Chapter 3

**2.** We need to find net income first. So:

Profit margin = Net income / Sales

Net income = Sales(Profit margin)

Net income = ($29,000,000)(0.08) = $2,320,000

ROA = Net income / TA = $2,320,000 / $17,500,000 = .1326 or 13.26%

To find ROE, we need to find total equity. Since TL & OE equals TA:

TA = TD + TE

TE = TA – TD

TE = $17,500,000 – 6,300,000 = $11,200,000

ROE = Net income / TE = 2,320,000 / $11,200,000 = .2071 or 20.71%

**3.** Receivables turnover = Sales / Receivables

Receivables turnover = $3,943,709 / $431,287 = 9.14 times

Days’ sales in receivables = 365 days / Receivables turnover = 365 / 9.14 = 39.92 days

The average collection period for an outstanding accounts receivable balance was 39.92 days.

**6.** Net income = Addition to RE + Dividends = $430,000 + 175,000 = $605,000

Earnings per share = NI / Shares = $605,000 / 210,000 = $2.88 per share

Dividends per share = Dividends / Shares = $175,000 / 210,000 = $0.83 per share

Book value per share = TE / Shares = $5,300,000 / 210,000 = $25.24 per share

Market-to-book ratio = Share price / BVPS = $63 / $25.24 = 2.50 times

P/E ratio = Share price / EPS = $63 / $2.88 = 21.87 times

Sales per share = Sales / Shares = $4,500,000 / 210,000 = $21.43

P/S ratio = Share price / Sales per share = $63 / $21.43 = 2.94 times

**10.** Payables turnover = COGS / Accounts payable

Payables turnover = $28,834 / $6,105 = 4.72 times

Days’ sales in payables = 365 days / Payables turnover

Days’ sales in payables = 365 / 4.72 = 77.28 days

The company left its bills to suppliers outstanding for 77.25 days on average. A large value for this ratio could imply that either (1) the company is having liquidity problems, making it difficult to pay off its short-term obligations, or (2) that the company has successfully negotiated lenient credit terms from its suppliers.

**18.** This is a multi-step problem involving several ratios. The ratios given are all part of the DuPont Identity. The only DuPont Identity ratio not given is the profit margin. If we know the profit margin, we can find the net income since sales are given. So, we begin with the DuPont Identity:

ROE = 0.15 = (PM)(TAT)(EM) = (PM)(S / TA)(1 + D/E)

Solving the DuPont Identity for profit margin, we get:

PM = [(ROE)(TA)] / [(1 + D/E)(S)]

PM = [(0.15)($3,105)] / [(1 + 1.4)( $5,726)] = .0339

Now that we have the profit margin, we can use this number and the given sales figure to solve for net income:

PM = .0339 = NI / S

NI = .0339($5,726) = $194.06

**20.** The solution to this problem requires a number of steps. First, remember that CA + NFA = TA. So, if we find the CA and the TA, we can solve for NFA. Using the numbers given for the current ratio and the current liabilities, we solve for CA:

CR = CA / CL

CA = CR(CL) = 1.25($875) = $1,093.75

To find the total assets, we must first find the total debt and equity from the information given. So, we find the sales using the profit margin:

PM = NI / Sales

NI = PM(Sales) = .095($5,870) = $549.10

We now use the net income figure as an input into ROE to find the total equity:

ROE = NI / TE

TE = NI / ROE = $549.10 / .185 = $2,968.11

Next, we need to find the long-term debt. The long-term debt ratio is:

Long-term debt ratio = 0.45 = LTD / (LTD + TE)

Inverting both sides gives:

1 / 0.45 = (LTD + TE) / LTD = 1 + (TE / LTD)

Substituting the total equity into the equation and solving for long-term debt gives the following:

2.222 = 1 + ($2,968.11 / LTD)

LTD = $2,968.11 / 1.222 = $2,428.45

Now, we can find the total debt of the company:

TD = CL + LTD = $875 + 2,428.45 = $3,303.45

And, with the total debt, we can find the TD&E, which is equal to TA:

TA = TD + TE = $3,303.45 + 2,968.11 = $6,271.56

And finally, we are ready to solve the balance sheet identity as:

NFA = TA – CA = $6,271.56 – 1,093.75 = $5,177.81

**22.** The solution requires substituting two ratios into a third ratio. Rearranging D/TA:

Firm A Firm B

D / TA = .35 D / TA = .30

(TA – E) / TA = .35 (TA – E) / TA = .30

(TA / TA) – (E / TA) = .35 (TA / TA) – (E / TA) = .30

1 – (E / TA) = .35 1 – (E / TA) = .30

E / TA = .65 E / TA = .30

E = .65(TA) E = .70 (TA)

Rearranging ROA, we find:

NI / TA = .12 NI / TA = .11

NI = .12(TA) NI = .11(TA)

Since ROE = NI / E, we can substitute the above equations into the ROE formula, which yields:

ROE = .12(TA) / .65(TA) = .12 / .65 = 18.46% ROE = .11(TA) / .70 (TA) = .11 / .70 = 15.71%

**23.** This problem requires you to work backward through the income statement. First, recognize that Net income = (1 – t)EBT. Plugging in the numbers given and solving for EBT, we get:

EBT = $13,168 / (1 – 0.34) = $19,951.52

Now, we can add interest to EBT to get EBIT as follows:

EBIT = EBT + Interest paid = $19,951.52 + 3,605 = $23,556.52

Chapter 5

**6.** To answer this question, we can use either the FV or the PV formula. Both will give the same answer since they are the inverse of each other. We will use the FV formula, that is:

FV = PV(1 + *r*)*t*

Solving for *r*, we get:

*r* = (FV / PV)1 / *t* – 1

*r* = ($290,000 / $55,000)1/18 – 1 = .0968 or 9.68%

**7.** To find the length of time for money to double, triple, etc., the present value and future value are irrelevant as long as the future value is twice the present value for doubling, three times as large for tripling, etc. To answer this question, we can use either the FV or the PV formula. Both will give the same answer since they are the inverse of each other. We will use the FV formula, that is:

FV = PV(1 + *r*)*t*

Solving for *t*, we get:

*t* = ln(FV / PV) / ln(1 + *r*)

The length of time to double your money is:

FV = $2 = $1(1.07)*t*

*t* = ln 2 / ln 1.07 = 10.24 years

The length of time to quadruple your money is:

FV = $4 = $1(1.07)*t*

*t* = ln 4 / ln 1.07 = 20.49 years

Notice that the length of time to quadruple your money is twice as long as the time needed to double your money (the difference in these answers is due to rounding). This is an important concept of time value of money.

**13.** To answer this question, we can use either the FV or the PV formula. Both will give the same answer since they are the inverse of each other. We will use the FV formula, that is:

FV = PV(1 + *r*)*t*

Solving for *r*, we get:

*r* = (FV / PV)1 / *t* – 1

*r* = ($1,260,000 / $150)1/112 – 1 = .0840 or 8.40%

To find the FV of the first prize, we use:

FV = PV(1 + *r*)*t*

FV = $1,260,000(1.0840)33 = $18,056,409.94

**16.** To answer this question, we can use either the FV or the PV formula. Both will give the same answer since they are the inverse of each other. We will use the FV formula, that is:

FV = PV(1 + *r*)*t*

Solving for *r*, we get:

*r* = (FV / PV)1 / *t* – 1

*a.* PV = $100,000 / (1 + *r*)30 = $24,099

*r* = ($100,000 / $24,099)1/30 – 1 = .0486 or 4.86%

*b.* PV = $38,260 / (1 + *r*)12 = $24,099

*r* = ($38,260 / $24,099)1/12 – 1 = .0393 or 3.93%

*c.* PV = $100,000 / (1 + *r*)18 = $38,260

*r* = ($100,000 / $38,260)1/18 – 1 = .0548 or 5.48%

**17.** To find the PV of a lump sum, we use:

PV = FV / (1 + *r)t*

PV = $170,000 / (1.12)9 = $61,303.70

**18.** To find the FV of a lump sum, we use:

FV = PV(1 + *r*)*t*

FV = $4,000(1.11)45 = $438,120.97

FV = $4,000(1.11)35 = $154,299.40

Better start early!

Chapter 6

**29.** The total interest paid by First Simple Bank is the interest rate per period times the number of periods. In other words, the interest by First Simple Bank paid over 10 years will be:

.07(10) = .7

First Complex Bank pays compound interest, so the interest paid by this bank will be the FV factor of $1, or:

(1 + *r*)10

Setting the two equal, we get:

(.07)(10) = (1 + *r*)10 – 1

*r* = 1.71/10 – 1 = .0545 or 5.45%

**31.** Here we need to find the FV of a lump sum, with a changing interest rate. We must do this problem in two parts.After the first six months, the balance will be:

FV = $5,000 [1 + (.015/12)]6 = $5,037.62

This is the balance in six months. The FV in another six months will be:

FV = $5,037.62[1 + (.18/12)]6 = $5,508.35

The problem asks for the interest accrued, so, to find the interest, we subtract the beginning balance

from the FV. The interest accrued is:

Interest = $5,508.35 – 5,000.00 = $508.35

**32.** We need to find the annuity payment in retirement. Our retirement savings ends and the retirement withdrawals begin, so the PV of the retirement withdrawals will be the FV of the retirement savings. So, we find the FV of the stock account and the FV of the bond account and add the two FVs.

Stock account: FVA = $700[{[1 + (.11/12) ]360 – 1} / (.11/12)] = $1,963,163.82

Bond account: FVA = $300[{[1 + (.06/12) ]360 – 1} / (.06/12)] = $301,354.51

So, the total amount saved at retirement is:

$1,963,163.82 + 301,354.51 = $2,264,518.33

Solving for the withdrawal amount in retirement using the PVA equation gives us:

PVA = $2,264,518.33 = $*C*[1 – {1 / [1 + (.09/12)]300} / (.09/12)]

*C* = $2,264,518.33 / 119.1616 = $19,003.763 withdrawal per month

**36.** Since we have an APR compounded monthly and an annual payment, we must first convert the interest rate to an EAR so that the compounding period is the same as the cash flows.

EAR = [1 + (.10 / 12)]12 – 1 = .104713 or 10.4713%

PVA1 = $95,000 {[1 – (1 / 1.104713)2] / .104713} = $163,839.09

PVA2 = $45,000 + $70,000{[1 – (1/1.104713)2] / .104713} = $165,723.54

You would choose the second option since it has a higher PV.

**38.** Since your salary grows at 4 percent per year, your salary next year will be:

Next year’s salary = $50,000 (1 + .04)

Next year’s salary = $52,000

This means your deposit next year will be:

Next year’s deposit = $52,000(.05)

Next year’s deposit = $2,600

Since your salary grows at 4 percent, you deposit will also grow at 4 percent. We can use the present value of a growing perpetuity equation to find the value of your deposits today. Doing so, we find:

PV = *C* {[1/(*r* – *g*)] – [1/(*r* – *g*)] × [(1 + *g*)/(1 + *r*)]*t*}

PV = $2,600{[1/(.11 – .04)] – [1/(.11 – .04)] × [(1 + .04)/(1 + .11)]40}

PV = $34,399.45

Now, we can find the future value of this lump sum in 40 years. We find:

FV = PV(1 + *r*)*t*

FV = $34,366.45(1 + .11)40

FV = $2,235,994.31

This is the value of your savings in 40 years.

**40.** Here we are given the FVA, the interest rate, and the amount of the annuity. We need to solve for the number of payments. Using the FVA equation:

FVA = $20,000 = $340[{[1 + (.06/12)]*t* – 1 } / (.06/12)]

Solving for *t*, we get:

1.005*t* = 1 + [($20,000)/($340)](.06/12)

*t* = ln 1.294118 / ln 1.005 = 51.69 payments

**42.** The amount of principal paid on the loan is the PV of the monthly payments you make. So, the present value of the $1,150 monthly payments is:

PVA = $1,150[(1 – {1 / [1 + (.0635/12)]}360) / (.0635/12)] = $184,817.42

The monthly payments of $1,150 will amount to a principal payment of $184,817.42. The amount of principal you will still owe is:

$240,000 – 184,817.42 = $55,182.58

This remaining principal amount will increase at the interest rate on the loan until the end of the loan period. So the balloon payment in 30 years, which is the FV of the remaining principal will be:

Balloon payment = $55,182.58[1 + (.0635/12)]360 = $368,936.54

**43.** We are given the total PV of all four cash flows. If we find the PV of the three cash flows we know, and

subtract them from the total PV, the amount left over must be the PV of the missing cash flow. So, the PV of the cash flows we know are:

PV of Year 1 CF: $1,700 / 1.10 = $1,545.45

PV of Year 3 CF: $2,100 / 1.103 = $1,577.76

PV of Year 4 CF: $2,800 / 1.104 = $1,912.44

So, the PV of the missing CF is:

$6,550 – 1,545.45 – 1,577.76 – 1,912.44 = $1,514.35

The question asks for the value of the cash flow in Year 2, so we must find the future value of this amount. The value of the missing CF is:

$1,514.35(1.10)2 = $1,832.36

**48.** This question is asking for the present value of an annuity, but the interest rate changes during the life of the annuity. We need to find the present value of the cash flows for the last eight years first. The PV of these cash flows is:

PVA2 = $1,500 [{1 – 1 / [1 + (.07/12)]96} / (.07/12)] = $110,021.35

Note that this is the PV of this annuity exactly seven years from today. Now we can discount this lump sum to today. The value of this cash flow today is:

PV = $110,021.35 / [1 + (.11/12)]84 = $51,120.33

Now we need to find the PV of the annuity for the first seven years. The value of these cash flows today is:

PVA1 = $1,500 [{1 – 1 / [1 + (.11/12)]84} / (.11/12)] = $87,604.36

The value of the cash flows today is the sum of these two cash flows, so:

PV = $51,120.33 + 87,604.36 = $138,724.68

**51.** To find the APR and EAR, we need to use the actual cash flows of the loan. In other words, the interest rate quoted in the problem is only relevant to determine the total interest under the terms given. The interest rate for the cash flows of the loan is:

PVA = $25,000 = $2,416.67{(1 – [1 / (1 + *r*)]12 ) / *r* }

Again, we cannot solve this equation for *r*, so we need to solve this equation on a financial calculator, using a spreadsheet, or by trial and error. Using a spreadsheet, we find:

*r* = 2.361% per month

So the APR is:

APR = 12(2.361%) = 28.33%

And the EAR is:

EAR = (1.02361)12 – 1 = .3231 or 32.31%

To answer this question, we should find the PV of both options, and compare them. Since we are purchasing the car, the lowest PV is the best option. The PV of the leasing is simply the PV of the lease payments, plus the $99. The interest rate we would use for the leasing option is the same as the interest rate of the loan. The PV of leasing is:

PV = $99 + $450{1 – [1 / (1 + .07/12)12(3)]} / (.07/12) = $14,672.91

The PV of purchasing the car is the current price of the car minus the PV of the resale price. The PV of the resale price is:

PV = $23,000 / [1 + (.07/12)]12(3) = $18,654.82

The PV of the decision to purchase is:

$32,000 – 18,654.82 = $13,345.18

In this case, it is cheaper to buy the car than leasing it since the PV of the purchase cash flows is lower. To find the breakeven resale price, we need to find the resale price that makes the PV of the two options the same. In other words, the PV of the decision to buy should be:

$32,000 – PV of resale price = $14,672.91

PV of resale price = $17,327.09

The resale price that would make the PV of the lease versus buy decision is the FV of this value, so:

Breakeven resale price = $17,327.09[1 + (.07/12)]12(3) = $21,363.01

**61.** Here we have cash flows that would have occurred in the past and cash flows that would occur in the future. We need to bring both cash flows to today. Before we calculate the value of the cash flows today, we must adjust the interest rate so we have the effective monthly interest rate. Finding the APR with monthly compounding and dividing by 12 will give us the effective monthly rate. The APR with monthly compounding is:

APR = 12[(1.08)1/12 – 1] = .0772 or 7.72%

To find the value today of the back pay from two years ago, we will find the FV of the annuity, and then find the FV of the lump sum. Doing so gives us:

FVA = ($47,000/12) [{[ 1 + (.0772/12)]12 – 1} / (.0772/12)] = $48,699.39

FV = $48,699.39(1.08) = $52,595.34

Notice we found the FV of the annuity with the effective monthly rate, and then found the FV of the lump sum with the EAR. Alternatively, we could have found the FV of the lump sum with the effective monthly rate as long as we used 12 periods. The answer would be the same either way.

Now, we need to find the value today of last year’s back pay:

FVA = ($50,000/12) [{[ 1 + (.0772/12)]12 – 1} / (.0772/12)] = $51,807.86

Next, we find the value today of the five year’s future salary:

PVA = ($55,000/12){[{1 – {1 / [1 + (.0772/12)]12(5)}] / (.0772/12)}= $227,539.14

The value today of the jury award is the sum of salaries, plus the compensation for pain and suffering, and court costs. The award should be for the amount of:

Award = $52,595.34 + 51,807.86 + 227,539.14 + 100,000 + 20,000 = $451,942.34

As the plaintiff, you would prefer a lower interest rate. In this problem, we are calculating both the PV and FV of annuities. A lower interest rate will decrease the FVA, but increase the PVA. So, by a lower interest rate, we are lowering the value of the back pay. But, we are also increasing the PV of the future salary. Since the future salary is larger and has a longer time, this is the more important cash flow to the plaintiff.

**65.** Be careful of interest rate quotations. The actual interest rate of a loan is determined by the cash flows. Here, we are told that the PV of the loan is $1,000, and the payments are $41.15 per month for three years, so the interest rate on the loan is:

PVA = $1,000 = $41.15[{1 – [1 / (1 + *r*)]36 } / *r* ]

Solving for *r* with a spreadsheet, on a financial calculator, or by trial and error, gives:

*r* = 2.30% per month

APR = 12(2.30%) = 27.61%

EAR = (1 + .0230)12 – 1 = 31.39%

It’s called add-on interest because the interest amount of the loan is added to the principal amount of the loan before the loan payments are calculated.

**66.** Here we are solving a two-step time value of money problem. Each question asks for a different possible cash flow to fund the same retirement plan. Each savings possibility has the same FV, that is, the PV of the retirement spending when your friend is ready to retire. The amount needed when your friend is ready to retire is:

PVA = $105,000{[1 – (1/1.07)20] / .07} = $1,112,371.50

This amount is the same for all three parts of this question.

*a.* If your friend makes equal annual deposits into the account, this is an annuity with the FVA equal to the amount needed in retirement. The required savings each year will be:

FVA = $1,112,371.50 = *C*[(1.0730 – 1) / .07]

*C* = $11,776.01

*b.* Here we need to find a lump sum savings amount. Using the FV for a lump sum equation, we get:

FV = $1,112,371.50 = PV(1.07)30

PV = $146,129.04

*c.* In this problem, we have a lump sum savings in addition to an annual deposit. Since we already know the value needed at retirement, we can subtract the value of the lump sum savings at retirement to find out how much your friend is short. Doing so gives us:

FV of trust fund deposit = $150,000(1.07)10 = $295,072.70

So, the amount your friend still needs at retirement is:

FV = $1,112,371.50 – 295,072.70 = $817,298.80

Using the FVA equation, and solving for the payment, we get:

$817,298.80 = *C*[(1.07 30 – 1) / .07]

*C* = $8,652.25

This is the total annual contribution, but your friend’s employer will contribute $1,500 per year, so your friend must contribute:

Friend's contribution = $8,652.25 – 1,500 = $7,152.25

Chapter 7

**3.** The price of any bond is the PV of the interest payment, plus the PV of the par value. Notice this problem assumes an annual coupon. The price of the bond will be:

P = $75({1 – [1/(1 + .0875)]10 } / .0875) + $1,000[1 / (1 + .0875)10] = $918.89

We would like to introduce shorthand notation here. Rather than write (or type, as the case may be) the entire equation for the PV of a lump sum, or the PVA equation, it is common to abbreviate the equations as:

PVIF*R,t* = 1 / (1 + *r)t*

which stands for Present Value Interest Factor

PVIFA*R,t*= ({1 – [1/(1 + *r)*]*t* } / *r* )

which stands for Present Value Interest Factor of an Annuity

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

**5.** Here we need to find the coupon rate of the bond. All we need to do is to set up the bond pricing equation and solve for the coupon payment as follows:

P = $1,045 = *C*(PVIFA7.5%,13) + $1,000(PVIF7.5%,36)

Solving for the coupon payment, we get:

*C* = $80.54

The coupon payment is the coupon rate times par value. Using this relationship, we get:

Coupon rate = $80.54 / $1,000 = .0805 or 8.05%

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

P = $1,050 = $42(PVIFA*R%*,20) + $1,000(PVIF*R%*,20)

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

*R* = 3.837%

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

YTM = 23.837% = 7.67%

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

P = *C*(PVIFA*R%*,*t*) + $1,000(PVIF*R%*,*t*)

X: P0 = $80(PVIFA6%,13) + $1,000(PVIF6%,13) = $1,177.05

P1 = $80(PVIFA6%,12) + $1,000(PVIF6%,12) = $1,167.68

P3 = $80(PVIFA6%,10) + $1,000(PVIF6%,10) = $1,147.20

P8 = $80(PVIFA6%,5) + $1,000(PVIF6%,5) = $1,084.25

P12 = $80(PVIFA6%,1) + $1,000(PVIF6%,1) = $1,018.87

P13 = $1,000

Y: P0 = $60(PVIFA8%,13) + $1,000(PVIF8%,13) = $841.92

P1 = $60(PVIFA8%,12) + $1,000(PVIF8%,12) = $849.28

P3 = $60(PVIFA8%,10) + $1,000(PVIF8%,10) = $865.80

P8 = $60(PVIFA8%,5) + $1,000(PVIF8%,5) = $920.15

P12 = $60(PVIFA8%,1) + $1,000(PVIF8%,1) = $981.48

P13 = $1,000

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

Also, notice that the price of each bond when no time is left to maturity is the par value, even though the purchaser would receive the par value plus the coupon payment immediately. This is because we calculate the clean price of the bond.

**16.** Any bond that sells at par has a YTM equal to the coupon rate. Both bonds sell at par, so the initial YTM on both bonds is the coupon rate, 9 percent. If the YTM suddenly rises to 11 percent:

PSam = $45(PVIFA5.5%,6) + $1,000(PVIF5.5%,6) = $950.04

PDave = $45(PVIFA5.5%,40) + $1,000(PVIF5.5%,40) = $839.54

The percentage change in price is calculated as:

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

ΔPSam% = ($950.04 – 1,000) / $1,000 = – 5.00%

ΔPDave% = ($839.54 – 1,000) / $1,000 = – 16.05%

If the YTM suddenly falls to 7 percent:

PSam = $45(PVIFA3.5%,6) + $1,000(PVIF3.5%,6) = $1,053.29

PDave = $45(PVIFA3.5%,40) + $1,000(PVIF3.5%,40) = $1,213.55

ΔPSam% = ($1,053.29 – 1,000) / $1,000 = + 5.33%

ΔPDave% = ($1,213.55 – 1,000) / $1,000 = + 21.36%

All else the same, the longer the maturity of a bond, the greater is its price sensitivity to changes in interest rates.

**19.** The company should set the coupon rate on its new bonds equal to the required return. The required return can be observed in the market by finding the YTM on the outstanding bonds of the company. So, the YTM on the bonds currently sold in the market is:

P = $930 = $40(PVIFA*R%*,40) + $1,000(PVIF*R%*,40)

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

*R* = 4.373%

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

YTM = 2 × 4.373% = 8.75%

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

Current yield = .0755 = $80/P0

P0 = $80/.0755 = $1,059.60

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

P = $1,059.60 = $80[(1 – (1/1.072)*t* ) / .072 ] + $1,000/1.072*t*

We can solve this equation for *t* as follows:

$1,059.60(1.072)*t* = $1,111.11(1.072)*t* – 1,111.11 + 1,000

111.11 = 51.51(1.072)*t*

2.1570 = 1.072*t*

*t* = log 2.1570 / log 1.072 = 11.06 ≈ 11 years

The bond has 11 years to maturity.

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

PM = $1,100(PVIFA3.5%,16)(PVIF3.5%,12) + $1,400(PVIFA3.5%,12)(PVIF3.5%,28) + $20,000(PVIF3.5%,40)

PM = $19,018.78

Notice that for the coupon payments of $1,400, we found the PVA for the coupon payments, and then discounted the lump sum back to today.

Bond N is a zero coupon bond with a $20,000 par value, therefore, the price of the bond is the PV of the par, or:

PN = $20,000(PVIF3.5%,40) = $5,051.45

Chapter 8

**1.** The constant dividend growth model is:

P*t* = D*t* × (1 + *g*) / (*R* – *g*)

So the price of the stock today is:

P0 = D0 (1 + *g*) / (*R* – *g*) = $1.95 (1.06) / (.11 – .06) = $41.34

The dividend at year 4 is the dividend today times the FVIF for the growth rate in dividends and four years, so:

P3 = D3 (1 + *g*) / (*R* – *g*) = D0 (1 + g)4 / (*R* – *g*) = $1.95 (1.06)4 / (.11 – .06) = $49.24

We can do the same thing to find the dividend in Year 16, which gives us the price in Year 15, so:

P15 = D15 (1 + *g*) / (*R* – *g*) = D0 (1 + g)16 / (*R* – *g*) = $1.95 (1.06)16 / (.11 – .06) = $99.07

There is another feature of the constant dividend growth model: The stock price grows at the dividend growth rate. So, if we know the stock price today, we can find the future value for any time in the future we want to calculate the stock price. In this problem, we want to know the stock price in three years, and we have already calculated the stock price today. The stock price in three years will be:

P3 = P0(1 + *g*)3 = $41.34(1 + .06)3 = $49.24

And the stock price in 15 years will be:

P15 = P0(1 + *g*)15 = $41.34(1 + .06)15 = $99.07

**5.** The required return of a stock is made up of two parts: The dividend yield and the capital gains yield. So, the required return of this stock is:

*R* = Dividend yield + Capital gains yield = .063 + .052 = .1150 or 11.50%

**7.** The price of any financial instrument is the PV of the future cash flows. The future dividends of this stock are an annuity for 11 years, so the price of the stock is the PVA, which will be:

P0 = $9.75(PVIFA10%,11) = $63.33

**8.** The price a share of preferred stock is the dividend divided by the required return. This is the same equation as the constant growth model, with a dividend growth rate of zero percent. Remember, most preferred stock pays a fixed dividend, so the growth rate is zero. Using this equation, we find the price per share of the preferred stock is:

*R* = D/P0 = $5.50/$108 = .0509 or 5.09%

**10.** This stock has a constant growth rate of dividends, but the required return changes twice. To find the value of the stock today, we will begin by finding the price of the stock at Year 6, when both the dividend growth rate and the required return are stable forever. The price of the stock in Year 6 will be the dividend in Year 7, divided by the required return minus the growth rate in dividends. So:

P6 = D6 (1 + *g*) / (*R* – *g*) = D0 (1 + *g*)7 / (*R* – *g*) = $3.50 (1.05)7 / (.10 – .05) = $98.50

Now we can find the price of the stock in Year 3. We need to find the price here since the required return changes at that time. The price of the stock in Year 3 is the PV of the dividends in Years 4, 5, and 6, plus the PV of the stock price in Year 6. The price of the stock in Year 3 is:

P3 = $3.50(1.05)4 / 1.12 + $3.50(1.05)5 / 1.122 + $3.50(1.05)6 / 1.123 + $98.50 / 1.123

P3 = $80.81

Finally, we can find the price of the stock today. The price today will be the PV of the dividends in Years 1, 2, and 3, plus the PV of the stock in Year 3. The price of the stock today is:

P0 = $3.50(1.05) / 1.14 + $3.50(1.05)2 / (1.14)2 + $3.50(1.05)3 / (1.14)3 + $80.81 / (1.14)3

P0 = $63.47

**12.** The price of a stock is the PV of the future dividends. This stock is paying four dividends, so the price of the stock is the PV of these dividends using the required return. The price of the stock is:

P0 = $10 / 1.11 + $14 / 1.112 + $18 / 1.113 + $22 / 1.114 + $26 / 1.115 = $63.45

**14.** With supernormal dividends, we find the price of the stock when the dividends level off at a constant growth rate, and then find the PV of the futures stock price, plus the PV of all dividends during the supernormal growth period. The stock begins constant growth in Year 4, so we can find the price of the stock in Year 3, one year before the constant dividend growth begins as:

P3 = D3 (1 + *g*) / (*R* – *g*) = D0 (1 + *g1*)3 (1 + *g2*) / (*R* – *g*)

P3 = $1.80(1.30)3(1.06) / (.13 – .06)

P3 = $59.88

The price of the stock today is the PV of the first three dividends, plus the PV of the Year 3 stock price. The price of the stock today will be:

P0 = $1.80(1.30) / 1.13 + $1.80(1.30)2 / 1.132 + $1.80(1.30)3 / 1.133 + $59.88 / 1.133

P0 = $48.70

We could also use the two-stage dividend growth model for this problem, which is:

P0 = [D0(1 + *g*1)/(R – *g*1)]{1 – [(1 + *g*1)/(1 + R)]T}+ [(1 + *g*1)/(1 + R)]T[D0(1 + *g*1)/(R – *g*1)]

P0 **=** [$1.80(1.30)/(.13 – .30)][1 – (1.30/1.13)3] + [(1 + .30)/(1 + .13)]3[$1.80(1.06)/(.13 – .06)]

P0 **=** $48.70

**16.** The constant growth model can be applied even if the dividends are declining by a constant percentage, just make sure to recognize the negative growth. So, the price of the stock today will be:

P0 = D0 (1 + *g*) / (*R* – *g*)

P0 = $10.46(1 – .04) / [(.115 – (–.04)]

P0 = $64.78

**21.** We can use the two-stage dividend growth model for this problem, which is:

P0 = [D0(1 + *g*1)/(R – *g*1)]{1 – [(1 + *g*1)/(1 + R)]T}+ [(1 + *g*1)/(1 + R)]T[D0(1 + *g*2)/(R – *g*2)]

P0 **=** [$1.74(1.25)/(.12 – .25)][1 – (1.25/1.12)11] + [(1.25)/(1.12)]11[$1.74(1.06)/(.12 – .06)]

P0 **=** $142.14

**25.** Here we want to find the required return that makes the PV of the dividends equal to the current stock price. The equation for the stock price is:

P = $2.45(1.20)/(1 + *R*) + $2.45(1.20)(1.15)/(1 + *R*)2 + $2.45(1.20)(1.15)(1.10)/(1 + *R*)3

+ [$2.45(1.20)(1.15)(1.10)(1.05)/(*R* – .05)]/(1 + *R*)3 = $63.82

We need to find the roots of this equation. Using spreadsheet, trial and error, or a calculator with a root solving function, we find that:

*R* = 10.24%

Chapter 9

**3.** Project A has cash flows of $19,000 in Year 1, so the cash flows are short by $21,000 of recapturing the initial investment, so the payback for Project A is:

Payback = 1 + ($21,000 / $25,000) = 1.84 years

Project B has cash flows of:

Cash flows = $14,000 + 17,000 + 24,000 = $55,000

during this first three years. The cash flows are still short by $5,000 of recapturing the initial investment, so the payback for Project B is:

B: Payback = 3 + ($5,000 / $270,000) = 3.019 years

Using the payback criterion and a cutoff of 3 years, accept project A and reject project B.

**5.** R = 0%: 3 + ($2,100 / $4,300) = 3.49 years

discounted payback = regular payback = 3.49 years

R = 5%: $4,300/1.05 + $4,300/1.052 + $4,300/1.053 = $11,709.97

$4,300/1.054 = $3,537.62

discounted payback = 3 + ($15,000 – 11,709.97) / $3,537.62 = 3.93 years

R = 19%: $4,300(PVIFA19%,6) = $14,662.04

The project never pays back.

**6.** Our definition of AAR is the average net income divided by the average book value. The average net income for this project is:

Average net income = ($1,938,200 + 2,201,600 + 1,876,000 + 1,329,500) / 4 = $1,836,325

And the average book value is:

Average book value = ($15,000,000 + 0) / 2 = $7,500,000

So, the AAR for this project is:

AAR = Average net income / Average book value = $1,836,325 / $7,500,000 = .2448 or 24.48%

**9.** The NPV of a project is the PV of the outflows minus the PV of the inflows. Since the cash inflows are an annuity, the equation for the NPV of this project at an 8 percent required return is:

NPV = –$138,000 + $28,500(PVIFA8%, 9) = $40,036.31

At an 8 percent required return, the NPV is positive, so we would accept the project.

The equation for the NPV of the project at a 20 percent required return is:

NPV = –$138,000 + $28,500(PVIFA20%, 9) = –$23,117.45

At a 20 percent required return, the NPV is negative, so we would reject the project.

We would be indifferent to the project if the required return was equal to the IRR of the project, since at that required return the NPV is zero. The IRR of the project is:

0 = –$138,000 + $28,500(PVIFAIRR, 9)

IRR = 14.59%

**12.** *a.* The IRR is the interest rate that makes the NPV of the project equal to zero. The equation for the IRR of Project A is:

0 = –$43,000 + $23,000/(1+IRR) + $17,900/(1+IRR)2 + $12,400/(1+IRR)3 + $9,400/(1+IRR)4

Using a spreadsheet, financial calculator, or trial and error to find the root of the equation, we find that:

IRR = 20.44%

The equation for the IRR of Project B is:

0 = –$43,000 + $7,000/(1+IRR) + $13,800/(1+IRR)2 + $24,000/(1+IRR)3 + $26,000/(1+IRR)4

Using a spreadsheet, financial calculator, or trial and error to find the root of the equation, we find that:

IRR = 18.84%

Examining the IRRs of the projects, we see that the IRRA is greater than the IRRB, so IRR decision rule implies accepting project A. This may not be a correct decision; however, because the IRR criterion has a ranking problem for mutually exclusive projects. To see if the IRR decision rule is correct or not, we need to evaluate the project NPVs.

*b.* The NPV of Project A is:

NPVA = –$43,000 + $23,000/1.11+ $17,900/1.112 + $12,400/1.113 + $9,400/1.114

NPVA = $7,507.61

And the NPV of Project B is:

NPVB = –$43,000 + $7,000/1.11 + $13,800/1.112 + $24,000/1.113 + $26,000/1.114

NPVB = $9,182.29

The NPVB is greater than the NPVA, so we should accept Project B.

*c.* To find the crossover rate, we subtract the cash flows from one project from the cash flows of the other project. Here, we will subtract the cash flows for Project B from the cash flows of Project A. Once we find these differential cash flows, we find the IRR. The equation for the crossover rate is:

Crossover rate: 0 = $16,000/(1+R) + $4,100/(1+R)2 – $11,600/(1+R)3 – $16,600/(1+R)4

Using a spreadsheet, financial calculator, or trial and error to find the root of the equation, we find that:

R = 15.30%

At discount rates above 15.30% choose project A; for discount rates below 15.30% choose project B; indifferent between A and B at a discount rate of 15.30%.

**15.** The profitability index is defined as the PV of the cash inflows divided by the PV of the cash outflows. The equation for the profitability index at a required return of 10 percent is:

PI = [$7,300/1.1 + $6,900/1.12 + $5,700/1.13] / $14,000 = 1.187

The equation for the profitability index at a required return of 15 percent is:

PI = [$7,300/1.15 + $6,900/1.152 + $5,700/1.153] / $14,000 = 1.094

The equation for the profitability index at a required return of 22 percent is:

PI = [$7,300/1.22 + $6,900/1.222 + $5,700/1.223] / $14,000 = 0.983

We would accept the project if the required return were 10 percent or 15 percent since the PI is greater than one. We would reject the project if the required return were 22 percent since the PI is less than one.

**19.** The MIRR for the project with all three approaches is:

*Discounting approach:*

In the discounting approach, we find the value of all cash outflows to time 0, while any cash inflows remain at the time at which they occur. So, the discounting the cash outflows to time 0, we find:

Time 0 cash flow = –$16,000 – $5,100 / 1.105

Time 0 cash flow = –$19,166.70

So, the MIRR using the discounting approach is:

0 = –$19,166.70 + $6,100/(1+MIRR) + $7,800/(1+MIRR)2 + $8,400/(1+MIRR)3 + 6,500/(1+MIRR)4

Using a spreadsheet, financial calculator, or trial and error to find the root of the equation, we find that:

MIRR = 18.18%

*Reinvestment approach:*

In the reinvestment approach, we find the future value of all cash except the initial cash flow at the end of the project. So, reinvesting the cash flows to time 5, we find:

Time 5 cash flow = $6,100(1.104) + $7,800(1.103) + $8,400(1.102) + $6,500(1.10) – $5,100

Time 5 cash flow = $31,526.81

So, the MIRR using the reinvestment approach is:

0 = –$16,000 + $31,526.81/(1+MIRR)5

$31,526.81 / $16,000 = (1+MIRR)5

MIRR = ($31,526.81 / $16,000)1/5 – 1

MIRR = .1453 or 14.53%

*Combination approach:*

In the combination approach, we find the value of all cash outflows at time 0, and the value of all cash inflows at the end of the project. So, the value of the cash flows is:

Time 0 cash flow = –$16,000 – $5,100 / 1.105

Time 0 cash flow = –$19,166.70

Time 5 cash flow = $6,100(1.104) + $7,800(1.103) + $8,400(1.102) + $6,500(1.10)

Time 5 cash flow = $36,626.81

So, the MIRR using the combination approach is:

0 = –$19,166.70 + $36,626.81/(1+MIRR)5

$36,626.81 / $19,166.70 = (1+MIRR)5

MIRR = ($36,626.81 / $19,166.70)1/5 – 1

MIRR = .1383 or 13.83%

**25.** *a.* Here the cash inflows of the project go on forever, which is a perpetuity. Unlike ordinary perpetuity cash flows, the cash flows here grow at a constant rate forever, which is a growing perpetuity. If you remember back to the chapter on stock valuation, we presented a formula for valuing a stock with constant growth in dividends. This formula is actually the formula for a growing perpetuity, so we can use it here. The PV of the future cash flows from the project is:

PV of cash inflows = *C1*/(*R* – *g*)

PV of cash inflows = $85,000/(.13 – .06) = $1,214,285.71

NPV is the PV of the outflows minus the PV of the inflows, so the NPV is:

NPV of the project = –$1,400,000 + 1,214,285.71 = –$185,714.29

The NPV is negative, so we would reject the project.

*b.* Here we want to know the minimum growth rate in cash flows necessary to accept the project. The minimum growth rate is the growth rate at which we would have a zero NPV. The equation for a zero NPV, using the equation for the PV of a growing perpetuity is:

0 = –$1,400,000 + $85,000/(.13 – *g*)

Solving for *g*, we get:

*g* = .0693 or 6.93%

Chapter 10

**1.** The $6 million acquisition cost of the land six years ago is a sunk cost. The $6.4 million current aftertax value of the land is an opportunity cost if the land is used rather than sold off. The $14.2 million cash outlay and $890,000 grading expenses are the initial fixed asset investments needed to get the project going. Therefore, the proper year zero cash flow to use in evaluating this project is

$6,400,000 + 14,200,000 + 890,000 = $21,490,000

**7.** The asset has an 8 year useful life and we want to find the BV of the asset after 5 years. With straight-line depreciation, the depreciation each year will be:

Annual depreciation = $548,000 / 8

Annual depreciation = $68,500

So, after five years, the accumulated depreciation will be:

Accumulated depreciation = 5($68,500)

Accumulated depreciation = $342,500

The book value at the end of year five is thus:

BV5 = $548,000 – 342,500

BV5 = $205,500

The asset is sold at a loss to book value, so the depreciation tax shield of the loss is recaptured.

Aftertax salvage value = $105,000 + ($205,500 – 105,000)(0.35)

Aftertax salvage value = $140,175

To find the taxes on salvage value, remember to use the equation:

Taxes on salvage value = (BV – MV)tc

This equation will always give the correct sign for a tax inflow (refund) or outflow (payment).

**13.** First we will calculate the annual depreciation of the new equipment. It will be:

Annual depreciation = $560,000/5

Annual depreciation = $112,000

Now, we calculate the aftertax salvage value. The aftertax salvage value is the market price minus (or plus) the taxes on the sale of the equipment, so:

Aftertax salvage value = MV + (BV – MV)tc

Very often the book value of the equipment is zero as it is in this case. If the book value is zero, the equation for the aftertax salvage value becomes:

Aftertax salvage value = MV + (0 – MV)tc

Aftertax salvage value = MV(1 – tc)

We will use this equation to find the aftertax salvage value since we know the book value is zero. So, the aftertax salvage value is:

Aftertax salvage value = $85,000(1 – 0.34)

Aftertax salvage value = $56,100

Using the tax shield approach, we find the OCF for the project is:

OCF = $165,000(1 – 0.34) + 0.34($112,000)

OCF = $146,980

Now we can find the project NPV. Notice we include the NWC in the initial cash outlay. The recovery of the NWC occurs in Year 5, along with the aftertax salvage value.

NPV = –$560,000 – 29,000 + $146,980(PVIFA10%,5) + [($56,100 + 29,000) / 1.105]

NPV = $21,010.24

**14.** First we will calculate the annual depreciation of the new equipment. It will be:

Annual depreciation charge = $720,000/5

Annual depreciation charge = $144,000

The aftertax salvage value of the equipment is:

Aftertax salvage value = $75,000(1 – 0.35)

Aftertax salvage value = $48,750

Using the tax shield approach, the OCF is:

OCF = $260,000(1 – 0.35) + 0.35($144,000)

OCF = $219,400

Now we can find the project IRR. There is an unusual feature that is a part of this project. Accepting this project means that we will reduce NWC. This reduction in NWC is a cash inflow at Year 0. This reduction in NWC implies that when the project ends, we will have to increase NWC. So, at the end of the project, we will have a cash outflow to restore the NWC to its level before the project. We also must include the aftertax salvage value at the end of the project. The IRR of the project is:

NPV = 0 = –$720,000 + 110,000 + $219,400(PVIFAIRR%,5) + [($48,750 – 110,000) / (1+IRR)5]

IRR = 21.65%

**15.** To evaluate the project with a $300,000 cost savings, we need the OCF to compute the NPV. Using the tax shield approach, the OCF is:

OCF = $300,000(1 – 0.35) + 0.35($144,000) = $245,400

NPV = –$720,000 + 110,000 + $245,400(PVIFA20%,5) + [($48,750 – 110,000) / (1.20)5]

NPV = $99,281.22

The NPV with a $240,000 cost savings is:

OCF = $240,000(1 – 0.35) + 0.35($144,000)

OCF = $206,400

NPV = –$720,000 + 110,000 + $206,400(PVIFA20%,5) + [($48,750 – 110,000) / (1.20)5]

NPV = –$17,352.66

We would accept the project if cost savings were $300,000, and reject the project if the cost savings were $240,000. The required pretax cost savings that would make us indifferent about the project is the cost savings that results in a zero NPV. The NPV of the project is:

NPV = 0 = –$720,000 + $110,000 + OCF(PVIFA20%,5) + [($48,750 – 110,000) / (1.20)5]

Solving for the OCF, we find the necessary OCF for zero NPV is:

OCF = $212,202.38

Using the tax shield approach to calculating OCF, we get:

OCF = $212,202.38 = (S – C)(1 – 0.35) + 0.35($144,000)

(S – C) = $248,926.73

The cost savings that will make us indifferent is $248,926.73.

**19.** First, we will calculate the depreciation each year, which will be:

D1 = $560,000(0.2000) = $112,000

D2 = $560,000(0.3200) = $179,200

D3 = $560,000(0.1920) = $107,520

D4 = $560,000(0.1152) = $64,512

The book value of the equipment at the end of the project is:

BV4 = $560,000 – ($112,000 + 179,200 + 107,520 + 64,512) = $96,768

The asset is sold at a loss to book value, so this creates a tax refund.

After-tax salvage value = $80,000 + ($96,768 – 80,000)(0.35) = $85,868.80

OCF1 = $210,000(1 – 0.35) + 0.35($112,000) = $172,700

OCF2 = $210,000(1 – 0.35) + 0.35($179,200) = $196,220

OCF3 = $210,000(1 – 0.35) + 0.35($107,520) = $171,132

OCF4 = $210,000(1 – 0.35) + 0.35($64,512) = $159,079.20

Now we have all the necessary information to calculate the project NPV. We need to be careful with the NWC in this project. Notice the project requires $20,000 of NWC at the beginning, and $3,000 more in NWC each successive year. We will subtract the $20,000 from the initial cash flow, and subtract $3,000 each year from the OCF to account for this spending. In Year 4, we will add back the total spent on NWC, which is $29,000. The $3,000 spent on NWC capital during Year 4 is irrelevant. Why? Well, during this year the project required an additional $3,000, but we would get the money back immediately. So, the net cash flow for additional NWC would be zero. With all this, the equation for the NPV of the project is:

NPV = – $560,000 – 20,000 + ($172,700 – 3,000)/1.09 + ($196,220 – 3,000)/1.092

+ ($171,132 – 3,000)/1.093 + ($159,079.20 + 29,000 + 85,868.80)/1.094

NPV = $69,811.79

**20.** If we are trying to decide between two projects that will not be replaced when they wear out, the proper capital budgeting method to use is NPV. Both projects only have costs associated with them, not sales, so we will use these to calculate the NPV of each project. Using the tax shield approach to calculate the OCF, the NPV of System A is:

OCFA = –$110,000(1 – 0.34) + 0.34($430,000/4)

OCFA = –$36,050

NPVA = –$430,000 – $36,050(PVIFA11%,4)

NPVA = –$541,843.17

And the NPV of System B is:

OCFB = –$98,000(1 – 0.34) + 0.34($570,000/6)

OCFB = –$32,380

NPVB = –$570,000 – $32,380(PVIFA11%,6)

NPVB = –$706,984.82

If the system will not be replaced when it wears out, then System A should be chosen, because it has the more positive NPV.

**32.** This is an in-depth capital budgeting problem. Probably the easiest OCF calculation for this problem is the bottom up approach, so we will construct an income statement for each year. Beginning with the initial cash flow at time zero, the project will require an investment in equipment. The project will also require an investment in NWC. The initial NWC investment is given, and the subsequent NWC investment will be 15 percent of the next year’s sales. In this case, it will be Year 1 sales. Realizing we need Year 1 sales to calculate the required NWC capital at time 0, we find that Year 1 sales will be $35,340,000. So, the cash flow required for the project today will be:

|  |  |  |
| --- | --- | --- |
|  | Capital spending | –$24,000,000 |
|  | Initial NWC | –1,800,000 |
|  | Total cash flow | –$25,800,000 |

Now we can begin the remaining calculations. Sales figures are given for each year, along with the price per unit. The variable costs per unit are used to calculate total variable costs, and fixed costs are given at $1,200,000 per year. To calculate depreciation each year, we use the initial equipment cost of $24 million, times the appropriate MACRS depreciation each year. The remainder of each income statement is calculated below. Notice at the bottom of the income statement we added back depreciation to get the OCF for each year. The section labeled “Net cash flows” will be discussed below:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Year | 1 | 2 | 3 | 4 | 5 |
|  | Ending book value | $20,570,400 | $14,692,800 | $10,495,200 | $7,497,600 | $5,354,400 |
|  |  |  |  |  |  |  |
|  | Sales | $35,340,000 | $39,900,000 | $48,640,000 | $50,920,000 | $33,060,000 |
|  | Variable costs | 24,645,000 | 27,825,000 | 33,920,000 | 35,510,000 | 23,055,000 |
|  | Fixed costs | 1,200,000 | 1,200,000 | 1,200,000 | 1,200,000 | 1,200,000 |
|  | Depreciation | 3,429,600 | 5,877,600 | 4,197,600 | 2,997,600 | 2,143,200 |
|  | EBIT | $6,065,400 | $4,997,400 | $9,322,400 | $11,212,400 | $6,661,800 |
|  | Taxes | 2,122,890 | 1,749,090 | 3,262,840 | 3,924,340 | 2,331,630 |
|  | Net income | $3,942,510 | $3,248,310 | $6,059,560 | $7,288,060 | $4,330,170 |
|  | Depreciation | 3,429,600 | 5,877,600 | 4,197,600 | 2,997,600 | 2,143,200 |
|  | Operating cash flow | $7,372,110 | $9,125,910 | $10,257,160 | $10,285,660 | $6,473,370 |
|  |  |  |  |  |  |  |
|  | *Net cash flows* |  |  |  |  |  |
|  | Operating cash flow | $7,372,110 | $9,125,910 | $10,257,160 | $10,285,660 | $6,473,370 |
|  | Change in NWC | –684,000 | –1,311,000 | –342,000 | 2,679,000 | 1,458,000 |
|  | Capital spending | 0 | 0 | 0 | 0 | 4,994,040 |
|  | Total cash flow | $6,688,110 | $7,814,910 | $9,915,160 | $12,964,660 | $12,925,410 |

After we calculate the OCF for each year, we need to account for any other cash flows. The other cash flows in this case are NWC cash flows and capital spending, which is the aftertax salvage of the equipment. The required NWC capital is 15 percent of the increase in sales in the next year. We will work through the NWC cash flow for Year 1. The total NWC in Year 1 will be 15 percent of sales increase from Year 1 to Year 2, or:

Increase in NWC for Year 1 = .15($39,900,000 – 35,340,000)

Increase in NWC for Year 1 = $684,000

Notice that the NWC cash flow is negative. Since the sales are increasing, we will have to spend more money to increase NWC. In Year 4, the NWC cash flow is positive since sales are declining. And, in Year 5, the NWC cash flow is the recovery of all NWC the company still has in the project.

To calculate the aftertax salvage value, we first need the book value of the equipment. The book value at the end of the five years will be the purchase price, minus the total depreciation. So, the ending book value is:

Ending book value = $24,000,000 – ($3,429,600 + 5,877,600 + 4,197,600 + 2,997,600

+ 2,143,200)

Ending book value = $5,354,400

The market value of the used equipment is 20 percent of the purchase price, or $4.8 million, so the aftertax salvage value will be:

Aftertax salvage value = $4,800,000 + ($5,354,400 – 4,800,000)(.35)

Aftertax salvage value = $4,994,040

The aftertax salvage value is included in the total cash flows are capital spending. Now we have all of the cash flows for the project. The NPV of the project is:

NPV = –$25,800,000 + $6,688,110/1.18 + $7,814,910/1.182 + $9,915,160/1.183

+ $12,964,660/1.184 + $12,925,410/1.185

NPV = $3,851,952.23

And the IRR is:

NPV = 0 = –$25,800,000 + $6,688,110/(1 + IRR) + $7,814,910/(1 + IRR)2

+ $9,915,160/(1 + IRR)3 + $12,964,660/(1 + IRR)4 + $12,925,410/(1 + IRR)5

IRR = 23.62%

We should accept the project.

Chapter 13

**1.** The portfolio weight of an asset is total investment in that asset divided by the total portfolio value. First, we will find the portfolio value, which is:

Total value = 180($45) + 140($27) = $11,880

The portfolio weight for each stock is:

WeightA = 180($45)/$11,880 = .6818

WeightB = 140($27)/$11,880 = .3182

**3.** The expected return of a portfolio is the sum of the weight of each asset times the expected return of each asset. So, the expected return of the portfolio is:

E(Rp) = .60(.09) + .25(.17) + .15(.13) = .1160 or 11.60%

**7.** The expected return of an asset is the sum of the probability of each return occurring times the probability of that return occurring. So, the expected return of each stock asset is:

E(RA) = .15(.05) + .65(.08) + .20(.13) = .0855 or 8.55%

E(RB) = .15(–.17) + .65(.12) + .20(.29) = .1105 or 11.05%

To calculate the standard deviation, we first need to calculate the variance. To find the variance, we find the squared deviations from the expected return. We then multiply each possible squared deviation by its probability, then add all of these up. The result is the variance. So, the variance and standard deviation of each stock is:

σA2 =.15(.05 – .0855)2 + .65(.08 – .0855)2 + .20(.13 – .0855)2 = .00060

σA = (.00060)1/2 = .0246 or 2.46%

σB2 =.15(–.17 – .1105)2 + .65(.12 – .1105)2 + .20(.29 – .1105)2 = .01830

σB = (.01830)1/2 = .1353 or 13.53%

**9.** *a.* To find the expected return of the portfolio, we need to find the return of the portfolio in each state of the economy. This portfolio is a special case since all three assets have the same weight. To find the expected return in an equally weighted portfolio, we can sum the returns of each asset and divide by the number of assets, so the expected return of the portfolio in each state of the economy is:

Boom: E(Rp) = (.07 + .15 + .33)/3 = .1833 or 18.33%

Bust: E(Rp) = (.13 + .03 −.06)/3 = .0333 or 3.33%

To find the expected return of the portfolio, we multiply the return in each state of the economy by the probability of that state occurring, and then sum. Doing this, we find:

E(Rp) = .35(.1833) + .65(.0333) = .0858 or 8.58%

*b.* This portfolio does not have an equal weight in each asset. We still need to find the return of the portfolio in each state of the economy. To do this, we will multiply the return of each asset by its portfolio weight and then sum the products to get the portfolio return in each state of the economy. Doing so, we get:

Boom: E(Rp) = .20(.07) +.20(.15) + .60(.33) =.2420 or 24.20%

Bust: E(Rp) = .20(.13) +.20(.03) + .60(−.06) = –.0040 or –0.40%

And the expected return of the portfolio is:

E(Rp) = .35(.2420) + .65(−.004) = .0821 or 8.21%

To find the variance, we find the squared deviations from the expected return. We then multiply each possible squared deviation by its probability, than add all of these up. The result is the variance. So, the variance and standard deviation of the portfolio is:

σp2 = .35(.2420 – .0821)2 + .65(−.0040 – .0821)2 = .013767

**11.** The beta of a portfolio is the sum of the weight of each asset times the beta of each asset. So, the beta of the portfolio is:

βp = .25(.84) + .20(1.17) + .15(1.11) + .40(1.36) = 1.15

**15.** Here we need to find the expected return of the market using the CAPM. Substituting the values given, and solving for the expected return of the market, we find:

E(Ri) = .135 = .055 + [E(RM) – .055](1.17)

E(RM) = .1234 or 12.34%

**19.** There are two ways to correctly answer this question. We will work through both. First, we can use the CAPM. Substituting in the value we are given for each stock, we find:

E(RY) = .08 + .075(1.30) = .1775 or 17.75%

It is given in the problem that the expected return of Stock Y is 18.5 percent, but according to the CAPM, the return of the stock based on its level of risk, the expected return should be 17.75 percent. This means the stock return is too high, given its level of risk. Stock Y plots above the SML and is undervalued. In other words, its price must increase to reduce the expected return to 17.75 percent. For Stock Z, we find:

E(RZ) = .08 + .075(0.70) = .1325 or 13.25%

The return given for Stock Z is 12.1 percent, but according to the CAPM the expected return of the stock should be 13.25 percent based on its level of risk. Stock Z plots below the SML and is overvalued. In other words, its price must decrease to increase the expected return to 13.25 percent.

We can also answer this question using the reward-to-risk ratio. All assets must have the same reward-to-risk ratio. The reward-to-risk ratio is the risk premium of the asset divided by its β. We are given the market risk premium, and we know the β of the market is one, so the reward-to-risk ratio for the market is 0.075, or 7.5 percent. Calculating the reward-to-risk ratio for Stock Y, we find:

Reward-to-risk ratio Y = (.185 – .08) / 1.30 = .0808

The reward-to-risk ratio for Stock Y is too high, which means the stock plots above the SML, and the stock is undervalued. Its price must increase until its reward-to-risk ratio is equal to the market reward-to-risk ratio. For Stock Z, we find:

Reward-to-risk ratio Z = (.121 – .08) / .70 = .0586

The reward-to-risk ratio for Stock Z is too low, which means the stock plots below the SML, and the stock is overvalued. Its price must decrease until its reward-to-risk ratio is equal to the market reward-to-risk ratio.

**23.** *a.* We need to find the return of the portfolio in each state of the economy. To do this, we will multiply the return of each asset by its portfolio weight and then sum the products to get the portfolio return in each state of the economy. Doing so, we get:

Boom: E(Rp) = .4(.24) + .4(.36) + .2(.55) = .3500 or 35.00%

Normal: E(Rp) = .4(.17) + .4(.13) + .2(.09) = .1380 or 13.80%

Bust: E(Rp) = .4(.00) + .4(–.28) + .2(–.45) = –.2020 or –20.20%

And the expected return of the portfolio is:

E(Rp) = .35(.35) + .50(.138) + .15(–.202) = .1612 or 16.12%

To calculate the standard deviation, we first need to calculate the variance. To find the variance, we find the squared deviations from the expected return. We then multiply each possible squared deviation by its probability, than add all of these up. The result is the variance. So, the variance and standard deviation of the portfolio is:

σ2p = .35(.35 – .1612)2 + .50(.138 – .1612)2 + .15(–.202 – .1612)2

σ2p = .03253

σp = (.03253)1/2 = .1804 or 18.04%

*b.* The risk premium is the return of a risky asset, minus the risk-free rate. T-bills are often used as the risk-free rate, so:

RPi = E(Rp) – Rf = .1612 – .0380 = .1232 or 12.32%

*c.* The approximate expected real return is the expected nominal return minus the inflation rate, so:

Approximate expected real return = .1612 – .035 = .1262 or 12.62%

To find the exact real return, we will use the Fisher equation. Doing so, we get:

1 + E(Ri) = (1 + h)[1 + e(ri)]

1.1612 = (1.0350)[1 + e(ri)]

e(ri) = (1.1612/1.035) – 1 = .1219 or 12.19%

The approximate real risk premium is the expected return minus the risk-free rate, so:

Approximate expected real risk premium = .1612 – .038 = .1232 or 12.32%

The exact expected real risk premium is the approximate expected real risk premium, divided by one plus the inflation rate, so:

Exact expected real risk premium = .1168/1.035 = .1190 or 11.90%

**25.** We are given the expected return of the assets in the portfolio. We also know the sum of the weights of each asset must be equal to one. Using this relationship, we can express the expected return of the portfolio as:

E(Rp) = .185 = wX(.172) + wY(.136)

.185 = wX(.172) + (1 – wX)(.136)

.185 = .172wX + .136 – .136wX

.049 = .036wX

wX = 1.36111

And the weight of Stock Y is:

wY = 1 – 1.36111

wY = –.36111

The amount to invest in Stock Y is:

Investment in Stock Y = –.36111($100,000)

Investment in Stock Y = –$36,111.11

A negative portfolio weight means that you short sell the stock. If you are not familiar with short selling, it means you borrow a stock today and sell it. You must then purchase the stock at a later date to repay the borrowed stock. If you short sell a stock, you make a profit if the stock decreases in value.

To find the beta of the portfolio, we can multiply the portfolio weight of each asset times its beta and sum. So, the beta of the portfolio is:

βP = 1.36111(1.40) + (–.36111)(0.95)

βP = 1.56

**27.** Here we have the expected return and beta for two assets. We can express the returns of the two assets using CAPM. If the CAPM is true, then the security market line holds as well, which means all assets have the same risk premium. Setting the risk premiums of the assets equal to each other and solving for the risk-free rate, we find:

(.132 – Rf)/1.35 = (.101 – Rf)/.80

.80(.132 – Rf) = 1.35(.101 – Rf)

.1056 – .8Rf = .13635 – 1.35Rf

.55Rf = .03075

Rf = .0559 or 5.59%

Now using CAPM to find the expected return on the market with both stocks, we find:

.132 = .0559 + 1.35(RM – .0559) .101 = .0559 + .80(RM – .0559)

RM = .1123 or 11.23% RM = .1123 or 11.23%

Chapter 14

**1.** With the information given, we can find the cost of equity using the dividend growth model. Using this model, the cost of equity is:

RE = [$2.40(1.055)/$52] + .055 = .1037 or 10.37%

**4.** To use the dividend growth model, we first need to find the growth rate in dividends. So, the increase in dividends each year was:

g1 = ($1.12 – 1.05)/$1.05 = .0667 or 6.67%

g2 = ($1.19 – 1.12)/$1.12 = .0625 or 6.25%

g3 = ($1.30 – 1.19)/$1.19 = .0924 or 9.24%

g4 = ($1.43 – 1.30)/$1.30 = .1000 or 10.00%

So, the average arithmetic growth rate in dividends was:

g = (.0667 + .0625 + .0924 + .1000)/4 = .0804 or 8.04%

Using this growth rate in the dividend growth model, we find the cost of equity is:

RE = [$1.43(1.0804)/$45.00] + .0804 = .1147 or 11.47%

Calculating the geometric growth rate in dividends, we find:

$1.43 = $1.05(1 + g)4

g = .0803 or 8.03%

The cost of equity using the geometric dividend growth rate is:

RE = [$1.43(1.0803)/$45.00] + .0803 = .1146 or 11.46%

**6.** The pretax cost of debt is the YTM of the company’s bonds, so:

P0 = $1,070 = $35(PVIFAR%,30) + $1,000(PVIFR%,30)

R = 3.137%

YTM = 2 × 3.137% = 6.27%

And the aftertax cost of debt is:

RD = .0627(1 – .35) = .0408 or 4.08%

**9.** *a.* Using the equation to calculate the WACC, we find:

WACC = .60(.14) + .05(.06) + .35(.08)(1 – .35) = .1052 or 10.52%

*b.* Since interest is tax deductible and dividends are not, we must look at the after-tax cost of debt, which is:

.08(1 – .35) = .0520 or 5.20%

Hence, on an after-tax basis, debt is cheaper than the preferred stock.

**15.** We will begin by finding the market value of each type of financing. We find:

MVD = 8,000($1,000)(0.92) = $7,360,000

MVE = 250,000($57) = $14,250,000

MVP = 15,000($93) = $1,395,000

And the total market value of the firm is:

V = $7,360,000 + 14,250,000 + 1,395,000 = $23,005,000

Now, we can find the cost of equity using the CAPM. The cost of equity is:

RE = .045 + 1.05(.08) = .1290 or 12.90%

The cost of debt is the YTM of the bonds, so:

P0 = $920 = $32.50(PVIFAR%,40) + $1,000(PVIFR%,40)

R = 3.632%

YTM = 3.632% × 2 = 7.26%

And the aftertax cost of debt is:

RD = (1 – .35)(.0726) = .0472 or 4.72%

The cost of preferred stock is:

RP = $5/$93 = .0538 or 5.38%

Now we have all of the components to calculate the WACC. The WACC is:

WACC = .0472(7.36/23.005) + .1290(14.25/23.005) + .0538(1.395/23.005) = .0983 or 9.83%

Notice that we didn’t include the (1 – tC) term in the WACC equation. We used the aftertax cost of debt in the equation, so the term is not needed here.

**20.** Using the debt-equity ratio to calculate the WACC, we find:

WACC = (.90/1.90)(.048) + (1/1.90)(.13) = .0912 or 9.12%

Since the project is riskier than the company, we need to adjust the project discount rate for the additional risk. Using the subjective risk factor given, we find:

Project discount rate = 9.12% + 2.00% = 11.12%

We would accept the project if the NPV is positive. The NPV is the PV of the cash outflows plus the PV of the cash inflows. Since we have the costs, we just need to find the PV of inflows. The cash inflows are a growing perpetuity. If you remember, the equation for the PV of a growing perpetuity is the same as the dividend growth equation, so:

PV of future CF = $2,700,000/(.1112 – .04) = $37,943,787

The project should only be undertaken if its cost is less than $37,943,787 since costs less than this amount will result in a positive NPV.

Chapter 16

**1.** *a.* A table outlining the income statement for the three possible states of the economy is shown below. The EPS is the net income divided by the 5,000 shares outstanding. The last row shows the percentage change in EPS the company will experience in a recession or an expansion economy.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | Recession | Normal | Expansion |
|  |  | EBIT | $14,000 | $28,000 | $36,400 |
|  |  | Interest | 0 | 0 | 0 |
|  |  | NI | $14,000 | $28,000 | $36,400 |
|  |  | EPS | $ 2.80 | $ 5.60 | $ 7.28 |
|  |  | %ΔEPS | –50 | ––– | +30 |

*b.* If the company undergoes the proposed recapitalization, it will repurchase:

Share price = Equity / Shares outstanding

Share price = $250,000/5,000

Share price = $50

Shares repurchased = Debt issued / Share price

Shares repurchased =$90,000/$50

Shares repurchased = 1,800

The interest payment each year under all three scenarios will be:

Interest payment = $90,000(.07) = $6,300

The last row shows the percentage change in EPS the company will experience in a recession or an expansion economy under the proposed recapitalization.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | Recession | Normal | Expansion |
|  |  | EBIT | $14,000 | $28,000 | $36,400 |
|  |  | Interest | 6,300 | 6,300 | 6,300 |
|  |  | NI | $7,700 | $21,700 | $30,100 |
|  |  | EPS | $2.41 | $ 6.78 | $9.41 |
|  |  | %ΔEPS | –64.52 | ––– | +38.71 |

**4.** *a.* Under Plan I, the unlevered company, net income is the same as EBIT with no corporate tax. The EPS under this capitalization will be:

EPS = $350,000/160,000 shares

EPS = $2.19

Under Plan II, the levered company, EBIT will be reduced by the interest payment. The interest payment is the amount of debt times the interest rate, so:

NI = $500,000 – .08($2,800,000)

NI = $126,000

And the EPS will be:

EPS = $126,000/80,000 shares

EPS = $1.58

Plan I has the higher EPS when EBIT is $350,000.

*b.* Under Plan I, the net income is $500,000 and the EPS is:

EPS = $500,000/160,000 shares

EPS = $3.13

Under Plan II, the net income is:

NI = $500,000 – .08($2,800,000)

NI = $276,000

And the EPS is:

EPS = $276,000/80,000 shares

EPS = $3.45

Plan II has the higher EPS when EBIT is $500,000.

*c.* To find the breakeven EBIT for two different capital structures, we simply set the equations for EPS equal to each other and solve for EBIT. The breakeven EBIT is:

EBIT/160,000 = [EBIT – .08($2,800,000)]/80,000

EBIT = $448,000

**7.** To find the value per share of the stock under each capitalization plan, we can calculate the price as the value of shares repurchased divided by the number of shares repurchased. So, under Plan I, the value per share is:

P = $160,000/(11,000 – 7,000 shares)

P = $40 per share

And under Plan II, the value per share is:

P = $240,000/(11,000 – 5,000 shares)

P = $40 per share

This shows that when there are no corporate taxes, the stockholder does not care about the capital structure decision of the firm. This is M&M Proposition I without taxes.

**13.** *a*. For an all-equity financed company:

WACC = RU = RE = .11 or 11%

*b.* To find the cost of equity for the company with leverage we need to use M&M Proposition II with taxes, so:

RE = RU + (RU – RD)(D/E)(1 – tC)

RE = .11 + (.11 – .082)(.25/.75)(.65)

RE = .1161 or 11.61%

*c.* Using M&M Proposition II with taxes again, we get:

RE = RU + (RU – RD)(D/E)(1 – tC)

RE = .11 + (.11 – .082)(.50/.50)(1 – .35)

RE = .1282 or 12.82%

*d.* The WACC with 25 percent debt is:

WACC = (E/V)RE + (D/V)RD(1 – tC)

WACC = .75(.1161) + .25(.082)(1 – .35)

WACC = .1004 or 10.04%

And the WACC with 50 percent debt is:

WACC = (E/V)RE + (D/V)RD(1 – tC)

WACC = .50(.1282) + .50(.082)(1 – .35)

WACC = .0908 or 9.08%

**17.** With no debt, we are finding the value of an unlevered firm, so:

VU = EBIT(1 – tC)/RU

VU = $14,000(1 – .35)/.16

VU = $56,875

With debt, we simply need to use the equation for the value of a levered firm. With 50 percent debt, one-half of the firm value is debt, so the value of the levered firm is:

VL = VU  + tC(D/V)VU

VL = $56,875 + .35(.50)($56,875)

VL = $66,828.13

And with 100 percent debt, the value of the firm is:

VL = VU  + tC(D/V)VU

VL = $56,875 + .35(1.0)($56,875)

VL = $76,781.25