of $1,000 and calculating the market value at $961.79. The formula to derive to a bond price or market price (MP) is as follows:

$$\text{MV} = \sum_1^n \frac{\text{CP}}{(1+\text{YTM})^n} + \frac{\$1{,}000}{(1+\text{YTM})^n} \text{ and } \text{MP} = \frac{\text{MV}}{10}$$

where MV is the market value of the bond, CP is the coupon payment, YTM is the yield to maturity, and n is the number of years remaining until maturity. The market price (MP) or the trading price can be calculated by dividing the market value of the bonds by a factor of 10.

Duration (D) calculation: This is a measurement the price sensitivity of the bond and/or bond funds to changes with interest rates. They are two types of duration measurement:

- The **Macaulay duration**, expressed in years, identifies how many years it will take to recover the initial investment (market value) by calculating the weighted average of each present value of future coupon payments using the yield as a discount rate times the payment year. The formula to calculate the Macaulay duration is as follows:

$$\text{Dm} = \frac{\sum_1^n \frac{\text{CF}}{(1+y)^t} \cdot t}{\text{MV}}$$

Where Dm is the Macaulay duration, t is the time period, CF is the cash flow payment or the coupon payment, y is the periodic yield, n is the number is periods, and MV is the market value of the bond (market price x 10).

- The **modified duration**: This duration, expressed in percentages, measures the average percentage of movement of the bond price for every 1% movement of the interest rate. For example, the price of a bond with a duration of 5 would be expected to move 5% for every 1% move in interest rates. The formula for calculating the modified duration is as follows:

$$\text{Modified Duration} = \frac{\text{Dm}}{1 + \frac{\text{y}}{\text{n}}}$$

Where Dm is the Macaulay duration, y is the periodic yield, and n is the number is periods.

- **Convexity (C) calculation**: Like the modified duration, convexity is a further measurement of the relationship between the value of the bond and a movement of interest rates. It also measures the sensitivity of the bond price to 1% movement of the interest rates, but it's calculated on non-linear relationships. Duration can be a good measure of how bond prices may be affected due to sudden fluctuations in interest rates. Nevertheless, the relationship between bond prices and yields has more of a sloped or convex relationship. It is represented as a derivative to the duration. The formula for calculating the convexity is as follows:

$$\text{Convexity} = \frac{\frac{1}{(1+\text{y})^2} \sum_1^{\text{n}} \frac{\text{CF}}{(1+\text{y})^{\text{t}}} (\text{t}^2 - \text{t})}{\text{MV} \cdot \text{f}^2}$$

Where y is the periodic yield, t is the time period, CF is the cash flow payment or the coupon payment, n is the number is periods, and f is the frequency of payments per year.

Figure 11.8 shows the calculation of all three including market price/market value, duration, and convexity.

	B	C	D	E	F	G	H	I	J	K	L
2	**BOND PRICE, DURATION & CONVEXITY**										
3	**Sensitivity to interest rate movements**										
4											
5	Face Value	1,000									
6	Coupon Rate	8.00%									
7	Life in Years	5									
8	Yield	10.00%									
9	Frequency	2									
10	**Bond Price**	$922.78	=-PV(E9/E10,E8*E10,E7*E6/E10,E6)								
11											
12	**Macaulay Duration**	4.18									
13											
14	Modified Duration	4.1%	=+E13/(1+E9/E8)/100								
15											
16	**Convexity**	17.83	1.93%	=+E17/E11							
17											
18	**Period**	**Cash Flow**	**PV Cash Flow**			**Weighted**	**Duration Calc**		**Factor years**	**Convexity Calc**	
19	0	($922.78)									
20	1	40.00	38.10	=+C21/(1+($E$9/2))^B21		4.128%	0.04128	=+F21*B21	2.000	76.19	=+I21*D21
21	2	40.00	36.28			3.932%	0.07863		6.000	217.69	
22	3	40.00	34.55			3.744%	0.11233	=+B21+B21^2	12.000	414.64	
23	4	40.00	32.91			3.566%	0.14265		20.000	658.16	
24	5	40.00	31.34			3.396%	0.16982		30.000	940.23	
25	6	40.00	29.85			3.235%	0.19408		42.000	1,253.64	
26	7	40.00	28.43			3.081%	0.21564		56.000	1,591.93	
27	8	40.00	27.07			2.934%	0.23471		72.000	1,949.30	
28	9	40.00	25.78			2.794%	0.25148		90.000	2,320.59	
29	10	1,040.00	638.47			69.190%	6.91896		110.000	70,231.68	
30						100.000%	8.35959	=SUM(G21:G30)		79,654.05	=SUM(J20:J30)
31											
32		**PRICE**	922.78	=SUM(D20:D30)		**DURATION**	4.18	=+G31/2	**CONVEXITY**	17.83	=+((J31/((1+E9)^2))/(D33*E10^2))
33											

Figure 11.8

[Insert Figure 11.8]

Case Studies and Practice Cases

To access the Excel spreadsheet applications used in this chapter go to www.ProfessorDrou.com under "Textbook Spreadsheets" under "Chapter 11 Case Studies and Practice Cases."