Chapter 5: How to Value Bonds and Stocks

5.1 The present value of any pure discount bond is its face value discounted back to the present.

a. PV $= F / (1+r)^{10}$
$= \$1,000 / (1.05)^{10}$
$=$ **\$613.91**

b. PV $= \$1,000 / (1.10)^{10}$
$=$ **\$385.54**

c. PV $= \$1,000 / (1.15)^{10}$
$=$ **\$247.19**

5.2 First, find the amount of the semiannual coupon payment.

Semiannual Coupon Payment = Annual Coupon Payment / 2
$= (0.08 \times \$1,000) / 2$
$= \$40$

a. Since the stated annual interest rate is compounded semiannually, simply divide this rate by two in order to calculate the semiannual interest rate.

Semiannual Interest Rate $= 0.08 / 2$
$= 0.04$

The bond has 40 coupon payments (=20 years × 2 payments per year). Apply the annuity formula to calculate the PV of the 40 coupon payments. In addition, the \$1,000 payment at maturity must be discounted back 40 periods.

P $= C\, A^{T}_{r} + F / (1+r)^{40}$
$= \$40\, A^{40}_{0.04} + \$1,000 / (1.04)^{40}$
$=$ **\$1,000**

The price of the bond is \$1,000. Notice that whenever the coupon rate and the market rate are the same, the bond is priced at par. That is, its market value is equal to its face value.

b. Semiannual Interest Rate $= 0.10 / 2$
$= 0.05$

P $= \$40\, A^{40}_{0.05} + \$1,000 / (1.05)^{40}$
$=$ **\$828.41**

The price of the bond is \$828.41. Notice that whenever the coupon rate is below the market rate, the bond is priced below par.

c. Semiannual Interest Rate $= 0.06 / 2$
$= 0.03$

P $= \$40\, A^{40}_{0.03} + \$1,000 / (1.03)^{40}$
$=$ **\$1,231.15**

The price of the bond is \$1,231.15. Notice that whenever the coupon rate is above the market rate, the bond is priced above par.

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5.4 First, calculate the semiannual interest rate.

Semiannual Interest Rate $= (1+EAY)^{1/T} - 1$
$= (1.10)^{1/2} - 1$
$= 0.04881$

Next, find the semiannual coupon payment.

Semiannual Coupon Payment $= (0.08 \times \$1{,}000) / 2$
$= \$40$

The bond has 40 payments (=20 years × 2 payments per year). Apply the annuity formula to find the PV of the coupon payments. In addition, discount the $1,000 payment at maturity back 40 periods. The appropriate discount rate is the semiannual interest rate.

$$\begin{aligned} P &= C\,A^{T}_{r} + F / (1+r)^{40} \\ &= \$40\,A^{40}_{0.04881} + \$1{,}000 / (1.04881)^{40} \\ &= \mathbf{\$846.33} \end{aligned}$$

The price of the bond is $846.33.

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5.9 Set the price of the bond equal to the PV of its cash flows, discounted at the yield to maturity, *r*. Solve for *r*.

a. P $= C\, A^{T}_{r} + F / (1+r)^{20}$

$1,200 $= \$80\, A^{20}_{r} + \$1{,}000 / (1+r)^{20}$

r $= \mathbf{0.0622}$

The yield to maturity is 6.22 percent.

b. $950 $= \$80\, A^{10}_{r} + \$1{,}000 / (1+r)^{10}$

r $= \mathbf{0.0877}$

The yield to maturity is 8.77 percent.

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5.11 a. **True.** The bond with the shortest maturity is the ATT 5 1/8, which matures in 2003. Its closing price is 100, or 100 percent of the $1,000 face value.

b. **True.** The coupon rate of the bond maturing in 2018 is nine percent. The coupon payment is $90 (=$1,000 × 0.09).

c. **True.** The price of the bond on February 10, 2002 was 107 3/8. Since that price marked a 1/8 decline from the day before, the price on February 9, 2002 was 107 4/8, or $1,075.

d. **False.** The current yield is the annual coupon payment divided by the price of the bond. For the AT&T bond maturing in 2002, the current yield is 6.84 percent (=$71.25 / $1,041.25).

e. **True.** Since the bond is priced at a premium, the coupon rate must be higher than the current yield to maturity.

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5.13 The price of a share of stock is the PV of its dividend payments. Since a dividend of $2 was paid yesterday, the next dividend payment, to be received one year from today, will be $2.16 (=$2 × 1.08). The dividend for each of the two successive years will also grow at eight percent.

$$\begin{aligned} PV(\text{Year } 1-3) &= Div_1 / (1+r) + Div_2 / (1+r)^2 + Div_3 / (1+r)^3 \\ &= \$2.16 / (1.12) + \$2.33 / (1.12)^2 + \$2.52 / (1.12)^3 \\ &= \$5.58 \end{aligned}$$

The dividend at year 4 is $2.62 since the $2 dividend that occurred yesterday has grown three years at eight percent and one year at four percent [=$2 × $(1.08)^3$ × 1.04]. Applying the perpetuity formula to the dividends that begin in year 4 will generate the PV as of the end of year 3. Discount that value back three periods to find the PV as of today, year 0.

$$\begin{aligned} PV(\text{Year } 4 - \infty) &= [Div_4 / (r-g)] / (1+r)^3 \\ &= [\$2.62 / (0.12 - 0.04)] / (1.12)^3 \\ &= \$23.31 \end{aligned}$$

The price of the bond is the sum of the PVs of the first three dividend payments and the PV of the dividend payments thereafter.

$$\begin{aligned} P &= Div_1 / (1+r) + Div_2 / (1+r)^2 + Div_3 / (1+r)^3 + [Div_4 / (r-g)] / (1+r)^3 \\ &= \$2.16 / (1.12) + \$2.33 / (1.12)^2 + \$2.52 / (1.12)^3 + [\$2.62 / (0.12 - 0.04)] / (1.12)^3 \\ &= \mathbf{\$28.89} \end{aligned}$$

The price of the stock is $28.89.

5.14 a. **True.** The dividend yield is the dividend payment divided by the price of the stock.

$$\begin{aligned} \text{Dividend Yield} &= Div_1 / P_0 \\ &= \$1.8 / \$115 \\ &= \mathbf{0.0156} \end{aligned}$$

b. **False.** On February 11, 2002, the stock closed at $115, marking a $1.25 decline from the previous day's close. Thus, on February 10, 2002, the stock's closing price was $116.25.

c. **True.** The closing price of the stock was $115 on February 11, 2002.

d. **True.** Set the price-earnings ratio (P/E) of 30 equal to the stock's price (P) divided by the earnings per share (EPS). Solve for earnings.

P/E	$= P_0$ / EPS
30	= $115 / EPS
EPS	= $115 / 30
EPS	= **$3.83**

5.15 Use the growing perpetuity formula to price the stock. The first dividend payment is $1.39 (=$1.30 × 1.07). The dividend of $1.30 was paid yesterday, and thus, does not figure into today's stock price. Solve for the discount rate, *r*.

P	$= Div_1 / (r - g)$
$98.13	= $1.39 / (r – .07)
r	= **0.084**

The required return is 8.4 percent.

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5.17 a. Apply the constant-dividend growth model to find the price of the stock.

$$P = Div_1 / (r - g)$$
$$= \$2 / (0.12 - 0.05)$$
$$= \mathbf{\$28.57}$$

The price of the stock is $28.57.

b. To determine the price of the stock 10 years from today, find the PV of the stock's dividends as of year 10. The first relevant dividend is paid at year 11. That payment is equal to the original $2 dividend compounded at five percent over 10 years, $3.26 [$=(1.05)^{10} \times \$2$]. Apply the growing perpetuity formula, discounted at 12 percent and growing at five percent. Remember that the growing perpetuity formula values the cash flows as of one year prior to the first cash flow. Therefore, the result is the PV of the dividend payments as of year 10, the year at which you are valuing the stock.

$$P_{10} = Div_{11} / (r - g)$$
$$= (1.05)^{10}\ \$2 / (0.12 - 0.05)$$
$$= \mathbf{\$46.54}$$

The price of the stock in 10 years from today will be $46.54.

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5.29 a. Value the firm as a "cash cow," ignoring future projects. Apply the perpetuity formula to calculate the PV of the firm's revenues. The price per share is the PV of the revenues divided by the number of shares outstanding.

$$PV = C_1 / r$$
$$= \$100{,}000{,}000 / 0.15$$
$$= \$666{,}666{,}666.67$$

Share Price = \$666,666,666.67 / 20,000,000
= **\$33.33**

The share price, excluding future growth opportunities, is \$33.33.

b. Calculate the NPV of the growth opportunity (NPVGO). The initial cash outlay occurs today and does not need to be discounted. Discount the cash outlay in the second year back to today (year 0). Apply the perpetuity formula to find the PV of the annual earnings as of the end of year 1. Discount that value back one year to find the PV of the annual earnings as of today.

$NPVGO = C_0 + C_1 + [C_2 / r] / (1+r)^T$
= -\$15,000,000 – \$5,000,000 / 1.15 + [\$10,000,000 / 0.15] / (1.15)
= **\$38,623,188.41**

The value of the growth opportunity is \$38,623,188.41.

c. Apply the NPVGO model to calculate the price of the stock. The share price is equal to the per-share value of the firm's existing operations, plus the per-share value of growth opportunities. The earnings per share of the firm's existing operations was calculated in part (*a*) and the NPV of the growth opportunity was calculated in part (*b*). Divide the NPVGO by the number of shares to find the per-share NPVGO.

Share Price = Per-Share PV(Existing Operations) + NPVGO / (Number of Shares)
= \$33.33 + \$38,623,188.41 / 20,000,000
= **\$35.26**

The share price will be \$35.26 if the firm undertakes the investment.

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5.33. Using dividend model, price of a stock can be written as P = D/(k – g)
Or it can be written as P = E*PO/(k – g) where PO is the dividend payout ratio and denotes multiplication
Rearranging terms we get, P/E = PO/(k – g)
Substituting values 12 = .4/(k – g)
→ 1/(k – g) = 12/0.4
→ 1/(k – g) = 30

P = E*PO/(k – g)
Now substituting P = $32, PO = 40%, 1/(k – g) = 30 we get
32 = E*.4*30
→ E = 8/3

If the dividend payout ratio were 60%
P = E*PO/(k – g)
P = (8/3)*.6*30 = **$48**

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