

# **Solutions Manual**

*Fundamentals of Corporate Finance* 8<sup>th</sup> edition  
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# **CHAPTER 1**

# **INTRODUCTION TO CORPORATE FINANCE**

## **Answers to Concepts Review and Critical Thinking Questions**

1. Capital budgeting (deciding whether to expand a manufacturing plant), capital structure (deciding whether to issue new equity and use the proceeds to retire outstanding debt), and working capital management (modifying the firm's credit collection policy with its customers).
2. Disadvantages: unlimited liability, limited life, difficulty in transferring ownership, hard to raise capital funds. Some advantages: simpler, less regulation, the owners are also the managers, sometimes personal tax rates are better than corporate tax rates.
3. The primary disadvantage of the corporate form is the double taxation to shareholders of distributed earnings and dividends. Some advantages include: limited liability, ease of transferability, ability to raise capital, unlimited life, and so forth.
4. In response to Sarbanes-Oxley, small firms have elected to go dark because of the costs of compliance. The costs to comply with Sarbox can be several million dollars, which can be a large percentage of a small firms profits. A major cost of going dark is less access to capital. Since the firm is no longer publicly traded, it can no longer raise money in the public market. Although the company will still have access to bank loans and the private equity market, the costs associated with raising funds in these markets are usually higher than the costs of raising funds in the public market.
5. The treasurer's office and the controller's office are the two primary organizational groups that report directly to the chief financial officer. The controller's office handles cost and financial accounting, tax management, and management information systems, while the treasurer's office is responsible for cash and credit management, capital budgeting, and financial planning. Therefore, the study of corporate finance is concentrated within the treasury group's functions.
6. To maximize the current market value (share price) of the equity of the firm (whether it's publicly-traded or not).
7. In the corporate form of ownership, the shareholders are the owners of the firm. The shareholders elect the directors of the corporation, who in turn appoint the firm's management. This separation of ownership from control in the corporate form of organization is what causes agency problems to exist. Management may act in its own or someone else's best interests, rather than those of the shareholders. If such events occur, they may contradict the goal of maximizing the share price of the equity of the firm.
8. A primary market transaction.

## B-2 SOLUTIONS

9. In auction markets like the NYSE, brokers and agents meet at a physical location (the exchange) to match buyers and sellers of assets. Dealer markets like NASDAQ consist of dealers operating at dispersed locales who buy and sell assets themselves, communicating with other dealers either electronically or literally over-the-counter.
10. Such organizations frequently pursue social or political missions, so many different goals are conceivable. One goal that is often cited is revenue minimization; i.e., provide whatever goods and services are offered at the lowest possible cost to society. A better approach might be to observe that even a not-for-profit business has equity. Thus, one answer is that the appropriate goal is to maximize the value of the equity.
11. Presumably, the current stock value reflects the risk, timing, and magnitude of all future cash flows, both short-term *and* long-term. If this is correct, then the statement is false.
12. An argument can be made either way. At the one extreme, we could argue that in a market economy, all of these things are priced. There is thus an optimal level of, for example, ethical and/or illegal behavior, and the framework of stock valuation explicitly includes these. At the other extreme, we could argue that these are non-economic phenomena and are best handled through the political process. A classic (and highly relevant) thought question that illustrates this debate goes something like this: "A firm has estimated that the cost of improving the safety of one of its products is \$30 million. However, the firm believes that improving the safety of the product will only save \$20 million in product liability claims. What should the firm do?"
13. The goal will be the same, but the best course of action toward that goal may be different because of differing social, political, and economic institutions.
14. The goal of management should be to maximize the share price for the current shareholders. If management believes that it can improve the profitability of the firm so that the share price will exceed \$35, then they should fight the offer from the outside company. If management believes that this bidder or other unidentified bidders will actually pay more than \$35 per share to acquire the company, then they should still fight the offer. However, if the current management cannot increase the value of the firm beyond the bid price, and no other higher bids come in, then management is not acting in the interests of the shareholders by fighting the offer. Since current managers often lose their jobs when the corporation is acquired, poorly monitored managers have an incentive to fight corporate takeovers in situations such as this.
15. We would expect agency problems to be less severe in other countries, primarily due to the relatively small percentage of individual ownership. Fewer individual owners should reduce the number of diverse opinions concerning corporate goals. The high percentage of institutional ownership might lead to a higher degree of agreement between owners and managers on decisions concerning risky projects. In addition, institutions may be better able to implement effective monitoring mechanisms on managers than can individual owners, based on the institutions' deeper resources and experiences with their own management. The increase in institutional ownership of stock in the United States and the growing activism of these large shareholder groups may lead to a reduction in agency problems for U.S. corporations and a more efficient market for corporate control.

- 16.** How much is too much? Who is worth more, Larry Ellison or Tiger Woods? The simplest answer is that there is a market for executives just as there is for all types of labor. Executive compensation is the price that clears the market. The same is true for athletes and performers. Having said that, one aspect of executive compensation deserves comment. A primary reason executive compensation has grown so dramatically is that companies have increasingly moved to stock-based compensation. Such movement is obviously consistent with the attempt to better align stockholder and management interests. In recent years, stock prices have soared, so management has cleaned up. It is sometimes argued that much of this reward is simply due to rising stock prices in general, not managerial performance. Perhaps in the future, executive compensation will be designed to reward only differential performance, i.e., stock price increases in excess of general market increases.

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# **CHAPTER 2**

## **FINANCIAL STATEMENTS, TAXES AND CASH FLOW**

### **Answers to Concepts Review and Critical Thinking Questions**

1. Liquidity measures how quickly and easily an asset can be converted to cash without significant loss in value. It's desirable for firms to have high liquidity so that they have a large factor of safety in meeting short-term creditor demands. However, since liquidity also has an opportunity cost associated with it—namely that higher returns can generally be found by investing the cash into productive assets—low liquidity levels are also desirable to the firm. It's up to the firm's financial management staff to find a reasonable compromise between these opposing needs.
2. The recognition and matching principles in financial accounting call for revenues, and the costs associated with producing those revenues, to be "booked" when the revenue process is essentially complete, not necessarily when the cash is collected or bills are paid. Note that this way is not necessarily correct; it's the way accountants have chosen to do it.
3. Historical costs can be objectively and precisely measured whereas market values can be difficult to estimate, and different analysts would come up with different numbers. Thus, there is a tradeoff between relevance (market values) and objectivity (book values).
4. Depreciation is a non-cash deduction that reflects adjustments made in asset book values in accordance with the matching principle in financial accounting. Interest expense is a cash outlay, but it's a financing cost, not an operating cost.
5. Market values can never be negative. Imagine a share of stock selling for  $-\$20$ . This would mean that if you placed an order for 100 shares, you would get the stock along with a check for  $\$2,000$ . How many shares do you want to buy? More generally, because of corporate and individual bankruptcy laws, net worth for a person or a corporation cannot be negative, implying that liabilities cannot exceed assets in market value.
6. For a successful company that is rapidly expanding, for example, capital outlays will be large, possibly leading to negative cash flow from assets. In general, what matters is whether the money is spent wisely, not whether cash flow from assets is positive or negative.
7. It's probably not a good sign for an established company, but it would be fairly ordinary for a start-up, so it depends.
8. For example, if a company were to become more efficient in inventory management, the amount of inventory needed would decline. The same might be true if it becomes better at collecting its receivables. In general, anything that leads to a decline in ending NWC relative to beginning would have this effect. Negative net capital spending would mean more long-lived assets were liquidated than purchased.

9. If a company raises more money from selling stock than it pays in dividends in a particular period, its cash flow to stockholders will be negative. If a company borrows more than it pays in interest, its cash flow to creditors will be negative.
10. The adjustments discussed were purely accounting changes; they had no cash flow or market value consequences unless the new accounting information caused stockholders to revalue the derivatives.
11. Enterprise value is the theoretical takeover price. In the event of a takeover, an acquirer would have to take on the company's debt, but would pocket its cash. Enterprise value differs significantly from simple market capitalization in several ways, and it may be a more accurate representation of a firm's value. In a takeover, the value of a firm's debt would need to be paid by the buyer when taking over a company. This enterprise value provides a much more accurate takeover valuation because it includes debt in its value calculation.
12. In general, it appears that investors prefer companies that have a steady earning stream. If true, this encourages companies to manage earnings. Under GAAP, there are numerous choices for the way a company reports its financial statements. Although not the reason for the choices under GAAP, one outcome is the ability of a company to manage earnings, which is not an ethical decision. Even though earnings and cash flow are often related, earnings management should have little effect on cash flow (except for tax implications). If the market is "fooled" and prefers steady earnings, shareholder wealth can be increased, at least temporarily. However, given the questionable ethics of this practice, the company (and shareholders) will lose value if the practice is discovered.

### Solutions to Questions and Problems

*NOTE: All end of chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.*

#### Basic

1. To find owner's equity, we must construct a balance sheet as follows:

<u>Balance Sheet</u>			
CA	\$4,000	CL	\$3,400
NFA	<u>22,500</u>	LTD	6,800
		OE	<u>??</u>
TA	<u>\$26,500</u>	TL & OE	<u>\$26,500</u>

We know that total liabilities and owner's equity (TL & OE) must equal total assets of \$26,500. We also know that TL & OE is equal to current liabilities plus long-term debt plus owner's equity, so owner's equity is:

$$OE = \$26,500 - 6,800 - 3,400 = \$16,300$$

$$NWC = CA - CL = \$4,000 - 3,400 = \$600$$

## B-6 SOLUTIONS

2. The income statement for the company is:

<u>Income Statement</u>	
Sales	\$634,000
Costs	305,000
Depreciation	<u>46,000</u>
EBIT	\$283,000
Interest	<u>29,000</u>
EBT	\$254,000
Taxes(35%)	<u>88,900</u>
Net income	<u><u>\$165,100</u></u>

3. One equation for net income is:

$$\text{Net income} = \text{Dividends} + \text{Addition to retained earnings}$$

Rearranging, we get:

$$\text{Addition to retained earnings} = \text{Net income} - \text{Dividends} = \$165,100 - 86,000 = \$79,100$$

4.  $\text{EPS} = \text{Net income} / \text{Shares} = \$165,100 / 30,000 = \$5.50$  per share

$$\text{DPS} = \text{Dividends} / \text{Shares} = \$86,000 / 30,000 = \$2.87$$
 per share

5. To find the book value of current assets, we use:  $\text{NWC} = \text{CA} - \text{CL}$ . Rearranging to solve for current assets, we get:

$$\text{CA} = \text{NWC} + \text{CL} = \$410,000 + 1,300,000 = \$1,710,000$$

The market value of current assets and fixed assets is given, so:

Book value CA	= \$1,710,000	Market value CA	= \$1,800,000
Book value NFA	= <u>\$2,600,000</u>	Market value NFA	= <u>\$3,700,000</u>
Book value assets	= <u>\$4,310,000</u>	Market value assets	= <u>\$5,500,000</u>

6.  $\text{Taxes} = 0.15(\$50\text{K}) + 0.25(\$25\text{K}) + 0.34(\$25\text{K}) + 0.39(\$325 - 100\text{K}) = \$110,000$

7. The average tax rate is the total tax paid divided by net income, so:

$$\text{Average tax rate} = \$110,000 / \$325,000 = 33.85\%$$

The marginal tax rate is the tax rate on the next \$1 of earnings, so the marginal tax rate = 39%.

8. To calculate OCF, we first need the income statement:

<u>Income Statement</u>	
Sales	\$14,200
Costs	5,600
Depreciation	<u>1,200</u>
EBIT	\$7,400
Interest	<u>680</u>
Taxable income	\$6,720
Taxes (35%)	<u>2,352</u>
Net income	<u>\$4,368</u>

$$\text{OCF} = \text{EBIT} + \text{Depreciation} - \text{Taxes} = \$7,400 + 1,200 - 2,352 = \$6,248$$

9. Net capital spending =  $\text{NFA}_{\text{end}} - \text{NFA}_{\text{beg}} + \text{Depreciation} = \$5.2\text{M} - 4.6\text{M} + 875\text{K} = \$1.475\text{M}$

10. Change in NWC =  $\text{NWC}_{\text{end}} - \text{NWC}_{\text{beg}}$   
 Change in NWC =  $(\text{CA}_{\text{end}} - \text{CL}_{\text{end}}) - (\text{CA}_{\text{beg}} - \text{CL}_{\text{beg}})$   
 Change in NWC =  $(\$1,650 - 920) - (\$1,400 - 870)$   
 Change in NWC =  $\$730 - 530 = \$200$

11. Cash flow to creditors = Interest paid – Net new borrowing =  $\$340\text{K} - (\text{LTD}_{\text{end}} - \text{LTD}_{\text{beg}})$   
 Cash flow to creditors =  $\$280\text{K} - (\$3.3\text{M} - 3.1\text{M}) = \$280\text{K} - 200\text{K} = \$80\text{K}$

12. Cash flow to stockholders = Dividends paid – Net new equity  
 Cash flow to stockholders =  $\$600\text{K} - [(\text{Common}_{\text{end}} + \text{APIS}_{\text{end}}) - (\text{Common}_{\text{beg}} + \text{APIS}_{\text{beg}})]$   
 Cash flow to stockholders =  $\$600\text{K} - [(\$860\text{K} + 6.9\text{M}) - (\$885\text{K} + 7.7\text{M})]$   
 Cash flow to stockholders =  $\$600\text{K} - [\$7.76\text{M} - 8.585\text{M}] = -\$225\text{K}$

Note, APIS is the additional paid-in surplus.

13. Cash flow from assets = Cash flow to creditors + Cash flow to stockholders  
 =  $\$80\text{K} - 225\text{K} = -\$145\text{K}$

$$\begin{aligned} \text{Cash flow from assets} &= -\$145\text{K} = \text{OCF} - \text{Change in NWC} - \text{Net capital spending} \\ &= -\$145\text{K} = \text{OCF} - (-\$165\text{K}) - 760\text{K} \end{aligned}$$

$$\text{Operating cash flow} = -\$145\text{K} - 165\text{K} + 760\text{K} = \$450\text{K}$$

B-8 SOLUTIONS

Intermediate

14. To find the OCF, we first calculate net income.

<u>Income Statement</u>	
Sales	\$162,000
Costs	93,000
Depreciation	8,400
Other expenses	<u>5,100</u>
EBIT	\$55,500
Interest	<u>16,500</u>
Taxable income	\$39,000
Taxes (34%)	<u>14,820</u>
Net income	<u>\$24,180</u>
Dividends	\$9,400
Additions to RE	\$14,780

- a.  $OCF = EBIT + Depreciation - Taxes = \$55,500 + 8,400 - 14,820 = \$49,080$
- b.  $CFC = Interest - Net\ new\ LTD = \$16,500 - (-6,400) = \$22,900$

Note that the net new long-term debt is negative because the company repaid part of its long-term debt.

- c.  $CFS = Dividends - Net\ new\ equity = \$9,400 - 7,350 = \$2,050$
- d. We know that  $CFA = CFC + CFS$ , so:

$$CFA = \$22,900 + 2,050 = \$24,950$$

CFA is also equal to  $OCF - Net\ capital\ spending - Change\ in\ NWC$ . We already know OCF. Net capital spending is equal to:

$$Net\ capital\ spending = Increase\ in\ NFA + Depreciation = \$12,000 + 8,400 = \$20,400$$

Now we can use:

$$CFA = OCF - Net\ capital\ spending - Change\ in\ NWC$$

$$\$24,950 = \$49,080 - 20,400 - Change\ in\ NWC$$

Solving for the change in NWC gives \$3,730, meaning the company increased its NWC by \$3,730.

15. The solution to this question works the income statement backwards. Starting at the bottom:

$$Net\ income = Dividends + Addition\ to\ ret.\ earnings = \$1,200 + 4,300 = \$5,500$$

Now, looking at the income statement:

$$EBT - EBT \times \text{Tax rate} = \text{Net income}$$

Recognize that  $EBT \times \text{tax rate}$  is simply the calculation for taxes. Solving this for EBT yields:

$$EBT = NI / (1 - \text{tax rate}) = \$5,500 / (1 - 0.35) = \$8,462$$

Now you can calculate:

$$EBIT = EBT + \text{Interest} = \$8,462 + 2,300 = \$10,762$$

The last step is to use:

$$EBIT = \text{Sales} - \text{Costs} - \text{Depreciation}$$

$$EBIT = \$34,000 - 16,000 - \text{Depreciation} = \$10,762$$

Solving for depreciation, we find that depreciation = \$7,238

16. The balance sheet for the company looks like this:

<u>Balance Sheet</u>			
Cash	\$210,000	Accounts payable	\$430,000
Accounts receivable	149,000	Notes payable	<u>180,000</u>
Inventory	<u>265,000</u>	Current liabilities	\$610,000
Current assets	\$624,000	Long-term debt	<u>1,430,000</u>
		Total liabilities	\$2,040,000
Tangible net fixed assets	2,900,000	Common stock	??
Intangible net fixed assets	<u>720,000</u>	Accumulated ret. earnings	<u>1,865,000</u>
Total assets	<u>\$4,244,000</u>	Total liab. & owners' equity	<u>\$4,244,000</u>

Total liabilities and owners' equity is:

$$TL \ \& \ OE = CL + LTD + \text{Common stock} + \text{Retained earnings}$$

Solving for this equation for equity gives us:

$$\text{Common stock} = \$4,244,000 - 1,865,000 - 2,040,000 = \$339,000$$

17. The market value of shareholders' equity cannot be zero. A negative market value in this case would imply that the company would pay you to own the stock. The market value of shareholders' equity can be stated as:  $\text{Shareholders' equity} = \text{Max} [(TA - TL), 0]$ . So, if TA is \$6,700, equity is equal to \$600, and if TA is \$5,900, equity is equal to \$0. We should note here that the book value of shareholders' equity can be negative.

B-10 SOLUTIONS

18. a. Taxes Growth =  $0.15(\$50K) + 0.25(\$25K) + 0.34(\$7K) = \$16,130$   
 Taxes Income =  $0.15(\$50K) + 0.25(\$25K) + 0.34(\$25K) + 0.39(\$235K) + 0.34(\$7.865M)$   
 =  $\$2,788,000$

b. Each firm has a marginal tax rate of 34% on the next \$10,000 of taxable income, despite their different average tax rates, so both firms will pay an additional \$3,400 in taxes.

19.

Income Statement

Sales	\$840,000
COGS	625,000
A&S expenses	120,000
Depreciation	<u>130,000</u>
EBIT	-\$35,000
Interest	<u>85,000</u>
Taxable income	-\$120,000
Taxes (35%)	<u>0</u>
a. Net income	<u><u>-\$120,000</u></u>

b.  $OCF = EBIT + Depreciation - Taxes = -\$35,000 + 130,000 - 0 = \$95,000$

c. Net income was negative because of the tax deductibility of depreciation and interest expense. However, the actual cash flow from operations was positive because depreciation is a non-cash expense and interest is a financing expense, not an operating expense.

20. A firm can still pay out dividends if net income is negative; it just has to be sure there is sufficient cash flow to make the dividend payments.

Change in NWC = Net capital spending = Net new equity = 0. (Given)

Cash flow from assets =  $OCF - \text{Change in NWC} - \text{Net capital spending}$

Cash flow from assets =  $\$95K - 0 - 0 = \$95K$

Cash flow to stockholders =  $\text{Dividends} - \text{Net new equity} = \$30K - 0 = \$30K$

Cash flow to creditors =  $\text{Cash flow from assets} - \text{Cash flow to stockholders} = \$95K - 30K = \$65K$

Cash flow to creditors =  $\text{Interest} - \text{Net new LTD}$

Net new LTD =  $\text{Interest} - \text{Cash flow to creditors} = \$85K - 65K = \$20K$

21. a.

Income Statement

Sales	\$15,200
Cost of good sold	11,400
Depreciation	<u>2,700</u>
EBIT	\$ 1,100
Interest	<u>520</u>
Taxable income	\$ 580
Taxes (34%)	<u>197</u>
Net income	<u><u>\$ 383</u></u>

b.  $OCF = EBIT + Depreciation - Taxes$   
 =  $\$1,100 + 2,700 - 197 = \$3,603$

$$\begin{aligned}
 c. \text{ Change in NWC} &= \text{NWC}_{\text{end}} - \text{NWC}_{\text{beg}} \\
 &= (\text{CA}_{\text{end}} - \text{CL}_{\text{end}}) - (\text{CA}_{\text{beg}} - \text{CL}_{\text{beg}}) \\
 &= (\$3,850 - 2,100) - (\$3,200 - 1,800) \\
 &= \$1,750 - 1,400 = \$350
 \end{aligned}$$

$$\begin{aligned}
 \text{Net capital spending} &= \text{NFA}_{\text{end}} - \text{NFA}_{\text{beg}} + \text{Depreciation} \\
 &= \$9,700 - 9,100 + 2,700 = \$3,300
 \end{aligned}$$

$$\begin{aligned}
 \text{CFA} &= \text{OCF} - \text{Change in NWC} - \text{Net capital spending} \\
 &= \$3,603 - 350 - 3,300 = -\$47
 \end{aligned}$$

The cash flow from assets can be positive or negative, since it represents whether the firm raised funds or distributed funds on a net basis. In this problem, even though net income and OCF are positive, the firm invested heavily in both fixed assets and net working capital; it had to raise a net \$47 in funds from its stockholders and creditors to make these investments.

$$\begin{aligned}
 d. \text{ Cash flow to creditors} &= \text{Interest} - \text{Net new LTD} = \$520 - 0 = \$520 \\
 \text{Cash flow to stockholders} &= \text{Cash flow from assets} - \text{Cash flow to creditors} \\
 &= -\$47 - 520 = -\$567
 \end{aligned}$$

We can also calculate the cash flow to stockholders as:

$$\text{Cash flow to stockholders} = \text{Dividends} - \text{Net new equity}$$

Solving for net new equity, we get:

$$\text{Net new equity} = \$600 - (-567) = \$1,167$$

The firm had positive earnings in an accounting sense ( $\text{NI} > 0$ ) and had positive cash flow from operations. The firm invested \$350 in new net working capital and \$3,300 in new fixed assets. The firm had to raise \$47 from its stakeholders to support this new investment. It accomplished this by raising \$1,167 in the form of new equity. After paying out \$600 of this in the form of dividends to shareholders and \$520 in the form of interest to creditors, \$47 was left to meet the firm's cash flow needs for investment.

$$\begin{aligned}
 22. \quad a. \text{ Total assets 2006} &= \$725 + 2,990 = \$3,715 \\
 \text{Total liabilities 2006} &= \$290 + 1,580 = \$1,870 \\
 \text{Owners' equity 2006} &= \$3,715 - 1,870 = \$1,845
 \end{aligned}$$

$$\begin{aligned}
 \text{Total assets 2007} &= \$785 + 3,600 = \$4,385 \\
 \text{Total liabilities 2007} &= \$325 + 1,680 = \$2,005 \\
 \text{Owners' equity 2007} &= \$4,385 - 2,005 = \$2,380
 \end{aligned}$$

$$\begin{aligned}
 b. \text{ NWC 2006} &= \text{CA}_{06} - \text{CL}_{06} = \$725 - 290 = \$435 \\
 \text{NWC 2007} &= \text{CA}_{07} - \text{CL}_{07} = \$785 - 325 = \$460 \\
 \text{Change in NWC} &= \text{NWC}_{07} - \text{NWC}_{06} = \$460 - 435 = \$25
 \end{aligned}$$

## B-12 SOLUTIONS

c. We can calculate net capital spending as:

$$\begin{aligned}\text{Net capital spending} &= \text{Net fixed assets 2007} - \text{Net fixed assets 2006} + \text{Depreciation} \\ \text{Net capital spending} &= \$3,600 - 2,990 + 820 = \$1,430\end{aligned}$$

So, the company had a net capital spending cash flow of \$1,430. We also know that net capital spending is:

$$\begin{aligned}\text{Net capital spending} &= \text{Fixed assets bought} - \text{Fixed assets sold} \\ \$1,430 &= \$1,500 - \text{Fixed assets sold} \\ \text{Fixed assets sold} &= \$1,500 - 1,430 = \$70\end{aligned}$$

To calculate the cash flow from assets, we must first calculate the operating cash flow. The operating cash flow is calculated as follows (you can also prepare a traditional income statement):

$$\begin{aligned}\text{EBIT} &= \text{Sales} - \text{Costs} - \text{Depreciation} = \$9,200 - 4,290 - 820 = \$4,090 \\ \text{EBT} &= \text{EBIT} - \text{Interest} = \$4,090 - 234 = \$3,856 \\ \text{Taxes} &= \text{EBT} \times .35 = \$3,856 \times .35 = \$1,350 \\ \text{OCF} &= \text{EBIT} + \text{Depreciation} - \text{Taxes} = \$4,090 + 820 - 1,350 = \$3,560 \\ \text{Cash flow from assets} &= \text{OCF} - \text{Change in NWC} - \text{Net capital spending.} \\ &= \$3,560 - 25 - 1,430 = \$2,105\end{aligned}$$

$$\begin{aligned}d. \text{ Net new borrowing} &= \text{LTD07} - \text{LTD06} = \$1,680 - 1,580 = \$100 \\ \text{Cash flow to creditors} &= \text{Interest} - \text{Net new LTD} = \$234 - 100 = \$134 \\ \text{Net new borrowing} &= \$100 = \text{Debt issued} - \text{Debt retired} \\ \text{Debt retired} &= \$300 - 100 = \$200\end{aligned}$$

### Challenge

$$\begin{aligned}23. \text{ Net capital spending} &= \text{NFA}_{\text{end}} - \text{NFA}_{\text{beg}} + \text{Depreciation} \\ &= (\text{NFA}_{\text{end}} - \text{NFA}_{\text{beg}}) + (\text{Depreciation} + \text{AD}_{\text{beg}}) - \text{AD}_{\text{beg}} \\ &= (\text{NFA}_{\text{end}} - \text{NFA}_{\text{beg}}) + \text{AD}_{\text{end}} - \text{AD}_{\text{beg}} \\ &= (\text{NFA}_{\text{end}} + \text{AD}_{\text{end}}) - (\text{NFA}_{\text{beg}} + \text{AD}_{\text{beg}}) = \text{FA}_{\text{end}} - \text{FA}_{\text{beg}}\end{aligned}$$

24. a. The tax bubble causes average tax rates to catch up to marginal tax rates, thus eliminating the tax advantage of low marginal rates for high income corporations.

$$b. \text{ Taxes} = 0.15(\$50\text{K}) + 0.25(\$25\text{K}) + 0.34(\$25\text{K}) + 0.39(\$235\text{K}) = \$113.9\text{K}$$

$$\text{Average tax rate} = \$113.9\text{K} / \$335\text{K} = 34\%$$

The marginal tax rate on the next dollar of income is 34 percent.

For corporate taxable income levels of \$335K to \$10M, average tax rates are equal to marginal tax rates.

$$\text{Taxes} = 0.34(\$10\text{M}) + 0.35(\$5\text{M}) + 0.38(\$3.333\text{M}) = \$6,416,667$$

$$\text{Average tax rate} = \$6,416,667 / \$18,333,334 = 35\%$$

The marginal tax rate on the next dollar of income is 35 percent. For corporate taxable income levels over \$18,333,334, average tax rates are again equal to marginal tax rates.

c. Taxes = 0.34(\$200K) = \$68K = 0.15(\$50K) + 0.25(\$25K) + 0.34(\$25K) + X(\$100K);  
 X(\$100K) = \$68K - 22.25K = \$45.75K  
 X = \$45.75K / \$100K  
 X = 45.75%

25.

<u>Balance sheet as of Dec. 31, 2006</u>			
Cash	\$2,528	Accounts payable	\$2,656
Accounts receivable	3,347	Notes payable	<u>488</u>
Inventory	<u>5,951</u>	Current liabilities	\$3,144
Current assets	\$11,826		
		Long-term debt	\$8,467
Net fixed assets	<u>\$21,203</u>	Owners' equity	<u>21,418</u>
Total assets	<u>\$33,029</u>	Total liab. & equity	<u>\$33,029</u>

<u>Balance sheet as of Dec. 31, 2007</u>			
Cash	\$2,694	Accounts payable	\$2,683
Accounts receivable	3,928	Notes payable	<u>478</u>
Inventory	<u>6,370</u>	Current liabilities	\$3,161
Current assets	\$12,992		
		Long-term debt	\$10,290
Net fixed assets	<u>\$22,614</u>	Owners' equity	<u>22,155</u>
Total assets	<u>\$35,606</u>	Total liab. & equity	<u>\$35,606</u>

<u>2006 Income Statement</u>	
Sales	\$4,822.00
COGS	1,658.00
Other expenses	394.00
Depreciation	<u>692.00</u>
EBIT	\$2,078.00
Interest	<u>323.00</u>
EBT	\$1,755.00
Taxes (34%)	<u>596.70</u>
Net income	<u>\$1,158.30</u>

<u>2007 Income Statement</u>	
Sales	\$5,390.00
COGS	1,961.00
Other expenses	343.00
Depreciation	<u>723.00</u>
EBIT	\$2,363.00
Interest	<u>386.00</u>
EBT	\$1,977.00
Taxes (34%)	<u>672.18</u>
Net income	<u>\$1,304.82</u>

Dividends	\$588.00
Additions to RE	570.30

Dividends	\$674.00
Additions to RE	630.82

B-14 SOLUTIONS

**26.**  $OCF = EBIT + \text{Depreciation} - \text{Taxes} = \$2,363 + 723 - 672.18 = \$2,413.82$

$$\begin{aligned} \text{Change in NWC} &= NWC_{\text{end}} - NWC_{\text{beg}} = (CA - CL)_{\text{end}} - (CA - CL)_{\text{beg}} \\ &= (\$12,992 - 3,161) - (\$11,826 - 3,144) \\ &= \$1,149 \end{aligned}$$

$$\begin{aligned} \text{Net capital spending} &= NFA_{\text{end}} - NFA_{\text{beg}} + \text{Depreciation} \\ &= \$22,614 - 21,203 + 723 = \$2,134 \end{aligned}$$

$$\begin{aligned} \text{Cash flow from assets} &= OCF - \text{Change in NWC} - \text{Net capital spending} \\ &= \$2,413.82 - 1,149 - 2,134 = -\$869.18 \end{aligned}$$

$$\text{Cash flow to creditors} = \text{Interest} - \text{Net new LTD}$$

$$\text{Net new LTD} = LTD_{\text{end}} - LTD_{\text{beg}}$$

$$\text{Cash flow to creditors} = \$386 - (\$10,290 - 8,467) = -\$1,437$$

$$\text{Net new equity} = \text{Common stock}_{\text{end}} - \text{Common stock}_{\text{beg}}$$

$$\text{Common stock} + \text{Retained earnings} = \text{Total owners' equity}$$

$$\begin{aligned} \text{Net new equity} &= (OE - RE)_{\text{end}} - (OE - RE)_{\text{beg}} \\ &= OE_{\text{end}} - OE_{\text{beg}} + RE_{\text{beg}} - RE_{\text{end}} \end{aligned}$$

$$RE_{\text{end}} = RE_{\text{beg}} + \text{Additions to RE}$$

$$\therefore \text{Net new equity} = OE_{\text{end}} - OE_{\text{beg}} + RE_{\text{beg}} - (RE_{\text{beg}} + \text{Additions to RE})$$

$$= OE_{\text{end}} - OE_{\text{beg}} - \text{Additions to RE}$$

$$\text{Net new equity} = \$22,155 - 21,418 - 630.82 = \$106.18$$

$$\text{CFS} = \text{Dividends} - \text{Net new equity}$$

$$\text{CFS} = \$674 - 106.18 = \$567.82$$

As a check, cash flow from assets is  $-\$869.18$ .

$$\text{CFA} = \text{Cash flow from creditors} + \text{Cash flow to stockholders}$$

$$\text{CFA} = -\$1,437 + 567.82 = -\$869.18$$

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# CHAPTER 3

## WORKING WITH FINANCIAL STATEMENTS

### Answers to Concepts Review and Critical Thinking Questions

1.
  - a. If inventory is purchased with cash, then there is no change in the current ratio. If inventory is purchased on credit, then there is a decrease in the current ratio if it was initially greater than 1.0.
  - b. Reducing accounts payable with cash increases the current ratio if it was initially greater than 1.0.
  - c. Reducing short-term debt with cash increases the current ratio if it was initially greater than 1.0.
  - d. As long-term debt approaches maturity, the principal repayment and the remaining interest expense become current liabilities. Thus, if debt is paid off with cash, the current ratio increases if it was initially greater than 1.0. If the debt has not yet become a current liability, then paying it off will reduce the current ratio since current liabilities are not affected.
  - e. Reduction of accounts receivables and an increase in cash leaves the current ratio unchanged.
  - f. Inventory sold at cost reduces inventory and raises cash, so the current ratio is unchanged.
  - g. Inventory sold for a profit raises cash in excess of the inventory recorded at cost, so the current ratio increases.
2. The firm has increased inventory relative to other current assets; therefore, assuming current liability levels remain unchanged, liquidity has potentially decreased.
3. A current ratio of 0.50 means that the firm has twice as much in current liabilities as it does in current assets; the firm potentially has poor liquidity. If pressed by its short-term creditors and suppliers for immediate payment, the firm might have a difficult time meeting its obligations. A current ratio of 1.50 means the firm has 50% more current assets than it does current liabilities. This probably represents an improvement in liquidity; short-term obligations can generally be met completely with a safety factor built in. A current ratio of 15.0, however, might be excessive. Any excess funds sitting in current assets generally earn little or no return. These excess funds might be put to better use by investing in productive long-term assets or distributing the funds to shareholders.
4.
  - a. Quick ratio provides a measure of the short-term liquidity of the firm, after removing the effects of inventory, generally the least liquid of the firm's current assets.
  - b. Cash ratio represents the ability of the firm to completely pay off its current liabilities with its most liquid asset (cash).
  - c. Total asset turnover measures how much in sales is generated by each dollar of firm assets.
  - d. Equity multiplier represents the degree of leverage for an equity investor of the firm; it measures the dollar worth of firm assets each equity dollar has a claim to.
  - e. Long-term debt ratio measures the percentage of total firm capitalization funded by long-term debt.

## B-16 SOLUTIONS

- f.* Times interest earned ratio provides a relative measure of how well the firm's operating earnings can cover current interest obligations.
  - g.* Profit margin is the accounting measure of bottom-line profit per dollar of sales.
  - h.* Return on assets is a measure of bottom-line profit per dollar of total assets.
  - i.* Return on equity is a measure of bottom-line profit per dollar of equity.
  - j.* Price-earnings ratio reflects how much value per share the market places on a dollar of accounting earnings for a firm.
5. Common size financial statements express all balance sheet accounts as a percentage of total assets and all income statement accounts as a percentage of total sales. Using these percentage values rather than nominal dollar values facilitates comparisons between firms of different size or business type. Common-base year financial statements express each account as a ratio between their current year nominal dollar value and some reference year nominal dollar value. Using these ratios allows the total growth trend in the accounts to be measured.
6. Peer group analysis involves comparing the financial ratios and operating performance of a particular firm to a set of peer group firms in the same industry or line of business. Comparing a firm to its peers allows the financial manager to evaluate whether some aspects of the firm's operations, finances, or investment activities are out of line with the norm, thereby providing some guidance on appropriate actions to take to adjust these ratios if appropriate. An aspirant group would be a set of firms whose performance the company in question would like to emulate. The financial manager often uses the financial ratios of aspirant groups as the target ratios for his or her firm; some managers are evaluated by how well they match the performance of an identified aspirant group.
7. Return on equity is probably the most important accounting ratio that measures the bottom-line performance of the firm with respect to the equity shareholders. The Du Pont identity emphasizes the role of a firm's profitability, asset utilization efficiency, and financial leverage in achieving an ROE figure. For example, a firm with ROE of 20% would seem to be doing well, but this figure may be misleading if it were marginally profitable (low profit margin) and highly levered (high equity multiplier). If the firm's margins were to erode slightly, the ROE would be heavily impacted.
8. The book-to-bill ratio is intended to measure whether demand is growing or falling. It is closely followed because it is a barometer for the entire high-tech industry where levels of revenues and earnings have been relatively volatile.
9. If a company is growing by opening new stores, then presumably total revenues would be rising. Comparing total sales at two different points in time might be misleading. Same-store sales control for this by only looking at revenues of stores open within a specific period.
10. *a.* For an electric utility such as Con Ed, expressing costs on a per kilowatt hour basis would be a way to compare costs with other utilities of different sizes.
- b.* For a retailer such as Sears, expressing sales on a per square foot basis would be useful in comparing revenue production against other retailers.
- c.* For an airline such as Southwest, expressing costs on a per passenger mile basis allows for comparisons with other airlines by examining how much it costs to fly one passenger one mile.

- d. For an on-line service provider such as AOL, using a per call basis for costs would allow for comparisons with smaller services. A per subscriber basis would also make sense.
  - e. For a hospital such as Holy Cross, revenues and costs expressed on a per bed basis would be useful.
  - f. For a college textbook publisher such as McGraw-Hill/Irwin, the leading publisher of finance textbooks for the college market, the obvious standardization would be per book sold.
11. Reporting the sale of Treasury securities as cash flow from operations is an accounting “trick”, and as such, should constitute a possible red flag about the companies accounting practices. For most companies, the gain from a sale of securities should be placed in the financing section. Including the sale of securities in the cash flow from operations would be acceptable for a financial company, such as an investment or commercial bank.
12. Increasing the payables period increases the cash flow from operations. This could be beneficial for the company as it may be a cheap form of financing, but it is basically a one time change. The payables period cannot be increased indefinitely as it will negatively affect the company’s credit rating if the payables period becomes too long.

### Solutions to Questions and Problems

*NOTE: All end of chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.*

#### Basic

1. Using the formula for NWC, we get:

$$\text{NWC} = \text{CA} - \text{CL}$$

$$\text{CA} = \text{CL} + \text{NWC} = \$1,570 + 4,380 = \$5,950$$

So, the current ratio is:

$$\text{Current ratio} = \text{CA} / \text{CL} = \$5,950 / \$4,380 = 1.36 \text{ times}$$

And the quick ratio is:

$$\text{Quick ratio} = (\text{CA} - \text{Inventory}) / \text{CL} = (\$5,950 - 1,875) / \$4,380 = 0.93 \text{ times}$$

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

$$\text{Profit margin} = \text{Net income} / \text{Sales}$$

$$\text{Net income} = \text{Sales}(\text{Profit margin})$$

$$\text{Net income} = (\$28,000,000)(0.08) = \$1,920,000$$

$$\text{ROA} = \text{Net income} / \text{TA} = \$1,920,000 / \$18,000,000 = .1067 \text{ or } 10.67\%$$

## B-18 SOLUTIONS

To find ROE, we need to find total equity.

$$TL \ \& \ OE = TD + TE$$

$$TE = TL \ \& \ OE - TD$$

$$TE = \$18,000,000 - 7,000,000 = \$11,000,000$$

$$ROE = \text{Net income} / TE = \$1,920,000 / \$11,000,000 = .1745 \text{ or } 17.45\%$$

3. Receivables turnover = Sales / Receivables  
Receivables turnover =  $\$2,945,600 / \$387,615 = 7.60$  times

$$\text{Days' sales in receivables} = 365 \text{ days} / \text{Receivables turnover} = 365 / 7.60 = 48.03 \text{ days}$$

The average collection period for an outstanding accounts receivable balance was 48.03 days.

4. Inventory turnover = COGS / Inventory  
Inventory turnover =  $\$2,987,165 / \$324,600 = 9.20$  times

$$\text{Days' sales in inventory} = 365 \text{ days} / \text{Inventory turnover} = 365 / 9.20 = 39.66 \text{ days}$$

On average, a unit of inventory sat on the shelf 39.66 days before it was sold.

5. Total debt ratio = 0.29 = TD / TA

Substituting total debt plus total equity for total assets, we get:

$$0.29 = TD / (TD + TE)$$

Solving this equation yields:

$$0.29(TE) = 0.71(TD)$$

$$\text{Debt/equity ratio} = TD / TE = 0.29 / 0.71 = 0.41$$

$$\text{Equity multiplier} = 1 + D/E = 1.41$$

6. Net income = Addition to RE + Dividends =  $\$350,000 + 160,000 = \$510,000$   
Earnings per share = NI / Shares =  $\$510,000 / 210,000 = \$2.43$  per share  
Dividends per share = Dividends / Shares =  $\$160,000 / 210,000 = \$0.76$  per share  
Book value per share = TE / Shares =  $\$4,100,000 / 210,000 = \$19.52$  per share  
Market-to-book ratio = Share price / BVPS =  $\$58 / \$19.52 = 2.97$  times  
P/E ratio = Share price / EPS =  $\$58 / \$2.43 = 23.88$  times  
Sales per share = Sales / Shares =  $\$3,900,000 / 210,000 = \$18.57$   
P/S ratio = Share price / Sales per share =  $\$58 / \$18.57 = 3.12$  times

7.  $ROE = (PM)(TAT)(EM)$   
 $ROE = (.085)(1.30)(1.35) = .1492$  or 14.92%
8. This question gives all of the necessary ratios for the DuPont Identity except the equity multiplier, so, using the DuPont Identity:

$$ROE = (PM)(TAT)(EM)$$
$$ROE = .1867 = (.087)(1.45)(EM)$$

$$EM = .1867 / (.087)(1.45) = 1.48$$

$$D/E = EM - 1 = 1.48 - 1 = 0.48$$

9. Decrease in inventory is a source of cash  
Decrease in accounts payable is a use of cash  
Increase in notes payable is a source of cash  
Decrease in accounts receivable is a source of cash  
Changes in cash = sources – uses =  $\$400 + 580 + 210 - 160 = \$1,030$   
Cash increased by \$1,030
10. Payables turnover =  $COGS / \text{Accounts payable}$   
Payables turnover =  $\$21,587 / \$5,832 = 3.70$  times

$$\text{Days' sales in payables} = 365 \text{ days} / \text{Payables turnover}$$

$$\text{Days' sales in payables} = 365 / 3.70 = 98.61 \text{ days}$$

The company left its bills to suppliers outstanding for 98.61 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.

11. New investment in fixed assets is found by:

$$\text{Net investment in FA} = (NFA_{\text{end}} - NFA_{\text{beg}}) + \text{Depreciation}$$

$$\text{Net investment in FA} = \$625 + 170 = \$795$$

The company bought \$795 in new fixed assets; this is a use of cash.

12. The equity multiplier is:

$$EM = 1 + D/E$$

$$EM = 1 + 0.80 = 1.80$$

One formula to calculate return on equity is:

$$ROE = (ROA)(EM)$$

$$ROE = .092(1.80) = .1656$$
 or 16.56%

B-20 SOLUTIONS

ROE can also be calculated as:

$$\text{ROE} = \text{NI} / \text{TE}$$

So, net income is:

$$\text{NI} = \text{ROE}(\text{TE})$$

$$\text{NI} = (.1656)(\$520,000) = \$86,112$$

13. through 15:

	2006	#13	2007	#13	#14	#15
Assets						
Current assets						
Cash	\$ 15,183	3.45%	\$ 16,185	3.40%	1.0660	0.9850
Accounts receivable	35,612	8.09%	37,126	7.79%	1.0425	0.9633
Inventory	<u>62,182</u>	<u>14.13%</u>	<u>64,853</u>	<u>13.62%</u>	<u>1.0430</u>	<u>0.9637</u>
Total	\$ 112,977	25.67%	\$ 118,164	24.81%	1.0459	0.9664
Fixed assets						
Net plant and equipment	<u>327,156</u>	<u>74.33%</u>	<u>358,163</u>	<u>75.19%</u>	<u>1.0948</u>	<u>1.0116</u>
Total assets	<u>\$ 440,133</u>	<u>100%</u>	<u>\$ 476,327</u>	<u>100%</u>	<u>1.0822</u>	<u>1.0000</u>
Liabilities and Owners' Equity						
Current liabilities						
Accounts payable	\$ 78,159	17.76%	\$ 59,309	12.45%	0.7588	0.7012
Notes payable	<u>46,382</u>	<u>10.54%</u>	<u>48,168</u>	<u>10.11%</u>	<u>1.0385</u>	<u>0.9596</u>
Total	\$ 124,541	28.30%	\$ 107,477	22.56%	0.8630	0.7974
Long-term debt	60,000	13.63%	75,000	15.75%	1.2500	1.1550
Owners' equity						
Common stock and paid-in surplus	\$ 90,000	20.45%	\$ 90,000	18.89%	1.0000	0.9240
Accumulated retained earnings	<u>165,592</u>	<u>37.62%</u>	<u>203,850</u>	<u>42.80%</u>	<u>1.2310</u>	<u>1.1375</u>
Total	<u>\$ 255,592</u>	<u>58.07%</u>	<u>\$ 293,850</u>	<u>61.69%</u>	<u>1.1497</u>	<u>1.0623</u>
Total liabilities and owners' equity	<u>\$ 440,133</u>	<u>100%</u>	<u>\$ 476,327</u>	<u>100%</u>	<u>1.0822</u>	<u>1.0000</u>

The common-size balance sheet answers are found by dividing each category by total assets. For example, the cash percentage for 2006 is:

$$\$15,183 / \$440,133 = .0345 \text{ or } 3.45\%$$

This means that cash is 3.45% of total assets.

The common-base year answers for Question 14 are found by dividing each category value for 2007 by the same category value for 2006. For example, the cash common-base year number is found by:

$$\$16,185 / \$15,183 = 1.0660$$

This means the cash balance in 2007 is 1.0660 times as large as the cash balance in 2006.

The common-size, common-base year answers for Question 15 are found by dividing the common-size percentage for 2007 by the common-size percentage for 2006. For example, the cash calculation is found by:

$$3.40\% / 3.45\% = 0.9850$$

This tells us that cash, as a percentage of assets, fell by:

$$1 - .9850 = .0150 \text{ or } 1.50 \text{ percent.}$$

16.	2006	Sources/Uses		2007
Assets				
Current assets				
Cash	\$ 15,183	1,002	U	\$ 16,185
Accounts receivable	35,612	1,514	U	37,126
Inventory	<u>62,182</u>	<u>2,671</u>	U	<u>64,853</u>
Total	\$ 112,977	5,187	U	\$118,164
Fixed assets				
Net plant and equipment	<u>327,156</u>	<u>31,007</u>	U	<u>358,163</u>
Total assets	<u>\$ 440,133</u>	<u>36,194</u>	U	<u>\$476,327</u>
Liabilities and Owners' Equity				
Current liabilities				
Accounts payable	\$ 78,159	-18,850	U	\$ 59,309
Notes payable	<u>46,382</u>	<u>1,786</u>	S	<u>48,168</u>
Total	\$ 124,541	-17,064	U	\$107,477
Long-term debt	60,000	15,000	S	75,000
Owners' equity				
Common stock and paid-in surplus	\$ 90,000	0		\$ 90,000
Accumulated retained earnings	<u>165,592</u>	<u>38,258</u>	S	<u>203,850</u>
Total	<u>\$ 255,592</u>	<u>38,258</u>	S	<u>\$293,850</u>
Total liabilities and owners' equity	<u>\$ 440,133</u>	<u>36,194</u>	S	<u>\$476,327</u>

The firm used \$36,194 in cash to acquire new assets. It raised this amount of cash by increasing liabilities and owners' equity by \$36,194. In particular, the needed funds were raised by internal financing (on a net basis), out of the additions to retained earnings and by an issue of long-term debt.

B-22 SOLUTIONS

17. a. Current ratio = Current assets / Current liabilities  
 Current ratio 2006 = \$112,977 / \$124,541 = 0.91 times  
 Current ratio 2007 = \$118,164 / \$107,477 = 1.10 times
- b. Quick ratio = (Current assets – Inventory) / Current liabilities  
 Quick ratio 2006 = (\$112,977 – 62,182) / \$124,541 = 0.41 times  
 Quick ratio 2007 = (\$118,164 – 64,853) / \$107,477 = 0.50 times
- c. Cash ratio = Cash / Current liabilities  
 Cash ratio 2006 = \$15,183 / \$124,541 = 0.12 times  
 Cash ratio 2007 = \$16,185 / \$107,477 = 0.15 times
- d. NWC ratio = NWC / Total assets  
 NWC ratio 2006 = (\$112,977 – 124,541) / \$440,133 = –2.63%  
 NWC ratio 2007 = (\$118,164 – 107,477) / \$476,327 = 2.24%
- e. Debt-equity ratio = Total debt / Total equity  
 Debt-equity ratio 2006 = (\$124,541 + 60,000) / \$255,592 = 0.72 times  
 Debt-equity ratio 2007 = (\$107,477 + 75,000) / \$293,850 = 0.62 times
- Equity multiplier = 1 + D/E  
 Equity multiplier 2006 = 1 + 0.72 = 1.72  
 Equity multiplier 2007 = 1 + 0.62 = 1.62
- f. Total debt ratio = (Total assets – Total equity) / Total assets  
 Total debt ratio 2006 = (\$440,133 – 255,592) / \$440,133 = 0.42  
 Total debt ratio 2007 = (\$476,327 – 293,850) / \$476,327 = 0.38
- Long-term debt ratio = Long-term debt / (Long-term debt + Total equity)  
 Long-term debt ratio 2006 = \$60,000 / (\$60,000 + 255,592) = 0.19  
 Long-term debt ratio 2007 = \$75,000 / (\$75,000 + 293,850) = 0.20

Intermediate

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:

$$ROE = 0.16 = (PM)(TAT)(EM) = (PM)(S / TA)(1 + D/E)$$

Solving the DuPont Identity for profit margin, we get:

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

$$PM = [(0.16)(\$2,685)] / [(1 + 1.2)(\$4,800)] = .0407$$

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

$$PM = .0407 = NI / S$$

$$NI = .0407(\$4,800) = \$195.27$$

19. This is a multi-step problem involving several ratios. It is often easier to look backward to determine where to start. We need receivables turnover to find days' sales in receivables. To calculate receivables turnover, we need credit sales, and to find credit sales, we need total sales. Since we are given the profit margin and net income, we can use these to calculate total sales as:

$$PM = 0.084 = NI / \text{Sales} = \$195,000 / \text{Sales}; \text{Sales} = \$2,074,468$$

Credit sales are 75 percent of total sales, so:

$$\text{Credit sales} = \$2,074,468(0.75) = \$1,555,851$$

Now we can find receivables turnover by:

$$\text{Receivables turnover} = \text{Credit sales} / \text{Accounts receivable} = \$1,555,851 / \$106,851 = 14.56 \text{ times}$$

$$\text{Days' sales in receivables} = 365 \text{ days} / \text{Receivables turnover} = 365 / 14.56 = 25.07 \text{ days}$$

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:

$$CR = CA / CL$$

$$CA = CR(CL) = 1.30(\$980) = \$1,274$$

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:

$$PM = NI / \text{Sales}$$

$$NI = PM(\text{Sales}) = .095(\$5,105) = \$484.98$$

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

$$ROE = NI / TE$$

$$TE = NI / ROE = \$484.98 / .185 = \$2,621.49$$

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

$$\text{Long-term debt ratio} = 0.60 = LTD / (LTD + TE)$$

Inverting both sides gives:

$$1 / 0.60 = (LTD + TE) / LTD = 1 + (TE / LTD)$$

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

$$1 + \$2,621.49 / LTD = 1.667$$

$$LTD = \$2,621.49 / .667 = \$3,932.23$$

## B-24 SOLUTIONS

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

$$TD = CL + LTD = \$980 + 3,932.23 = \$4,912.23$$

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

$$TA = TD + TE = \$4,912.23 + 2,621.49 = \$7,533.72$$

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

$$NFA = TA - CA = \$7,533.72 - 1,274 = \$6,259.72$$

**21.** Child: Profit margin =  $NI / S = \$2.00 / \$50 = 4\%$

Store: Profit margin =  $NI / S = \$17M / \$850M = 2\%$

The advertisement is referring to the store's profit margin, but a more appropriate earnings measure for the firm's owners is the return on equity.

$$ROE = NI / TE = NI / (TA - TD)$$

$$ROE = \$17M / (\$215M - 105M) = .1545 \text{ or } 15.45\%$$

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

Firm A

$$D / TA = .55$$

$$(TA - E) / TA = .55$$

$$(TA / TA) - (E / TA) = .55$$

$$1 - (E / TA) = .55$$

$$E / TA = .45$$

$$E = .45(TA)$$

Firm B

$$D / TA = .45$$

$$(TA - E) / TA = .45$$

$$(TA / TA) - (E / TA) = .45$$

$$1 - (E / TA) = .45$$

$$E / TA = .55$$

$$E = .55(TA)$$

Rearranging ROA, we find:

$$NI / TA = .20$$

$$NI = .20(TA)$$

$$NI / TA = .28$$

$$NI = .28(TA)$$

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

$$ROE = .20(TA) / .45(TA) = .20 / .45 = 44.44\% \quad ROE = .28(TA) / .55(TA) = .28 / .55 = 50.91\%$$

**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:

$$EBT = \$10,157 / (1 - 0.34) = \$15,389.39$$

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

$$EBIT = EBT + \text{Interest paid} = \$15,389.39 + 3,405 = \$18,794.39$$

To get EBITD (earnings before interest, taxes, and depreciation), the numerator in the cash coverage ratio, add depreciation to EBIT:

$$\text{EBITD} = \text{EBIT} + \text{Depreciation} = \$18,794.39 + 2,186 = \$20,980.39$$

Now, simply plug the numbers into the cash coverage ratio and calculate:

$$\text{Cash coverage ratio} = \text{EBITD} / \text{Interest} = \$20,980.39 / \$3,405 = 6.16 \text{ times}$$

24. The only ratio given which includes cost of goods sold is the inventory turnover ratio, so it is the last ratio used. Since current liabilities is given, we start with the current ratio:

$$\begin{aligned} \text{Current ratio} &= 3.3 = \text{CA} / \text{CL} = \text{CA} / \$410,000 \\ \text{CA} &= \$1,353,000 \end{aligned}$$

Using the quick ratio, we solve for inventory:

$$\begin{aligned} \text{Quick ratio} &= 1.8 = (\text{CA} - \text{Inventory}) / \text{CL} = (\$1,353,000 - \text{Inventory}) / \$410,000 \\ \text{Inventory} &= \text{CA} - (\text{Quick ratio} \times \text{CL}) \\ \text{Inventory} &= \$1,353,000 - (1.8 \times \$410,000) \\ \text{Inventory} &= \$615,000 \end{aligned}$$

$$\begin{aligned} \text{Inventory turnover} &= 4.2 = \text{COGS} / \text{Inventory} = \text{COGS} / \$615,000 \\ \text{COGS} &= \$2,583,000 \end{aligned}$$

25.  $\text{PM} = \text{NI} / \text{S} = -\text{£}18,465 / \text{£}151,387 = -0.1220$  or  $-12.20\%$

As long as both net income and sales are measured in the same currency, there is no problem; in fact, except for some market value ratios like EPS and BVPS, none of the financial ratios discussed in the text are measured in terms of currency. This is one reason why financial ratio analysis is widely used in international finance to compare the business operations of firms and/or divisions across national economic borders. The net income in dollars is:

$$\begin{aligned} \text{NI} &= \text{PM} \times \text{Sales} \\ \text{NI} &= -0.1220(\$269,566) = -\$32,879.55 \end{aligned}$$

26. *Short-term solvency ratios:*

$$\begin{aligned} \text{Current ratio} &= \text{Current assets} / \text{Current liabilities} \\ \text{Current ratio 2006} &= \$52,169 / \$35,360 = 1.48 \text{ times} \\ \text{Current ratio 2007} &= \$60,891 / \$41,769 = 1.46 \text{ times} \end{aligned}$$

$$\begin{aligned} \text{Quick ratio} &= (\text{Current assets} - \text{Inventory}) / \text{Current liabilities} \\ \text{Quick ratio 2006} &= (\$52,169 - 21,584) / \$35,360 = 0.86 \text{ times} \\ \text{Quick ratio 2007} &= (\$60,891 - 24,876) / \$41,769 = 0.86 \text{ times} \end{aligned}$$

$$\begin{aligned} \text{Cash ratio} &= \text{Cash} / \text{Current liabilities} \\ \text{Cash ratio 2006} &= \$18,270 / \$35,360 = 0.52 \text{ times} \\ \text{Cash ratio 2007} &= \$22,150 / \$41,769 = 0.53 \text{ times} \end{aligned}$$

## B-26 SOLUTIONS

### *Asset utilization ratios:*

Total asset turnover	= Sales / Total assets
Total asset turnover	= \$285,760 / \$245,626 = 1.16 times
Inventory turnover	= Cost of goods sold / Inventory
Inventory turnover	= \$205,132 / \$24,876 = 8.25 times
Receivables turnover	= Sales / Accounts receivable
Receivables turnover	= \$285,760 / \$13,865 = 20.61 times

### *Long-term solvency ratios:*

Total debt ratio	= (Total assets – Total equity) / Total assets
Total debt ratio 2006	= (\$220,495 – 105,135) / \$220,495 = 0.52
Total debt ratio 2007	= (\$245,626 – 118,857) / \$245,626 = 0.52
Debt-equity ratio	= Total debt / Total equity
Debt-equity ratio 2006	= (\$35,360 + 80,000) / \$105,135 = 1.10
Debt-equity ratio 2007	= (\$41,769 + 85,000) / \$118,857 = 1.07
Equity multiplier	= 1 + D/E
Equity multiplier 2006	= 1 + 1.10 = 2.10
Equity multiplier 2007	= 1 + 1.07 = 2.07
Times interest earned	= EBIT / Interest
Times interest earned	= \$58,678 / \$9,875 = 5.94 times
Cash coverage ratio	= (EBIT + Depreciation) / Interest
Cash coverage ratio	= (\$58,678 + 21,950) / \$9,875 = 8.16 times

### *Profitability ratios:*

Profit margin	= Net income / Sales
Profit margin	= \$31,722 / \$285,760 = 0.1110 or 11.10%
Return on assets	= Net income / Total assets
Return on assets	= \$31,722 / \$245,626 = 0.1291 or 12.91%
Return on equity	= Net income / Total equity
Return on equity	= \$31,722 / \$118,857 = 0.2669 or 26.69%

27. The DuPont identity is:

$$\text{ROE} = (\text{PM})(\text{TAT})(\text{EM})$$
$$\text{ROE} = (0.110)(1.16)(2.07) = 0.2669 \text{ or } 26.69\%$$

28.

SMOLIRA GOLF CORP.  
Statement of Cash Flows  
For 2007

<b>Cash, beginning of the year</b>	\$ 18,270
 <i>Operating activities</i>	
Net income	\$ 31,722
Plus:	
Depreciation	\$ 21,950
Increase in accounts payable	1,103
Increase in other current liabilities	3,306
Less:	
Increase in accounts receivable	\$ (1,550)
Increase in inventory	(3,292)
	\$ 53,239
 <i>Investment activities</i>	
Fixed asset acquisition	\$(38,359)
<i>Net cash from investment activities</i>	\$(38,359)
 <i>Financing activities</i>	
Increase in notes payable	\$ 2,000
Dividends paid	(18,000)
Increase in long-term debt	5,000
<i>Net cash from financing activities</i>	\$(11,000)
 <i>Net increase in cash</i>	 \$ 3,880
 <b>Cash, end of year</b>	 \$ 22,150

29. Earnings per share = Net income / Shares  
Earnings per share =  $\$31,722 / 20,000 = \$1.59$  per share
- P/E ratio = Shares price / Earnings per share  
P/E ratio =  $\$43 / \$1.59 = 27.11$  times
- Dividends per share = Dividends / Shares  
Dividends per share =  $\$18,000 / 20,000 = \$0.90$  per share
- Book value per share = Total equity / Shares  
Book value per share =  $\$118,857 / 20,000 \text{ shares} = \$5.94$  per share

## B-28 SOLUTIONS

$$\begin{aligned}\text{Market-to-book ratio} &= \text{Share price} / \text{Book value per share} \\ \text{Market-to-book ratio} &= \$43 / \$5.94 = 7.24 \text{ times}\end{aligned}$$

$$\begin{aligned}\text{PEG ratio} &= \text{P/E ratio} / \text{Growth rate} \\ \text{PEG ratio} &= 27.11 / 9 = 3.01 \text{ times}\end{aligned}$$

- 30.** First, we will find the market value of the company's equity, which is:

$$\begin{aligned}\text{Market value of equity} &= \text{Shares} \times \text{Share price} \\ \text{Market value of equity} &= 20,000(\$43) = \$860,000\end{aligned}$$

The total book value of the company's debt is:

$$\begin{aligned}\text{Total debt} &= \text{Current liabilities} + \text{Long-term debt} \\ \text{Total debt} &= \$41,769 + 85,000 = \$126,769\end{aligned}$$

Now we can calculate Tobin's Q, which is:

$$\begin{aligned}\text{Tobin's Q} &= (\text{Market value of equity} + \text{Book value of debt}) / \text{Book value of assets} \\ \text{Tobin's Q} &= (\$860,000 + 126,769) / \$245,626 \\ \text{Tobin's Q} &= 4.02\end{aligned}$$

Using the book value of debt implicitly assumes that the book value of debt is equal to the market value of debt. This will be discussed in more detail in later chapters, but this assumption is generally true. Using the book value of assets assumes that the assets can be replaced at the current value on the balance sheet. There are several reasons this assumption could be flawed. First, inflation during the life of the assets can cause the book value of the assets to understate the market value of the assets. Since assets are recorded at cost when purchased, inflation means that it is more expensive to replace the assets. Second, improvements in technology could mean that the assets could be replaced with more productive, and possibly cheaper, assets. If this is true, the book value can overstate the market value of the assets. Finally, the book value of assets may not accurately represent the market value of the assets because of depreciation. Depreciation is done according to some schedule, generally straight-line or MACRS. Thus, the book value and market value can often diverge.

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# CHAPTER 4

## LONG-TERM FINANCIAL PLANNING AND GROWTH

### Answers to Concepts Review and Critical Thinking Questions

1. The reason is that, ultimately, sales are the driving force behind a business. A firm's assets, employees, and, in fact, just about every aspect of its operations and financing exist to directly or indirectly support sales. Put differently, a firm's future need for things like capital assets, employees, inventory, and financing are determined by its future sales level.
2. Two assumptions of the sustainable growth formula are that the company does not want to sell new equity, and that financial policy is fixed. If the company raises outside equity, or increases its debt-equity ratio it can grow at a higher rate than the sustainable growth rate. Of course the company could also grow faster than its profit margin increases, if it changes its dividend policy by increasing the retention ratio, or its total asset turnover increases.
3. The internal growth rate is greater than 15%, because at a 15% growth rate the negative EFN indicates that there is excess internal financing. If the internal growth rate is greater than 15%, then the sustainable growth rate is certainly greater than 15%, because there is additional debt financing used in that case (assuming the firm is not 100% equity-financed). As the retention ratio is increased, the firm has more internal sources of funding, so the EFN will decline. Conversely, as the retention ratio is decreased, the EFN will rise. If the firm pays out all its earnings in the form of dividends, then the firm has no internal sources of funding (ignoring the effects of accounts payable); the internal growth rate is zero in this case and the EFN will rise to the change in total assets.
4. The sustainable growth rate is greater than 20%, because at a 20% growth rate the negative EFN indicates that there is excess financing still available. If the firm is 100% equity financed, then the sustainable and internal growth rates are equal and the internal growth rate would be greater than 20%. However, when the firm has some debt, the internal growth rate is always less than the sustainable growth rate, so it is ambiguous whether the internal growth rate would be greater than or less than 20%. If the retention ratio is increased, the firm will have more internal funding sources available, and it will have to take on more debt to keep the debt/equity ratio constant, so the EFN will decline. Conversely, if the retention ratio is decreased, the EFN will rise. If the retention rate is zero, both the internal and sustainable growth rates are zero, and the EFN will rise to the change in total assets.
5. Presumably not, but, of course, if the product had been *much* less popular, then a similar fate would have awaited due to lack of sales.
6. Since customers did not pay until shipment, receivables rose. The firm's NWC, but not its cash, increased. At the same time, costs were rising faster than cash revenues, so operating cash flow declined. The firm's capital spending was also rising. Thus, all three components of cash flow from assets were negatively impacted.

## B-30 SOLUTIONS

7. Apparently not! In hindsight, the firm may have underestimated costs and also underestimated the extra demand from the lower price.
8. Financing possibly could have been arranged if the company had taken quick enough action. Sometimes it becomes apparent that help is needed only when it is too late, again emphasizing the need for planning.
9. All three were important, but the lack of cash or, more generally, financial resources ultimately spelled doom. An inadequate cash resource is usually cited as the most common cause of small business failure.
10. Demanding cash up front, increasing prices, subcontracting production, and improving financial resources via new owners or new sources of credit are some of the options. When orders exceed capacity, price increases may be especially beneficial.

### Solutions to Questions and Problems

*NOTE: All end of chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.*

#### Basic

1. It is important to remember that equity will not increase by the same percentage as the other assets. If every other item on the income statement and balance sheet increases by 10 percent, the pro forma income statement and balance sheet will look like this:

<u>Pro forma income statement</u>		<u>Pro forma balance sheet</u>			
Sales	\$20,900	Assets	\$10,890	Debt	\$ 5,610
Costs	<u>14,850</u>			Equity	<u>5,280</u>
Net income	<u>\$ 6,050</u>	Total	<u>\$10,890</u>	Total	<u>\$10,890</u>

In order for the balance sheet to balance, equity must be:

$$\text{Equity} = \text{Total liabilities and equity} - \text{Debt}$$

$$\text{Equity} = \$10,890 - 5,610$$

$$\text{Equity} = \$5,280$$

Equity increased by:

$$\text{Equity increase} = \$5,280 - 4,800$$

$$\text{Equity increase} = \$480$$

Net income is \$6,050 but equity only increased by \$480; therefore, a dividend of:

$$\begin{aligned} \text{Dividend} &= \$6,050 - 480 \\ \text{Dividend} &= \$5,570 \end{aligned}$$

must have been paid. Dividends paid is the plug variable.

2. Here we are given the dividend amount, so dividends paid is not a plug variable. If the company pays out one-half of its net income as dividends, the pro forma income statement and balance sheet will look like this:

<u>Pro forma income statement</u>		<u>Pro forma balance sheet</u>			
Sales	\$20,090	Assets	\$10,890	Debt	\$ 5,100
Costs	<u>14,850</u>			Equity	<u>7,825</u>
Net income	<u>\$ 6,050</u>	Total	<u>\$10,890</u>	Total	<u>\$12,925</u>
Dividends	\$ 3,025				
Add. to RE	3,025				

Note that the balance sheet does not balance. This is due to EFN. The EFN for this company is:

$$\begin{aligned} \text{EFN} &= \text{Total assets} - \text{Total liabilities and equity} \\ \text{EFN} &= \$10,890 - 12,925 \\ \text{EFN} &= -\$2,035 \end{aligned}$$

3. An increase of sales to \$5,967 is an increase of:

$$\begin{aligned} \text{Sales increase} &= (\$5,967 - 5,100) / \$5,100 \\ \text{Sales increase} &= .17 \text{ or } 17\% \end{aligned}$$

Assuming costs and assets increase proportionally, the pro forma financial statements will look like this:

<u>Pro forma income statement</u>		<u>Pro forma balance sheet</u>			
Sales	\$ 5,967	Assets	\$ 16,965	Debt	\$ 10,200
Costs	<u>4,072</u>			Equity	<u>6,195</u>
Net income	<u>\$ 1,895</u>	Total	<u>\$ 16,965</u>	Total	<u>\$ 16,395</u>

If no dividends are paid, the equity account will increase by the net income, so:

$$\begin{aligned} \text{Equity} &= \$4,300 + 1,895 \\ \text{Equity} &= \$6,195 \end{aligned}$$

So the EFN is:

$$\begin{aligned} \text{EFN} &= \text{Total assets} - \text{Total liabilities and equity} \\ \text{EFN} &= \$16,965 - 16,395 = \$570 \end{aligned}$$

B-32 SOLUTIONS

4. An increase of sales to \$27,600 is an increase of:

$$\text{Sales increase} = (\$27,600 - 23,000) / \$23,000$$

$$\text{Sales increase} = .20 \text{ or } 20\%$$

Assuming costs and assets increase proportionally, the pro forma financial statements will look like this:

<u>Pro forma income statement</u>		<u>Pro forma balance sheet</u>			
Sales	\$ 27,600	Assets	\$ 138,000	Debt	\$ 38,600
Costs	<u>19,800</u>			Equity	<u>79,208</u>
EBIT	7,800	Total	<u>\$ 138,000</u>	Total	<u>\$ 117,808</u>
Taxes (40%)	<u>3,120</u>				
Net income	<u>\$ 4,680</u>				

The payout ratio is constant, so the dividends paid this year is the payout ratio from last year times net income, or:

$$\text{Dividends} = (\$1,560 / \$3,900)(\$4,680)$$

$$\text{Dividends} = \$1,872$$

The addition to retained earnings is:

$$\text{Addition to retained earnings} = \$4,680 - 1,872$$

$$\text{Addition to retained earnings} = \$2,808$$

And the new equity balance is:

$$\text{Equity} = \$76,400 + 2,808$$

$$\text{Equity} = \$79,208$$

So the EFN is:

$$\text{EFN} = \text{Total assets} - \text{Total liabilities and equity}$$

$$\text{EFN} = \$138,000 - 117,808$$

$$\text{EFN} = \$20,192$$

5. Assuming costs and assets increase proportionally, the pro forma financial statements will look like this:

<u>Pro forma income statement</u>		<u>Pro forma balance sheet</u>			
Sales	\$3,910.00	CA	\$5,060.00	CL	\$1,012.00
Costs	<u>3,220.00</u>	FA	6,555.00	LTD	3,580.00
Taxable income	690.00			Equity	<u>5,867.70</u>
Taxes (34%)	<u>234.60</u>	Total	<u>\$11,615.00</u>	Total	<u>\$10,459.70</u>
Net income	<u>\$ 455.40</u>				

The payout ratio is 50 percent, so dividends will be:

$$\begin{aligned}\text{Dividends} &= 0.50(\$455.40) \\ \text{Dividends} &= \$227.70\end{aligned}$$

The addition to retained earnings is:

$$\begin{aligned}\text{Addition to retained earnings} &= \$455.40 - 227.70 \\ \text{Addition to retained earnings} &= \$227.70\end{aligned}$$

So the EFN is:

$$\begin{aligned}\text{EFN} &= \text{Total assets} - \text{Total liabilities and equity} \\ \text{EFN} &= \$11,615.00 - 10,459.70 \\ \text{EFN} &= \$1,155.30\end{aligned}$$

6. To calculate the internal growth rate, we first need to calculate the ROA, which is:

$$\begin{aligned}\text{ROA} &= \text{NI} / \text{TA} \\ \text{ROA} &= \$2,805 / \$42,300 \\ \text{ROA} &= .0663 \text{ or } 6.63\%\end{aligned}$$

The plowback ratio,  $b$ , is one minus the payout ratio, so:

$$\begin{aligned}b &= 1 - .20 \\ b &= .80\end{aligned}$$

Now we can use the internal growth rate equation to get:

$$\begin{aligned}\text{Internal growth rate} &= (\text{ROA} \times b) / [1 - (\text{ROA} \times b)] \\ \text{Internal growth rate} &= [0.0663(.80)] / [1 - 0.0663(.80)] \\ \text{Internal growth rate} &= .0560 \text{ or } 5.60\%\end{aligned}$$

7. To calculate the sustainable growth rate, we first need to calculate the ROE, which is:

$$\begin{aligned}\text{ROE} &= \text{NI} / \text{TE} \\ \text{ROE} &= \$2,805 / \$17,400 \\ \text{ROE} &= .1612 \text{ or } 16.12\%\end{aligned}$$

The plowback ratio,  $b$ , is one minus the payout ratio, so:

$$\begin{aligned}b &= 1 - .20 \\ b &= .80\end{aligned}$$

Now we can use the sustainable growth rate equation to get:

$$\begin{aligned}\text{Sustainable growth rate} &= (\text{ROE} \times b) / [1 - (\text{ROE} \times b)] \\ \text{Sustainable growth rate} &= [0.1612(.80)] / [1 - 0.1612(.80)] \\ \text{Sustainable growth rate} &= .1481 \text{ or } 14.81\%\end{aligned}$$

## B-34 SOLUTIONS

8. The maximum percentage sales increase is the sustainable growth rate. To calculate the sustainable growth rate, we first need to calculate the ROE, which is:

$$\text{ROE} = \text{NI} / \text{TE}$$

$$\text{ROE} = \$10,890 / \$65,000$$

$$\text{ROE} = .1675$$

The plowback ratio,  $b$ , is one minus the payout ratio, so:

$$b = 1 - .30$$

$$b = .70$$

Now we can use the sustainable growth rate equation to get:

$$\text{Sustainable growth rate} = (\text{ROE} \times b) / [1 - (\text{ROE} \times b)]$$

$$\text{Sustainable growth rate} = [.1675(.70)] / [1 - .1675(.70)]$$

$$\text{Sustainable growth rate} = .1329 \text{ or } 13.29\%$$

So, the maximum dollar increase in sales is:

$$\text{Maximum increase in sales} = \$46,000(.1329)$$

$$\text{Maximum increase in sales} = \$6,111.47$$

9. Assuming costs vary with sales and a 20 percent increase in sales, the pro forma income statement will look like this:

HEIR JORDAN CORPORATION	
Pro Forma Income Statement	
Sales	\$38,400.00
Costs	<u>15,480.00</u>
Taxable income	\$22,920.00
Taxes (34%)	<u>7,792.80</u>
Net income	<u>\$ 15,127.20</u>

The payout ratio is constant, so the dividends paid this year is the payout ratio from last year times net income, or:

$$\text{Dividends} = (\$4,800/\$12,606)(\$15,127.20)$$

$$\text{Dividends} = \$5,760.00$$

And the addition to retained earnings will be:

$$\text{Addition to retained earnings} = \$15,127.20 - 5,760$$

$$\text{Addition to retained earnings} = \$9,367.20$$

10. Below is the balance sheet with the percentage of sales for each account on the balance sheet. Notes payable, total current liabilities, long-term debt, and all equity accounts do not vary directly with sales.

HEIR JORDAN CORPORATION					
Balance Sheet					
Assets			Liabilities and Owners' Equity		
	(\$)	(%)		(\$)	(%)
<b>Assets</b>			<b>Liabilities and Owners' Equity</b>		
<b>Current assets</b>			<b>Current liabilities</b>		
Cash	\$ 3,650	11.41	Accounts payable	\$ 2,900	9.06
Accounts receivable	7,200	22.50	Notes payable	<u>7,600</u>	n/a
Inventory	<u>6,300</u>	<u>19.69</u>	Total	<u>\$10,500</u>	n/a
Total	<u>\$17,150</u>	<u>53.59</u>	Long-term debt	<u>21,000</u>	n/a
<b>Fixed assets</b>			<b>Owners' equity</b>		
Net plant and equipment	<u>31,500</u>	<u>98.44</u>	Common stock and paid-in surplus	\$15,000	n/a
			Retained earnings	<u>2,150</u>	n/a
			Total	<u>\$17,150</u>	n/a
Total assets	<u>\$48,650</u>	<u>152.03</u>	Total liabilities and owners' equity	<u>\$48,650</u>	n/a

11. Assuming costs vary with sales and a 15 percent increase in sales, the pro forma income statement will look like this:

HEIR JORDAN CORPORATION	
Pro Forma Income Statement	
Sales	\$36,800.00
Costs	<u>14,835.00</u>
Taxable income	\$21,965.00
Taxes (34%)	<u>7,468.10</u>
Net income	<u>\$ 14,496.90</u>

The payout ratio is constant, so the dividends paid this year is the payout ratio from last year times net income, or:

$$\text{Dividends} = (\$4,800/\$12,606)(\$14,496.90)$$

$$\text{Dividends} = \$5,520.00$$

And the addition to retained earnings will be:

$$\text{Addition to retained earnings} = \$14,496.90 - 5,520$$

$$\text{Addition to retained earnings} = \$8,976.90$$

The new accumulated retained earnings on the pro forma balance sheet will be:

$$\text{New accumulated retained earnings} = \$2,150 + 8,976.90$$

$$\text{New accumulated retained earnings} = \$11,126.90$$

B-36 SOLUTIONS

The pro forma balance sheet will look like this:

HEIR JORDAN CORPORATION  
Pro Forma Balance Sheet

Assets		Liabilities and Owners' Equity	
Current assets		Current liabilities	
Cash	\$ 4,197.50	Accounts payable	\$ 3,335.00
Accounts receivable	8,280.00	Notes payable	<u>7,600.00</u>
Inventory	<u>7,245.00</u>	Total	\$ 10,935.00
Total	\$ 19,722.50	Long-term debt	21,000.00
Fixed assets		Owners' equity	
Net plant and equipment	<u>36,225</u>	Common stock and paid-in surplus	\$ 15,000.00
		Retained earnings	<u>11,126.90</u>
		Total	<u>\$ 26,126.90</u>
Total assets	<u>\$ 55,947.50</u>	Total liabilities and owners' equity	<u>\$ 58,061.90</u>

So the EFN is:

$$\begin{aligned} \text{EFN} &= \text{Total assets} - \text{Total liabilities and equity} \\ \text{EFN} &= \$55,947.50 - 58,061.90 \\ \text{EFN} &= -\$2,114.40 \end{aligned}$$

12. We need to calculate the retention ratio to calculate the internal growth rate. The retention ratio is:

$$\begin{aligned} b &= 1 - .15 \\ b &= .85 \end{aligned}$$

Now we can use the internal growth rate equation to get:

$$\begin{aligned} \text{Internal growth rate} &= (\text{ROA} \times b) / [1 - (\text{ROA} \times b)] \\ \text{Internal growth rate} &= [.09(.85)] / [1 - .09(.85)] \\ \text{Internal growth rate} &= .0828 \text{ or } 8.28\% \end{aligned}$$

13. We need to calculate the retention ratio to calculate the sustainable growth rate. The retention ratio is:

$$\begin{aligned} b &= 1 - .20 \\ b &= .80 \end{aligned}$$

Now we can use the sustainable growth rate equation to get:

$$\begin{aligned} \text{Sustainable growth rate} &= (\text{ROE} \times b) / [1 - (\text{ROE} \times b)] \\ \text{Sustainable growth rate} &= [.16(.80)] / [1 - .16(.80)] \\ \text{Sustainable growth rate} &= .1468 \text{ or } 14.68\% \end{aligned}$$

14. We first must calculate the ROE to calculate the sustainable growth rate. To do this we must realize two other relationships. The total asset turnover is the inverse of the capital intensity ratio, and the equity multiplier is  $1 + D/E$ . Using these relationships, we get:

$$\begin{aligned} \text{ROE} &= (\text{PM})(\text{TAT})(\text{EM}) \\ \text{ROE} &= (.089)(1/.75)(1 + .60) \\ \text{ROE} &= .1899 \text{ or } 18.99\% \end{aligned}$$

The plowback ratio is one minus the dividend payout ratio, so:

$$\begin{aligned} b &= 1 - (\$16,000 / \$34,000) \\ b &= .5294 \end{aligned}$$

Now we can use the sustainable growth rate equation to get:

$$\begin{aligned} \text{Sustainable growth rate} &= (\text{ROE} \times b) / [1 - (\text{ROE} \times b)] \\ \text{Sustainable growth rate} &= [.1899(.5294)] / [1 - .1899(.5294)] \\ \text{Sustainable growth rate} &= .1118 \text{ or } 11.18\% \end{aligned}$$

15. We must first calculate the ROE using the DuPont ratio to calculate the sustainable growth rate. The ROE is:

$$\begin{aligned} \text{ROE} &= (\text{PM})(\text{TAT})(\text{EM}) \\ \text{ROE} &= (.076)(1.90)(1.40) \\ \text{ROE} &= .2022 \text{ or } 20.22\% \end{aligned}$$

The plowback ratio is one minus the dividend payout ratio, so:

$$\begin{aligned} b &= 1 - .40 \\ b &= .60 \end{aligned}$$

Now we can use the sustainable growth rate equation to get:

$$\begin{aligned} \text{Sustainable growth rate} &= (\text{ROE} \times b) / [1 - (\text{ROE} \times b)] \\ \text{Sustainable growth rate} &= [.2022(.60)] / [1 - .2022(.60)] \\ \text{Sustainable growth rate} &= .1380 \text{ or } 13.80\% \end{aligned}$$

### Intermediate

16. To determine full capacity sales, we divide the current sales by the capacity the company is currently using, so:

$$\begin{aligned} \text{Full capacity sales} &= \$610,000 / .90 \\ \text{Full capacity sales} &= \$677,778 \end{aligned}$$

The maximum sales growth is the full capacity sales divided by the current sales, so:

$$\begin{aligned} \text{Maximum sales growth} &= (\$677,778 / \$610,000) - 1 \\ \text{Maximum sales growth} &= .1111 \text{ or } 11.11\% \end{aligned}$$

## B-38 SOLUTIONS

17. To find the new level of fixed assets, we need to find the current percentage of fixed assets to full capacity sales. Doing so, we find:

$$\text{Fixed assets} / \text{Full capacity sales} = \$470,000 / \$677,778$$

$$\text{Fixed assets} / \text{Full capacity sales} = .6934$$

Next, we calculate the total dollar amount of fixed assets needed at the new sales figure.

$$\text{Total fixed assets} = .6934(\$710,000)$$

$$\text{Total fixed assets} = \$492,344$$

The new fixed assets necessary is the total fixed assets at the new sales figure minus the current level of fixed assets.

$$\text{New fixed assets} = \$492,344 - 470,000$$

$$\text{New fixed assets} = \$22,344$$

18. We have all the variables to calculate ROE using the DuPont identity except the profit margin. If we find ROE, we can solve the DuPont identity for profit margin. We can calculate ROE from the sustainable growth rate equation. For this equation we need the retention ratio, so:

$$b = 1 - .30$$

$$b = .70$$

Using the sustainable growth rate equation and solving for ROE, we get:

$$\text{Sustainable growth rate} = (\text{ROE} \times b) / [1 - (\text{ROE} \times b)]$$

$$.12 = [\text{ROE}(.70)] / [1 - \text{ROE}(.70)]$$

$$\text{ROE} = .1531 \text{ or } 15.31\%$$

Now we can use the DuPont identity to find the profit margin as:

$$\text{ROE} = \text{PM}(\text{TAT})(\text{EM})$$

$$.1531 = \text{PM}(1 / 0.95)(1 + .60)$$

$$\text{PM} = (.1531) / [(1 / 0.95)(1.60)]$$

$$\text{PM} = .0909 \text{ or } 9.09\%$$

19. We have all the variables to calculate ROE using the DuPont identity except the equity multiplier. Remember that the equity multiplier is one plus the debt-equity ratio. If we find ROE, we can solve the DuPont identity for equity multiplier, then the debt-equity ratio. We can calculate ROE from the sustainable growth rate equation. For this equation we need the retention ratio, so:

$$b = 1 - .40$$

$$b = .60$$

Using the sustainable growth rate equation and solving for ROE, we get:

$$\text{Sustainable growth rate} = (\text{ROE} \times b) / [1 - (\text{ROE} \times b)]$$

$$.14 = [\text{ROE}(.60)] / [1 - \text{ROE}(.60)]$$

$$\text{ROE} = .2047 \text{ or } 20.47\%$$

Now we can use the DuPont identity to find the equity multiplier as:

$$\begin{aligned} \text{ROE} &= \text{PM}(\text{TAT})(\text{EM}) \\ .2047 &= (.085)(1 / .8)\text{EM} \\ \text{EM} &= (.2047)(.8) / .085 \\ \text{EM} &= 1.93 \end{aligned}$$

So, the D/E ratio is:

$$\begin{aligned} \text{D/E} &= \text{EM} - 1 \\ \text{D/E} &= 1.93 - 1 \\ \text{D/E} &= 0.93 \end{aligned}$$

- 20.** We are given the profit margin. Remember that:

$$\text{ROA} = \text{PM}(\text{TAT})$$

We can calculate the ROA from the internal growth rate formula, and then use the ROA in this equation to find the total asset turnover. The retention ratio is:

$$\begin{aligned} b &= 1 - .20 \\ b &= .80 \end{aligned}$$

Using the internal growth rate equation to find the ROA, we get:

$$\begin{aligned} \text{Internal growth rate} &= (\text{ROA} \times b) / [1 - (\text{ROA} \times b)] \\ .08 &= [\text{ROA}(.80)] / [1 - \text{ROA}(.80)] \\ \text{ROA} &= .0926 \text{ or } 9.26\% \end{aligned}$$

Plugging ROA and PM into the equation we began with and solving for TAT, we get:

$$\begin{aligned} \text{ROA} &= (\text{PM})(\text{TAT}) \\ .0926 &= .07(\text{PM}) \\ \text{TAT} &= .0926 / .07 \\ \text{TAT} &= 1.32 \text{ times} \end{aligned}$$

- 21.** We should begin by calculating the D/E ratio. We calculate the D/E ratio as follows:

$$\text{Total debt ratio} = .40 = \text{TD} / \text{TA}$$

Inverting both sides we get:

$$1 / .40 = \text{TA} / \text{TD}$$

Next, we need to recognize that

$$\text{TA} / \text{TD} = 1 + \text{TE} / \text{TD}$$

Substituting this into the previous equation, we get:

$$1 / .40 = 1 + \text{TE} / \text{TD}$$

## B-40 SOLUTIONS

Subtract 1 (one) from both sides and inverting again, we get:

$$\begin{aligned} D/E &= 1 / [(1 / .40) - 1] \\ D/E &= 0.67 \end{aligned}$$

With the D/E ratio, we can calculate the EM and solve for ROE using the DuPont identity:

$$\begin{aligned} \text{ROE} &= (\text{PM})(\text{TAT})(\text{EM}) \\ \text{ROE} &= (.064)(1.70)(1 + 0.67) \\ \text{ROE} &= .1813 \text{ or } 18.13\% \end{aligned}$$

Now we can calculate the retention ratio as:

$$\begin{aligned} b &= 1 - .40 \\ b &= .60 \end{aligned}$$

Finally, putting all the numbers we have calculated into the sustainable growth rate equation, we get:

$$\begin{aligned} \text{Sustainable growth rate} &= (\text{ROE} \times b) / [1 - (\text{ROE} \times b)] \\ \text{Sustainable growth rate} &= [.1813(.60)] / [1 - .1813(.60)] \\ \text{Sustainable growth rate} &= .1221 \text{ or } 12.21\% \end{aligned}$$

22. To calculate the sustainable growth rate, we first must calculate the retention ratio and ROE. The retention ratio is:

$$\begin{aligned} b &= 1 - \$11,500 / \$16,000 \\ b &= .2813 \end{aligned}$$

And the ROE is:

$$\begin{aligned} \text{ROE} &= \$16,000 / \$44,000 \\ \text{ROE} &= .3636 \text{ or } 36.36\% \end{aligned}$$

So, the sustainable growth rate is:

$$\begin{aligned} \text{Sustainable growth rate} &= (\text{ROE} \times b) / [1 - (\text{ROE} \times b)] \\ \text{Sustainable growth rate} &= [.3636(.2813)] / [1 - .3636(.2813)] \\ \text{Sustainable growth rate} &= .1139 \text{ or } 11.39\% \end{aligned}$$

If the company grows at the sustainable growth rate, the new level of total assets is:

$$\text{New TA} = 1.1139(\$164,000) = \$182,683.54$$

To find the new level of debt in the company's balance sheet, we take the percentage of debt in the capital structure times the new level of total assets. The additional borrowing will be the new level of debt minus the current level of debt. So:

$$\begin{aligned} \text{New TD} &= [D / (D + E)](\text{TA}) \\ \text{New TD} &= [\$120,000 / (\$120,000 + 44,000)](\$182,683.54) \\ \text{New TD} &= \$133,670.89 \end{aligned}$$

And the additional borrowing will be:

$$\begin{aligned}\text{Additional borrowing} &= \$133,670.89 - 120,000 \\ \text{Additional borrowing} &= \$13,670.89\end{aligned}$$

The growth rate that can be supported with no outside financing is the internal growth rate. To calculate the internal growth rate, we first need the ROA, which is:

$$\begin{aligned}\text{ROA} &= \$16,000 / \$164,000 \\ \text{ROA} &= .0976 \text{ or } 9.76\%\end{aligned}$$

This means the internal growth rate is:

$$\begin{aligned}\text{Internal growth rate} &= (\text{ROA} \times b) / [1 - (\text{ROA} \times b)] \\ \text{Internal growth rate} &= [.0976(.2813)] / [1 - .0976(.2813)] \\ \text{Internal growth rate} &= .0282 \text{ or } 2.82\%\end{aligned}$$

- 23.** Since the company issued no new equity, shareholders' equity increased by retained earnings. Retained earnings for the year were:

$$\begin{aligned}\text{Retained earnings} &= \text{NI} - \text{Dividends} \\ \text{Retained earnings} &= \$60,000 - 26,000 \\ \text{Retained earnings} &= \$34,000\end{aligned}$$

So, the equity at the end of the year was:

$$\begin{aligned}\text{Ending equity} &= \$145,000 + 34,000 \\ \text{Ending equity} &= \$179,000\end{aligned}$$

The ROE based on the end of period equity is:

$$\begin{aligned}\text{ROE} &= \$60,000 / \$179,000 \\ \text{ROE} &= 33.52\%\end{aligned}$$

The plowback ratio is:

$$\begin{aligned}\text{Plowback ratio} &= \text{Addition to retained earnings} / \text{NI} \\ \text{Plowback ratio} &= \$34,000 / \$60,000 \\ \text{Plowback ratio} &= .5667 \text{ or } 56.67\%\end{aligned}$$

Using the equation presented in the text for the sustainable growth rate, we get:

$$\begin{aligned}\text{Sustainable growth rate} &= (\text{ROE} \times b) / [1 - (\text{ROE} \times b)] \\ \text{Sustainable growth rate} &= [.3352(.5667)] / [1 - .3352(.5667)] \\ \text{Sustainable growth rate} &= .2345 \text{ or } 23.45\%\end{aligned}$$

The ROE based on the beginning of period equity is

$$\begin{aligned}\text{ROE} &= \$60,000 / \$145,000 \\ \text{ROE} &= .4138 \text{ or } 41.38\%\end{aligned}$$

## B-42 SOLUTIONS

Using the shortened equation for the sustainable growth rate and the beginning of period ROE, we get:

$$\begin{aligned}\text{Sustainable growth rate} &= \text{ROE} \times b \\ \text{Sustainable growth rate} &= .4138 \times .5667 \\ \text{Sustainable growth rate} &= .2345 \text{ or } 23.45\%\end{aligned}$$

Using the shortened equation for the sustainable growth rate and the end of period ROE, we get:

$$\begin{aligned}\text{Sustainable growth rate} &= \text{ROE} \times b \\ \text{Sustainable growth rate} &= .3352 \times .5667 \\ \text{Sustainable growth rate} &= .1899 \text{ or } 18.99\%\end{aligned}$$

Using the end of period ROE in the shortened sustainable growth rate results in a growth rate that is too low. This will always occur whenever the equity increases. If equity increases, the ROE based on end of period equity is lower than the ROE based on the beginning of period equity. The ROE (and sustainable growth rate) in the abbreviated equation is based on equity that did not exist when the net income was earned.

- 24.** The ROA using end of period assets is:

$$\begin{aligned}\text{ROA} &= \$60,000 / \$270,000 \\ \text{ROA} &= .2222 \text{ or } 22.22\%\end{aligned}$$

The beginning of period assets had to have been the ending assets minus the addition to retained earnings, so:

$$\begin{aligned}\text{Beginning assets} &= \text{Ending assets} - \text{Addition to retained earnings} \\ \text{Beginning assets} &= \$270,000 - (\$60,000 - 26,000) \\ \text{Beginning assets} &= \$236,000\end{aligned}$$

And the ROA using beginning of period assets is:

$$\begin{aligned}\text{ROA} &= \$60,000 / \$236,000 \\ \text{ROA} &= .2542 \text{ or } 25.42\%\end{aligned}$$

Using the internal growth rate equation presented in the text, we get:

$$\begin{aligned}\text{Internal growth rate} &= (\text{ROA} \times b) / [1 - (\text{ROA} \times b)] \\ \text{Internal growth rate} &= [.2222(.5667)] / [1 - .2222(.5667)] \\ \text{Internal growth rate} &= .1441 \text{ or } 14.41\%\end{aligned}$$

Using the formula  $\text{ROA} \times b$ , and end of period assets:

$$\begin{aligned}\text{Internal growth rate} &= .2222 \times .5667 \\ \text{Internal growth rate} &= .1259 \text{ or } 12.59\%\end{aligned}$$

Using the formula  $\text{ROA} \times b$ , and beginning of period assets:

$$\begin{aligned}\text{Internal growth rate} &= .2542 \times .5667 \\ \text{Internal growth rate} &= .1441 \text{ or } 14.41\%\end{aligned}$$

25. Assuming costs vary with sales and a 20 percent increase in sales, the pro forma income statement will look like this:

MOOSE TOURS INC. Pro Forma Income Statement	
Sales	\$ 1,014,000
Costs	788,400
Other expenses	<u>21,000</u>
EBIT	\$ 204,600
Interest	<u>12,500</u>
Taxable income	\$ 192,100
Taxes(35%)	<u>67,235</u>
Net income	<u>\$ 124,865</u>

The payout ratio is constant, so the dividends paid this year is the payout ratio from last year times net income, or:

$$\text{Dividends} = (\$30,810/\$102,700)(\$124,865)$$

$$\text{Dividends} = \$37,460$$

And the addition to retained earnings will be:

$$\text{Addition to retained earnings} = \$124,865 - 37,460$$

$$\text{Addition to retained earnings} = \$87,406$$

The new addition to retained earnings on the pro forma balance sheet will be:

$$\text{New addition to retained earnings} = \$193,000 + 87,406$$

$$\text{New addition to retained earnings} = \$280,406$$

The pro forma balance sheet will look like this:

MOOSE TOURS INC. Pro Forma Balance Sheet			
Assets		Liabilities and Owners' Equity	
Current assets		Current liabilities	
Cash	\$ 27,600	Accounts payable	\$ 74,400
Accounts receivable	44,400	Notes payable	<u>15,000</u>
Inventory	<u>94,800</u>	Total	\$ 89,400
Total	\$ 166,800	Long-term debt	<u>144,000</u>
Fixed assets		Owners' equity	
Net plant and equipment	<u>450,000</u>	Common stock and paid-in surplus	\$ 100,000
		Retained earnings	<u>280,406</u>
		Total	<u>\$ 380,406</u>
Total assets	<u>\$ 616,800</u>	Total liabilities and owners' equity	<u>\$ 613,806</u>

## B-44 SOLUTIONS

So the EFN is:

$$\text{EFN} = \text{Total assets} - \text{Total liabilities and equity}$$

$$\text{EFN} = \$616,800 - 613,806$$

$$\text{EFN} = \$2,994.50$$

**26.** First, we need to calculate full capacity sales, which is:

$$\text{Full capacity sales} = \$845,000 / .80$$

$$\text{Full capacity sales} = \$1,056,250$$

The capital intensity ratio at full capacity sales is:

$$\text{Capital intensity ratio} = \text{Fixed assets} / \text{Full capacity sales}$$

$$\text{Capital intensity ratio} = \$375,000 / \$1,056,250$$

$$\text{Capital intensity ratio} = .35503$$

The fixed assets required at full capacity sales is the capital intensity ratio times the projected sales level:

$$\text{Total fixed assets} = .35503(\$1,014,000) = \$360,000$$

So, EFN is:

$$\text{EFN} = (\$166,800 + 360,000) - \$613,806 = -\$87,006$$

Note that this solution assumes that fixed assets are decreased (sold) so the company has a 100 percent fixed asset utilization. If we assume fixed assets are not sold, the answer becomes:

$$\text{EFN} = (\$166,800 + 375,000) - \$613,806 = -\$72,006$$

**27.** The D/E ratio of the company is:

$$\text{D/E} = (\$77,000 + 144,000) / \$293,000$$

$$\text{D/E} = .75427$$

So the new total debt amount will be:

$$\text{New total debt} = .75427(\$380,406)$$

$$\text{New total debt} = \$286,927$$

So the EFN is:

$$\text{EFN} = \$616,800 - (\$286,927 + 380,406) = -\$50,533$$

An interpretation of the answer is not that the company has a negative EFN. Looking back at Problem 25, we see that for the same sales growth, the EFN is \$2,995. The negative number in this case means the company has too much capital. There are two possible solutions. First, the company can put the excess funds in cash, which has the effect of changing the current asset growth rate. Second, the company can use the excess funds to repurchase debt and equity. To maintain the current capital structure, the repurchase must be in the same proportion as the current capital structure.

Challenge

28. The pro forma income statements for all three growth rates will be:

MOOSE TOURS INC.			
Pro Forma Income Statement			
	<i>15 % Sales Growth</i>	<i>20% Sales Growth</i>	<i>25% Sales Growth</i>
Sales	\$971,750	\$1,014,000	\$1,056,250
Costs	755,550	788,400	821,250
Other expenses	<u>20,125</u>	<u>21,000</u>	<u>21,875</u>
EBIT	\$ 196,075	\$ 204,600	\$213,125
Interest	<u>12,500</u>	<u>12,500</u>	<u>12,500</u>
Taxable income	\$ 183,575	\$ 192,100	\$200,625
Taxes (35%)	<u>64,251</u>	<u>67,235</u>	<u>70,219</u>
Net income	<u>\$ 119,324</u>	<u>\$ 124,865</u>	<u>\$130,406</u>
Dividends	\$ 35,797	\$ 37,460	\$39,122
Add to RE	83,527	87,406	91,284

We will calculate the EFN for the 15 percent growth rate first. Assuming the payout ratio is constant, the dividends paid will be:

$$\text{Dividends} = (\$30,810/\$102,700)(\$119,324)$$

$$\text{Dividends} = \$35,797$$

And the addition to retained earnings will be:

$$\text{Addition to retained earnings} = \$119,324 - 35,797$$

$$\text{Addition to retained earnings} = \$83,527$$

The new addition to retained earnings on the pro forma balance sheet will be:

$$\text{New addition to retained earnings} = \$193,000 + 83,527$$

$$\text{New addition to retained earnings} = \$276,527$$

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The pro forma balance sheet will look like this:

15% Sales Growth:

MOOSE TOURS INC.  
Pro Forma Balance Sheet

Assets		Liabilities and Owners' Equity	
Current assets		Current liabilities	
Cash	\$ 26,450	Accounts payable	\$ 71,300
Accounts receivable	42,550	Notes payable	<u>15,000</u>
Inventory	<u>90,850</u>	Total	\$ 86,300
Total	\$ 159,850	Long-term debt	<u>144,000</u>
Fixed assets		Owners' equity	
Net plant and equipment	<u>431,250</u>	Common stock and paid-in surplus	\$ 100,000
		Retained earnings	<u>276,527</u>
		Total	\$ <u>376,527</u>
Total assets	<u>\$ 591,100</u>	Total liabilities and owners' equity	<u>\$ 606,827</u>

So the EFN is:

$$\text{EFN} = \text{Total assets} - \text{Total liabilities and equity}$$

$$\text{EFN} = \$591,100 - 606,827$$

$$\text{EFN} = -\$15,727$$

At a 20 percent growth rate, and assuming the payout ratio is constant, the dividends paid will be:

$$\text{Dividends} = (\$30,810/\$102,700)(\$124,865)$$

$$\text{Dividends} = \$37,460$$

And the addition to retained earnings will be:

$$\text{Addition to retained earnings} = \$124,865 - 37,460$$

$$\text{Addition to retained earnings} = \$87,406$$

The new addition to retained earnings on the pro forma balance sheet will be:

$$\text{New addition to retained earnings} = \$193,000 + 87,406$$

$$\text{New addition to retained earnings} = \$280,406$$

The pro forma balance sheet will look like this:

20% Sales Growth:

MOOSE TOURS INC.  
Pro Forma Balance Sheet

Assets	Liabilities and Owners' Equity
<p>Current assets</p> <p style="padding-left: 20px;">Cash                                 \$    27,600</p> <p style="padding-left: 20px;">Accounts receivable                 44,400</p> <p style="padding-left: 20px;">Inventory                                 <u>94,800</u></p> <p style="padding-left: 40px;">Total                                 \$   166,800</p> <p>Fixed assets</p> <p style="padding-left: 20px;">Net plant and equipment             <u>450,000</u></p> <p style="margin-top: 20px;">Total assets                             <u>\$   616,800</u></p>	<p>Current liabilities</p> <p style="padding-left: 20px;">Accounts payable                     \$    74,400</p> <p style="padding-left: 20px;">Notes payable                         <u>15,000</u></p> <p style="padding-left: 40px;">Total                                 \$    89,400</p> <p>Long-term debt                         <u>144,000</u></p> <p>Owners' equity</p> <p style="padding-left: 20px;">Common stock and paid-in surplus             \$   100,000</p> <p style="padding-left: 20px;">Retained earnings                     <u>280,406</u></p> <p style="padding-left: 40px;">Total                                 \$   380,406</p> <p>Total liabilities and owners' equity                             <u>\$   613,806</u></p>

So the EFN is:

$$\begin{aligned} \text{EFN} &= \text{Total assets} - \text{Total liabilities and equity} \\ \text{EFN} &= \$616,800 - 613,806 \\ \text{EFN} &= \$2,994.50 \end{aligned}$$

At a 25 percent growth rate, and assuming the payout ratio is constant, the dividends paid will be:

$$\begin{aligned} \text{Dividends} &= (\$30,810/\$102,700)(\$130,406) \\ \text{Dividends} &= \$39,122 \end{aligned}$$

And the addition to retained earnings will be:

$$\begin{aligned} \text{Addition to retained earnings} &= \$130,406 - 39,122 \\ \text{Addition to retained earnings} &= \$91,284 \end{aligned}$$

The new addition to retained earnings on the pro forma balance sheet will be:

$$\begin{aligned} \text{New addition to retained earnings} &= \$193,000 + 91,284 \\ \text{New addition to retained earnings} &= \$284,284 \end{aligned}$$

The pro forma balance sheet will look like this:

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25% Sales Growth:

MOOSE TOURS INC.  
Pro Forma Balance Sheet

Assets		Liabilities and Owners' Equity	
Current assets		Current liabilities	
Cash	\$ 28,750	Accounts payable	\$ 77,500
Accounts receivable	46,250	Notes payable	<u>15,000</u>
Inventory	<u>98,750</u>	Total	\$ 92,500
Total	\$ 173,750	Long-term debt	<u>144,000</u>
Fixed assets		Owners' equity	
Net plant and equipment	<u>468,750</u>	Common stock and paid-in surplus	\$ 100,000
		Retained earnings	<u>284,284</u>
		Total	<u>\$ 384,284</u>
Total assets	<u>\$ 642,500</u>	Total liabilities and owners' equity	<u>\$ 620,784</u>

So the EFN is:

$$\text{EFN} = \text{Total assets} - \text{Total liabilities and equity}$$

$$\text{EFN} = \$642,500 - 620,784$$

$$\text{EFN} = \$21,716$$

29. The pro forma income statements for all three growth rates will be:

MOOSE TOURS INC.			
Pro Forma Income Statement			
	20% Sales Growth	30% Sales Growth	35% Sales Growth
Sales	\$1,014,000	\$1,098,500	\$1,140,750
Costs	788,400	854,100	886,950
Other expenses	<u>21,000</u>	<u>22,750</u>	<u>23,625</u>
EBIT	\$ 204,600	\$ 221,650	\$ 230,175
Interest	<u>12,500</u>	<u>12,500</u>	<u>12,500</u>
Taxable income	\$ 192,100	\$ 209,150	\$ 217,675
Taxes (35%)	<u>67,235</u>	<u>73,203</u>	<u>76,186</u>
Net income	<u>\$ 124,865</u>	<u>\$ 135,948</u>	<u>\$ 141,489</u>
Dividends	\$ 37,460	\$ 40,784	\$42,447
Add to RE	87,406	95,163	99,042

Under the sustainable growth rate assumption, the company maintains a constant debt-equity ratio. The D/E ratio of the company is:

$$\text{D/E} = (\$144,000 + 77,000) / \$293,000$$

$$\text{D/E} = .75427$$

At a 20 percent growth rate, and assuming the payout ratio is constant, the dividends paid will be:

$$\text{Dividends} = (\$30,810/\$102,700)(\$124,865)$$

$$\text{Dividends} = \$37,460$$

And the addition to retained earnings will be:

$$\text{Addition to retained earnings} = \$124,865 - 37,460$$

$$\text{Addition to retained earnings} = \$87,406$$

The new addition to retained earnings on the pro forma balance sheet will be:

$$\text{New addition to retained earnings} = \$193,000 + 87,406$$

$$\text{New addition to retained earnings} = \$280,406$$

The new total debt will be:

$$\text{New total debt} = .75427(\$380,406)$$

$$\text{New total debt} = \$286,927$$

So, the new long-term debt will be the new total debt minus the new short-term debt, or:

$$\text{New long-term debt} = \$286,927 - 89,400$$

$$\text{New long-term debt} = \$197,527$$

The pro forma balance sheet will look like this:

*Sales growth rate = 20% and Debt/Equity ratio = .75427:*

MOOSE TOURS INC.  
Pro Forma Balance Sheet

Assets	Liabilities and Owners' Equity
Current assets	Current liabilities
Cash	Accounts payable
Accounts receivable	Notes payable
Inventory	Total
Total	Long-term debt
Fixed assets	Owners' equity
Net plant and equipment	Common stock and paid-in surplus
	Retained earnings
	Total
	Total liabilities and owners' equity
Total assets	

## B-50 SOLUTIONS

So the EFN is:

$$\text{EFN} = \text{Total assets} - \text{Total liabilities and equity}$$

$$\text{EFN} = \$616,800 - 667,333$$

$$\text{EFN} = -\$50,533$$

At a 30 percent growth rate, and assuming the payout ratio is constant, the dividends paid will be:

$$\text{Dividends} = (\$30,810/\$102,700)(\$135,948)$$

$$\text{Dividends} = \$40,784$$

And the addition to retained earnings will be:

$$\text{Addition to retained earnings} = \$135,948 - 40,784$$

$$\text{Addition to retained earnings} = \$95,163$$

The new addition to retained earnings on the pro forma balance sheet will be:

$$\text{New addition to retained earnings} = \$193,000 + 95,163$$

$$\text{New addition to retained earnings} = \$288,163$$

The new total debt will be:

$$\text{New total debt} = .75427(\$388,163)$$

$$\text{New total debt} = \$292,778$$

So, the new long-term debt will be the new total debt minus the new short-term debt, or:

$$\text{New long-term debt} = \$292,778 - 95,600$$

$$\text{New long-term debt} = \$197,178$$

*Sales growth rate = 30% and debt/equity ratio = .75427:*

MOOSE TOURS INC.  
Pro Forma Balance Sheet

Assets		Liabilities and Owners' Equity	
Current assets		Current liabilities	
Cash	\$ 29,900	Accounts payable	\$ 80,600
Accounts receivable	48,100	Notes payable	<u>15,000</u>
Inventory	<u>102,700</u>	Total	\$ 95,600
Total	\$ 180,700	Long-term debt	<u>197,178</u>
Fixed assets		Owners' equity	
Net plant and equipment	<u>487,500</u>	Common stock and paid-in surplus	\$ 100,000
		Retained earnings	<u>288,163</u>
		Total	\$ 388,163
Total assets	<u>\$ 668,200</u>	Total liabilities and owners' equity	<u>\$ 680,942</u>

So the EFN is:

$$\text{EFN} = \text{Total assets} - \text{Total liabilities and equity}$$

$$\text{EFN} = \$668,200 - 680,943$$

$$\text{EFN} = -\$12,742$$

At a 35 percent growth rate, and assuming the payout ratio is constant, the dividends paid will be:

$$\text{Dividends} = (\$30,810/\$102,700)(\$141,489)$$

$$\text{Dividends} = \$42,447$$

And the addition to retained earnings will be:

$$\text{Addition to retained earnings} = \$141,489 - 42,447$$

$$\text{Addition to retained earnings} = \$99,042$$

The new addition to retained earnings on the pro forma balance sheet will be:

$$\text{New addition to retained earnings} = \$193,000 + 99,042$$

$$\text{New addition to retained earnings} = \$292,042$$

The new total debt will be:

$$\text{New total debt} = .75427(\$392,042)$$

$$\text{New total debt} = \$295,704$$

So, the new long-term debt will be the new total debt minus the new short-term debt, or:

$$\text{New long-term debt} = \$295,704 - 98,700$$

$$\text{New long-term debt} = \$197,004$$

B-52 SOLUTIONS

*Sales growth rate = 35% and debt/equity ratio = .75427:*

MOOSE TOURS INC.  
Pro Forma Balance Sheet

Assets		Liabilities and Owners' Equity	
Current assets		Current liabilities	
Cash	\$ 31,050	Accounts payable	\$ 83,700
Accounts receivable	49,950	Notes payable	<u>15,000</u>
Inventory	<u>106,650</u>	Total	\$ 98,700
Total	\$ 187,650	Long-term debt	<u>197,004</u>
Fixed assets		Owners' equity	
Net plant and equipment	<u>506,250</u>	Common stock and paid-in surplus	\$ 100,000
		Retained earnings	<u>292,042</u>
		Total	<u>\$ 392,042</u>
Total assets	<u>\$ 693,900</u>	Total liabilities and owners' equity	<u>\$ 687,746</u>

So the EFN is:

$$\text{EFN} = \text{Total assets} - \text{Total liabilities and equity}$$

$$\text{EFN} = \$693,900 - 687,746$$

$$\text{EFN} = \$6,154$$

**30.** We must need the ROE to calculate the sustainable growth rate. The ROE is:

$$\text{ROE} = (\text{PM})(\text{TAT})(\text{EM})$$

$$\text{ROE} = (.059)(1 / 1.25)(1 + 0.25)$$

$$\text{ROE} = .0590 \text{ or } 5.90\%$$

Now we can use the sustainable growth rate equation to find the retention ratio as:

$$\text{Sustainable growth rate} = (\text{ROE} \times b) / [1 - (\text{ROE} \times b)]$$

$$\text{Sustainable growth rate} = .14 = [.0590(b)] / [1 - .0590(b)]$$

$$b = 2.08$$

This implies the payout ratio is:

$$\text{Payout ratio} = 1 - b$$

$$\text{Payout ratio} = 1 - 2.08$$

$$\text{Payout ratio} = -1.08$$

This is a negative dividend payout ratio of 108 percent, which is impossible. The growth rate is not consistent with the other constraints. The lowest possible payout rate is 0, which corresponds to retention ratio of 1, or total earnings retention.

The maximum sustainable growth rate for this company is:

$$\text{Maximum sustainable growth rate} = (\text{ROE} \times b) / [1 - (\text{ROE} \times b)]$$

$$\text{Maximum sustainable growth rate} = [.0590(1)] / [1 - .0590(1)]$$

$$\text{Maximum sustainable growth rate} = .0627 \text{ or } 6.27\%$$

**31.** We know that EFN is:

$$\text{EFN} = \text{Increase in assets} - \text{Addition to retained earnings}$$

The increase in assets is the beginning assets times the growth rate, so:

$$\text{Increase in assets} = A \times g$$

The addition to retained earnings next year is the current net income times the retention ratio, times one plus the growth rate, so:

$$\text{Addition to retained earnings} = (\text{NI} \times b)(1 + g)$$

And rearranging the profit margin to solve for net income, we get:

$$\text{NI} = \text{PM}(S)$$

Substituting the last three equations into the EFN equation we started with and rearranging, we get:

$$\text{EFN} = A(g) - \text{PM}(S)b(1 + g)$$

$$\text{EFN} = A(g) - \text{PM}(S)b - [\text{PM}(S)b]g$$

$$\text{EFN} = -\text{PM}(S)b + [A - \text{PM}(S)b]g$$

**32.** We start with the EFN equation we derived in Problem 32 and set it equal to zero:

$$\text{EFN} = 0 = -\text{PM}(S)b + [A - \text{PM}(S)b]g$$

Substituting the rearranged profit margin equation into the internal growth rate equation, we have:

$$\text{Internal growth rate} = [\text{PM}(S)b] / [A - \text{PM}(S)b]$$

Since:

$$\text{ROA} = \text{NI} / A$$

$$\text{ROA} = \text{PM}(S) / A$$

We can substitute this into the internal growth rate equation and divide both the numerator and denominator by A. This gives:

$$\text{Internal growth rate} = \{[\text{PM}(S)b] / A\} / \{[A - \text{PM}(S)b] / A\}$$

$$\text{Internal growth rate} = b(\text{ROA}) / [1 - b(\text{ROA})]$$

## B-54 SOLUTIONS

To derive the sustainable growth rate, we must realize that to maintain a constant D/E ratio with no external equity financing, EFN must equal the addition to retained earnings times the D/E ratio:

$$EFN = (D/E)[PM(S)b(1 + g)]$$

$$EFN = A(g) - PM(S)b(1 + g)$$

Solving for g and then dividing numerator and denominator by A:

$$\text{Sustainable growth rate} = PM(S)b(1 + D/E) / [A - PM(S)b(1 + D/E)]$$

$$\text{Sustainable growth rate} = [ROA(1 + D/E)b] / [1 - ROA(1 + D/E)b]$$

$$\text{Sustainable growth rate} = b(ROE) / [1 - b(ROE)]$$

- 33.** In the following derivations, the subscript “E” refers to end of period numbers, and the subscript “B” refers to beginning of period numbers. TE is total equity and TA is total assets.

For the sustainable growth rate:

$$\text{Sustainable growth rate} = (ROE_E \times b) / (1 - ROE_E \times b)$$

$$\text{Sustainable growth rate} = (NI/TE_E \times b) / (1 - NI/TE_E \times b)$$

We multiply this equation by:

$$(TE_E / TE_E)$$

$$\text{Sustainable growth rate} = (NI / TE_E \times b) / (1 - NI / TE_E \times b) \times (TE_E / TE_E)$$

$$\text{Sustainable growth rate} = (NI \times b) / (TE_E - NI \times b)$$

Recognize that the numerator is equal to beginning of period equity, that is:

$$(TE_E - NI \times b) = TE_B$$

Substituting this into the previous equation, we get:

$$\text{Sustainable rate} = (NI \times b) / TE_B$$

Which is equivalent to:

$$\text{Sustainable rate} = (NI / TE_B) \times b$$

$$\text{Since } ROE_B = NI / TE_B$$

The sustainable growth rate equation is:

$$\text{Sustainable growth rate} = ROE_B \times b$$

For the internal growth rate:

$$\text{Internal growth rate} = (ROA_E \times b) / (1 - ROA_E \times b)$$

$$\text{Internal growth rate} = (NI / TA_E \times b) / (1 - NI / TA_E \times b)$$

We multiply this equation by:

$$(TA_E / TA_E)$$

$$\text{Internal growth rate} = (NI / TA_E \times b) / (1 - NI / TA_E \times b) \times (TA_E / TA_E)$$

$$\text{Internal growth rate} = (NI \times b) / (TA_E - NI \times b)$$

Recognize that the numerator is equal to beginning of period assets, that is:

$$(TA_E - NI \times b) = TA_B$$

Substituting this into the previous equation, we get:

$$\text{Internal growth rate} = (NI \times b) / TA_B$$

Which is equivalent to:

$$\text{Internal growth rate} = (NI / TA_B) \times b$$

$$\text{Since } ROA_B = NI / TA_B$$

The internal growth rate equation is:

$$\text{Internal growth rate} = ROA_B \times b$$

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# **CHAPTER 5**

## **INTRODUCTION TO VALUATION: THE TIME VALUE OF MONEY**

### **Answers to Concepts Review and Critical Thinking Questions**

1. The four parts are the present value (PV), the future value (FV), the discount rate ( $r$ ), and the life of the investment ( $t$ ).
2. Compounding refers to the growth of a dollar amount through time via reinvestment of interest earned. It is also the process of determining the future value of an investment. Discounting is the process of determining the value today of an amount to be received in the future.
3. Future values grow (assuming a positive rate of return); present values shrink.
4. The future value rises (assuming it's positive); the present value falls.
5. It would appear to be both deceptive and unethical to run such an ad without a disclaimer or explanation.
6. It's a reflection of the time value of money. TMCC gets to use the \$1,163. If TMCC uses it wisely, it will be worth more than \$10,000 in thirty years.
7. This will probably make the security less desirable. TMCC will only repurchase the security prior to maturity if it is to its advantage, i.e. interest rates decline. Given the drop in interest rates needed to make this viable for TMCC, it is unlikely the company will repurchase the security. This is an example of a "call" feature. Such features are discussed at length in a later chapter.
8. The key considerations would be: (1) Is the rate of return implicit in the offer attractive relative to other, similar risk investments? and (2) How risky is the investment; i.e., how certain are we that we will actually get the \$10,000? Thus, our answer does depend on who is making the promise to repay.
9. The Treasury security would have a somewhat higher price because the Treasury is the strongest of all borrowers.
10. The price would be higher because, as time passes, the price of the security will tend to rise toward \$10,000. This rise is just a reflection of the time value of money. As time passes, the time until receipt of the \$10,000 grows shorter, and the present value rises. In 2015, the price will probably be higher for the same reason. We cannot be sure, however, because interest rates could be much higher, or TMCC's financial position could deteriorate. Either event would tend to depress the security's price.

**Solutions to Questions and Problems**

*NOTE: All end of chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.*

Basic

1. The simple interest per year is:

$$\$5,000 \times .06 = \$300$$

So after 10 years you will have:

$$\$300 \times 10 = \$3,000 \text{ in interest.}$$

The total balance will be  $\$5,000 + 3,000 = \$8,000$

With compound interest we use the future value formula:

$$\begin{aligned} FV &= PV(1+r)^t \\ FV &= \$5,000(1.06)^{10} = \$8,954.24 \end{aligned}$$

The difference is:

$$\$8,954.24 - 8,000 = \$954.24$$

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

$$FV = PV(1+r)^t$$

$$\begin{aligned} FV &= \$2,250(1.10)^{16} &&= \$ 10,338.69 \\ FV &= \$8,752(1.08)^{13} &&= \$ 23,802.15 \\ FV &= \$76,355(1.17)^4 &&= \$143,080.66 \\ FV &= \$183,796(1.07)^{12} &&= \$413,943.81 \end{aligned}$$

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

$$PV = FV / (1+r)^t$$

$$\begin{aligned} PV &= \$15,451 / (1.04)^6 &&= \$12,211.15 \\ PV &= \$51,557 / (1.11)^7 &&= \$24,832.86 \\ PV &= \$886,073 / (1.20)^{23} &&= \$13,375.22 \\ PV &= \$550,164 / (1.13)^{18} &&= \$60,964.94 \end{aligned}$$

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4. 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:

$$r = (FV / PV)^{1/t} - 1$$

$$\begin{array}{ll} FV = \$307 = \$240(1 + r)^2; & r = (\$307 / \$240)^{1/2} - 1 = 13.10\% \\ FV = \$896 = \$360(1 + r)^{10}; & r = (\$896 / \$360)^{1/10} - 1 = 9.55\% \\ FV = \$174,384 = \$39,000(1 + r)^{15}; & r = (\$174,384 / \$39,000)^{1/15} - 1 = 10.50\% \\ FV = \$483,500 = \$38,261(1 + r)^{30}; & r = (\$483,500 / \$38,261)^{1/30} - 1 = 8.82\% \end{array}$$

5. 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:

$$t = \ln(FV / PV) / \ln(1 + r)$$

$$\begin{array}{ll} FV = \$1,284 = \$560(1.08)^t; & t = \ln(\$1,284 / \$560) / \ln 1.08 = 10.78 \text{ years} \\ FV = \$4,341 = \$810(1.09)^t; & t = \ln(\$4,341 / \$810) / \ln 1.09 = 19.48 \text{ years} \\ FV = \$364,518 = \$18,400(1.21)^t; & t = \ln(\$364,518 / \$18,400) / \ln 1.21 = 15.67 \text{ years} \\ FV = \$173,439 = \$21,500(1.13)^t; & t = \ln(\$173,439 / \$21,500) / \ln 1.13 = 17.08 \text{ years} \end{array}$$

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:

$$\begin{array}{l} r = (FV / PV)^{1/t} - 1 \\ r = (\$280,000 / \$50,000)^{1/18} - 1 = 10.04\% \end{array}$$

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:

$$FV = \$2 = \$1(1.09)^t$$

$$t = \ln 2 / \ln 1.09 = 8.04 \text{ years}$$

The length of time to quadruple your money is:

$$FV = \$4 = \$1(1.09)^t$$

$$t = \ln 4 / \ln 1.09 = 16.09 \text{ years}$$

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.

8. 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:

$$r = (FV / PV)^{1/t} - 1$$

$$r = (\$27,958 / \$21,608)^{1/7} - 1 = 3.75\%$$

9. 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:

$$t = \ln(FV / PV) / \ln(1 + r)$$

$$t = \ln (\$170,000 / \$40,000) / \ln 1.062 = 24.05 \text{ years}$$

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

$$PV = FV / (1 + r)^t$$

$$PV = \$700,000,000 / (1.085)^{20} = \$136,931,471.85$$

## B-60 SOLUTIONS

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

$$\begin{aligned}PV &= FV / (1 + r)^t \\PV &= \$1,000,000 / (1.09)^{80} = \$1,013.63\end{aligned}$$

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

$$\begin{aligned}FV &= PV(1 + r)^t \\FV &= \$50(1.045)^{102} = \$4,454.84\end{aligned}$$

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:

$$\begin{aligned}r &= (FV / PV)^{1/t} - 1 \\r &= (\$1,170,000 / \$150)^{1/111} - 1 = 8.41\%\end{aligned}$$

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

$$\begin{aligned}FV &= PV(1 + r)^t \\FV &= \$1,170,000(1.0841)^{34} = \$18,212,056.26\end{aligned}$$

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

$$\begin{aligned}PV &= FV / (1 + r)^t \\PV &= \$485,000 / (1.2590)^{67} = \$0.10\end{aligned}$$

15. 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:

$$\begin{aligned}r &= (FV / PV)^{1/t} - 1 \\r &= (\$10,311,500 / \$12,377,500)^{1/4} - 1 = -4.46\%\end{aligned}$$

Notice that the interest rate is negative. This occurs when the FV is less than the PV.

Intermediate

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.  $PV = \$10,000 / (1 + r)^{30} = \$500$   
 $r = (\$10,000 / \$1,163)^{1/30} - 1 = 7.44\%$
- b.  $PV = \$2,500 / (1 + r)^9 = \$1,163$   
 $r = (\$2,500 / \$1,163)^{1/9} - 1 = 8.88\%$
- c.  $PV = \$10,000 / (1 + r)^{21} = \$2,500$   
 $r = (\$10,000 / \$2,500)^{1/21} - 1 = 6.82\%$

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

$$PV = FV / (1 + r)^t$$
$$PV = \$170,000 / (1.11)^{10} = \$59,871.36$$

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

$$FV = PV(1 + r)^t$$
$$FV = \$2,000 (1.12)^{45} = \$327,975.21$$
$$FV = \$2,000 (1.12)^{35} = \$105,599.24$$

Better start early!

19. We need to find the FV of a lump sum. However, the money will only be invested for six years, so the number of periods is six.

$$FV = PV(1 + r)^t$$
$$FV = \$25,000(1.079)^6 = \$35,451.97$$

## B-62 SOLUTIONS

20. 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:

$$t = \ln(FV / PV) / \ln(1 + r)$$

$$t = \ln(\$100,000 / \$10,000) / \ln(1.11) = 22.06$$

So, the money must be invested for 22.06 years. However, you will not receive the money for another two years. From now, you'll wait:

$$2 \text{ years} + 22.06 \text{ years} = 24.06 \text{ years}$$

### Calculator Solutions

1.

Enter	10	6%	\$5,000		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$8,954.24

$$\$8,954.24 - 8,000 = \$954.24$$

2.

Enter	16	10%	\$2,250		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$10,338.69

Enter	13	8%	\$8,752		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$23,802.15

Enter	4	17%	\$76,355		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$143,080.66

Enter	12	7%	\$183,796		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$413,943.81

3.

Enter	6	4%			\$15,451
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for			\$12,211.15		





**13.**

Enter	111		±\$150		\$1,170,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for		8.41%			

Enter	34	8.41%	\$1,170,000		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$18,212,056.26

**14.**

Enter	67	25.90%			\$485,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for			\$0.10		

**15.**

Enter	4		±\$12,377,500		\$10,311,500
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for		-4.46%			

**16. a.**

Enter	30		±\$1,163		\$10,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for		7.44%			

**16. b.**

Enter	9		±\$1,163		\$2,500
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for		8.88%			

**16. c.**

Enter	21		±\$2,500		\$10,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for		6.82%			

**17.**

Enter	10	11%			\$170,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for			\$59,871.36		

**18.**

Enter	45	12%	\$2,000		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$327,975.21

Enter	35	12%	\$2,000		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$105,599.24

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**19.**

Enter	6	7.90%	\$25,000		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$39,451.97

**20.**

Enter		11%	±\$10,000		\$100,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for	22.06				

From now, you'll wait  $2 + 22.06 = 24.06$  years

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# **CHAPTER 6**

## **DISCOUNTED CASH FLOW VALUATION**

### **Answers to Concepts Review and Critical Thinking Questions**

1. The four pieces are the present value (PV), the periodic cash flow ( $C$ ), the discount rate ( $r$ ), and the number of payments, or the life of the annuity,  $t$ .
2. Assuming positive cash flows, both the present and the future values will rise.
3. Assuming positive cash flows, the present value will fall and the future value will rise.
4. It's deceptive, but very common. The basic concept of time value of money is that a dollar today is not worth the same as a dollar tomorrow. The deception is particularly irritating given that such lotteries are usually government sponsored!
5. If the total money is fixed, you want as much as possible as soon as possible. The team (or, more accurately, the team owner) wants just the opposite.
6. The better deal is the one with equal installments.
7. Yes, they should. APRs generally don't provide the relevant rate. The only advantage is that they are easier to compute, but, with modern computing equipment, that advantage is not very important.
8. A freshman does. The reason is that the freshman gets to use the money for much longer before interest starts to accrue. The subsidy is the present value (on the day the loan is made) of the interest that would have accrued up until the time it actually begins to accrue.
9. The problem is that the subsidy makes it easier to repay the loan, not obtain it. However, ability to repay the loan depends on future employment, not current need. For example, consider a student who is currently needy, but is preparing for a career in a high-paying area (such as corporate finance!). Should this student receive the subsidy? How about a student who is currently not needy, but is preparing for a relatively low-paying job (such as becoming a college professor)?

## B-68 SOLUTIONS

10. In general, viatical settlements are ethical. In the case of a viatical settlement, it is simply an exchange of cash today for payment in the future, although the payment depends on the death of the seller. The purchaser of the life insurance policy is bearing the risk that the insured individual will live longer than expected. Although viatical settlements are ethical, they may not be the best choice for an individual. In a *Business Week* article (October 31, 2005), options were examined for a 72 year old male with a life expectancy of 8 years and a \$1 million dollar life insurance policy with an annual premium of \$37,000. The four options were: 1) Cash the policy today for \$100,000. 2) Sell the policy in a viatical settlement for \$275,000. 3) Reduce the death benefit to \$375,000, which would keep the policy in force for 12 years without premium payments. 4) Stop paying premiums and don't reduce the death benefit. This will run the cash value of the policy to zero in 5 years, but the viatical settlement would be worth \$475,000 at that time. If he died within 5 years, the beneficiaries would receive \$1 million. Ultimately, the decision rests on the individual on what they perceive as best for themselves. The values that will affect the value of the viatical settlement are the discount rate, the face value of the policy, and the health of the individual selling the policy.

### Solutions to Questions and Problems

*NOTE: All end of chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.*

#### Basic

1. To solve this problem, we must find the PV of each cash flow and add them. To find the PV of a lump sum, we use:

$$PV = FV / (1 + r)^t$$

$$PV@10\% = \$1,100 / 1.10 + \$720 / 1.10^2 + \$940 / 1.10^3 + \$1,160 / 1.10^4 = \$3,093.57$$

$$PV@18\% = \$1,100 / 1.18 + \$720 / 1.18^2 + \$940 / 1.18^3 + \$1,160 / 1.18^4 = \$2,619.72$$

$$PV@24\% = \$1,100 / 1.24 + \$720 / 1.24^2 + \$940 / 1.24^3 + \$1,160 / 1.24^4 = \$2,339.03$$

2. To find the PVA, we use the equation:

$$PVA = C(\{1 - [1/(1 + r)]^t\} / r)$$

At a 5 percent interest rate:

$$X@5\%: PVA = \$7,000 \{ [1 - (1/1.05)^8] / .05 \} = \$45,242.49$$

$$Y@5\%: PVA = \$9,000 \{ [1 - (1/1.05)^5] / .05 \} = \$38,965.29$$

And at a 22 percent interest rate:

$$X@22\%: PVA = \$7,000 \{ [1 - (1/1.22)^8] / .22 \} = \$25,334.87$$

$$Y@22\%: PVA = \$9,000 \{ [1 - (1/1.22)^5] / .22 \} = \$25,772.76$$

Notice that the PV of cash flow X has a greater PV at a 5 percent interest rate, but a lower PV at a 22 percent interest rate. The reason is that X has greater total cash flows. At a lower interest rate, the total cash flow is more important since the cost of waiting (the interest rate) is not as great. At a higher interest rate, Y is more valuable since it has larger cash flows. At the higher interest rate, these bigger cash flows early are more important since the cost of waiting (the interest rate) is so much greater.

3. To solve this problem, we must find the FV of each cash flow and add them. To find the FV of a lump sum, we use:

$$FV = PV(1 + r)^t$$

$$FV@8\% = \$700(1.08)^3 + \$950(1.08)^2 + \$1,200(1.08) + \$1,300 = \$4,585.88$$

$$FV@11\% = \$700(1.11)^3 + \$950(1.11)^2 + \$1,200(1.11) + \$1,300 = \$4,759.84$$

$$FV@24\% = \$700(1.24)^3 + \$950(1.24)^2 + \$1,200(1.24) + \$1,300 = \$5,583.36$$

Notice we are finding the value at Year 4, the cash flow at Year 4 is simply added to the FV of the other cash flows. In other words, we do not need to compound this cash flow.

4. To find the PVA, we use the equation:

$$PVA = C \{ [1 - 1/(1 + r)^t] / r \}$$

$$PVA@15 \text{ yrs: } PVA = \$4,600 \{ [1 - (1/1.08)^{15}] / .08 \} = \$39,373.60$$

$$PVA@40 \text{ yrs: } PVA = \$4,600 \{ [1 - (1/1.08)^{40}] / .08 \} = \$54,853.22$$

$$PVA@75 \text{ yrs: } PVA = \$4,600 \{ [1 - (1/1.08)^{75}] / .08 \} = \$57,320.99$$

To find the PV of a perpetuity, we use the equation:

$$PV = C / r$$

$$PV = \$4,600 / .08 = \$57,500.00$$

Notice that as the length of the annuity payments increases, the present value of the annuity approaches the present value of the perpetuity. The present value of the 75 year annuity and the present value of the perpetuity imply that the value today of all perpetuity payments beyond 75 years is only \$179.01.

## B-70 SOLUTIONS

5. Here we have the PVA, the length of the annuity, and the interest rate. We want to calculate the annuity payment. Using the PVA equation:

$$\begin{aligned}PVA &= C\{1 - [1/(1+r)]^t\} / r \\PVA &= \$28,000 = \$C\{[1 - (1/1.0825)^{15}] / .0825\}\end{aligned}$$

We can now solve this equation for the annuity payment. Doing so, we get:

$$C = \$28,000 / 8.43035 = \$3,321.33$$

6. To find the PVA, we use the equation:

$$\begin{aligned}PVA &= C\{1 - [1/(1+r)]^t\} / r \\PVA &= \$65,000\{[1 - (1/1.085)^8] / .085\} = \$366,546.89\end{aligned}$$

7. Here we need to find the FVA. The equation to find the FVA is:

$$FVA = C\{[(1+r)^t - 1] / r\}$$

$$FVA \text{ for 20 years} = \$3,000[(1.105^{20} - 1) / .105] = \$181,892.42$$

$$FVA \text{ for 40 years} = \$3,000[(1.105^{40} - 1) / .105] = \$1,521,754.74$$

Notice that because of exponential growth, doubling the number of periods does not merely double the FVA.

8. Here we have the FVA, the length of the annuity, and the interest rate. We want to calculate the annuity payment. Using the FVA equation:

$$\begin{aligned}FVA &= C\{[(1+r)^t - 1] / r\} \\\$80,000 &= \$C[(1.065^{10} - 1) / .065]\end{aligned}$$

We can now solve this equation for the annuity payment. Doing so, we get:

$$C = \$80,000 / 13.49442 = \$5,928.38$$

9. Here we have the PVA, the length of the annuity, and the interest rate. We want to calculate the annuity payment. Using the PVA equation:

$$\begin{aligned}PVA &= C\{1 - [1/(1+r)]^t\} / r \\\$30,000 &= C\{[1 - (1/1.08)^7] / .08\}\end{aligned}$$

We can now solve this equation for the annuity payment. Doing so, we get:

$$C = \$30,000 / 5.20637 = \$5,762.17$$

10. This cash flow is a perpetuity. To find the PV of a perpetuity, we use the equation:

$$\begin{aligned}PV &= C / r \\PV &= \$20,000 / .08 = \$250,000.00\end{aligned}$$

11. Here we need to find the interest rate that equates the perpetuity cash flows with the PV of the cash flows. Using the PV of a perpetuity equation:

$$PV = C / r$$

$$\$280,000 = \$20,000 / r$$

We can now solve for the interest rate as follows:

$$r = \$20,000 / \$280,000 = .0714 \text{ or } 7.14\%$$

12. For discrete compounding, to find the EAR, we use the equation:

$$EAR = [1 + (APR / m)]^m - 1$$

$$EAR = [1 + (.07 / 4)]^4 - 1 = .0719 \text{ or } 7.19\%$$

$$EAR = [1 + (.18 / 12)]^{12} - 1 = .1956 \text{ or } 19.56\%$$

$$EAR = [1 + (.10 / 365)]^{365} - 1 = .1052 \text{ or } 10.52\%$$

To find the EAR with continuous compounding, we use the equation:

$$EAR = e^q - 1$$

$$EAR = e^{.14} - 1 = .1503 \text{ or } 15.03\%$$

13. Here we are given the EAR and need to find the APR. Using the equation for discrete compounding:

$$EAR = [1 + (APR / m)]^m - 1$$

We can now solve for the APR. Doing so, we get:

$$APR = m[(1 + EAR)^{1/m} - 1]$$

$$EAR = .1220 = [1 + (APR / 2)]^2 - 1 \quad APR = 2[(1.1220)^{1/2} - 1] = .1185 \text{ or } 11.85\%$$

$$EAR = .0940 = [1 + (APR / 12)]^{12} - 1 \quad APR = 12[(1.0940)^{1/12} - 1] = .0902 \text{ or } 9.02\%$$

$$EAR = .0860 = [1 + (APR / 52)]^{52} - 1 \quad APR = 52[(1.0860)^{1/52} - 1] = .0826 \text{ or } 8.26\%$$

Solving the continuous compounding EAR equation:

$$EAR = e^q - 1$$

We get:

$$APR = \ln(1 + EAR)$$

$$APR = \ln(1 + .2380)$$

$$APR = .2135 \text{ or } 21.35\%$$

## B-72 SOLUTIONS

- 14.** For discrete compounding, to find the EAR, we use the equation:

$$\text{EAR} = [1 + (\text{APR} / m)]^m - 1$$

So, for each bank, the EAR is:

$$\text{First National: } \text{EAR} = [1 + (.1310 / 12)]^{12} - 1 = .1392 \text{ or } 13.92\%$$

$$\text{First United: } \text{EAR} = [1 + (.1340 / 2)]^2 - 1 = .1385 \text{ or } 13.85\%$$

Notice that the higher APR does not necessarily mean the higher EAR. The number of compounding periods within a year will also affect the EAR.

- 15.** The reported rate is the APR, so we need to convert the EAR to an APR as follows:

$$\text{EAR} = [1 + (\text{APR} / m)]^m - 1$$

$$\text{APR} = m[(1 + \text{EAR})^{1/m} - 1]$$

$$\text{APR} = 365[(1.14)^{1/365} - 1] = .1311 \text{ or } 13.11\%$$

This is deceptive because the borrower is actually paying annualized interest of 14% per year, not the 13.11% reported on the loan contract.

- 16.** For this problem, we simply need to find the FV of a lump sum using the equation:

$$\text{FV} = \text{PV}(1 + r)^t$$

It is important to note that compounding occurs semiannually. To account for this, we will divide the interest rate by two (the number of compounding periods in a year), and multiply the number of periods by two. Doing so, we get:

$$\text{FV} = \$1,400[1 + (.096/2)]^{40} = \$9,132.28$$

- 17.** For this problem, we simply need to find the FV of a lump sum using the equation:

$$\text{FV} = \text{PV}(1 + r)^t$$

It is important to note that compounding occurs daily. To account for this, we will divide the interest rate by 365 (the number of days in a year, ignoring leap year), and multiply the number of periods by 365. Doing so, we get:

$$\text{FV in 5 years} = \$6,000[1 + (.084/365)]^{5(365)} = \$9,131.33$$

$$\text{FV in 10 years} = \$6,000[1 + (.084/365)]^{10(365)} = \$13,896.86$$

$$\text{FV in 20 years} = \$6,000[1 + (.084/365)]^{20(365)} = \$32,187.11$$

18. For this problem, we simply need to find the PV of a lump sum using the equation:

$$PV = FV / (1 + r)^t$$

It is important to note that compounding occurs daily. To account for this, we will divide the interest rate by 365 (the number of days in a year, ignoring leap year), and multiply the number of periods by 365. Doing so, we get:

$$PV = \$45,000 / [(1 + .11/365)^{6(365)}] = \$23,260.62$$

19. The APR is simply the interest rate per period times the number of periods in a year. In this case, the interest rate is 25 percent per month, and there are 12 months in a year, so we get:

$$APR = 12(25\%) = 300\%$$

To find the EAR, we use the EAR formula:

$$EAR = [1 + (APR / m)]^m - 1$$

$$EAR = (1 + .25)^{12} - 1 = 1,355.19\%$$

Notice that we didn't need to divide the APR by the number of compounding periods per year. We do this division to get the interest rate per period, but in this problem we are already given the interest rate per period.

20. We first need to find the annuity payment. We have the PVA, the length of the annuity, and the interest rate. Using the PVA equation:

$$PVA = C(\{1 - [1/(1 + r)]^t\} / r)$$

$$\$61,800 = \$C[1 - \{1 / [1 + (.074/12)]^{60}\}] / (.074/12)$$

Solving for the payment, we get:

$$C = \$61,800 / 50.02385 = \$1,235.41$$

To find the EAR, we use the EAR equation:

$$EAR = [1 + (APR / m)]^m - 1$$

$$EAR = [1 + (.074 / 12)]^{12} - 1 = .0766 \text{ or } 7.66\%$$

21. Here we need to find the length of an annuity. We know the interest rate, the PV, and the payments. Using the PVA equation:

$$PVA = C(\{1 - [1/(1 + r)]^t\} / r)$$

$$\$17,000 = \$300\{[1 - (1/1.009)^t] / .009\}$$

## B-74 SOLUTIONS

Now we solve for  $t$ :

$$\begin{aligned}1/1.009^t &= 1 - \{[(\$17,000)/(\$300)](.009)\} \\1/1.009^t &= 0.49 \\1.009^t &= 1/(0.49) = 2.0408 \\t &= \ln 2.0408 / \ln 1.009 = 79.62 \text{ months}\end{aligned}$$

22. Here we are trying to find the interest rate when we know the PV and FV. Using the FV equation:

$$\begin{aligned}\text{FV} &= \text{PV}(1 + r) \\\$4 &= \$3(1 + r) \\r &= 4/3 - 1 = 33.33\% \text{ per week}\end{aligned}$$

The interest rate is 33.33% per week. To find the APR, we multiply this rate by the number of weeks in a year, so:

$$\text{APR} = (52)33.33\% = 1,733.33\%$$

And using the equation to find the EAR:

$$\begin{aligned}\text{EAR} &= [1 + (\text{APR} / m)]^m - 1 \\ \text{EAR} &= [1 + .3333]^{52} - 1 = 313,916,515.69\%\end{aligned}$$

23. Here we need to find the interest rate that equates the perpetuity cash flows with the PV of the cash flows. Using the PV of a perpetuity equation:

$$\begin{aligned}\text{PV} &= C / r \\ \$63,000 &= \$1,200 / r\end{aligned}$$

We can now solve for the interest rate as follows:

$$r = \$1,200 / \$63,000 = .0190 \text{ or } 1.90\% \text{ per month}$$

The interest rate is 1.90% per month. To find the APR, we multiply this rate by the number of months in a year, so:

$$\text{APR} = (12)1.90\% = 22.86\%$$

And using the equation to find an EAR:

$$\begin{aligned}\text{EAR} &= [1 + (\text{APR} / m)]^m - 1 \\ \text{EAR} &= [1 + .0190]^{12} - 1 = 25.41\%\end{aligned}$$

24. This problem requires us to find the FVA. The equation to find the FVA is:

$$\begin{aligned}\text{FVA} &= C \{[(1 + r)^t - 1] / r\} \\ \text{FVA} &= \$250 \{ [1 + (.10/12)]^{360} - 1 \} / (.10/12) = \$565,121.98\end{aligned}$$

25. In the previous problem, the cash flows are monthly and the compounding period is monthly. This assumption still holds. Since the cash flows are annual, we need to use the EAR to calculate the future value of annual cash flows. It is important to remember that you have to make sure the compounding periods of the interest rate times with the cash flows. In this case, we have annual cash flows, so we need the EAR since it is the true annual interest rate you will earn. So, finding the EAR:

$$\begin{aligned} \text{EAR} &= [1 + (\text{APR} / m)]^m - 1 \\ \text{EAR} &= [1 + (.10/12)]^{12} - 1 = .1047 \text{ or } 10.47\% \end{aligned}$$

Using the FVA equation, we get:

$$\begin{aligned} \text{FVA} &= C \{ [(1 + r)^t - 1] / r \} \\ \text{FVA} &= \$3,000 [(1.1047^{30} - 1) / .1047] = \$539,686.21 \end{aligned}$$

26. The cash flows are simply an annuity with four payments per year for four years, or 16 payments. We can use the PVA equation:

$$\begin{aligned} \text{PVA} &= C \{ [1 - 1/(1 + r)^t] / r \} \\ \text{PVA} &= \$1,500 \{ [1 - (1/1.0075)^{16}] / .0075 \} = \$22,536.47 \end{aligned}$$

27. The cash flows are annual and the compounding period is quarterly, so we need to calculate the EAR to make the interest rate comparable with the timing of the cash flows. Using the equation for the EAR, we get:

$$\begin{aligned} \text{EAR} &= [1 + (\text{APR} / m)]^m - 1 \\ \text{EAR} &= [1 + (.11/4)]^4 - 1 = .1146 \text{ or } 11.46\% \end{aligned}$$

And now we use the EAR to find the PV of each cash flow as a lump sum and add them together:

$$\text{PV} = \$900 / 1.1146 + \$850 / 1.1146^2 + \$1,140 / 1.1146^4 = \$2,230.20$$

28. Here the cash flows are annual and the given interest rate is annual, so we can use the interest rate given. We simply find the PV of each cash flow and add them together.

$$\text{PV} = \$2,800 / 1.0845 + \$5,600 / 1.0845^3 + \$1,940 / 1.0845^4 = \$8,374.62$$

### Intermediate

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:

$$.06(10) = .6$$

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

$$(1 + r)^{10}$$

B-76 SOLUTIONS

Setting the two equal, we get:

$$(.06)(10) = (1 + r)^{10} - 1$$

$$r = 1.6^{1/10} - 1 = .0481 \text{ or } 4.81\%$$

- 30.** Here we need to convert an EAR into interest rates for different compounding periods. Using the equation for the EAR, we get:

$$\text{EAR} = [1 + (\text{APR} / m)]^m - 1$$

$$\text{EAR} = .18 = (1 + r)^2 - 1; \quad r = (1.18)^{1/2} - 1 = .0863 \text{ or } 8.63\% \text{ per six months}$$

$$\text{EAR} = .18 = (1 + r)^4 - 1; \quad r = (1.18)^{1/4} - 1 = .0422 \text{ or } 4.22\% \text{ per quarter}$$

$$\text{EAR} = .18 = (1 + r)^{12} - 1; \quad r = (1.18)^{1/12} - 1 = .0139 \text{ or } 1.39\% \text{ per month}$$

Notice that the effective six month rate is not twice the effective quarterly rate because of the effect of compounding.

- 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:

$$\text{FV} = \$5,000 [1 + (.025/12)]^6 = \$5,062.83$$

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

$$\text{FV} = \$5,062.83 [1 + (.17/12)]^6 = \$5,508.70$$

The problem asks for the interest accrued, so, to find the interest, we subtract the beginning balance from the FV. The interest accrued is:

$$\text{Interest} = \$5,508.70 - 5,000.00 = \$508.70$$

- 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.

$$\text{Stock account: FVA} = \$600 \left\{ \frac{[1 + (.12/12)]^{360} - 1}{(.12/12)} \right\} = \$2,096,978.48$$

$$\text{Bond account: FVA} = \$300 \left\{ \frac{[1 + (.07/12)]^{360} - 1}{(.07/12)} \right\} = \$365,991.30$$

So, the total amount saved at retirement is:

$$\$2,096,978.48 + 365,991.30 = \$2,462,969.78$$

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

$$\begin{aligned} \text{PVA} &= \$2,462,969.78 = \$C \left[ 1 - \frac{1}{[1 + (.09/12)]^{300}} \right] / (.09/12) \\ C &= \$2,462,969.78 / 119.1616 = \$20,669.15 \text{ withdrawal per month} \end{aligned}$$

- 33.** We need to find the FV of a lump sum in one year and two years. It is important that we use the number of months in compounding since interest is compounded monthly in this case. So:

$$\text{FV in one year} = \$1(1.0108)^{12} = \$1.14$$

$$\text{FV in two years} = \$1(1.0108)^{24} = \$1.29$$

There is also another common alternative solution. We could find the EAR, and use the number of years as our compounding periods. So we will find the EAR first:

$$\text{EAR} = (1 + .0108)^{12} - 1 = .1376 \text{ or } 13.76\%$$

Using the EAR and the number of years to find the FV, we get:

$$\text{FV in one year} = \$1(1.1376)^1 = \$1.14$$

$$\text{FV in two years} = \$1(1.1376)^2 = \$1.29$$

Either method is correct and acceptable. We have simply made sure that the interest compounding period is the same as the number of periods we use to calculate the FV.

- 34.** Here we are finding the annuity payment necessary to achieve the same FV. The interest rate given is a 10 percent APR, with monthly deposits. We must make sure to use the number of months in the equation. So, using the FVA equation:

$$\begin{aligned} \text{FVA in 40 years} &= C \left[ \frac{[1 + (.11/12)]^{480} - 1}{(.11/12)} \right] \\ C &= \$1,000,000 / 8,600.127 = \$116.28 \end{aligned}$$

$$\begin{aligned} \text{FVA in 30 years} &= C \left[ \frac{[1 + (.11/12)]^{360} - 1}{(.11/12)} \right] \\ C &= \$1,000,000 / 2,804.52 = \$356.57 \end{aligned}$$

$$\begin{aligned} \text{FVA in 20 years} &= C \left[ \frac{[1 + (.11/12)]^{240} - 1}{(.11/12)} \right] \\ C &= \$1,000,000 / 865.638 = \$1,155.22 \end{aligned}$$

Notice that a deposit for half the length of time, i.e. 20 years versus 40 years, does not mean that the annuity payment is doubled. In this example, by reducing the savings period by one-half, the deposit necessary to achieve the same terminal value is about nine times as large.

- 35.** Since we are looking to quadruple our money, the PV and FV are irrelevant as long as the FV is four times as large as the PV. The number of periods is four, the number of quarters per year. So:

$$\begin{aligned} \text{FV} = \$4 &= \$1(1 + r)^{(12/3)} \\ r &= .4142 \text{ or } 41.42\% \end{aligned}$$

## B-78 SOLUTIONS

- 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.

$$\text{EAR} = [1 + (.10 / 12)]^{12} - 1 = .104713 \text{ or } 10.4713\%$$

$$\text{PVA}_1 = \$90,000 \{ [1 - (1 / 1.104713)^2] / .104713 \} = \$155,215.98$$

$$\text{PVA}_2 = \$45,000 + \$65,000 \{ [1 - (1 / 1.104713)^2] / .104713 \} = \$157,100.43$$

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

- 37.** We can use the present value of a growing perpetuity equation to find the value of your deposits today. Doing so, we find:

$$\begin{aligned} \text{PV} &= C \{ [1/(r - g)] - [1/(r - g)] \times [(1 + g)/(1 + r)]^t \} \\ \text{PV} &= \$1,000,000 \{ [1/ (.09 - .05)] - [1/ (.09 - .05)] \times [(1 + .05)/(1 + .09)]^{25} \} \\ \text{PV} &= \$15,182,293.68 \end{aligned}$$

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

$$\text{Next year's salary} = \$50,000 (1 + .04)$$

$$\text{Next year's salary} = \$52,000$$

This means your deposit next year will be:

$$\text{Next year's deposit} = \$52,000(.02)$$

$$\text{Next year's deposit} = \$1,040$$

Since your salary grows at 4 percent, your 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:

$$\begin{aligned} \text{PV} &= C \{ [1/(r - g)] - [1/(r - g)] \times [(1 + g)/(1 + r)]^t \} \\ \text{PV} &= \$1,040 \{ [1/ (.10 - .04)] - [1/ (.10 - .04)] \times [(1 + .04)/(1 + .10)]^{40} \} \\ \text{PV} &= \$15,494.64 \end{aligned}$$

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

$$\text{FV} = \text{PV}(1 + r)^t$$

$$\text{FV} = \$15,494.64(1 + .10)^{40}$$

$$\text{FV} = \$701,276.07$$

This is the value of your savings in 40 years.

39. The relationship between the PVA and the interest rate is:

PVA falls as  $r$  increases, and PVA rises as  $r$  decreases  
 FVA rises as  $r$  increases, and FVA falls as  $r$  decreases

The present values of \$7,000 per year for 10 years at the various interest rates given are:

$$\text{PVA}@10\% = \$7,000 \{ [1 - (1/1.10)^{10}] / .10 \} = \$43,011.97$$

$$\text{PVA}@5\% = \$7,000 \{ [1 - (1/1.05)^{10}] / .05 \} = \$54,052.14$$

$$\text{PVA}@15\% = \$7,000 \{ [1 - (1/1.15)^{10}] / .15 \} = \$35,131.38$$

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:

$$\text{FVA} = \$20,000 = \$225 \{ [1 + (.09/12)]^t - 1 \} / (.09/12)$$

Solving for  $t$ , we get:

$$1.0075^t = 1 + [(\$20,000)/(\$225)](.09/12)$$

$$t = \ln 1.66667 / \ln 1.0075 = 68.37 \text{ payments}$$

41. Here we are given the PVA, number of periods, and the amount of the annuity. We need to solve for the interest rate. Using the PVA equation:

$$\text{PVA} = \$55,000 = \$1,120 \{ [1 - [1 / (1 + r)]^{60}] / r \}$$

To find the interest rate, we need to solve this equation on a financial calculator, using a spreadsheet, or by trial and error. If you use trial and error, remember that increasing the interest rate lowers the PVA, and increasing the interest rate decreases the PVA. Using a spreadsheet, we find:

$$r = 0.682\%$$

The APR is the periodic interest rate times the number of periods in the year, so:

$$\text{APR} = 12(0.682\%) = 8.18\%$$

## B-80 SOLUTIONS

42. The amount of principal paid on the loan is the PV of the monthly payments you make. So, the present value of the \$1,100 monthly payments is:

$$PVA = \$1,100[(1 - \{1 / [1 + (.068/12)]\}^{360}) / (.068/12)] = \$168,731.02$$

The monthly payments of \$1,100 will amount to a principal payment of \$168,731.02. The amount of principal you will still owe is:

$$\$220,000 - 168,731.02 = \$51,268.98$$

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:

$$\text{Balloon payment} = \$51,268.98 [1 + (.068/12)]^{360} = \$392,025.82$$

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:

$$\text{PV of Year 1 CF: } \$1,500 / 1.10 = \$1,363.64$$

$$\text{PV of Year 3 CF: } \$1,800 / 1.10^3 = \$1,352.37$$

$$\text{PV of Year 4 CF: } \$2,400 / 1.10^4 = \$1,639.23$$

So, the PV of the missing CF is:

$$\$6,785 - 1,363.64 - 1,352.37 - 1,639.23 = \$2,429.76$$

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:

$$\$2,429.76(1.10)^2 = \$2,940.02$$

44. To solve this problem, we simply need to find the PV of each lump sum and add them together. It is important to note that the first cash flow of \$1 million occurs today, so we do not need to discount that cash flow. The PV of the lottery winnings is:

$$\begin{aligned} & \$1,000,000 + \$1,400,000/1.09 + \$1,800,000/1.09^2 + \$2,200,000/1.09^3 + \$2,600,000/1.09^4 + \\ & \quad \$3,000,000/1.09^5 + \$3,400,000/1.09^6 + \$3,800,000/1.09^7 + \$4,200,000/1.09^8 + \\ & \quad \$4,600,000/1.09^9 + \$5,000,000/1.09^{10} = \$19,733,830.26 \end{aligned}$$

45. Here we are finding interest rate for an annuity cash flow. We are given the PVA, number of periods, and the amount of the annuity. We need to solve for the number of payments. We should also note that the PV of the annuity is not the amount borrowed since we are making a down payment on the warehouse. The amount borrowed is:

$$\text{Amount borrowed} = 0.80(\$2,400,000) = \$1,920,000$$

Using the PVA equation:

$$PVA = \$1,920,000 = \$13,000 \left[ \frac{1 - [1 / (1 + r)]^{360}}{r} \right]$$

Unfortunately this equation cannot be solved to find the interest rate using algebra. To find the interest rate, we need to solve this equation on a financial calculator, using a spreadsheet, or by trial and error. If you use trial and error, remember that increasing the interest rate lowers the PVA, and increasing the interest rate decreases the PVA. Using a spreadsheet, we find:

$$r = 0.598\%$$

The APR is the monthly interest rate times the number of months in the year, so:

$$APR = 12(0.598\%) = 7.17\%$$

And the EAR is:

$$EAR = (1 + .00598)^{12} - 1 = .0742 \text{ or } 7.42\%$$

- 46.** The profit the firm earns is just the PV of the sales price minus the cost to produce the asset. We find the PV of the sales price as the PV of a lump sum:

$$PV = \$145,000 / 1.13^3 = \$100,492.27$$

And the firm's profit is:

$$\text{Profit} = \$100,492.27 - 94,000.00 = \$6,492.27$$

To find the interest rate at which the firm will break even, we need to find the interest rate using the PV (or FV) of a lump sum. Using the PV equation for a lump sum, we get:

$$\begin{aligned} \$94,000 &= \$145,000 / (1 + r)^3 \\ r &= (\$145,000 / \$94,000)^{1/3} - 1 = .1554 \text{ or } 15.54\% \end{aligned}$$

- 47.** We want to find the value of the cash flows today, so we will find the PV of the annuity, and then bring the lump sum PV back to today. The annuity has 17 payments, so the PV of the annuity is:

$$PVA = \$2,000 \left\{ \frac{1 - (1/1.10)^{17}}{.10} \right\} = \$16,043.11$$

Since this is an ordinary annuity equation, this is the PV one period before the first payment, so it is the PV at  $t = 8$ . To find the value today, we find the PV of this lump sum. The value today is:

$$PV = \$16,043.11 / 1.10^8 = \$7,484.23$$

- 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:

$$PVA_2 = \$1,500 \left[ \frac{1 - 1 / [1 + (.10/12)]^{96}}{(.10/12)} \right] = \$98,852.23$$

## B-82 SOLUTIONS

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:

$$PV = \$98,852.23 / [1 + (.13/12)]^{84} = \$39,985.62$$

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

$$PVA_1 = \$1,500 \left[ \frac{1 - 1 / [1 + (.13/12)]^{84}}{(.13/12)} \right] = \$82,453.99$$

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

$$PV = \$39,985.62 + 82,453.99 = \$122,439.62$$

- 49.** Here we are trying to find the dollar amount invested today that will equal the FVA with a known interest rate, and payments. First we need to determine how much we would have in the annuity account. Finding the FV of the annuity, we get:

$$FVA = \$1,000 \left[ \frac{[1 + (.095/12)]^{180} - 1}{(.095/12)} \right] = \$395,948.63$$

Now we need to find the PV of a lump sum that will give us the same FV. So, using the FV of a lump sum with continuous compounding, we get:

$$\begin{aligned} FV &= \$395,948.63 = PV e^{.09(15)} \\ PV &= \$395,948.63 e^{-1.35} = \$102,645.83 \end{aligned}$$

- 50.** To find the value of the perpetuity at  $t = 7$ , we first need to use the PV of a perpetuity equation. Using this equation we find:

$$PV = \$5,000 / .057 = \$87,719.30$$

Remember that the PV of a perpetuity (and annuity) equations give the PV one period before the first payment, so, this is the value of the perpetuity at  $t = 14$ . To find the value at  $t = 7$ , we find the PV of this lump sum as:

$$PV = \$87,719.30 / 1.057^7 = \$59,507.30$$

- 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:

$$PVA = \$20,000 = \$1,916.67 \left\{ \frac{1 - [1 / (1 + r)]^{12}}{r} \right\}$$

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:

$$r = 2.219\% \text{ per month}$$

So the APR is:

$$\text{APR} = 12(2.219\%) = 26.62\%$$

And the EAR is:

$$\text{EAR} = (1.02219)^{12} - 1 = .3012 \text{ or } 30.12\%$$

- 52.** The cash flows in this problem are semiannual, so we need the effective semiannual rate. The interest rate given is the APR, so the monthly interest rate is:

$$\text{Monthly rate} = .10 / 12 = .00833$$

To get the semiannual interest rate, we can use the EAR equation, but instead of using 12 months as the exponent, we will use 6 months. The effective semiannual rate is:

$$\text{Semiannual rate} = (1.00833)^6 - 1 = .0511 \text{ or } 5.11\%$$

We can now use this rate to find the PV of the annuity. The PV of the annuity is:

$$\text{PVA @ } t = 9: \$6,000 \{ [1 - (1 / 1.0511)^{10}] / .0511 \} = \$46,094.33$$

Note, this is the value one period (six months) before the first payment, so it is the value at  $t = 9$ . So, the value at the various times the questions asked for uses this value 9 years from now.

$$\text{PV @ } t = 5: \$46,094.33 / 1.0511^8 = \$30,949.21$$

Note, you can also calculate this present value (as well as the remaining present values) using the number of years. To do this, you need the EAR. The EAR is:

$$\text{EAR} = (1 + .0083)^{12} - 1 = .1047 \text{ or } 10.47\%$$

So, we can find the PV at  $t = 5$  using the following method as well:

$$\text{PV @ } t = 5: \$46,094.33 / 1.1047^4 = \$30,949.21$$

The value of the annuity at the other times in the problem is:

$$\text{PV @ } t = 3: \$46,094.33 / 1.0511^{12} = \$25,360.08$$

$$\text{PV @ } t = 3: \$46,094.33 / 1.1047^6 = \$25,360.08$$

$$\text{PV @ } t = 0: \$46,094.33 / 1.0511^{18} = \$18,810.58$$

$$\text{PV @ } t = 0: \$46,094.33 / 1.1047^9 = \$18,810.58$$

- 53. a.** Calculating the PV of an ordinary annuity, we get:

$$\text{PVA} = \$950 \{ [1 - (1/1.095)^8] / .095 \} = \$5,161.76$$

B-84 SOLUTIONS

- b. To calculate the PVA due, we calculate the PV of an ordinary annuity for  $t - 1$  payments, and add the payment that occurs today. So, the PV of the annuity due is:

$$PVA = \$950 + \$950\{[1 - (1/1.095)^7] / .095\} = \$5,652.13$$

54. We need to use the PVA due equation, that is:

$$PVA_{\text{due}} = (1 + r) PVA$$

Using this equation:

$$PVA_{\text{due}} = \$61,000 = [1 + (.0815/12)] \times C\{[1 - 1 / [1 + (.0815/12)]^{60}] / (.0815/12)\}$$

$$\$60,588.50 = \$C\{1 - [1 / (1 + .0815/12)^{60}]\} / (.0815/12)$$

$$C = \$1,232.87$$

Notice, when we find the payment for the PVA due, we simply discount the PV of the annuity due back one period. We then use this value as the PV of an ordinary annuity.

55. The payment for a loan repaid with equal payments is the annuity payment with the loan value as the PV of the annuity. So, the loan payment will be:

$$PVA = \$36,000 = C \{[1 - 1 / (1 + .09)^5] / .09\}$$

$$C = \$9,255.33$$

The interest payment is the beginning balance times the interest rate for the period, and the principal payment is the total payment minus the interest payment. The ending balance is the beginning balance minus the principal payment. The ending balance for a period is the beginning balance for the next period. The amortization table for an equal payment is:

<u>Year</u>	<u>Beginning Balance</u>	<u>Total Payment</u>	<u>Interest Payment</u>	<u>Principal Payment</u>	<u>Ending Balance</u>
1	\$36,000.00	\$9,255.33	\$3,240.00	\$6,015.33	\$29,984.67
2	29,984.67	9,255.33	2,698.62	6,556.71	23,427.96
3	23,427.96	9,255.33	2,108.52	7,146.81	16,281.15
4	16,281.15	9,255.33	1,465.30	7,790.02	8,491.13
5	8,491.13	9,255.33	764.20	8,491.13	0.00

In the third year, \$2,108.52 of interest is paid.

$$\text{Total interest over life of the loan} = \$3,240 + 2,698.62 + 2,108.52 + 1,465.30 + 764.20 = \$10,276.64$$

56. This amortization table calls for equal principal payments of \$7,200 per year. The interest payment is the beginning balance times the interest rate for the period, and the total payment is the principal payment plus the interest payment. The ending balance for a period is the beginning balance for the next period. The amortization table for an equal principal reduction is:

<u>Year</u>	<u>Beginning Balance</u>	<u>Total Payment</u>	<u>Interest Payment</u>	<u>Principal Payment</u>	<u>Ending Balance</u>
1	\$36,000.00	\$10,440.00	\$3,240.00	\$7,200.00	\$28,800.00
2	28,800.00	9,792.00	2,592.00	7,200.00	21,600.00
3	21,600.00	9,144.00	1,944.00	7,200.00	14,400.00
4	14,400.00	8,496.00	1,296.00	7,200.00	7,200.00
5	7,200.00	7,848.00	648.00	7,200.00	0.00

In the third year, \$1,944 of interest is paid.

Total interest over life of the loan = \$3,240 + 2,592 + 1,944 + 1,296 + 648 = \$9,720

Notice that the total payments for the equal principal reduction loan are lower. This is because more principal is repaid early in the loan, which reduces the total interest expense over the life of the loan.

### Challenge

57. The cash flows for this problem occur monthly, and the interest rate given is the EAR. Since the cash flows occur monthly, we must get the effective monthly rate. One way to do this is to find the APR based on monthly compounding, and then divide by 12. So, the pre-retirement APR is:

$$\text{EAR} = .11 = [1 + (\text{APR} / 12)]^{12} - 1; \quad \text{APR} = 12[(1.11)^{1/12} - 1] = 10.48\%$$

And the post-retirement APR is:

$$\text{EAR} = .08 = [1 + (\text{APR} / 12)]^{12} - 1; \quad \text{APR} = 12[(1.08)^{1/12} - 1] = 7.72\%$$

First, we will calculate how much he needs at retirement. The amount needed at retirement is the PV of the monthly spending plus the PV of the inheritance. The PV of these two cash flows is:

$$\text{PVA} = \$20,000 \{1 - [1 / (1 + .0772/12)]^{12(20)}\} / (.0772/12) = \$2,441,554.61$$

$$\text{PV} = \$750,000 / [1 + (.0772/12)]^{240} = \$160,911.16$$

So, at retirement, he needs:

$$\$2,441,544.61 + 160,911.16 = \$2,602,465.76$$

He will be saving \$2,100 per month for the next 10 years until he purchases the cabin. The value of his savings after 10 years will be:

$$\text{FVA} = \$2,000 \{ [1 + (.1048/12)]^{12(10)} - 1 \} / (.1048/12) = \$421,180.66$$

## B-86 SOLUTIONS

After he purchases the cabin, the amount he will have left is:

$$\$421,180.66 - 325,000 = \$96,180.66$$

He still has 20 years until retirement. When he is ready to retire, this amount will have grown to:

$$FV = \$96,180.66[1 + (.1048/12)]^{12(20)} = \$775,438.43$$

So, when he is ready to retire, based on his current savings, he will be short:

$$\$2,602,465.76 - 775,438.43 = \$1,827,027.33$$

This amount is the FV of the monthly savings he must make between years 10 and 30. So, finding the annuity payment using the FVA equation, we find his monthly savings will need to be:

$$FVA = \$1,827,027.33 = C[\{1 + (.1048/12)\}^{12(20)} - 1] / (.1048/12)$$
$$C = \$2,259.65$$

- 58.** 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 \$1. 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:

$$PV = \$1 + \$380\{1 - [1 / (1 + .08/12)]^{12(3)}\} / (.08/12) = \$12,127.49$$

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:

$$PV = \$15,000 / [1 + (.08/12)]^{12(3)} = \$11,808.82$$

The PV of the decision to purchase is:

$$\$28,000 - 11,808.82 = \$16,191.18$$

In this case, it is cheaper to lease the car than buy it since the PV of the leasing 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:

$$\$28,000 - PV \text{ of resale price} = \$12,127.49$$

$$PV \text{ of resale price} = \$15,872.51$$

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

$$\text{Breakeven resale price} = \$15,872.51[1 + (.08/12)]^{12(3)} = \$20,161.86$$

- 59.** To find the quarterly salary for the player, we first need to find the PV of the current contract. The cash flows for the contract are annual, and we are given a daily interest rate. We need to find the EAR so the interest compounding is the same as the timing of the cash flows. The EAR is:

$$\text{EAR} = [1 + (.055/365)]^{365} - 1 = 5.65\%$$

The PV of the current contract offer is the sum of the PV of the cash flows. So, the PV is:

$$\begin{aligned} \text{PV} &= \$8,000,000 + \$4,000,000/1.0565 + \$4,800,000/1.0565^2 + \$5,700,000/1.0565^3 \\ &\quad + \$6,400,000/1.0565^4 + \$7,000,000/1.0565^5 + \$7,500,000/1.0565^6 \\ \text{PV} &= \$36,764,432.45 \end{aligned}$$

The player wants the contract increased in value by \$750,000, so the PV of the new contract will be:

$$\text{PV} = \$36,764,432.45 + 750,000 = \$37,514,432.45$$

The player has also requested a signing bonus payable today in the amount of \$9 million. We can simply subtract this amount from the PV of the new contract. The remaining amount will be the PV of the future quarterly paychecks.

$$\$37,514,432.45 - 9,000,000 = \$28,514,432.45$$

To find the quarterly payments, first realize that the interest rate we need is the effective quarterly rate. Using the daily interest rate, we can find the quarterly interest rate using the EAR equation, with the number of days being 91.25, the number of days in a quarter ( $365 / 4$ ). The effective quarterly rate is:

$$\text{Effective quarterly rate} = [1 + (.055/365)]^{91.25} - 1 = .01384 \text{ or } 1.384\%$$

Now we have the interest rate, the length of the annuity, and the PV. Using the PVA equation and solving for the payment, we get:

$$\begin{aligned} \text{PVA} &= \$28,514,432.45 = C\{[1 - (1/1.01384)^{24}] / .01384\} \\ C &= \$1,404,517.39 \end{aligned}$$

- 60.** 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 cash flows of the loan are the \$20,000 you must repay in one year, and the \$17,200 you borrow today. The interest rate of the loan is:

$$\begin{aligned} \$20,000 &= \$17,200(1 + r) \\ r &= (\$20,000 - 17,200) / 17,200 = .1628 \text{ or } 16.28\% \end{aligned}$$

Because of the discount, you only get the use of \$17,200, and the interest you pay on that amount is 16.28%, not 14%.

## B-88 SOLUTIONS

- 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:

$$\text{APR} = 12[(1.09)^{1/12} - 1] = 8.65\%$$

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:

$$\text{FVA} = (\$44,000/12) \left[ \frac{[1 + (.0865/12)]^{12} - 1}{(.0865/12)} \right] = \$45,786.76$$

$$\text{FV} = \$45,786.76(1.09) = \$49,907.57$$

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:

$$\text{FVA} = (\$46,000/12) \left[ \frac{[1 + (.0865/12)]^{12} - 1}{(.0865/12)} \right] = \$47,867.98$$

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

$$\text{PVA} = (\$49,000/12) \left\{ \left[ 1 - \frac{1}{[1 + (.0865/12)]^{12(5)}} \right] / (.0865/12) \right\} = \$198,332.55$$

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:

$$\text{Award} = \$49,907.57 + 47,867.98 + 198,332.55 + 100,000 + 20,000 = \$416,108.10$$

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.

- 62.** Again, to find the interest rate of a loan, we need to look at the cash flows of the loan. Since this loan is in the form of a lump sum, the amount you will repay is the FV of the principal amount, which will be:

$$\text{Loan repayment amount} = \$10,000(1.09) = \$10,900$$

The amount you will receive today is the principal amount of the loan times one minus the points.

$$\text{Amount received} = \$10,000(1 - .03) = \$9,700$$

Now, we simply find the interest rate for this PV and FV.

$$\$10,900 = \$9,700(1 + r)$$

$$r = (\$10,900 / \$9,700) - 1 = .1237 \text{ or } 12.37\%$$

63. This is the same question as before, with different values. So:

$$\text{Loan repayment amount} = \$10,000(1.12) = \$11,200$$

$$\text{Amount received} = \$10,000(1 - .02) = \$9,800$$

$$\$11,200 = \$9,800(1 + r)$$

$$r = (\$11,200 / \$9,800) - 1 = .1429 \text{ or } 14.29\%$$

The effective rate is not affected by the loan amount since it drops out when solving for  $r$ .

64. First we will find the APR and EAR for the loan with the refundable fee. Remember, we need to use the actual cash flows of the loan to find the interest rate. With the \$1,500 application fee, you will need to borrow \$221,500 to have \$220,000 after deducting the fee. Solving for the payment under these circumstances, we get:

$$\text{PVA} = \$221,500 = C \{ [1 - 1/(1.006)^{360}] / .006 \} \text{ where } .006 = .072/12$$

$$C = \$1,503.52$$

We can now use this amount in the PVA equation with the original amount we wished to borrow, \$220,000. Solving for  $r$ , we find:

$$\text{PVA} = \$220,000 = \$1,503.52 [ \{ 1 - [1 / (1 + r)]^{360} \} / r ]$$

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

$$r = 0.6057\% \text{ per month}$$

$$\text{APR} = 12(0.6057\%) = 7.27\%$$

$$\text{EAR} = (1 + .006057)^{12} - 1 = 7.52\%$$

With the nonrefundable fee, the APR of the loan is simply the quoted APR since the fee is not considered part of the loan. So:

$$\text{APR} = 7.20\%$$

$$\text{EAR} = [1 + (.072/12)]^{12} - 1 = 7.44\%$$

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 \$40.08 per month for three years, so the interest rate on the loan is:

$$\text{PVA} = \$1,000 = \$40.08 [ \{ 1 - [1 / (1 + r)]^{36} \} / r ]$$

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

$$r = 2.13\% \text{ per month}$$

## B-90 SOLUTIONS

$$\text{APR} = 12(2.13\%) = 25.60\%$$

$$\text{EAR} = (1 + .0213)^{12} - 1 = 28.83\%$$

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:

$$\text{PVA} = \$90,000 \{ [1 - (1/1.08)^{20}] / .08 \} = \$883,633.27$$

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:

$$\begin{aligned} \text{FVA} &= \$883,633.27 = C[(1.08^{30} - 1) / .08] \\ C &= \$7,800.21 \end{aligned}$$

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

$$\begin{aligned} \text{FV} &= \$883,633.27 = \text{PV}(1.08)^{30} \\ \text{PV} &= \$87,813.12 \end{aligned}$$

- 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:

$$\text{FV of trust fund deposit} = \$25,000(1.08)^{10} = \$53,973.12$$

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

$$\text{FV} = \$883,633.27 - 53,973.12 = \$829,660.15$$

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

$$\$829,660.15 = C[(1.08^{30} - 1) / .08]$$

$$C = \$7,323.77$$

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

$$\text{Friend's contribution} = \$7,323.77 - 1,500 = \$5,823.77$$

67. We will calculate the number of periods necessary to repay the balance with no fee first. We simply need to use the PVA equation and solve for the number of payments.

Without fee and annual rate = 18.20%:

$$PVA = \$10,000 = \$200 \{ [1 - (1/1.0152)^t] / .0152 \} \text{ where } .0152 = .182/12$$

Solving for  $t$ , we get:

$$1/1.0152^t = 1 - (\$10,000/\$200)(.0152)$$

$$1/1.0152^t = .2417$$

$$t = \ln(1/.2417) / \ln 1.0152$$

$$t = 94.35 \text{ months}$$

Without fee and annual rate = 8.20%:

$$PVA = \$10,000 = \$200 \{ [1 - (1/1.006833)^t] / .006833 \} \text{ where } .006833 = .082/12$$

Solving for  $t$ , we get:

$$1/1.006833^t = 1 - (\$10,000/\$200)(.006833)$$

$$1/1.006833^t = .6583$$

$$t = \ln(1/.6583) / \ln 1.006833$$

$$t = 61.39 \text{ months}$$

Note that we do not need to calculate the time necessary to repay your current credit card with a fee since no fee will be incurred. The time to repay the new card with a transfer fee is:

With fee and annual rate = 8.20%:

$$PVA = \$10,200 = \$200 \{ [1 - (1/1.006833)^t] / .006833 \} \text{ where } .006833 = .082/12$$

Solving for  $t$ , we get:

$$1/1.006833^t = 1 - (\$10,200/\$200)(.006833)$$

$$1/1.006833^t = .6515$$

$$t = \ln(1/.6515) / \ln 1.006833$$

$$t = 62.92 \text{ months}$$

68. We need to find the FV of the premiums to compare with the cash payment promised at age 65. We have to find the value of the premiums at year 6 first since the interest rate changes at that time. So:

$$FV_1 = \$800(1.11)^5 = \$1,348.05$$

$$FV_2 = \$800(1.11)^4 = \$1,214.46$$

$$FV_3 = \$900(1.11)^3 = \$1,230.87$$

## B-92 SOLUTIONS

$$FV_4 = \$900(1.11)^2 = \$1,108.89$$

$$FV_5 = \$1,000(1.11)^1 = \$1,110.00$$

$$\text{Value at year six} = \$1,348.05 + 1,214.46 + 1,230.87 + 1,108.89 + 1,110.00 + 1,000 = \$7,012.26$$

Finding the FV of this lump sum at the child's 65<sup>th</sup> birthday:

$$FV = \$7,012.26(1.07)^{59} = \$379,752.76$$

The policy is not worth buying; the future value of the deposits is \$379,752.76, but the policy contract will pay off \$350,000. The premiums are worth \$29,752.76 more than the policy payoff.

Note, we could also compare the PV of the two cash flows. The PV of the premiums is:

$$PV = \$800/1.11 + \$800/1.11^2 + \$900/1.11^3 + \$900/1.11^4 + \$1,000/1.11^5 + \$1,000/1.11^6 = \$3,749.04$$

And the value today of the \$350,000 at age 65 is:

$$PV = \$350,000/1.07^{59} = \$6,462.87$$

$$PV = \$6,462.87/1.11^6 = \$3,455.31$$

The premiums still have the higher cash flow. At time zero, the difference is \$2,148.25. Whenever you are comparing two or more cash flow streams, the cash flow with the highest value at one time will have the highest value at any other time.

Here is a question for you: Suppose you invest \$293.73, the difference in the cash flows at time zero, for six years at an 11 percent interest rate, and then for 59 years at a seven percent interest rate. How much will it be worth? Without doing calculations, you know it will be worth \$29,752.76, the difference in the cash flows at time 65!

- 69.** The monthly payments with a balloon payment loan are calculated assuming a longer amortization schedule, in this case, 30 years. The payments based on a 30-year repayment schedule would be:

$$PVA = \$450,000 = C(\{1 - [1 / (1 + .085/12)]^{360}\} / (.085/12))$$
$$C = \$3,460.11$$

Now, at time = 8, we need to find the PV of the payments which have not been made. The balloon payment will be:

$$PVA = \$3,460.11(\{1 - [1 / (1 + .085/12)]^{12(22)}\} / (.085/12))$$
$$PVA = \$412,701.01$$

- 70.** Here we need to find the interest rate that makes the PVA, the college costs, equal to the FVA, the savings. The PV of the college costs are:

$$PVA = \$15,000[\{1 - [1 / (1 + r)^4]\} / r]$$

And the FV of the savings is:

$$FVA = \$5,000 \{ [(1+r)^6 - 1] / r \}$$

Setting these two equations equal to each other, we get:

$$\$15,000 \{ [1 - [1 / (1+r)^4] ] / r \} = \$5,000 \{ [(1+r)^6 - 1] / r \}$$

Reducing the equation gives us:

$$(1+r)^6 - 4.00(1+r)^4 + 30.00 = 0$$

Now we need to find the roots of this equation. We can solve using trial and error, a root-solving calculator routine, or a spreadsheet. Using a spreadsheet, we find:

$$r = 14.52\%$$

- 71.** Here we need to find the interest rate that makes us indifferent between an annuity and a perpetuity. To solve this problem, we need to find the PV of the two options and set them equal to each other. The PV of the perpetuity is:

$$PV = \$15,000 / r$$

And the PV of the annuity is:

$$PVA = \$20,000 \{ [1 - [1 / (1+r)]^{10}] / r \}$$

Setting them equal and solving for  $r$ , we get:

$$\$15,000 / r = \$20,000 \{ [1 - [1 / (1+r)]^{10}] / r \}$$

$$\$15,000 / \$20,000 = 1 - [1 / (1+r)]^{10}$$

$$.25^{1/10} = 1 / (1+r)$$

$$r = .1487 \text{ or } 14.87\%$$

- 72.** The cash flows in this problem occur every two years, so we need to find the effective two year rate. One way to find the effective two year rate is to use an equation similar to the EAR, except use the number of days in two years as the exponent. (We use the number of days in two years since it is daily compounding; if monthly compounding was assumed, we would use the number of months in two years.) So, the effective two-year interest rate is:

$$\text{Effective 2-year rate} = [1 + (.11/365)]^{365(2)} - 1 = .2460 \text{ or } 24.60\%$$

We can use this interest rate to find the PV of the perpetuity. Doing so, we find:

$$PV = \$7,500 / .2460 = \$30,483.41$$

B-94 SOLUTIONS

This is an important point: Remember that the PV equation for a perpetuity (and an ordinary annuity) tells you the PV one period before the first cash flow. In this problem, since the cash flows are two years apart, we have found the value of the perpetuity one period (two years) before the first payment, which is one year ago. We need to compound this value for one year to find the value today. The value of the cash flows today is:

$$PV = \$30,483.41(1 + .11/365)^{365} = \$34,027.40$$

The second part of the question assumes the perpetuity cash flows begin in four years. In this case, when we use the PV of a perpetuity equation, we find the value of the perpetuity two years from today. So, the value of these cash flows today is:

$$PV = \$30,483.41 / (1 + .11/365)^{2(365)} = \$24,464.32$$

73. To solve for the PVA due:

$$PVA = \frac{C}{(1+r)} + \frac{C}{(1+r)^2} + \dots + \frac{C}{(1+r)^t}$$

$$PVA_{\text{due}} = C + \frac{C}{(1+r)} + \dots + \frac{C}{(1+r)^{t-1}}$$

$$PVA_{\text{due}} = (1+r) \left( \frac{C}{(1+r)} + \frac{C}{(1+r)^2} + \dots + \frac{C}{(1+r)^t} \right)$$

$$PVA_{\text{due}} = (1+r) PVA$$

And the FVA due is:

$$FVA = C + C(1+r) + C(1+r)^2 + \dots + C(1+r)^{t-1}$$

$$FVA_{\text{due}} = C(1+r) + C(1+r)^2 + \dots + C(1+r)^t$$

$$FVA_{\text{due}} = (1+r)[C + C(1+r) + \dots + C(1+r)^{t-1}]$$

$$FVA_{\text{due}} = (1+r)FVA$$

74. We need to find the first payment into the retirement account. The present value of the desired amount at retirement is:

$$PV = FV/(1+r)^t$$

$$PV = \$1,000,000/(1 + .10)^{30}$$

$$PV = \$57,308.55$$

This is the value today. Since the savings are in the form of a growing annuity, we can use the growing annuity equation and solve for the payment. Doing so, we get:

$$PV = C \{ [1 - ((1+g)/(1+r))^t] / (r-g) \}$$

$$\$57,308.55 = C \{ [1 - ((1+.03)/(1+.10))^{30}] / (.10 - .03) \}$$

$$C = \$4,659.79$$

This is the amount you need to save next year. So, the percentage of your salary is:

$$\begin{aligned}\text{Percentage of salary} &= \$4,659.79/\$55,000 \\ \text{Percentage of salary} &= .0847 \text{ or } 8.47\%\end{aligned}$$

Note that this is the percentage of your salary you must save each year. Since your salary is increasing at 3 percent, and the savings are increasing at 3 percent, the percentage of salary will remain constant.

75. a. The APR is the interest rate per week times 52 weeks in a year, so:

$$\text{APR} = 52(8\%) = 416\%$$

$$\text{EAR} = (1 + .08)^{52} - 1 = 53.7060 \text{ or } 5,370.60\%$$

- b. In a discount loan, the amount you receive is lowered by the discount, and you repay the full principal. With an 8 percent discount, you would receive \$9.20 for every \$10 in principal, so the weekly interest rate would be:

$$\begin{aligned}\$10 &= \$9.20(1 + r) \\ r &= (\$10 / \$9.20) - 1 = .0870 \text{ or } 8.70\%\end{aligned}$$

Note the dollar amount we use is irrelevant. In other words, we could use \$0.92 and \$1, \$92 and \$100, or any other combination and we would get the same interest rate. Now we can find the APR and the EAR:

$$\text{APR} = 52(8.70\%) = 452.17\%$$

$$\text{EAR} = (1 + .0870)^{52} - 1 = 75.3894 \text{ or } 7,538.94\%$$

- c. Using the cash flows from the loan, we have the PVA and the annuity payments and need to find the interest rate, so:

$$\text{PVA} = \$68.92 = \$25[\{1 - [1 / (1 + r)]^4\} / r]$$

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

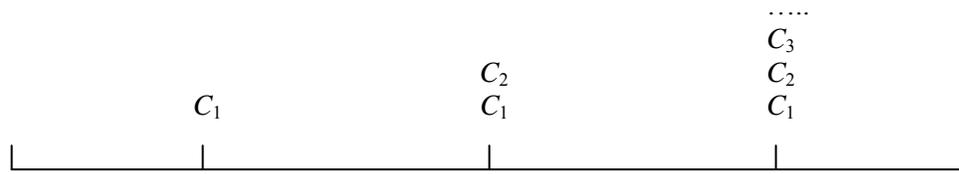
$$r = 16.75\% \text{ per week}$$

$$\text{APR} = 52(16.75\%) = 871.00\%$$

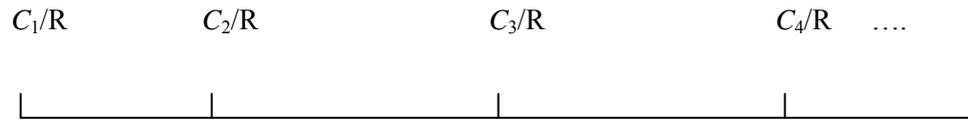
$$\text{EAR} = 1.1675^{52} - 1 = 3142.1572 \text{ or } 314,215.72\%$$

B-96 SOLUTIONS

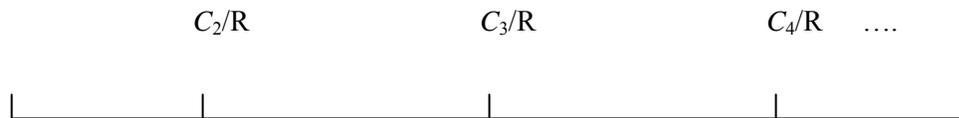
76. To answer this, we need to diagram the perpetuity cash flows, which are: (Note, the subscripts are only to differentiate when the cash flows begin. The cash flows are all the same amount.)



Thus, each of the increased cash flows is a perpetuity in itself. So, we can write the cash flows stream as:



So, we can write the cash flows as the present value of a perpetuity, and a perpetuity of:



The present value of this perpetuity is:

$$PV = (C/R) / R = C/R^2$$

So, the present value equation of a perpetuity that increases by  $C$  each period is:

$$PV = C/R + C/R^2$$

77. We are only concerned with the time it takes money to double, so the dollar amounts are irrelevant. So, we can write the future value of a lump sum as:

$$FV = PV(1 + R)^t$$

$$\$2 = \$1(1 + R)^t$$

Solving for  $t$ , we find:

$$\ln(2) = t[\ln(1 + R)]$$

$$t = \ln(2) / \ln(1 + R)$$

Since  $R$  is expressed as a percentage in this case, we can write the expression as:

$$t = \ln(2) / \ln(1 + R/100)$$

To simplify the equation, we can make use of a Taylor Series expansion:

$$\ln(1 + R) = R - R^2/2 + R^3/3 - \dots$$

Since R is small, we can truncate the series after the first term:

$$\ln(1 + R) = R$$

Combine this with the solution for the doubling expression:

$$t = \ln(2) / (R/100)$$

$$t = 100\ln(2) / R$$

$$t = 69.3147 / R$$

This is the exact (approximate) expression, Since 69.3147 is not easily divisible, and we are only concerned with an approximation, 72 is substituted.

- 78.** We are only concerned with the time it takes money to double, so the dollar amounts are irrelevant. So, we can write the future value of a lump sum with continuously compounded interest as:

$$\$1 = \$2e^{Rt}$$

$$2 = e^{Rt}$$

$$Rt = \ln(2)$$

$$Rt = .693147$$

$$t = .691347 / R$$

Since we are using interest rates while the equation uses decimal form, to make the equation correct with percentages, we can multiply by 100:

$$t = 69.1347 / R$$





B-100 SOLUTIONS

5.

Enter	15	8.25%	\$28,000		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for				\$3,321.33	

6.

Enter	8	8.5%		\$65,000	
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for			\$366,546.89		

7.

Enter	20	10.5%		\$3,000	
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$181,892.42

Enter	40	10.5%		\$3,000	
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$1,521,754.74

8.

Enter	10	6.5%			\$80,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for				\$5,928.38	

9.

Enter	7	8%	\$30,000		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for				\$5,762.17	

12.

Enter	7%		4		
	<b>NOM</b>	<b>EFF</b>	<b>C/Y</b>		
Solve for		7.19%			

Enter	18%		12		
	<b>NOM</b>	<b>EFF</b>	<b>C/Y</b>		
Solve for		19.56%			

Enter	10%		365		
	<b>NOM</b>	<b>EFF</b>	<b>C/Y</b>		
Solve for		10.52%			

13.

Enter		12.2%	2		
	<b>NOM</b>	<b>EFF</b>	<b>C/Y</b>		
Solve for	11.85%				

Enter 9.4% 12  
**NOM** **EFF** **C/Y**  
 Solve for 9.02%

Enter 8.6% 52  
**NOM** **EFF** **C/Y**  
 Solve for 8.26%

**14.**

Enter 13.1% 12  
**NOM** **EFF** **C/Y**  
 Solve for 13.92%

Enter 13.4% 2  
**NOM** **EFF** **C/Y**  
 Solve for 13.85%

**15.**

Enter 14% 365  
**NOM** **EFF** **C/Y**  
 Solve for 13.11%

**16.**

Enter  $20 \times 2$  9.6%/2 \$1,400  
**N** **I/Y** **PV** **PMT** **FV**  
 Solve for \$9,132.28

**17.**

Enter  $5 \times 365$  8.4% / 365 \$6,000  
**N** **I/Y** **PV** **PMT** **FV**  
 Solve for \$9,131.33

Enter  $10 \times 365$  8.4% / 365 \$6,000  
**N** **I/Y** **PV** **PMT** **FV**  
 Solve for \$13,896.86

Enter  $20 \times 365$  8.4% / 365 \$6,000  
**N** **I/Y** **PV** **PMT** **FV**  
 Solve for \$32,187.11

**18.**

Enter  $6 \times 365$  11% / 365 \$45,000  
**N** **I/Y** **PV** **PMT** **FV**  
 Solve for \$23,260.62



27.

Enter            11.00%                            4  
                   **NOM**                    **EFF**                    **C/Y**  
 Solve for                            11.46%

<b>CF<sub>0</sub></b>	\$0
<b>C01</b>	\$900
<b>F01</b>	1
<b>C02</b>	\$850
<b>F02</b>	1
<b>C03</b>	\$0
<b>F03</b>	1
<b>C04</b>	\$1,140
<b>F04</b>	1

I = 11.46%  
 NPV CPT  
 \$2,230.20

28.

<b>CF<sub>0</sub></b>	\$0
<b>C01</b>	\$2,800
<b>F01</b>	1
<b>C02</b>	\$0
<b>F02</b>	1
<b>C03</b>	\$5,600
<b>F03</b>	1
<b>C04</b>	\$1,940
<b>F04</b>	1

I = 8.45%  
 NPV CPT  
 \$8,374.62

30.

Enter            18%                            2  
                   **NOM**                    **EFF**                    **C/Y**  
 Solve for                            17.26%  
                    $17.26\% / 2 = 8.63\%$

Enter            18%                            4  
                   **NOM**                    **EFF**                    **C/Y**  
 Solve for                            16.90%  
                    $16.90\% / 4 = 4.22\%$

Enter            18%                            12  
                   **NOM**                    **EFF**                    **C/Y**  
 Solve for                            16.67%  
                    $16.67\% / 12 = 1.39\%$

B-104 SOLUTIONS

**31.**

Enter	6	2.50% / 12	\$5,000		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$5,062.83

Enter	6	17% / 12	\$5,062.83		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$5,508.70

$\$5,508.70 - 5,000 = \$508.70$

**32.** Stock account:

Enter	360	12% / 12		\$600	
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$2,096,978.48

Bond account:

Enter	360	7% / 12		\$300	
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$365,991.30

Savings at retirement =  $\$2,096,978.48 + 365,991.30 = \$2,462,969.78$

Enter	300	9% / 12	\$2,462,969.78		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$20,669.15

**33.**

Enter	12	1.08%	\$1		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$1.14

Enter	24	1.08%	\$1		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$1.29

**34.**

Enter	480	11% / 12			\$1,000,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$116.28

Enter	360	11% / 12			\$1,000,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$356.57



B-106 SOLUTIONS

41.

Enter                    60                    \$55,000                    ±\$1,120  
                              **N**                    **I/Y**                    **PV**                    **PMT**                    **FV**  
 Solve for                    0.682%  
                               $0.682\% \times 12 = 8.18\%$

42.

Enter                    360                    6.8% / 12                    \$1,100  
                              **N**                    **I/Y**                    **PV**                    **PMT**                    **FV**  
 Solve for                    \$168,731.02  
                               $\$220,000 - 168,731.02 = \$51,268.98$

Enter                    360                    6.8% / 12                    \$51,268.98  
                              **N**                    **I/Y**                    **PV**                    **PMT**                    **FV**  
 Solve for                    \$392,025.82

43.

<b>CF<sub>0</sub></b>	\$0
<b>C01</b>	\$1,500
<b>F01</b>	1
<b>C02</b>	\$0
<b>F02</b>	1
<b>C03</b>	\$1,800
<b>F03</b>	1
<b>C04</b>	\$2,400
<b>F04</b>	1

I = 10%  
 NPV CPT  
 \$4,355.24

PV of missing CF =  $\$6,785 - 4,355.24 = \$2,429.76$   
 Value of missing CF:

Enter                    2                    10%                    \$2,429.76  
                              **N**                    **I/Y**                    **PV**                    **PMT**                    **FV**  
 Solve for                    \$2,940.02



B-108 SOLUTIONS

47.

Enter	17	10%	\$2,000		
	<b>N</b>	<b>I/Y</b>	<b>PMT</b>	<b>PV</b>	<b>FV</b>
Solve for				\$16,043.11	

Enter	8	10%			\$16,043.11
	<b>N</b>	<b>I/Y</b>	<b>PMT</b>	<b>PV</b>	<b>FV</b>
Solve for				\$7,484.23	

48.

Enter	84	13% / 12	\$1,500		
	<b>N</b>	<b>I/Y</b>	<b>PMT</b>	<b>PV</b>	<b>FV</b>
Solve for				\$82,453.99	

Enter	96	10% / 12	\$1,500		
	<b>N</b>	<b>I/Y</b>	<b>PMT</b>	<b>PV</b>	<b>FV</b>
Solve for				\$98,852.23	

Enter	84	13% / 12			\$98,852.23
	<b>N</b>	<b>I/Y</b>	<b>PMT</b>	<b>PV</b>	<b>FV</b>
Solve for				\$39,985.62	

$$\$82,453.99 + 39,985.62 = \$122,439.62$$

49.

Enter	15 × 12	9.5%/12	\$1,000		
	<b>N</b>	<b>I/Y</b>	<b>PMT</b>	<b>PV</b>	<b>FV</b>
Solve for					\$395,984.63

$$FV = \$395,984.63 = PV e^{0.09(15)}; PV = \$395,984.63 e^{-1.35} = \$102,645.83$$

50. PV@ t = 14:  $\$5,000 / 0.057 = \$87,719.30$

Enter	7	5.7%			\$87,719.30
	<b>N</b>	<b>I/Y</b>	<b>PMT</b>	<b>PV</b>	<b>FV</b>
Solve for				\$59,507.30	

51.

Enter	12		\$20,000	±\$1,916.67	
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for		2.219%			

$$APR = 2.219\% \times 12 = 26.62\%$$

Enter	26.62%		12	
	<b>NOM</b>	<b>EFF</b>	<b>C/Y</b>	
Solve for		30.12%		

52. Monthly rate =  $.10 / 12 = .0083$ ; semiannual rate =  $(1.0083)^6 - 1 = 5.11\%$

Enter	10	5.11%	\$6,000		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for			\$46,094.33		

Enter	8	5.11%			\$46,094.33
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for			\$30,949.21		

Enter	12	5.11%			\$46,094.33
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for			\$25,360.08		

Enter	18	5.11%			\$46,094.33
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for			\$18,810.58		

53.

a.

Enter	8	9.5%	\$950		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for			\$5,161.76		

b. 2<sup>nd</sup> BGN 2<sup>nd</sup> SET

Enter	8	9.5%	\$950		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for			\$5,652.13		

54. 2<sup>nd</sup> BGN 2<sup>nd</sup> SET

Enter	60	8.15% / 12	\$61,000		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for				\$1,232.87	

57. Pre-retirement APR:

Enter		11%	12		
	<b>NOM</b>	<b>EFF</b>	<b>C/Y</b>		
Solve for	10.48%				

Post-retirement APR:

Enter		8%	12		
	<b>NOM</b>	<b>EFF</b>	<b>C/Y</b>		
Solve for	7.72%				

B-110 SOLUTIONS

At retirement, he needs:

Enter	240	7.72% / 12		\$20,000	\$750,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for			\$2,602,465.76		

In 10 years, his savings will be worth:

Enter	120	10.48% / 12		\$2,000	
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$421,180.66

After purchasing the cabin, he will have:  $\$421,180.66 - 325,000 = \$96,180.66$

Each month between years 10 and 30, he needs to save:

Enter	240	10.48% / 12	\$96,180.66		\$2,602,465.76±
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for				\$2,259.65	

58. PV of purchase:

Enter	36	8% / 12			\$15,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for			\$11,808.82		

$\$28,000 - 11,808.82 = \$16,191.18$

PV of lease:

Enter	36	8% / 12		\$380	
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for			\$12,126.49		

$\$12,126.49 + 1 = \$12,127.49$

Lease the car.

You would be indifferent when the PV of the two cash flows are equal. The present value of the purchase decision must be \$12,127.49. Since the difference in the two cash flows is  $\$28,000 - 12,127.49 = \$15,872.51$ , this must be the present value of the future resale price of the car. The break-even resale price of the car is:

Enter	36	8% / 12	\$15,872.51		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$20,161.86

59.

Enter	5.50%		365		
	<b>NOM</b>	<b>EFF</b>	<b>C/Y</b>		
Solve for		5.65%			





65.

Enter	36		\$1,000	±\$40.08	
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for		2.13%			

$$\text{APR} = 2.13\% \times 12 = 25.60\%$$

Enter	25.60%		12		
	<b>NOM</b>	<b>EFF</b>	<b>C/Y</b>		
Solve for		28.83%			

66. What she needs at age 65:

Enter	20	8%		\$90,000	
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for			\$883,633.27		

a.

Enter	30	8%			\$883,633.27
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for				\$7,800.21	

b.

Enter	30	8%			\$883,633.27
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for			\$87,813.12		

c.

Enter	10	8%	\$25,000		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$53,973.12

$$\text{At 65, she is short: } \$883,633.27 - \$53,973.12 = \$829,660.15$$

Enter	30	8%			±\$829,660.15
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for				\$7,323.77	

Her employer will contribute \$1,500 per year, so she must contribute:

$$\$7,323.77 - 1,500 = \$5,823.77 \text{ per year}$$

67. Without fee:

Enter		18.2% / 12	\$10,000	±\$200	
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for	94.35				

B-114 SOLUTIONS

Enter		8.2% / 12	\$10,000	±\$200	
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for	61.39				

With fee:

Enter		8.2% / 12	\$10,200	±\$200	
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for	62.92				

68. Value at Year 6:

Enter	5	11%	\$800		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$1,348.05

Enter	4	11%	\$800		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$1,214.46

Enter	3	11%	\$900		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$1,230.87

Enter	2	11%	\$900		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$1,108.89

Enter	1	11%	\$1,000		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$1,110

So, at Year 5, the value is:  $\$1,348.05 + 1,214.46 + 1,230.87 + 1,108.89 + 1,100 + 1,000 = \$7,012.26$

At Year 65, the value is:

Enter	59	7%	\$7,012.26		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for					\$379,752.76

The policy is not worth buying; the future value of the deposits is \$379,752.76 but the policy contract will pay off \$350,000.

69.

Enter	30 × 12	8.5% / 12	\$450,000		
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for				\$3,460.11	

Enter	22 × 12	8.5% / 12		\$3,460.11	
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for			\$412,701.01		

70.

<b>CF<sub>0</sub></b>	±\$5,000
<b>C01</b>	±\$5,000
<b>F01</b>	5
<b>C02</b>	\$15,000
<b>F02</b>	4
IRR CPT	
14.52%	

75.

a. APR = 8% × 52 = 416%

Enter	416%		52
	<b>NOM</b>	<b>EFF</b>	<b>C/Y</b>
Solve for		5,370.60%	

b.

Enter	1		\$9.20		±\$10.00
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for		8.70%			

APR = 8.70% × 52 = 452.17%

Enter	452.17%		52
	<b>NOM</b>	<b>EFF</b>	<b>C/Y</b>
Solve for		7,538.94%	

c.

Enter	4		\$68.92	±\$25	
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for		16.75%			

APR = 16.75% × 52 = 871.00%

Enter	871.00%		52
	<b>NOM</b>	<b>EFF</b>	<b>C/Y</b>
Solve for		314,215.72%	

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# CHAPTER 7

## INTEREST RATES AND BOND VALUATION

### Answers to Concepts Review and Critical Thinking Questions

1. No. As interest rates fluctuate, the value of a Treasury security will fluctuate. Long-term Treasury securities have substantial interest rate risk.
2. All else the same, the Treasury security will have lower coupons because of its lower default risk, so it will have greater interest rate risk.
3. No. If the bid price were higher than the ask price, the implication would be that a dealer was willing to sell a bond and immediately buy it back at a higher price. How many such transactions would you like to do?
4. Prices and yields move in opposite directions. Since the bid price must be lower, the bid yield must be higher.
5. There are two benefits. First, the company can take advantage of interest rate declines by calling in an issue and replacing it with a lower coupon issue. Second, a company might wish to eliminate a covenant for some reason. Calling the issue does this. The cost to the company is a higher coupon. A put provision is desirable from an investor's standpoint, so it helps the company by reducing the coupon rate on the bond. The cost to the company is that it may have to buy back the bond at an unattractive price.
6. Bond issuers look at outstanding bonds of similar maturity and risk. The yields on such bonds are used to establish the coupon rate necessary for a particular issue to initially sell for par value. Bond issuers also simply ask potential purchasers what coupon rate would be necessary to attract them. The coupon rate is fixed and simply determines what the bond's coupon payments will be. The required return is what investors actually demand on the issue, and it will fluctuate through time. The coupon rate and required return are equal only if the bond sells for exactly at par.
7. Yes. Some investors have obligations that are denominated in dollars; i.e., they are nominal. Their primary concern is that an investment provide the needed nominal dollar amounts. Pension funds, for example, often must plan for pension payments many years in the future. If those payments are fixed in dollar terms, then it is the nominal return on an investment that is important.
8. Companies pay to have their bonds rated simply because unrated bonds can be difficult to sell; many large investors are prohibited from investing in unrated issues.
9. Treasury bonds have no credit risk since it is backed by the U.S. government, so a rating is not necessary. Junk bonds often are not rated because there would be no point in an issuer paying a rating agency to assign its bonds a low rating (it's like paying someone to kick you!).

10. The term structure is based on pure discount bonds. The yield curve is based on coupon-bearing issues.
11. Bond ratings have a subjective factor to them. Split ratings reflect a difference of opinion among credit agencies.
12. As a general constitutional principle, the federal government cannot tax the states without their consent if doing so would interfere with state government functions. At one time, this principle was thought to provide for the tax-exempt status of municipal interest payments. However, modern court rulings make it clear that Congress can revoke the municipal exemption, so the only basis now appears to be historical precedent. The fact that the states and the federal government do not tax each other's securities is referred to as "reciprocal immunity."
13. Lack of transparency means that a buyer or seller can't see recent transactions, so it is much harder to determine what the best bid and ask prices are at any point in time.
14. One measure of liquidity is the bid-ask spread. Liquid instruments have relatively small spreads. Looking at Figure 7.4, the bellwether bond has a spread of one tick; it is one of the most liquid of all investments. Generally, liquidity declines after a bond is issued. Some older bonds, including some of the callable issues, have spreads as wide as six ticks.
15. Companies charge that bond rating agencies are pressuring them to pay for bond ratings. When a company pays for a rating, it has the opportunity to make its case for a particular rating. With an unsolicited rating, the company has no input.
16. A 100-year bond looks like a share of preferred stock. In particular, it is a loan with a life that almost certainly exceeds the life of the lender, assuming that the lender is an individual. With a junk bond, the credit risk can be so high that the borrower is almost certain to default, meaning that the creditors are very likely to end up as part owners of the business. In both cases, the "equity in disguise" has a significant tax advantage.

### **Solutions to Questions and Problems**

*NOTE: All end of chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.*

#### Basic

1. The yield to maturity is the required rate of return on a bond expressed as a nominal annual interest rate. For noncallable bonds, the yield to maturity and required rate of return are interchangeable terms. Unlike YTM and required return, the coupon rate is not a return used as the interest rate in bond cash flow valuation, but is a fixed percentage of par over the life of the bond used to set the coupon payment amount. For the example given, the coupon rate on the bond is still 10 percent, and the YTM is 8 percent.
2. Price and yield move in opposite directions; if interest rates rise, the price of the bond will fall. This is because the fixed coupon payments determined by the fixed coupon rate are not as valuable when interest rates rise—hence, the price of the bond decreases.

## B-118 SOLUTIONS

*NOTE: Most problems do not explicitly list a par value for bonds. Even though a bond can have any par value, in general, corporate bonds in the United States will have a par value of \$1,000. We will use this par value in all problems unless a different par value is explicitly stated.*

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:

$$P = \$80\left(\{1 - [1/(1 + .09)]^{10}\} / .09\right) + \$1,000[1 / (1 + .09)^{10}] = \$935.82$$

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.

4. Here we need to find the YTM of a bond. The equation for the bond price is:

$$P = \$1,080 = \$70(PVIFA_{R\%,9}) + \$1,000(PVIF_{R\%,9})$$

Notice the equation cannot be solved directly for  $R$ . Using a spreadsheet, a financial calculator, or trial and error, we find:

$$R = \text{YTM} = 5.83\%$$

If you are using trial and error to find the YTM of the bond, you might be wondering how to pick an interest rate to start the process. First, we know the YTM has to be higher than the coupon rate since the bond is a discount bond. That still leaves a lot of interest rates to check. One way to get a starting point is to use the following equation, which will give you an approximation of the YTM:

$$\text{Approximate YTM} = [\text{Annual interest payment} + (\text{Price difference from par} / \text{Years to maturity})] / [(\text{Price} + \text{Par value}) / 2]$$

Solving for this problem, we get:

$$\text{Approximate YTM} = [\$70 + (-\$80 / 9)] / [(\$1,080 + 1,000) / 2] = 5.88\%$$

This is not the exact YTM, but it is close, and it will give you a place to start.

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:

$$P = \$870 = C(PVIFA_{7.5\%,16}) + \$1,000(PVIF_{7.5\%,16})$$

Solving for the coupon payment, we get:

$$C = \$60.78$$

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

$$\text{Coupon rate} = \$60.78 / \$1,000 = .0608 \text{ or } 6.08\%$$

6. To find the price of this bond, we need to realize that the maturity of the bond is 10 years. The bond was issued one year ago, with 11 years to maturity, so there are 10 years left on the bond. Also, the coupons are semiannual, so we need to use the semiannual interest rate and the number of semiannual periods. The price of the bond is:

$$P = \$39(PVIFA_{4.3\%,20}) + \$1,000(PVIF_{4.3\%,20}) = \$947.05$$

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

$$P = \$1,040 = \$46(PVIFA_{R\%,20}) + \$1,000(PVIF_{R\%,20})$$

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

$$R = 4.298\%$$

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

$$\text{YTM} = 2 \times 4.298\% = 8.60\%$$

8. 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:

$$P = \$1,136.50 = C(PVIFA_{3.4\%,29}) + \$1,000(PVIF_{3.4\%,29})$$

Solving for the coupon payment, we get:

$$C = \$41.48$$

Since this is the semiannual payment, the annual coupon payment is:

$$2 \times \$41.48 = \$82.95$$

And the coupon rate is the annual coupon payment divided by par value, so:

$$\begin{aligned} \text{Coupon rate} &= \$82.95 / \$1,000 \\ \text{Coupon rate} &= .08295 \text{ or } 8.30\% \end{aligned}$$

## B-120 SOLUTIONS

9. The approximate relationship between nominal interest rates ( $R$ ), real interest rates ( $r$ ), and inflation ( $h$ ) is:

$$R = r + h$$

$$\text{Approximate } r = .08 - .045 = .035 \text{ or } 3.50\%$$

The Fisher equation, which shows the exact relationship between nominal interest rates, real interest rates, and inflation is:

$$(1 + R) = (1 + r)(1 + h)$$

$$(1 + .08) = (1 + r)(1 + .045)$$

$$\text{Exact } r = [(1 + .08) / (1 + .045)] - 1 = .0335 \text{ or } 3.35\%$$

10. The Fisher equation, which shows the exact relationship between nominal interest rates, real interest rates, and inflation is:

$$(1 + R) = (1 + r)(1 + h)$$

$$R = (1 + .058)(1 + .04) - 1 = .1003 \text{ or } 10.03\%$$

11. The Fisher equation, which shows the exact relationship between nominal interest rates, real interest rates, and inflation is:

$$(1 + R) = (1 + r)(1 + h)$$

$$h = [(1 + .15) / (1 + .07)] - 1 = .0748 \text{ or } 7.48\%$$

12. The Fisher equation, which shows the exact relationship between nominal interest rates, real interest rates, and inflation is:

$$(1 + R) = (1 + r)(1 + h)$$

$$r = [(1 + .142) / (1.053)] - 1 = .0845 \text{ or } 8.45\%$$

13. This is a bond since the maturity is greater than 10 years. The coupon rate, located in the first column of the quote is 6.125%. The bid price is:

$$\text{Bid price} = 110:07 = 110 \frac{7}{32} = 110.21875\% \times \$1,000 = \$1,102.1875$$

The previous day's ask price is found by:

$$\text{Previous day's asked price} = \text{Today's asked price} - \text{Change} = 110 \frac{8}{32} - (-\frac{3}{32}) = 110 \frac{11}{32}$$

The previous day's price in dollars was:

$$\text{Previous day's dollar price} = 110.34375\% \times \$1,000 = \$1,103.4375$$

14. This is a premium bond because it sells for more than 100% of face value. The current yield is:

$$\text{Current yield} = \text{Annual coupon payment} / \text{Price} = \$75 / \$1,255.00 = 5.978\%$$

The YTM is located under the “ASK YLD” column, so the YTM is 5.32%.

The bid-ask spread is the difference between the bid price and the ask price, so:

$$\text{Bid-Ask spread} = 125:16 - 125:15 = 1/32$$

### Intermediate

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

$$P = C(\text{PVIFA}_{R\%,t}) + \$1,000(\text{PVIF}_{R\%,t})$$

X:	$P_0$	=	$\$90(\text{PVIFA}_{7\%,13}) + \$1,000(\text{PVIF}_{7\%,13})$	=	\$1,167.15
	$P_1$	=	$\$90(\text{PVIFA}_{7\%,12}) + \$1,000(\text{PVIF}_{7\%,12})$	=	\$1,158.85
	$P_3$	=	$\$90(\text{PVIFA}_{7\%,10}) + \$1,000(\text{PVIF}_{7\%,10})$	=	\$1,140.47
	$P_8$	=	$\$90(\text{PVIFA}_{7\%,5}) + \$1,000(\text{PVIF}_{7\%,5})$	=	\$1,082.00
	$P_{12}$	=	$\$90(\text{PVIFA}_{7\%,1}) + \$1,000(\text{PVIF}_{7\%,1})$	=	\$1,018.69
	$P_{13}$			=	\$1,000
Y:	$P_0$	=	$\$70(\text{PVIFA}_{9\%,13}) + \$1,000(\text{PVIF}_{9\%,13})$	=	\$850.26
	$P_1$	=	$\$70(\text{PVIFA}_{9\%,12}) + \$1,000(\text{PVIF}_{9\%,12})$	=	\$856.79
	$P_3$	=	$\$70(\text{PVIFA}_{9\%,10}) + \$1,000(\text{PVIF}_{9\%,10})$	=	\$871.65
	$P_8$	=	$\$70(\text{PVIFA}_{9\%,5}) + \$1,000(\text{PVIF}_{9\%,5})$	=	\$922.21
	$P_{12}$	=	$\$70(\text{PVIFA}_{9\%,1}) + \$1,000(\text{PVIF}_{9\%,1})$	=	\$981.65
	$P_{13}$			=	\$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.

B-122 SOLUTIONS

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, 8 percent. If the YTM suddenly rises to 10 percent:

$$P_{\text{Sam}} = \$40(\text{PVIFA}_{5\%,4}) + \$1,000(\text{PVIF}_{5\%,4}) = \$964.54$$

$$P_{\text{Dave}} = \$40(\text{PVIFA}_{5\%,30}) + \$1,000(\text{PVIF}_{5\%,30}) = \$846.28$$

The percentage change in price is calculated as:

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

$$\Delta P_{\text{Sam}}\% = (\$964.54 - 1,000) / \$1,000 = -3.55\%$$

$$\Delta P_{\text{Dave}}\% = (\$846.28 - 1,000) / \$1,000 = -15.37\%$$

If the YTM suddenly falls to 6 percent:

$$P_{\text{Sam}} = \$40(\text{PVIFA}_{3\%,4}) + \$1,000(\text{PVIF}_{3\%,4}) = \$1,037.17$$

$$P_{\text{Dave}} = \$40(\text{PVIFA}_{3\%,30}) + \$1,000(\text{PVIF}_{3\%,30}) = \$1,196.00$$

$$\Delta P_{\text{Sam}}\% = (\$1,037.17 - 1,000) / \$1,000 = +3.72\%$$

$$\Delta P_{\text{Dave}}\% = (\$1,196.00 - 1,000) / \$1,000 = +19.60\%$$

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

17. Initially, at a YTM of 7 percent, the prices of the two bonds are:

$$P_J = \$20(\text{PVIFA}_{3.5\%,16}) + \$1,000(\text{PVIF}_{3.5\%,16}) = \$818.59$$

$$P_K = \$60(\text{PVIFA}_{3.5\%,16}) + \$1,000(\text{PVIF}_{3.5\%,16}) = \$1,302.35$$

If the YTM rises from 7 percent to 9 percent:

$$P_J = \$20(\text{PVIFA}_{4.5\%,16}) + \$1,000(\text{PVIF}_{4.5\%,16}) = \$719.15$$

$$P_K = \$60(\text{PVIFA}_{4.5\%,16}) + \$1,000(\text{PVIF}_{4.5\%,16}) = \$1,168.51$$

The percentage change in price is calculated as:

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

$$\Delta P_J\% = (\$719.15 - 818.59) / \$818.59 = -12.15\%$$

$$\Delta P_K\% = (\$1,168.51 - 1,302.35) / \$1,302.35 = -10.28\%$$

If the YTM declines from 7 percent to 5 percent:

$$P_J = \$20(PVIFA_{2.5\%,16}) + \$1,000(PVIF_{2.5\%,16}) = \$934.72$$

$$P_K = \$60(PVIFA_{2.5\%,16}) + \$1,000(PVIF_{2.5\%,16}) = \$1,456.93$$

$$\Delta P_J\% = (\$934.72 - 818.59) / \$818.59 = + 14.19\%$$

$$\Delta P_K\% = (\$1,456.93 - 1,302.35) / \$1,302.35 = + 11.87\%$$

All else the same, the lower the coupon rate on a bond, the greater is its price sensitivity to changes in interest rates.

- 18.** The bond price equation for this bond is:

$$P_0 = \$955 = \$42(PVIFA_{R\%,18}) + \$1,000(PVIF_{R\%,18})$$

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

$$R = 4.572\%$$

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

$$YTM = 2 \times 4.572\% = 9.14\%$$

The current yield is:

$$\text{Current yield} = \text{Annual coupon payment} / \text{Price} = \$84 / \$955 = .0880 \text{ or } 8.80\%$$

The effective annual yield is the same as the EAR, so using the EAR equation from the previous chapter:

$$\text{Effective annual yield} = (1 + 0.04572)^2 - 1 = .0935 \text{ or } 9.35\%$$

- 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 outstanding bonds of the company. So, the YTM on the bonds currently sold in the market is:

$$P = \$1,062 = \$35(PVIFA_{R\%,40}) + \$1,000(PVIF_{R\%,40})$$

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

$$R = 3.22\%$$

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

$$YTM = 2 \times 3.22\% = 6.44\%$$

## B-124 SOLUTIONS

- 20.** Accrued interest is the coupon payment for the period times the fraction of the period that has passed since the last coupon payment. Since we have a semiannual coupon bond, the coupon payment per six months is one-half of the annual coupon payment. There are five months until the next coupon payment, so one month has passed since the last coupon payment. The accrued interest for the bond is:

$$\text{Accrued interest} = \$86/2 \times 1/6 = \$7.17$$

And we calculate the clean price as:

$$\text{Clean price} = \text{Dirty price} - \text{Accrued interest} = \$1,090 - 7.17 = \$1,082.83$$

- 21.** Accrued interest is the coupon payment for the period times the fraction of the period that has passed since the last coupon payment. Since we have a semiannual coupon bond, the coupon payment per six months is one-half of the annual coupon payment. There are three months until the next coupon payment, so three months have passed since the last coupon payment. The accrued interest for the bond is:

$$\text{Accrued interest} = \$75/2 \times 3/6 = \$18.75$$

And we calculate the dirty price as:

$$\text{Dirty price} = \text{Clean price} + \text{Accrued interest} = \$865 + 18.75 = \$883.75$$

- 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:

$$\text{Current yield} = .0710 = \$90/P_0$$

$$P_0 = \$90/.0710 = \$1,267.61$$

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

$$P = \$1,267.61 = \$90[(1 - (1/1.063)^t) / .063] + \$1,000/1.063^t$$

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

$$\$1,267.61(1.063)^t = \$1,428.57(1.063)^t - 1,428.57 + 1,000$$

$$428.57 = 160.96(1.063)^t$$

$$2.6626 = 1.063^t$$

$$t = \log 2.6626 / \log 1.063 = 16.03 \approx 16 \text{ years}$$

The bond has 16 years to maturity.

23. The bond has 10 years to maturity, so the bond price equation is:

$$P = \$843.50 = \$42(\text{PVIFA}_{R\%,20}) + \$1,000(\text{PVIF}_{R\%,20})$$

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

$$R = 5.511\%$$

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

$$\text{YTM} = 2 \times 5.51\% = 11.02\%$$

The current yield is the annual coupon payment divided by the bond price, so:

$$\text{Current yield} = \$84 / \$843.50 = 9.96\%$$

The “EST Spread” column shows the difference between the YTM of the bond quoted and the YTM of the U.S. Treasury bond with a similar maturity. The column lists the spread in basis points. One basis point is one-hundredth of one percent, so 100 basis points equals one percent. The spread for this bond is 468 basis points, or 4.68%. This makes the equivalent Treasury yield:

$$\text{Equivalent Treasury yield} = 11.02\% - 4.68\% = 6.34\%$$

24. *a.* The bond price is the present value of the cash flows from a bond. The YTM is the interest rate used in valuing the cash flows from a bond.
- b.* If the coupon rate is higher than the required return on a bond, the bond will sell at a premium, since it provides periodic income in the form of coupon payments in excess of that required by investors on other similar bonds. If the coupon rate is lower than the required return on a bond, the bond will sell at a discount since it provides insufficient coupon payments compared to that required by investors on other similar bonds. For premium bonds, the coupon rate exceeds the YTM; for discount bonds, the YTM exceeds the coupon rate, and for bonds selling at par, the YTM is equal to the coupon rate.
- c.* Current yield is defined as the annual coupon payment divided by the current bond price. For premium bonds, the current yield exceeds the YTM, for discount bonds the current yield is less than the YTM, and for bonds selling at par value, the current yield is equal to the YTM. In all cases, the current yield plus the expected one-period capital gains yield of the bond must be equal to the required return.
25. The price of a zero coupon bond is the PV of the par, so:

$$a. \quad P_0 = \$1,000/1.08^{25} = \$146.02$$

- b.* In one year, the bond will have 24 years to maturity, so the price will be:

$$P_1 = \$1,000/1.08^{24} = \$157.70$$

## B-126 SOLUTIONS

The interest deduction is the price of the bond at the end of the year, minus the price at the beginning of the year, so:

$$\text{Year 1 interest deduction} = \$157.70 - 146.02 = \$11.68$$

The price of the bond when it has one year left to maturity will be:

$$P_{24} = \$1,000/1.08 = \$925.93$$

$$\text{Year 24 interest deduction} = \$1,000 - 925.93 = \$74.07$$

- c. Previous IRS regulations required a straight-line calculation of interest. The total interest received by the bondholder is:

$$\text{Total interest} = \$1,000 - 146.02 = \$853.98$$

The annual interest deduction is simply the total interest divided by the maturity of the bond, so the straight-line deduction is:

$$\text{Annual interest deduction} = \$853.98 / 25 = \$34.16$$

- d. The company will prefer straight-line methods when allowed because the valuable interest deductions occur earlier in the life of the bond.

26. a. The coupon bonds have a 7% coupon which matches the 7% required return, so they will sell at par. The number of bonds that must be sold is the amount needed divided by the bond price, so:

$$\text{Number of coupon bonds to sell} = \$20,000,000 / \$1,000 = 20,000$$

The number of zero coupon bonds to sell would be:

$$\text{Price of zero coupon bonds} = \$1,000/1.07^{30} = \$131.37$$

$$\text{Number of zero coupon bonds to sell} = \$20,000,000 / \$131.37 = 152,241.76$$

Note: In this case, the price of the bond was rounded to the number of cents when calculating the number of bonds to sell.

- b. The repayment of the coupon bond will be the par value plus the last coupon payment times the number of bonds issued. So:

$$\text{Coupon bonds repayment} = 20,000(\$1,070) = \$21,400,000$$

The repayment of the zero coupon bond will be the par value times the number of bonds issued, so:

$$\text{Zeroes: repayment} = 152,242(\$1,000) = \$152,241,760$$

- c. The total coupon payment for the coupon bonds will be the number bonds times the coupon payment. For the cash flow of the coupon bonds, we need to account for the tax deductibility of the interest payments. To do this, we will multiply the total coupon payment times one minus the tax rate. So:

$$\text{Coupon bonds: } (20,000)(\$70)(1-.35) = \$910,000 \text{ cash outflow}$$

Note that this is cash outflow since the company is making the interest payment.

For the zero coupon bonds, the first year interest payment is the difference in the price of the zero at the end of the year and the beginning of the year. The price of the zeroes in one year will be:

$$P_1 = \$1,000/1.07^{29} = \$140.56$$

The year 1 interest deduction per bond will be this price minus the price at the beginning of the year, which we found in part *b*, so:

$$\text{Year 1 interest deduction per bond} = \$140.56 - 131.37 = \$9.19$$

The total cash flow for the zeroes will be the interest deduction for the year times the number of zeroes sold, times the tax rate. The cash flow for the zeroes in year 1 will be:

$$\text{Cash flows for zeroes in Year 1} = (152,242)(\$9.19)(.35) = \$489,989.25$$

Notice the cash flow for the zeroes is a cash inflow. This is because of the tax deductibility of the imputed interest expense. That is, the company gets to write off the interest expense for the year even though the company did not have a cash flow for the interest expense. This reduces the company's tax liability, which is a cash inflow.

During the life of the bond, the zero generates cash inflows to the firm in the form of the interest tax shield of debt. We should note an important point here: If you find the PV of the cash flows from the coupon bond and the zero coupon bond, they will be the same. This is because of the much larger repayment amount for the zeroes.

27. We found the maturity of a bond in Problem 22. However, in this case, the maturity is indeterminate. A bond selling at par can have any length of maturity. In other words, when we solve the bond pricing equation as we did in Problem 22, the number of periods can be any positive number.
28. We first need to find the real interest rate on the savings. Using the Fisher equation, the real interest rate is:

$$\begin{aligned} (1 + R) &= (1 + r)(1 + h) \\ 1 + .11 &= (1 + r)(1 + .045) \\ r &= .0622 \text{ or } 6.22\% \end{aligned}$$

## B-128 SOLUTIONS

Now we can use the future value of an annuity equation to find the annual deposit. Doing so, we find:

$$\begin{aligned} FVA &= C \{ [(1+r)^t - 1] / r \} \\ \$1,000,000 &= \$C [(1.0622^{40} - 1) / .0622] \\ C &= \$6,112.81 \end{aligned}$$

### Challenge

29. To find the capital gains yield and the current yield, we need to find the price of the bond. The current price of Bond P and the price of Bond P in one year is:

$$P: P_0 = \$90(PVIFA_{7\%,5}) + \$1,000(PVIF_{7\%,5}) = \$1,082.00$$

$$P_1 = \$90(PVIFA_{7\%,4}) + \$1,000(PVIF_{7\%,4}) = \$1,067.67$$

$$\text{Current yield} = \$900 / \$1,082.00 = .0832 \text{ or } 8.32\%$$

The capital gains yield is:

$$\text{Capital gains yield} = (\text{New price} - \text{Original price}) / \text{Original price}$$

$$\text{Capital gains yield} = (\$1,067.67 - 1,082.00) / \$1,082.00 = -.0132 \text{ or } -1.32\%$$

The current price of Bond D and the price of Bond D in one year is:

$$D: P_0 = \$50(PVIFA_{7\%,5}) + \$1,000(PVIF_{7\%,5}) = \$918.00$$

$$P_1 = \$50(PVIFA_{7\%,4}) + \$1,000(PVIF_{7\%,4}) = \$932.26$$

$$\text{Current yield} = \$50 / \$918.00 = .0555 \text{ or } 5.55\%$$

$$\text{Capital gains yield} = (\$932.26 - 918.00) / \$918.00 = +.0155 \text{ or } +1.55\%$$

All else held constant, premium bonds pay high current income while having price depreciation as maturity nears; discount bonds do not pay high current income but have price appreciation as maturity nears. For either bond, the total return is still 7%, but this return is distributed differently between current income and capital gains.

30. a. The rate of return you expect to earn if you purchase a bond and hold it until maturity is the YTM. The bond price equation for this bond is:

$$P_0 = \$1,105 = \$80(PVIFA_{R\%,10}) + \$1,000(PVIF_{R\%,10})$$

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

$$R = \text{YTM} = 6.54\%$$

- b. To find our HPY, we need to find the price of the bond in two years. The price of the bond in two years, at the new interest rate, will be:

$$P_2 = \$80(\text{PVIFA}_{5.54\%,8}) + \$1,000(\text{PVIF}_{5.54\%,8}) = \$1,155.80$$

To calculate the HPY, we need to find the interest rate that equates the price we paid for the bond with the cash flows we received. The cash flows we received were \$80 each year for two years, and the price of the bond when we sold it. The equation to find our HPY is:

$$P_0 = \$1,105 = \$80(\text{PVIFA}_{R\%,2}) + \$1,155.80(\text{PVIF}_{R\%,2})$$

Solving for  $R$ , we get:

$$R = \text{HPY} = 9.43\%$$

The realized HPY is greater than the expected YTM when the bond was bought because interest rates dropped by 1 percent; bond prices rise when yields fall.

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:

$$\begin{aligned} P_M &= \$1,100(\text{PVIFA}_{4.5\%,16})(\text{PVIF}_{4.5\%,12}) + \$1,400(\text{PVIFA}_{4.5\%,12})(\text{PVIF}_{4.5\%,28}) + \$20,000(\text{PVIF}_{4.5\%,40}) \\ P_M &= \$14,447.49 \end{aligned}$$

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:

$$P_N = \$20,000(\text{PVIF}_{4.5\%,40}) = \$3,438.57$$

32. To calculate this, we need to set up an equation with the callable bond equal to a weighted average of the noncallable bonds. We will invest  $X$  percent of our money in the first noncallable bond, which means our investment in Bond 3 (the other noncallable bond) will be  $(1 - X)$ . The equation is:

$$\begin{aligned} C_2 &= C_1 X + C_3(1 - X) \\ 8.25 &= 6.50 X + 12(1 - X) \\ 8.25 &= 6.50 X + 12 - 12 X \\ X &= 0.68181 \end{aligned}$$

So, we invest about 68 percent of our money in Bond 1, and about 32 percent in Bond 3. This combination of bonds should have the same value as the callable bond, excluding the value of the call. So:

$$\begin{aligned} P_2 &= 0.68181P_1 + 0.31819P_3 \\ P_2 &= 0.68181(106.375) + 0.31819(134.96875) \\ P_2 &= 115.4730 \end{aligned}$$

## B-130 SOLUTIONS

The call value is the difference between this implied bond value and the actual bond price. So, the call value is:

$$\text{Call value} = 115.4730 - 103.50 = 11.9730$$

Assuming \$1,000 par value, the call value is \$119.73.

- 33.** In general, this is not likely to happen, although it can (and did). The reason this bond has a negative YTM is that it is a callable U.S. Treasury bond. Market participants know this. Given the high coupon rate of the bond, it is extremely likely to be called, which means the bondholder will not receive all the cash flows promised. A better measure of the return on a callable bond is the yield to call (YTC). The YTC calculation is basically the same as the YTM calculation, but the number of periods is the number of periods until the call date. If the YTC were calculated on this bond, it would be positive.
- 34.** To find the present value, we need to find the real weekly interest rate. To find the real return, we need to use the effective annual rates in the Fisher equation. So, we find the real EAR is:

$$\begin{aligned}(1 + R) &= (1 + r)(1 + h) \\ 1 + .104 &= (1 + r)(1 + .039) \\ r &= .0626 \text{ or } 6.26\%\end{aligned}$$

Now, to find the weekly interest rate, we need to find the APR. Using the equation for discrete compounding:

$$\text{EAR} = [1 + (\text{APR} / m)]^m - 1$$

We can solve for the APR. Doing so, we get:

$$\begin{aligned}\text{APR} &= m[(1 + \text{EAR})^{1/m} - 1] \\ \text{APR} &= 52[(1 + .0626)^{1/52} - 1] \\ \text{APR} &= .0607 \text{ or } 6.07\%\end{aligned}$$

So, the weekly interest rate is:

$$\begin{aligned}\text{Weekly rate} &= \text{APR} / 52 \\ \text{Weekly rate} &= .0607 / 52 \\ \text{Weekly rate} &= .0012 \text{ or } 0.12\%\end{aligned}$$

Now we can find the present value of the cost of the roses. The real cash flows are an ordinary annuity, discounted at the real interest rate. So, the present value of the cost of the roses is:

$$\begin{aligned}\text{PVA} &= C(\{1 - [1/(1 + r)]^t\} / r) \\ \text{PVA} &= \$5(\{1 - [1/(1 + .0012)]^{30(52)}\} / .0012) \\ \text{PVA} &= \$3,588.66\end{aligned}$$

35. To answer this question, we need to find the monthly interest rate, which is the APR divided by 12. We also must be careful to use the real interest rate. The Fisher equation uses the effective annual rate, so, the real effective annual interest rates, and the monthly interest rates for each account are:

Stock account:

$$(1 + R) = (1 + r)(1 + h)$$

$$1 + .11 = (1 + r)(1 + .04)$$

$$r = .0673 \text{ or } 6.73\%$$

$$\text{APR} = m[(1 + \text{EAR})^{1/m} - 1]$$

$$\text{APR} = 12[(1 + .0673)^{1/12} - 1]$$

$$\text{APR} = .0653 \text{ or } 6.53\%$$

$$\text{Monthly rate} = \text{APR} / 12$$

$$\text{Monthly rate} = .0653 / 12$$

$$\text{Monthly rate} = .0054 \text{ or } 0.54\%$$

Bond account:

$$(1 + R) = (1 + r)(1 + h)$$

$$1 + .07 = (1 + r)(1 + .04)$$

$$r = .0288 \text{ or } 2.88\%$$

$$\text{APR} = m[(1 + \text{EAR})^{1/m} - 1]$$

$$\text{APR} = 12[(1 + .0288)^{1/12} - 1]$$

$$\text{APR} = .0285 \text{ or } 2.85\%$$

$$\text{Monthly rate} = \text{APR} / 12$$

$$\text{Monthly rate} = .0285 / 12$$

$$\text{Monthly rate} = .0024 \text{ or } 0.24\%$$

Now we can find the future value of the retirement account in real terms. The future value of each account will be:

Stock account:

$$\text{FVA} = C \{(1 + r)^t - 1\} / r\}$$

$$\text{FVA} = \$700 \{[(1 + .0054)^{360} - 1] / .0054\}$$

$$\text{FVA} = \$779,103.15$$

Bond account:

$$\text{FVA} = C \{(1 + r)^t - 1\} / r\}$$

$$\text{FVA} = \$300 \{[(1 + .0024)^{360} - 1] / .0024\}$$

$$\text{FVA} = \$170,316.78$$

The total future value of the retirement account will be the sum of the two accounts, or:

$$\text{Account value} = \$779,103.15 + 170,316.78$$

$$\text{Account value} = \$949,419.93$$

B-132 SOLUTIONS

Now we need to find the monthly interest rate in retirement. We can use the same procedure that we used to find the monthly interest rates for the stock and bond accounts, so:

$$(1 + R) = (1 + r)(1 + h)$$

$$1 + .09 = (1 + r)(1 + .04)$$

$$r = .0481 \text{ or } 4.81\%$$

$$\text{APR} = m[(1 + \text{EAR})^{1/m} - 1]$$

$$\text{APR} = 12[(1 + .0481)^{1/12} - 1]$$

$$\text{APR} = .0470 \text{ or } 4.70\%$$

$$\text{Monthly rate} = \text{APR} / 12$$

$$\text{Monthly rate} = .0470 / 12$$

$$\text{Monthly rate} = .0039 \text{ or } 0.39\%$$

Now we can find the real monthly withdrawal in retirement. Using the present value of an annuity equation and solving for the payment, we find:

$$\text{PVA} = C(\{1 - [1/(1 + r)]^t\} / r)$$

$$\$949,419.93 = C(\{1 - [1/(1 + .0039)]^{300}\} / .0039)$$

$$C = \$5,388.21$$

This is the real dollar amount of the monthly withdrawals. The nominal monthly withdrawals will increase by the inflation rate each month. To find the nominal dollar amount of the last withdrawal, we can increase the real dollar withdrawal by the inflation rate. We can increase the real withdrawal by the effective annual inflation rate since we are only interested in the nominal amount of the last withdrawal. So, the last withdrawal in nominal terms will be:

$$\text{FV} = \text{PV}(1 + r)^t$$

$$\text{FV} = \$5,388.21(1 + .04)^{(30 + 25)}$$

$$\text{FV} = \$46,588.42$$

**Calculator Solutions**

3.

Enter	10	9%		\$80	\$1,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for			\$935.82		

4.

Enter	9		±\$1,080	\$70	\$1,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for		5.83%			

5.

Enter	16	7.5%	±\$870		\$1,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for				\$60.78	

$$\text{Coupon rate} = \$60.78 / \$1,000 = 6.08\%$$

6.

Enter	20	4.30%		\$39	\$1,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for			\$947.05		

7.

Enter	20		±\$1,040	\$46	\$1,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for		4.30%			
	$4.30\% \times 2 = 8.60\%$				

8.

Enter	29	3.40%	±\$1,136.50		\$1,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for				\$41.48	
	$\$41.48 \times 2 = \$82.95$				
	$\$82.95 / \$1,000 = 8.30\%$				

15. Bond X

P<sub>0</sub>

Enter	13	7%		\$90	\$1,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for			\$1,167.15		

P<sub>1</sub>

Enter	12	7%		\$90	\$1,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for			\$1,158.85		

P<sub>3</sub>

Enter	10	7%		\$90	\$1,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for			\$1,140.47		

P<sub>8</sub>

Enter	5	7%		\$90	\$1,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for			\$1,082.00		

P<sub>12</sub>

Enter	1	7%		\$90	\$1,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>
Solve for			\$1,018.69		





B-136 SOLUTIONS

18.

Enter	18		±\$955	\$42	\$1,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>

Solve for 4.572%

$$4.572\% \times 2 = 9.14\%$$

Enter	9.14 %		2	
	<b>NOM</b>	<b>EFF</b>	<b>C/Y</b>	

Solve for 9.35%

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 outstanding bonds of the company.

Enter	40		±\$1,062	\$35	\$1,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>

Solve for 3.22%

$$3.22\% \times 2 = 6.44\%$$

22. Current yield = .0710 = \$90/P<sub>0</sub> ; P<sub>0</sub> = \$90/.0710 = \$1,267.61

Enter		6.3%	±\$1,267.61	\$90	\$1,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>

Solve for 16.03  
16.03 or ≈ 16 years

23.

Enter	20		±\$843.50	\$42	\$1,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>

Solve for 5.511%

$$5.511\% \times 2 = 11.02\%$$

25.

a. P<sub>0</sub>

Enter	25	8%			\$1,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>

Solve for \$146.02

b. P<sub>1</sub>

Enter	24	8%			\$1,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>

Solve for \$157.70

$$\text{year 1 interest deduction} = \$157.70 - 146.02 = \$11.68$$

P<sub>19</sub>

Enter	1	8%			\$1,000
	<b>N</b>	<b>I/Y</b>	<b>PV</b>	<b>PMT</b>	<b>FV</b>

Solve for \$925.93

$$\text{year 19 interest deduction} = \$1,000 - 925.93 = \$74.07$$





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# CHAPTER 8

## STOCK VALUATION

### Answers to Concepts Review and Critical Thinking Questions

1. The value of any investment depends on the present value of its cash flows; i.e., what investors will actually receive. The cash flows from a share of stock are the dividends.
2. Investors believe the company will eventually start paying dividends (or be sold to another company).
3. In general, companies that need the cash will often forgo dividends since dividends are a cash expense. Young, growing companies with profitable investment opportunities are one example; another example is a company in financial distress. This question is examined in depth in a later chapter.
4. The general method for valuing a share of stock is to find the present value of all expected future dividends. The dividend growth model presented in the text is only valid (i) if dividends are expected to occur forever, that is, the stock provides dividends in perpetuity, and (ii) if a constant growth rate of dividends occurs forever. A violation of the first assumption might be a company that is expected to cease operations and dissolve itself some finite number of years from now. The stock of such a company would be valued by applying the general method of valuation explained in this chapter. A violation of the second assumption might be a start-up firm that isn't currently paying any dividends, but is expected to eventually start making dividend payments some number of years from now. This stock would also be valued by the general dividend valuation method explained in this chapter.
5. The common stock probably has a higher price because the dividend can grow, whereas it is fixed on the preferred. However, the preferred is less risky because of the dividend and liquidation preference, so it is possible the preferred could be worth more, depending on the circumstances.
6. The two components are the dividend yield and the capital gains yield. For most companies, the capital gains yield is larger. This is easy to see for companies that pay no dividends. For companies that do pay dividends, the dividend yields are rarely over five percent and are often much less.
7. Yes. If the dividend grows at a steady rate, so does the stock price. In other words, the dividend growth rate and the capital gains yield are the same.
8. In a corporate election, you can buy votes (by buying shares), so money can be used to influence or even determine the outcome. Many would argue the same is true in political elections, but, in principle at least, no one has more than one vote.
9. It wouldn't seem to be. Investors who don't like the voting features of a particular class of stock are under no obligation to buy it.
10. Investors buy such stock because they want it, recognizing that the shares have no voting power. Presumably, investors pay a little less for such shares than they would otherwise.

## B-140 SOLUTIONS

11. Presumably, the current stock value reflects the risk, timing and magnitude of all future cash flows, both short-term and long-term. If this is correct, then the statement is false.
12. If this assumption is violated, the two-stage dividend growth model is not valid. In other words, the price calculated will not be correct. Depending on the stock, it may be more reasonable to assume that the dividends fall from the high growth rate to the low perpetual growth rate over a period of years, rather than in one year.

### Solutions to Questions and Problems

*NOTE: All end of chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.*

#### Basic

1. The constant dividend growth model is:

$$P_t = D_t \times (1 + g) / (R - g)$$

So the price of the stock today is:

$$P_0 = D_0 (1 + g) / (R - g) = \$1.60 (1.06) / (.12 - .06) = \$28.27$$

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

$$P_3 = D_3 (1 + g) / (R - g) = D_0 (1 + g)^4 / (R - g) = \$1.60 (1.06)^4 / (.12 - .06) = \$33.67$$

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

$$P_{15} = D_{15} (1 + g) / (R - g) = D_0 (1 + g)^{16} / (R - g) = \$1.60 (1.06)^{16} / (.12 - .06) = \$67.74$$

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:

$$P_3 = P_0(1 + g)^3 = \$28.27(1 + .06)^3 = \$33.67$$

And the stock price in 15 years will be:

$$P_{15} = P_0(1 + g)^{15} = \$28.27(1 + .06)^{15} = \$67.74$$

2. We need to find the required return of the stock. Using the constant growth model, we can solve the equation for  $R$ . Doing so, we find:

$$R = (D_1 / P_0) + g = (\$2.50 / \$48.00) + .05 = .1021 \text{ or } 10.21\%$$

3. The dividend yield is the dividend next year divided by the current price, so the dividend yield is:

$$\text{Dividend yield} = D_1 / P_0 = \$2.50 / \$48.00 = .0521 \text{ or } 5.21\%$$

The capital gains yield, or percentage increase in the stock price, is the same as the dividend growth rate, so:

$$\text{Capital gains yield} = 5\%$$

4. Using the constant growth model, we find the price of the stock today is:

$$P_0 = D_1 / (R - g) = \$3.60 / (.11 - .045) = \$55.38$$

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:

$$R = \text{Dividend yield} + \text{Capital gains yield} = .036 + .065 = .1010 \text{ or } 10.10\%$$

6. We know the stock has a required return of 12 percent, and the dividend and capital gains yield are equal, so:

$$\text{Dividend yield} = 1/2(.12) = .06 = \text{Capital gains yield}$$

Now we know both the dividend yield and capital gains yield. The dividend is simply the stock price times the dividend yield, so:

$$D_1 = .06(\$60) = \$3.60$$

This is the dividend next year. The question asks for the dividend this year. Using the relationship between the dividend this year and the dividend next year:

$$D_1 = D_0(1 + g)$$

We can solve for the dividend that was just paid:

$$\$3.60 = D_0(1 + .06)$$

$$D_0 = \$3.60 / 1.06 = \$3.40$$

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 eight years, so the price of the stock is the PVA, which will be:

$$P_0 = \$11.00(\text{PVIFA}_{10\%,8}) = \$58.68$$

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:

$$R = D/P_0 = \$6.50/\$113 = .0575 \text{ or } 5.75\%$$

## B-142 SOLUTIONS

### Intermediate

9. 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:

$$P_6 = D_6 (1 + g) / (R - g) = D_0 (1 + g)^7 / (R - g) = \$3.50 (1.05)^7 / (.11 - .05) = \$82.08$$

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:

$$P_3 = \$3.50(1.050)^4 / 1.14 + \$3.50(1.050)^5 / 1.14^2 + \$3.50(1.05)^6 / 1.14^3 + \$82.08 / 1.14^3$$
$$P_3 = \$65.74$$

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:

$$P_0 = \$3.50(1.050) / 1.16 + \$3.50(1.050)^2 / (1.16)^2 + \$3.50(1.050)^3 / (1.16)^3 + \$65.74 / (1.16)^3$$
$$P_0 = \$50.75$$

10. Here we have a stock that pays no dividends for 10 years. Once the stock begins paying dividends, it will have a constant growth rate of dividends. We can use the constant growth model at that point. It is important to remember that general constant dividend growth formula is:

$$P_t = [D_t \times (1 + g)] / (R - g)$$

This means that since we will use the dividend in Year 10, we will be finding the stock price in Year 9. The dividend growth model is similar to the PVA and the PV of a perpetuity: The equation gives you the PV one period before the first payment. So, the price of the stock in Year 9 will be:

$$P_9 = D_{10} / (R - g) = \$10.00 / (.13 - .06) = \$142.86$$

The price of the stock today is simply the PV of the stock price in the future. We simply discount the future stock price at the required return. The price of the stock today will be:

$$P_0 = \$142.86 / 1.13^9 = \$47.55$$

11. 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:

$$P_0 = \$11 / 1.11 + \$15 / 1.11^2 + \$19 / 1.11^3 + \$23 / 1.11^4 = \$51.13$$

12. 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 future 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 4, at the beginning of the constant dividend growth, as:

$$P_4 = D_4 (1 + g) / (R - g) = \$2.00(1.05) / (.11 - .05) = \$35.00$$

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

$$P_0 = \$8.00 / 1.11 + \$7.00 / 1.11^2 + \$5.00 / 1.11^3 + \$2.00 / 1.11^4 + \$35.00 / 1.11^4 = \$40.92$$

13. 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:

$$P_3 = D_3 (1 + g) / (R - g) = D_0 (1 + g_1)^3 (1 + g_2) / (R - g)$$

$$P_3 = \$3.10(1.25)^3(1.07) / (.13 - .07)$$

$$P_3 = \$107.98$$

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:

$$P_0 = 3.10(1.25) / 1.13 + \$3.10(1.25)^2 / 1.13^2 + \$3.10(1.25)^3 / 1.13^3 + \$107.98 / 1.13^3$$

$$P_0 = \$86.25$$

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

$$P_0 = [D_0(1 + g_1)/(R - g_1)]\{1 - [(1 + g_1)/(1 + R)]^T\} + [(1 + g_1)/(1 + R)]^T[D_0(1 + g_1)/(R - g_1)]$$

$$P_0 = [\$3.10(1.25)/(1.13 - .25)][1 - (1.25/1.13)^3] + [(1 + .25)/(1 + .13)]^3[\$3.10(1.07)/(1.13 - .07)]$$

$$P_0 = \$86.25$$

14. Here we need to find the dividend next year for a stock experiencing supernormal growth. We know the stock price, the dividend growth rates, and the required return, but not the dividend. First, we need to realize that the dividend in Year 3 is the current dividend times the FVIF. The dividend in Year 3 will be:

$$D_3 = D_0 (1.25)^3$$

And the dividend in Year 4 will be the dividend in Year 3 times one plus the growth rate, or:

$$D_4 = D_0 (1.25)^3 (1.15)$$

The stock begins constant growth in Year 4, so we can find the price of the stock in Year 4 as the dividend in Year 5, divided by the required return minus the growth rate. The equation for the price of the stock in Year 4 is:

$$P_4 = D_4 (1 + g) / (R - g)$$

## B-144 SOLUTIONS

Now we can substitute the previous dividend in Year 4 into this equation as follows:

$$P_4 = D_0 (1 + g_1)^3 (1 + g_2) (1 + g_3) / (R - g)$$

$$P_4 = D_0 (1.25)^3 (1.15) (1.08) / (.14 - .08) = 40.43D_0$$

When we solve this equation, we find that the stock price in Year 4 is 40.43 times as large as the dividend today. Now we need to find the equation for the stock price today. The stock price today is the PV of the dividends in Years 1, 2, 3, and 4, plus the PV of the Year 4 price. So:

$$P_0 = D_0(1.25)/1.14 + D_0(1.25)^2/1.14^2 + D_0(1.25)^3/1.14^3 + D_0(1.25)^3(1.15)/1.14^4 + 40.43D_0/1.14^4$$

We can factor out  $D_0$  in the equation, and combine the last two terms. Doing so, we get:

$$P_0 = \$65 = D_0 \{ 1.25/1.14 + 1.25^2/1.14^2 + 1.25^3/1.14^3 + [(1.25)^3(1.15) + 40.43] / 1.14^4 \}$$

Reducing the equation even further by solving all of the terms in the braces, we get:

$$\$65 = \$28.87D_0$$

$$D_0 = \$65 / \$28.87$$

$$D_0 = \$2.25$$

This is the dividend today, so the projected dividend for the next year will be:

$$D_1 = \$2.25(1.25)$$

$$D_1 = \$2.81$$

- 15.** 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:

$$P_0 = D_0 (1 + g) / (R - g)$$

$$P_0 = \$10.00(1 - .06) / [(.11 - (-.06))]$$

$$P_0 = \$55.29$$

- 16.** We are given the stock price, the dividend growth rate, and the required return, and are asked to find the dividend. Using the constant dividend growth model, we get:

$$P_0 = \$50 = D_0 (1 + g) / (R - g)$$

Solving this equation for the dividend gives us:

$$D_0 = \$50(.13 - .05) / (1.05)$$

$$D_0 = \$3.81$$

17. The price of a share of preferred stock is the dividend payment divided by the required return. We know the dividend payment in Year 10, so we can find the price of the stock in Year 9, one year before the first dividend payment. Doing so, we get:

$$P_9 = \$10.00 / .07$$

$$P_9 = \$142.86$$

The price of the stock today is the PV of the stock price in the future, so the price today will be:

$$P_0 = \$142.86 / (1.07)^9$$

$$P_0 = \$77.70$$

18. The annual dividend paid to stockholders is \$1.36, and the dividend yield is 2.7 percent. Using the equation for the dividend yield:

$$\text{Dividend yield} = \text{Dividend} / \text{Stock price}$$

We can plug the numbers in and solve for the stock price:

$$.027 = \$1.36 / P_0$$

$$P_0 = \$1.36 / .027 = \$50.37$$

The “Net Chg” of the stock shows the stock decreased by \$0.23 on this day, so the closing stock price yesterday was:

$$\text{Yesterday's closing price} = \$50.37 + 0.23 = \$50.60$$

To find the net income, we need to find the EPS. The stock quote tells us the P/E ratio for the stock is 14. Since we know the stock price as well, we can use the P/E ratio to solve for EPS as follows:

$$P/E = 14 = \text{Stock price} / \text{EPS} = \$50.37 / \text{EPS}$$

$$\text{EPS} = \$50.37 / 14 = \$3.60$$

We know that EPS is just the total net income divided by the number of shares outstanding, so:

$$\text{EPS} = \text{NI} / \text{Shares} = \$3.60 = \text{NI} / 25,000,000$$

$$\text{NI} = \$3.60(25,000,000) = \$89,947,090$$

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

$$P_0 = [D_0(1 + g_1)/(R - g_1)]\{1 - [(1 + g_1)/(1 + R)]^T\} + [(1 + g_1)/(1 + R)]^T [D_0(1 + g_2)/(R - g_2)]$$

$$P_0 = [\$1.45(1.30)/(.13 - .30)][1 - (1.30/1.13)^8] + [(1.30)/(1.13)]^8 [\$1.45(1.07)/(.13 - .07)]$$

$$P_0 = \$102.28$$

B-146 SOLUTIONS

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

$$P_0 = [D_0(1 + g_1)/(R - g_1)]\{1 - [(1 + g_1)/(1 + R)]^T\} + [(1 + g_1)/(1 + R)]^T [D_0(1 + g_2)/(R - g_2)]$$

$$P_0 = [\$1.05(1.25)/(.12 - .25)][1 - (1.25/1.12)^9] + [(1.25)/(1.12)]^9 [\$1.05(1.06)/(.12 - .06)]$$

$$P_0 = \$66.87$$

Challenge

21. We are asked to find the dividend yield and capital gains yield for each of the stocks. All of the stocks have a 15 percent required return, which is the sum of the dividend yield and the capital gains yield. To find the components of the total return, we need to find the stock price for each stock. Using this stock price and the dividend, we can calculate the dividend yield. The capital gains yield for the stock will be the total return (required return) minus the dividend yield.

W:  $P_0 = D_0(1 + g) / (R - g) = \$4.50(1.10)/(.18 - .10) = \$61.88$

Dividend yield =  $D_1/P_0 = \$4.50(1.10)/\$61.88 = .08$  or 8%

Capital gains yield =  $.18 - .08 = .10$  or 10%

X:  $P_0 = D_0(1 + g) / (R - g) = \$4.50/(.18 - 0) = \$25.00$

Dividend yield =  $D_1/P_0 = \$4.50/\$25.00 = .18$  or 18%

Capital gains yield =  $.18 - .18 = 0\%$

Y:  $P_0 = D_0(1 + g) / (R - g) = \$4.50(1 - .05)/(.18 + .05) = \$18.59$

Dividend yield =  $D_1/P_0 = \$4.50(0.95)/\$18.59 = .23$  or 23%

Capital gains yield =  $.18 - .23 = -.05$  or -5%

Z:  $P_2 = D_2(1 + g) / (R - g) = D_0(1 + g)^2(1 + g_2)/(R - g) = \$4.50(1.20)^2(1.12)/(.18 - .12) = \$120.96$

$P_0 = \$4.50(1.20) / (1.18) + \$4.50(1.20)^2 / (1.18)^2 + \$120.96 / (1.18)^2 = \$96.10$

Dividend yield =  $D_1/P_0 = \$4.50(1.20)/\$96.10 = .056$  or 5.6%

Capital gains yield =  $.18 - .056 = .124$  or 12.4%

In all cases, the required return is 18%, but the return is distributed differently between current income and capital gains. High growth stocks have an appreciable capital gains component but a relatively small current income yield; conversely, mature, negative-growth stocks provide a high current income but also price depreciation over time.

22. a. Using the constant growth model, the price of the stock paying annual dividends will be:

$P_0 = D_0(1 + g) / (R - g) = \$2.40(1.06)/(.12 - .06) = \$42.40$

- b. If the company pays quarterly dividends instead of annual dividends, the quarterly dividend will be one-fourth of annual dividend, or:

$$\text{Quarterly dividend: } \$2.40(1.06)/4 = \$0.636$$

To find the equivalent annual dividend, we must assume that the quarterly dividends are reinvested at the required return. We can then use this interest rate to find the equivalent annual dividend. In other words, when we receive the quarterly dividend, we reinvest it at the required return on the stock. So, the effective quarterly rate is:

$$\text{Effective quarterly rate: } 1.12^{.25} - 1 = .0287$$

The effective annual dividend will be the FVA of the quarterly dividend payments at the effective quarterly required return. In this case, the effective annual dividend will be:

$$\text{Effective } D_1 = \$0.636(\text{FVIFA}_{2.87\%,4}) = \$2.66$$

Now, we can use the constant growth model to find the current stock price as:

$$P_0 = \$2.66/(\.12 - .06) = \$44.26$$

Note that we can not simply find the quarterly effective required return and growth rate to find the value of the stock. This would assume the dividends increased each quarter, not each year.

23. Here we have a stock with supernormal growth, but the dividend growth changes every year for the first four years. We can find the price of the stock in Year 3 since the dividend growth rate is constant after the third dividend. The price of the stock in Year 3 will be the dividend in Year 4, divided by the required return minus the constant dividend growth rate. So, the price in Year 3 will be:

$$P_3 = \$2.75(1.20)(1.15)(1.10)(1.05) / (.13 - .05) = \$54.79$$

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

$$P_0 = \$2.75(1.20)/(1.13) + \$2.75(1.20)(1.15)/1.13^2 + \$2.75(1.20)(1.15)(1.10)/1.13^3 + \$54.79/1.13^3$$

$$P_0 = \$46.76$$

24. 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:

$$P = \$2.75(1.20)/(1 + R) + \$2.75(1.20)(1.15)/(1 + R)^2 + \$2.75(1.20)(1.15)(1.10)/(1 + R)^3$$

$$+ [\$2.75(1.20)(1.15)(1.10)(1.05)/(R - .05)]/(1 + R)^3 = \$60.98$$

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:

$$R = 11.15\%$$

B-148 SOLUTIONS

25. Even though the question concerns a stock with a constant growth rate, we need to begin with the equation for two-stage growth given in the chapter, which is:

$$P_0 = \frac{D_0(1 + g_1)}{R - g_1} \left[ 1 - \left( \frac{1 + g_1}{1 + R} \right)^t \right] + \frac{P_t}{(1 + R)^t}$$

We can expand the equation (see Problem 26 for more detail) to the following:

$$P_0 = \frac{D_0(1 + g_1)}{R - g_1} \left[ 1 - \left( \frac{1 + g_1}{1 + R} \right)^t \right] + \left( \frac{1 + g_1}{1 + R} \right)^t \frac{D(1 + g_2)}{R - g_2}$$

Since the growth rate is constant,  $g_1 = g_2$ , so:

$$P_0 = \frac{D_0(1 + g)}{R - g} \left[ 1 - \left( \frac{1 + g}{1 + R} \right)^t \right] + \left( \frac{1 + g}{1 + R} \right)^t \frac{D(1 + g)}{R - g}$$

Since we want the first  $t$  dividends to constitute one-half of the stock price, we can set the two terms on the right hand side of the equation equal to each other, which gives us:

$$\frac{D_0(1+g)}{R-g} \left[ 1 - \left( \frac{1+g}{1+R} \right)^t \right] = \left( \frac{1+g}{1+R} \right)^t \frac{D(1+g)}{R-g}$$

Since  $\frac{D_0(1+g)}{R-g}$  appears on both sides of the equation, we can eliminate this, which leaves:

$$1 - \left( \frac{1+g}{1+R} \right)^t = \left( \frac{1+g}{1+R} \right)^t$$

Solving this equation, we get:

$$1 = \left( \frac{1+g}{1+R} \right)^t + \left( \frac{1+g}{1+R} \right)^t$$

$$1 = 2 \left( \frac{1+g}{1+R} \right)^t$$

$$1/2 = \left( \frac{1+g}{1+R} \right)^t$$

$$t \ln \left( \frac{1+g}{1+R} \right) = \ln(0.5)$$

$$t = \frac{\ln(0.5)}{\ln \left( \frac{1+g}{1+R} \right)}$$

This expression will tell you the number of dividends that constitute one-half of the current stock price.

- 26.** To find the value of the stock with two-stage dividend growth, consider that the present value of the first  $t$  dividends is the present value of a growing annuity. Additionally, to find the price of the stock, we need to add the present value of the stock price at time  $t$ . So, the stock price today is:

$$P_0 = \text{PV of } t \text{ dividends} + \text{PV}(P_t)$$

Using  $g_1$  to represent the first growth rate and substituting the equation for the present value of a growing annuity, we get:

$$P_0 = D_1 \left[ \frac{1 - \left( \frac{1+g_1}{1+R} \right)^t}{R - g_1} \right] + \text{PV}(P_t)$$

Since the dividend in one year will increase at  $g_1$ , we can re-write the expression as:

$$P_0 = D_0(1+g_1) \left[ \frac{1 - \left( \frac{1+g_1}{1+R} \right)^t}{R - g_1} \right] + \text{PV}(P_t)$$

Now we can re-write the equation again as:

$$P_0 = \frac{D_0(1+g_1)}{R - g_1} \left[ 1 - \left( \frac{1+g_1}{1+R} \right)^t \right] + \text{PV}(P_t)$$

To find the price of the stock at time  $t$ , we can use the constant dividend growth model, or:

$$P_t = \frac{D_{t+1}}{R - g_2}$$

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The dividend at  $t + 1$  will have grown at  $g_1$  for  $t$  periods, and at  $g_2$  for one period, so:

$$D_{t+1} = D_0(1 + g_1)^t(1 + g_2)$$

So, we can re-write the equation as:

$$P_t = \frac{D(1 + g_1)^t(1 + g_2)}{R - g_2}$$

Next, we can find value today of the future stock price as:

$$PV(P_t) = \frac{D(1 + g_1)^t(1 + g_2)}{R - g_2} \times \frac{1}{(1 + R)^t}$$

which can be written as:

$$PV(P_t) = \left( \frac{1 + g_1}{1 + R} \right)^t \frac{D(1 + g_2)}{R - g_2}$$

Substituting this into the stock price equation, we get:

$$P_0 = \frac{D_0(1 + g_1)}{R - g_1} \left[ 1 - \left( \frac{1 + g_1}{1 + R} \right)^t \right] + \left( \frac{1 + g_1}{1 + R} \right)^t \frac{D(1 + g_2)}{R - g_2}$$

In this equation, the first term on the left hand side is the present value of the first  $t$  dividends, and the second term is the present value of the stock price when constant dividend growth forever begins.

- 27.** To find the expression when the growth rate for the first stage is exactly equal to the required return, consider we can find the present value of the dividends in the first stage as:

$$PV = \frac{D_0(1 + g_1)^1}{(1 + R)^1} + \frac{D_0(1 + g_1)^2}{(1 + R)^2} + \frac{D_0(1 + g_1)^3}{(1 + R)^3} + \dots$$

Since  $g_1$  is equal to  $R$ , each of the terms reduces to:

$$PV = D_0 + D_0 + D_0 + \dots$$

$$PV = t \times D_0$$

So, the expression for the price of a stock when the first growth rate is exactly equal to the required return is:

$$P_t = t \times D_0 + \frac{D_0 \times (1 + g_1)^t \times (1 + g_2)}{R - g_2}$$

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# CHAPTER 9

## NET PRESENT VALUE AND OTHER INVESTMENT CRITERIA

### Answers to Concepts Review and Critical Thinking Questions

1. A payback period less than the project's life means that the NPV is positive for a zero discount rate, but nothing more definitive can be said. For discount rates greater than zero, the payback period will still be less than the project's life, but the NPV may be positive, zero, or negative, depending on whether the discount rate is less than, equal to, or greater than the IRR. The discounted payback includes the effect of the relevant discount rate. If a project's discounted payback period is less than the project's life, it must be the case that NPV is positive.
2. If a project has a positive NPV for a certain discount rate, then it will also have a positive NPV for a zero discount rate; thus, the payback period must be less than the project life. Since discounted payback is calculated at the same discount rate as is NPV, if NPV is positive, the discounted payback period must be less than the project's life. If NPV is positive, then the present value of future cash inflows is greater than the initial investment cost; thus PI must be greater than 1. If NPV is positive for a certain discount rate  $R$ , then it will be zero for some larger discount rate  $R^*$ ; thus the IRR must be greater than the required return.
3.
  - a. Payback period is simply the accounting break-even point of a series of cash flows. To actually compute the payback period, it is assumed that any cash flow occurring during a given period is realized continuously throughout the period, and not at a single point in time. The payback is then the point in time for the series of cash flows when the initial cash outlays are fully recovered. Given some predetermined cutoff for the payback period, the decision rule is to accept projects that payback before this cutoff, and reject projects that take longer to payback.
  - b. The worst problem associated with payback period is that it ignores the time value of money. In addition, the selection of a hurdle point for payback period is an arbitrary exercise that lacks any steadfast rule or method. The payback period is biased towards short-term projects; it fully ignores any cash flows that occur after the cutoff point.
  - c. Despite its shortcomings, payback is often used because (1) the analysis is straightforward and simple and (2) accounting numbers and estimates are readily available. Materiality considerations often warrant a payback analysis as sufficient; maintenance projects are another example where the detailed analysis of other methods is often not needed. Since payback is biased towards liquidity, it may be a useful and appropriate analysis method for short-term projects where cash management is most important.
4.
  - a. The discounted payback is calculated the same as is regular payback, with the exception that each cash flow in the series is first converted to its present value. Thus discounted payback provides a measure of financial/economic break-even because of this discounting, just as regular payback provides a measure of accounting break-even because it does not discount the cash flows. Given some predetermined cutoff for the discounted payback period, the decision rule is to accept projects whose discounted cash flows payback before this cutoff period, and to reject all other projects.



8.
  - a. The profitability index is the present value of cash inflows relative to the project cost. As such, it is a benefit/cost ratio, providing a measure of the relative profitability of a project. The profitability index decision rule is to accept projects with a PI greater than one, and to reject projects with a PI less than one.
  - b.  $PI = (NPV + cost)/cost = 1 + (NPV/cost)$ . If a firm has a basket of positive NPV projects and is subject to capital rationing, PI may provide a good ranking measure of the projects, indicating the “bang for the buck” of each particular project.

9. For a project with future cash flows that are an annuity:

$$\text{Payback} = I / C$$

And the IRR is:

$$0 = -I + C / \text{IRR}$$

Solving the IRR equation for IRR, we get:

$$\text{IRR} = C / I$$

Notice this is just the reciprocal of the payback. So:

$$\text{IRR} = 1 / \text{PB}$$

For long-lived projects with relatively constant cash flows, the sooner the project pays back, the greater is the IRR.

10. There are a number of reasons. Two of the most important have to do with transportation costs and exchange rates. Manufacturing in the U.S. places the finished product much closer to the point of sale, resulting in significant savings in transportation costs. It also reduces inventories because goods spend less time in transit. Higher labor costs tend to offset these savings to some degree, at least compared to other possible manufacturing locations. Of great importance is the fact that manufacturing in the U.S. means that a much higher proportion of the costs are paid in dollars. Since sales are in dollars, the net effect is to immunize profits to a large extent against fluctuations in exchange rates. This issue is discussed in greater detail in the chapter on international finance.
11. The single biggest difficulty, by far, is coming up with reliable cash flow estimates. Determining an appropriate discount rate is also not a simple task. These issues are discussed in greater depth in the next several chapters. The payback approach is probably the simplest, followed by the AAR, but even these require revenue and cost projections. The discounted cash flow measures (discounted payback, NPV, IRR, and profitability index) are really only slightly more difficult in practice.
12. Yes, they are. Such entities generally need to allocate available capital efficiently, just as for-profits do. However, it is frequently the case that the “revenues” from not-for-profit ventures are not tangible. For example, charitable giving has real opportunity costs, but the benefits are generally hard to measure. To the extent that benefits are measurable, the question of an appropriate required return remains. Payback rules are commonly used in such cases. Finally, realistic cost/benefit analysis along the lines indicated should definitely be used by the U.S. government and would go a long way toward balancing the budget!

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13. The MIRR is calculated by finding the present value of all cash outflows, the future value of all cash inflows to the end of the project, and then calculating the IRR of the two cash flows. As a result, the cash flows have been discounted or compounded by one interest rate (the required return), and then the interest rate between the two remaining cash flows is calculated. As such, the MIRR is not a true interest rate. In contrast, consider the IRR. If you take the initial investment, and calculate the future value at the IRR, you can replicate the future cash flows of the project exactly.
14. The statement is incorrect. It is true that if you calculate the future value of all intermediate cash flows to the end of the project at the required return, then calculate the NPV of this future value and the initial investment, you will get the same NPV. However, NPV says nothing about reinvestment of intermediate cash flows. The NPV is the present value of the project cash flows. What is actually done with those cash flows once they are generated is not relevant. Put differently, the value of a project depends on the cash flows generated by the project, not on the future value of those cash flows. The fact that the reinvestment “works” only if you use the required return as the reinvestment rate is also irrelevant simply because reinvestment is not relevant in the first place to the value of the project.

One caveat: Our discussion here assumes that the cash flows are truly available once they are generated, meaning that it is up to firm management to decide what to do with the cash flows. In certain cases, there may be a requirement that the cash flows be reinvested. For example, in international investing, a company may be required to reinvest the cash flows in the country in which they are generated and not “repatriate” the money. Such funds are said to be “blocked” and reinvestment becomes relevant because the cash flows are not truly available.

15. The statement is incorrect. It is true that if you calculate the future value of all intermediate cash flows to the end of the project at the IRR, then calculate the IRR of this future value and the initial investment, you will get the same IRR. However, as in the previous question, what is done with the cash flows once they are generated does not affect the IRR. Consider the following example:

	$C_0$	$C_1$	$C_2$	IRR
Project A	-\$100	\$10	\$110	10%

Suppose this \$100 is a deposit into a bank account. The IRR of the cash flows is 10 percent. Does the IRR change if the Year 1 cash flow is reinvested in the account, or if it is withdrawn and spent on pizza? No. Finally, consider the yield to maturity calculation on a bond. If you think about it, the YTM is the IRR on the bond, but no mention of a reinvestment assumption for the bond coupons is suggested. The reason is that reinvestment is irrelevant to the YTM calculation; in the same way, reinvestment is irrelevant in the IRR calculation. Our caveat about blocked funds applies here as well.

**Solutions to Questions and Problems**

*NOTE: All end of chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.*

Basic

1. To calculate the payback period, we need to find the time that the project has recovered its initial investment. After two years, the project has created:

$$\$1,500 + 2,600 = \$4,100$$

in cash flows. The project still needs to create another:

$$\$4,800 - 4,100 = \$700$$

in cash flows. During the third year, the cash flows from the project will be \$3,400. So, the payback period will be 2 years, plus what we still need to make divided by what we will make during the third year. The payback period is:

$$\text{Payback} = 2 + (\$700 / \$2,900) = 2.24 \text{ years}$$

2. To calculate the payback period, we need to find the time that the project has recovered its initial investment. The cash flows in this problem are an annuity, so the calculation is simpler. If the initial cost is \$3,000, the payback period is:

$$\text{Payback} = 3 + (\$420 / \$860) = 3.49 \text{ years}$$

There is a shortcut to calculate the future cash flows are an annuity. Just divide the initial cost by the annual cash flow. For the \$3,000 cost, the payback period is:

$$\text{Payback} = \$3,000 / \$860 = 3.49 \text{ years}$$

For an initial cost of \$5,000, the payback period is:

$$\text{Payback} = \$5,000 / \$860 = 5.81 \text{ years}$$

The payback period for an initial cost of \$7,000 is a little trickier. Notice that the total cash inflows after eight years will be:

$$\text{Total cash inflows} = 8(\$860) = \$6,880$$

If the initial cost is \$7,000, the project never pays back. Notice that if you use the shortcut for annuity cash flows, you get:

$$\text{Payback} = \$7,000 / \$860 = 8.14 \text{ years.}$$

This answer does not make sense since the cash flows stop after eight years, so again, we must conclude the payback period is never.

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3. Project A has cash flows of \$35,000 in Year 1, so the cash flows are short by \$15,000 of recapturing the initial investment, so the payback for Project A is:

$$\text{Payback} = 1 + (\$15,000 / \$21,000) = 1.71 \text{ years}$$

Project B has cash flows of:

$$\text{Cash flows} = \$15,000 + 22,000 + 31,000 = \$68,000$$

during this first three years. The cash flows are still short by \$2,000 of recapturing the initial investment, so the payback for Project B is:

$$\text{B: Payback} = 3 + (\$2,000 / \$240,000) = 3.008 \text{ years}$$

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

4. When we use discounted payback, we need to find the value of all cash flows today. The value today of the project cash flows for the first four years is:

$$\text{Value today of Year 1 cash flow} = \$6,500/1.14 = \$5,701.75$$

$$\text{Value today of Year 2 cash flow} = \$7,000/1.14^2 = \$5,386.27$$

$$\text{Value today of Year 3 cash flow} = \$7,500/1.14^3 = \$5,062.29$$

$$\text{Value today of Year 4 cash flow} = \$8,000/1.14^4 = \$4,736.64$$

To find the discounted payback, we use these values to find the payback period. The discounted first year cash flow is \$5,701.75, so the discounted payback for an \$8,000 initial cost is:

$$\text{Discounted payback} = 1 + (\$8,000 - 5,701.75)/\$5,386.27 = 1.43 \text{ years}$$

For an initial cost of \$13,000, the discounted payback is:

$$\text{Discounted payback} = 2 + (\$13,000 - 5,701.75 - 5,386.27)/\$5,062.29 = 2.38 \text{ years}$$

Notice the calculation of discounted payback. We know the payback period is between two and three years, so we subtract the discounted values of the Year 1 and Year 2 cash flows from the initial cost. This is the numerator, which is the discounted amount we still need to make to recover our initial investment. We divide this amount by the discounted amount we will earn in Year 3 to get the fractional portion of the discounted payback.

If the initial cost is \$18,000, the discounted payback is:

$$\text{Discounted payback} = 3 + (\$18,000 - 5,701.75 - 5,386.27 - 5,062.29) / \$4,736.64 = 3.39 \text{ years}$$

5. R = 0%:  $4 + (\$200 / \$3,700) = 4.05 \text{ years}$   
discounted payback = regular payback = 4.05 years

$$\text{R} = 5\%: \$3,700/1.05 + \$3,700/1.05^2 + \$3,700/1.05^3 + \$3,700/1.05^4 = \$13,120.01$$

$$\$3,700/1.05^5 = \$2,899.05$$

$$\text{discounted payback} = 4 + (\$15,000 - 13,120.01) / \$2,899.05 = 4.65 \text{ years}$$

$$R = 15\%: \$3,700/1.15 + \$3,700/1.15^2 + \$3,700/1.15^3 + \$3,700/1.15^4 + \$3,700/1.15^5 + \$3,700/1.15^6 \\ = \$14,002.59; \text{ The project never pays back.}$$

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

$$\text{Average net income} = (\$1,632,000 + 2,106,500 + 1,941,700 + 1,298,000) / 4 = \$1,744,550$$

And the average book value is:

$$\text{Average book value} = (\$18,000,000 + 0) / 2 = \$9,000,000$$

So, the AAR for this project is:

$$\text{AAR} = \text{Average net income} / \text{Average book value} = \$1,744,500 / \$9,000,000 = .1938 \text{ or } 19.38\%$$

7. The IRR is the interest rate that makes the NPV of the project equal to zero. So, the equation that defines the IRR for this project is:

$$0 = -\$30,000 + \$13,000/(1+\text{IRR}) + \$19,000/(1+\text{IRR})^2 + \$12,000/(1+\text{IRR})^3$$

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

$$\text{IRR} = 22.06\%$$

Since the IRR is greater than the required return we would accept the project.

8. The NPV of a project is the PV of the outflows minus the PV of the inflows. The equation for the NPV of this project at an 11 percent required return is:

$$\text{NPV} = -\$30,000 + \$13,000/1.11 + \$19,000/1.11^2 + \$12,000/1.11^3 = \$5,906.83$$

At an 11 percent required return, the NPV is positive, so we would accept the project.

The equation for the NPV of the project at a 30 percent required return is:

$$\text{NPV} = -\$30,000 + \$13,000/1.30 + \$19,000/1.30^2 + \$12,000/1.30^3 = -\$3,295.40$$

At a 30 percent required return, the NPV is negative, so we would reject the project.

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:

$$\text{NPV} = -\$110,000 + \$24,000(\text{PVIFA}_{8\%, 9}) = \$39,925.31$$

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

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

$$\text{NPV} = -\$110,000 + \$24,000(\text{PVIFA}_{20\%, 9}) = -\$13,256.80$$

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:

$$0 = -\$110,000 + \$24,000(\text{PVIFA}_{\text{IRR}, 9})$$

$$\text{IRR} = 16.15\%$$

- 10.** The IRR is the interest rate that makes the NPV of the project equal to zero. So, the equation that defines the IRR for this project is:

$$0 = -\$18,000 + \$9,800/(1+\text{IRR}) + \$7,500/(1+\text{IRR})^2 + \$7,300/(1+\text{IRR})^3$$

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

$$\text{IRR} = 18.49\%$$

- 11.** The NPV of a project is the PV of the outflows minus the PV of the inflows. At a zero discount rate (and only at a zero discount rate), the cash flows can be added together across time. So, the NPV of the project at a zero percent required return is:

$$\text{NPV} = -\$18,000 + 9,800 + 7,500 + 7,300 = \$6,600$$

The NPV at a 10 percent required return is:

$$\text{NPV} = -\$18,000 + \$9,800/1.1 + \$7,500/1.1^2 + \$7,300/1.1^3 = \$2,592.04$$

The NPV at a 20 percent required return is:

$$\text{NPV} = -\$18,000 + \$9,800/1.2 + \$7,500/1.2^2 + \$7,300/1.2^3 = -\$400.46$$

And the NPV at a 30 percent required return is:

$$\text{NPV} = -\$18,000 + \$9,800/1.3 + \$7,500/1.3^2 + \$7,300/1.3^3 = -\$2,700.96$$

Notice that as the required return increases, the NPV of the project decreases. This will always be true for projects with conventional cash flows. Conventional cash flows are negative at the beginning of the project and positive throughout the rest of the project.

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:

$$0 = -\$37,000 + \$19,000/(1+IRR) + \$14,500/(1+IRR)^2 + \$12,000/(1+IRR)^3 + \$9,000/(1+IRR)^4$$

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

$$IRR = 20.30\%$$

The equation for the IRR of Project B is:

$$0 = -\$37,000 + \$6,000/(1+IRR) + \$12,500/(1+IRR)^2 + \$19,000/(1+IRR)^3 + \$23,000/(1+IRR)^4$$

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

$$IRR = 18.55\%$$

Examining the IRRs of the projects, we see that the  $IRR_A$  is greater than the  $IRR_B$ , 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:

$$\begin{aligned} NPV_A &= -\$37,000 + \$19,000/1.11 + \$14,500/1.11^2 + \$12,000/1.11^3 + \$9,000/1.11^4 \\ NPV_A &= \$6,588.52 \end{aligned}$$

And the NPV of Project B is:

$$\begin{aligned} NPV_B &= -\$37,000 + \$6,000/1.11 + \$12,500/1.11^2 + \$19,000/1.11^3 + \$23,000/1.11^4 \\ NPV_B &= \$7,594.13 \end{aligned}$$

The  $NPV_B$  is greater than the  $NPV_A$ , 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:

$$\text{Crossover rate: } 0 = \$13,000/(1+R) + \$2,000/(1+R)^2 - \$7,000/(1+R)^3 - \$14,000/(1+R)^4$$

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

$$R = 14.25\%$$

At discount rates above 14.25% choose project A; for discount rates below 14.25% choose project B; indifferent between A and B at a discount rate of 14.25%.

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13. The IRR is the interest rate that makes the NPV of the project equal to zero. The equation to calculate the IRR of Project X is:

$$0 = -\$10,000 + \$5,400/(1+IRR) + \$3,400/(1+IRR)^2 + \$4,500/(1+IRR)^3$$

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

$$IRR = 16.41\%$$

For Project Y, the equation to find the IRR is:

$$0 = -\$10,000 + \$4,500/(1+IRR) + \$3,600/(1+IRR)^2 + \$5,400/(1+IRR)^3$$

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

$$IRR = 16.08\%$$

To find the crossover rate, we subtract the cash flows from one project from the cash flows of the other project, and find the IRR of the differential cash flows. We will subtract the cash flows from Project Y from the cash flows from Project X. It is irrelevant which cash flows we subtract from the other. Subtracting the cash flows, the equation to calculate the IRR for these differential cash flows is:

$$\text{Crossover rate: } 0 = \$900/(1+R) - \$200/(1+R)^2 - \$900/(1+R)^3$$

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

$$R = 11.73\%$$

The table below shows the NPV of each project for different required returns. Notice that Project Y always has a higher NPV for discount rates below 11.73 percent, and always has a lower NPV for discount rates above 11.73 percent.

<u>R</u>	<u>\$NPV<sub>X</sub></u>	<u>\$NPV<sub>Y</sub></u>
0%	\$3,300.00	\$3,500.00
5%	\$2,114.03	\$2,215.74
10%	\$1,099.92	\$1,123.22
15%	\$225.36	\$185.75
20%	-\$534.72	-\$625.00
25%	-\$1,200.00	-\$1,331.20

14. a. The equation for the NPV of the project is:

$$NPV = -\$27,000,000 + \$46,000,000/1.1 - \$6,000,000/1.1^2 = \$9,859,504.13$$

The NPV is greater than 0, so we would accept the project.

b. The equation for the IRR of the project is:

$$0 = -\$27,000,000 + \$46,000,000/(1+IRR) - \$6,000,000/(1+IRR)^2$$

From Descartes rule of signs, we know there are two IRRs since the cash flows change signs twice. From trial and error, the two IRRs are:

$$IRR = 56.14\%, -85.77\%$$

When there are multiple IRRs, the IRR decision rule is ambiguous. Both IRRs are correct, that is, both interest rates make the NPV of the project equal to zero. If we are evaluating whether or not to accept this project, we would not want to use the IRR to make our decision.

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:

$$PI = [\$6,200/1.1 + \$5,600/1.1^2 + \$3,900/1.1^3] / \$12,000 = 1.100$$

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

$$PI = [\$6,200/1.15 + \$5,600/1.15^2 + \$3,900/1.15^3] / \$12,000 = 1.016$$

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

$$PI = [\$6,200/1.22 + \$5,600/1.22^2 + \$3,900/1.22^3] / \$12,000 = 0.916$$

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.

16. a. The profitability index is the PV of the future cash flows divided by the initial investment. The cash flows for both projects are an annuity, so:

$$PI_I = \$18,000(PVIFA_{10\%,3}) / \$40,000 = 1.119$$

$$PI_{II} = \$6,100(PVIFA_{10\%,3}) / \$12,000 = 1.264$$

The profitability index decision rule implies that we accept project II, since  $PI_{II}$  is greater than the  $PI_I$ .

b. The NPV of each project is:

$$NPV_I = -\$40,000 + \$18,000(PVIFA_{10\%,3}) = \$4,763.34$$

$$NPV_{II} = -\$12,000 + \$6,100(PVIFA_{10\%,3}) = \$3,169.80$$

The NPV decision rule implies accepting Project I, since the  $NPV_I$  is greater than the  $NPV_{II}$ .

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- c. Using the profitability index to compare mutually exclusive projects can be ambiguous when the magnitude of the cash flows for the two projects are of different scale. In this problem, project I is roughly 3 times as large as project II and produces a larger NPV, yet the profitability index criterion implies that project II is more acceptable.

17. a. The payback period for each project is:

$$A: 3 + (\$185,000/\$430,000) = 3.43 \text{ years}$$

$$B: 2 + (\$7,000/\$17,000) = 2.41 \text{ years}$$

The payback criterion implies accepting project B, because it pays back sooner than project A.

- b. The discounted payback for each project is:

$$A: \$25,000/1.15 + \$70,000/1.15^2 + \$70,000/1.15^3 = \$120,695.32$$
$$\$430,000/1.15^4 = \$245,853.90$$

$$\text{Discounted payback} = 3 + (\$350,000 - 120,695.32)/\$245,853.90 = 3.93 \text{ years}$$

$$B: \$17,000/1.15 + \$11,000/1.15^2 + \$17,000/1.15^3 = \$34,277.96$$
$$\$11,000/1.15^4 = \$6,289.29$$

$$\text{Discounted payback} = 3 + (\$35,000 - 34,277.96)/\$6,289.29 = 3.11 \text{ years}$$

The discounted payback criterion implies accepting project B because it pays back sooner than A

- c. The NPV for each project is:

$$A: \text{NPV} = -\$350,000 + \$25,000/1.15 + \$70,000/1.15^2 + \$70,000/1.15^3 + \$430,000/1.15^4$$
$$\text{NPV} = \$16,549.22$$

$$B: \text{NPV} = -\$35,000 + \$17,000/1.15 + \$11,000/1.15^2 + \$17,000/1.15^3 + \$11,000/1.15^4$$
$$\text{NPV} = \$5,567.25$$

NPV criterion implies we accept project A because project A has a higher NPV than project B.

- d. The IRR for each project is:

$$A: \$350,000 = \$25,000/(1+\text{IRR}) + \$70,000/(1+\text{IRR})^2 + \$70,000/(1+\text{IRR})^3 + \$430,000/(1+\text{IRR})^4$$

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

$$\text{IRR} = 16.57\%$$

$$B: \$35,000 = \$17,000/(1+IRR) + \$11,000/(1+IRR)^2 + \$17,000/(1+IRR)^3 + \$11,000/(1+IRR)^4$$

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

$$IRR = 23.05\%$$

IRR decision rule implies we accept project B because IRR for B is greater than IRR for A.

e. The profitability index for each project is:

$$A: PI = (\$25,000/1.15 + \$70,000/1.15^2 + \$70,000/1.15^3 + \$430,000/1.15^4) / \$350,000 = 1.047$$

$$B: PI = (\$17,000/1.15 + \$11,000/1.15^2 + \$17,000/1.15^3 + \$11,000/1.15^4) / \$35,000 = 1.159$$

Profitability index criterion implies accept project B because its PI is greater than project A's.

f. In this instance, the NPV criteria implies that you should accept project A, while profitability index, payback period, discounted payback and IRR imply that you should accept project B. The final decision should be based on the NPV since it does not have the ranking problem associated with the other capital budgeting techniques. Therefore, you should accept project A.

**18.** At a zero discount rate (and only at a zero discount rate), the cash flows can be added together across time. So, the NPV of the project at a zero percent required return is:

$$NPV = -\$724,860 + 324,186 + 375,085 + 354,302 + 205,680 = \$534,393$$

If the required return is infinite, future cash flows have no value. Even if the cash flow in one year is \$1 trillion, at an infinite rate of interest, the value of this cash flow today is zero. So, if the future cash flows have no value today, the NPV of the project is simply the cash flow today, so at an infinite interest rate:

$$NPV = -\$724,860$$

The interest rate that makes the NPV of a project equal to zero is the IRR. The equation for the IRR of this project is:

$$0 = -\$724,860 + \$324,186/(1+IRR) + \$375,085/(1+IRR)^2 + \$354,302/(1+IRR)^3 + 205,860/(1+IRR)^4$$

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

$$IRR = 28.25\%$$

## B-164 SOLUTIONS

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:

$$\begin{aligned}\text{Time 0 cash flow} &= -\$12,000 - \$4,300 / 1.10^5 \\ \text{Time 0 cash flow} &= -\$14,669.96\end{aligned}$$

So, the MIRR using the discounting approach is:

$$0 = -\$14,669.96 + \$5,800/(1+\text{MIRR}) + \$6,500/(1+\text{MIRR})^2 + \$6,200/(1+\text{MIRR})^3 + 5,100/(1+\text{MIRR})^4$$

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

$$\text{MIRR} = 22.63\%$$

*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:

$$\begin{aligned}\text{Time 5 cash flow} &= \$5,800(1.10^4) + \$6,500(1.10^3) + \$6,200(1.10^2) + \$5,100(1.10) - \$4,300 \\ \text{Time 5 cash flow} &= \$25,955.28\end{aligned}$$

So, the MIRR using the discounting approach is:

$$\begin{aligned}0 &= -\$12,000 + \$25,955.28/(1+\text{MIRR})^5 \\ \$25,955.28 / \$12,000 &= (1+\text{MIRR})^5 \\ \text{MIRR} &= (\$25,955.28 / \$12,000)^{1/5} - 1 \\ \text{MIRR} &= .1668 \text{ or } 16.68\%\end{aligned}$$

*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:

$$\begin{aligned}\text{Time 0 cash flow} &= -\$12,000 - \$4,300 / 1.10^5 \\ \text{Time 0 cash flow} &= -\$14,669.96\end{aligned}$$

$$\begin{aligned}\text{Time 5 cash flow} &= \$5,800(1.10^4) + \$6,500(1.10^3) + \$6,200(1.10^2) + \$5,100(1.10) \\ \text{Time 5 cash flow} &= \$30,255.28\end{aligned}$$

So, the MIRR using the discounting approach is:

$$\begin{aligned}0 &= -\$14,669.96 + \$30,255.28/(1+\text{MIRR})^5 \\ \$30,255.28 / \$14,669.96 &= (1+\text{MIRR})^5 \\ \text{MIRR} &= (\$30,255.28 / \$14,669.96)^{1/5} - 1 \\ \text{MIRR} &= .1558 \text{ or } 15.58\%\end{aligned}$$

Intermediate

20. Since the NPV index has the cost subtracted in the numerator, NPV index =  $PI - 1$ .
21. a. To have a payback equal to the project's life, given  $C$  is a constant cash flow for  $N$  years:

$$C = I/N$$

- b. To have a positive NPV,  $I < C (PVIFA_{R\%, N})$ . Thus,  $C > I / (PVIFA_{R\%, N})$ .

c. Benefits =  $C (PVIFA_{R\%, N}) = 2 \times \text{costs} = 2I$   
 $C = 2I / (PVIFA_{R\%, N})$

22. With different discounting and reinvestment rates, we need to make sure to use the appropriate interest rate. 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 at the discount rate, while any cash inflows remain at the time at which they occur. So, the discounting the cash outflows to time 0, we find:

$$\begin{aligned} \text{Time 0 cash flow} &= -\$12,000 - \$4,300 / 1.11^5 \\ \text{Time 0 cash flow} &= -\$14,551.84 \end{aligned}$$

So, the MIRR using the discounting approach is:

$$0 = -\$14,551.84 + \$5,800/(1+\text{MIRR}) + \$6,500/(1+\text{MIRR})^2 + \$6,200/(1+\text{MIRR})^3 + 5,100/(1+\text{MIRR})^4$$

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

$$\text{MIRR} = 23.08\%$$

*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 using the reinvestment rate. So, the reinvesting the cash flows to time 5, we find:

$$\begin{aligned} \text{Time 5 cash flow} &= \$5,800(1.08^4) + \$6,500(1.08^3) + \$6,200(1.08^2) + \$5,100(1.08) - \$4,300 \\ \text{Time 5 cash flow} &= \$25,618.64 \end{aligned}$$

So, the MIRR using the discounting approach is:

$$\begin{aligned} 0 &= -\$12,000 + \$25,618.64/(1+\text{MIRR})^5 \\ \$25,618.64 / \$12,000 &= (1+\text{MIRR})^5 \\ \text{MIRR} &= (\$25,618.64 / \$12,000)^{1/5} - 1 \\ \text{MIRR} &= .1536 \text{ or } 15.36\% \end{aligned}$$

## B-166 SOLUTIONS

### *Combination approach:*

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

$$\begin{aligned} \text{Time 0 cash flow} &= -\$12,000 - \$4,300 / 1.11^5 \\ \text{Time 0 cash flow} &= -\$14,551.84 \end{aligned}$$

$$\begin{aligned} \text{Time 5 cash flow} &= \$5,800(1.08^4) + \$6,500(1.08^3) + \$6,200(1.08^2) + \$5,100(1.08) \\ \text{Time 5 cash flow} &= \$28,818.64 \end{aligned}$$

So, the MIRR using the discounting approach is:

$$\begin{aligned} 0 &= -\$14,551.84 + \$28,818.64/(1+\text{MIRR})^5 \\ \$28,818.64 / \$14,551.84 &= (1+\text{MIRR})^5 \\ \text{MIRR} &= (\$28,818.64 / \$14,551.84)^{1/5} - 1 \\ \text{MIRR} &= .1464 \text{ or } 14.64\% \end{aligned}$$

### Challenge

23. Given the seven year payback, the worst case is that the payback occurs at the end of the seventh year. Thus, the worst-case:

$$\text{NPV} = -\$537,000 + \$537,000/1.12^7 = -\$294,088.47$$

The best case has infinite cash flows beyond the payback point. Thus, the best-case NPV is infinite.

24. The equation for the IRR of the project is:

$$0 = -\$756 + \$4,293/(1 + \text{IRR}) - \$9,105/(1 + \text{IRR})^2 + \$8,550/(1 + \text{IRR})^3 - \$3,000/(1 + \text{IRR})^4$$

Using Descartes rule of signs, from looking at the cash flows we know there are four IRRs for this project. Even with most computer spreadsheets, we have to do some trial and error. From trial and error, IRRs of 25%, 33.33%, 42.86%, and 66.67% are found.

We would accept the project when the NPV is greater than zero. See for yourself if that NPV is greater than zero for required returns between 25% and 33.33% or between 42.86% and 66.67%.

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:

$$\begin{aligned} \text{PV of cash inflows} &= C_1/(R - g) \\ \text{PV of cash inflows} &= \$60,000/ (.13 - .06) = \$857,142.86 \end{aligned}$$

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

$$\text{NPV of the project} = -\$925,000 + 857,142.86 = -\$67,857.14$$

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:

$$0 = -\$925,000 + \$60,000/(\.13 - g)$$

Solving for  $g$ , we get:

$$g = .0651 \text{ or } 6.51\%$$

26. The IRR of the project is:

$$\$64,000 = \$30,000/(1+\text{IRR}) + \$48,000/(1+\text{IRR})^2$$

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

$$\text{IRR} = 13.16\%$$

At an interest rate of 12 percent, the NPV is:

$$\begin{aligned}\text{NPV} &= \$64,000 - \$30,000/1.12 - \$48,000/1.12^2 \\ \text{NPV} &= -\$1,051.02\end{aligned}$$

At an interest rate of zero percent, we can add cash flows, so the NPV is:

$$\begin{aligned}\text{NPV} &= \$64,000 - \$30,000 - \$48,000 \\ \text{NPV} &= -\$14,000.00\end{aligned}$$

And at an interest rate of 24 percent, the NPV is:

$$\begin{aligned}\text{NPV} &= \$64,000 - \$30,000/1.24 - \$48,000/1.24^2 \\ \text{NPV} &= +\$8,588.97\end{aligned}$$

The cash flows for the project are unconventional. Since the initial cash flow is positive and the remaining cash flows are negative, the decision rule for IRR is invalid in this case. The NPV profile is upward sloping, indicating that the project is more valuable when the interest rate increases.

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27. The IRR is the interest rate that makes the NPV of the project equal to zero. So, the IRR of the project is:

$$0 = \$20,000 - \$26,000 / (1 + \text{IRR}) + \$13,000 / (1 + \text{IRR})^2$$

Even though it appears there are two IRRs, a spreadsheet, financial calculator, or trial and error will not give an answer. The reason is that there is no real IRR for this set of cash flows. If you examine the IRR equation, what we are really doing is solving for the roots of the equation. Going back to high school algebra, in this problem we are solving a quadratic equation. In case you don't remember, the quadratic equation is:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

In this case, the equation is:

$$x = \frac{-(-26,000) \pm \sqrt{(-26,000)^2 - 4(20,000)(13,000)}}{2(26,000)}$$

The square root term works out to be:

$$676,000,000 - 1,040,000,000 = -364,000,000$$

The square root of a negative number is a complex number, so there is no real number solution, meaning the project has no real IRR.

28. First, we need to find the future value of the cash flows for the one year in which they are blocked by the government. So, reinvesting each cash inflow for one year, we find:

$$\text{Year 2 cash flow} = \$165,000(1.04) = \$171,600$$

$$\text{Year 3 cash flow} = \$190,000(1.04) = \$197,600$$

$$\text{Year 4 cash flow} = \$205,000(1.04) = \$213,200$$

$$\text{Year 5 cash flow} = \$183,000(1.04) = \$190,320$$

So, the NPV of the project is:

$$\text{NPV} = -\$450,000 + \$171,600/1.11^2 + \$197,600/1.11^3 + \$213,200/1.11^4 + \$190,320/1.11^5$$
$$\text{NPV} = \$87,144.93$$

And the IRR of the project is:

$$0 = -\$450,000 + \$171,600/(1 + \text{IRR})^2 + \$197,600/(1 + \text{IRR})^3 + \$213,200/(1 + \text{IRR})^4 + \$190,320/(1 + \text{IRR})^5$$

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

$$\text{IRR} = 16.95\%$$

While this may look like a MIRR calculation, it is not an MIRR, rather it is a standard IRR calculation. Since the cash inflows are blocked by the government, they are not available to the company for a period of one year. Thus, all we are doing is calculating the IRR based on when the cash flows actually occur for the company.

### Calculator Solutions

7.

<b>CF<sub>0</sub></b>	-\$30,000
<b>C01</b>	\$13,000
<b>F01</b>	1
<b>C02</b>	\$19,000
<b>F02</b>	1
<b>C03</b>	\$12,000
<b>F03</b>	1
IRR CPT	
22.06%	

8.

<b>CF<sub>0</sub></b>	-\$30,000
<b>C01</b>	\$13,000
<b>F01</b>	1
<b>C02</b>	\$19,000
<b>F02</b>	1
<b>C03</b>	\$12,000
<b>F03</b>	1
I = 11%	
NPV CPT	
\$5,906.83	

<b>CF<sub>0</sub></b>	-\$30,000
<b>C01</b>	\$13,000
<b>F01</b>	1
<b>C02</b>	\$19,000
<b>F02</b>	1
<b>C03</b>	\$12,000
<b>F03</b>	1
I = 30%	
NPV CPT	
-\$3,295.40	

9.

<b>CF<sub>0</sub></b>	-\$110,000
<b>C01</b>	\$24,000
<b>F01</b>	9
I = 8%	
NPV CPT	
\$39,925.31	

<b>CF<sub>0</sub></b>	-\$110,000
<b>C01</b>	\$24,000
<b>F01</b>	9
I = 20%	
NPV CPT	
-\$13,256.80	

<b>CF<sub>0</sub></b>	-\$110,000
<b>C01</b>	\$24,000
<b>F01</b>	9
IRR CPT	
16.15%	

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10.

<b>CF<sub>0</sub></b>	-\$18,000
<b>C01</b>	\$9,800
<b>F01</b>	1
<b>C02</b>	\$7,500
<b>F02</b>	1
<b>C03</b>	\$7,300
<b>F03</b>	1

IRR CPT  
18.49%

11.

<b>CF<sub>0</sub></b>	-\$18,000
<b>C01</b>	\$9,800
<b>F01</b>	1
<b>C02</b>	\$7,500
<b>F02</b>	1
<b>C03</b>	\$7,300
<b>F03</b>	1

I = 0%  
NPV CPT  
\$6,600

<b>CF<sub>0</sub></b>	-\$18,000
<b>C01</b>	\$9,800
<b>F01</b>	1
<b>C02</b>	\$7,500
<b>F02</b>	1
<b>C03</b>	\$7,300
<b>F03</b>	1

I = 10%  
NPV CPT  
\$2,592.04

<b>CF<sub>0</sub></b>	-\$18,000
<b>C01</b>	\$9,800
<b>F01</b>	1
<b>C02</b>	\$7,500
<b>F02</b>	1
<b>C03</b>	\$7,300
<b>F03</b>	1

I = 20%  
NPV CPT  
-\$400.46

<b>CF<sub>0</sub></b>	-\$18,000
<b>C01</b>	\$9,800
<b>F01</b>	1
<b>C02</b>	\$7,500
<b>F02</b>	1
<b>C03</b>	\$7,300
<b>F03</b>	1

I = 30%  
NPV CPT  
-\$2,700.96

12.

*Project A*

<b>CF<sub>0</sub></b>	-\$37,000
<b>C01</b>	\$19,000
<b>F01</b>	1
<b>C02</b>	\$14,500
<b>F02</b>	1
<b>C03</b>	\$12,000
<b>F03</b>	1
<b>C04</b>	\$9,000
<b>F04</b>	1

IRR CPT  
20.30%

<b>CF<sub>0</sub></b>	-\$37,000
<b>C01</b>	\$19,000
<b>F01</b>	1
<b>C02</b>	\$14,500
<b>F02</b>	1
<b>C03</b>	\$12,000
<b>F03</b>	1
<b>C04</b>	\$9,000
<b>F04</b>	1

I = 11%  
NPV CPT  
\$6,588.52

*Project B*

<b>CF<sub>0</sub></b>	-\$37,000
<b>C01</b>	\$6,000
<b>F01</b>	1
<b>C02</b>	\$12,500
<b>F02</b>	1
<b>C03</b>	\$19,000
<b>F03</b>	1
<b>C04</b>	\$23,000
<b>F04</b>	1

IRR CPT  
18.55%

<b>CF<sub>0</sub></b>	-\$37,000
<b>C01</b>	\$6,000
<b>F01</b>	1
<b>C02</b>	\$12,500
<b>F02</b>	1
<b>C03</b>	\$19,000
<b>F03</b>	1
<b>C04</b>	\$23,000
<b>F04</b>	1

I = 11%  
NPV CPT  
\$7,594.13

*Crossover rate*

<b>CF<sub>0</sub></b>	\$0
<b>C01</b>	\$13,000
<b>F01</b>	1
<b>C02</b>	\$2,000
<b>F02</b>	1
<b>C03</b>	-\$7,000
<b>F03</b>	1
<b>C04</b>	-\$14,000
<b>F04</b>	1

IRR CPT  
14.25%

13.

*Project X*

<b>CF<sub>0</sub></b>	-\$10,000
<b>C01</b>	\$5,400
<b>F01</b>	1
<b>C02</b>	\$3,400
<b>F02</b>	1
<b>C03</b>	\$4,500
<b>F03</b>	1

I = 0%  
NPV CPT  
\$3,300.00

<b>CF<sub>0</sub></b>	-\$10,000
<b>C01</b>	\$5,400
<b>F01</b>	1
<b>C02</b>	\$3,400
<b>F02</b>	1
<b>C03</b>	\$4,500
<b>F03</b>	1

I = 15%  
NPV CPT  
\$225.36

<b>CF<sub>0</sub></b>	-\$10,000
<b>C01</b>	\$5,400
<b>F01</b>	1
<b>C02</b>	\$3,400
<b>F02</b>	1
<b>C03</b>	\$4,500
<b>F03</b>	1

I = 25%  
NPV CPT  
-\$1,200.00

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*Project Y*

<b>CF<sub>0</sub></b>	-\$10,000
<b>C01</b>	\$4,500
<b>F01</b>	1
<b>C02</b>	\$3,600
<b>F02</b>	1
<b>C03</b>	\$5,400
<b>F03</b>	1

I = 0%  
NPV CPT  
\$3,500.00

<b>CF<sub>0</sub></b>	-\$10,000
<b>C01</b>	\$4,500
<b>F01</b>	1
<b>C02</b>	\$3,600
<b>F02</b>	1
<b>C03</b>	\$5,400
<b>F03</b>	1

I = 15%  
NPV CPT  
\$185.75

<b>CF<sub>0</sub></b>	-\$10,000
<b>C01</b>	\$4,500
<b>F01</b>	1
<b>C02</b>	\$3,600
<b>F02</b>	1
<b>C03</b>	\$5,400
<b>F03</b>	1

I = 25%  
NPV CPT  
-\$1,331.20

*Crossover rate*

<b>CF<sub>0</sub></b>	\$0
<b>C01</b>	\$900
<b>F01</b>	1
<b>C02</b>	-\$200
<b>F02</b>	1
<b>C03</b>	-\$900
<b>F03</b>	1

IRR CPT  
11.73%

14.

<b>CF<sub>0</sub></b>	-\$27,000,000
<b>C01</b>	\$46,000,000
<b>F01</b>	1
<b>C02</b>	-\$6,000,000
<b>F02</b>	1

I = 10%  
NPV CPT  
\$9,859,504.13

<b>CF<sub>0</sub></b>	-\$27,000,000
<b>C01</b>	\$46,000,000
<b>F01</b>	1
<b>C02</b>	-\$6,000,000
<b>F02</b>	1

IRR CPT  
56.14%

Financial calculators will only give you one IRR, even if there are multiple IRRs. Using trial and error, or a root solving calculator, the other IRR is -85.77%.

15.

<b>CF<sub>0</sub></b>	\$0
<b>C01</b>	\$6,200
<b>F01</b>	1
<b>C02</b>	\$5,600
<b>F02</b>	1
<b>C03</b>	\$3,900
<b>F03</b>	1

I = 10%  
NPV CPT  
\$13,194.59

<b>CF<sub>0</sub></b>	\$0
<b>C01</b>	\$6,200
<b>F01</b>	1
<b>C02</b>	\$5,600
<b>F02</b>	1
<b>C03</b>	\$3,900
<b>F03</b>	1

I = 15%  
NPV CPT  
\$12,190.02

<b>CF<sub>0</sub></b>	\$0
<b>C01</b>	\$6,200
<b>F01</b>	1
<b>C02</b>	\$5,600
<b>F02</b>	1
<b>C03</b>	\$3,900
<b>F03</b>	1

I = 22%  
NPV CPT  
\$10,992.15

@10%:  $PI = \$13,194.59 / \$12,000 = 1.100$

@15%:  $PI = \$12,190.02 / \$12,000 = 1.016$

@22%:  $PI = \$10,992.15 / \$12,000 = 0.916$

16.

*Project I*

<b>CF<sub>0</sub></b>	\$0
<b>C01</b>	\$18,000
<b>F01</b>	3

I = 10%  
NPV CPT  
\$44,763.34

<b>CF<sub>0</sub></b>	-\$40,000
<b>C01</b>	\$18,000
<b>F01</b>	3

I = 10%  
NPV CPT  
\$4,763.34

$PI = \$44,763.34 / \$40,000 = 1.119$

*Project II*

<b>CF<sub>0</sub></b>	\$0
<b>C01</b>	\$6,100
<b>F01</b>	3

I = 10%  
NPV CPT  
\$15,169.80

<b>CF<sub>0</sub></b>	-\$12,000
<b>C01</b>	\$6,100
<b>F01</b>	3

I = 10%  
NPV CPT  
\$3,169.80

$PI = \$15,169.80 / \$12,000 = 1.264$

17.

CF(A)

*c.*

<b>Cf<sub>0</sub></b>	-\$350,000
<b>C01</b>	\$25,000
<b>F01</b>	1
<b>C02</b>	\$70,000
<b>F02</b>	2
<b>C03</b>	\$430,000
<b>F03</b>	1

I = 15%  
NPV CPT  
\$16,549.22

*d.*

<b>CF<sub>0</sub></b>	-\$350,000
<b>C01</b>	\$25,000
<b>F01</b>	1
<b>C02</b>	\$70,000
<b>F02</b>	2
<b>C03</b>	\$430,000
<b>F03</b>	1

IRR CPT  
16.57%

*e.*

<b>CF<sub>0</sub></b>	\$0
<b>C01</b>	\$25,000
<b>F01</b>	1
<b>C02</b>	\$70,000
<b>F02</b>	2
<b>C03</b>	\$430,000
<b>F03</b>	1

I = 15%  
NPV CPT  
\$366,549.22

$PI = \$366,549.22 / \$350,000 = 1.047$

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CF(B)

*c.*

<b>CF<sub>0</sub></b>	-\$35,000
<b>C01</b>	\$17,000
<b>F01</b>	1
<b>C02</b>	\$11,000
<b>F02</b>	1
<b>C03</b>	\$17,000
<b>F03</b>	1
<b>C04</b>	\$11,000
<b>F04</b>	1

I = 15%  
NPV CPT  
\$5,567.25

*d.*

<b>CF<sub>0</sub></b>	-\$35,000
<b>C01</b>	\$17,000
<b>F01</b>	1
<b>C02</b>	\$11,000
<b>F02</b>	1
<b>C03</b>	\$17,000
<b>F03</b>	1
<b>C04</b>	\$11,000
<b>F04</b>	1

IRR CPT  
23.05%

*e.*

<b>CF<sub>0</sub></b>	\$0
<b>C01</b>	\$17,000
<b>F01</b>	1
<b>C02</b>	\$11,000
<b>F02</b>	1
<b>C03</b>	\$17,000
<b>F03</b>	1
<b>C04</b>	\$11,000
<b>F04</b>	1

I = 15%  
NPV CPT  
\$40,567.25

$$PI = \$40,567.25 / \$35,000 = 1.159$$

- f.* In this instance, the NPV criteria implies that you should accept project A, while payback period, discounted payback, profitability index, and IRR imply that you should accept project B. The final decision should be based on the NPV since it does not have the ranking problem associated with the other capital budgeting techniques. Therefore, you should accept project A.

18.

<b>CF<sub>0</sub></b>	-\$724,860
<b>C01</b>	\$324,186
<b>F01</b>	1
<b>C02</b>	\$375,085
<b>F02</b>	1
<b>C03</b>	\$354,302
<b>F03</b>	1
<b>C04</b>	\$205,680
<b>F04</b>	1

I = 0%  
NPV CPT  
\$534,393

<b>CF<sub>0</sub></b>	-\$724,860
<b>C01</b>	\$324,186
<b>F01</b>	1
<b>C02</b>	\$375,085
<b>F02</b>	1
<b>C03</b>	\$354,302
<b>F03</b>	1
<b>C04</b>	\$205,680
<b>F04</b>	1

IRR CPT  
28.25%

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# CHAPTER 10

## MAKING CAPITAL INVESTMENT DECISIONS

### Answers to Concepts Review and Critical Thinking Questions

1. In this context, an opportunity cost refers to the value of an asset or other input that will be used in a project. The relevant cost is what the asset or input is actually worth today, not, for example, what it cost to acquire.
2. For tax purposes, a firm would choose MACRS because it provides for larger depreciation deductions earlier. These larger deductions reduce taxes, but have no other cash consequences. Notice that the choice between MACRS and straight-line is purely a time value issue; the total depreciation is the same, only the timing differs.
3. It's probably only a mild over-simplification. Current liabilities will all be paid, presumably. The cash portion of current assets will be retrieved. Some receivables won't be collected, and some inventory will not be sold, of course. Counterbalancing these losses is the fact that inventory sold above cost (and not replaced at the end of the project's life) acts to increase working capital. These effects tend to offset one another.
4. Management's discretion to set the firm's capital structure is applicable at the firm level. Since any one particular project could be financed entirely with equity, another project could be financed with debt, and the firm's overall capital structure remains unchanged, financing costs are not relevant in the analysis of a project's incremental cash flows according to the stand-alone principle.
5. The EAC approach is appropriate when comparing mutually exclusive projects with different lives that will be replaced when they wear out. This type of analysis is necessary so that the projects have a common life span over which they can be compared; in effect, each project is assumed to exist over an infinite horizon of N-year repeating projects. Assuming that this type of analysis is valid implies that the project cash flows remain the same forever, thus ignoring the possible effects of, among other things: (1) inflation, (2) changing economic conditions, (3) the increasing unreliability of cash flow estimates that occur far into the future, and (4) the possible effects of future technology improvement that could alter the project cash flows.
6. Depreciation is a non-cash expense, but it is tax-deductible on the income statement. Thus depreciation causes taxes paid, an actual cash outflow, to be reduced by an amount equal to the depreciation tax shield  $t_c D$ . A reduction in taxes that would otherwise be paid is the same thing as a cash inflow, so the effects of the depreciation tax shield must be added in to get the total incremental aftertax cash flows.
7. There are two particularly important considerations. The first is erosion. Will the essentialized book simply displace copies of the existing book that would have otherwise been sold? This is of special concern given the lower price. The second consideration is competition. Will other publishers step in and produce such a product? If so, then any erosion is much less relevant. A particular concern to

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book publishers (and producers of a variety of other product types) is that the publisher only makes money from the sale of new books. Thus, it is important to examine whether the new book would displace sales of used books (good from the publisher's perspective) or new books (not good). The concern arises any time there is an active market for used product.

8. Definitely. The damage to Porsche's reputation is definitely a factor the company needed to consider. If the reputation was damaged, the company would have lost sales of its existing car lines.
9. One company may be able to produce at lower incremental cost or market better. Also, of course, one of the two may have made a mistake!
10. Porsche would recognize that the outsized profits would dwindle as more product comes to market and competition becomes more intense.

### Solutions to Questions and Problems

*NOTE: All end of chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.*

#### Basic

1. The \$5 million acquisition cost of the land six years ago is a sunk cost. The \$5.3 million current aftertax value of the land is an opportunity cost if the land is used rather than sold off. The \$11.6 million cash outlay and \$425,000 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

$$\$5,300,000 + 11,600,000 + 425,000 = \$17,325,000$$

2. Sales due solely to the new product line are:

$$19,000(\$12,000) = \$228,000,000$$

Increased sales of the motor home line occur because of the new product line introduction; thus:

$$4,500(\$45,000) = \$202,500,000$$

in new sales is relevant. Erosion of luxury motor coach sales is also due to the new mid-size campers; thus:

$$900(\$85,000) = \$76,500,000 \text{ loss in sales}$$

is relevant. The net sales figure to use in evaluating the new line is thus:

$$\$228,000,000 + 202,500,000 - 76,500,000 = \$354,000,000$$

3. We need to construct a basic income statement. The income statement is:

Sales	\$ 740,000
Variable costs	444,000
Fixed costs	173,000
Depreciation	<u>75,000</u>
EBT	\$ 48,000
Taxes@35%	<u>16,800</u>
Net income	<u>\$ 31,200</u>

4. To find the OCF, we need to complete the income statement as follows:

Sales	\$ 876,400
Costs	547,300
Depreciation	<u>128,000</u>
EBT	\$ 201,100
Taxes@34%	<u>68,374</u>
Net income	<u>\$ 132,726</u>

The OCF for the company is:

$$\begin{aligned} \text{OCF} &= \text{EBIT} + \text{Depreciation} - \text{Taxes} \\ \text{OCF} &= \$201,100 + 128,000 - 68,374 \\ \text{OCF} &= \$260,726 \end{aligned}$$

The depreciation tax shield is the depreciation times the tax rate, so:

$$\begin{aligned} \text{Depreciation tax shield} &= t_c \text{Depreciation} \\ \text{Depreciation tax shield} &= .34(\$128,000) \\ \text{Depreciation tax shield} &= \$43,520 \end{aligned}$$

The depreciation tax shield shows us the increase in OCF by being able to expense depreciation.

5. To calculate the OCF, we first need to calculate net income. The income statement is:

Sales	\$ 96,000
Variable costs	49,000
Depreciation	<u>4,500</u>
EBT	\$ 42,500
Taxes@35%	<u>14,875</u>
Net income	<u>\$ 27,625</u>

Using the most common financial calculation for OCF, we get:

$$\begin{aligned} \text{OCF} &= \text{EBIT} + \text{Depreciation} - \text{Taxes} \\ \text{OCF} &= \$42,500 + 4,500 - 14,875 \\ \text{OCF} &= \$32,125 \end{aligned}$$

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The top-down approach to calculating OCF yields:

$$\begin{aligned} \text{OCF} &= \text{Sales} - \text{Costs} - \text{Taxes} \\ \text{OCF} &= \$96,000 - 49,000 - 14,875 \\ \text{OCF} &= \$32,125 \end{aligned}$$

The tax-shield approach is:

$$\begin{aligned} \text{OCF} &= (\text{Sales} - \text{Costs})(1 - t_c) + t_c \text{Depreciation} \\ \text{OCF} &= (\$96,000 - 49,000)(1 - .35) + .35(4,500) \\ \text{OCF} &= \$32,125 \end{aligned}$$

And the bottom-up approach is:

$$\begin{aligned} \text{OCF} &= \text{Net income} + \text{Depreciation} \\ \text{OCF} &= \$27,625 + 4,500 \\ \text{OCF} &= \$32,125 \end{aligned}$$

All four methods of calculating OCF should always give the same answer.

6. The MACRS depreciation schedule is shown in Table 10.7. The ending book value for any year is the beginning book value minus the depreciation for the year. Remember, to find the amount of depreciation for any year, you multiply the purchase price of the asset times the MACRS percentage for the year. The depreciation schedule for this asset is:

<u>Year</u>	<u>Beginning Book Value</u>	<u>MACRS</u>	<u>Depreciation</u>	<u>Ending Book value</u>
1	\$925,000.00	0.1429	\$132,182.50	\$792,817.50
2	792,817.50	0.2449	226,532.50	566,285.00
3	566,285.00	0.1749	161,782.50	404,502.50
4	404,502.50	0.1249	115,532.50	288,970.00
5	288,970.00	0.0893	82,602.50	206,367.50
6	206,367.50	0.0893	82,602.50	123,765.00
7	123,765.00	0.0893	82,602.50	41,162.50
8	41,162.50	0.0445	41,162.50	0

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:

$$\begin{aligned} \text{Annual depreciation} &= \$468,000 / 8 \\ \text{Annual depreciation} &= \$58,500 \end{aligned}$$

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

$$\begin{aligned} \text{Accumulated depreciation} &= 5(\$58,500) \\ \text{Accumulated depreciation} &= \$292,500 \end{aligned}$$

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

$$BV_5 = \$468,000 - 292,500$$

$$BV_5 = \$175,500$$

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

$$\text{Aftertax salvage value} = \$72,000 + (\$175,500 - 72,000)(0.35)$$

$$\text{Aftertax salvage value} = \$108,225$$

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

$$\text{Taxes on salvage value} = (BV - MV)t_c$$

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

8. To find the BV at the end of four years, we need to find the accumulated depreciation for the first four years. We could calculate a table as in Problem 6, but an easier way is to add the MACRS depreciation amounts for each of the first four years and multiply this percentage times the cost of the asset. We can then subtract this from the asset cost. Doing so, we get:

$$BV_4 = \$8,400,000 - 8,400,000(0.2000 + 0.3200 + 0.1920 + 0.1152)$$

$$BV_4 = \$1,451,520$$

The asset is sold at a gain to book value, so this gain is taxable.

$$\text{Aftertax salvage value} = \$1,750,000 + (\$1,451,520 - 1,750,000)(.35)$$

$$\text{Aftertax salvage value} = \$1,645,532$$

9. Using the tax shield approach to calculating OCF (Remember the approach is irrelevant; the final answer will be the same no matter which of the four methods you use.), we get:

$$\text{OCF} = (\text{Sales} - \text{Costs})(1 - t_c) + t_c \text{Depreciation}$$

$$\text{OCF} = (\$3,100,000 - 990,000)(1 - 0.35) + 0.35(\$4,200,000/3)$$

$$\text{OCF} = \$1,861,500$$

10. Since we have the OCF, we can find the NPV as the initial cash outlay, plus the PV of the OCFs, which are an annuity, so the NPV is:

$$\text{NPV} = -\$4,200,000 + \$1,861,500(\text{PVIFA}_{12\%,3})$$

$$\text{NPV} = \$271,008.91$$

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11. The cash outflow at the beginning of the project will increase because of the spending on NWC. At the end of the project, the company will recover the NWC, so it will be a cash inflow. The sale of the equipment will result in a cash inflow, but we also must account for the taxes which will be paid on this sale. So, the cash flows for each year of the project will be:

<u>Year</u>	<u>Cash Flow</u>	
0	-\$4,500,000	= -\$4,200,000 - 300,000
1	1,861,500	
2	1,861,500	
3	2,298,000	= \$1,861,500 + 300,000 + 210,000 + (0 - 210,000)(.35)

And the NPV of the project is:

$$\text{NPV} = -\$4,500,000 + \$1,861,500(\text{PVIFA}_{12\%,2}) + (\$2,298,000 / 1.12^3)$$

$$\text{NPV} = \$281,700.98$$

12. First we will calculate the annual depreciation for the equipment necessary for the project. The depreciation amount each year will be:

$$\text{Year 1 depreciation} = \$4,200,000(0.3333) = \$1,399,860$$

$$\text{Year 2 depreciation} = \$4,200,000(0.4444) = \$1,866,480$$

$$\text{Year 3 depreciation} = \$4,200,000(0.1482) = \$622,440$$

So, the book value of the equipment at the end of three years, which will be the initial investment minus the accumulated depreciation, is:

$$\text{Book value in 3 years} = \$4,200,000 - (\$1,399,860 + 1,866,480 + 622,440)$$

$$\text{Book value in 3 years} = \$311,220$$

The asset is sold at a loss to book value, so this loss is taxable deductible.

$$\text{Aftertax salvage value} = \$210,000 + (\$311,220 - 210,000)(0.35)$$

$$\text{Aftertax salvage value} = \$245,427$$

To calculate the OCF, we will use the tax shield approach, so the cash flow each year is:

$$\text{OCF} = (\text{Sales} - \text{Costs})(1 - t_c) + t_c \text{Depreciation}$$

<u>Year</u>	<u>Cash Flow</u>	
0	-\$4,500,000	= -\$4,200,000 - 300,000
1	1,861,451.00	= (\$2,110,000)(.65) + 0.35(\$1,399,860)
2	2,024,768.00	= (\$2,110,000)(.65) + 0.35(\$1,866,480)
3	2,134,781.00	= (\$2,110,000)(.65) + 0.35(\$622,440) + \$245,427 + 300,000

Remember to include the NWC cost in Year 0, and the recovery of the NWC at the end of the project. The NPV of the project with these assumptions is:

$$\text{NPV} = -\$4,500,000 + (\$1,861,451/1.12) + (\$2,024,768/1.12^2) + (\$2,134,781/1.12^3)$$

$$\text{NPV} = \$295,637.42$$

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

$$\begin{aligned}\text{Annual depreciation} &= \$440,000/5 \\ \text{Annual depreciation} &= \$88,000\end{aligned}$$

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:

$$\text{Aftertax salvage value} = MV + (BV - MV)t_c$$

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:

$$\begin{aligned}\text{Aftertax salvage value} &= MV + (0 - MV)t_c \\ \text{Aftertax salvage value} &= MV(1 - t_c)\end{aligned}$$

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:

$$\begin{aligned}\text{Aftertax salvage value} &= \$60,000(1 - 0.34) \\ \text{Aftertax salvage value} &= \$39,600\end{aligned}$$

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

$$\begin{aligned}\text{OCF} &= \$130,000(1 - 0.34) + 0.34(\$88,000) \\ \text{OCF} &= \$115,720\end{aligned}$$

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.

$$\begin{aligned}\text{NPV} &= -\$440,000 - 34,000 + \$115,720(\text{PVIFA}_{10\%,5}) + [(\$39,600 + 34,000) / 1.1^5] \\ \text{NPV} &= \$10,369.55\end{aligned}$$

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

$$\begin{aligned}\text{Annual depreciation charge} &= \$840,000/5 \\ \text{Annual depreciation charge} &= \$168,000\end{aligned}$$

The aftertax salvage value of the equipment is:

$$\begin{aligned}\text{Aftertax salvage value} &= \$75,000(1 - 0.35) \\ \text{Aftertax salvage value} &= \$48,750\end{aligned}$$

Using the tax shield approach, the OCF is:

$$\begin{aligned}\text{OCF} &= \$330,000(1 - 0.35) + 0.35(\$168,000) \\ \text{OCF} &= \$273,300\end{aligned}$$

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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:

$$NPV = 0 = -\$840,000 + 125,000 + \$273,300(PVIFA_{IRR\%,5}) + [(\$48,750 - 125,000) / (1+IRR)^5]$$

$$IRR = 24.65\%$$

15. To evaluate the project with a \$380,000 cost savings, we need the OCF to compute the NPV. Using the tax shield approach, the OCF is:

$$OCF = \$380,000(1 - 0.35) + 0.35(\$168,000) = \$305,800$$

$$NPV = -\$840,000 + 125,000 + \$305,800(PVIFA_{20\%,5}) + [(\$48,750 - 125,000) / (1.20)^5]$$
$$NPV = \$168,886.03$$

The NPV with a \$280,000 cost savings is:

$$OCF = \$280,000(1 - 0.35) + 0.35(\$168,000)$$
$$OCF = \$240,800$$

$$NPV = -\$840,000 + 125,000 + \$240,800(PVIFA_{20\%,5}) + [(\$48,750 - 125,000) / (1.20)^5]$$
$$NPV = -\$25,503.76$$

We would accept the project if cost savings were \$380,000, and reject the project if the cost savings were \$280,000. 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:

$$NPV = 0 = -\$840,000 + \$125,000 + OCF(PVIFA_{20\%,5}) + [(\$48,750 - 125,000) / (1.20)^5]$$

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

$$OCF = \$249,327.94$$

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

$$OCF = \$249,327.94 = (S - C)(1 - 0.35) + 0.35(\$168,000)$$
$$(S - C) = \$293,119.91$$

The cost savings that will make us indifferent is \$293,119.91.

- 16.** To calculate the EAC of the project, we first need the NPV of the project. Notice that we include the NWC expenditure at the beginning of the project, and recover the NWC at the end of the project. The NPV of the project is:

$$\text{NPV} = -\$240,000 - 20,000 - \$32,000(\text{PVIFA}_{11\%,5}) + \$20,000/1.11^5 = -\$366,399.68$$

Now we can find the EAC of the project. The EAC is:

$$\text{EAC} = -\$366,399.68 / (\text{PVIFA}_{11\%,5}) = -\$99,136.87$$

- 17.** We will need the aftertax salvage value of the equipment to compute the EAC. Even though the equipment for each product has a different initial cost, both have the same salvage value. The aftertax salvage value for both is:

$$\text{Both cases: aftertax salvage value} = \$20,000(1 - 0.35) = \$13,000$$

To calculate the EAC, we first need the OCF and NPV of each option. The OCF and NPV for Techron I is:

$$\text{OCF} = -\$41,000(1 - 0.35) + 0.35(\$330,000/3) = \$11,850$$

$$\text{NPV} = -\$330,000 + \$11,850(\text{PVIFA}_{14\%,3}) + (\$13,000/1.14^3) = -\$293,714.03$$

$$\text{EAC} = -\$293,714.03 / (\text{PVIFA}_{14\%,3}) = -\$126,511.88$$

And the OCF and NPV for Techron II is:

$$\text{OCF} = -\$33,000(1 - 0.35) + 0.35(\$480,000/5) = \$12,150$$

$$\text{NPV} = -\$480,000 + \$12,150(\text{PVIFA}_{14\%,5}) + (\$13,000/1.14^5) = -\$431,536.27$$

$$\text{EAC} = -\$431,536.27 / (\text{PVIFA}_{14\%,5}) = -\$125,699.42$$

The two milling machines have unequal lives, so they can only be compared by expressing both on an equivalent annual basis, which is what the EAC method does. Thus, you prefer the Techron II because it has the lower (less negative) annual cost.

- 18.** To find the bid price, we need to calculate all other cash flows for the project, and then solve for the bid price. The aftertax salvage value of the equipment is:

$$\text{Aftertax salvage value} = \$60,000(1 - 0.35) = \$39,000$$

Now we can solve for the necessary OCF that will give the project a zero NPV. The equation for the NPV of the project is:

$$\text{NPV} = 0 = -\$840,000 - 75,000 + \text{OCF}(\text{PVIFA}_{12\%,5}) + [(\$75,000 + 39,000) / 1.12^5]$$

## B-184 SOLUTIONS

Solving for the OCF, we find the OCF that makes the project NPV equal to zero is:

$$\text{OCF} = \$850,313.34 / \text{PVIFA}_{12\%,5} = \$235,885.20$$

The easiest way to calculate the bid price is the tax shield approach, so:

$$\begin{aligned}\text{OCF} &= \$235,885.20 = [(P - v)Q - FC](1 - t_c) + t_c D \\ \$235,885.20 &= [(P - \$8.50)(160,000) - \$290,000](1 - 0.35) + 0.35(\$840,000/5) \\ P &= \$12.02\end{aligned}$$

### Intermediate

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

$$\begin{aligned}D_1 &= \$530,000(0.2000) = \$106,000 \\ D_2 &= \$530,000(0.3200) = \$169,600 \\ D_3 &= \$530,000(0.1920) = \$101,760 \\ D_4 &= \$530,000(0.1152) = \$61,056\end{aligned}$$

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

$$\text{BV}_4 = \$530,000 - (\$106,000 + 169,600 + 101,760 + 61,056) = \$91,584$$

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

$$\text{After-tax salvage value} = \$90,000 + (\$91,584 - 90,000)(0.35) = \$90,554.40$$

So, the OCF for each year will be:

$$\begin{aligned}\text{OCF}_1 &= \$205,000(1 - 0.35) + 0.35(\$106,000) = \$170,350.00 \\ \text{OCF}_2 &= \$205,000(1 - 0.35) + 0.35(\$169,600) = \$192,610.00 \\ \text{OCF}_3 &= \$205,000(1 - 0.35) + 0.35(\$101,760) = \$168,866.00 \\ \text{OCF}_4 &= \$205,000(1 - 0.35) + 0.35(\$61,056) = \$154,619.60\end{aligned}$$

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:

$$\begin{aligned}\text{NPV} &= -\$530,000 - 20,000 + (\$170,350 - 3,000)/1.09 + (\$192,610 - 3,000)/1.09^2 \\ &\quad + (\$168,866 - 3,000)/1.09^3 + (\$154,619.60 + 29,000 + 90,554.40)/1.09^4 \\ \text{NPV} &= \$85,433.81\end{aligned}$$

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:

$$\begin{aligned} \text{OCF}_A &= -\$105,000(1 - 0.34) + 0.34(\$380,000/4) \\ \text{OCF}_A &= -\$37,000 \end{aligned}$$

$$\begin{aligned} \text{NPV}_A &= -\$380,000 - \$37,000(\text{PVIFA}_{13\%,4}) \\ \text{NPV}_A &= -\$490,055.44 \end{aligned}$$

And the NPV of System B is:

$$\begin{aligned} \text{OCF}_B &= -\$90,000(1 - 0.34) + 0.34(\$490,000/6) \\ \text{OCF}_B &= -\$31,633 \end{aligned}$$

$$\begin{aligned} \text{NPV}_B &= -\$490,000 - \$31,633(\text{PVIFA}_{13\%,6}) \\ \text{NPV}_B &= -\$616,455.82 \end{aligned}$$

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

21. If the equipment will be replaced at the end of its useful life, the correct capital budgeting technique is EAC. Using the NPVs we calculated in the previous problem, the EAC for each system is:

$$\begin{aligned} \text{EAC}_A &= -\$490,055.44 / (\text{PVIFA}_{13\%,4}) \\ \text{EAC}_A &= -\$164,753.80 \end{aligned}$$

$$\begin{aligned} \text{EAC}_B &= -\$616,455.82 / (\text{PVIFA}_{13\%,6}) \\ \text{EAC}_B &= -\$154,208.42 \end{aligned}$$

If the conveyor belt system will be continually replaced, we should choose System B since it has the more positive EAC.

22. To find the bid price, we need to calculate all other cash flows for the project, and then solve for the bid price. The aftertax salvage value of the equipment is:

$$\begin{aligned} \text{After-tax salvage value} &= \$650,000(1 - 0.34) \\ \text{After-tax salvage value} &= \$429,000 \end{aligned}$$

Now we can solve for the necessary OCF that will give the project a zero NPV. The current aftertax value of the land is an opportunity cost, but we also need to include the aftertax value of the land in five years since we can sell the land at that time. The equation for the NPV of the project is:

$$\begin{aligned} \text{NPV} = 0 &= -\$3,800,000 - 1,200,000 - 500,000 + \text{OCF}(\text{PVIFA}_{12\%,5}) - \$50,000(\text{PVIFA}_{12\%,4}) \\ &\quad + \{(\$429,000 + 500,000 + 4(50,000) + 1,500,000) / 1.12^5\} \end{aligned}$$

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Solving for the OCF, we find the OCF that makes the project NPV equal to zero is:

$$\begin{aligned} \text{OCF} &= \$4,160,102.26 / \text{PVIFA}_{12\%,5} \\ \text{OCF} &= \$1,154,052.85 \end{aligned}$$

The easiest way to calculate the bid price is the tax shield approach, so:

$$\begin{aligned} \text{OCF} &= \$1,154,052.85 = [(P - v)Q - FC](1 - t_c) + t_c D \\ \$1,154,052.85 &= [(P - \$0.005)(100,000,000) - \$900,000](1 - 0.34) + 0.34(\$3,800,000/5) \\ P &= \$0.02757 \end{aligned}$$

23. At a given price, taking accelerated depreciation compared to straight-line depreciation causes the NPV to be higher; similarly, at a given price, lower net working capital investment requirements will cause the NPV to be higher. Thus, NPV would be zero at a lower price in this situation. In the case of a bid price, you could submit a lower price and still break-even, or submit the higher price and make a positive NPV.
24. Since we need to calculate the EAC for each machine, sales are irrelevant. EAC only uses the costs of operating the equipment, not the sales. Using the bottom up approach, or net income plus depreciation, method to calculate OCF, we get:

	Machine A	Machine B
Variable costs	-\$3,150,000	-\$2,700,000
Fixed costs	-160,000	-110,000
Depreciation	<u>-433,333</u>	<u>-544,444</u>
EBT	-\$3,743,333	-\$3,354,444
Tax	<u>1,310,167</u>	<u>1,174,056</u>
Net income	-\$2,433,167	-\$2,180,389
+ Depreciation	<u>433,333</u>	<u>544,444</u>
OCF	-\$1,999,833	-\$1,635,944

The NPV and EAC for Machine A is:

$$\begin{aligned} \text{NPV}_A &= -\$2,600,000 - \$1,999,833(\text{PVIFA}_{10\%,6}) \\ \text{NPV}_A &= -\$11,309,795.52 \end{aligned}$$

$$\begin{aligned} \text{EAC}_A &= -\$11,309,795.52 / (\text{PVIFA}_{10\%,6}) \\ \text{EAC}_A &= -\$2,596,812.52 \end{aligned}$$

And the NPV and EAC for Machine B is:

$$\begin{aligned} \text{NPV}_B &= -\$4,900,000 - 1,635,944(\text{PVIFA}_{10\%,9}) \\ \text{NPV}_B &= -\$14,321,443.02 \end{aligned}$$

$$\begin{aligned} \text{EAC}_B &= -\$14,321,443.02 / (\text{PVIFA}_{10\%,9}) \\ \text{EAC}_B &= -\$2,486,783.09 \end{aligned}$$

You should choose Machine B since it has a more positive EAC.

Challenge

25. We will begin by calculating the aftertax salvage value of the equipment at the end of the project's life. The aftertax salvage value is the market value of the equipment minus any taxes paid (or refunded), so the aftertax salvage value in four years will be:

$$\begin{aligned} \text{Taxes on salvage value} &= (BV - MV)t_C \\ \text{Taxes on salvage value} &= (\$0 - 400,000)(.38) \\ \text{Taxes on salvage value} &= -\$152,000 \end{aligned}$$

Market price	\$400,000
Tax on sale	<u>-152,000</u>
Aftertax salvage value	\$248,000

Now we need to calculate the operating cash flow each year. Using the bottom up approach to calculating operating cash flow, we find:

	<u>Year 0</u>	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>	<u>Year 4</u>
Revenues		\$2,030,000	\$2,660,000	\$1,890,000	\$1,330,000
Fixed costs		350,000	350,000	350,000	350,000
Variable costs		304,500	399,000	283,500	199,500
Depreciation		<u>1,266,540</u>	<u>1,688,720</u>	<u>563,160</u>	<u>281,580</u>
EBT		\$ 108,960	\$ 222,280	\$693,340	\$ 498,920
Taxes		<u>41,405</u>	<u>84,466</u>	<u>263,469</u>	<u>189,590</u>
Net income		\$ 67,555	\$ 137,814	\$ 429,871	\$ 309,330
OCF		<u>\$1,334,095</u>	<u>\$1,826,534</u>	<u>\$ 993,031</u>	<u>\$ 590,910</u>
Capital spending	-\$3,800,000				\$248,000
Land	-800,000				1,000,000
NWC	<u>-\$120,000</u>				<u>120,000</u>
Total cash flow	-\$4,720,000	\$1,334,095	\$1,826,534	\$993,031	\$1,958,910

Notice the calculation of the cash flow at time 0. The capital spending on equipment and investment in net working capital are cash outflows. The aftertax selling price of the land is also a cash outflow. Even though no cash is actually spent on the land because the company already owns it, the aftertax cash flow from selling the land is an opportunity cost, so we need to include it in the analysis. The company can sell the land at the end of the project, so we need to include that value as well. With all the project cash flows, we can calculate the NPV, which is:

$$\begin{aligned} \text{NPV} &= -\$4,720,000 + \$1,334,095 / 1.13 + \$1,826,534 / 1.13^2 + \$993,031 / 1.13^3 \\ &\quad + \$1,958,910 / 1.13^4 \\ \text{NPV} &= -\$219,284.46 \end{aligned}$$

The company should reject the new product line.

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26. 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 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 \$29,920,000. So, the cash flow required for the project today will be:

Capital spending	-\$22,000,000
Change in NWC	<u>-1,500,000</u>
Total cash flow	-\$23,500,000

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 \$850,000 per year. To calculate depreciation each year, we use the initial equipment cost of \$22 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:

<u>Year</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Ending book value	\$18,856,200	\$13,468,400	\$9,620,600	\$6,872,800	\$4,908,200
Sales	\$29,920,000	\$32,640,000	\$37,060,000	\$40,120,000	\$32,300,000
Variable costs	21,120,000	23,040,000	26,160,000	28,320,000	22,800,000
Fixed costs	850,000	850,000	850,000	850,000	850,000
Depreciation	3,143,800	5,387,800	3,847,800	2,747,800	1,964,600
EBIT	4,806,200	3,362,200	6,202,200	8,202,200	6,685,400
Taxes	1,682,170	1,176,770	2,170,770	2,870,770	2,339,890
Net income	3,124,030	2,185,430	4,031,430	5,331,430	4,345,510
Depreciation	3,143,800	5,387,800	3,847,800	2,747,800	1,964,600
Operating cash flow	<u>\$6,267,830</u>	<u>\$7,573,230</u>	<u>\$7,879,230</u>	<u>\$8,079,230</u>	<u>\$6,310,110</u>
<i>Net cash flows</i>					
Operating cash flow	\$6,267,830	\$7,573,230	\$7,879,230	\$8,079,230	\$6,310,110
Change in NWC	-408,000	-663,000	-459,000	1,173,000	1,857,000
Capital spending	0	0	0	0	4,577,870
Total cash flow	<u>\$5,859,830</u>	<u>\$6,910,230</u>	<u>\$7,420,230</u>	<u>\$9,252,230</u>	<u>\$12,744,980</u>

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 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:

$$\begin{aligned}\text{Increase in NWC for Year 1} &= .15(\$32,640,000 - 29,920,000) \\ \text{Increase in NWC for Year 1} &= \$408,000\end{aligned}$$

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:

$$\begin{aligned}\text{Ending book value} &= \$22,000,000 - (\$3,143,800 + 5,387,800 + 3,847,800 + 2,747,800 + 1,964,600) \\ \text{Ending book value} &= \$4,908,200\end{aligned}$$

The market value of the used equipment is 20 percent of the purchase price, or \$4.4 million, so the aftertax salvage value will be:

$$\begin{aligned}\text{Aftertax salvage value} &= \$4,400,000 + (\$4,908,200 - 4,400,000)(.35) \\ \text{Aftertax salvage value} &= \$4,577,870\end{aligned}$$

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:

$$\begin{aligned}\text{NPV} &= -\$23,500,000 + \$5,859,830/1.18 + \$6,910,230/1.18^2 + \$7,420,230/1.18^3 + \$9,252,230/1.18^4 \\ &\quad + \$12,744,980/1.18^5 \\ \text{NPV} &= \$1,288,103.80\end{aligned}$$

And the IRR is:

$$\begin{aligned}\text{NPV} = 0 &= -\$23,500,000 + \$5,859,830/(1 + \text{IRR}) + \$6,910,230/(1 + \text{IRR})^2 + \$7,420,230/(1 + \text{IRR})^3 \\ &\quad + \$9,252,230/(1 + \text{IRR})^4 + \$12,744,980/(1 + \text{IRR})^5 \\ \text{IRR} &= 20.10\%\end{aligned}$$

We should accept the project.

27. To find the initial pretax cost savings necessary to buy the new machine, we should use the tax shield approach to find the OCF. We begin by calculating the depreciation each year using the MACRS depreciation schedule. The depreciation each year is:

$$\begin{aligned}D_1 &= \$540,000(0.3333) = \$179,982 \\ D_2 &= \$540,000(0.4444) = \$239,976 \\ D_3 &= \$540,000(0.1482) = \$80,028 \\ D_4 &= \$540,000(0.0741) = \$40,014\end{aligned}$$

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Using the tax shield approach, the OCF each year is:

$$OCF_1 = (S - C)(1 - 0.35) + 0.35(\$179,982)$$

$$OCF_2 = (S - C)(1 - 0.35) + 0.35(\$239,976)$$

$$OCF_3 = (S - C)(1 - 0.35) + 0.35(\$80,028)$$

$$OCF_4 = (S - C)(1 - 0.35) + 0.35(\$40,014)$$

$$OCF_5 = (S - C)(1 - 0.35)$$

Now we need the aftertax salvage value of the equipment. The aftertax salvage value is:

$$\text{After-tax salvage value} = \$60,000(1 - 0.35) = \$39,000$$

To find the necessary cost reduction, we must realize that we can split the cash flows each year. The OCF in any given year is the cost reduction  $(S - C)$  times one minus the tax rate, which is an annuity for the project life, and the depreciation tax shield. To calculate the necessary cost reduction, we would require a zero NPV. The equation for the NPV of the project is:

$$\text{NPV} = 0 = -\$540,000 - 40,000 + (S - C)(0.65)(\text{PVIFA}_{12\%,5}) + 0.35(\$179,982/1.12 + \$239,976/1.12^2 + \$80,028/1.12^3 + \$40,014/1.12^4) + (\$40,000 + 39,000)/1.12^5$$

Solving this equation for the sales minus costs, we get:

$$(S - C)(0.65)(\text{PVIFA}_{12\%,5}) = \$383,134.12$$

$$(S - C) = \$163,515.59$$

28. a. This problem is basically the same as Problem 18, except we are given a sales price. The cash flow at Time 0 for all three parts of this question will be:

Capital spending	-\$840,000
Change in NWC	<u>-75,000</u>
Total cash flow	-\$915,000

We will use the initial cash flow and the salvage value we already found in that problem. Using the bottom up approach to calculating the OCF, we get:

Assume price per unit = \$13 and units/year = 160,000

Year	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Sales	\$2,080,000	\$2,080,000	\$2,080,000	\$2,080,000	\$2,080,000
Variable costs	1,360,000	1,360,000	1,360,000	1,360,000	1,360,000
Fixed costs	290,000	290,000	290,000	290,000	290,000
Depreciation	168,000	168,000	168,000	168,000	168,000
EBIT	<u>262,000</u>	<u>262,000</u>	<u>262,000</u>	<u>262,000</u>	<u>262,000</u>
Taxes (35%)	91,700	91,700	91,700	91,700	91,700
Net Income	<u>170,300</u>	<u>170,300</u>	<u>170,300</u>	<u>170,300</u>	<u>170,300</u>
Depreciation	168,000	168,000	168,000	168,000	168,000
Operating CF	<u>\$338,300</u>	<u>\$338,300</u>	<u>\$338,300</u>	<u>\$338,300</u>	<u>\$338,300</u>

<u>Year</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Operating CF	\$338,300	\$338,300	\$338,300	\$338,300	\$338,300
Change in NWC	0	0	0	0	75,000
Capital spending	0	0	0	0	39,000
Total CF	\$338,300	\$338,300	\$338,300	\$338,300	\$452,300

With these cash flows, the NPV of the project is:

$$\text{NPV} = -\$840,000 - 75,000 + \$338,300(\text{PVIFA}_{12\%,5}) + [(\$75,000 + 39,000) / 1.12^5]$$

$$\text{NPV} = \$369,182.45$$

If the actual price is above the bid price that results in a zero NPV, the project will have a positive NPV. As for the cartons sold, if the number of cartons sold increases, the NPV will increase, and if the costs increase, the NPV will decrease.

b. To find the minimum number of cartons sold to still breakeven, we need to use the tax shield approach to calculating OCF, and solve the problem similar to finding a bid price. Using the initial cash flow and salvage value we already calculated, the equation for a zero NPV of the project is:

$$\text{NPV} = 0 = -\$840,000 - 75,000 + \text{OCF}(\text{PVIFA}_{12\%,5}) + [(\$75,000 + 39,000) / 1.12^5]$$

So, the necessary OCF for a zero NPV is:

$$\text{OCF} = \$850,313.34 / \text{PVIFA}_{12\%,5} = \$235,885.20$$

Now we can use the tax shield approach to solve for the minimum quantity as follows:

$$\text{OCF} = \$235,885.20 = [(P - v)Q - \text{FC}](1 - t_c) + t_c D$$

$$\$235,885.20 = [(\$13.00 - 8.50)Q - 290,000](1 - 0.35) + 0.35(\$840,000/5)$$

$$Q = 124,986$$

As a check, we can calculate the NPV of the project with this quantity. The calculations are:

<u>Year</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Sales	\$1,624,823	\$1,624,823	\$1,624,823	\$1,624,823	\$1,624,823
Variable costs	1,062,384	1,062,384	1,062,384	1,062,384	1,062,384
Fixed costs	290,000	290,000	290,000	290,000	290,000
Depreciation	168,000	168,000	168,000	168,000	168,000
EBIT	104,439	104,439	104,439	104,439	104,439
Taxes (35%)	36,554	36,554	36,554	36,554	36,554
Net Income	67,885	67,885	67,885	67,885	67,885
Depreciation	168,000	168,000	168,000	168,000	168,000
Operating CF	\$235,885	\$235,885	\$235,885	\$235,885	\$235,885

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<u>Year</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Operating CF	\$235,885	\$235,885	\$235,885	\$235,885	\$235,885
Change in NWC	0	0	0	0	75,000
Capital spending	0	0	0	0	39,000
Total CF	\$235,885	\$235,885	\$235,885	\$235,885	\$349,885

$$NPV = -\$840,000 - 75,000 + \$235,885(PVIFA_{12\%,5}) + [(\$75,000 + 39,000) / 1.12^5] \approx \$0$$

Note, the NPV is not exactly equal to zero because we had to round the number of cartons sold; you cannot sell one-half of a carton.

c. To find the highest level of fixed costs and still breakeven, we need to use the tax shield approach to calculating OCF, and solve the problem similar to finding a bid price. Using the initial cash flow and salvage value we already calculated, the equation for a zero NPV of the project is:

$$NPV = 0 = -\$840,000 - 75,000 + OCF(PVIFA_{12\%,5}) + [(\$75,000 + 39,000) / 1.12^5]$$

$$OCF = \$850,313.34 / PVIFA_{12\%,5} = \$235,885.20$$

Notice this is the same OCF we calculated in part *b*. Now we can use the tax shield approach to solve for the maximum level of fixed costs as follows:

$$OCF = \$235,885.20 = [(P-v)Q - FC](1 - t_c) + t_c D$$

$$\$235,885.20 = [(\$13.00 - 8.50)(160,000) - FC](1 - 0.35) + 0.35(\$840,000/5)$$

$$FC = \$447,561.24$$

As a check, we can calculate the NPV of the project with this quantity. The calculations are:

<u>Year</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Sales	\$2,080,000	\$2,080,000	\$2,080,000	\$2,080,000	\$2,080,000
Variable costs	1,360,000	1,360,000	1,360,000	1,360,000	1,360,000
Fixed costs	447,561	447,561	447,561	447,561	447,561
Depreciation	168,000	168,000	168,000	168,000	168,000
EBIT	104,439	104,439	104,439	104,439	104,439
Taxes (35%)	36,554	36,554	36,554	36,554	36,554
Net Income	67,885	67,885	67,885	67,885	67,885
Depreciation	168,000	168,000	168,000	168,000	168,000
Operating CF	\$235,885	\$235,885	\$235,885	\$235,885	\$235,885

<u>Year</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Operating CF	\$235,885	\$235,885	\$235,885	\$235,885	\$235,885
Change in NWC	0	0	0	0	75,000
Capital spending	0	0	0	0	39,000
Total CF	\$235,885	\$235,885	\$235,885	\$235,885	\$349,885

$$\text{NPV} = -\$840,000 - 75,000 + \$235,885(\text{PVIFA}_{12\%,5}) + [(\$75,000 + 39,000) / 1.12^5] \approx \$0$$

29. We need to find the bid price for a project, but the project has extra cash flows. Since we don't already produce the keyboard, the sales of the keyboard outside the contract are relevant cash flows. Since we know the extra sales number and price, we can calculate the cash flows generated by these sales. The cash flow generated from the sale of the keyboard outside the contract is:

	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Sales	\$840,000	\$1,680,000	\$2,240,000	\$1,400,000
Variable costs	525,000	1,050,000	1,400,000	875,000
EBT	\$315,000	\$630,000	\$840,000	\$525,000
Tax	126,000	252,000	336,000	210,000
Net income (and OCF)	\$189,000	\$378,000	\$504,000	\$315,000

So, the addition to NPV of these market sales is:

$$\begin{aligned} \text{NPV of market sales} &= \$189,000/1.13 + \$378,000/1.13^2 + \$504,000/1.13^3 + \$315,000/1.13^4 \\ \text{NPV of market sales} &= \$1,005,778.76 \end{aligned}$$

You may have noticed that we did not include the initial cash outlay, depreciation or fixed costs in the calculation of cash flows from the market sales. The reason is that it is irrelevant whether or not we include these here. Remember, we are not only trying to determine the bid price, but we are also determining whether or not the project is feasible. In other words, we are trying to calculate the NPV of the project, not just the NPV of the bid price. We will include these cash flows in the bid price calculation. The reason we stated earlier that whether we included these costs in this initial calculation was irrelevant is that you will come up with the same bid price if you include these costs in this calculation, or if you include them in the bid price calculation.

Next, we need to calculate the aftertax salvage value, which is:

$$\text{Aftertax salvage value} = \$250,000(1 - .40) = \$150,000$$

Instead of solving for a zero NPV as is usual in setting a bid price, the company president requires an NPV of \$100,000, so we will solve for a NPV of that amount. The NPV equation for this project is (remember to include the NWC cash flow at the beginning of the project, and the NWC recovery at the end):

$$\text{NPV} = \$100,000 = -\$2,900,000 - 75,000 + 1,005,778.76 + \text{OCF} (\text{PVIFA}_{13\%,4}) + [(\$150,000 + 75,000) / 1.13^4]$$

## B-194 SOLUTIONS

Solving for the OCF, we get:

$$\text{OCF} = \$1,931,224.52 / \text{PVIFA}_{13\%,4} = \$649,266.48$$

Now we can solve for the bid price as follows:

$$\begin{aligned}\text{OCF} &= \$649,266.48 = [(P - v)Q - FC](1 - t_c) + t_c D \\ \$649,266.48 &= [(P - \$175)(15,000) - \$550,000](1 - 0.40) + 0.40(\$2,900,000/4) \\ P &= \$251.59\end{aligned}$$

- 30.** Since the two computers have unequal lives, the correct method to analyze the decision is the EAC. We will begin with the EAC of the new computer. Using the depreciation tax shield approach, the OCF for the new computer system is:

$$\text{OCF} = (\$130,000)(1 - .38) + (\$730,000 / 5)(.38) = \$136,080$$

Notice that the costs are positive, which represents a cash inflow. The costs are positive in this case since the new computer will generate a cost savings. The only initial cash flow for the new computer is cost of \$730,000. We next need to calculate the aftertax salvage value, which is:

$$\text{Aftertax salvage value} = \$135,000(1 - .38) = \$83,700$$

Now we can calculate the NPV of the new computer as:

$$\begin{aligned}\text{NPV} &= -\$730,000 + \$136,080(\text{PVIFA}_{14\%,5}) + \$83,700 / 1.14^5 \\ \text{NPV} &= -\$219,355.18\end{aligned}$$

And the EAC of the new computer is:

$$\text{EAC} = -\$219,355.18 / (\text{PVIFA}_{14\%,5}) = -\$63,894.56$$

Analyzing the old computer, the only OCF is the depreciation tax shield, so:

$$\text{OCF} = \$120,000(.38) = \$45,600$$

The initial cost of the old computer is a little trickier. You might assume that since we already own the old computer there is no initial cost, but we can sell the old computer, so there is an opportunity cost. We need to account for this opportunity cost. To do so, we will calculate the aftertax salvage value of the old computer today. We need the book value of the old computer to do so. The book value is not given directly, but we are told that the old computer has depreciation of \$120,000 per year for the next three years, so we can assume the book value is the total amount of depreciation over the remaining life of the system, or \$360,000. So, the aftertax salvage value of the old computer is:

$$\text{Aftertax salvage value} = \$190,000 + (\$360,000 - 190,000)(.38) = \$254,600$$

This is the initial cost of the old computer system today because we are forgoing the opportunity to sell it today. We next need to calculate the aftertax salvage value of the computer system in two years since we are “buying” it today. The aftertax salvage value in two years is:

$$\text{Aftertax salvage value} = \$80,000 + (\$120,000 - 80,000)(.38) = \$95,200$$

Now we can calculate the NPV of the old computer as:

$$\begin{aligned} \text{NPV} &= -\$254,600 + \$45,600(\text{PVIFA}_{14\%,2}) + 95,200 / 1.14^2 \\ \text{NPV} &= -\$106,258.97 \end{aligned}$$

And the EAC of the old computer is:

$$\text{EAC} = -\$106,258.97 / (\text{PVIFA}_{14\%,2}) = -\$64,529.98$$

Even if we are going to replace the system in two years no matter what our decision today, we should not replace it today since the EAC is lower.

*b.* If we are only concerned with whether or not to replace the machine now, and are not worrying about what will happen in two years, the correct analysis is NPV. To calculate the NPV of the decision on the computer system now, we need the difference in the total cash flows of the old computer system and the new computer system. From our previous calculations, we can say the cash flows for each computer system are:

<i>t</i>	<u>New computer</u>	<u>Old computer</u>	<u>Difference</u>
0	-\$730,000	-\$254,600	-\$475,400
1	136,080	45,600	90,480
2	136,080	140,800	-4,720
3	136,080	0	136,080
4	136,080	0	136,080
5	219,780	0	219,780

Since we are only concerned with marginal cash flows, the cash flows of the decision to replace the old computer system with the new computer system are the differential cash flows. The NPV of the decision to replace, ignoring what will happen in two years is:

$$\begin{aligned} \text{NPV} &= -\$475,400 + \$90,480/1.14 - \$4,720/1.14^2 + \$136,080/1.14^3 + \$136,080/1.14^4 \\ &\quad + \$219,780/1.14^5 \\ \text{NPV} &= -\$113,096.21 \end{aligned}$$

If we are not concerned with what will happen in two years, we should not replace the old computer system.

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# **CHAPTER 11**

## **PROJECT ANALYSIS AND EVALUATION**

### **Answers to Concepts Review and Critical Thinking Questions**

1. Forecasting risk is the risk that a poor decision is made because of errors in projected cash flows. The danger is greatest with a new product because the cash flows are probably harder to predict.
2. With a sensitivity analysis, one variable is examined over a broad range of values. With a scenario analysis, all variables are examined for a limited range of values.
3. It is true that if average revenue is less than average cost, the firm is losing money. This much of the statement is therefore correct. At the margin, however, accepting a project with marginal revenue in excess of its marginal cost clearly acts to increase operating cash flow.
4. It makes wages and salaries a fixed cost, driving up operating leverage.
5. Fixed costs are relatively high because airlines are relatively capital intensive (and airplanes are expensive). Skilled employees such as pilots and mechanics mean relatively high wages which, because of union agreements, are relatively fixed. Maintenance expenses are significant and relatively fixed as well.
6. From the shareholder perspective, the financial break-even point is the most important. A project can exceed the accounting and cash break-even points but still be below the financial break-even point. This causes a reduction in shareholder (your) wealth.
7. The project will reach the cash break-even first, the accounting break-even next and finally the financial break-even. For a project with an initial investment and sales after, this ordering will always apply. The cash break-even is achieved first since it excludes depreciation. The accounting break-even is next since it includes depreciation. Finally, the financial break-even, which includes the time value of money, is achieved.
8. Soft capital rationing implies that the firm as a whole isn't short of capital, but the division or project does not have the necessary capital. The implication is that the firm is passing up positive NPV projects. With hard capital rationing the firm is unable to raise capital for a project under any circumstances. Probably the most common reason for hard capital rationing is financial distress, meaning bankruptcy is a possibility.
9. The implication is that they will face hard capital rationing.

**Solutions to Questions and Problems**

*NOTE: All end of chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.*

Basic

1. a. The total variable cost per unit is the sum of the two variable costs, so:

$$\text{Total variable costs per unit} = \$4.68 + 2.27$$

$$\text{Total variable costs per unit} = \$6.95$$

- b. The total costs include all variable costs and fixed costs. We need to make sure we are including all variable costs for the number of units produced, so:

$$\text{Total costs} = \text{Variable costs} + \text{Fixed costs}$$

$$\text{Total costs} = \$6.95(320,000) + \$650,000$$

$$\text{Total costs} = \$2,874,000$$

- c. The cash breakeven, that is the point where cash flow is zero, is:

$$Q_C = \$650,000 / (\$11.99 - 6.95)$$

$$Q_C = 128,968 \text{ units}$$

And the accounting breakeven is:

$$Q_A = (\$650,000 + 190,000) / (\$11.99 - 6.95)$$

$$Q_A = 166,667 \text{ units}$$

2. The total costs include all variable costs and fixed costs. We need to make sure we are including all variable costs for the number of units produced, so:

$$\text{Total costs} = (\$17.82 + 12.05)(150,000) + \$950,000$$

$$\text{Total costs} = \$5,430,500$$

The marginal cost, or cost of producing one more unit, is the total variable cost per unit, so:

$$\text{Marginal cost} = \$17.82 + 12.05$$

$$\text{Marginal cost} = \$29.87$$

## B-198 SOLUTIONS

The average cost per unit is the total cost of production, divided by the quantity produced, so:

$$\text{Average cost} = \text{Total cost} / \text{Total quantity}$$

$$\text{Average cost} = \$5,430,500/150,000$$

$$\text{Average cost} = \$36.20$$

$$\text{Minimum acceptable total revenue} = 10,000(\$29.87)$$

$$\text{Minimum acceptable total revenue} = \$298,700$$

Additional units should be produced only if the cost of producing those units can be recovered.

3. The base-case, best-case, and worst-case values are shown below. Remember that in the best-case, sales and price increase, while costs decrease. In the worst-case, sales and price decrease, and costs increase.

<u>Scenario</u>	<u>Unit Sales</u>	<u>Unit Price</u>	<u>Unit</u>	
			<u>Variable Cost</u>	<u>Fixed Costs</u>
Base	110,000	\$1,600.00	\$180.00	\$5,500,000
Best	126,500	\$1,840.00	\$153.00	\$4,675,000
Worst	93,500	\$1,360.00	\$207.00	\$6,325,000

4. An estimate for the impact of changes in price on the profitability of the project can be found from the sensitivity of NPV with respect to price:  $\Delta\text{NPV}/\Delta\text{P}$ . This measure can be calculated by finding the NPV at any two different price levels and forming the ratio of the changes in these parameters. Whenever a sensitivity analysis is performed, all other variables are held constant at their base-case values.
5. a. To calculate the accounting breakeven, we first need to find the depreciation for each year. The depreciation is:

$$\text{Depreciation} = \$936,000/8$$

$$\text{Depreciation} = \$117,000 \text{ per year}$$

And the accounting breakeven is:

$$Q_A = (\$850,000 + 117,000)/(\$41 - 26)$$

$$Q_A = 64,467 \text{ units}$$

To calculate the accounting breakeven, we must realize at this point (and only this point), the OCF is equal to depreciation. So, the DOL at the accounting breakeven is:

$$\text{DOL} = 1 + \text{FC}/\text{OCF} = 1 + \text{FC}/\text{D}$$

$$\text{DOL} = 1 + [\$850,000/\$117,000]$$

$$\text{DOL} = 8.265$$

- b. We will use the tax shield approach to calculate the OCF. The OCF is:

$$\text{OCF}_{\text{base}} = [(P - v)Q - \text{FC}](1 - t_c) + t_c D$$

$$\text{OCF}_{\text{base}} = [(\$41 - 26)(100,000) - \$850,000](0.65) + 0.35(\$117,000)$$

$$\text{OCF}_{\text{base}} = \$463,450$$

Now we can calculate the NPV using our base-case projections. There is no salvage value or NWC, so the NPV is:

$$\begin{aligned} \text{NPV}_{\text{base}} &= -\$936,000 + \$463,450(\text{PVIFA}_{15\%,8}) \\ \text{NPV}_{\text{base}} &= \$1,143,649.15 \end{aligned}$$

To calculate the sensitivity of the NPV to changes in the quantity sold, we will calculate the NPV at a different quantity. We will use sales of 105,000 units. The NPV at this sales level is:

$$\begin{aligned} \text{OCF}_{\text{new}} &= [(\$41 - 26)(105,000) - \$850,000](0.65) + 0.35(\$117,000) \\ \text{OCF}_{\text{new}} &= \$512,200 \end{aligned}$$

And the NPV is:

$$\begin{aligned} \text{NPV}_{\text{new}} &= -\$936,000 + \$512,200(\text{PVIFA}_{15\%,8}) \\ \text{NPV}_{\text{new}} &= \$1,362,406.08 \end{aligned}$$

So, the change in NPV for every unit change in sales is:

$$\begin{aligned} \Delta\text{NPV}/\Delta\text{S} &= (\$1,143,649.15 - 1,362,406.08)/(100,000 - 105,000) \\ \Delta\text{NPV}/\Delta\text{S} &= +\$43.751 \end{aligned}$$

If sales were to drop by 500 units, then NPV would drop by:

$$\text{NPV drop} = \$43.751(500) = \$21,875.69$$

You may wonder why we chose 105,000 units. Because it doesn't matter! Whatever sales number we use, when we calculate the change in NPV per unit sold, the ratio will be the same.

- c. To find out how sensitive OCF is to a change in variable costs, we will compute the OCF at a variable cost of \$25. Again, the number we choose to use here is irrelevant: We will get the same ratio of OCF to a one dollar change in variable cost no matter what variable cost we use. So, using the tax shield approach, the OCF at a variable cost of \$25 is:

$$\begin{aligned} \text{OCF}_{\text{new}} &= [(\$41 - 25)(100,000) - 850,000](0.65) + 0.35(\$117,000) \\ \text{OCF}_{\text{new}} &= \$528,450 \end{aligned}$$

So, the change in OCF for a \$1 change in variable costs is:

$$\begin{aligned} \Delta\text{OCF}/\Delta\text{v} &= (\$463,450 - 528,450)/(\$26 - 25) \\ \Delta\text{OCF}/\Delta\text{v} &= -\$65,000 \end{aligned}$$

If variable costs decrease by \$1 then, OCF would increase by \$65,000

## B-200 SOLUTIONS

6. We will use the tax shield approach to calculate the OCF for the best- and worst-case scenarios. For the best-case scenario, the price and quantity increase by 10 percent, so we will multiply the base case numbers by 1.1, a 10 percent increase. The variable and fixed costs both decrease by 10 percent, so we will multiply the base case numbers by .9, a 10 percent decrease. Doing so, we get:

$$\begin{aligned} \text{OCF}_{\text{best}} &= \{[(\$41)(1.1) - (\$26)(0.9)](100\text{K})(1.1) - \$850\text{K}(0.9)\}(0.65) + 0.35(\$117\text{K}) \\ \text{OCF}_{\text{best}} &= \$1,095,250 \end{aligned}$$

The best-case NPV is:

$$\begin{aligned} \text{NPV}_{\text{best}} &= -\$936,000 + \$1,095,250(\text{PVIFA}_{15\%,8}) \\ \text{NPV}_{\text{best}} &= \$3,978,738.88 \end{aligned}$$

For the worst-case scenario, the price and quantity decrease by 10 percent, so we will multiply the base case numbers by .9, a 10 percent decrease. The variable and fixed costs both increase by 10 percent, so we will multiply the base case numbers by 1.1, a 10 percent increase. Doing so, we get:

$$\begin{aligned} \text{OCF}_{\text{worst}} &= \{[(\$41)(0.9) - (\$26)(1.1)](100\text{K})(0.9) - \$850\text{K}(1.1)\}(0.65) + 0.35(\$117\text{K}) \\ \text{OCF}_{\text{worst}} &= -\$81,250 \end{aligned}$$

The worst-case NPV is:

$$\begin{aligned} \text{NPV}_{\text{worst}} &= -\$936,000 - \$81,250(\text{PVIFA}_{15\%,8}) \\ \text{NPV}_{\text{worst}} &= -\$1,300,594.87 \end{aligned}$$

7. The cash breakeven equation is:

$$Q_C = \text{FC}/(P - v)$$

And the accounting breakeven equation is:

$$Q_A = (\text{FC} + D)/(P - v)$$

Using these equations, we find the following cash and accounting breakeven points:

(1): $Q_C = \$14\text{M}/(\$3,000 - 2,275)$	$Q_A = (\$14\text{M} + 6.5\text{M})/(\$3,000 - 2,275)$
$Q_C = 19,310$	$Q_A = 28,276$
(2): $Q_C = \$73,000/(\$39 - 27)$	$Q_A = (\$73,000 + 150,000)/(\$39 - 27)$
$Q_C = 6,083$	$Q_A = 18,583$
(3): $Q_C = \$1,200/(\$10 - 4)$	$Q_A = (\$1,200 + 840)/(\$10 - 4)$
$Q_C = 200$	$Q_A = 340$

8. We can use the accounting breakeven equation:

$$Q_A = (FC + D)/(P - v)$$

to solve for the unknown variable in each case. Doing so, we find:

$$(1): Q_A = 127,500 = (\$820,000 + D)/(\$41 - 30)$$

$$D = \$582,500$$

$$(2): Q_A = 135,000 = (\$3.2M + 1.15M)/(P - \$43)$$

$$P = \$75.22$$

$$(3): Q_A = 5,478 = (\$160,000 + 105,000)/(\$98 - v)$$

$$v = \$49.62$$

9. The accounting breakeven for the project is:

$$Q_A = [\$8,000 + (\$12,000/4)]/(\$68 - 41)$$

$$Q_A = 407$$

And the cash breakeven is:

$$Q_C = \$8,000/(\$68 - 41)$$

$$Q_C = 296$$

At the financial breakeven, the project will have a zero NPV. Since this is true, the initial cost of the project must be equal to the PV of the cash flows of the project. Using this relationship, we can find the OCF of the project must be:

$$NPV = 0 \text{ implies } \$12,000 = OCF(PVIFA_{15\%,4})$$

$$OCF = \$4,203.18$$

Using this OCF, we can find the financial breakeven is:

$$Q_F = (\$8,000 + \$4,203.18)/(\$68 - 41) = 452$$

And the DOL of the project is:

$$DOL = 1 + (\$8,000/\$4,203.18) = 2.903$$

10. In order to calculate the financial breakeven, we need the OCF of the project. We can use the cash and accounting breakeven points to find this. First, we will use the cash breakeven to find the price of the product as follows:

$$Q_C = FC/(P - v)$$

$$12,000 = \$130,000/(P - \$23)$$

$$P = \$33.83$$

## B-202 SOLUTIONS

Now that we know the product price, we can use the accounting breakeven equation to find the depreciation. Doing so, we find the annual depreciation must be:

$$Q_A = (FC + D)/(P - v)$$
$$17,000 = (\$130,000 + D)/(\$33.83 - 23)$$
$$\text{Depreciation} = \$54,167$$

We now know the annual depreciation amount. Assuming straight-line depreciation is used, the initial investment in equipment must be five times the annual depreciation, or:

$$\text{Initial investment} = 5(\$54,167) = \$270,833$$

The PV of the OCF must be equal to this value at the financial breakeven since the NPV is zero, so:

$$\$270,833 = \text{OCF}(\text{PVIFA}_{16\%,5})$$
$$\text{OCF} = \$82,715.04$$

We can now use this OCF in the financial breakeven equation to find the financial breakeven sales figure is:

$$Q_F = (\$130,000 + 82,715.04)/(\$33.83 - 23)$$
$$Q_F = 19,635$$

11. We know that the DOL is the percentage change in OCF divided by the percentage change in quantity sold. Since we have the original and new quantity sold, we can use the DOL equation to find the percentage change in OCF. Doing so, we find:

$$\text{DOL} = \% \Delta \text{OCF} / \% \Delta Q$$

Solving for the percentage change in OCF, we get:

$$\% \Delta \text{OCF} = (\text{DOL})(\% \Delta Q)$$
$$\% \Delta \text{OCF} = 3.25[(64,000 - 55,000)/55,000]$$
$$\% \Delta \text{OCF} = .5318 \text{ or } 53.18\%$$

The new level of operating leverage is lower since FC/OCF is smaller.

12. Using the DOL equation, we find:

$$\text{DOL} = 1 + \text{FC} / \text{OCF}$$
$$3.25 = 1 + \$150,000/\text{OCF}$$
$$\text{OCF} = \$66,667$$

The percentage change in quantity sold at 48,000 units is:

$$\% \Delta Q = (48,000 - 55,000) / 55,000$$
$$\% \Delta Q = -.1273 \text{ or } -12.73\%$$

So, using the same equation as in the previous problem, we find:

$$\begin{aligned}\% \Delta \text{OCF} &= 3.25(-12.73\%) \\ \% \Delta Q &= -41.36\%\end{aligned}$$

So, the new OCF level will be:

$$\begin{aligned}\text{New OCF} &= (1 - .4136)(\$66,667) \\ \text{New OCF} &= \$39,091\end{aligned}$$

And the new DOL will be:

$$\begin{aligned}\text{New DOL} &= 1 + (\$150,000/\$39,091) \\ \text{New DOL} &= 4.837\end{aligned}$$

- 13.** The DOL of the project is:

$$\begin{aligned}\text{DOL} &= 1 + (\$43,000/\$79,000) \\ \text{DOL} &= 1.5443\end{aligned}$$

If the quantity sold changes to 8,500 units, the percentage change in quantity sold is:

$$\begin{aligned}\% \Delta Q &= (8,500 - 8,000)/8,000 \\ \% \Delta Q &= .0625 \text{ or } 6.25\%\end{aligned}$$

So, the OCF at 8,500 units sold is:

$$\begin{aligned}\% \Delta \text{OCF} &= \text{DOL}(\% \Delta Q) \\ \% \Delta \text{OCF} &= 1.5443(.0625) \\ \% \Delta \text{OCF} &= .0965 \text{ or } 9.65\%\end{aligned}$$

This makes the new OCF:

$$\begin{aligned}\text{New OCF} &= \$79,000(1.0965) \\ \text{New OCF} &= \$86,625\end{aligned}$$

And the DOL at 8,500 units is:

$$\begin{aligned}\text{DOL} &= 1 + (\$43,000/\$86,625) \\ \text{DOL} &= 1.4964\end{aligned}$$

- 14.** We can use the equation for DOL to calculate fixed costs. The fixed cost must be:

$$\begin{aligned}\text{DOL} = 2.15 &= 1 + \text{FC}/\text{OCF} \\ \text{FC} &= (2.15 - 1)\$28,000 \\ \text{FC} &= \$32,200\end{aligned}$$

If the output rises to 11,000 units, the percentage change in quantity sold is:

$$\begin{aligned}\% \Delta Q &= (11,000 - 10,000)/10,000 \\ \% \Delta Q &= .10 \text{ or } 10.00\%\end{aligned}$$

## B-204 SOLUTIONS

The percentage change in OCF is:

$$\% \Delta \text{OCF} = 2.15(.10)$$

$$\% \Delta \text{OCF} = .2150 \text{ or } 21.50\%$$

So, the operating cash flow at this level of sales will be:

$$\text{OCF} = \$28,000(1.215)$$

$$\text{OCF} = \$34,020$$

If the output falls to 9,000 units, the percentage change in quantity sold is:

$$\% \Delta Q = (9,000 - 10,000)/10,000$$

$$\% \Delta Q = -.10 \text{ or } -10.00\%$$

The percentage change in OCF is:

$$\% \Delta \text{OCF} = 2.15(-.10)$$

$$\% \Delta \text{OCF} = -.2150 \text{ or } -21.50\%$$

So, the operating cash flow at this level of sales will be:

$$\text{OCF} = \$28,000(1 - .215)$$

$$\text{OCF} = \$21,980$$

15. Using the equation for DOL, we get:

$$\text{DOL} = 1 + \text{FC}/\text{OCF}$$

At 11,000 units

$$\text{DOL} = 1 + \$32,200/\$34,020$$

$$\text{DOL} = 1.9465$$

At 9,000 units

$$\text{DOL} = 1 + \$32,200/\$21,980$$

$$\text{DOL} = 2.4650$$

### Intermediate

16. a. At the accounting breakeven, the IRR is zero percent since the project recovers the initial investment. The payback period is N years, the length of the project since the initial investment is exactly recovered over the project life. The NPV at the accounting breakeven is:

$$\text{NPV} = I [(1/N)(\text{PVIFA}_{R\%,N}) - 1]$$

- b. At the cash breakeven level, the IRR is -100 percent, the payback period is negative, and the NPV is negative and equal to the initial cash outlay.

- c. The definition of the financial breakeven is where the NPV of the project is zero. If this is true, then the IRR of the project is equal to the required return. It is impossible to state the payback period, except to say that the payback period must be less than the length of the project. Since the discounted cash flows are equal to the initial investment, the undiscounted cash flows are greater than the initial investment, so the payback must be less than the project life.

17. Using the tax shield approach, the OCF at 110,000 units will be:

$$\begin{aligned} \text{OCF} &= [(P - v)Q - FC](1 - t_c) + t_c(D) \\ \text{OCF} &= [(\$26 - 18)(110,000) - 190,000](0.66) + 0.34(\$460,000/4) \\ \text{OCF} &= \$494,500 \end{aligned}$$

We will calculate the OCF at 111,000 units. The choice of the second level of quantity sold is arbitrary and irrelevant. No matter what level of units sold we choose, we will still get the same sensitivity. So, the OCF at this level of sales is:

$$\begin{aligned} \text{OCF} &= [(\$26 - 18)(111,000) - 190,000](0.66) + 0.34(\$460,000/4) \\ \text{OCF} &= \$499,780 \end{aligned}$$

The sensitivity of the OCF to changes in the quantity sold is:

$$\begin{aligned} \text{Sensitivity} &= \Delta\text{OCF}/\Delta Q = (\$499,780 - 494,500)/(111,000 - 110,000) \\ \Delta\text{OCF}/\Delta Q &= +\$5.28 \end{aligned}$$

OCF will increase by \$5.28 for every additional unit sold.

18. At 110,000 units, the DOL is:

$$\begin{aligned} \text{DOL} &= 1 + \text{FC}/\text{OCF} \\ \text{DOL} &= 1 + (\$190,000/\$494,500) \\ \text{DOL} &= 1.3842 \end{aligned}$$

The accounting breakeven is:

$$\begin{aligned} Q_A &= (\text{FC} + D)/(P - v) \\ Q_A &= [\$190,000 + (\$460,000/4)]/(\$26 - 18) \\ Q_A &= 38,125 \end{aligned}$$

And, at the accounting breakeven level, the DOL is:

$$\begin{aligned} \text{DOL} &= 1 + (\$190,000/\$115,000) \\ \text{DOL} &= 2.6522 \end{aligned}$$

B-206 SOLUTIONS

19. a. The base-case, best-case, and worst-case values are shown below. Remember that in the best-case, sales and price increase, while costs decrease. In the worst-case, sales and price decrease, and costs increase.

<u>Scenario</u>	<u>Unit sales</u>	<u>Variable cost</u>	<u>Fixed costs</u>
Base	170	\$10,500	\$380,000
Best	187	\$9,450	\$342,000
Worst	153	\$11,550	\$418,000

Using the tax shield approach, the OCF and NPV for the base case estimate is:

$$\text{OCF}_{\text{base}} = [(\$17,000 - 10,500)(170) - \$380,000](0.65) + 0.35(\$1,400,000/4)$$

$$\text{OCF}_{\text{base}} = \$593,750$$

$$\text{NPV}_{\text{base}} = -\$1,400,000 + \$593,750(\text{PVIFA}_{12\%,4})$$

$$\text{NPV}_{\text{base}} = \$403,426.17$$

The OCF and NPV for the worst case estimate are:

$$\text{OCF}_{\text{worst}} = [(\$17,000 - 11,550)(153) - \$418,000](0.65) + 0.35(\$1,400,000/4)$$

$$\text{OCF}_{\text{worst}} = \$392,802.50$$

$$\text{NPV}_{\text{worst}} = -\$1,400,000 + \$392,802.50(\text{PVIFA}_{12\%,4})$$

$$\text{NPV}_{\text{worst}} = -\$206,921.58$$

And the OCF and NPV for the best case estimate are:

$$\text{OCF}_{\text{best}} = [(\$17,000 - 9,450)(187) - \$342,000](0.65) + 0.35(\$1,400,000/4)$$

$$\text{OCF}_{\text{best}} = \$817,902.50$$

$$\text{NPV}_{\text{best}} = -\$1,400,000 + \$817,902.50(\text{PVIFA}_{12\%,4})$$

$$\text{NPV}_{\text{best}} = \$1,084,255.62$$

- b. To calculate the sensitivity of the NPV to changes in fixed costs we choose another level of fixed costs. We will use fixed costs of \$390,000. The OCF using this level of fixed costs and the other base case values with the tax shield approach, we get:

$$\text{OCF} = [(\$17,000 - 10,500)(170) - \$390,000](0.65) + 0.35(\$1,400,000/4)$$

$$\text{OCF} = \$587,250$$

And the NPV is:

$$\text{NPV} = -\$1,400,000 + \$587,250(\text{PVIFA}_{12\%,4})$$

$$\text{NPV} = \$383,683.40$$

The sensitivity of NPV to changes in fixed costs is:

$$\Delta\text{NPV}/\Delta\text{FC} = (\$403,426.17 - 383,683.40)/(\$380,000 - 390,000)$$

$$\Delta\text{NPV}/\Delta\text{FC} = -\$1.974$$

For every dollar FC increase, NPV falls by \$1.974.

c. The cash breakeven is:

$$Q_C = FC/(P - v)$$

$$Q_C = \$380,000/(\$17,000 - 10,500)$$

$$Q_C = 58$$

d. The accounting breakeven is:

$$Q_A = (FC + D)/(P - v)$$

$$Q_A = [\$380,000 + (\$1,400,000/4)]/(\$17,000 - 10,500)$$

$$Q_A = 112$$

At the accounting breakeven, the DOL is:

$$DOL = 1 + FC/OCF$$

$$DOL = 1 + (\$380,000/\$350,000) = 2.0857$$

For each 1% increase in unit sales, OCF will increase by 2.0857%.

20. The marketing study and the research and development are both sunk costs and should be ignored. We will calculate the sales and variable costs first. Since we will lose sales of the expensive clubs and gain sales of the cheap clubs, these must be accounted for as erosion. The total sales for the new project will be:

<u>Sales</u>	
New clubs	$\$700 \times 48,000 = \$33,600,000$
Exp. clubs	$\$1,100 \times (-11,000) = -12,100,000$
Cheap clubs	$\$400 \times 9,000 = \underline{3,600,000}$
	$\$25,100,000$

For the variable costs, we must include the units gained or lost from the existing clubs. Note that the variable costs of the expensive clubs are an inflow. If we are not producing the sets anymore, we will save these variable costs, which is an inflow. So:

<u>Var. costs</u>	
New clubs	$-\$320 \times 48,000 = -\$15,360,000$
Exp. clubs	$-\$600 \times (-11,000) = \underline{6,600,000}$
Cheap clubs	$-\$180 \times 9,000 = \underline{-1,620,000}$
	$-\$10,380,000$

The pro forma income statement will be:

Sales	$\$25,100,000$
Variable costs	$10,380,000$
Costs	$7,500,000$
Depreciation	$\underline{2,600,000}$
EBT	$\$4,620,000$
Taxes	$\underline{1,848,000}$
Net income	$\$2,772,000$

## B-208 SOLUTIONS

Using the bottom up OCF calculation, we get:

$$\begin{aligned} \text{OCF} &= \text{NI} + \text{Depreciation} = \$2,772,000 + 2,600,000 \\ \text{OCF} &= \$5,372,000 \end{aligned}$$

So, the payback period is:

$$\begin{aligned} \text{Payback period} &= 3 + \$3,034,000/\$5,372,000 \\ \text{Payback period} &= 3.565 \text{ years} \end{aligned}$$

The NPV is:

$$\begin{aligned} \text{NPV} &= -\$18,200,000 - 950,000 + \$5,372,000(\text{PVIFA}_{10\%,7}) + \$950,000/1.10^7 \\ \text{NPV} &= \$7,490,646.10 \end{aligned}$$

And the IRR is:

$$\begin{aligned} \text{IRR} &= -\$18,200,000 - 950,000 + \$5,372,000(\text{PVIFA}_{\text{IRR}\%,7}) + \$950,000/\text{IRR}^7 \\ \text{IRR} &= 20.89\% \end{aligned}$$

21. The best case and worst cases for the variables are:

	<u>Base Case</u>	<u>Best Case</u>	<u>Worst Case</u>
Unit sales (new)	48,000	52,800	43,200
Price (new)	\$700	\$770	\$630
VC (new)	\$320	\$288	\$352
Fixed costs	\$7,500,000	\$6,750,000	\$8,250,000
Sales lost (expensive)	11,000	9,900	12,100
Sales gained (cheap)	9,000	9,900	8,100

### Best-case

We will calculate the sales and variable costs first. Since we will lose sales of the expensive clubs and gain sales of the cheap clubs, these must be accounted for as erosion. The total sales for the new project will be:

#### Sales

New clubs	$\$770 \times 52,800 =$	\$40,656,000
Exp. clubs	$\$1,100 \times (-9,900) =$	- 10,890,000
Cheap clubs	$\$400 \times 9,900 =$	<u>3,960,000</u>
		\$33,726,000

For the variable costs, we must include the units gained or lost from the existing clubs. Note that the variable costs of the expensive clubs are an inflow. If we are not producing the sets anymore, we will save these variable costs, which is an inflow. So:

#### Var. costs

New clubs	$\$288 \times 52,800 =$	\$15,206,000
Exp. clubs	$\$600 \times (-9,900) =$	- 5,940,000
Cheap clubs	$\$180 \times 9,900 =$	<u>1,782,000</u>
		\$11,048,400

The pro forma income statement will be:

Sales	\$33,726,000
Variable costs	11,048,400
Costs	6,750,000
Depreciation	<u>2,600,000</u>
EBT	13,327,600
Taxes	<u>5,331,040</u>
Net income	<u>\$7,996,560</u>

Using the bottom up OCF calculation, we get:

$$\text{OCF} = \text{Net income} + \text{Depreciation} = \$7,996,560 + 2,600,000$$

$$\text{OCF} = \$10,596,560$$

And the best-case NPV is:

$$\text{NPV} = -\$18,200,000 - 950,000 + \$10,596,560(\text{PVIFA}_{10\%,7}) + 950,000/1.10^7$$

$$\text{NPV} = \$32,925,992.32$$

Worst-case

We will calculate the sales and variable costs first. Since we will lose sales of the expensive clubs and gain sales of the cheap clubs, these must be accounted for as erosion. The total sales for the new project will be:

<u>Sales</u>	
New clubs	$\$630 \times 43,200 = \$27,216,000$
Exp. clubs	$\$1,100 \times (-12,100) = -13,310,000$
Cheap clubs	$\$400 \times 8,100 = \underline{3,240,000}$
	\$17,146,000

For the variable costs, we must include the units gained or lost from the existing clubs. Note that the variable costs of the expensive clubs are an inflow. If we are not producing the sets anymore, we will save these variable costs, which is an inflow. So:

<u>Var. costs</u>	
New clubs	$\$352 \times 43,200 = \$15,206,400$
Exp. clubs	$\$600 \times (-12,100) = -7,260,000$
Cheap clubs	$\$180 \times 8,100 = \underline{1,458,000}$
	\$9,404,400

The pro forma income statement will be:

Sales	\$17,146,000	
Variable costs	9,404,400	
Costs	8,250,000	
Depreciation	<u>2,600,000</u>	
EBT	-3,108,400	
Taxes	<u>1,243,360</u>	*assumes a tax credit
Net income	<u>-\$1,865,040</u>	

## B-210 SOLUTIONS

Using the bottom up OCF calculation, we get:

$$\text{OCF} = \text{NI} + \text{Depreciation} = -\$1,865,040 + 2,600,000$$

$$\text{OCF} = \$734,960$$

And the worst-case NPV is:

$$\text{NPV} = -\$18,200,000 - 950,000 + \$734,960(\text{PVIFA}_{10\%,7}) + 950,000/1.10^7$$

$$\text{NPV} = -\$15,084,406.69$$

22. To calculate the sensitivity of the NPV to changes in the price of the new club, we simply need to change the price of the new club. We will choose \$750, but the choice is irrelevant as the sensitivity will be the same no matter what price we choose.

We will calculate the sales and variable costs first. Since we will lose sales of the expensive clubs and gain sales of the cheap clubs, these must be accounted for as erosion. The total sales for the new project will be:

Sales

New clubs	$\$750 \times 48,000 =$	$\$36,000,000$
Exp. clubs	$\$1,100 \times (-11,000) =$	$-\$12,100,000$
Cheap clubs	$\$400 \times 9,000 =$	$\underline{\$3,600,000}$
		$\underline{\$27,500,000}$

For the variable costs, we must include the units gained or lost from the existing clubs. Note that the variable costs of the expensive clubs are an inflow. If we are not producing the sets anymore, we will save these variable costs, which is an inflow. So:

Var. costs

New clubs	$\$320 \times 48,000 =$	$\$15,360,000$
Exp. clubs	$\$600 \times (-11,000) =$	$-\$6,600,000$
Cheap clubs	$\$180 \times 9,000 =$	$\underline{\$1,620,000}$
		$\underline{\$10,380,000}$

The pro forma income statement will be:

Sales	$\$27,500,000$
Variable costs	$10,380,000$
Costs	$7,500,000$
Depreciation	$\underline{2,600,000}$
EBT	$7,020,000$
Taxes	$\underline{2,808,000}$
Net income	$\underline{\underline{\$4,212,000}}$

Using the bottom up OCF calculation, we get:

$$\text{OCF} = \text{NI} + \text{Depreciation} = \$4,212,000 + 2,600,000$$

$$\text{OCF} = \$6,812,000$$

And the NPV is:

$$\text{NPV} = -\$18,200,000 - 950,000 + \$6,812,000(\text{PVIFA}_{10\%,7}) + 950,000/1.10^7$$

$$\text{NPV} = \$14,501,169.20$$

So, the sensitivity of the NPV to changes in the price of the new club is:

$$\Delta\text{NPV}/\Delta\text{P} = (\$14,501,169.20 - 7,490,646.10)/(\$750 - 700)$$

$$\Delta\text{NPV}/\Delta\text{P} = \$140,210.46$$

For every dollar increase (decrease) in the price of the clubs, the NPV increases (decreases) by \$140,210.46.

To calculate the sensitivity of the NPV to changes in the quantity sold of the new club, we simply need to change the quantity sold. We will choose 50,000 units, but the choice is irrelevant as the sensitivity will be the same no matter what quantity we choose.

We will calculate the sales and variable costs first. Since we will lose sales of the expensive clubs and gain sales of the cheap clubs, these must be accounted for as erosion. The total sales for the new project will be:

<u>Sales</u>	
New clubs	$\$700 \times 50,000 = \$35,000,000$
Exp. clubs	$\$1,100 \times (-11,000) = -12,100,000$
Cheap clubs	$\$400 \times 9,000 = \underline{3,600,000}$
	$\underline{\underline{\$26,500,000}}$

For the variable costs, we must include the units gained or lost from the existing clubs. Note that the variable costs of the expensive clubs are an inflow. If we are not producing the sets anymore, we will save these variable costs, which is an inflow. So:

<u>Var. costs</u>	
New clubs	$\$320 \times 50,000 = \$16,000,000$
Exp. clubs	$\$600 \times (-11,000) = -6,600,000$
Cheap clubs	$\$180 \times 9,000 = \underline{1,620,000}$
	$\underline{\underline{\$11,020,000}}$

The pro forma income statement will be:

Sales	\$26,500,000
Variable costs	11,020,000
Costs	7,500,000
Depreciation	<u>2,600,000</u>
EBT	5,380,000
Taxes	<u>2,152,000</u>
Net income	<u><u>\$ 3,228,000</u></u>

## B-212 SOLUTIONS

Using the bottom up OCF calculation, we get:

$$\begin{aligned}\text{OCF} &= \text{NI} + \text{Depreciation} = \$3,228,000 + 2,600,000 \\ \text{OCF} &= \$5,828,000\end{aligned}$$

The NPV at this quantity is:

$$\begin{aligned}\text{NPV} &= -\$18,200,000 - \$950,000 + \$5,828,000(\text{PVIFA}_{10\%,7}) + \$950,000/1.10^7 \\ \text{NPV} &= \$9,710,645.08\end{aligned}$$

So, the sensitivity of the NPV to changes in the quantity sold is:

$$\begin{aligned}\Delta\text{NPV}/\Delta Q &= (\$9,710,645.08 - 7,490,646.10)/(50,000 - 48,000) \\ \Delta\text{NPV}/\Delta Q &= \$1,100.00\end{aligned}$$

For an increase (decrease) of one set of clubs sold per year, the NPV increases (decreases) by \$1,100.00.

23. a. First we need to determine the total additional cost of the hybrid. The hybrid costs more to purchase and more each year, so the total additional cost is:

$$\begin{aligned}\text{Total additional cost} &= \$5,450 + 6(\$400) \\ \text{Total additional cost} &= \$7,850\end{aligned}$$

Next, we need to determine the cost per mile for each vehicle. The cost per mile is the cost per gallon of gasoline divided by the miles per gallon, or:

$$\begin{aligned}\text{Cost per mile for traditional} &= \$2.80/23 \\ \text{Cost per mile for traditional} &= \$0.121739\end{aligned}$$

$$\begin{aligned}\text{Cost per mile for hybrid} &= \$2.80/25 \\ \text{Cost per mile for hybrid} &= \$0.11200\end{aligned}$$

So, the savings per mile driven for the hybrid will be:

$$\begin{aligned}\text{Savings per mile} &= \$0.121739 - 0.11200 \\ \text{Savings per mile} &= \$0.009739\end{aligned}$$

We can now determine the breakeven point by dividing the total additional cost by the savings per mile, which is:

$$\begin{aligned}\text{Total breakeven miles} &= \$7,850 / \$0.009739 \\ \text{Total breakeven miles} &= 806,027\end{aligned}$$

So, the miles you would need to drive per year is the total breakeven miles divided by the number of years of ownership, or:

$$\begin{aligned}\text{Miles per year} &= 806,027 \text{ miles} / 6 \text{ years} \\ \text{Miles per year} &= 134,338 \text{ miles/year}\end{aligned}$$

- b. First, we need to determine the total miles driven over the life of either vehicle, which will be:

$$\text{Total miles driven} = 6(15,000)$$

$$\text{Total miles driven} = 90,000$$

Since we know the total additional cost of the hybrid from part *a*, we can determine the necessary savings per mile to make the hybrid financially attractive. The necessary cost savings per mile will be:

$$\text{Cost savings needed per mile} = \$7,850 / 90,000$$

$$\text{Cost savings needed per mile} = \$0.08722$$

Now we can find the price per gallon for the miles driven. If we let *P* be the price per gallon, the necessary price per gallon will be:

$$P/23 - P/25 = \$0.08722$$

$$P(1/23 - 1/25) = \$0.08722$$

$$P = \$25.08$$

- c. To find the number of miles it is necessary to drive, we need the present value of the costs and savings to be equal to zero. If we let MDPY equal the miles driven per year, the breakeven equation for the hybrid car as:

$$\text{Cost} = 0 = -\$5,400 - \$400(\text{PVIFA}_{10\%,6}) + \$0.009739(\text{MDPY})(\text{PVIFA}_{10\%,6})$$

The savings per mile driven, \$0.009739, is the same as we calculated in part *a*. Solving this equation for the number of miles driven per year, we find:

$$\$0.009739(\text{MDPY})(\text{PVIFA}_{10\%,6}) = \$7,192.10$$

$$\text{MDPY}(\text{PVIFA}_{10\%,6}) = \$738,474.99$$

$$\text{Miles driven per year} = 169,559$$

To find the cost per gallon of gasoline necessary to make the hybrid break even in a financial sense, if we let CSPG equal the cost savings per gallon of gas, the cost equation is:

$$\text{Cost} = 0 = -\$5,400 - \$400(\text{PVIFA}_{10\%,6}) + \text{CSPG}(15,000)(\text{PVIFA}_{10\%,6})$$

Solving this equation for the cost savings per gallon of gas necessary for the hybrid to breakeven from a financial sense, we find:

$$\text{CSPG}(15,000)(\text{PVIFA}_{10\%,6}) = \$7,192.10$$

$$\text{CSPG}(\text{PVIFA}_{10\%,6}) = \$0.47947$$

$$\text{Cost savings per gallon of gas} = \$0.110091$$

Now we can find the price per gallon for the miles driven. If we let *P* be the price per gallon, the necessary price per gallon will be:

$$P/23 - P/25 = \$0.110091$$

$$P(1/23 - 1/25) = \$0.110091$$

$$P = \$31.65$$

## B-214 SOLUTIONS

- d. The implicit assumption in the previous analysis is that each car depreciates by the same dollar amount.

24. a. The cash flow per plane is the initial cost divided by the breakeven number of planes, or:

$$\text{Cash flow per plane} = \$13,000,000,000 / 249$$

$$\text{Cash flow per plane} = \$52,208,835$$

- b. In this case the cash flows are a perpetuity. Since we know the cash flow per plane, we need to determine the annual cash flow necessary to deliver a 20 percent return. Using the perpetuity equation, we find:

$$PV = C / R$$

$$\$13,000,000,000 = C / .20$$

$$C = \$2,600,000,000$$

This is the total cash flow, so the number of planes that must be sold is the total cash flow divided by the cash flow per plane, or:

$$\text{Number of planes} = \$2,600,000,000 / \$52,208,835$$

$$\text{Number of planes} = 49.80 \text{ or about } 50 \text{ planes per year}$$

- c. In this case the cash flows are an annuity. Since we know the cash flow per plane, we need to determine the annual cash flow necessary to deliver a 20 percent return. Using the present value of an annuity equation, we find:

$$PV = C(PVIFA_{20\%,10})$$

$$\$13,000,000,000 = C(PVIFA_{20\%,10})$$

$$C = \$3,100,795,839$$

This is the total cash flow, so the number of planes that must be sold is the total cash flow divided by the cash flow per plane, or:

$$\text{Number of planes} = \$3,100,795,839 / \$52,208,835$$

$$\text{Number of planes} = 59.39 \text{ or about } 60 \text{ planes per year}$$

### Challenge

25. a. The tax shield definition of OCF is:

$$OCF = [(P - v)Q - FC](1 - t_c) + t_cD$$

Rearranging and solving for Q, we find:

$$(OCF - t_cD)/(1 - t_c) = (P - v)Q - FC$$

$$Q = \{FC + [(OCF - t_cD)/(1 - t_c)]\}/(P - v)$$

b. The cash breakeven is:

$$Q_C = \$500,000 / (\$40,000 - 20,000)$$

$$Q_C = 25$$

And the accounting breakeven is:

$$Q_A = \{ \$500,000 + [(\$700,000 - \$700,000(0.38))/0.62] \} / (\$40,000 - 20,000)$$

$$Q_A = 60$$

The financial breakeven is the point at which the NPV is zero, so:

$$OCF_F = \$3,500,000 / PVIFA_{20\%,5}$$

$$OCF_F = \$1,170,328.96$$

So:

$$Q_F = [FC + (OCF - t_C \times D) / (1 - t_C)] / (P - v)$$

$$Q_F = \{ \$500,000 + [\$1,170,328.96 - .38(\$700,000)] / (1 - .38) \} / (\$40,000 - 20,000)$$

$$Q_F = 97.93 \approx 98$$

c. At the accounting break-even point, the net income is zero. This using the bottom up definition of OCF:

$$OCF = NI + D$$

We can see that OCF must be equal to depreciation. So, the accounting breakeven is:

$$Q_A = \{ FC + [(D - t_C D) / (1 - t)] \} / (P - v)$$

$$Q_A = (FC + D) / (P - v)$$

$$Q_A = (FC + OCF) / (P - v)$$

The tax rate has cancelled out in this case.

**26.** The DOL is expressed as:

$$DOL = \% \Delta OCF / \% \Delta Q$$

$$DOL = \{ [(OCF_1 - OCF_0) / OCF_0] / [(Q_1 - Q_0) / Q_0] \}$$

The OCF for the initial period and the first period is:

$$OCF_1 = [(P - v)Q_1 - FC](1 - t_C) + t_C D$$

$$OCF_0 = [(P - v)Q_0 - FC](1 - t_C) + t_C D$$

The difference between these two cash flows is:

$$OCF_1 - OCF_0 = (P - v)(1 - t_C)(Q_1 - Q_0)$$

## B-216 SOLUTIONS

Dividing both sides by the initial OCF we get:

$$(OCF_1 - OCF_0)/OCF_0 = (P - v)(1 - t_c)(Q_1 - Q_0) / OCF_0$$

Rearranging we get:

$$[(OCF_1 - OCF_0)/OCF_0][(Q_1 - Q_0)/Q_0] = [(P - v)(1 - t_c)Q_0]/OCF_0 = [OCF_0 - t_cD + FC(1 - t)]/OCF_0$$

$$DOL = 1 + [FC(1 - t) - t_cD]/OCF_0$$

27. a. Using the tax shield approach, the OCF is:

$$OCF = [(\$245 - 210)(45,000) - \$450,000](0.62) + 0.38(\$1,900,000/5)$$

$$OCF = \$841,900$$

And the NPV is:

$$NPV = -\$1.9M - 450K + \$841,900(PVIFA_{13\%,5}) + [\$450K + \$500K(1 - .38)]/1.13^5$$

$$NPV = \$1,023,654.55$$

- b. In the worst-case, the OCF is:

$$OCF_{\text{worst}} = \{[(\$245)(0.9) - 210](45,000) - \$450,000\}(0.62) + 0.38(\$2,185,000/5)$$

$$OCF_{\text{worst}} = \$180,010$$

And the worst-case NPV is:

$$NPV_{\text{worst}} = -\$2,185,000 - \$450,000(1.05) + \$180,010(PVIFA_{13\%,5}) +$$

$$[\$450,000(1.05) + \$500,000(0.85)(1 - .38)]/1.13^5$$

$$NPV_{\text{worst}} = -\$1,624,891.89$$

The best-case OCF is:

$$OCF_{\text{best}} = \{[\$245(1.1) - 210](45,000) - \$450,000\}(0.62) + 0.38(\$1,615,000/5)$$

$$OCF_{\text{best}} = \$1,503,790$$

And the best-case NPV is:

$$NPV_{\text{best}} = -\$1,615,000 - \$450,000(0.95) + \$1,503,790(PVIFA_{13\%,5}) +$$

$$[\$450,000(0.95) + \$500,000(1.15)(1 - .38)]/1.13^5$$

$$NPV_{\text{best}} = \$3,672,200.99$$

28. To calculate the sensitivity to changes in quantity sold, we will choose a quantity of 46,000. The OCF at this level of sale is:

$$OCF = [(\$245 - 210)(46,000) - \$450,000](0.62) + 0.38(\$1,900,000/5)$$

$$OCF = \$863,600$$

The sensitivity of changes in the OCF to quantity sold is:

$$\begin{aligned}\Delta\text{OCF}/\Delta Q &= (\$863,600 - 841,900)/(46,000 - 45,000) \\ \Delta\text{OCF}/\Delta Q &= +\$21.70\end{aligned}$$

The NPV at this level of sales is:

$$\begin{aligned}\text{NPV} &= -\$1.9\text{M} - \$450,000 + \$863,600(\text{PVIFA}_{13\%,5}) + [\$450\text{K} + \$500\text{K}(1 - .38)]/1.13^5 \\ \text{NPV} &= \$1,099,978.47\end{aligned}$$

And the sensitivity of NPV to changes in the quantity sold is:

$$\begin{aligned}\Delta\text{NPV}/\Delta Q &= (\$1,099,978.47 - 1,023,654.55)/(46,000 - 45,000) \\ \Delta\text{NPV}/\Delta Q &= +\$76.32\end{aligned}$$

You wouldn't want the quantity to fall below the point where the NPV is zero. We know the NPV changes \$76.32 for every unit sale, so we can divide the NPV for 45,000 units by the sensitivity to get a change in quantity. Doing so, we get:

$$\begin{aligned}\$1,023,654.55 &= \$76.32(\Delta Q) \\ \Delta Q &= 13,412\end{aligned}$$

For a zero NPV, we need to decrease sales by 13,412 units, so the minimum quantity is:

$$\begin{aligned}Q_{\text{Min}} &= 45,000 - 13,412 \\ Q_{\text{Min}} &= 31,588\end{aligned}$$

- 29.** At the cash breakeven, the OCF is zero. Setting the tax shield equation equal to zero and solving for the quantity, we get:

$$\begin{aligned}\text{OCF} = 0 &= [(\$245 - 210)Q_C - \$450,000](0.62) + 0.38(\$1,900,000/5) \\ Q_C &= 6,203\end{aligned}$$

The accounting breakeven is:

$$\begin{aligned}Q_A &= [\$450,000 + (\$1,900,000/5)]/(\$245 - 210) \\ Q_A &= 23,714\end{aligned}$$

From Problem 28, we know the financial breakeven is 31,588 units.

## B-218 SOLUTIONS

- 30.** Using the tax shield approach to calculate the OCF, the DOL is:

$$\text{DOL} = 1 + [\$450,000(1 - 0.38) - 0.38(\$1,900,000/5)] / \$841,900$$
$$\text{DOL} = 1.1599$$

Thus a 1% rise leads to a 1.1599% rise in OCF. If Q rises to 46,000, then

The percentage change in quantity is:

$$\Delta Q = (46,000 - 45,000) / 45,000 = .0222 \text{ or } 2.22\%$$

So, the percentage change in OCF is:

$$\% \Delta \text{OCF} = 2.22\% (1.1599)$$

$$\% \Delta \text{OCF} = 2.5775\%$$

From Problem 26:

$$\Delta \text{OCF} / \text{OCF} = (\$863,600 - 841,900) / \$841,900$$

$$\Delta \text{OCF} / \text{OCF} = 0.025775$$

In general, if Q rises by 1,000 units, OCF rises by 2.5775%.

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# **CHAPTER 12**

## **SOME LESSONS FROM CAPITAL MARKET HISTORY**

### **Answers to Concepts Review and Critical Thinking Questions**

1. They all wish they had! Since they didn't, it must have been the case that the stellar performance was not foreseeable, at least not by most.
2. As in the previous question, it's easy to see after the fact that the investment was terrible, but it probably wasn't so easy ahead of time.
3. No, stocks are riskier. Some investors are highly risk averse, and the extra possible return doesn't attract them relative to the extra risk.
4. On average, the only return that is earned is the required return—investors buy assets with returns in excess of the required return (positive NPV), bidding up the price and thus causing the return to fall to the required return (zero NPV); investors sell assets with returns less than the required return (negative NPV), driving the price lower and thus causing the return to rise to the required return (zero NPV).
5. The market is not weak form efficient.
6. Yes, historical information is also public information; weak form efficiency is a subset of semi-strong form efficiency.
7. Ignoring trading costs, on average, such investors merely earn what the market offers; the trades all have zero NPV. If trading costs exist, then these investors lose by the amount of the costs.
8. Unlike gambling, the stock market is a positive sum game; everybody can win. Also, speculators provide liquidity to markets and thus help to promote efficiency.
9. The EMH only says, within the bounds of increasingly strong assumptions about the information processing of investors, that assets are fairly priced. An implication of this is that, on average, the typical market participant cannot earn excessive profits from a particular trading strategy. However, that does not mean that a few particular investors cannot outperform the market over a particular investment horizon. Certain investors who do well for a period of time get a lot of attention from the financial press, but the scores of investors who do not do well over the same period of time generally get considerably less attention from the financial press.
10. *a.* If the market is not weak form efficient, then this information could be acted on and a profit earned from following the price trend. Under (2), (3), and (4), this information is fully impounded in the current price and no abnormal profit opportunity exists.

## B-220 SOLUTIONS

- b. Under (2), if the market is not semi-strong form efficient, then this information could be used to buy the stock “cheap” before the rest of the market discovers the financial statement anomaly. Since (2) is stronger than (1), both imply that a profit opportunity exists; under (3) and (4), this information is fully impounded in the current price and no profit opportunity exists.
- c. Under (3), if the market is not strong form efficient, then this information could be used as a profitable trading strategy, by noting the buying activity of the insiders as a signal that the stock is underpriced or that good news is imminent. Since (1) and (2) are weaker than (3), all three imply that a profit opportunity exists. Note that this assumes the individual who sees the insider trading is the only one who sees the trading. If the information about the trades made by company management is public information, it will be discounted in the stock price and no profit opportunity exists. Under (4), this information does not signal any profit opportunity for traders; any pertinent information the manager-insiders may have is fully reflected in the current share price.

### Solutions to Questions and Problems

*NOTE: All end of chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.*

#### Basic

1. The return of any asset is the increase in price, plus any dividends or cash flows, all divided by the initial price. The return of this stock is:

$$R = [(\$97 - 84) + 2.05] / \$84 = .1792 \text{ or } 17.92\%$$

2. The dividend yield is the dividend divided by price at the beginning of the period price, so:

$$\text{Dividend yield} = \$2.05 / \$84 = .0244 \text{ or } 2.44\%$$

And the capital gains yield is the increase in price divided by the initial price, so:

$$\text{Capital gains yield} = (\$97 - 84) / \$84 = .1548 \text{ or } 15.48\%$$

3. Using the equation for total return, we find:

$$R = [(\$79 - 84) + 2.05] / \$84 = -.0351 \text{ or } -3.51\%$$

And the dividend yield and capital gains yield are:

$$\text{Dividend yield} = \$2.05 / \$84 = .0244 \text{ or } 2.44\%$$

$$\text{Capital gains yield} = (\$79 - 84) / \$84 = -.0595 \text{ or } -5.95\%$$

Here's a question for you: Can the dividend yield ever be negative? No, that would mean you were paying the company for the privilege of owning the stock. It has happened on bonds. Remember the Buffett bond's we discussed in the bond chapter.

4. The total dollar return is the increase in price plus the coupon payment, so:

$$\text{Total dollar return} = \$920 - 940 + 60 = \$40$$

The total percentage return of the bond is:

$$R = [(\$920 - 940) + 60] / \$940 = .0426 \text{ or } 4.26\%$$

Notice here that we could have simply used the total dollar return of \$40 in the numerator of this equation.

Using the Fisher equation, the real return was:

$$(1 + R) = (1 + r)(1 + h)$$

$$r = (1.0426 / 1.04) - 1 = .0025 \text{ or } 0.25\%$$

5. The nominal return is the stated return, which is 12.30 percent. Using the Fisher equation, the real return was:

$$(1 + R) = (1 + r)(1 + h)$$

$$r = (1.123)/(1.031) - 1 = .0892 \text{ or } 8.92\%$$

6. Using the Fisher equation, the real returns for government and corporate bonds were:

$$(1 + R) = (1 + r)(1 + h)$$

$$r_G = 1.058/1.031 - 1 = .0262 \text{ or } 2.62\%$$

$$r_C = 1.062/1.031 - 1 = .0301 \text{ or } 3.01\%$$

7. The average return is the sum of the returns, divided by the number of returns. The average return for each stock was:

$$\bar{X} = \left[ \sum_{i=1}^N x_i \right] / N = \frac{[.06 + .24 + .13 - .14 + .15]}{5} = .0880 \text{ or } 8.80\%$$

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$$\bar{Y} = \left[ \sum_{i=1}^N y_i \right] / N = \frac{[.18 + .39 - .06 - .20 + .47]}{5} = .1560 \text{ or } 15.60\%$$

Remembering back to “sadistics,” we calculate the variance of each stock as:

$$\sigma_X^2 = \left[ \sum_{i=1}^N (x_i - \bar{x})^2 \right] / (N - 1)$$

$$\sigma_X^2 = \frac{1}{5-1} \{ (.06 - .088)^2 + (.24 - .088)^2 + (.13 - .088)^2 + (-.14 - .088)^2 + (.15 - .088)^2 \} = .020370$$

$$\sigma_Y^2 = \frac{1}{5-1} \{ (.18 - .156)^2 + (.39 - .156)^2 + (-.06 - .156)^2 + (-.20 - .156)^2 + (.47 - .156)^2 \} = .081830$$

The standard deviation is the square root of the variance, so the standard deviation of each stock is:

$$\sigma_X = (.020370)^{1/2} = .1427 \text{ or } 14.27\%$$

$$\sigma_Y = (.081830)^{1/2} = .2861 \text{ or } 28.61\%$$

8. We will calculate the sum of the returns for each asset and the observed risk premium first. Doing so, we get:

<u>Year</u>	<u>Large co. stock return</u>	<u>T-bill return</u>	<u>Risk premium</u>
1970	3.94%	6.50%	-2.56%
1971	14.30	4.36	9.94
1972	18.99	4.23	14.76
1973	-14.69	7.29	-21.98
1974	-26.47	7.99	-34.46
1975	<u>37.23</u>	<u>5.87</u>	<u>31.36</u>
	33.30	36.24	-2.94

- a. The average return for large company stocks over this period was:

$$\text{Large company stocks average return} = 33.30\% / 6 = 5.55\%$$

And the average return for T-bills over this period was:

$$\text{T-bills average return} = 36.24\% / 6 = 6.04\%$$

- b. Using the equation for variance, we find the variance for large company stocks over this period was:

$$\begin{aligned} \text{Variance} &= 1/5[(.0394 - .0555)^2 + (.1430 - .0555)^2 + (.1899 - .0555)^2 + (-.1469 - .0555)^2 + \\ &\quad (-.2647 - .0555)^2 + (.3723 - .0555)^2] \\ \text{Variance} &= 0.053967 \end{aligned}$$

And the standard deviation for large company stocks over this period was:

$$\text{Standard deviation} = (0.053967)^{1/2} = 0.2323 \text{ or } 23.23\%$$

Using the equation for variance, we find the variance for T-bills over this period was:

$$\begin{aligned} \text{Variance} &= 1/5[(.0650 - .0604)^2 + (.0436 - .0604)^2 + (.0423 - .0604)^2 + (.0729 - .0604)^2 + \\ &\quad (.0799 - .0604)^2 + (.0587 - .0604)^2] \\ \text{Variance} &= 0.000234 \end{aligned}$$

And the standard deviation for T-bills over this period was:

$$\text{Standard deviation} = (0.000234)^{1/2} = 0.0153 \text{ or } 1.53\%$$

- c. The average observed risk premium over this period was:

$$\text{Average observed risk premium} = -2.94\% / 6 = -0.49\%$$

The variance of the observed risk premium was:

$$\begin{aligned} \text{Variance} &= 1/5[(-.0256 - (-.0049))^2 + (.0994 - (-.0049))^2 + (.1476 - (-.0049))^2 + \\ &\quad (-.2198 - (-.0049))^2 + (-.3446 - (-.0049))^2 + (.3136 - (-.0049))^2] \\ \text{Variance} &= 0.059517 \end{aligned}$$

And the standard deviation of the observed risk premium was:

$$\text{Standard deviation} = (0.059517)^{1/2} = 0.2440 \text{ or } 24.40\%$$

- d. Before the fact, for most assets the risk premium will be positive; investors demand compensation over and above the risk-free return to invest their money in the risky asset. After the fact, the observed risk premium can be negative if the asset's nominal return is unexpectedly low, the risk-free return is unexpectedly high, or if some combination of these two events occurs.

9. a. To find the average return, we sum all the returns and divide by the number of returns, so:

$$\text{Average return} = (.02 - .08 + .24 + .19 + .12)/5 = .0980 \text{ or } 9.80\%$$

## B-224 SOLUTIONS

b. Using the equation to calculate variance, we find:

$$\text{Variance} = 1/4[(.02 - .098)^2 + (-.08 - .098)^2 + (.24 - .098)^2 + (.19 - .098)^2 + (.12 - .098)^2]$$

$$\text{Variance} = 0.01672$$

So, the standard deviation is:

$$\text{Standard deviation} = (0.01672)^{1/2} = 0.1293 \text{ or } 12.93\%$$

10. a. To calculate the average real return, we can use the average return of the asset, and the average risk-free rate in the Fisher equation. Doing so, we find:

$$(1 + R) = (1 + r)(1 + h)$$

$$\bar{r} = (1.0980/1.035) - 1 = .0609 \text{ or } 6.09\%$$

b. The average risk premium is simply the average return of the asset, minus the average risk-free rate, so, the average risk premium for this asset would be:

$$\overline{\text{RP}} = \bar{R} - \bar{R}_f = .0980 - .042 = .0560 \text{ or } 5.60\%$$

11. We can find the average real risk-free rate using the Fisher equation. The average real risk-free rate was:

$$(1 + R) = (1 + r)(1 + h)$$

$$\bar{r}_f = (1.042/1.035) - 1 = .0068 \text{ or } 0.68\%$$

And to calculate the average real risk premium, we can subtract the average risk-free rate from the average real return. So, the average real risk premium was:

$$\overline{\text{rp}} = \bar{r} - \bar{r}_f = 6.09\% - 0.68\% = 5.41\%$$

12. T-bill rates were highest in the early eighties. This was during a period of high inflation and is consistent with the Fisher effect.

Intermediate

13. To find the real return, we first need to find the nominal return, which means we need the current price of the bond. Going back to the chapter on pricing bonds, we find the current price is:

$$P_1 = \$70(\text{PVIFA}_{8\%,6}) + \$1,000(\text{PVIF}_{8\%,6}) = \$953.77$$

So the nominal return is:

$$R = [(\$953.77 - 920) + 70]/\$920 = .1128 \text{ or } 11.28\%$$

And, using the Fisher equation, we find the real return is:

$$1 + R = (1 + r)(1 + h)$$

$$r = (1.1128/1.042) - 1 = .0679 \text{ or } 6.79\%$$

14. Here we know the average stock return, and four of the five returns used to compute the average return. We can work the average return equation backward to find the missing return. The average return is calculated as:

$$.55 = .13 - .09 - .15 + .41 + R$$

$$R = .25 \text{ or } 25\%$$

The missing return has to be 25 percent. Now we can use the equation for the variance to find:

$$\text{Variance} = 1/4[(.13 - .11)^2 + (-.09 - .11)^2 + (-.15 - .11)^2 + (.41 - .11)^2 + (.25 - .11)^2]$$

$$\text{Variance} = 0.054400$$

And the standard deviation is:

$$\text{Standard deviation} = (0.054400)^{1/2} = 0.2332 \text{ or } 23.32\%$$

15. The arithmetic average return is the sum of the known returns divided by the number of returns, so:

$$\text{Arithmetic average return} = (.18 + .04 + .39 - .05 + .26 - .11) / 6$$

$$\text{Arithmetic average return} = .1183 \text{ or } 11.83\%$$

Using the equation for the geometric return, we find:

$$\text{Geometric average return} = [(1 + R_1) \times (1 + R_2) \times \dots \times (1 + R_T)]^{1/T} - 1$$

$$\text{Geometric average return} = [(1 + .18)(1 + .04)(1 + .39)(1 - .05)(1 + .26)(1 - .11)]^{(1/6)} - 1$$

$$\text{Geometric average return} = .1047 \text{ or } 10.47\%$$

Remember, the geometric average return will always be less than the arithmetic average return if the returns have any variation.

## B-226 SOLUTIONS

- 16.** To calculate the arithmetic and geometric average returns, we must first calculate the return for each year. The return for each year is:

$$R_1 = (\$52.89 - 51.87 + 0.84) / \$51.87 = .0359 \text{ or } 3.59\%$$

$$R_2 = (\$64.12 - 52.89 + 0.91) / \$52.89 = .2295 \text{ or } 22.95\%$$

$$R_3 = (\$57.18 - 64.12 + 1.00) / \$64.12 = -.0926 \text{ or } -9.26\%$$

$$R_4 = (\$67.13 - 57.18 + 1.11) / \$57.18 = .1934 \text{ or } 19.34\%$$

$$R_5 = (\$75.82 - 67.13 + 1.24) / \$67.13 = .1479 \text{ or } 14.79\%$$

The arithmetic average return was:

$$R_A = (0.0359 + 0.2295 - 0.0926 + 0.1934 + 0.1479) / 5 = 0.1028 \text{ or } 10.28\%$$

And the geometric average return was:

$$R_G = [(1 + .0359)(1 + .2295)(1 - .0926)(1 + .1934)(1 + .1479)]^{1/5} - 1 = 0.0962 \text{ or } 9.62\%$$

- 17.** Looking at the long-term corporate bond return history in Figure 12.10, we see that the mean return was 6.2 percent, with a standard deviation of 8.5 percent. In the normal probability distribution, approximately 2/3 of the observations are within one standard deviation of the mean. This means that 1/3 of the observations are outside one standard deviation away from the mean. Or:

$$\Pr(R < -2.3 \text{ or } R > 14.7) \approx 1/3$$

But we are only interested in one tail here, that is, returns less than -3.6 percent, so:

$$\Pr(R < -2.3) \approx 1/6$$

You can use the z-statistic and the cumulative normal distribution table to find the answer as well. Doing so, we find:

$$z = (X - \mu) / \sigma$$

$$z = (-2.3\% - 6.2) / 8.5\% = -1.00$$

Looking at the z-table, this gives a probability of 15.87%, or:

$$\Pr(R < -2.3) \approx .1587 \text{ or } 15.87\%$$

The range of returns you would expect to see 95 percent of the time is the mean plus or minus 2 standard deviations, or:

$$95\% \text{ level: } R \in \mu \pm 2\sigma = 6.2\% \pm 2(8.5\%) = -10.80\% \text{ to } 23.20\%$$

The range of returns you would expect to see 99 percent of the time is the mean plus or minus 3 standard deviations, or:

$$99\% \text{ level: } R \in \mu \pm 3\sigma = 6.2\% \pm 3(8.5\%) = -19.30\% \text{ to } 31.70\%$$

- 18.** The mean return for small company stocks was 17.4 percent, with a standard deviation of 32.9 percent. Doubling your money is a 100% return, so if the return distribution is normal, we can use the z-statistic. So:

$$z = (X - \mu)/\sigma$$

$$z = (100\% - 17.4)/32.9\% = 2.511 \text{ standard deviations above the mean}$$

This corresponds to a probability of  $\approx 1\%$ , or once every 100 years. Tripling your money would be:

$$z = (200\% - 17.4)/32.9\% = 5.550 \text{ standard deviations above the mean.}$$

This corresponds to a probability of (much) less than 0.5%, or once every 200 years. (The actual answer is  $\approx .000001\%$ , or about once every 1 million years).

- 19.** It is impossible to lose more than 100 percent of your investment. Therefore, return distributions are truncated on the lower tail at  $-100$  percent.

- 20.** To find the best forecast, we apply Blume's formula as follows:

$$R(5) = \frac{5-1}{29} \times 10.7\% + \frac{30-5}{29} \times 12.8\% = 12.51\%$$

$$R(10) = \frac{10-1}{29} \times 10.7\% + \frac{30-10}{29} \times 12.8\% = 12.15\%$$

$$R(20) = \frac{20-1}{29} \times 10.7\% + \frac{30-20}{29} \times 12.8\% = 11.42\%$$

- 21.** The best forecast for a one year return is the arithmetic average, which is 12.3 percent. The geometric average, found in Table 12.4 is 10.4 percent. To find the best forecast for other periods, we apply Blume's formula as follows:

$$R(5) = \frac{5-1}{80-1} \times 10.4\% + \frac{80-5}{80-1} \times 12.3\% = 12.20\%$$

$$R(20) = \frac{20-1}{80-1} \times 10.4\% + \frac{80-20}{80-1} \times 12.3\% = 11.84\%$$

$$R(30) = \frac{30-1}{80-1} \times 10.4\% + \frac{80-30}{80-1} \times 12.3\% = 11.60\%$$

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22. To find the real return we need to use the Fisher equation. Re-writing the Fisher equation to solve for the real return, we get:

$$r = [(1 + R)/(1 + h)] - 1$$

So, the real return each year was:

<u>Year</u>	<u>T-bill return</u>	<u>Inflation</u>	<u>Real return</u>
1973	0.0729	0.0871	-0.0131
1974	0.0799	0.1234	-0.0387
1975	0.0587	0.0694	-0.0100
1976	0.0507	0.0486	0.0020
1977	0.0545	0.0670	-0.0117
1978	0.0764	0.0902	-0.0127
1979	0.1056	0.1329	-0.0241
1980	0.1210	0.1252	-0.0037
	0.6197	0.7438	-0.1120

- a. The average return for T-bills over this period was:

$$\begin{aligned} \text{Average return} &= 0.619 / 8 \\ \text{Average return} &= .0775 \text{ or } 7.75\% \end{aligned}$$

And the average inflation rate was:

$$\begin{aligned} \text{Average inflation} &= 0.7438 / 8 \\ \text{Average inflation} &= .0930 \text{ or } 9.30\% \end{aligned}$$

- b. Using the equation for variance, we find the variance for T-bills over this period was:

$$\begin{aligned} \text{Variance} &= 1/7[(.0729 - .0775)^2 + (.0799 - .0775)^2 + (.0587 - .0775)^2 + (.0507 - .0775)^2 + \\ &\quad (.0545 - .0775)^2 + (.0764 - .0775)^2 + (.1056 - .0775)^2 + (.1210 - .0775)^2] \\ \text{Variance} &= 0.000616 \end{aligned}$$

And the standard deviation for T-bills was:

$$\begin{aligned} \text{Standard deviation} &= (0.000616)^{1/2} \\ \text{Standard deviation} &= 0.0248 \text{ or } 2.48\% \end{aligned}$$

The variance of inflation over this period was:

$$\begin{aligned} \text{Variance} &= 1/7[(.0871 - .0930)^2 + (.1234 - .0930)^2 + (.0694 - .0930)^2 + (.0486 - .0930)^2 + \\ &\quad (.0670 - .0930)^2 + (.0902 - .0930)^2 + (.1329 - .0930)^2 + (.1252 - .0930)^2] \\ \text{Variance} &= 0.000971 \end{aligned}$$

And the standard deviation of inflation was:

$$\begin{aligned} \text{Standard deviation} &= (0.000971)^{1/2} \\ \text{Standard deviation} &= 0.0312 \text{ or } 3.12\% \end{aligned}$$

c. The average observed real return over this period was:

$$\begin{aligned}\text{Average observed real return} &= -.1122 / 8 \\ \text{Average observed real return} &= -.0140 \text{ or } -1.40\%\end{aligned}$$

d. The statement that T-bills have no risk refers to the fact that there is only an extremely small chance of the government defaulting, so there is little default risk. Since T-bills are short term, there is also very limited interest rate risk. However, as this example shows, there is inflation risk, i.e. the purchasing power of the investment can actually decline over time even if the investor is earning a positive return.

### Challenge

23. Using the z-statistic, we find:

$$z = (X - \mu) / \sigma$$

$$z = (0\% - 12.3) / 20.2\% = -0.6089$$

$$\Pr(R \leq 0) \approx 27.13\%$$

24. For each of the questions asked here, we need to use the z-statistic, which is:

$$z = (X - \mu) / \sigma$$

$$a. \quad z_1 = (10\% - 6.2) / 8.5\% = 0.4471$$

This z-statistic gives us the probability that the return is less than 10 percent, but we are looking for the probability the return is greater than 10 percent. Given that the total probability is 100 percent (or 1), the probability of a return greater than 10 percent is 1 minus the probability of a return less than 10 percent. Using the cumulative normal distribution table, we get:

$$\Pr(R \geq 10\%) = 1 - \Pr(R \leq 10\%) = 1 - .6726 \approx 32.74\%$$

For a return greater than 0 percent:

$$z_2 = (0\% - 6.2) / 8.5 = -0.7294$$

$$\Pr(R \geq 10\%) = 1 - \Pr(R \leq 10\%) = 1 - .7673 \approx 23.29\%$$

b. The probability that T-bill returns will be greater than 10 percent is:

$$z_3 = (10\% - 3.8) / 3.1\% = 2$$

$$\Pr(R \geq 10\%) = 1 - \Pr(R \leq 10\%) = 1 - .9772 \approx 2.28\%$$

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And the probability that T-bill returns will be less than 0 percent is:

$$z_4 = (0\% - 3.8)/3.1\% = -1.2258$$

$$\Pr(R \leq 0) \approx 11.01\%$$

c. The probability that the return on long-term corporate bonds will be less than -4.18 percent is:

$$z_5 = (-4.18\% - 6.2)/8.5\% = -1.2212$$

$$\Pr(R \leq -4.18\%) \approx 11.10\%$$

And the probability that T-bill returns will be greater than 10.32 percent is:

$$z_6 = (10.32\% - 3.8)/3.1\% = 2.1032$$

$$\Pr(R \geq 10.32\%) = 1 - \Pr(R \leq 10.32\%) = 1 - .9823 \approx 1.77\%$$

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# CHAPTER 13

## RISK, RETURN, AND THE SECURITY MARKET LINE

### Answers to Concepts Review and Critical Thinking Questions

1. Some of the risk in holding any asset is unique to the asset in question. By investing in a variety of assets, this unique portion of the total risk can be eliminated at little cost. On the other hand, there are some risks that affect all investments. This portion of the total risk of an asset cannot be costlessly eliminated. In other words, systematic risk can be controlled, but only by a costly reduction in expected returns.
2. If the market expected the growth rate in the coming year to be 2 percent, then there would be no change in security prices if this expectation had been fully anticipated and priced. However, if the market had been expecting a growth rate other than 2 percent and the expectation was incorporated into security prices, then the government's announcement would most likely cause security prices in general to change; prices would drop if the anticipated growth rate had been more than 2 percent, and prices would rise if the anticipated growth rate had been less than 2 percent.
3.
  - a. systematic
  - b. unsystematic
  - c. both; probably mostly systematic
  - d. unsystematic
  - e. unsystematic
  - f. systematic
4.
  - a. a change in systematic risk has occurred; market prices in general will most likely decline.
  - b. no change in unsystematic risk; company price will most likely stay constant.
  - c. no change in systematic risk; market prices in general will most likely stay constant.
  - d. a change in unsystematic risk has occurred; company price will most likely decline.
  - e. no change in systematic risk; market prices in general will most likely stay constant.
5. No to both questions. The portfolio expected return is a weighted average of the asset returns, so it must be less than the largest asset return and greater than the smallest asset return.
6. False. The variance of the individual assets is a measure of the total risk. The variance on a well-diversified portfolio is a function of systematic risk only.
7. Yes, the standard deviation can be less than that of every asset in the portfolio. However,  $\beta_p$  cannot be less than the smallest beta because  $\beta_p$  is a weighted average of the individual asset betas.
8. Yes. It is possible, in theory, to construct a zero beta portfolio of risky assets whose return would be equal to the risk-free rate. It is also possible to have a negative beta; the return would be less than the risk-free rate. A negative beta asset would carry a negative risk premium because of its value as a diversification instrument.

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9. Such layoffs generally occur in the context of corporate restructurings. To the extent that the market views a restructuring as value-creating, stock prices will rise. So, it's not layoffs per se that are being cheered on. Nonetheless, Wall Street does encourage corporations to take actions to create value, even if such actions involve layoffs.
10. Earnings contain information about recent sales and costs. This information is useful for projecting future growth rates and cash flows. Thus, unexpectedly low earnings often lead market participants to reduce estimates of future growth rates and cash flows; price drops are the result. The reverse is often true for unexpectedly high earnings.

### Solutions to Questions and Problems

*NOTE: All end of chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.*

#### Basic

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:

$$\text{Total value} = 100(\$40) + 130(\$22) = \$6,860$$

The portfolio weight for each stock is:

$$\text{Weight}_A = 100(\$40)/\$6,860 = .5831$$

$$\text{Weight}_B = 130(\$22)/\$6,860 = .4169$$

2. The expected return of a portfolio is the sum of the weight of each asset times the expected return of each asset. The total value of the portfolio is:

$$\text{Total value} = \$2,300 + 3,400 = \$5,700$$

So, the expected return of this portfolio is:

$$E(R_p) = (\$2,300/\$5,700)(0.11) + (\$3,400/\$5,700)(0.16) = .1398 \text{ or } 13.98\%$$

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:

$$E(R_p) = .50(.10) + .30(.16) + .20(.12) = .1220 \text{ or } 12.20\%$$

4. Here we are given the expected return of the portfolio and the expected return of each asset in the portfolio, and are asked to find the weight of each asset. We can use the equation for the expected return of a portfolio to solve this problem. Since the total weight of a portfolio must equal 1 (100%), the weight of Stock Y must be one minus the weight of Stock X. Mathematically speaking, this means:

$$E(R_p) = .122 = .15w_X + .10(1 - w_X)$$

We can now solve this equation for the weight of Stock X as:

$$.122 = .15w_X + .10 - .10w_X$$

$$.022 = .05w_X$$

$$w_X = 0.44$$

So, the dollar amount invested in Stock X is the weight of Stock X times the total portfolio value, or:

$$\text{Investment in X} = 0.44(\$10,000) = \$4,400$$

And the dollar amount invested in Stock Y is:

$$\text{Investment in Y} = (1 - 0.44)(\$10,000) = \$5,600$$

5. 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 the asset is:

$$E(R) = .3(-.09) + .7(.33) = .2040 \text{ or } 20.40\%$$

6. 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 the asset is:

$$E(R) = .25(-.05) + .40(.12) + .35(.25) = .1230 \text{ or } 12.30\%$$

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:

$$E(R_A) = .15(.06) + .60(.07) + .25(.11) = .0785 \text{ or } 7.85\%$$

$$E(R_B) = .15(-.2) + .60(.13) + .25(.33) = .1305 \text{ or } 13.05\%$$

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:

$$\sigma_A^2 = .15(.06 - .0785)^2 + .60(.07 - .0785)^2 + .25(.11 - .0785)^2 = .00034$$

$$\sigma_A = (.00034)^{1/2} = .0185 \text{ or } 1.85\%$$

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$$\sigma_B^2 = .15(-.2 - .1305)^2 + .60(.13 - .1305)^2 + .25(.33 - .1305)^2 = .02633$$

$$\sigma_B = (.02633)^{1/2} = .1623 \text{ or } 16.23\%$$

8. 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:

$$E(R_p) = .10(.08) + .75(.15) + .15(.24) = .1565 \text{ or } 15.65\%$$

If we own this portfolio, we would expect to get a return of 15.65 percent.

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:

$$\text{Boom: } E(R_p) = (.07 + .15 + .33)/3 = .1833 \text{ or } 18.33\%$$

$$\text{Bust: } E(R_p) = (.13 + .03 - .06)/3 = .0333 \text{ or } 3.33\%$$

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:

$$E(R_p) = .75(.1833) + .25(.0333) = .1458 \text{ or } 14.58\%$$

- 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:

$$\text{Boom: } E(R_p) = .20(.07) + .20(.15) + .60(.33) = .2420 \text{ or } 24.20\%$$

$$\text{Bust: } E(R_p) = .20(.13) + .20(.03) + .60(-.06) = -.0040 \text{ or } -0.40\%$$

And the expected return of the portfolio is:

$$E(R_p) = .75(.2420) + .25(-.004) = .1805 \text{ or } 18.05\%$$

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 the portfolio is:

$$\sigma_p^2 = .75(.2420 - .1805)^2 + .25(-.0040 - .1805)^2 = .011347$$

10. a. This portfolio does not have an equal weight in each asset. We first 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:

$$\text{Boom: } E(R_p) = .30(.3) + .40(.45) + .30(.33) = .3690 \text{ or } 36.90\%$$

$$\text{Good: } E(R_p) = .30(.12) + .40(.10) + .30(.15) = .1210 \text{ or } 12.10\%$$

$$\text{Poor: } E(R_p) = .30(.01) + .40(-.15) + .30(-.05) = -.0720 \text{ or } -7.20\%$$

$$\text{Bust: } E(R_p) = .30(-.06) + .40(-.30) + .30(-.09) = -.1650 \text{ or } -16.50\%$$

And the expected return of the portfolio is:

$$E(R_p) = .20(.3690) + .40(.1210) + .30(-.0720) + .10(-.1650) = .0841 \text{ or } 8.41\%$$

- b. 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 the portfolio is:

$$\sigma_p^2 = .20(.3690 - .0841)^2 + .40(.1210 - .0841)^2 + .30(-.0720 - .0841)^2 + .10(-.1650 - .0841)^2$$

$$\sigma_p^2 = .03029$$

$$\sigma_p = (.03029)^{1/2} = .1741 \text{ or } 17.41\%$$

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:

$$\beta_p = .25(.75) + .20(1.24) + .15(1.09) + .40(1.42) = 1.17$$

12. The beta of a portfolio is the sum of the weight of each asset times the beta of each asset. If the portfolio is as risky as the market it must have the same beta as the market. Since the beta of the market is one, we know the beta of our portfolio is one. We also need to remember that the beta of the risk-free asset is zero. It has to be zero since the asset has no risk. Setting up the equation for the beta of our portfolio, we get:

$$\beta_p = 1.0 = 1/3(0) + 1/3(1.65) + 1/3(\beta_X)$$

Solving for the beta of Stock X, we get:

$$\beta_X = 1.35$$

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- 13.** CAPM states the relationship between the risk of an asset and its expected return. CAPM is:

$$E(R_i) = R_f + [E(R_M) - R_f] \times \beta_i$$

Substituting the values we are given, we find:

$$E(R_i) = .052 + (.14 - .052)(1.25) = .162 \text{ or } 16.2\%$$

- 14.** We are given the values for the CAPM except for the  $\beta$  of the stock. We need to substitute these values into the CAPM, and solve for the  $\beta$  of the stock. One important thing we need to realize is that we are given the market risk premium. The market risk premium is the expected return of the market minus the risk-free rate. We must be careful not to use this value as the expected return of the market. Using the CAPM, we find:

$$E(R_i) = .13 = .045 + .07\beta_i$$

$$\beta_i = 1.21$$

- 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:

$$E(R_i) = .10 = .055 + [E(R_M) - .055](.70)$$

$$E(R_M) = .1193 \text{ or } 11.93\%$$

- 16.** Here we need to find the risk-free rate using the CAPM. Substituting the values given, and solving for the risk-free rate, we find:

$$E(R_i) = .15 = R_f + (.12 - R_f)(1.45)$$

$$.15 = R_f + .174 - 1.45R_f$$

$$R_f = .0533 \text{ or } 5.33\%$$

- 17. a.** Again we have a special case where the portfolio is equally weighted, so we can sum the returns of each asset and divide by the number of assets. The expected return of the portfolio is:

$$E(R_p) = (.17 + .05)/2 = .1100 \text{ or } 11.00\%$$

- b. We need to find the portfolio weights that result in a portfolio with a  $\beta$  of 0.75. We know the  $\beta$  of the risk-free asset is zero. We also know the weight of the risk-free asset is one minus the weight of the stock since the portfolio weights must sum to one, or 100 percent. So:

$$\begin{aligned}\beta_p &= 0.75 = w_S(1.3) + (1 - w_S)(0) \\ 0.75 &= 1.3w_S + 0 - 0w_S \\ w_S &= 0.75/1.3 \\ w_S &= .5769\end{aligned}$$

And, the weight of the risk-free asset is:

$$w_{RF} = 1 - .5769 = .4231$$

- c. We need to find the portfolio weights that result in a portfolio with an expected return of 8 percent. We also know the weight of the risk-free asset is one minus the weight of the stock since the portfolio weights must sum to one, or 100 percent. So:

$$\begin{aligned}E(R_p) &= .08 = .17w_S + .05(1 - w_S) \\ .08 &= .17w_S + .05 - .05w_S \\ w_S &= .2500\end{aligned}$$

So, the  $\beta$  of the portfolio will be:

$$\beta_p = .2500(1.3) + (1 - .2500)(0) = 0.325$$

- d. Solving for the  $\beta$  of the portfolio as we did in part a, we find:

$$\begin{aligned}\beta_p &= 2.6 = w_S(1.3) + (1 - w_S)(0) \\ w_S &= 2.6/1.3 = 2 \\ w_{RF} &= 1 - 2 = -1\end{aligned}$$

The portfolio is invested 200% in the stock and -100% in the risk-free asset. This represents borrowing at the risk-free rate to buy more of the stock.

- 18.** First, we need to find the  $\beta$  of the portfolio. The  $\beta$  of the risk-free asset is zero, and the weight of the risk-free asset is one minus the weight of the stock, the  $\beta$  of the portfolio is:

$$\beta_p = w_W(1.2) + (1 - w_W)(0) = 1.2w_W$$

So, to find the  $\beta$  of the portfolio for any weight of the stock, we simply multiply the weight of the stock times its  $\beta$ .

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Even though we are solving for the  $\beta$  and expected return of a portfolio of one stock and the risk-free asset for different portfolio weights, we are really solving for the SML. Any combination of this stock, and the risk-free asset will fall on the SML. For that matter, a portfolio of any stock and the risk-free asset, or any portfolio of stocks, will fall on the SML. We know the slope of the SML line is the market risk premium, so using the CAPM and the information concerning this stock, the market risk premium is:

$$E(R_w) = .15 = .05 + \text{MRP}(1.20)$$

$$\text{MRP} = .11/1.2 = .0833 \text{ or } 8.33\%$$

So, now we know the CAPM equation for any stock is:

$$E(R_p) = .05 + .0833\beta_p$$

The slope of the SML is equal to the market risk premium, which is 0.0833. Using these equations to fill in the table, we get the following results:

$w_w$	$E(R_p)$	$\beta_p$
0%	.0500	0
25	.0750	0.300
50	.1000	0.600
75	.1250	0.900
100	.1500	1.200
125	.1750	1.500
150	.2000	1.800

- 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:

$$E(R_Y) = .06 + .088(1.40) = .1832 \text{ or } 18.32\%$$

It is given in the problem that the expected return of Stock Y is 19 percent, but according to the CAPM, the return of the stock based on its level of risk, the expected return should be 18.32 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 18.32 percent. For Stock Z, we find:

$$E(R_Z) = .06 + .088(0.65) = .1172 \text{ or } 11.72\%$$

The return given for Stock Z is 10.5 percent, but according to the CAPM the expected return of the stock should be 11.72 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 11.72 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  $\beta$ . We are given the market risk premium, and we know the  $\beta$  of the market is one, so the reward-to-risk ratio for the market is 0.088, or 8.8 percent. Calculating the reward-to-risk ratio for Stock Y, we find:

$$\text{Reward-to-risk ratio Y} = (.19 - .06) / 1.40 = .0929$$

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:

$$\text{Reward-to-risk ratio Z} = (.105 - .06) / .65 = .0692$$

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.

- 20.** We need to set the reward-to-risk ratios of the two assets equal to each other, which is:

$$(.19 - R_f) / 1.40 = (.105 - R_f) / 0.65$$

We can cross multiply to get:

$$0.65(.19 - R_f) = 1.40(.105 - R_f)$$

Solving for the risk-free rate, we find:

$$0.1235 - 0.65R_f = 0.147 - 1.40R_f$$

$$R_f = .0313 \text{ or } 3.13\%$$

### Intermediate

- 21.** For a portfolio that is equally invested in large-company stocks and long-term bonds:

$$\text{Return} = (12.30\% + 5.80\%) / 2 = 9.05\%$$

For a portfolio that is equally invested in small stocks and Treasury bills:

$$\text{Return} = (17.40\% + 3.80\%) / 2 = 10.60\%$$

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22. We know that the reward-to-risk ratios for all assets must be equal. This can be expressed as:

$$[E(R_A) - R_f]/\beta_A = [E(R_B) - R_f]/\beta_B$$

The numerator of each equation is the risk premium of the asset, so:

$$RP_A/\beta_A = RP_B/\beta_B$$

We can rearrange this equation to get:

$$\beta_B/\beta_A = RP_B/RP_A$$

If the reward-to-risk ratios are the same, the ratio of the betas of the assets is equal to the ratio of the risk premiums of the assets.

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:

$$\text{Boom: } E(R_p) = .4(.24) + .4(.36) + .2(.55) = .3500 \text{ or } 35.00\%$$

$$\text{Normal: } E(R_p) = .4(.17) + .4(.13) + .2(.09) = .1380 \text{ or } 13.80\%$$

$$\text{Bust: } E(R_p) = .4(.00) + .4(-.28) + .2(-.45) = -.2020 \text{ or } -20.20\%$$

And the expected return of the portfolio is:

$$E(R_p) = .4(.35) + .4(.138) + .2(-.202) = .1548 \text{ or } 15.48\%$$

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 the portfolio is:

$$\sigma_p^2 = .4(.35 - .1548)^2 + .4(.138 - .1548)^2 + .2(-.202 - .1548)^2$$

$$\sigma_p^2 = .04082$$

$$\sigma_p = (.04082)^{1/2} = .2020 \text{ or } 20.20\%$$

- 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:

$$RP_1 = E(R_p) - R_f = .1548 - .038 = .1168 \text{ or } 11.68\%$$

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

$$\text{Approximate expected real return} = .1548 - .035 = .1198 \text{ or } 11.98\%$$

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

$$\begin{aligned} 1 + E(R_i) &= (1 + h)[1 + e(r_i)] \\ 1.1548 &= (1.0350)[1 + e(r_i)] \\ e(r_i) &= (1.1548/1.035) - 1 = .1157 \text{ or } 11.57\% \end{aligned}$$

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

$$\text{Approximate expected real risk premium} = .1548 - .038 = .1168 \text{ or } 11.68\%$$

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

$$\text{Exact expected real risk premium} = .1168/1.035 = .1129 \text{ or } 11.29\%$$

- 24.** Since the portfolio is as risky as the market, the  $\beta$  of the portfolio must be equal to one. We also know the  $\beta$  of the risk-free asset is zero. We can use the equation for the  $\beta$  of a portfolio to find the weight of the third stock. Doing so, we find:

$$\beta_p = 1.0 = w_A(.8) + w_B(1.3) + w_C(1.5) + w_{Rf}(0)$$

Solving for the weight of Stock C, we find:

$$w_C = .313333$$

So, the dollar investment in Stock C must be:

$$\text{Invest in Stock C} = .313333(\$1,000,000) = \$313,333$$

We know the total portfolio value and the investment of two stocks in the portfolio, so we can find the weight of these two stocks. The weights of Stock A and Stock B are:

$$w_A = \$175,000 / \$1,000,000 = .175$$

$$w_B = \$300,000 / \$1,000,000 = .30$$

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We also know the total portfolio weight must be one, so the weight of the risk-free asset must be one minus the asset weight we know, or:

$$1 = w_A + w_B + w_C + w_{Rf} = 1 - .175 - .30 - .31333 - w_{Rf}$$

$$w_{Rf} = .211667$$

So, the dollar investment in the risk-free asset must be:

$$\text{Invest in risk-free asset} = .211667(\$1,000,000) = \$211,667$$

- 25.** We are given the expected return and  $\beta$  of a portfolio and the expected return and  $\beta$  of assets in the portfolio. We know the  $\beta$  of the risk-free asset is zero. We also know the sum of the weights of each asset must be equal to one. So, the weight of the risk-free asset is one minus the weight of Stock X and the weight of Stock Y. Using this relationship, we can express the expected return of the portfolio as:

$$E(R_p) = .130 = w_X(.31) + w_Y(.20) + (1 - w_X - w_Y)(.07)$$

And the  $\beta$  of the portfolio is:

$$\beta_p = .7 = w_X(1.8) + w_Y(1.3) + (1 - w_X - w_Y)(0)$$

We have two equations and two unknowns. Solving these equations, we find that:

$$w_X = -0.16667$$

$$w_Y = 0.76923$$

$$w_{Rf} = 0.39744$$

The amount to invest in Stock X is:

$$\text{Investment in stock X} = -0.16667(\$100,000) = -\$16,666.67$$

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.

26. The amount of systematic risk is measured by the  $\beta$  of an asset. Since we know the market risk premium and the risk-free rate, if we know the expected return of the asset we can use the CAPM to solve for the  $\beta$  of the asset. The expected return of Stock I is:

$$E(R_I) = .25(.09) + .50(.42) + .25(.26) = .2975 \text{ or } 29.75\%$$

Using the CAPM to find the  $\beta$  of Stock I, we find:

$$\begin{aligned} .2975 &= .04 + .08\beta_I \\ \beta_I &= 3.22 \end{aligned}$$

The total risk of the asset is measured by its standard deviation, so we need to calculate the standard deviation of Stock I. Beginning with the calculation of the stock's variance, we find:

$$\begin{aligned} \sigma_I^2 &= .25(.09 - .2975)^2 + .50(.42 - .2975)^2 + .25(.26 - .2975)^2 \\ \sigma_I^2 &= .01862 \end{aligned}$$

$$\sigma_I = (.01862)^{1/2} = .1365 \text{ or } 13.65\%$$

Using the same procedure for Stock II, we find the expected return to be:

$$E(R_{II}) = .25(-.30) + .50(.12) + .25(.44) = .0950$$

Using the CAPM to find the  $\beta$  of Stock II, we find:

$$\begin{aligned} .0950 &= .04 + .08\beta_{II} \\ \beta_{II} &= 0.69 \end{aligned}$$

And the standard deviation of Stock II is:

$$\begin{aligned} \sigma_{II}^2 &= .25(-.30 - .0950)^2 + .50(.12 - .0950)^2 + .25(.44 - .0950)^2 \\ \sigma_{II}^2 &= .06908 \end{aligned}$$

$$\sigma_{II} = (.06908)^{1/2} = .2628 \text{ or } 26.28\%$$

Although Stock II has more total risk than I, it has much less systematic risk, since its beta is much smaller than I's. Thus, I has more systematic risk, and II has more unsystematic and more total risk. Since unsystematic risk can be diversified away, I is actually the "riskier" stock despite the lack of volatility in its returns. Stock I will have a higher risk premium and a greater expected return.

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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:

$$\begin{aligned} (.15 - R_f)/1.4 &= (.115 - R_f)/.90 \\ .90(.15 - R_f) &= 1.4(.115 - R_f) \\ .135 - .9R_f &= .161 - 1.4R_f \\ .5R_f &= .026 \\ R_f &= .052 \text{ or } 5.20\% \end{aligned}$$

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

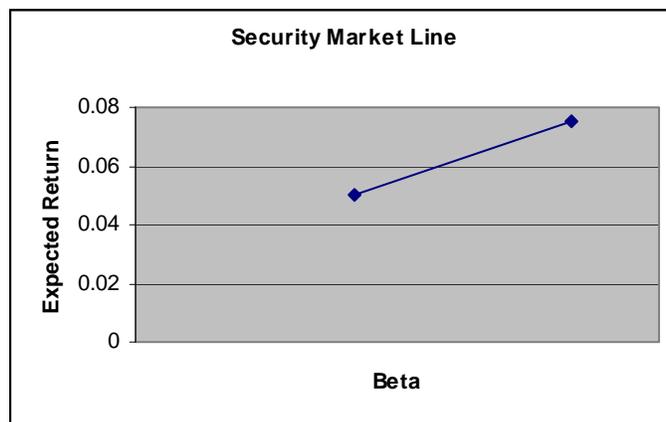
$$\begin{aligned} .15 &= .0520 + 1.4(R_M - .0520) & .115 &= .0520 + .9(R_M - .0520) \\ R_M &= .1220 \text{ or } 12.20\% & R_M &= .1220 \text{ or } 12.20\% \end{aligned}$$

28. a. 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 is:

$$E(R_A) = .25(-.10) + .50(.10) + .25(.20) = .0750 \text{ or } 7.50\%$$

$$E(R_B) = .25(-.30) + .50(.05) + .25(.40) = .0500 \text{ or } 5.00\%$$

- b. We can use the expected returns we calculated to find the slope of the Security Market Line. We know that the beta of Stock A is .25 greater than the beta of Stock B. Therefore, as beta increases by .25, the expected return on a security increases by .025 (= .075 - .05). The slope of



the security market line (SML) equals:

$$\begin{aligned} \text{Slope}_{\text{SML}} &= \text{Rise} / \text{Run} \\ \text{Slope}_{\text{SML}} &= \text{Increase in expected return} / \text{Increase in beta} \\ \text{Slope}_{\text{SML}} &= (.075 - .05) / .25 \\ \text{Slope}_{\text{SML}} &= .1000 \text{ or } 10\% \end{aligned}$$

Since the market's beta is 1 and the risk-free rate has a beta of zero, the slope of the Security Market Line equals the expected market risk premium. So, the expected market risk premium must be 10 percent.

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# CHAPTER 14

## OPTIONS AND CORPORATE FINANCE

### Answers to Concepts Review and Critical Thinking Questions

1. A call option confers the right, without the obligation, to buy an asset at a given price on or before a given date. A put option confers the right, without the obligation, to sell an asset at a given price on or before a given date. You would buy a call option if you expect the price of the asset to increase. You would buy a put option if you expect the price of the asset to decrease. A call option has unlimited potential profit, while a put option has limited potential profit; the underlying asset's price cannot be less than zero.
2.
  - a. The buyer of a call option pays money for the right to buy....
  - b. The buyer of a put option pays money for the right to sell....
  - c. The seller of a call option receives money for the obligation to sell....
  - d. The seller of a put option receives money for the obligation to buy....
3. The intrinsic value of a call option is  $\text{Max}[S - E, 0]$ . It is the value of the option at expiration.
4. The value of a put option at expiration is  $\text{Max}[E - S, 0]$ . By definition, the intrinsic value of an option is its value at expiration, so  $\text{Max}[E - S, 0]$  is the intrinsic value of a put option.
5. The call is selling for less than its intrinsic value; an arbitrage opportunity exists. Buy the call for \$10, exercise the call by paying \$35 in return for a share of stock, and sell the stock for \$50. You've made a riskless \$5 profit.
6. The prices of both the call and the put option should increase. The higher level of downside risk still results in an option price of zero, but the upside potential is greater since there is a higher probability that the asset will finish in the money.
7. False. The value of a call option depends on the total variance of the underlying asset, not just the systematic variance.
8. The call option will sell for more since it provides an unlimited profit opportunity, while the potential profit from the put is limited (the stock price cannot fall below zero).
9. The value of a call option will increase, and the value of a put option will decrease.
10. The reason they don't show up is that the U.S. government uses cash accounting; i.e., only actual cash inflows and outflows are counted, not contingent cash flows. From a political perspective, they would make the deficit larger, so that is another reason not to count them! Whether they should be included depends on whether we feel cash accounting is appropriate or not, but these contingent liabilities should be measured and reported. They currently are not, at least not in a systematic fashion.
11. The option to abandon reflects our ability to shut down a project if it is losing money. Since this option acts to limit losses, we will underestimate NPV if we ignore it.

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12. The option to expand reflects our ability to increase production if the new product sells more than we initially expected. Since this option increases the potential future cash flows beyond our initial estimate, we will underestimate NPV if we ignore it.
13. This is a good example of the option to expand.
14. With oil, for example, we can simply stop pumping if prices drop too far, and we can do so quickly. The oil itself is not affected; it just sits in the ground until prices rise to a point where pumping is profitable. Given the volatility of natural resource prices, the option to suspend output is very valuable.
15. There are two possible benefits. First, awarding employee stock options may better align the interests of the employees with the interests of the stockholders, lowering agency costs. Secondly, if the company has little cash available to pay top employees, employee stock options may help attract qualified employees for less pay.

### Solutions to Questions and Problems

*NOTE: All end of chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.*

#### Basic

1. a. The value of the call is the stock price minus the present value of the exercise price, so:

$$C_0 = \$55 - [\$45/1.062] = \$12.63$$

The intrinsic value is the amount by which the stock price exceeds the exercise price of the call, so the intrinsic value is \$10.

- b. The value of the call is the stock price minus the present value of the exercise price, so:

$$C_0 = \$55 - [\$35/1.062] = \$22.04$$

The intrinsic value is the amount by which the stock price exceeds the exercise price of the call, so the intrinsic value is \$20.

- c. The value of the put option is \$0 since there is no possibility that the put will finish in the money. The intrinsic value is also \$0.

2. a. The calls are in the money. The intrinsic value of the calls is \$4.

- b. The puts are out of the money. The intrinsic value of the puts is \$0.

- c. The Mar call and the Oct put are mispriced. The call is mispriced because it is selling for less than its intrinsic value. If the option expired today, the arbitrage strategy would be to buy the call for \$2.80, exercise it and pay \$90 for a share of stock, and sell the stock for \$94. A riskless profit of \$1.20 results. The October put is mispriced because it sells for less than the July put. To take advantage of this, sell the July put for \$3.90 and buy the October put for \$3.65, for a cash inflow of \$0.25. The exposure of the short position is completely covered by the long position in the October put, with a positive cash inflow today.

3. a. Each contract is for 100 shares, so the total cost is:

$$\text{Cost} = 10(100 \text{ shares/contract})(\$8.05)$$

$$\text{Cost} = \$8,050$$

- b. If the stock price at expiration is \$130, the payoff is:

$$\text{Payoff} = 10(100)(\$130 - 110)$$

$$\text{Payoff} = \$20,000$$

If the stock price at expiration is \$118, the payoff is:

$$\text{Payoff} = 10(100)(\$118 - 110)$$

$$\text{Payoff} = \$8,000$$

- c. Remembering that each contract is for 100 shares of stock, the cost is:

$$\text{Cost} = 10(100)(\$5.15)$$

$$\text{Cost} = \$5,150$$

The maximum gain on the put option would occur if the stock price goes to \$0. We also need to subtract the initial cost, so:

$$\text{Maximum gain} = 10(100)(\$110) - \$5,150$$

$$\text{Maximum gain} = \$104,850$$

If the stock price at expiration is \$104, the position will be worth:

$$\text{Position value} = 10(100)(\$110 - 104)$$

$$\text{Position value} = \$6,000$$

And your profit will be:

$$\text{Profit} = \$6,000 - 5,150$$

$$\text{Profit} = \$850$$

- d. At a stock price of \$103 the put is in the money. As the writer you will make:

$$\text{Net gain(loss)} = \$5,150 - 10(100)(\$110 - 103)$$

$$\text{Net gain(loss)} = -\$1,850$$

## B-248 SOLUTIONS

At a stock price of \$132 the put is out of the money, so the writer will make the initial cost:

$$\text{Net gain} = \$5,150$$

At the breakeven, you would recover the initial cost of \$5,150, so:

$$\$5,150 = 10(100)(\$110 - S_T)$$

$$S_T = \$104.85$$

For terminal stock prices above \$104.85, the writer of the put option makes a net profit (ignoring transaction costs and the effects of the time value of money).

4. a. The value of the call is the stock price minus the present value of the exercise price, so:

$$C_0 = \$80 - 75/1.06$$

$$C_0 = \$9.25$$

- b. Using the equation presented in the text to prevent arbitrage, we find the value of the call is:

$$\$80 = [(\$93 - 77)/(\$93 - 85)]C_0 + \$77/1.06$$

$$C_0 = \$3.68$$

5. a. The value of the call is the stock price minus the present value of the exercise price, so:

$$C_0 = \$75 - \$45/1.05$$

$$C_0 = \$32.14$$

- b. Using the equation presented in the text to prevent arbitrage, we find the value of the call is:

$$\$75 = [(\$96 - 65)/(\$85 - 70)]C_0 + \$65/1.05$$

$$C_0 = \$9.82$$

6. Each option contract is for 100 shares of stock, so the price of a call on one share is:

$$C_0 = \$1,200/100 \text{ shares per contract}$$

$$C_0 = \$12$$

Using the no arbitrage model, we find that the price of the stock is:

$$S_0 = \$12[(\$65 - 45)/(\$65 - 60)] + \$45/1.09$$

$$S_0 = \$89.28$$

7. a. The equity can be valued as a call option on the firm with an exercise price equal to the value of the debt, so:

$$E_0 = \$1,040 - [\$1,000/1.06]$$

$$E_0 = \$96.60$$

- b.* The current value of debt is the value of the firm's assets minus the value of the equity, so:

$$D_0 = \$1,040 - 96.60$$

$$D_0 = \$943.40$$

We can use the face value of the debt and the current market value of the debt to find the interest rate, so:

$$\text{Interest rate} = [\$1,000/\$943.40] - 1$$

$$\text{Interest rate} = .06 \text{ or } 6\%$$

- c.* The value of the equity will increase. The debt then requires a higher return; therefore the present value of the debt is less while the value of the firm does not change.

- 8.** *a.* Using the no arbitrage valuation model, we can use the current market value of the firm as the stock price, and the par value of the bond as the strike price to value the equity. Doing so, we get:

$$\$1,200 = [(\$1,500 - 900)/(\$1,500 - 1,000)]E_0 + [\$900/1.06]$$

$$E_0 = \$299.07$$

The current value of the debt is the value of the firm's assets minus the value of the equity, so:

$$D_0 = \$1,200 - 299.07$$

$$D_0 = \$900.93$$

- b.* Using the no arbitrage model as in part *a*, we get:

$$\$1,200 = [(\$1,700 - 700)/(\$1,700 - 1,000)]E_0 + [\$700/1.06]$$

$$E_0 = \$382.06$$

The stockholders will prefer the new asset structure because their potential gain increases while their maximum potential loss remains unchanged.

- 9.** The conversion ratio is the par value divided by the conversion price, so:

$$\text{Conversion ratio} = \$1,000/\$40$$

$$\text{Conversion ratio} = 25.00$$

The conversion value is the conversion ratio times the stock price, so:

$$\text{Conversion value} = 25.00(\$55)$$

$$\text{Conversion value} = \$1,375.00$$

## B-250 SOLUTIONS

10. a. The minimum bond price is the greater of the straight bond value or the conversion price. The straight bond value is:

$$\text{Straight bond value} = \$32.50(\text{PVIFA}_{4\%,40}) + \$1,000/1.04^{40}$$

$$\text{Straight bond value} = \$851.55$$

The conversion ratio is the par value divided by the conversion price, so:

$$\text{Conversion ratio} = \$1,000/\$50$$

$$\text{Conversion ratio} = 20$$

The conversion value is the conversion ratio times the stock price, so:

$$\text{Conversion value} = 20(\$38)$$

$$\text{Conversion value} = \$760.00$$

The minimum value for this bond is the straight bond value of \$851.55.

- b. The option embedded in the bond adds the extra value.

11. a. The minimum bond price is the greater of the straight bond value or the conversion value. The straight bond value is:

$$\text{Straight bond value} = \$70(\text{PVIFA}_{9\%,30}) + \$1,000/1.09^{30}$$

$$\text{Straight bond value} = \$794.53$$

The conversion ratio is the par value divided by the conversion price, so:

$$\text{Conversion ratio} = \$1,000/\$60$$

$$\text{Conversion ratio} = 16.67$$

The conversion price is the conversion ratio times the stock price, so:

$$\text{Conversion value} = 16.67(\$50)$$

$$\text{Conversion value} = \$833.33$$

The minimum value for this bond is the convertible floor value of \$833.33.

- b. The conversion premium is the difference between the current stock price and conversion price, divided by the current stock price, so:

$$\text{Conversion premium} = (\$60 - \$50)/\$50 = .20 \text{ or } 20\%$$

12. The value of the bond without warrants is:

$$\begin{aligned}\text{Straight bond value} &= \$105(\text{PVIFA}_{12\%,15}) + \$1,000/1.12^{15} \\ \text{Straight bond value} &= \$897.84\end{aligned}$$

The value of the warrants is the selling price of the bond minus the value of the bond without warrants, so:

$$\begin{aligned}\text{Total warrant value} &= \$1,000 - 897.84 \\ \text{Total warrant value} &= \$102.16\end{aligned}$$

Since the bond has 20 warrants attached, the price of each warrant is:

$$\begin{aligned}\text{Price of one warrant} &= \$102.16/20 \\ \text{Price of one warrant} &= \$5.11\end{aligned}$$

13. If we purchase the machine today, the NPV is the cost plus the present value of the increased cash flows, so:

$$\begin{aligned}\text{NPV}_0 &= -\$2,000,000 + \$350,000(\text{PVIFA}_{12\%,10}) \\ \text{NPV}_0 &= -\$22,421.94\end{aligned}$$

We should not purchase the machine today. We would want to purchase the machine when the NPV is the highest. So, we need to calculate the NPV each year. The NPV each year will be the cost plus the present value of the increased cash savings. We must be careful however. In order to make the correct decision, the NPV for each year must be taken to a common date. We will discount all of the NPVs to today. Doing so, we get:

$$\begin{aligned}\text{Year 1: NPV}_1 &= [-\$1,840,000 + \$350,000(\text{PVIFA}_{12\%,9})] / 1.12 \\ \text{NPV}_1 &= \$22,220.92\end{aligned}$$

$$\begin{aligned}\text{Year 2: NPV}_2 &= [-\$1,680,000 + \$350,000(\text{PVIFA}_{12\%,8})] / 1.12^2 \\ \text{NPV}_2 &= \$46,774.49\end{aligned}$$

$$\begin{aligned}\text{Year 3: NPV}_3 &= [-\$1,520,000 + \$350,000(\text{PVIFA}_{12\%,7})] / 1.12^3 \\ \text{NPV}_3 &= \$55,031.14\end{aligned}$$

$$\begin{aligned}\text{Year 4: NPV}_4 &= [-\$1,360,000 + \$350,000(\text{PVIFA}_{12\%,6})] / 1.12^4 \\ \text{NPV}_4 &= \$50,201.20\end{aligned}$$

$$\begin{aligned}\text{Year 5: NPV}_5 &= [-\$1,200,000 + \$350,000(\text{PVIFA}_{12\%,5})] / 1.12^5 \\ \text{NPV}_5 &= \$34,994.16\end{aligned}$$

$$\begin{aligned}\text{Year 6: NPV}_6 &= [-\$1,200,000 + \$350,000(\text{PVIFA}_{12\%,4})] / 1.12^6 \\ \text{NPV}_6 &= -\$69,371.85\end{aligned}$$

The company should purchase the machine three years from now when the NPV is the highest.

## B-252 SOLUTIONS

### Intermediate

14. a. The base-case NPV is:

$$\begin{aligned} \text{NPV} &= -\$1,800,000 + \$455,000(\text{PVIFA}_{16\%,10}) \\ \text{NPV} &= \$399,118.50 \end{aligned}$$

- b. We would abandon the project if the cash flow from selling the equipment is greater than the present value of the future cash flows. We need to find the sale quantity where the two are equal, so:

$$\begin{aligned} \$1,400,000 &= (\$65)Q(\text{PVIFA}_{16\%,9}) \\ Q &= \$1,400,000/[\$65(4.6065)] \\ Q &= 4,676 \end{aligned}$$

Abandon the project if  $Q < 4,676$  units, because the NPV of abandoning the project is greater than the NPV of the future cash flows.

- c. The \$1,400,000 is the market value of the project. If you continue with the project in one year, you forego the \$1,400,000 that could have been used for something else.

15. a. If the project is a success, present value of the future cash flows will be:

$$\begin{aligned} \text{PV future CFs} &= \$65(9,000)(\text{PVIFA}_{16\%,9}) \\ \text{PV future CFs} &= \$2,694,828.17 \end{aligned}$$

From the previous question, if the quantity sold is 4,000, we would abandon the project, and the cash flow would be \$1,400,000. Since the project has an equal likelihood of success or failure in one year, the expected value of the project in one year is the average of the success and failure cash flows, plus the cash flow in one year, so:

$$\begin{aligned} \text{Expected value of project at year 1} &= [(\$2,694,828.17 + \$1,400,000)/2] + \$455,000 \\ \text{Expected value of project at year 1} &= \$2,502,414.08 \end{aligned}$$

The NPV is the present value of the expected value in one year plus the cost of the equipment, so:

$$\begin{aligned} \text{NPV} &= -\$1,800,000 + (\$2,502,414.08)/1.16 \\ \text{NPV} &= \$357,253.52 \end{aligned}$$

- b. If we couldn't abandon the project, the present value of the future cash flows when the quantity is 4,000 will be:

$$\begin{aligned} \text{PV future CFs} &= \$65(4,000)(\text{PVIFA}_{16\%,9}) \\ \text{PV future CFs} &= \$1,197,701.41 \end{aligned}$$

The gain from the option to abandon is the abandonment value minus the present value of the cash flows if we cannot abandon the project, so:

$$\begin{aligned} \text{Gain from option to abandon} &= \$1,400,000 - 1,197,701.41 \\ \text{Gain from option to abandon} &= \$202,298.59 \end{aligned}$$

We need to find the value of the option to abandon times the likelihood of abandonment. So, the value of the option to abandon today is:

$$\begin{aligned}\text{Option value} &= (.50)(\$202,298.59)/1.16 \\ \text{Option value} &= \$87,197.67\end{aligned}$$

16. If the project is a success, present value of the future cash flows will be:

$$\begin{aligned}\text{PV future CFs} &= \$65(18,000)(\text{PVIFA}_{16\%,9}) \\ \text{PV future CFs} &= \$5,389,656.33\end{aligned}$$

If the sales are only 4,000 units, from Problem #14, we know we will abandon the project, with a value of \$1,400,000. Since the project has an equal likelihood of success or failure in one year, the expected value of the project in one year is the average of the success and failure cash flows, plus the cash flow in one year, so:

$$\begin{aligned}\text{Expected value of project at year 1} &= [(\$5,389,656.33 + \$1,400,000)/2] + \$455,000 \\ \text{Expected value of project at year 1} &= \$3,849,828.17\end{aligned}$$

The NPV is the present value of the expected value in one year plus the cost of the equipment, so:

$$\begin{aligned}\text{NPV} &= -\$1,800,000 + \$3,849,828.17/1.16 \\ \text{NPV} &= \$1,518,817.39\end{aligned}$$

The gain from the option to expand is the present value of the cash flows from the additional units sold, so:

$$\begin{aligned}\text{Gain from option to expand} &= \$65(9,000)(\text{PVIFA}_{16\%,9}) \\ \text{Gain from option to expand} &= \$2,694,828.17\end{aligned}$$

We need to find the value of the option to expand times the likelihood of expansion. We also need to find the value of the option to expand today, so:

$$\begin{aligned}\text{Option value} &= (.50)(\$2,694,828.17)/1.16 \\ \text{Option value} &= \$1,161,563.87\end{aligned}$$

17. a. The value of the call is the maximum of the stock price minus the present value of the exercise price, or zero, so:

$$\begin{aligned}C_0 &= \text{Max}[\$75 - (\$85/1.05), 0] \\ C_0 &= \$0\end{aligned}$$

The option isn't worth anything.

- b. The stock price is too low for the option to finish in the money. The minimum return on the stock required to get the option in the money is:

$$\begin{aligned}\text{Minimum stock return} &= (\$85 - 75)/\$75 \\ \text{Minimum stock return} &= .1333 \text{ or } 13.33\%\end{aligned}$$

which is much higher than the risk-free rate of interest.

## B-254 SOLUTIONS

**18.** B is the more typical case; A presents an arbitrage opportunity. You could buy the bond for \$800 and immediately convert it into stock that can be sold for \$1,000. A riskless \$200 profit results.

**19. a.** The conversion ratio is given at 25. The conversion price is the par value divided by the conversion ratio, so:

$$\text{Conversion price} = \$1,000/25$$

$$\text{Conversion price} = \$40$$

The conversion premium is the percent increase in stock price that results in no profit when the bond is converted, so:

$$\text{Conversion premium} = (\$40 - \$36)/\$36$$

$$\text{Conversion premium} = .1111 \text{ or } 11.11\%$$

**b.** The straight bond value is:

$$\text{Straight bond value} = \$35(\text{PVIFA}_{5\%,20}) + \$1,000/1.05^{20}$$

$$\text{Straight bond value} = \$813.07$$

And the conversion value is the conversion ratio times the stock price, so:

$$\text{Conversion value} = 25(\$36)$$

$$\text{Conversion value} = \$900.00$$

**c.** We simply need to set the straight bond value equal to the conversion ratio times the stock price, and solve for the stock price, so:

$$\$813.07 = 25S$$

$$S = \$32.52$$

**d.** There are actually two option values to consider with a convertible bond. The conversion option value, defined as the market value less the floor value, and the speculative option value, defined as the floor value less the straight bond value. When the conversion value is less than the straight-bond value, the speculative option is worth zero.

$$\text{Conversion option value} = \$950 - 900 = \$50$$

$$\text{Speculative option value} = \$900 - 813.07 = \$86.93$$

$$\text{Total option value} = \$50.00 + 86.93 = \$136.93$$

**20. a.** The NPV of the project is the sum of the present value of the cash flows generated by the project. The cash flows from this project are an annuity, so the NPV is:

$$\text{NPV} = -\$100,000,000 + \$25,000,000(\text{PVIFA}_{20\%,10})$$

$$\text{NPV} = \$4,811,802.14$$

- b. The company should abandon the project if the PV of the revised cash flows for the next nine years is less than the project's aftertax salvage value. Since the option to abandon the project occurs in year 1, discount the revised cash flows to year 1 as well. To determine the level of expected cash flows below which the company should abandon the project, calculate the equivalent annual cash flows the project must earn to equal the aftertax salvage value. We will solve for  $C_2$ , the revised cash flow beginning in year 2. So, the revised annual cash flow below which it makes sense to abandon the project is:

$$\text{Aftertax salvage value} = C_2(\text{PVIFA}_{20\%,9})$$

$$\$50,000,000 = C_2(\text{PVIFA}_{20\%,9})$$

$$C_2 = \$50,000,000 / \text{PVIFA}_{20\%,9}$$

$$C_2 = \$12,403,973.08$$

### Challenge

21. The straight bond value today is:

$$\text{Straight bond value} = \$72(\text{PVIFA}_{10\%,25}) + \$1,000/1.10^{25}$$

$$\text{Straight bond value} = \$745.84$$

And the conversion value of the bond today is:

$$\text{Conversion value} = \$38.50(\$1,000/\$160)$$

$$\text{Conversion value} = \$240.63$$

We expect the bond to be called when the conversion value increases to \$1,300, so we need to find the number of periods it will take for the current conversion value to reach the expected value at which the bond will be converted. Doing so, we find:

$$\$240.63(1.11)^t = \$1,300$$

$$t = 16.16 \text{ years}$$

The bond will be called in 16.16 years.

The bond value is the present value of the expected cash flows. The cash flows will be the annual coupon payments plus the conversion price. The present value of these cash flows is:

$$\text{Bond value} = \$72(\text{PVIFA}_{10\%,16.16}) + \$1,300/1.10^{16.16} = \$844.27$$

B-256 SOLUTIONS

22. We will use the bottom up approach to calculate the operating cash flow. Assuming we operate the project for all four years, the cash flows are:

Year	0	1	2	3	4
Sales		\$8,500,000	\$8,500,000	\$8,500,000	\$8,500,000
Operating costs		3,600,000	3,600,000	3,600,000	3,600,000
Depreciation		2,250,000	2,250,000	2,250,000	2,250,000
EBT		\$2,650,000	\$2,650,000	\$2,650,000	\$2,650,000
Tax		1,007,000	1,007,000	1,007,000	1,007,000
Net income		\$1,643,000	\$1,643,000	\$1,643,000	\$1,643,000
+Depreciation		2,250,000	2,250,000	2,250,000	2,250,000
Operating CF		\$3,893,000	\$3,893,000	\$3,893,000	\$3,893,000
Change in NWC	-\$750,000	0	0	0	\$750,000
Capital spending	-\$9,000,000	0	0	0	0
Total cash flow	-\$9,750,000	\$3,893,000	\$3,893,000	\$3,893,000	\$4,643,000

There is no salvage value for the equipment. The NPV is:

$$\text{NPV} = -\$9,750,000 + \$3,893,000(\text{PVIFA}_{16\%,3}) + \$4,643,000/1.16^4$$

$$\text{NPV} = \$1,557,535.55$$

b. The cash flows if we abandon the project after one year are:

Year	0	1
Sales		\$8,500,000
Operating costs		3,600,000
Depreciation		2,250,000
EBT		\$2,650,000
Tax		1,007,000
Net income		\$1,643,000
+Depreciation		2,250,000
Operating CF		\$3,893,000
Change in NWC	-\$750,000	\$750,000
Capital spending	-\$9,000,000	\$6,595,000
Total cash flow	-\$9,750,000	\$11,238,000

The book value of the equipment is:

$$\text{Book value} = \$9,000,000 - (1)(\$9,000,000/4)$$

$$\text{Book value} = \$6,750,000$$

So, the taxes on the salvage value will be:

$$\begin{aligned} \text{Taxes} &= (\$6,750,000 - 6,500,000)(.38) \\ \text{Taxes} &= \$95,000 \end{aligned}$$

This makes the aftertax salvage value:

$$\begin{aligned} \text{Aftertax salvage value} &= \$6,500,000 + 95,000 \\ \text{Aftertax salvage value} &= \$6,595,000 \end{aligned}$$

The NPV if we abandon the project after one year is:

$$\begin{aligned} \text{NPV} &= -\$9,750,000 + \$11,238,000/1.16 \\ \text{NPV} &= -\$62,068.97 \end{aligned}$$

If we abandon the project after two years, the cash flows are:

Year	0	1	2
Sales		\$8,500,000	\$8,500,000
Operating costs		3,600,000	3,600,000
Depreciation		2,250,000	2,250,000
EBT		\$2,650,000	\$2,650,000
Tax		1,007,000	1,007,000
Net income		\$1,643,000	\$1,643,000
+Depreciation		2,250,000	2,250,000
Operating CF		\$3,893,000	\$3,893,000
Change in NWC	-\$750,000	0	\$750,000
Capital spending	-\$9,000,000	0	\$5,430,000
Total cash flow	-\$9,750,000	\$3,893,000	\$10,073,000

The book value of the equipment is:

$$\begin{aligned} \text{Book value} &= \$9,000,000 - (2)(\$9,000,000/4) \\ \text{Book value} &= \$4,500,000 \end{aligned}$$

So the taxes on the salvage value will be:

$$\begin{aligned} \text{Taxes} &= (\$4,500,000 - 6,000,000)(.38) \\ \text{Taxes} &= -\$570,000 \end{aligned}$$

This makes the aftertax salvage value:

$$\begin{aligned} \text{Aftertax salvage value} &= \$6,000,000 - 570,000 \\ \text{Aftertax salvage value} &= \$5,430,000 \end{aligned}$$

## B-258 SOLUTIONS

The NPV if we abandon the project after two years is:

$$\text{NPV} = -\$9,750,000 + \$3,893,000/1.16 + \$10,073,000/1.16^2$$

$$\text{NPV} = \$1,091,914.39$$

If we abandon the project after three years, the cash flows are:

Year	0	1	2	3
Sales		\$8,500,000	\$8,500,000	\$8,500,000
Operating costs		3,600,000	3,600,000	3,600,000
Depreciation		2,250,000	2,250,000	2,250,000
EBT		\$2,650,000	\$2,650,000	\$2,650,000
Tax		1,007,000	1,007,000	1,007,000
Net income		\$1,643,000	\$1,643,000	\$1,643,000
+Depreciation		2,250,000	2,250,000	2,250,000
Operating CF		\$3,893,000	\$3,893,000	\$3,893,000
Change in NWC	-\$750,000	0	0	\$750,000
Capital spending	-\$9,000,000	0	0	\$3,645,000
Total cash flow	-\$9,750,000	\$3,893,000	\$3,893,000	\$8,288,000

The book value of the equipment is:

$$\text{Book value} = \$9,000,000 - (3)(\$9,000,000/4)$$

$$\text{Book value} = \$2,250,000$$

So the taxes on the salvage value will be:

$$\text{Taxes} = (\$2,250,000 - 4,500,000)(.38)$$

$$\text{Taxes} = -\$855,000$$

This makes the aftertax salvage value:

$$\text{Aftertax salvage value} = \$4,500,000 - 855,000$$

$$\text{Aftertax salvage value} = \$3,645,000$$

The NPV if we abandon the project after three years is:

$$\text{NPV} = -\$9,750,000 + \$3,893,000(\text{PVIFA}_{16\%,2}) + \$8,288,000/1.16^3$$

$$\text{NPV} = \$1,808,978.46$$

We should abandon the equipment after three years since the NPV of abandoning the project after three years has the highest NPV.

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# CHAPTER 15

## COST OF CAPITAL

### Answers to Concepts Review and Critical Thinking Questions

1. It is the minimum rate of return the firm must earn overall on its existing assets. If it earns more than this, value is created.
2. Book values for debt are likely to be much closer to market values than are equity book values.
3. No. The cost of capital depends on the risk of the project, not the source of the money.
4. Interest expense is tax-deductible. There is no difference between pretax and aftertax equity costs.
5. The primary advantage of the DCF model is its simplicity. The method is disadvantaged in that (1) the model is applicable only to firms that actually pay dividends; many do not; (2) even if a firm does pay dividends, the DCF model requires a constant dividend growth rate forever; (3) the estimated cost of equity from this method is very sensitive to changes in  $g$ , which is a very uncertain parameter; and (4) the model does not explicitly consider risk, although risk is implicitly considered to the extent that the market has impounded the relevant risk of the stock into its market price. While the share price and most recent dividend can be observed in the market, the dividend growth rate must be estimated. Two common methods of estimating  $g$  are to use analysts' earnings and payout forecasts or to determine some appropriate average historical  $g$  from the firm's available data.
6. Two primary advantages of the SML approach are that the model explicitly incorporates the relevant risk of the stock and the method is more widely applicable than is the DCF model, since the SML doesn't make any assumptions about the firm's dividends. The primary disadvantages of the SML method are (1) three parameters (the risk-free rate, the expected return on the market, and beta) must be estimated, and (2) the method essentially uses historical information to estimate these parameters. The risk-free rate is usually estimated to be the yield on very short maturity T-bills and is, hence, observable; the market risk premium is usually estimated from historical risk premiums and, hence, is not observable. The stock beta, which is unobservable, is usually estimated either by determining some average historical beta from the firm and the market's return data, or by using beta estimates provided by analysts and investment firms.
7. The appropriate aftertax cost of debt to the company is the interest rate it would have to pay if it were to issue new debt today. Hence, if the YTM on outstanding bonds of the company is observed, the company has an accurate estimate of its cost of debt. If the debt is privately-placed, the firm could still estimate its cost of debt by (1) looking at the cost of debt for similar firms in similar risk classes, (2) looking at the average debt cost for firms with the same credit rating (assuming the firm's private debt is rated), or (3) consulting analysts and investment bankers. Even if the debt is publicly traded, an additional complication is when the firm has more than one issue outstanding; these issues rarely have the same yield because no two issues are ever completely homogeneous.

## B-260 SOLUTIONS

8.
  - a. This only considers the dividend yield component of the required return on equity.
  - b. This is the current yield only, not the promised yield to maturity. In addition, it is based on the book value of the liability, and it ignores taxes.
  - c. Equity is inherently more risky than debt (except, perhaps, in the unusual case where a firm's assets have a negative beta). For this reason, the cost of equity exceeds the cost of debt. If taxes are considered in this case, it can be seen that at reasonable tax rates, the cost of equity does exceed the cost of debt.
9.  $R_{\text{Sup}} = .12 + .75(.08) = .1800$  or 18.00%  
Both should proceed. The appropriate discount rate does not depend on which company is investing; it depends on the risk of the project. Since Superior is in the business, it is closer to a pure play. Therefore, its cost of capital should be used. With an 18% cost of capital, the project has an NPV of \$1 million regardless of who takes it.
10. If the different operating divisions were in much different risk classes, then separate cost of capital figures should be used for the different divisions; the use of a single, overall cost of capital would be inappropriate. If the single hurdle rate were used, riskier divisions would tend to receive more funds for investment projects, since their return would exceed the hurdle rate despite the fact that they may actually plot below the SML and, hence, be unprofitable projects on a risk-adjusted basis. The typical problem encountered in estimating the cost of capital for a division is that it rarely has its own securities traded on the market, so it is difficult to observe the market's valuation of the risk of the division. Two typical ways around this are to use a pure play proxy for the division, or to use subjective adjustments of the overall firm hurdle rate based on the perceived risk of the division.

### Solutions to Questions and Problems

*NOTE: All end of chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.*

#### Basic

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:

$$R_E = [\$2.60(1.06)/\$60] + .06 = .1059 \text{ or } 10.59\%$$

2. Here we have information to calculate the cost of equity using the CAPM. The cost of equity is:

$$R_E = .045 + 1.20(.13 - .045) = .1470 \text{ or } 14.70\%$$

3. We have the information available to calculate the cost of equity using the CAPM and the dividend growth model. Using the CAPM, we find:

$$R_E = .05 + 1.25(.07) = .1375 \text{ or } 13.75\%$$

And using the dividend growth model, the cost of equity is

$$R_E = [\$2.10(1.05)/\$34] + .05 = .1149 \text{ or } 11.49\%$$

Both estimates of the cost of equity seem reasonable. If we remember the historical return on large capitalization stocks, the estimate from the CAPM model is about two percent higher than average, and the estimate from the dividend growth model is about one percent higher than the historical average, so we cannot definitively say one of the estimates is incorrect. Given this, we will use the average of the two, so:

$$R_E = (.1375 + .1149)/2 = .1262 \text{ or } 12.62\%$$

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:

$$\begin{aligned} g_1 &= (\$.90 - .85)/\$.85 = .0588 \text{ or } 5.88\% \\ g_2 &= (\$1.04 - .90)/\$.90 = .1556 \text{ or } 15.56\% \\ g_3 &= (\$1.10 - 1.04)/\$1.04 = .0577 \text{ or } 5.77\% \\ g_4 &= (\$1.25 - 1.10)/\$1.10 = .1364 \text{ or } 13.64\% \end{aligned}$$

So, the average arithmetic growth rate in dividends was:

$$g = (.0588 + .1556 + .0577 + .1364)/4 = .1021 \text{ or } 10.21\%$$

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

$$R_E = [\$1.25(1.1021)/\$45.00] + .1021 = .1327 \text{ or } 13.27\%$$

Calculating the geometric growth rate in dividends, we find:

$$\begin{aligned} \$1.25 &= \$0.85(1 + g)^4 \\ g &= .1012 \text{ or } 10.12\% \end{aligned}$$

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

$$R_E = [\$1.25(1.1012)/\$45.00] + .1012 = 13.18\%$$

5. The cost of preferred stock is the dividend payment divided by the price, so:

$$R_P = \$5/\$87 = .0575 \text{ or } 5.75\%$$

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

$$\begin{aligned} P_0 &= \$940 = \$35(PVIFA_{R\%,24}) + \$1,000(PVIF_{R\%,24}) \\ R &= 3.889\% \\ \text{YTM} &= 2 \times 3.889\% = 7.78\% \end{aligned}$$

And the aftertax cost of debt is:

$$R_D = .0778(1 - .35) = .0506 \text{ or } 5.06\%$$

## B-262 SOLUTIONS

7. a. The pretax cost of debt is the YTM of the company's bonds, so:

$$P_0 = \$1,080 = \$45(\text{PVIFA}_{R\%,46}) + \$1,000(\text{PVIF}_{R\%,46})$$

$$R = 4.11\%$$

$$\text{YTM} = 2 \times 4.11\% = 8.22\%$$

- b. The aftertax cost of debt is:

$$R_D = .0822(1 - .35) = .0534 \text{ or } 5.34\%$$

- c. The after-tax rate is more relevant because that is the actual cost to the company.

8. The book value of debt is the total par value of all outstanding debt, so:

$$\text{BV}_D = \$70,000,000 + 50,000,000 = \$120,000,000$$

To find the market value of debt, we find the price of the bonds and multiply by the number of bonds. Alternatively, we can multiply the price quote of the bond times the par value of the bonds. Doing so, we find:

$$\text{MV}_D = 1.08(\$70,000,000) + .61(\$50,000,000)$$

$$\text{MV}_D = \$75,600,000 + 30,500,000$$

$$\text{MV}_D = \$106,100,000$$

The YTM of the zero coupon bonds is:

$$P_Z = \$610 = \$1,000(\text{PVIF}_{R\%,7})$$

$$R = 7.32\%$$

So, the aftertax cost of the zero coupon bonds is:

$$R_Z = .0732(1 - .35) = .0476 \text{ or } 4.76\%$$

The aftertax cost of debt for the company is the weighted average of the aftertax cost of debt for all outstanding bond issues. We need to use the market value weights of the bonds. The total aftertax cost of debt for the company is:

$$R_D = .0534(\$75.6/\$106.1) + .0476(\$30.5/\$106.1) = .0517 \text{ or } 5.17\%$$

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

$$\text{WACC} = .50(.15) + .05(.06) + .45(.08)(1 - .35) = .1014 \text{ or } 10.14\%$$

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

$$.08(1 - .35) = .0520 \text{ or } 5.20\%$$

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

10. Here we need to use the debt-equity ratio to calculate the WACC. Doing so, we find:

$$\text{WACC} = .17(1/1.80) + .10(.80/1.80)(1 - .35) = .1233 \text{ or } 12.33\%$$

11. Here we have the WACC and need to find the debt-equity ratio of the company. Setting up the WACC equation, we find:

$$\text{WACC} = .1020 = .14(E/V) + .084(D/V)(1 - .35)$$

Rearranging the equation, we find:

$$.1020(V/E) = .14 + .084(.65)(D/E)$$

Now we must realize that the V/E is just the equity multiplier, which is equal to:

$$V/E = 1 + D/E$$

$$.1020(D/E + 1) = .14 + .0546(D/E)$$

Now we can solve for D/E as:

$$.0474(D/E) = .038$$

$$D/E = .8017$$

12. a. The book value of equity is the book value per share times the number of shares, and the book value of debt is the face value of the company's debt, so:

$$BV_E = 12,000,000(\$9) = \$108,000,000$$

$$BV_D = \$90,000,000 + 85,000,000 = \$175,000,000$$

So, the total value of the company is:

$$V = \$108,000,000 + 175,000,000 = \$283,000,000$$

And the book value weights of equity and debt are:

$$E/V = \$108,000,000/\$283,000,000 = .3816$$

$$D/V = 1 - E/V = .6184$$

- b. The market value of equity is the share price times the number of shares, so:

$$MV_E = 12,000,000(\$64) = \$768,000,000$$

Using the relationship that the total market value of debt is the price quote times the par value of the bond, we find the market value of debt is:

$$MV_D = .93(\$90,000,000) + .965(\$85,000,000) = \$165,725,000$$

## B-264 SOLUTIONS

This makes the total market value of the company:

$$V = \$768,000,000 + 165,725,000 = \$933,725,000$$

And the market value weights of equity and debt are:

$$E/V = \$768,000,000/\$933,725,000 = .8225$$

$$D/V = 1 - E/V = .1775$$

c. The market value weights are more relevant.

- 13.** First, we will find the cost of equity for the company. The information provided allows us to solve for the cost of equity using the dividend growth model, so:

$$R_E = [\$4.10(1.06)/\$64] + .06 = .1279 \text{ or } 12.79\%$$

Next, we need to find the D/E ratio to find the debt weights. We are given  $D/V = .1775$  and  $E/V = .8225$ , so  $D/E = .1775 / .8225 = .2158$ .

b. Using the equation to calculate WACC, we find:

$$\begin{aligned} \text{WACC} &= .105 = (1/1.7)R_E + (.7/1.7)(.059) \\ R_E &= .1372 \text{ or } 13.72\% \end{aligned}$$

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

$$\begin{aligned} \text{MV}_D &= 5,000(\$1,000)(0.92) = \$4,600,000 \\ \text{MV}_E &= 100,000(\$57) = \$5,700,000 \\ \text{MV}_P &= 13,000(\$104) = \$1,352,000 \end{aligned}$$

And the total market value of the firm is:

$$V = \$4,600,000 + 5,700,000 + 1,352,000 = \$11,652,000$$

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

$$R_E = .06 + 1.15(.08) = .1520 \text{ or } 15.20\%$$

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

$$\begin{aligned} P_0 &= \$920 = \$35(\text{PVIFA}_{R\%,40}) + \$1,000(\text{PVIF}_{R\%,40}) \\ R &= 3.898\% \\ \text{YTM} &= 3.898\% \times 2 = 7.80\% \end{aligned}$$

And the aftertax cost of debt is:

$$R_D = (1 - .35)(.0780) = .0507 \text{ or } 5.07\%$$

The cost of preferred stock is:

$$R_P = \$7/\$104 = .0673 \text{ or } 6.73\%$$

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

$$\text{WACC} = .0507(4.6/11.652) + .1520(5.70/11.652) + .0673(1.352/11.652) = .1022 \text{ or } 10.22\%$$

Notice that we didn't include the  $(1 - t_c)$  term in the WACC equation. We used the aftertax cost of debt in the equation, so the term is not needed here.

16. a. We will begin by finding the market value of each type of financing. We find:

$$\begin{aligned} \text{MV}_D &= 85,000(\$1,000)(0.93) = \$79,050,000 \\ \text{MV}_E &= 8,500,000(\$34) = \$289,000,000 \\ \text{MV}_P &= 200,000(\$83) = \$16,600,000 \end{aligned}$$

And the total market value of the firm is:

$$V = \$79,050,000 + 289,000,000 + 16,600,000 = \$384,650,000$$

## B-266 SOLUTIONS

So, the market value weights of the company's financing is:

$$\begin{aligned}D/V &= \$79,050,000/\$384,650,000 = .2055 \\P/V &= \$16,600,000/\$384,650,000 = .0432 \\E/V &= \$289,000,000/\$384,650,000 = .7513\end{aligned}$$

- b. For projects equally as risky as the firm itself, the WACC should be used as the discount rate.

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

$$R_E = .05 + 1.20(.09) = .1580 \text{ or } 15.80\%$$

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

$$\begin{aligned}P_0 &= \$930 = \$42.5(PVIFA_{R\%,30}) + \$1,000(PVIF_{R\%,30}) \\R &= 4.69\% \\YTM &= 4.69\% \times 2 = 9.38\%\end{aligned}$$

And the aftertax cost of debt is:

$$R_D = (1 - .35)(.0938) = .0610 \text{ or } 6.10\%$$

The cost of preferred stock is:

$$R_P = \$7/\$83 = .0843 \text{ or } 8.43\%$$

Now we can calculate the WACC as:

$$WACC = .1580(.7513) + .0843(.0432) + .0610(.2055) = .1349 \text{ or } 13.49\%$$

17. a. Projects X, Y and Z.
- b. Using the CAPM to consider the projects, we need to calculate the expected return of the project given its level of risk. This expected return should then be compared to the expected return of the project. If the return calculated using the CAPM is lower than the project expected return, we should accept the project, if not, we reject the project. After considering risk via the CAPM:

$$\begin{aligned}E[W] &= .05 + .75(.12 - .05) = .1025 < .11, \text{ so accept W} \\E[X] &= .05 + .90(.12 - .05) = .1130 < .13, \text{ so accept X} \\E[Y] &= .05 + 1.15(.12 - .05) = .1305 < .14, \text{ so accept Y} \\E[Z] &= .05 + 1.60(.12 - .05) = .1620 > .16, \text{ so reject Z}\end{aligned}$$

- c. Project W would be incorrectly rejected; Project Z would be incorrectly accepted.

18. a. He should look at the weighted average flotation cost, not just the debt cost.

- b. The weighted average floatation cost is the weighted average of the floatation costs for debt and equity, so:

$$f_T = .05(.9/1.9) + .08(1/1.9) = .0658 \text{ or } 6.58\%$$

- c. The total cost of the equipment including floatation costs is:

$$\text{Amount raised}(1 - .0658) = \$15,000,000$$

$$\text{Amount raised} = \$15,000,000 / (1 - .0658) = \$16,056,338$$

Even if the specific funds are actually being raised completely from debt, the floatation costs, and hence true investment cost, should be valued as if the firm's target capital structure is used.

19. We first need to find the weighted average floatation cost. Doing so, we find:

$$f_T = .60(.10) + .10(.07) + .30(.04) = .079 \text{ or } 7.9\%$$

And the total cost of the equipment including floatation costs is:

$$\text{Amount raised}(1 - .079) = \$30,000,000$$

$$\text{Amount raised} = \$30,000,000 / (1 - .079) = \$32,573,290$$

#### Intermediate

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

$$\text{WACC} = (.70/1.70)(.055) + (1/1.70)(.13) = .0991 \text{ or } 9.91\%$$

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:

$$\text{Project discount rate} = 9.91\% + 2.00\% = 11.91\%$$

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:

$$\text{PV of future CF} = \$3,500,000 / (.1191 - .05) = \$50,638,298$$

The project should only be undertaken if its cost is less than \$50,638,298 since costs less than this amount will result in a positive NPV.

21. The total cost of the equipment including floatation costs was:

$$\text{Total costs} = \$10,500,000 + 750,000 = \$11,250,000$$

## B-268 SOLUTIONS

Using the equation to calculate the total cost including floatation costs, we get:

$$\begin{aligned}\text{Amount raised}(1 - f_T) &= \text{Amount needed after floatation costs} \\ \$11,250,000(1 - f_T) &= \$10,500,000 \\ f_T &= .0667 \text{ or } 6.67\%\end{aligned}$$

Now, we know the weighted average floatation cost. The equation to calculate the percentage floatation costs is:

$$f_T = .0667 = .08(E/V) + .03(D/V)$$

We can solve this equation to find the debt-equity ratio as follows:

$$.0667(V/E) = .08 + .03(D/E)$$

We must recognize that the V/E term is the equity multiplier, which is  $(1 + D/E)$ , so:

$$\begin{aligned}.0667(D/E + 1) &= .08 + .03(D/E) \\ D/E &= 0.3636\end{aligned}$$

- 22.** To find the aftertax cost of debt for the company, we need to find the weighted average of the four debt issues. We will begin by calculating the market value of each debt issue, which is:

$$\begin{aligned}MV_1 &= 1.02(\$20,000,000) \\ MV_1 &= \$20,400,000\end{aligned}$$

$$\begin{aligned}MV_2 &= 1.10(\$40,000,000) \\ MV_2 &= \$44,000,000\end{aligned}$$

$$\begin{aligned}MV_3 &= 0.99(\$45,000,000) \\ MV_3 &= \$44,550,000\end{aligned}$$

$$\begin{aligned}MV_4 &= 1.12(\$60,000,000) \\ MV_4 &= \$67,200,000\end{aligned}$$

So, the total market value of the company's debt is:

$$\begin{aligned}MV_D &= \$20,400,000 + 44,000,000 + 44,550,000 + 67,200,000 \\ MV_D &= \$176,150,000\end{aligned}$$

The weight of each debt issue is:

$$\begin{aligned}w_1 &= \$20,400,000/\$176,150,000 = .1158 \\ w_1 &= .1158 \text{ or } 11.58\%\end{aligned}$$

$$\begin{aligned}w_2 &= \$44,000,000/\$176,150,000 \\ w_2 &= .2498 \text{ or } 24.98\%\end{aligned}$$

$$\begin{aligned}w_3 &= \$44,550,000/\$176,150,000 \\ w_3 &= .2529 \text{ or } 25.29\%\end{aligned}$$

$$w_4 = \$67,200,000/\$176,150,000$$

$$w_4 = .3815 \text{ or } 38.15\%$$

Next, we need to find the YTM for each bond issue. The YTM for each issue is:

$$P_1 = \$1,020 = \$30(\text{PVIFA}_{R\%,10}) + \$1,000(\text{PVIF}_{R\%,10})$$

$$R_1 = 2.768\%$$

$$\text{YTM}_1 = 2.768\% \times 2$$

$$\text{YTM}_1 = 5.54\%$$

$$P_2 = \$1,100 = \$38(\text{PVIFA}_{R\%,16}) + \$1,000(\text{PVIF}_{R\%,16})$$

$$R_2 = 3.003\%$$

$$\text{YTM}_2 = 3.003\% \times 2$$

$$\text{YTM}_2 = 6.01\%$$

$$P_3 = \$990 = \$36(\text{PVIFA}_{R\%,31}) + \$1,000(\text{PVIF}_{R\%,31})$$

$$R_3 = 3.654\%$$

$$\text{YTM}_3 = 3.654\% \times 2$$

$$\text{YTM}_3 = 7.31\%$$

$$P_4 = \$1,120 = \$44.50(\text{PVIFA}_{R\%,50}) + \$1,000(\text{PVIF}_{R\%,50})$$

$$R_4 = 3.901\%$$

$$\text{YTM}_4 = 3.901\% \times 2$$

$$\text{YTM}_4 = 7.80\%$$

The weighted average YTM of the company's debt is thus:

$$\text{YTM} = .1158(.0554) + .2498(.0601) + .2529(.0731) + .3815(.0780)$$

$$\text{YTM} = .0697 \text{ or } 6.97\%$$

And the aftertax cost of debt is:

$$R_D = .0697(1 - .034)$$

$$R_D = .0460 \text{ or } 4.60\%$$

23. a. Using the dividend discount model, the cost of equity is:

$$R_E = [(0.60)(1.05)/\$54] + .05$$

$$R_E = .0617 \text{ or } 6.17\%$$

- b. Using the CAPM, the cost of equity is:

$$R_E = .055 + 1.15(.1150 - .0550)$$

$$R_E = .1240 \text{ or } 12.40\%$$

- c. When using the dividend growth model or the CAPM, you must remember that both are estimates for the cost of equity. Additionally, and perhaps more importantly, each method of estimating the cost of equity depends upon different assumptions.

## B-270 SOLUTIONS

### Challenge

24. We can use the debt-equity ratio to calculate the weights of equity and debt. The debt of the company has a weight for long-term debt and a weight for accounts payable. We can use the weight given for accounts payable to calculate the weight of accounts payable and the weight of long-term debt. The weight of each will be:

$$\text{Accounts payable weight} = .20/1.20 = .17$$

$$\text{Long-term debt weight} = 1/1.20 = .83$$

Since the accounts payable has the same cost as the overall WACC, we can write the equation for the WACC as:

$$\text{WACC} = (1/1.8)(.17) + (0.8/1.8)[(.20/1.2)\text{WACC} + (1/1.2)(.09)(1 - .35)]$$

Solving for WACC, we find:

$$\text{WACC} = .0944 + .4444[(.20/1.2)\text{WACC} + .0488]$$

$$\text{WACC} = .0944 + (.0741)\text{WACC} + .0217$$

$$(.9259)\text{WACC} = .1161$$

$$\text{WACC} = .1265 \text{ or } 12.65\%$$

We will use basically the same equation to calculate the weighted average flotation cost, except we will use the flotation cost for each form of financing. Doing so, we get:

$$\text{Flotation costs} = (1/1.8)(.08) + (0.8/1.8)[(.20/1.2)(0) + (1/1.2)(.04)] = .0593 \text{ or } 5.93\%$$

The total amount we need to raise to fund the new equipment will be:

$$\text{Amount raised cost} = \$75,000,000/(1 - .0593)$$

$$\text{Amount raised} = \$79,724,409$$

Since the cash flows go to perpetuity, we can calculate the present value using the equation for the PV of a perpetuity. The NPV is:

$$\text{NPV} = -\$79,724,409 + (\$10,900,000/.1265)$$

$$\text{NPV} = \$6,449,906$$

25. We can use the debt-equity ratio to calculate the weights of equity and debt. The weight of debt in the capital structure is:

$$w_D = .75 / 1.75 = .4286 \text{ or } 42.86$$

And the weight of equity is:

$$w_E = 1 - .4286 = .5714 \text{ or } 57.14\%$$

Now we can calculate the weighted average floatation costs for the various percentages of internally raised equity. To find the portion of equity floatation costs, we can multiply the equity costs by the percentage of equity raised externally, which is one minus the percentage raised internally. So, if the company raises all equity externally, the floatation costs are:

$$f_T = (0.5714)(.08)(1 - 0) + (0.4286)(.035)$$

$$f_T = .0607 \text{ or } 6.07\%$$

The initial cash outflow for the project needs to be adjusted for the floatation costs. To account for the floatation costs:

$$\text{Amount raised}(1 - .0607) = \$125,000,000$$

$$\text{Amount raised} = \$125,000,000 / (1 - .0607)$$

$$\text{Amount raised} = \$133,079,848$$

If the company uses 60 percent internally generated equity, the floatation cost is:

$$f_T = (0.5714)(.08)(1 - 0.60) + (0.4286)(.035)$$

$$f_T = .0333 \text{ or } 3.33\%$$

And the initial cash flow will be:

$$\text{Amount raised}(1 - .0333) = \$125,000,000$$

$$\text{Amount raised} = \$125,000,000 / (1 - .0333)$$

$$\text{Amount raised} = \$129,303,975$$

If the company uses 100 percent internally generated equity, the floatation cost is:

$$f_T = (0.5714)(.08)(1 - 1) + (0.4286)(.035)$$

$$f_T = .0150 \text{ or } 1.50\%$$

And the initial cash flow will be:

$$\text{Amount raised}(1 - .0150) = \$125,000,000$$

$$\text{Amount raised} = \$125,000,000 / (1 - .0150)$$

$$\text{Amount raised} = \$126,903,553$$

- 26.** The \$8 million cost of the land 3 years ago is a sunk cost and irrelevant; the \$10.2 million appraised value of the land is an opportunity cost and is relevant. The relevant market value capitalization weights are:

$$MV_D = 25,000(\$1,000)(0.92) = \$23,000,000$$

$$MV_E = 450,000(\$75) = \$33,750,000$$

$$MV_P = 30,000(\$72) = \$2,160,000$$

The total market value of the company is:

$$V = \$23,000,000 + 33,750,000 + 2,160,000 = \$58,910,000$$

## B-272 SOLUTIONS

Next we need to find the cost of funds. We have the information available to calculate the cost of equity using the CAPM, so:

$$R_E = .05 + 1.3(.08) = .1540 \text{ or } 15.40\%$$

The cost of debt is the YTM of the company's outstanding bonds, so:

$$P_0 = \$920 = \$35(PVIFA_{R\%,30}) + \$1,000(PVIF_{R\%,30})$$
$$R = 3.96\%$$

$$YTM = 3.96\% \times 2 = 7.92\%$$

And the aftertax cost of debt is:

$$R_D = (1 - .35)(.0792) = .0515 \text{ or } 5.15\%$$

The cost of preferred stock is:

$$R_P = \$5/\$72 = .0694 \text{ or } 6.94\%$$

- a. The weighted average floatation cost is the sum of the weight of each source of funds in the capital structure of the company times the floatation costs, so:

$$f_T = (\$33.75/\$58.91)(.09) + (\$2.16/\$58.91)(.07) + (\$23/\$58.91)(.04) = .0697 \text{ or } 6.97\%$$

The initial cash outflow for the project needs to be adjusted for the floatation costs. To account for the floatation costs:

$$\text{Amount raised}(1 - .0697) = \$30,000,000$$
$$\text{Amount raised} = \$30,000,000/(1 - .0697) = \$32,249,235$$

So the cash flow at time zero will be:

$$CF_0 = -\$10,200,000 - 32,249,235 - 900,000 = -\$43,349,235$$

There is an important caveat to this solution. This solution assumes that the increase in net working capital does not require the company to raise outside funds; therefore the floatation costs are not included. However, this is an assumption and the company could need to raise outside funds for the NWC. If this is true, the initial cash outlay includes these floatation costs, so:

Total cost of NWC including floatation costs:

$$\$900,000/(1 - .0697) = \$967,477$$

This would make the total initial cash flow:

$$CF_0 = -\$10,200,000 - 32,249,235 - 967,477 = -\$43,416,712$$

- b. To find the required return on this project, we first need to calculate the WACC for the company. The company's WACC is:

$$\text{WACC} = [(\$33.75/\$58.91)(.1540) + (\$2.16/\$58.91)(.0694) + (\$23/\$58.91)(.0515)] = .1109$$

The company wants to use the subjective approach to this project because it is located overseas. The adjustment factor is 2 percent, so the required return on this project is:

$$\text{Project required return} = .1109 + .02 = .1309$$

- c. The annual depreciation for the equipment will be:

$$\$30,000,000/8 = \$3,750,000$$

So, the book value of the equipment at the end of five years will be:

$$\text{BV}_5 = \$30,000,000 - 5(\$3,750,000) = \$11,250,000$$

So, the aftertax salvage value will be:

$$\text{Aftertax salvage value} = \$5,000,000 + .35(\$11,250,000 - 5,000,000) = \$7,187,500$$

- d. Using the tax shield approach, the OCF for this project is:

$$\text{OCF} = [(P - v)Q - FC](1 - t) + t_c D$$

$$\text{OCF} = [(\$10,000 - 9,000)(17,000) - 400,000](1 - .35) + .35(\$30,000,000/8) = \$12,102,500$$

- e. The accounting breakeven sales figure for this project is:

$$Q_A = (FC + D)/(P - v) = (\$400,000 + 3,750,000)/(\$10,000 - 9,000) = 4,150 \text{ units}$$

- f. We have calculated all cash flows of the project. We just need to make sure that in Year 5 we add back the aftertax salvage value and the recovery of the initial NWC. The cash flows for the project are:

<u>Year</u>	<u>Flow Cash</u>
0	-\$43,349,235
1	12,102,500
2	12,102,500
3	12,102,500
4	12,102,500
5	20,190,000

Using the required return of 13.09 percent, the NPV of the project is:

$$\text{NPV} = -\$43,349,235 + \$12,102,500(\text{PVIFA}_{13.09\%,4}) + \$20,190,000/1.1309^5$$

$$\text{NPV} = \$3,499,909.45$$

## B-274 SOLUTIONS

And the IRR is:

$$\text{NPV} = 0 = -\$43,349,235 + \$12,102,500(\text{PVIFA}_{\text{IRR}\%,4}) + \$20,190,000/(1 + \text{IRR})^5$$
$$\text{IRR} = 16.12\%$$

If the initial NWC is assumed to be financed from outside sources, the cash flows are:

<u>Year</u>	<u>Flow Cash</u>
0	-\$43,416,712
1	12,102,500
2	12,102,500
3	12,102,500
4	12,102,500
5	20,190,000

With this assumption, and the required return of 13.09 percent, the NPV of the project is:

$$\text{NPV} = -\$43,416,712 + \$12,102,500(\text{PVIFA}_{13.09\%,4}) + \$20,190,000/1.1309^5$$
$$\text{NPV} = \$3,432,432.40$$

And the IRR is:

$$\text{NPV} = 0 = -\$43,416,712 + \$12,102,500(\text{PVIFA}_{\text{IRR}\%,4}) + \$20,190,000/(1 + \text{IRR})^5$$
$$\text{IRR} = 16.06\%$$

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# CHAPTER 16

## RAISING CAPITAL

### Answers to Concepts Review and Critical Thinking Questions

1. A company's internally generated cash flow provides a source of equity financing. For a profitable company, outside equity may never be needed. Debt issues are larger because large companies have the greatest access to public debt markets (small companies tend to borrow more from private lenders). Equity issuers are frequently small companies going public; such issues are often quite small.
2. From the previous question, economies of scale are part of the answer. Beyond this, debt issues are simply easier and less risky to sell from an investment bank's perspective. The two main reasons are that very large amounts of debt securities can be sold to a relatively small number of buyers, particularly large institutional buyers such as pension funds and insurance companies, and debt securities are much easier to price.
3. They are riskier and harder to market from an investment bank's perspective.
4. Yields on comparable bonds can usually be readily observed, so pricing a bond issue accurately is much less difficult.
5. It is clear that the stock was sold too cheaply, so Eyetech had reason to be unhappy.
6. No, but, in fairness, pricing the stock in such a situation is extremely difficult.
7. It's an important factor. Only 5 million of the shares were underpriced. The other 38 million were, in effect, priced completely correctly.
8. The evidence suggests that a non-underwritten rights offering might be substantially cheaper than a cash offer. However, such offerings are rare, and there may be hidden costs or other factors not yet identified or well understood by researchers.
9. He could have done worse since his access to the oversubscribed and, presumably, underpriced issues was restricted while the bulk of his funds were allocated to stocks from the undersubscribed and, quite possibly, overpriced issues.
10.
  - a. The price will probably go up because IPOs are generally underpriced. This is especially true for smaller issues such as this one.
  - b. It is probably safe to assume that they are having trouble moving the issue, and it is likely that the issue is not substantially underpriced.

## B-276 SOLUTIONS

### Solutions to Questions and Problems

*NOTE: All end of chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.*

#### Basic

1. a. The new market value will be the current shares outstanding times the stock price plus the rights offered times the rights price, so:

$$\text{New market value} = 400,000(\$75) + 70,000(\$70) = \$34,900,000$$

- b. The number of rights associated with the old shares is the number of shares outstanding divided by the rights offered, so:

$$\text{Number of rights needed} = 400,000 \text{ old shares} / 70,000 \text{ new shares} = 5.71 \text{ rights per new share}$$

- c. The new price of the stock will be the new market value of the company divided by the total number of shares outstanding after the rights offer, which will be:

$$P_X = \$34,900,000 / (400,000 + 70,000) = \$74.26$$

- d. The value of the right

$$\text{Value of a right} = \$75.00 - 74.26 = \$0.74$$

- e. A rights offering usually costs less, it protects the proportionate interests of existing shareholders and also protects against underpricing.

2. a. The maximum subscription price is the current stock price, or \$60. The minimum price is anything greater than \$0.

- b. The number of new shares will be the amount raised divided by the subscription price, so:

$$\text{Number of new shares} = \$50,000,000 / \$55 = 909,091 \text{ shares}$$

And the number of rights needed to buy one share will be the current shares outstanding divided by the number of new shares offered, so:

$$\text{Number of rights needed} = 5,200,000 \text{ shares outstanding} / 909,091 \text{ new shares} = 5.72$$

- c. A shareholder can buy 5.72 rights on shares for:

$$5.72(\$60) = \$343.20$$

The shareholder can exercise these rights for \$55, at a total cost of:

$$\$343.20 + 55.00 = \$398.20$$

The investor will then have:

$$\text{Ex-rights shares} = 1 + 5.72$$

$$\text{Ex-rights shares} = 6.72$$

The ex-rights price per share is:

$$P_x = [5.72(\$60) + \$55]/6.72 = \$59.26$$

So, the value of a right is:

$$\text{Value of a right} = \$60 - 59.26 = \$0.74$$

- d. Before the offer, a shareholder will have the shares owned at the current market price, or:

$$\text{Portfolio value} = (1,000 \text{ shares})(\$60) = \$60,000$$

After the rights offer, the share price will fall, but the shareholder will also hold the rights, so:

$$\text{Portfolio value} = (1,000 \text{ shares})(\$59.26) + (1,000 \text{ rights})(\$0.74) = \$60,000$$

3. Using the equation we derived in Problem 2, part c to calculate the price of the stock ex-rights, we can find the number of shares a shareholder will have ex-rights, which is:

$$P_x = \$62.75 = [N(\$70) + \$40]/(N + 1)$$

$$N = 3.138$$

The number of new shares is the amount raised divided by the per-share subscription price, so:

$$\text{Number of new shares} = \$15,000,000/\$40 = 375,000$$

And the number of old shares is the number of new shares times the number of shares ex-rights, so:

$$\text{Number of old shares} = 3.138(375,000) = 1,176,724$$

## B-278 SOLUTIONS

4. If you receive 1,000 shares of each, the profit is:

$$\text{Profit} = 1,000(\$8) - 1,000(\$5) = \$3,000$$

Since you will only receive one-half of the shares of the oversubscribed issue, your profit will be:

$$\text{Expected profit} = 500(\$8) - 1,000(\$5) = -\$1,000$$

This is an example of the winner's curse.

5. Using  $X$  to stand for the required sale proceeds, the equation to calculate the total sale proceeds, including floatation costs is:

$$X(1 - .08) = \$40\text{M}$$

$$X = \$43,478,261 \text{ required total proceeds from sale.}$$

So the number of shares offered is the total amount raised divided by the offer price, which is:

$$\text{Number of shares offered} = \$43,478,261 / \$35 = 1,242,236$$

6. This is basically the same as the previous problem, except we need to include the \$900,000 of expenses in the amount the company needs to raise, so:

$$X(1 - .08) = \$40.9\text{M}$$

$$X = \$44,456,522 \text{ required total proceeds from sale.}$$

$$\text{Number of shares offered} = \$44,456,522 / \$35 = 1,270,186$$

7. We need to calculate the net amount raised and the costs associated with the offer. The net amount raised is the number of shares offered times the price received by the company, minus the costs associated with the offer, so:

$$\text{Net amount raised} = (5,000,000 \text{ shares})(\$15.05) - 800,000 - 250,000 = \$74,200,000$$

The company received \$74,200,000 from the stock offering. Now we can calculate the direct costs. Part of the direct costs are given in the problem, but the company also had to pay the underwriters. The stock was offered at \$16 per share, and the company received \$15.05 per share. The difference, which is the underwriters spread, is also a direct cost. The total direct costs were:

$$\text{Total direct costs} = \$800,000 + (\$16 - 15.05)(5,000,000 \text{ shares}) = \$5,550,000$$

We are given part of the indirect costs in the problem. Another indirect cost is the immediate price appreciation. The total indirect costs were:

$$\text{Total indirect costs} = \$250,000 + (\$19.50 - 16)(5,000,000 \text{ shares}) = \$17,750,000$$

This makes the total costs:

$$\text{Total costs} = \$5,550,000 + 17,750,000 = \$23,300,000$$

The flotation costs as a percentage of the amount raised is the total cost divided by the amount raised, so:

$$\text{Flotation cost percentage} = \$23,300,000/\$74,200,000 = .3140 \text{ or } 31.40\%$$

8. The number of rights needed per new share is:

$$\text{Number of rights needed} = 100,000 \text{ old shares}/20,000 \text{ new shares} = 5 \text{ rights per new share.}$$

Using  $P_{RO}$  as the rights-on price, and  $P_S$  as the subscription price, we can express the price per share of the stock ex-rights as:

$$P_X = [NP_{RO} + P_S]/(N + 1)$$

- a.  $P_X = [5(\$80) + \$80]/6 = \$80.00$ ; No change.  
 b.  $P_X = [5(\$80) + \$75]/6 = \$79.17$ ; Price drops by \$0.83 per share.  
 c.  $P_X = [5(\$80) + \$70]/6 = \$78.33$ ; Price drops by \$1.67 per share.

### Intermediate

9. a. The number of shares outstanding after the stock offer will be the current shares outstanding, plus the amount raised divided by the current stock price, assuming the stock price doesn't change. So:

$$\text{Number of shares after offering} = 10,000,000 + \$40,000,000/\$50 = 10,800,000$$

Since the book value per share is \$20, the old book value of the shares is the current number of shares outstanding times 20. From the previous solution, we can see the company will sell 500,000 shares, and these will have a book value of \$50 per share. The sum of these two values will give us the total book value of the company. If we divide this by the new number of shares outstanding. Doing so, we find the new book value per share will be:

$$\text{New book value per share} = [10,000,000(\$20) + 800,000(\$50)]/10,800,000 = \$22.22$$

The current EPS for the company is:

$$\text{EPS}_0 = \text{NI}_0/\text{Shares}_0 = \$18,000,000/10,000,000 \text{ shares} = \$1.80 \text{ per share}$$

And the current P/E is:

$$(P/E)_0 = \$50/\$1.80 = 27.78$$

## B-280 SOLUTIONS

If the net income increases by \$500,000, the new EPS will be:

$$\text{EPS}_1 = \text{NI}_1 / \text{shares}_1 = \$18,500,000 / 10,800,000 \text{ shares} = \$1.71 \text{ per share}$$

Assuming the P/E remains constant, the new share price will be:

$$P_1 = (\text{P/E})_0 (\text{EPS}_1) = 27.78(\$1.71) = \$47.58$$

The current market-to-book ratio is:

$$\text{Current market-to-book} = \$50 / \$20 = 2.50$$

Using the new share price and book value per share, the new market-to-book ratio will be:

$$\text{New market-to-book} = \$47.58 / \$22.22 = 2.1412$$

Accounting dilution has occurred because new shares were issued when the market-to-book ratio was less than one; market value dilution has occurred because the firm financed a negative NPV project. The cost of the project is given at \$40 million. The NPV of the project is the new market value of the firm minus the current market value of the firm, or:

$$\text{NPV} = -\$40,000,000 + [10,800,000(\$47.58) - 10,000,000(\$50)] = -\$26,111,111$$

- b. For the price to remain unchanged when the P/E ratio is constant, EPS must remain constant. The new net income must be the new number of shares outstanding times the current EPS, which gives:

$$\text{NI}_1 = (10,800,000 \text{ shares})(\$1.80 \text{ per share}) = \$19,440,000$$

10. The total equity of the company is total assets minus total liabilities, or:

$$\text{Equity} = \$9,000,000 - 3,600,000$$

$$\text{Equity} = \$5,400,000$$

So, the current ROE of the company is:

$$\text{ROE}_0 = \text{NI}_0 / \text{TE}_0 = \$1,200,000 / \$5,400,000 = .2222 \text{ or } 22.22\%$$

The new net income will be the ROE times the new total equity, or:

$$\text{NI}_1 = (\text{ROE}_0)(\text{TE}_1) = .2222(\$5,400,000 + 900,000) = \$1,400,000$$

The company's current earnings per share are:

$$\text{EPS}_0 = \text{NI}_0 / \text{Shares outstanding}_0 = \$1,200,000 / 20,000 \text{ shares} = \$60.00$$

The number of shares the company will offer is the cost of the investment divided by the current share price, so:

$$\text{Number of new shares} = \$900,000 / \$98 = 9,184$$

The earnings per share after the stock offer will be:

$$\text{EPS}_1 = \$1,400,000/29,184 \text{ shares} = \$47.97$$

The current P/E ratio is:

$$(\text{P/E})_0 = \$98/\$60.00 = 1.633$$

Assuming the P/E remains constant, the new stock price will be:

$$P_1 = 1.633(\$47.97) = \$78.35$$

The current book value per share and the new book value per share are:

$$\text{BVPS}_0 = \text{TE}_0/\text{shares}_0 = \$5,400,000/20,000 \text{ shares} = \$270.00 \text{ per share}$$

$$\text{BVPS}_1 = \text{TE}_1/\text{shares}_1 = (\$5,400,000 + 900,000)/29,184 \text{ shares} = \$215.87 \text{ per share}$$

So the current and new market-to-book ratios are:

$$\text{Market-to-book}_0 = \$98/\$270 = 0.3630$$

$$\text{Market-to-book}_1 = \$78.35/\$215.87 = 0.3630$$

The NPV of the project is the new market value of the firm minus the current market value of the firm, or:

$$\text{NPV} = -\$900,000 + [\$78.35(29,184) - \$98(20,000)] = -\$573,333$$

Accounting dilution takes place here because the market-to-book ratio is less than one. Market value dilution has occurred since the firm is investing in a negative NPV project.

- 11.** Using the P/E ratio to find the necessary EPS after the stock issue, we get:

$$P_1 = \$98 = 1.633(\text{EPS}_1)$$

$$\text{EPS}_1 = \$60.00$$

The additional net income level must be the EPS times the new shares outstanding, so:

$$\text{NI} = \$60(9,184 \text{ shares}) = \$551,020$$

And the new ROE is:

$$\text{ROE}_1 = \$551,020/\$900,000 = .6122 \text{ or } 61.22\%$$

## B-282 SOLUTIONS

Next, we need to find the NPV of the project. The NPV of the project is the new market value of the firm minus the current market value of the firm, or:

$$\text{NPV} = -\$900,000 + [\$98(29,184) - \$98(20,000)] = \$0$$

Accounting dilution still takes place, as BVPS still falls from \$270.00 to \$215.87, but no market dilution takes place because the firm is investing in a zero NPV project.

12. The number of new shares is the amount raised divided by the subscription price, so:

$$\text{Number of new shares} = \$60,000,000 / P_S$$

And the ex-rights number of shares (N) is equal to:

$$\begin{aligned} N &= \text{Old shares outstanding} / \text{New shares outstanding} \\ N &= 5,000,000 / (\$60,000,000 / P_S) \\ N &= 0.0833P_S \end{aligned}$$

We know the equation for the ex-rights stock price is:

$$P_X = [NP_{RO} + P_S] / (N + 1)$$

We can substitute in the numbers we are given, and then substitute the two previous results. Doing so, and solving for the subscription price, we get:

$$\begin{aligned} P_X &= \$52 = [N(\$60) + P_S] / (N + 1) \\ \$52 &= [55(0.0833P_S) + P_S] / (0.0833P_S + 1) \\ \$52 &= 4.58P_S / (1 + 0.0833P_S) \\ P_S &= \$41.60 \end{aligned}$$

13. Using  $P_{RO}$  as the rights-on price, and  $P_S$  as the subscription price, we can express the price per share of the stock ex-rights as:

$$P_X = [NP_{RO} + P_S] / (N + 1)$$

And the equation for the value of a right is:

$$\text{Value of a right} = P_{RO} - P_X$$

Substituting the ex-rights price equation into the equation for the value of a right and rearranging, we get:

$$\begin{aligned} \text{Value of a right} &= P_{RO} - \{[NP_{RO} + P_S] / (N + 1)\} \\ \text{Value of a right} &= [(N + 1)P_{RO} - NP_{RO} - P_S] / (N + 1) \\ \text{Value of a right} &= [P_{RO} - P_S] / (N + 1) \end{aligned}$$

- 14.** The net proceeds to the company on a per share basis is the subscription price times one minus the underwriter spread, so:

$$\text{Net proceeds to the company} = \$36(1 - .06) = \$33.84 \text{ per share}$$

So, to raise the required funds, the company must sell:

$$\text{New shares offered} = \$4,100,000/\$33.84 = 121,158$$

The number of rights needed per share is the current number of shares outstanding divided by the new shares offered, or:

$$\text{Number of rights needed} = 490,000 \text{ old shares}/121,158 \text{ new shares}$$

$$\text{Number of rights needed} = 4.04 \text{ rights per share}$$

The ex-rights stock price will be:

$$P_X = [NP_{RO} + P_S]/(N + 1)$$

$$P_X = [4.04(\$40) + 36]/5.04 = \$39.21$$

So, the value of a right is:

$$\text{Value of a right} = \$40 - 39.21 = \$0.91$$

And your proceeds from selling your rights will be:

$$\text{Proceeds from selling rights} = 5,000(\$0.91) = \$3,964.88$$

- 15.** Using the equation for valuing a stock ex-rights, we find:

$$P_X = [NP_{RO} + P_S]/(N + 1)$$

$$P_X = [4(\$80) + \$40]/5 = \$72$$

The stock is correctly priced. Calculating the value of a right, we find:

$$\text{Value of a right} = P_{RO} - P_X$$

$$\text{Value of a right} = \$80 - 72 = \$8$$

So, the rights are underpriced. You can create an immediate profit on the ex-rights day if the stock is selling for \$72 and the rights are selling for \$6 by executing the following transactions:

Buy 4 rights in the market for  $4(\$6) = \$24$ . Use these rights to purchase a new share at the subscription price of \$40. Immediately sell this share in the market for \$72, creating an instant \$8 profit.

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# **CHAPTER 17**

## **FINANCIAL LEVERAGE AND CAPITAL STRUCTURE POLICY**

### **Answers to Concepts Review and Critical Thinking Questions**

1. Business risk is the equity risk arising from the nature of the firm's operating activity, and is directly related to the systematic risk of the firm's assets. Financial risk is the equity risk that is due entirely to the firm's chosen capital structure. As financial leverage, or the use of debt financing, increases, so does financial risk and, hence, the overall risk of the equity. Thus, Firm B could have a higher cost of equity if it uses greater leverage.
2. No, it doesn't follow. While it is true that the equity and debt costs are rising, the key thing to remember is that the cost of debt is still less than the cost of equity. Since we are using more and more debt, the WACC does not necessarily rise.
3. Because many relevant factors such as bankruptcy costs, tax asymmetries, and agency costs cannot easily be identified or quantified, it's practically impossible to determine the precise debt/equity ratio that maximizes the value of the firm. However, if the firm's cost of new debt suddenly becomes much more expensive, it's probably true that the firm is too highly leveraged.
4. The more capital intensive industries, such as airlines, cable television, and electric utilities, tend to use greater financial leverage. Also, industries with less predictable future earnings, such as computers or drugs, tend to use less financial leverage. Such industries also have a higher concentration of growth and startup firms. Overall, the general tendency is for firms with identifiable, tangible assets and relatively more predictable future earnings to use more debt financing. These are typically the firms with the greatest need for external financing and the greatest likelihood of benefiting from the interest tax shelter.
5. It's called leverage (or "gearing" in the UK) because it magnifies gains or losses.
6. Homemade leverage refers to the use of borrowing on the personal level as opposed to the corporate level.
7. One answer is that the right to file for bankruptcy is a valuable asset, and the financial manager acts in shareholders' best interest by managing this asset in ways that maximize its value. To the extent that a bankruptcy filing prevents "a race to the courthouse steps," it would seem to be a reasonable use of the process.
8. As in the previous question, it could be argued that using bankruptcy laws as a sword may simply be the best use of the asset. Creditors are aware at the time a loan is made of the possibility of bankruptcy, and the interest charged incorporates it.

9. One side is that Continental was going to go bankrupt because its costs made it uncompetitive. The bankruptcy filing enabled Continental to restructure and keep flying. The other side is that Continental abused the bankruptcy code. Rather than renegotiate labor agreements, Continental simply abrogated them to the detriment of its employees. In this, and the last several, questions, an important thing to keep in mind is that the bankruptcy code is a creation of law, not economics. A strong argument can always be made that making the best use of the bankruptcy code is no different from, for example, minimizing taxes by making best use of the tax code. Indeed, a strong case can be made that it is the financial manager's duty to do so. As the case of Continental illustrates, the code can be changed if socially undesirable outcomes are a problem.
10. The basic goal is to minimize the value of non-marketed claims.

### Solutions to Questions and Problems

*NOTE: All end of chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.*

#### Basic

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 4,000 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	\$10,000	\$25,000	\$35,000
Interest	<u>0</u>	<u>0</u>	<u>0</u>
NI	<u>\$10,000</u>	<u>\$25,000</u>	<u>\$35,000</u>
EPS	\$ 2.50	\$ 6.25	\$ 8.75
%ΔEPS	-60	—	+40

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

$$\text{Share price} = \text{Equity} / \text{Shares outstanding}$$

$$\text{Share price} = \$200,000 / 4,000$$

$$\text{Share price} = \$50$$

$$\text{Shares repurchased} = \text{Debt issued} / \text{Share price}$$

$$\text{Shares repurchased} = \$70,000 / \$50$$

$$\text{Shares repurchased} = 1,400$$

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

$$\text{Interest payment} = \$70,000(.06) = \$4,200$$

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	\$10,000	\$25,000	\$35,000
Interest	<u>4,200</u>	<u>4,200</u>	<u>4,200</u>
NI	<u>\$5,800</u>	<u>\$20,800</u>	<u>\$30,800</u>
EPS	\$2.23	\$ 8.00	\$11.85
%ΔEPS	-72.12	—	+48.08

2. a. A table outlining the income statement with taxes for the three possible states of the economy is shown below. The share price is still \$50, and there are still 4,000 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	\$10,000	\$25,000	\$35,000
Interest	0	0	0
Taxes	<u>3,500</u>	<u>8,750</u>	<u>12,250</u>
NI	<u>\$6,500</u>	<u>\$16,250</u>	<u>\$22,750</u>
EPS	\$1.63	\$4.06	\$5.69
%ΔEPS	-60	—	+40

- b. A table outlining the income statement with taxes for the three possible states of the economy and assuming the company undertakes the proposed capitalization is shown below. The interest payment and shares repurchased are the same as in part *b* of Problem 1.

	Recession	Normal	Expansion
EBIT	\$10,000	\$25,000	\$35,000
Interest	4,200	4,200	4,200
Taxes	<u>2,030</u>	<u>7,280</u>	<u>10,780</u>
NI	<u>\$3,770</u>	<u>\$13,520</u>	<u>\$20,020</u>
EPS	\$1.45	\$5.20	\$7.70
%ΔEPS	-72.12	—	+48.08

Notice that the percentage change in EPS is the same both with and without taxes.

3. a. Since the company has a market-to-book ratio of 1.0, the total equity of the firm is equal to the market value of equity. Using the equation for ROE:

$$\text{ROE} = \text{NI}/\$200,000$$

The ROE for each state of the economy under the current capital structure and no taxes is:

	Recession	Normal	Expansion
ROE	.0500	.1250	.1750
%ΔROE	-60	—	+40

The second row shows the percentage change in ROE from the normal economy.

- b. If the company undertakes the proposed recapitalization, the new equity value will be:

$$\text{Equity} = \$200,000 - 70,000$$

$$\text{Equity} = \$130,000$$

So, the ROE for each state of the economy is:

$$\text{ROE} = \text{NI}/\$130,000$$

	Recession	Normal	Expansion
ROE	.0446	.1600	.2369
%ΔROE	-72.12	—	+48.08

- c. If there are corporate taxes and the company maintains its current capital structure, the ROE is:

ROE	.0325	.0813	.1138
%ΔROE	-60	—	+40

If the company undertakes the proposed recapitalization, and there are corporate taxes, the ROE for each state of the economy is:

ROE	.0290	.1040	.1540
%ΔROE	-72.12	—	+48.08

Notice that the percentage change in ROE is the same as the percentage change in EPS. The percentage change in ROE is also the same with or without taxes.

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:

$$\text{EPS} = \$150,000/200,000 \text{ shares}$$

$$\text{EPS} = \$0.75$$

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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:

$$NI = \$150,000 - .08(\$1,500,000)$$

$$NI = \$30,000$$

And the EPS will be:

$$EPS = \$30,000/90,000 \text{ shares}$$

$$EPS = \$0.33$$

Plan I has the higher EPS when EBIT is \$150,000.

- b. Under Plan I, the net income is \$300,000 and the EPS is:

$$EPS = \$300,000/200,000 \text{ shares}$$

$$EPS = \$1.50$$

Under Plan II, the net income is:

$$NI = \$300,000 - .08(\$1,500,000)$$

$$NI = \$180,000$$

And the EPS is:

$$EPS = \$180,000/90,000 \text{ shares}$$

$$EPS = \$2.00$$

Plan II has the higher EPS when EBIT is \$300,000.

- 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:

$$EBIT/200,000 = [EBIT - .08(\$1,500,000)]/90,000$$

$$EBIT = \$218,181.82$$

5. We can find the price per share by dividing the amount of debt used to repurchase shares by the number of shares repurchased. Doing so, we find the share price is:

$$\text{Share price} = \$1,500,000/(200,000 - 90,000)$$

$$\text{Share price} = \$13.64 \text{ per share}$$

The value of the company under the all-equity plan is:

$$V = \$13.64(200,000 \text{ shares}) = \$2,727,272.73$$

And the value of the company under the levered plan is:

$$V = \$13.64(90,000 \text{ shares}) + \$1,500,000 \text{ debt} = \$2,272,272.73$$

6. a. The income statement for each capitalization plan is:

	<i>I</i>	<i>II</i>	<i>All-equity</i>
EBIT	\$12,000	\$12,000	\$12,000
Interest	<u>2,000</u>	<u>3,000</u>	<u>0</u>
NI	<u>\$10,000</u>	<u>\$ 9,000</u>	<u>\$12,000</u>
EPS	\$ 6.67	\$ 8.18	\$ 5.22

Plan II has the highest EPS; the all-equity plan has the lowest EPS.

- b. The breakeven level of EBIT occurs when the capitalization plans result in the same EPS. The EPS is calculated as:

$$\text{EPS} = (\text{EBIT} - R_D D) / \text{Shares outstanding}$$

This equation calculates the interest payment ( $R_D D$ ) and subtracts it from the EBIT, which results in the net income. Dividing by the shares outstanding gives us the EPS. For the all-equity capital structure, the interest term is zero. To find the breakeven EBIT for two different capital structures, we simply set the equations equal to each other and solve for EBIT. The breakeven EBIT between the all-equity capital structure and Plan I is:

$$\begin{aligned} \text{EBIT}/2,300 &= [\text{EBIT} - .10(\$20,000)]/1,500 \\ \text{EBIT} &= \$5,750 \end{aligned}$$

And the breakeven EBIT between the all-equity capital structure and Plan II is:

$$\begin{aligned} \text{EBIT}/2,300 &= [\text{EBIT} - .10(\$30,000)]/1,100 \\ \text{EBIT} &= \$5,750 \end{aligned}$$

The break-even levels of EBIT are the same because of M&M Proposition I.

- c. Setting the equations for EPS from Plan I and Plan II equal to each other and solving for EBIT, we get:

$$\begin{aligned} [\text{EBIT} - .10(\$20,000)]/1,500 &= [\text{EBIT} - .10(\$30,000)]/1,100 \\ \text{EBIT} &= \$5,750 \end{aligned}$$

This break-even level of EBIT is the same as in part *b* again because of M&M Proposition I.

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d. The income statement for each capitalization plan with corporate income taxes is:

	<i>I</i>	<i>II</i>	<i>All-equity</i>
EBIT	\$12,000	\$12,000	\$12,000
Interest	2,000	3,000	0
Taxes	<u>4,000</u>	<u>3,600</u>	<u>4,800</u>
NI	<u>\$ 6,000</u>	<u>\$ 5,400</u>	<u>\$ 7,200</u>
EPS	\$ 4.00	\$ 4.91	\$ 3.13

Plan II still has the highest EPS; the all-equity plan still has the lowest EPS.

We can calculate the EPS as:

$$\text{EPS} = [(\text{EBIT} - R_D D)(1 - t_c)] / \text{Shares outstanding}$$

This is similar to the equation we used before, except now we need to account for taxes. Again, the interest expense term is zero in the all-equity capital structure. So, the breakeven EBIT between the all-equity plan and Plan I is:

$$\begin{aligned} \text{EBIT}(1 - .40)/2,300 &= [\text{EBIT} - .10(\$20,000)](1 - .40)/1,500 \\ \text{EBIT} &= \$5,750 \end{aligned}$$

The breakeven EBIT between the all-equity plan and Plan II is:

$$\begin{aligned} \text{EBIT}(1 - .40)/2,300 &= [\text{EBIT} - .10(\$30,000)](1 - .40)/1,100 \\ \text{EBIT} &= \$5,750 \end{aligned}$$

And the breakeven between Plan I and Plan II is:

$$\begin{aligned} [\text{EBIT} - .10(\$20,000)](1 - .40)/1,500 &= [\text{EBIT} - .10(\$30,000)](1 - .40)/1,100 \\ \text{EBIT} &= \$5,750 \end{aligned}$$

The break-even levels of EBIT do not change because the addition of taxes reduces the income of all three plans by the same percentage; therefore, they do not change relative to one another.

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:

$$\begin{aligned} P &= \$20,000 / (2,300 - 1,500 \text{ shares}) \\ P &= \$25 \text{ per share} \end{aligned}$$

And under Plan II, the value per share is:

$$\begin{aligned} P &= \$30,000 / (2,300 - 1,100 \text{ shares}) \\ P &= \$25 \text{ per share} \end{aligned}$$

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.

8. a. The earnings per share are:

$$\text{EPS} = \$28,000/5,000 \text{ shares}$$
$$\text{EPS} = \$5.60$$

So, the cash flow for the company is:

$$\text{Cash flow} = \$5.60(100 \text{ shares})$$
$$\text{Cash flow} = \$560$$

- b. To determine the cash flow to the shareholder, we need to determine the EPS of the firm under the proposed capital structure. The market value of the firm is:

$$V = \$60(5,000)$$
$$V = \$300,000$$

Under the proposed capital structure, the firm will raise new debt in the amount of:

$$D = 0.50(\$300,000)$$
$$D = \$150,000$$

in debt. This means the number of shares repurchased will be:

$$\text{Shares repurchased} = \$150,000/\$60$$
$$\text{Shares repurchased} = 2,500$$

Under the new capital structure, the company will have to make an interest payment on the new debt. The net income with the interest payment will be:

$$\text{NI} = \$28,000 - .08(\$150,000)$$
$$\text{NI} = \$16,000$$

This means the EPS under the new capital structure will be:

$$\text{EPS} = \$16,000/2,500 \text{ shares}$$
$$\text{EPS} = \$6.40$$

Since all earnings are paid as dividends, the shareholder will receive:

$$\text{Shareholder cash flow} = \$6.40(100 \text{ shares})$$
$$\text{Shareholder cash flow} = \$640$$

- c. To replicate the proposed capital structure, the shareholder should sell 50 percent of their shares, or 50 shares, and lend the proceeds at 8 percent. The shareholder will have an interest cash flow of:

$$\text{Interest cash flow} = 50(\$60)(.08)$$
$$\text{Interest cash flow} = \$240$$

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The shareholder will receive dividend payments on the remaining 50 shares, so the dividends received will be:

$$\text{Dividends received} = \$6.40(50 \text{ shares})$$

$$\text{Dividends received} = \$320$$

The total cash flow for the shareholder under these assumptions will be:

$$\text{Total cash flow} = \$240 + 320$$

$$\text{Total cash flow} = \$560$$

This is the same cash flow we calculated in part *a*.

*d.* The capital structure is irrelevant because shareholders can create their own leverage or unlever the stock to create the payoff they desire, regardless of the capital structure the firm actually chooses.

**9. a.** The rate of return earned will be the dividend yield. The company has debt, so it must make an interest payment. The net income for the company is:

$$\text{NI} = \$90,000 - .10(\$400,000)$$

$$\text{NI} = \$50,000$$

The investor will receive dividends in proportion to the percentage of the company's share they own. The total dividends received by the shareholder will be:

$$\text{Dividends received} = \$50,000(\$30,000/\$400,000)$$

$$\text{Dividends received} = \$3,750$$

So the return the shareholder expects is:

$$R = \$3,750/\$30,000$$

$$R = .1250 \text{ or } 12.50\%$$

*b.* To generate exactly the same cash flows in the other company, the shareholder needs to match the capital structure of ABC. The shareholder should sell all shares in XYZ. This will net \$30,000. The shareholder should then borrow \$30,000. This will create an interest cash flow of:

$$\text{Interest cash flow} = .10(-\$30,000)$$

$$\text{Interest cash flow} = -\$3,000$$

The investor should then use the proceeds of the stock sale and the loan to buy shares in ABC. The investor will receive dividends in proportion to the percentage of the company's share they own. The total dividends received by the shareholder will be:

$$\text{Dividends received} = \$90,000(\$60,000/\$800,000)$$

$$\text{Dividends received} = \$6,750$$

The total cash flow for the shareholder will be:

$$\begin{aligned}\text{Total cash flow} &= \$6,750 - 3,000 \\ \text{Total cash flow} &= \$3,750\end{aligned}$$

The shareholders return in this case will be:

$$\begin{aligned}R &= \$3,750/\$30,000 \\ R &= .1250 \text{ or } 12.50\%\end{aligned}$$

- c. ABC is an all equity company, so:

$$\begin{aligned}R_E = R_A &= \$90,000/\$800,000 \\ R_E &= .1125 \text{ or } 11.25\%\end{aligned}$$

To find the cost of equity for XYZ we need to use M&M Proposition II, so:

$$\begin{aligned}R_E &= R_A + (R_A - R_D)(D/E)(1 - t_c) \\ R_E &= .1125 + (.1125 - .10)(1)(1) \\ R_E &= .1250 \text{ or } 12.50\%\end{aligned}$$

- d. To find the WACC for each company we need to use the WACC equation:

$$\text{WACC} = (E/V)R_E + (D/V)R_D(1 - t_c)$$

So, for ABC, the WACC is:

$$\begin{aligned}\text{WACC} &= (1)(.1125) + (0)(.10) \\ \text{WACC} &= .1125 \text{ or } 11.25\%\end{aligned}$$

And for XYZ, the WACC is:

$$\begin{aligned}\text{WACC} &= (1/2)(.1250) + (1/2)(.10) \\ \text{WACC} &= .1125 \text{ or } 11.25\%\end{aligned}$$

When there are no corporate taxes, the cost of capital for the firm is unaffected by the capital structure; this is M&M Proposition II without taxes.

10. With no taxes, the value of an unlevered firm is the interest rate divided by the unlevered cost of equity, so:

$$\begin{aligned}V &= \text{EBIT}/\text{WACC} \\ \$25,000,000 &= \text{EBIT}/.11 \\ \text{EBIT} &= .11(\$25,000,000) \\ \text{EBIT} &= \$2,750,000\end{aligned}$$

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11. If there are corporate taxes, the value of an unlevered firm is:

$$V_U = \text{EBIT}(1 - t_c)/R_U$$

Using this relationship, we can find EBIT as:

$$\$25,000,000 = \text{EBIT}(1 - .35)/.11$$

$$\text{EBIT} = \$4,230,769.23$$

The WACC remains at 11 percent. Due to taxes, EBIT for an all-equity firm would have to be higher for the firm to still be worth \$25 million.

12. a. With the information provided, we can use the equation for calculating WACC to find the cost of equity. The equation for WACC is:

$$\text{WACC} = (E/V)R_E + (D/V)R_D(1 - t_c)$$

The company has a debt-equity ratio of 1.5, which implies the weight of debt is 1.5/2.5, and the weight of equity is 1/2.5, so

$$\text{WACC} = .11 = (1/2.5)R_E + (1.5/2.5)(.08)(1 - .35)$$

$$R_E = .1970 \text{ or } 19.70\%$$

- b. To find the unlevered cost of equity we need to use M&M Proposition II with taxes, so:

$$R_E = R_U + (R_U - R_D)(D/E)(1 - t_c)$$

$$.1970 = R_U + (R_U - .08)(1.5)(1 - .35)$$

$$R_U = .1541 \text{ or } 15.41\%$$

- c. To find the cost of equity under different capital structures, we can again use M&M Proposition II with taxes. With a debt-equity ratio of 2, the cost of equity is:

$$R_E = R_U + (R_U - R_D)(D/E)(1 - t_c)$$

$$R_E = .1541 + (.1541 - .08)(2)(1 - .35)$$

$$R_E = .2503 \text{ or } 25.03\%$$

With a debt-equity ratio of 1.0, the cost of equity is:

$$R_E = .1541 + (.1541 - .08)(1)(1 - .35)$$

$$R_E = .2022 \text{ or } 20.22\%$$

And with a debt-equity ratio of 0, the cost of equity is:

$$R_E = .1541 + (.1541 - .08)(0)(1 - .35)$$

$$R_E = R_U = .1541 \text{ or } 15.41\%$$

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

$$WACC = R_U = R_E = .10 \text{ or } 10\%$$

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

$$\begin{aligned} R_E &= R_U + (R_U - R_D)(D/E)(1 - t_c) \\ R_E &= .10 + (.10 - .075)(.25/.75)(.65) \\ R_E &= .1054 \text{ or } 10.54\% \end{aligned}$$

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

$$\begin{aligned} R_E &= R_U + (R_U - R_D)(D/E)(1 - t_c) \\ R_E &= .10 + (.10 - .075)(.50/.50)(1 - .35) \\ R_E &= .1163 \text{ or } 11.63\% \end{aligned}$$

- d. The WACC with 25 percent debt is:

$$\begin{aligned} WACC &= (E/V)R_E + (D/V)R_D(1 - t_c) \\ WACC &= .75(.1054) + .25(.075)(1 - .35) \\ WACC &= .0913 \text{ or } 9.13\% \end{aligned}$$

And the WACC with 50 percent debt is:

$$\begin{aligned} WACC &= (E/V)R_E + (D/V)R_D(1 - t_c) \\ WACC &= .50(.1163) + .50(.075)(1 - .35) \\ WACC &= .0825 \text{ or } 8.25\% \end{aligned}$$

14. a. The value of the unlevered firm is:

$$\begin{aligned} V &= EBIT(1 - t_c)/R_U \\ V &= \$85,000(1 - .35)/.18 \\ V &= \$306,944.44 \end{aligned}$$

- b. The value of the levered firm is:

$$\begin{aligned} V &= V_U + t_c D \\ V &= \$306,944.44 + .35(\$60,000) \\ V &= \$327,944.44 \end{aligned}$$

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15. We can find the cost of equity using M&M Proposition II with taxes. Doing so, we find:

$$\begin{aligned}R_E &= R_U + (R_U - R_D)(D/E)(1 - t) \\R_E &= .18 + (.18 - .11)(\$60,000/\$327,944)(1 - .35) \\R_E &= .1902 \text{ or } 19.02\%\end{aligned}$$

Using this cost of equity, the WACC for the firm after recapitalization is:

$$\begin{aligned}\text{WACC} &= (E/V)R_E + (D/V)R_D(1 - t_c) \\ \text{WACC} &= .1902(\$266,944/\$327,944) + .11(1 - .35)(\$60,000/\$327,944) \\ \text{WACC} &= .1685 \text{ or } 16.85\%\end{aligned}$$

When there are corporate taxes, the overall cost of capital for the firm declines the more highly leveraged is the firm's capital structure. This is M&M Proposition I with taxes.

### Intermediate

16. To find the value of the levered firm we first need to find the value of an unlevered firm. So, the value of the unlevered firm is:

$$\begin{aligned}V_U &= \text{EBIT}(1 - t_c)/R_U \\ V_U &= (\$45,000)(1 - .35)/.14 \\ V_U &= \$208,928.57\end{aligned}$$

Now we can find the value of the levered firm as:

$$\begin{aligned}V_L &= V_U + t_c D \\ V_L &= \$208,928.57 + .35(\$80,000) \\ V_L &= \$236,928.57\end{aligned}$$

Applying M&M Proposition I with taxes, the firm has increased its value by issuing debt. As long as M&M Proposition I holds, that is, there are no bankruptcy costs and so forth, then the company should continue to increase its debt/equity ratio to maximize the value of the firm.

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

$$\begin{aligned}V_U &= \text{EBIT}(1 - t_c)/R_U \\ V_U &= \$12,000(1 - .35)/.16 \\ V_U &= \$48,750\end{aligned}$$

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:

$$\begin{aligned}V_L &= V_U + t_c(D/V)V_U \\ V_L &= \$48,750 + .35(.50)(\$48,750) \\ V_L &= \$57,281.25\end{aligned}$$

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

$$V_L = V_U + t_c(D/V)V_U$$

$$V_L = \$48,750 + .35(1.0)(\$48,750)$$

$$V_L = \$65,812.50$$

18. a. To purchase 5 percent of Knight's equity, the investor would need:

$$\text{Knight investment} = .05(\$1,714,000) = \$85,700$$

And to purchase 5 percent of Veblen without borrowing would require:

$$\text{Veblen investment} = .05(\$2,400,000) = \$120,000$$

In order to compare dollar returns, the initial net cost of both positions should be the same. Therefore, the investor will need to borrow the difference between the two amounts, or:

$$\text{Amount to borrow} = \$120,000 - 85,700 = \$34,300$$

An investor who owns 5 percent of Knight's equity will be entitled to 5 percent of the firm's earnings available to common stock holders at the end of each year. While Knight's expected operating income is \$300,000, it must pay \$60,000 to debt holders before distributing any of its earnings to stockholders. So, the amount available to this shareholder will be:

$$\text{Cash flow from Knight to shareholder} = .05(\$300,000 - 60,000) = \$12,000$$

Veblen will distribute all of its earnings to shareholders, so the shareholder will receive:

$$\text{Cash flow from Veblen to shareholder} = .05(\$300,000) = \$15,000$$

However, to have the same initial cost, the investor has borrowed \$34,300 to invest in Veblen, so interest must be paid on the borrowings. The net cash flow from the investment in Veblen will be:

$$\text{Net cash flow from Veblen investment} = \$15,000 - .06(\$34,300) = \$12,942$$

For the same initial cost, the investment in Veblen produces a higher dollar return.

- b. Both of the two strategies have the same initial cost. Since the dollar return to the investment in Veblen is higher, all investors will choose to invest in Veblen over Knight. The process of investors purchasing Veblen's equity rather than Knight's will cause the market value of Veblen's equity to rise and the market value of Knight's equity to fall. Any differences in the dollar returns to the two strategies will be eliminated, and the process will cease when the total market values of the two firms are equal.

B-298 SOLUTIONS

Challenge

19. M&M Proposition II states:

$$R_E = R_A + (R_A - R_D)(D/E)(1 - t_C)$$

And the equation for WACC is:

$$WACC = (E/V)R_E + (D/V)R_D(1 - t_C)$$

Substituting the M&M Proposition II equation into the equation for WACC, we get:

$$WACC = (E/V)[R_A + (R_A - R_D)(D/E)(1 - t_C)] + (D/V)R_D(1 - t_C)$$

Rearranging and reducing the equation, we get:

$$WACC = R_A[(E/V) + (E/V)(D/E)(1 - t_C)] + R_D(1 - t_C)[(D/V) - (E/V)(D/E)]$$

$$WACC = R_A[(E/V) + (D/V)(1 - t_C)]$$

$$WACC = R_A[\{(E+D)/V\} - t_C(D/V)]$$

$$WACC = R_A[1 - t_C(D/V)]$$

20. The return on equity is net income divided by equity. Net income can be expressed as:

$$NI = (EBIT - R_D D)(1 - t_C)$$

So, ROE is:

$$R_E = (EBIT - R_D D)(1 - t_C)/E$$

Now we can rearrange and substitute as follows to arrive at M&M Proposition II with taxes:

$$R_E = [EBIT(1 - t_C)/E] - [R_D(D/E)(1 - t_C)]$$

$$R_E = R_A V_U/E - [R_D(D/E)(1 - t_C)]$$

$$R_E = R_A(V_L - t_C D)/E - [R_D(D/E)(1 - t_C)]$$

$$R_E = R_A(E + D - t_C D)/E - [R_D(D/E)(1 - t_C)]$$

$$R_E = R_A + (R_A - R_D)(D/E)(1 - t_C)$$

21. M&M Proposition II, with no taxes is:

$$R_E = R_A + (R_A - R_f)(D/E)$$

Note that we use the risk-free rate as the return on debt. This is an important assumption of M&M Proposition II. The CAPM to calculate the cost of equity is expressed as:

$$R_E = \beta_E(R_M - R_f) + R_f$$

We can rewrite the CAPM to express the return on an unlevered company as:

$$R_A = \beta_A(R_M - R_f) + R_f$$

We can now substitute the CAPM for an unlevered company into M&M Proposition II. Doing so and rearranging the terms we get:

$$R_E = \beta_A(R_M - R_f) + R_f + [\beta_A(R_M - R_f) + R_f - R_f](D/E)$$

$$R_E = \beta_A(R_M - R_f) + R_f + [\beta_A(R_M - R_f)](D/E)$$

$$R_E = (1 + D/E)\beta_A(R_M - R_f) + R_f$$

Now we set this equation equal to the CAPM equation to calculate the cost of equity and reduce:

$$\beta_E(R_M - R_f) + R_f = (1 + D/E)\beta_A(R_M - R_f) + R_f$$

$$\beta_E(R_M - R_f) = (1 + D/E)\beta_A(R_M - R_f)$$

$$\beta_E = \beta_A(1 + D/E)$$

22. Using the equation we derived in Problem 20:

$$\beta_E = \beta_A(1 + D/E)$$

The equity beta for the respective asset betas is:

<u>Debt-equity ratio</u>	<u>Equity beta</u>
0	$1(1 + 0) = 1$
1	$1(1 + 1) = 2$
5	$1(1 + 5) = 6$
20	$1(1 + 20) = 21$

The equity risk to the shareholder is composed of both business and financial risk. Even if the assets of the firm are not very risky, the risk to the shareholder can still be large if the financial leverage is high. These higher levels of risk will be reflected in the shareholder's required rate of return  $R_E$ , which will increase with higher debt/equity ratios.

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# CHAPTER 18

## DIVIDENDS AND DIVIDEND POLICY

### Answers to Concepts Review and Critical Thinking Questions

1. Dividend policy deals with the timing of dividend payments, not the amounts ultimately paid. Dividend policy is irrelevant when the timing of dividend payments doesn't affect the present value of all future dividends.
2. A stock repurchase reduces equity while leaving debt unchanged. The debt ratio rises. A firm could, if desired, use excess cash to reduce debt instead. This is a capital structure decision.
3. The chief drawback to a strict dividend policy is the variability in dividend payments. This is a problem because investors tend to want a somewhat predictable cash flow. Also, if there is information content to dividend announcements, then the firm may be inadvertently telling the market that it is expecting a downturn in earnings prospects when it cuts a dividend, when in reality its prospects are very good. In a compromise policy, the firm maintains a relatively constant dividend. It increases dividends only when it expects earnings to remain at a sufficiently high level to pay the larger dividends, and it lowers the dividend only if it absolutely has to.
4. Friday, December 29 is the ex-dividend day. Remember not to count January 1 because it is a holiday, and the exchanges are closed. Anyone who buys the stock before December 29 is entitled to the dividend, assuming they do not sell it again before December 29.
5. No, because the money could be better invested in stocks that pay dividends in cash which benefit the fundholders directly.
6. The change in price is due to the change in dividends, not due to the change in dividend *policy*. Dividend policy can still be irrelevant without a contradiction.
7. The stock price dropped because of an expected drop in future dividends. Since the stock price is the present value of all future dividend payments, if the expected future dividend payments decrease, then the stock price will decline.
8. The plan will probably have little effect on shareholder wealth. The shareholders can reinvest on their own, and the shareholders must pay the taxes on the dividends either way. However, the shareholders who take the option may benefit at the expense of the ones who don't (because of the discount). Also as a result of the plan, the firm will be able to raise equity by paying a 10% flotation cost (the discount), which may be a smaller discount than the market flotation costs of a new issue for some companies.
9. If these firms just went public, they probably did so because they were growing and needed the additional capital. Growth firms typically pay very small cash dividends, if they pay a dividend at all. This is because they have numerous projects available, and they reinvest the earnings in the firm instead of paying cash dividends.

10. It would not be irrational to find low-dividend, high-growth stocks. The trust should be indifferent between receiving dividends or capital gains since it does not pay taxes on either one (ignoring possible restrictions on invasion of principal, etc.). It would be irrational, however, to hold municipal bonds. Since the trust does not pay taxes on the interest income it receives, it does not need the tax break associated with the municipal bonds. Therefore, it should prefer to hold higher yield, taxable bonds.
11. The stock price drop on the ex-dividend date should be lower. With taxes, stock prices should drop by the amount of the dividend, less the taxes investors must pay on the dividends. A lower tax rate lowers the investors' tax liability.
12. With a high tax on dividends and a low tax on capital gains, investors, in general, will prefer capital gains. If the dividend tax rate declines, the attractiveness of dividends increases.

### Solutions to Questions and Problems

*NOTE: All end of chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.*

#### Basic

1. The aftertax dividend is the pretax dividend times one minus the tax rate, so:

$$\text{Aftertax dividend} = \$5.00(1 - .15) = \$4.25$$

The stock price should drop by the aftertax dividend amount, or:

$$\text{Ex-dividend price} = \$90.25 - 4.25 = \$86.00$$

2. a. The shares outstanding increases by 10 percent, so:

$$\text{New shares outstanding} = 20,000(1.10) = 22,000$$

$$\text{New shares issued} = 2,000$$

Since the par value of the new shares is \$1, the capital surplus per share is \$24. The total capital surplus is therefore:

$$\text{Capital surplus on new shares} = 2,000(\$24) = \$48,000$$

Common stock (\$1 par value)	\$ 22,000
Capital surplus	243,000
Retained earnings	<u>487,400</u>
	<u>\$752,400</u>

## B-302 SOLUTIONS

- b. The shares outstanding increases by 25 percent, so:

$$\text{New shares outstanding} = 20,000(1.25) = 25,000$$

$$\text{New shares issued} = 5,000$$

Since the par value of the new shares is \$1, the capital surplus per share is \$24. The total capital surplus is therefore:

$$\text{Capital surplus on new shares} = 5,000(\$24) = \$120,000$$

Common stock (\$1 par value)	\$ 25,000
Capital surplus	315,000
Retained earnings	<u>412,400</u>
	<u>\$752,400</u>

3. a. To find the new shares outstanding, we multiply the current shares outstanding times the ratio of new shares to old shares, so:

$$\text{New shares outstanding} = 20,000(4/1) = 80,000$$

The equity accounts are unchanged except the par value of the stock is changed by the ratio of new shares to old shares, so the new par value is:

$$\text{New par value} = \$1(1/4) = \$0.25 \text{ per share.}$$

- b. To find the new shares outstanding, we multiply the current shares outstanding times the ratio of new shares to old shares, so:

$$\text{New shares outstanding} = 20,000(1/5) = 4,000.$$

The equity accounts are unchanged except the par value of the stock is changed by the ratio of new shares to old shares, so the new par value is:

$$\text{New par value} = \$1(5/1) = \$5.00 \text{ per share.}$$

4. To find the new stock price, we multiply the current stock price by the ratio of old shares to new shares, so:

a.  $\$75(3/5) = \$45.00$

b.  $\$75(1/1.15) = \$65.22$

c.  $\$75(1/1.425) = \$52.63$

d.  $\$75(7/4) = \$131.25$

e. To find the new shares outstanding, we multiply the current shares outstanding times the ratio of new shares to old shares, so:

$$a: 250,000(5/3) = 416,667$$

$$b: 250,000(1.15) = 287,500$$

$$c: 250,000(1.425) = 356,250$$

$$d: 250,000(4/7) = 142,857$$

5. The stock price is the total market value of equity divided by the shares outstanding, so:

$$P_0 = \$215,000 \text{ equity} / 5,000 \text{ shares} = \$43.00 \text{ per share}$$

Ignoring tax effects, the stock price will drop by the amount of the dividend, so:

$$P_X = \$43.00 - 1.20 = \$41.80$$

The total dividends paid will be:

$$\$1.20 \text{ per share}(5,000 \text{ shares}) = \$6,000$$

The equity and cash accounts will both decline by \$6,000.

6. Repurchasing the shares will reduce shareholders' equity by \$6,000. The shares repurchased will be the total purchase amount divided by the stock price, so:

$$\text{Shares bought} = \$6,000 / \$43.00 = 139.53$$

And the new shares outstanding will be:

$$\text{New shares outstanding} = 5,000 - 139.53 = 4,860.47$$

After repurchase, the new stock price is:

$$\text{Share price} = (\$215,000 - 6,000) / 4,860.47 \text{ shares} = \$43.00$$

The repurchase is effectively the same as the cash dividend because you either hold a share worth \$43.00, or a share worth \$41.80 and \$1.20 in cash. Therefore, you participate in the repurchase according to the dividend payout percentage; you are unaffected.

## B-304 SOLUTIONS

7. The stock price is the total market value of equity divided by the shares outstanding, so:

$$P_0 = \$440,000 \text{ equity} / 15,000 \text{ shares} = \$29.33 \text{ per share}$$

The shares outstanding will increase by 25 percent, so:

$$\text{New shares outstanding} = 15,000(1.25) = 18,750$$

The new stock price is the market value of equity divided by the new shares outstanding, so:

$$P_x = \$440,000 / 18,750 \text{ shares} = \$23.47$$

8. With a stock dividend, the shares outstanding will increase by one plus the dividend amount, so:

$$\text{New shares outstanding} = 350,000(1.15) = 402,500$$

The capital surplus is the capital paid in excess of par value, which is \$1, so:

$$\text{Capital surplus for new shares} = 52,500(\$19) = \$997,500$$

The new capital surplus will be the old capital surplus plus the additional capital surplus for the new shares, so:

$$\text{Capital surplus} = \$1,650,000 + 997,500 = \$2,647,500$$

The new equity portion of the balance sheet will look like this:

Common stock (\$1 par value)	\$ 402,500
Capital surplus	2,647,500
Retained earnings	<u>1,950,000</u>
	<u>\$5,000,000</u>

9. The only equity account that will be affected is the par value of the stock. The par value will change by the ratio of old shares to new shares, so:

$$\text{New par value} = \$1(1/5) = \$0.20 \text{ per share.}$$

The total dividends paid this year will be the dividend amount times the number of shares outstanding. The company had 350,000 shares outstanding before the split. We must remember to adjust the shares outstanding for the stock split, so:

$$\text{Total dividends paid this year} = \$0.90(350,000 \text{ shares})(5/1 \text{ split}) = \$1,575,000$$

The dividends increased by 10 percent, so the total dividends paid last year were:

$$\text{Last year's dividends} = \$1,575,000 / 1.10 = \$1,431,818.18$$

And to find the dividends per share, we simply divide this amount by the shares outstanding last year. Doing so, we get:

$$\text{Dividends per share last year} = \$1,431,818.18 / 350,000 \text{ shares} = \$4.09$$

10. The equity portion of capital outlays is the retained earnings. Subtracting dividends from net income, we get:

$$\text{Equity portion of capital outlays} = \$1,500 - 390 = \$1,110$$

Since the debt-equity ratio is 1.20, we can find the new borrowings for the company by multiplying the equity investment by the debt-equity ratio, so:

$$\text{New borrowings} = 1.20(\$1,110) = \$1,332$$

And the total capital outlay will be the sum of the new equity and the new debt, which is:

$$\text{Total capital outlays} = \$1,110 + 1,332 = \$2,442$$

11. a. The payout ratio is the dividend per share divided by the earnings per share, so:

$$\text{Payout ratio} = \$0.80 / \$6.40$$

$$\text{Payout ratio} = .1250 \text{ or } 12.50\%$$

- b. Under a residual dividend policy, the additions to retained earnings, which is the equity portion of the planned capital outlays, is the retained earnings per share times the number of shares outstanding, so:

$$\text{Equity portion of capital outlays} = 7,000,000 \text{ shares} (\$6.40 - .80) = \$39,200,000$$

The debt-equity ratio is the new borrowing divided by the new equity, so:

$$\text{D/E ratio} = \$18,000,000 / \$39,200,000 = .4592$$

12. a. Since the company has a debt-equity ratio of 2.5, they can raise \$2.50 in debt for every \$1 of equity. The maximum capital outlay with no outside equity financing is:

$$\text{Maximum capital outlay} = \$190,000 + 2.50(\$190,000) = \$665,000$$

- b. If planned capital spending is \$760,000, then no dividend will be paid and new equity will be issued since this exceeds the amount calculated in a.

- c. No, they do not maintain a constant dividend payout because, with the strict residual policy, the dividend will depend on the investment opportunities and earnings. As these two things vary, the dividend payout will also vary.

## B-306 SOLUTIONS

13. *a.* We can find the new borrowings for the company by multiplying the equity investment by the debt-equity ratio, so we get:

$$\text{New debt} = 1.5(\$75,000,000) = \$112,500,000$$

Adding the new retained earnings, we get:

$$\text{Maximum investment with no outside equity financing} = \$75,000,000 + \$112,500,000$$

$$\text{Maximum investment with no outside equity financing} = \$187,500,000$$

- b.* A debt-equity ratio of 1.5 implies capital structure is 1.5/2.5 debt and 1/2.5 equity. The equity portion of the planned new investment will be:

$$\text{Equity portion of investment funds} = 1/2.5(\$72,000,000) = \$28,800,000$$

This is the addition to retained earnings, so the total available for dividend payments is:

$$\text{Residual} = \$75,000,000 - 28,800,000 = \$46,200,000$$

This makes the dividend per share:

$$\text{Dividend per share} = \$46,200,000/12,000,000 \text{ shares} = \$3.85$$

- c.* The borrowing will be:

$$\text{Borrowing} = \$72,000,000 - 28,800,000 = \$43,200,000$$

Alternatively, we could calculate the new borrowing as the weight of debt in the capital structure times the planned capital outlays, so:

$$\text{Borrowing} = 1.5/2.5(\$72,000,000) = \$43,200,000$$

The addition to retained earnings is \$28,800,000, which we calculated in part *b*.

- d.* If the company plans no capital outlays, no new borrowing will take place. The dividend per share will be:

$$\text{Dividend per share} = \$75,000,000/12,000,000 \text{ shares} = \$6.25$$

Intermediate

14. The price of the stock today is the PV of the dividends, so:

$$P_0 = \$1.50/1.15 + \$45/1.15^2 = \$35.33$$

To find the equal two year dividends with the same present value as the price of the stock, we set up the following equation and solve for the dividend (Note: The dividend is a two year annuity, so we could solve with the annuity factor as well):

$$\begin{aligned} \$35.33 &= D/1.15 + D/1.15^2 \\ D &= \$21.73 \end{aligned}$$

We now know the cash flow per share we want each of the next two years. We can find the price of stock in one year, which will be:

$$P_1 = \$45/1.15 = \$39.13$$

Since you own 1,000 shares, in one year you want:

$$\text{Cash flow in Year one} = 1,000(\$21.73) = \$21,732.56$$

But you'll only get:

$$\text{Dividends received in one year} = 1,000(\$1.50) = \$1,500$$

Thus, in one year you will need to sell additional shares in order to increase your cash flow. The number of shares to sell in year one is:

$$\text{Shares to sell at time one} = (\$21,732.56 - 1,500)/\$39.13 = 517.05 \text{ shares}$$

At Year 2, your cash flow will be the dividend payment times the number of shares you still own, so the Year 2 cash flow is:

$$\text{Year 2 cash flow} = \$45(1,000 - 517.05) = \$21,732.56$$

15. If you only want \$200 in Year 1, you will buy:

$$(\$1,500 - 200)/\$39.13 = 33.22 \text{ shares}$$

at time 1. Your dividend payment in Year 2 will be:

$$\text{Year 2 dividend} = (1,000 + 33.22)(\$45) = \$46,495.00$$

## B-308 SOLUTIONS

Note, the present value of each cash flow stream is the same. Below we show this by finding the present values as:

$$PV = \$200/1.15 + \$46,495/1.15^2 = \$35,330.81$$

$$PV = 1,000(\$1.50)/1.15 + 1,000(\$45)/1.15^2 = \$35,330.81$$

- 16. a.** If the company makes a dividend payment, we can calculate the wealth of a shareholder as:

$$\text{Dividend per share} = \$15,000/1,000 \text{ shares} = \$15.00$$

The stock price after the dividend payment will be:

$$P_x = \$48 - 15 = \$33 \text{ per share}$$

The shareholder will have a stock worth \$33 and a \$15 dividend for a total wealth of \$48. If the company makes a repurchase, the company will repurchase:

$$\text{Shares repurchased} = \$15,000/\$48 = 312.50 \text{ shares}$$

If the shareholder lets their shares be repurchased, they will have \$48 in cash. If the shareholder keeps their shares, they're still worth \$48.

- b.** If the company pays dividends, the current EPS is \$1.20, and the P/E ratio is:

$$P/E = \$33/\$1.20 = 27.50$$

If the company repurchases stock, the number of shares will decrease. The total net income is the EPS times the current number of shares outstanding. Dividing net income by the new number of shares outstanding, we find the EPS under the repurchase is:

$$EPS = \$1.20(1,000)/(1,000 - 312.50) = \$1.75$$

The stock price will remain at \$48 per share, so the P/E ratio is:

$$P/E = \$48/\$1.75 = 27.50$$

- c.** A share repurchase would seem to be the preferred course of action. Only those shareholders who wish to sell will do so, giving the shareholder a tax timing option that he or she doesn't get with a dividend payment.

Challenge

17. Assuming no capital gains tax, the aftertax return for the Gordon Company is the capital gains growth rate, plus the dividend yield times one minus the tax rate. Using the constant growth dividend model, we get:

$$\text{Aftertax return} = g + D(1 - t) = .15$$

Solving for  $g$ , we get:

$$\begin{aligned} .15 &= g + .05(1 - .35) \\ g &= .1175 \end{aligned}$$

The equivalent pretax return for Gecko Company, which pays no dividend, is:

$$\text{Pretax return} = g + D = .1175 + .05 = .1675 \text{ or } 16.75\%$$

18. Using the equation for the decline in the stock price ex-dividend for each of the tax rate policies, we get:

$$(P_0 - P_X)/D = (1 - T_P)/(1 - T_G)$$

a.  $P_0 - P_X = D(1 - 0)/(1 - 0)$   
 $P_0 - P_X = D$

b.  $P_0 - P_X = D(1 - .15)/(1 - 0)$   
 $P_0 - P_X = .85D$

c.  $P_0 - P_X = D(1 - .15)/(1 - .30)$   
 $P_0 - P_X = 1.2143D$

- d. With this tax policy, we simply need to multiply the personal tax rate times one minus the dividend exemption percentage, so:

$$\begin{aligned} P_0 - P_X &= D[1 - (.35)(.30)]/(1 - .65) \\ P_0 - P_X &= 1.377D \end{aligned}$$

- e. Since different investors have widely varying tax rates on ordinary income and capital gains, dividend payments have different after-tax implications for different investors. This differential taxation among investors is one aspect of what we have called the clientele effect.

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# **CHAPTER 19**

## **SHORT-TERM FINANCE AND PLANNING**

### **Answers to Concepts Review and Critical Thinking Questions**

1. These are firms with relatively long inventory periods and/or relatively long receivables periods. Thus, such firms tend to keep inventory on hand, and they allow customers to purchase on credit and take a relatively long time to pay.
2. These are firms that have a relatively long time between the time purchased inventory is paid for and the time that inventory is sold and payment received. Thus, these are firms that have relatively short payables periods and/or relatively long receivable cycles.
3.
  - a. Use: The cash balance declined by \$200 to pay the dividend.
  - b. Source: The cash balance increased by \$500, assuming the goods bought on payables credit were sold for cash.
  - c. Use: The cash balance declined by \$900 to pay for the fixed assets.
  - d. Use: The cash balance declined by \$625 to pay for the higher level of inventory.
  - e. Use: The cash balance declined by \$1,200 to pay for the redemption of debt.
4. Carrying costs will decrease because they are not holding goods in inventory. Shortage costs will probably increase depending on how close the suppliers are and how well they can estimate need. The operating cycle will decrease because the inventory period is decreased.
5. Since the cash cycle equals the operating cycle minus the accounts payable period, it is not possible for the cash cycle to be longer than the operating cycle if the accounts payable period is positive. Moreover, it is unlikely that the accounts payable period would ever be negative since that implies the firm pays its bills before they are incurred.
6. It lengthened its payables period, thereby shortening its cash cycle.
7. Their receivables period increased, thereby increasing their operating and cash cycles.
8. It is sometimes argued that large firms “take advantage of” smaller firms by threatening to take their business elsewhere. However, considering a move to another supplier to get better terms is the nature of competitive free enterprise.
9. They would like to! The payables period is a subject of much negotiation, and it is one aspect of the price a firm pays its suppliers. A firm will generally negotiate the best possible combination of payables period and price. Typically, suppliers provide strong financial incentives for rapid payment. This issue is discussed in detail in a later chapter on credit policy.

10. BlueSky will need less financing because it is essentially borrowing more from its suppliers. Among other things, BlueSky will likely need less short-term borrowing from other sources, so it will save on interest expense.

### Solutions to Questions and Problems

*NOTE: All end of chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.*

#### Basic

1. a. No change. A dividend paid for by the sale of debt will not change cash since the cash raised from the debt offer goes immediately to shareholders.
- b. No change. The real estate is paid for by the cash raised from the debt, so this will not change the cash balance.
- c. No change. Inventory and accounts payable will increase, but neither will impact the cash account.
- d. Decrease. The short-term bank loan is repaid with cash, which will reduce the cash balance.
- e. Decrease. The payment of taxes is a cash transaction.
- f. Decrease. The preferred stock will be repurchased with cash.
- g. No change. Accounts receivable will increase, but cash will not increase until the sales are paid off.
- h. Decrease. The interest is paid with cash, which will reduce the cash balance.
- i. Increase. When payments for previous sales, or accounts receivable, are paid off, the cash balance increases since the payment must be made in cash.
- j. Decrease. The accounts payable are reduced through cash payments to suppliers.
- k. Decrease. Here the dividend payments are made with cash, which is generally the case. This is different from part *a* where debt was raised to make the dividend payment.
- l. No change. The short-term note will not change the cash balance.
- m. Decrease. The utility bills must be paid in cash.
- n. Decrease. A cash payment will reduce cash.
- o. Increase. If marketable securities are sold, the company will receive cash from the sale.

## B-312 SOLUTIONS

2. The total liabilities and equity of the company are the net book worth, or market value of equity, plus the long-term debt, so:

$$\text{Total liabilities and equity} = \$8,500 + 1,800$$

$$\text{Total liabilities and equity} = \$10,300$$

This is also equal to the total assets of the company. Since total assets are the sum of all assets, and cash is an asset, the cash account must be equal to total assets minus all other assets, so:

$$\text{Cash} = \$10,300 - 6,400 - 2,380$$

$$\text{Cash} = \$1,520$$

We have NWC other than cash, so the total NWC is:

$$\text{NWC} = \$1,520 + 2,380$$

$$\text{NWC} = \$3,900$$

We can find total current assets by using the NWC equation. NWC is equal to:

$$\text{NWC} = \text{CA} - \text{CL}$$

$$\$3,900 = \text{CA} - \$1,250$$

$$\text{CA} = \$5,150$$

3. *a.* Increase. If receivables go up, the time to collect the receivables would increase, which increases the operating cycle.
- b.* Increase. If credit repayment times are increased, customers will take longer to pay their bills, which will lead to an increase in the operating cycle.
- c.* Decrease. If the inventory turnover increases, the inventory period decreases.
- d.* No change. The accounts payable period is part of the cash cycle, not the operating cycle.
- e.* Decrease. If the receivables turnover increases, the receivables period decreases.
- f.* No change. Payments to suppliers affects the accounts payable period, which is part of the cash cycle, not the operating cycle.
4. *a.* Increase; Increase. If the terms of the cash discount are made less favorable to customers, the accounts receivable period will lengthen. This will increase both the cash cycle and the operating cycle.
- b.* Increase; No change. This will shorten the accounts payable period, which will increase the cash cycle. It will have no effect on the operating cycle since the accounts payable period is not part of the operating cycle.

- c. Decrease; Decrease. If more customers pay in cash, the accounts receivable period will decrease. This will decrease both the cash cycle and the operating cycle.
- d. Decrease; Decrease. Assume the accounts payable period and inventory period do not change. Fewer raw materials purchased will reduce the inventory period, which will decrease both the cash cycle and the operating cycle.
- e. Decrease; No change. If more raw materials are purchased on credit, the accounts payable period will tend to increase, which would decrease the cash cycle. We should say that this may not be the case. The accounts payable period is a decision made by the company's management. The company could increase the accounts payable account and still make the payments in the same number of days. This would leave the accounts payable period unchanged, which would leave the cash cycle unchanged. The change in credit purchases made on credit will not affect the inventory period or the accounts payable period, so the operating cycle will not change.
- f. Increase; Increase. If more goods are produced for inventory, the inventory period will increase. This will increase both the cash cycle and operating cycle.
5. a. A 45-day collection period implies all receivables outstanding from the previous quarter are collected in the current quarter, and:

$(90 - 45)/90 = 1/2$  of current sales are collected. So:

	<i>Q1</i>	<i>Q2</i>	<i>Q3</i>	<i>Q4</i>
Beginning receivables	\$340	\$420	\$390	\$475
Sales	840	780	950	870
Cash collections	<u>(760)</u>	<u>(810)</u>	<u>(865)</u>	<u>(910)</u>
Ending receivables	<u>\$420</u>	<u>\$390</u>	<u>\$475</u>	<u>\$435</u>

- b. A 60-day collection period implies all receivables outstanding from previous quarter are collected in the current quarter, and:

$(90-60)/90 = 1/3$  of current sales are collected. So:

	<i>Q1</i>	<i>Q2</i>	<i>Q3</i>	<i>Q4</i>
Beginning receivables	\$340	\$560	\$520	\$633
Sales	840	780	950	870
Cash collections	<u>(620)</u>	<u>(820)</u>	<u>(837)</u>	<u>(923)</u>
Ending receivables	<u>\$560</u>	<u>\$520</u>	<u>\$633</u>	<u>\$580</u>

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- c. A 30-day collection period implies all receivables outstanding from previous quarter are collected in the current quarter, and:

$(90-30)/90 = 2/3$  of current sales are collected. So:

	<i>Q1</i>	<i>Q2</i>	<i>Q3</i>	<i>Q4</i>
Beginning receivables	\$340	\$280	\$260	\$317
Sales	840	780	950	870
Cash collections	<u>(900)</u>	<u>(800)</u>	<u>(893)</u>	<u>(897)</u>
Ending receivables	<u>\$280</u>	<u>\$260</u>	<u>\$317</u>	<u>\$290</u>

6. The operating cycle is the inventory period plus the receivables period. The inventory turnover and inventory period are:

Inventory turnover = COGS/Average inventory  
 Inventory turnover =  $\$57,687 / \{[\$9,215 + 10,876]/2\}$   
 Inventory turnover = 5.7426 times

Inventory period = 365 days/Inventory turnover  
 Inventory period = 365 days/5.7426  
 Inventory period = 63.56 days

And the receivables turnover and receivables period are:

Receivables turnover = Credit sales/Average receivables  
 Receivables turnover =  $\$85,682 / \{[\$5,387 + 5,932]/2\}$   
 Receivables turnover = 15.1395 times

Receivables period = 365 days/Receivables turnover  
 Receivables period = 365 days/15.1395  
 Receivables period = 24.11 days

So, the operating cycle is:

Operating cycle = 63.56 days + 24.11 days  
 Operating cycle = 87.67 days

The cash cycle is the operating cycle minus the payables period. The payables turnover and payables period are:

Payables turnover = COGS/Average payables  
 Payables turnover =  $\$57,687 / \{[\$7,438 + 7,847]/2\}$   
 Payables turnover = 7.5482 times

Payables period = 365 days/Payables turnover  
 Payables period = 365 days/7.5482  
 Payables period = 48.36 days

So, the cash cycle is:

$$\text{Cash cycle} = 87.67 \text{ days} - 48.36 \text{ days}$$

$$\text{Cash cycle} = 39.31 \text{ days}$$

The firm is receiving cash on average 39.31 days after it pays its bills.

7. If we factor immediately, we receive cash on an average of 38 days sooner. The number of periods in a year are:

$$\text{Number of periods} = 365/38$$

$$\text{Number of periods} = 9.6053$$

The EAR of this arrangement is:

$$\text{EAR} = (1 + \text{Periodic rate})^m - 1$$

$$\text{EAR} = (1 + 2/98)^{9.6053} - 1$$

$$\text{EAR} = .2142 \text{ or } 21.42\%$$

8. a. The payables period is zero since the company pays immediately. The payment in each period is 30 percent of next period's sales, so:

	<i>Q1</i>	<i>Q2</i>	<i>Q3</i>	<i>Q4</i>
Payment of accounts	\$219.00	\$234.00	\$258.00	\$234.60

- b. Since the payables period is 90 days, the payment in each period is 30 percent of the current period sales, so:

	<i>Q1</i>	<i>Q2</i>	<i>Q3</i>	<i>Q4</i>
Payment of accounts	\$204.00	\$219.00	\$234.00	\$258.00

- c. Since the payables period is 60 days, the payment in each period is 2/3 of last quarter's orders, plus 1/3 of this quarter's orders, or:

$$\text{Quarterly payments} = 2/3(.30) \text{ times current sales} + 1/3(.30) \text{ next period sales.}$$

	<i>Q1</i>	<i>Q2</i>	<i>Q3</i>	<i>Q4</i>
Payment of accounts	\$209.00	\$224.00	\$242.00	\$250.20

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9. Since the payables period is 60 days, the payables in each period will be:

Payables each period = 2/3 of last quarter's orders + 1/3 of this quarter's orders  
 Payables each period = 2/3(.75) times current sales + 1/3(.75) next period sales

	<i>Q1</i>	<i>Q2</i>	<i>Q3</i>	<i>Q4</i>
Payment of accounts	\$680.00	\$720.00	\$742.50	\$810.00
Wages, taxes, other expenses	174.00	196.00	184.00	226.00
Long-term financing expenses	80.00	80.00	80.00	80.00
Total	\$934.00	\$996.00	\$1,006.50	\$1,116.00

10. a. The November sales must have been the total uncollected sales minus the uncollected sales from December, divided by the collection rate two months after the sale, so:

November sales =  $(\$107,000 - 78,000)/0.15$   
 November sales = \$193,333.33

- b. The December sales are the uncollected sales from December divided by the collection rate of the previous months' sales, so:

December sales =  $\$78,000/0.35$   
 December sales = \$222,857.14

- c. The collections each month for this company are:

Collections =  $.15(\text{Sales from 2 months ago}) + .20(\text{Last months sales}) + .65(\text{Current sales})$

January collections =  $.15(\$193,333.33) + .20(\$222,857.14) + .65(\$275,000)$   
 January collections = \$252,321.43

February collections =  $.15(\$222,857.14) + .20(\$275,000) + .65(\$295,000)$   
 February collections = \$280,178.57

March collections =  $.15(\$275,000) + .20(\$295,000) + .65(\$320,000)$   
 March collections = \$308,250.00

11. The sales collections each month will be:

$$\text{Sales collections} = .35(\text{current month sales}) + .60(\text{previous month sales})$$

Given this collection, the cash budget will be:

	<u>April</u>	<u>May</u>	<u>June</u>
Beginning cash balance	\$210,000	\$174,250	\$230,350
Cash receipts			
Cash collections from credit sales	<u>252,500</u>	<u>357,100</u>	<u>376,150</u>
Total cash available	462,500	531,350	606,500
Cash disbursements			
Purchases	149,000	143,000	172,400
Wages, taxes, and expenses	48,750	56,500	67,300
Interest	12,500	12,500	12,500
Equipment purchases	78,000	89,000	0
Total cash disbursements	<u>288,250</u>	<u>301,000</u>	<u>252,200</u>
Ending cash balance	<u>\$174,250</u>	<u>\$230,350</u>	<u>\$354,300</u>

12. Item	<u>Source/Use</u>	<u>Amount</u>
Cash	Use	-\$7,000
Accounts receivable	Use	-\$9,750
Inventories	Use	-\$3,750
Property, plant, and equipment	Use	-\$12,725
Accounts payable	Source	\$5,500
Accrued expenses	Use	-\$3,300
Long-term debt	Use	-\$15,000
Common stock	Source	\$3,000
Accumulated retained earnings	Source	\$37,800

Intermediate

13. a. If you borrow \$50,000,000 for one month, you will pay interest of:

$$\text{Interest} = \$50,000,000(.0072)$$

$$\text{Interest} = \$360,000$$

However, with the compensating balance, you will only get the use of:

$$\text{Amount received} = \$50,000,000 - 50,000,000(.04)$$

$$\text{Amount received} = \$48,000,000$$

This means the periodic interest rate is:

$$\text{Periodic interest} = \$360,000/\$48,000,000$$

$$\text{Periodic interest} = .007500 \text{ or } 0.750\%$$

## B-318 SOLUTIONS

So, the EAR is:

$$\begin{aligned} \text{EAR} &= [1 + (\$360,000/\$48,000,000)]^{12} - 1 \\ \text{EAR} &= .0938 \text{ or } 9.38\% \end{aligned}$$

- b. To end up with \$15,000,000, you must borrow:

$$\begin{aligned} \text{Amount to borrow} &= \$15,000,000/(1 - .04) \\ \text{Amount to borrow} &= \$15,625,000.00 \end{aligned}$$

The total interest you will pay on the loan is:

$$\begin{aligned} \text{Total interest paid} &= \$15,625,000(1.0072)^6 - 15,625,000 \\ \text{Total interest paid} &= \$687,267.27 \end{aligned}$$

14. a. The EAR of your investment account is:

$$\begin{aligned} \text{EAR} &= 1.011^4 - 1 \\ \text{EAR} &= .0447 \text{ or } 4.47\% \end{aligned}$$

- b. To calculate the EAR of the loan, we can divide the interest on the loan by the amount of the loan. The interest on the loan includes the opportunity cost of the compensating balance. The opportunity cost is the amount of the compensating balance times the potential interest rate you could have earned. The compensating balance is only on the unused portion of the credit line, so:

$$\begin{aligned} \text{Opportunity cost} &= .05(\$80,000,000 - 45,000,000)(1.011)^4 - .05(\$80,000,000 - 45,000,000) \\ \text{Opportunity cost} &= \$78,279.84 \end{aligned}$$

And the interest you will pay to the bank on the loan is:

$$\begin{aligned} \text{Interest cost} &= \$45,000,000(1.019)^4 - 45,000,000 \\ \text{Interest cost} &= \$3,518,710.48 \end{aligned}$$

So, the EAR of the loan in the amount of \$45 million is:

$$\begin{aligned} \text{EAR} &= (\$3,518,710.48 + 78,279.84)/\$45,000,000 \\ \text{EAR} &= .0799 \text{ or } 7.99\% \end{aligned}$$

- c. The compensating balance is only applied to the unused portion of the credit line, so the EAR of a loan on the full credit line is:

$$\begin{aligned} \text{EAR} &= 1.019^4 - 1 \\ \text{EAR} &= .0782 \text{ or } 7.82\% \end{aligned}$$

15. a. A 45-day collection period means sales collections each quarter are:

$$\text{Collections} = 1/2 \text{ current sales} + 1/2 \text{ old sales}$$

A 36-day payables period means payables each quarter are:

$$\text{Payables} = 3/5 \text{ current orders} + 2/5 \text{ old orders}$$

So, the cash inflows each quarter are:

$$\begin{aligned} Q1 &= \$79 + 1/2(\$230) - 2/5(.45)(\$230) - 3/5(.45)(\$195) - .30(\$230) - \$15 \\ Q1 &= \$15.95 \end{aligned}$$

$$\begin{aligned} Q2 &= 1/2(\$230) + 1/2(\$195) - 2/5(.45)(\$195) - 3/5(.45)(\$270) - .30(\$195) - \$15 - 90 \\ Q2 &= -\$59.00 \end{aligned}$$

$$\begin{aligned} Q3 &= 1/2(\$195) + 1/2(\$270) - 2/5(.45)(\$270) - 3/5(.45)(\$290) - .30(\$270) - \$15 \\ Q3 &= \$9.60 \end{aligned}$$

$$\begin{aligned} Q4 &= 1/2(\$270) + 1/2(\$290) - 2/5(.45)(\$290) - 3/5(.45)(\$250) - .30(\$290) - \$15 \\ Q4 &= \$58.30 \end{aligned}$$

The company's cash budget will be:

WILDCAT, INC.				
Cash Budget				
(in millions)				
	<i>Q1</i>	<i>Q2</i>	<i>Q3</i>	<i>Q4</i>
Beginning cash balance	\$73.00	\$88.95	\$29.95	\$39.55
Net cash inflow	<u>15.95</u>	<u>-59.00</u>	<u>9.60</u>	<u>58.30</u>
Ending cash balance	\$88.95	\$29.95	\$39.55	\$97.85
Minimum cash balance	<u>-35.00</u>	<u>-35.00</u>	<u>-35.00</u>	<u>-35.00</u>
Cumulative surplus (deficit)	\$53.95	-\$5.05	\$ 4.55	\$62.85

B-320 SOLUTIONS

With a \$35M minimum cash balance, the short-term financial plan will be:

WILDCAT, INC.  
Short-Term Financial Plan  
(in millions)

<i>b.</i>	<i>Q1</i>	<i>Q2</i>	<i>Q3</i>	<i>Q4</i>
Beginning cash balance	\$35.00	\$35.00	\$35.00	\$35.00
Net cash inflow	15.95	-59.00	9.60	58.30
New short-term investments	-16.71	0	-6.31	-58.43
Income on short-term investments	0.76	1.09	0	0.13
Short-term investments sold	0	54.71	0	0
New short-term borrowing	0	3.20	0	0
Interest on short-term borrowing	0	0	-0.10	0
Short-term borrowing repaid	0	0	-3.20	0
Ending cash balance	\$35.00	\$35.00	\$35.00	\$35.00
Minimum cash balance	-35.00	-35.00	-35.00	-35.00
Cumulative surplus (deficit)	\$0	\$0	\$0	\$0
Beginning short-term investments	\$38.00	\$54.71	\$0	\$6.31
Ending short-term investments	54.71	0	6.31	64.73
Beginning short-term debt	0	0	3.20	0
Ending short-term debt	\$0	\$3.20	\$0	\$0

Below you will find the interest paid (or received) for each quarter:

Q1: excess funds at start of quarter of \$38 invested for 1 quarter earns  $.02(\$38) = \$0.76$  income

Q2: excess funds of \$54.71 invested for 1 quarter earns  $.02(\$54.71) = \$1.09$  in income

Q3: excess funds of \$3.20 invested for 1 quarter earns  $.02(\$3.20) = \$0.10$  in interest

Q4: excess funds of \$3.61 invested for 1 quarter earns  $.02(\$6.31) = \$0.13$  in income

16. a. With a minimum cash balance of \$50 million, the short-term financial plan will be:

WILDCAT, INC. Short-Term Financial Plan (in millions)				
	<i>Q1</i>	<i>Q2</i>	<i>Q3</i>	<i>Q4</i>
Beginning cash balance	\$50.00	\$50.00	\$50.00	\$50.00
Net cash inflow	15.95	-59.00	9.60	58.30
New short-term investments	-16.41	0	0	-48.24
Income on short-term investments	0.46	0.79	0	0
Short-term investments sold	0	39.41	0	0
New short-term borrowing	0	18.80	0	0
Interest on short-term borrowing	0	0	-0.56	-0.29
Short-term borrowing repaid	0	0	-9.04	-9.77
Ending cash balance	\$50.00	\$50.00	\$50.00	\$50.00
Minimum cash balance	-50.00	-50.00	-50.00	-50.00
Cumulative surplus (deficit)	\$0	\$0	\$0	\$0
Beginning short-term investments	\$23.00	\$39.41	\$0	\$0
Ending short-term investments	39.41	0	0	48.24
Beginning short-term debt	0	0	18.80	9.77
Ending short-term debt	\$0	\$18.80	\$9.77	\$0

- b. And with a minimum cash balance of \$20 million, the short-term financial plan will be:

WILDCAT, INC. Short-Term Financial Plan (in millions)				
	<i>Q1</i>	<i>Q2</i>	<i>Q3</i>	<i>Q4</i>
Beginning cash balance	\$20.00	\$20.00	\$20.00	\$20.00
Net cash inflow	15.95	-59.00	9.60	58.30
New short-term investments	-17.01	0	-9.85	-58.75
Income on short-term investments	1.06	1.40	0.25	0.45
Short-term investments sold	0	57.60	0	0
New short-term borrowing	0	0	0	0
Interest on short-term borrowing	0	0	0	0
Short-term borrowing repaid	0	0	0	0
Ending cash balance	\$20.00	\$20.00	\$20.00	\$20.00
Minimum cash balance	-20.00	-20.00	-20.00	-20.00
Cumulative surplus (deficit)	\$0	\$0	\$0	\$0
Beginning short-term investments	\$53.00	\$70.01	\$12.41	\$22.26
Ending short-term investments	70.01	12.41	22.26	81.00
Beginning short-term debt	0	0	0	0
Ending short-term debt	\$0	\$0	\$0	\$0

Since cash has an opportunity cost, the firm can boost its profit if it keeps its minimum cash balance low and invests the cash instead. However, the tradeoff is that in the event of unforeseen circumstances, the firm may not be able to meet its short-run obligations if enough cash is not available.

## B-322 SOLUTIONS

### Challenge

17. a. For every dollar borrowed, you pay interest of:

$$\text{Interest} = \$1(.016) = \$0.016$$

You also must maintain a compensating balance of 4 percent of the funds borrowed, so for each dollar borrowed, you will only receive:

$$\text{Amount received} = \$1(1 - .04) = \$0.96$$

We can adjust the EAR equation we have been using to account for the compensating balance by dividing the EAR by one minus the compensating balance, so:

$$\begin{aligned}\text{EAR} &= [(1.016)^4 - 1]/(1 - .04) \\ \text{EAR} &= .06828 \text{ or } 6.828\%\end{aligned}$$

Another way to calculate the EAR is using the FVIF (or PVIF). For each dollar borrowed, we must repay:

$$\begin{aligned}\text{Amount owed} &= \$1(1.016)^4 \\ \text{Amount owed} &= \$1.0655\end{aligned}$$

At the end of the year the compensating will be returned, so your net cash flow at the end of the year will be:

$$\begin{aligned}\text{End of year cash flow} &= \$1.0655 - .04 \\ \text{End of year cash flow} &= \$1.0255\end{aligned}$$

The present value of the end of year cash flow is the amount you receive at the beginning of the year, so the EAR is:

$$\begin{aligned}\text{FV} &= \text{PV}(1 + R) \\ \$1.0255 &= \$0.96(1 + R) \\ R &= \$1.0255/\$0.96 - 1 \\ \text{EAR} &= .06828 \text{ or } 6.828\%\end{aligned}$$

- b. The EAR is the amount of interest paid on the loan divided by the amount received when the loan is originated. The amount of interest you will pay on the loan is the amount of the loan times the effective annual interest rate, so:

$$\begin{aligned}\text{Interest} &= \$210,000,000[(1.016)^4 - 1] \\ \text{Interest} &= \$13,766,014.40\end{aligned}$$

For whatever loan amount you take, you will only receive 96 percent of that amount since you must maintain a 4 percent compensating balance on the portion of the credit line used. The credit line also has a fee of .125 percent, so you will only get to use:

$$\begin{aligned}\text{Amount received} &= .96(\$210,000,000) - .00125(\$400,000,000) \\ \text{Amount received} &= \$201,100,000\end{aligned}$$

So, the EAR of the loan is:

$$\begin{aligned} \text{EAR} &= \$13,766,014.40/\$201,100,000 \\ \text{EAR} &= .06845 \text{ or } 6.845\% \end{aligned}$$

**18.** You will pay interest of:

$$\text{Interest} = \$15,000,000(.09) = \$1,350,000$$

Additionally, the compensating balance on the loan is:

$$\text{Compensating balance} = \$15,000,000(.05) = \$750,000$$

Since this is a discount loan, you will receive the loan amount minus the interest payment. You will also not get to use the compensating balance. So, the amount of money you will actually receive on a \$15 million loan is:

$$\text{Cash received} = \$15,000,000 - 1,350,000 - 750,000 = \$12,900,000$$

The EAR is the interest amount divided by the loan amount, so:

$$\begin{aligned} \text{EAR} &= \$1,350,000/\$12,900,000 \\ \text{EAR} &= .1047 \text{ or } 10.47\% \end{aligned}$$

We can also use the FVIF (or PVIF) here to calculate the EAR. Your cash flow at the beginning of the year is \$12,990,000. At the end of the year, your cash flow loan repayment, but you will also receive your compensating balance back, so:

$$\begin{aligned} \text{End of year cash flow} &= \$15,000,000 - 750,000 \\ \text{End of year cash flow} &= \$14,250,000 \end{aligned}$$

So, using the time value of money, the EAR is:

$$\begin{aligned} \$14,250,000 &= \$12,900,000(1 + R) \\ R &= \$14,250,000/\$12,900,000 - 1 \\ \text{EAR} &= .1047 \text{ or } 10.47\% \end{aligned}$$

# ***CHAPTER 20***

## **CASH AND LIQUIDITY MANAGEMENT**

### **Answers to Concepts Review and Critical Thinking Questions**

1. Yes. Once a firm has more cash than it needs for operations and planned expenditures, the excess cash has an opportunity cost. It could be invested (by shareholders) in potentially more profitable ways. Question 10 discusses another reason.
2. If it has too much cash it can simply pay a dividend, or, more likely in the current financial environment, buy back stock. It can also reduce debt. If it has insufficient cash, then it must either borrow, sell stock, or improve profitability.
3. Probably not. Creditors would probably want substantially more.
4. In the case of Microsoft, the company's reason given for holding cash was to pay for potential settlements in its monopoly cases brought by the U.S. government and the European Union. GM generally argued that it held cash to guard against future economic downturns.
5. Cash management is associated more with the collection and disbursement of cash. Liquidity management is broader and concerns the optimal level of liquid assets needed by a firm. Thus, for example, Ford and Chrysler's stockpiling of cash was liquidity management; whereas, evaluating a lockbox system is cash management.
6. Such instruments go by a variety of names, but the key feature is that the dividend adjusts, keeping the price relatively stable. This price stability, along with the dividend tax exemption, makes so-called adjustable rate preferred stock very attractive relative to interest-bearing instruments.
7. Net disbursement float is more desirable because the bank thinks the firm has more money than it actually does, and the firm is, therefore, receiving interest on funds it has already spent.
8. The firm has a net disbursement float of \$500,000. If this is an ongoing situation, the firm may be tempted to write checks for more than it actually has in its account.
9.
  - a. About the only disadvantage to holding T-bills are the generally lower yields compared to alternative money market investments.
  - b. Some ordinary preferred stock issues pose both credit and price risks that are not consistent with most short-term cash management plans.
  - c. The primary disadvantage of NCDs is the normally large transactions sizes, which may not be feasible for the short-term investment plans of many smaller to medium-sized corporations.
  - d. The primary disadvantages of the commercial paper market are the higher default risk characteristics of the security and the lack of an active secondary market which may excessively restrict the flexibility of corporations to meet their liquidity adjustment needs.

- e. The primary disadvantages of RANs is that some possess non-trivial levels of default risk, and also, corporations are somewhat restricted in the type and amount of these tax-exempts that they can hold in their portfolios.
  - f. The primary disadvantage of the repo market is the generally very short maturities available.
10. The concern is that excess cash on hand can lead to poorly thought-out investments. The thought is that keeping cash levels relatively low forces management to pay careful attention to cash flow and capital spending.
  11. A potential advantage is that the quicker payment often means a better price. The disadvantage is that doing so increases the firm's cash cycle.
  12. This is really a capital structure decision. If the firm has an optimal capital structure, paying off debt moves it to an under-leveraged position. However, a combination of debt reduction and stock buy-backs could be structured to leave capital structure unchanged.
  13. It is unethical because you have essentially tricked the grocery store into making you an interest-free loan, and the grocery store is harmed because it could have earned interest on the money instead of loaning it to you.

### Solutions to Questions and Problems

*NOTE: All end of chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.*

#### Basic

1. The average daily float is the average amount of checks received per day times the average number of days delay, divided by the number of days in a month. Assuming 30 days in a month, the average daily float is:

$$\begin{aligned}\text{Average daily float} &= 5(\$135,000)/30 \\ \text{Average daily float} &= \$22,500\end{aligned}$$

2. a. The disbursement float is the average monthly checks written times the average number of days for the checks to clear, so:

$$\begin{aligned}\text{Disbursement float} &= 4(\$17,000) \\ \text{Disbursement float} &= \$68,000\end{aligned}$$

The collection float is the average monthly checks received times the average number of days for the checks to clear, so:

$$\begin{aligned}\text{Collection float} &= 2(-\$29,000) \\ \text{Collection float} &= -\$58,000\end{aligned}$$

## B-326 SOLUTIONS

The net float is the disbursement float plus the collection float, so:

$$\text{Net float} = \$68,000 - 58,000$$

$$\text{Net float} = \$10,000$$

- b. The new collection float will be:

$$\text{Collection float} = 1(-\$29,000)$$

$$\text{Collection float} = -\$29,000$$

And the new net float will be:

$$\text{Net float} = \$68,000 - 29,000$$

$$\text{Net float} = \$39,000$$

3. a. The collection float is the average daily checks received times the average number of days for the checks to clear, so:

$$\text{Collection float} = 4(\$1,000)$$

$$\text{Collection float} = \$44,000$$

- b. The firm should pay no more than the amount of the float, or \$44,000, to eliminate the float.

- c. The maximum daily charge the firm should be willing to pay is the collection float times the daily interest rate, so:

$$\text{Maximum daily charge} = \$44,000(.00016)$$

$$\text{Maximum daily charge} = \$7.04$$

4. a. Total float =  $4(\$13,000) + 5(\$4,000)$   
Total float = \$72,000

- b. The average daily float is the total float divided by the number of days in a month. Assuming 30 days in a month, the average daily float is:

$$\text{Average daily float} = \$72,000/30$$

$$\text{Average daily float} = \$2,400.00$$

- c. The average daily receipts are the average daily checks received divided by the number of days in a month. Assuming a 30 day month:

$$\text{Average daily receipts} = (\$13,000 + 4,000)/30$$

$$\text{Average daily receipts} = \$566.67$$

The weighted average delay is the sum of the days to clear a check, times the amount of the check divided by the average daily receipts, so:

$$\text{Weighted average delay} = 4(\$13,000/\$17,000) + 5(\$4,000/\$17,000)$$

$$\text{Weighted average delay} = 4.24 \text{ days}$$

5. The average daily collections are the number of checks received times the average value of a check, so:

$$\text{Average daily collections} = \$95(9,400)$$

$$\text{Average daily collections} = \$893,000$$

The present value of the lockbox service is the average daily receipts times the number of days the collection is reduced, so:

$$\text{PV} = (2 \text{ day reduction})(\$893,000)$$

$$\text{PV} = \$1,786,000$$

The daily cost is a perpetuity. The present value of the cost is the daily cost divided by the daily interest rate. So:

$$\text{PV of cost} = \$190/.00016$$

$$\text{PV of cost} = \$1,187,500$$

The firm should take the lockbox service. The NPV of the lockbox is the cost plus the present value of the reduction in collection time, so:

$$\text{NPV} = -\$1,187,400 + 1,786,000$$

$$\text{NPV} = \$598,500$$

The annual savings excluding the cost would be the future value of the savings minus the savings, so:

$$\text{Annual savings} = \$1,786,000(1.00016)^{365} - 1,786,000$$

$$\text{Annual savings} = \$107,399.35$$

And the annual cost would be the future value of the daily cost, which is an annuity, so:

$$\text{Annual cost} = \$190(\text{FVIFA}_{365,.016\%})$$

$$\text{Annual cost} = \$71,409.14$$

So, the annual net savings would be:

$$\text{Annual net savings} = \$107,399.35 - 71,409.14$$

$$\text{Annual net savings} = \$35,990.21$$

6. a. The average daily float is the sum of the percentage each check amount is of the total checks received times the number of checks received times the amount of the check times the number of days until the check clears, divided by the number of days in a month. Assuming a 30 day month, we get:

$$\text{Average daily float} = [.60(4,500)(\$50)(2) + .40(4,500)(\$70)(3)]/30$$

$$\text{Average daily float} = \$21,600$$

On average, there is \$21,600 that is uncollected and not available to the firm.

## B-328 SOLUTIONS

- b. The total collections are the sum of the percentage of each check amount received times the total checks received times the amount of the check, so:

$$\text{Total collections} = .60(4,500)(\$50) + .40(4,500)(\$70)$$

$$\text{Total collections} = \$135,000 + 126,000$$

$$\text{Total collections} = \$261,000$$

The weighted average delay is the sum of the average number of days a check of a specific amount is delayed, times the percentage that check amount makes up of the total checks received, so:

$$\text{Weighted average delay} = 2(\$135,000/\$261,000) + 3(\$126,000/\$261,000)$$

$$\text{Weighted average delay} = 2.48 \text{ days}$$

- c. The average daily float is the weighted average delay times the average checks received per day. Assuming a 30 day month, we get:

$$\text{Average daily float} = 2.48(\$261,000/30 \text{ days})$$

$$\text{Average daily float} = \$21,600$$

The most the firm should pay is the total amount of the average float, or \$21,600.

- d. The average daily interest rate is:

$$1.07 = (1 + R)^{365}$$

$$R = .01854\% \text{ per day}$$

The daily cost of float is the average daily float times the daily interest rate, so:

$$\text{Daily cost of the float} = \$21,600(.0001854)$$

$$\text{Daily cost of the float} = \$4.00$$

- e. The most the firm should pay is still the average daily float. Under the reduced collection time assumption, we get:

$$\text{New average daily float} = 1.5(\$261,000/30)$$

$$\text{New average daily float} = \$13,050$$

7. a. The present value of adopting the system is the number of days collections are reduced times the average daily collections, so:

$$PV = 3(410)(\$1,350)$$

$$PV = \$1,660,500$$

- b. The NPV of adopting the system is the present value of the savings minus the cost of adopting the system. The cost of adopting the system is the present value of the fee per transaction times the number of transactions. This is a perpetuity, so:

$$NPV = \$1,660,500 - [\$0.75(410)/.0002]$$

$$NPV = \$123,000$$

- c. The net cash flows is the present value of the average daily collections times the daily interest rate, minus the transaction cost per day, so:

$$\text{Net cash flow per day} = \$1,660,500(.0002) - \$0.75(410)$$

$$\text{Net cash flow per day} = \$24.60$$

The net cash flow per check is the net cash flow per day divided by the number of checks received per day, or:

$$\text{Net cash flow per check} = \$24.60/410$$

$$\text{Net cash flow per check} = \$0.06$$

Alternatively, we could find the net cash flow per check as the number of days the system reduces collection time times the average check amount times the daily interest rate, minus the transaction cost per check. Doing so, we confirm our previous answer as:

$$\text{Net cash flow per check} = 3(\$1,350)(.0002) - \$0.75$$

$$\text{Net cash flow per check} = \$0.06 \text{ per check}$$

8. a. The reduction in cash balance from adopting the lockbox is the number of days the system reduces collection time times the average daily collections, so:

$$\text{Cash balance reduction} = 3(\$98,000)$$

$$\text{Cash balance reduction} = \$294,000$$

- b. The dollar return that can be earned is the average daily interest rate times the cash balance reduction. The average daily interest rate is:

$$\text{Average daily rate} = 1.09^{1/365} - 1$$

$$\text{Average daily rate} = .0236\% \text{ per day}$$

The daily dollar return that can be earned from the reduction in days to clear the checks is:

$$\text{Daily dollar return} = \$294,000(.000236)$$

$$\text{Daily dollar return} = \$69.42$$

- c. If the company takes the lockbox, it will receive three payments early, with the first payment occurring today. We can use the daily interest rate from part b, so the savings are:

$$\text{Savings} = \$98,000 + \$98,000(\text{PVIFA}_{.0236\%,2})$$

$$\text{Savings} = \$293,930.60$$

If the lockbox payments occur at the end of the month, we need the effective monthly interest rate, which is:

$$\text{Monthly interest rate} = 1.09^{1/12} - 1$$

$$\text{Monthly interest rate} = 0.7207\%$$

## B-330 SOLUTIONS

Assuming the lockbox payments occur at the end of the month, the lockbox payments, which are a perpetuity, will be:

$$\begin{aligned}PV &= C/R \\ \$293,930.60 &= C / .007207 \\ C &= \$2,118.45\end{aligned}$$

It could also be assumed that the lockbox payments occur at the beginning of the month. If so, we would need to use the PV of a perpetuity due, which is:

$$PV = C + C / R$$

Solving for C:

$$\begin{aligned}C &= (PV \times R) / (1 + R) \\ C &= (\$293,930.60 \times .007207) / (1 + .007207) \\ C &= \$2,103.29\end{aligned}$$

9. The interest that the company could earn will be the amount of the checks times the number of days it will delay payment times the number of weeks that checks will be disbursed times the daily interest rate, so:

$$\begin{aligned}\text{Interest} &= \$57,000(7)(52/2)(.0002) \\ \text{Interest} &= \$2,074.80\end{aligned}$$

10. The benefit of the new arrangement is the \$6 million in accelerated collections since the new system will speed up collections by one day. The cost is the new compensating balance, but the company will recover the existing compensating balance, so:

$$\begin{aligned}\text{NPV} &= \$6,000,000 - (\$600,000 - 450,000) \\ \text{NPV} &= \$5,850,000\end{aligned}$$

The company should proceed with the new system. The savings are the NPV times the annual interest rate, so:

$$\begin{aligned}\text{Net savings} &= \$5,850,000(.05) \\ \text{Net savings} &= \$292,500\end{aligned}$$

### Intermediate

11. To find the NPV of taking the lockbox, we first need to calculate the present value of the savings. The present value of the savings will be the reduction in collection time times the average daily collections, so:

$$\begin{aligned}PV &= 2(400)(\$1,200) \\ PV &= \$960,000\end{aligned}$$

And the daily interest rate is:

$$\begin{aligned}\text{Daily interest rate} &= 1.060^{1/365} - 1 \\ \text{Daily interest rate} &= .000160 \text{ or } .0160\% \text{ per day}\end{aligned}$$

The transaction costs are a perpetuity. The cost per day is the cost per transaction times the number of transactions per day, so the NPV of taking the lockbox is:

$$\begin{aligned} \text{NPV} &= \$960,000 - [\$0.35(400)/.00016] \\ \text{NPV} &= \$83,101.45 \end{aligned}$$

Without the fee, the lockbox system should be accepted. To calculate the NPV of the lockbox with the annual fee, we can simply use the NPV of the lockbox without the annual fee and subtract the addition cost. The annual fee is a perpetuity, so, with the fee, the NPV of taking the lockbox is:

$$\begin{aligned} \text{NPV} &= \$83,101.45 - [\$6,000/.06] \\ \text{NPV} &= -\$16,898.55 \end{aligned}$$

With the fee, the lockbox system should not be accepted.

- 12.** To find the minimum number of payments per day needed to make the lockbox system feasible is the number of checks that makes the NPV of the decision equal to zero. The average daily interest rate is:

$$\begin{aligned} \text{Daily interest rate} &= 1.05^{1/365} - 1 \\ \text{Daily interest rate} &= .0134\% \text{ per day} \end{aligned}$$

The present value of the savings is the average payment amount times the days the collection period is reduced times the number of customers. The costs are the transaction fee and the annual fee. Both are perpetuities. The total transaction costs are the transaction costs per check times the number of checks. The equation for the NPV of the project, where N is the number of checks transacted per day, is:

$$\begin{aligned} \text{NPV} = 0 &= (\$4,800)(1)N - \$0.10(N)/.000134 - \$25,000/.05 \\ \$500,000 &= \$4,800N - \$748.05N \\ \$4,015.95N &= \$500,000 \\ N &= 123.40 \approx 123 \text{ customers per day} \end{aligned}$$

B-332 SOLUTIONS

**APPENDIX 20A**

1.
  - a. Decrease. This will lower the trading costs, which will cause a decrease in the target cash balance.
  - b. Decrease. This will increase the holding cost, which will cause a decrease in the target cash balance.
  - c. Increase. This will increase the amount of cash that the firm has to hold in non-interest bearing accounts, so they will have to raise the target cash balance to meet this requirement.
  - d. Decrease. If the credit rating improves, then the firm can borrow more easily, allowing it to lower the target cash balance and borrow if a cash shortfall occurs.
  - e. Increase. If the cost of borrowing increases, the firm will need to hold more cash to protect against cash shortfalls as its borrowing costs become more prohibitive.
  - f. Decrease. This depends somewhat on what the fees apply to, but if direct fees are established, then the compensating balance may be lowered, thus lowering the target cash balance. If, on the other hand, fees are charged on the number of transactions, then the firm may wish to hold a higher cash balance so they are not transferring money into the account as often.

2. The target cash balance using the BAT model is:

$$C^* = [(2T \times F)/R]^{1/2}$$
$$C^* = [2(\$9,000)(\$25)/.07]^{1/2}$$
$$C^* = \$2,535.46$$

The initial balance should be \$2,535.46, and whenever the balance drops to \$0, another \$2,535.46 should be transferred in.

3. The holding cost is the average daily cash balance times the interest rate, so:

$$\text{Holding cost} = (\$900)(.05)$$
$$\text{Holding cost} = \$45.00$$

The trading costs are the total cash needed times the replenishing costs, divided by the average daily balance times two, so:

$$\text{Trading cost} = [(\$37,000)(\$8)]/[(\$900)(2)]$$
$$\text{Trading cost} = \$164.44$$

The total cost is the sum of the holding cost and the trading cost, so:

$$\text{Total cost} = \$45.00 + 164.44$$
$$\text{Total cost} = \$209.44$$

The target cash balance using the BAT model is:

$$C^* = [(2T \times F)/R]^{1/2}$$
$$C^* = [2(\$37,000)(\$8)/.05]^{1/2}$$
$$C^* = \$3,440.93$$

They should increase their average daily cash balance to:

$$\text{New average cash balance} = \$3,440.93/2$$
$$\text{New average cash balance} = \$1,720.47$$

This would minimize the costs. The new total cost would be:

$$\text{New total cost} = (\$1,720.47)(.05) + [(\$37,000)(\$8)]/[2(\$1,720.47)]$$
$$\text{New total cost} = \$172.05$$

4. a. The opportunity costs are the amount transferred times the interest rate, divided by two, so:

$$\text{Opportunity cost} = (\$450)(.06)/2$$
$$\text{Opportunity cost} = \$13.50$$

The trading costs are the total cash balance times the trading cost per transaction, divided by the amount transferred, so:

$$\text{Trading cost} = (\$7,000)(\$25)/\$450$$
$$\text{Trading cost} = \$388.89$$

The firm keeps too little in cash because the trading costs are much higher than the opportunity costs.

- b. The target cash balance using the BAT model is:

$$C^* = [(2T \times F)/R]^{1/2}$$
$$C^* = [2(\$7,000)(\$25)/.06]^{1/2}$$
$$C^* = \$2,415.23$$

5. The total cash needed is the cash shortage per month times twelve months, so:

$$\text{Total cash} = 12(\$125,000)$$
$$\text{Total cash} = \$1,500,000$$

The target cash balance using the BAT model is:

$$C^* = [(2T \times F)/R]^{1/2}$$
$$C^* = [2(\$1,500,000)(\$500)/.065]^{1/2}$$
$$C^* = \$151,910.91$$

## B-334 SOLUTIONS

The company should invest:

$$\begin{aligned}\text{Invest} &= \$670,000 - 151,910.91 \\ \text{Invest} &= \$518,089.09\end{aligned}$$

of its current cash holdings in marketable securities to bring the cash balance down to the optimal level. Over the rest of the year, sell securities:

$$\begin{aligned}\text{Sell securities} &= \$1,500,000 / \$151,910.91 \\ \text{Sell securities} &= 9.87 \approx 10 \text{ times.}\end{aligned}$$

6. The lower limit is the minimum balance allowed in the account, and the upper limit is the maximum balance allowed in the account. When the account balance drops to the lower limit:

$$\begin{aligned}\text{Securities sold} &= \$75,000 - 50,000 \\ \text{Securities sold} &= \$25,000\end{aligned}$$

in marketable securities will be sold, and the proceeds deposited in the account. This moves the account balance back to the target cash level. When the account balance rises to the upper limit, then:

$$\begin{aligned}\text{Securities purchased} &= \$130,000 - 75,000 \\ \text{Upper limit} &= \$55,000\end{aligned}$$

of marketable securities will be purchased. This expenditure brings the cash level back down to the target balance of \$75,000.

7. The target cash balance using the Miller-Orr model is:

$$\begin{aligned}C^* &= L + (3/4 \times F \times \sigma^2 / R)^{1/3} \\ C^* &= \$1,200 + [3/4(\$75)(\$60)^2 / .00021]^{1/3} \\ C^* &= \$2,187.95\end{aligned}$$

The upper limit is:

$$\begin{aligned}U^* &= 3 \times C^* - 2 \times L \\ U^* &= 3(\$2,187.95) - 2(\$1,200) \\ U^* &= \$4,163.85\end{aligned}$$

When the balance in the cash account drops to \$1,200, the firm sells:

$$\begin{aligned} \text{Sell} &= \$2,187.95 - 1,200 \\ \text{Sell} &= \$987.95 \end{aligned}$$

of marketable securities. The proceeds from the sale are used to replenish the account back to the optimal target level of  $C^*$ . Conversely, when the upper limit is reached, the firm buys:

$$\begin{aligned} \text{Buy} &= \$4,163.85 - 2,187.95 \\ \text{Buy} &= \$1,975.90 \end{aligned}$$

of marketable securities. This expenditure lowers the cash level back down to the optimal level of \$2,187.95.

8. As variance increases, the upper limit and the spread will increase, while the lower limit remains unchanged. The lower limit does not change because it is an exogenous variable set by management. As the variance increases, however, the amount of uncertainty increases. When this happens, the target cash balance, and therefore the upper limit and the spread, will need to be higher. If the variance drops to zero, then the lower limit, the target balance, and the upper limit will all be the same.
9. The average daily interest rate is:

$$\begin{aligned} \text{Daily rate} &= 1.07^{1/365} - 1 \\ \text{Daily rate} &= .000185 \text{ or } .0185\% \text{ per day} \end{aligned}$$

The target cash balance using the Miller-Orr model is:

$$\begin{aligned} C^* &= L + (3/4 \times F \times \sigma^2 / R)^{1/3} \\ C^* &= \$150,000 + [3/4(\$840,000)(\$500)/.000185]^{1/3} \\ C^* &= \$161,932.92 \end{aligned}$$

The upper limit is:

$$\begin{aligned} U^* &= 3 \times C^* - 2 \times L \\ U^* &= 3(\$161,932.92) - 2(\$150,000) \\ U^* &= \$185,798.75 \end{aligned}$$

10. Using the BAT model and solving for R, we get:

$$\begin{aligned} C^* &= [(2T \times F)/R]^{1/2} \\ \$2,600 &= [2(\$23,000)(\$10)/R]^{1/2} \\ R &= [2(\$23,000)(\$10)]/\$2,600^2 \\ R &= .0680 \text{ or } 6.80\% \end{aligned}$$

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# CHAPTER 21

## CREDIT AND INVENTORY MANAGEMENT

### Answers to Concepts Review and Critical Thinking Questions

1.
  - a. A sight draft is a commercial draft that is payable immediately.
  - b. A time draft is a commercial draft that does not require immediate payment.
  - c. A bankers acceptance is when a bank guarantees the future payment of a commercial draft.
  - d. A promissory note is an IOU that the customer signs.
  - e. A trade acceptance is when the buyer accepts the commercial draft and promises to pay it in the future.
  
2. Trade credit is usually granted on open account. The invoice is the credit instrument.
  
3. Credit costs: cost of debt, probability of default, and the cash discount  
No-credit costs: lost sales  
The sum of these are the carrying costs.
  
4.
  1. Character: determines if a customer is willing to pay his or her debts.
  2. Capacity: determines if a customer is able to pay debts out of operating cash flow.
  3. Capital: determines the customer's financial reserves in case problems occur with operating cash flow.
  4. Collateral: assets that can be liquidated to pay off the loan in case of default.
  5. Conditions: customer's ability to weather an economic downturn and whether such a downturn is likely.
  
5.
  1. Perishability and collateral value
  2. Consumer demand
  3. Cost, profitability, and standardization
  4. Credit risk
  5. The size of the account
  6. Competition
  7. Customer type

If the credit period exceeds a customer's operating cycle, then the firm is financing the receivables and other aspects of the customer's business that go beyond the purchase of the selling firm's merchandise.
  
6.
  - a. B: A is likely to sell for cash only, unless the product really works. If it does, then they might grant longer credit periods to entice buyers.
  - b. A: Landlords have significantly greater collateral, and that collateral is not mobile.
  - c. A: Since A's customers turn over inventory less frequently, they have a longer inventory period, and thus, will most likely have a longer credit period as well.
  - d. B: Since A's merchandise is perishable and B's is not, B will probably have a longer credit period.

- e. A: Rugs are fairly standardized and they are transportable, while carpets are custom fit and are not particularly transportable.
7. The three main categories of inventory are: raw material (initial inputs to the firm's production process), work-in-progress (partially completed products), and finished goods (products ready for sale). From the firm's perspective, the demand for finished goods is independent from the demand for the other types of inventory. The demand for raw material and work-in-progress is derived from, or dependent on, the firm's needs for these inventory types in order to achieve the desired levels of finished goods.
8. JIT systems reduce inventory amounts. Assuming no adverse effects on sales, inventory turnover will increase. Since assets will decrease, total asset turnover will also increase. Recalling the DuPont equation, an increase in total asset turnover, all else being equal, has a positive effect on ROE.
9. Carrying costs should be equal to order costs. Since the carrying costs are low relative to the order costs, the firm should increase the inventory level.
10. Since the price of components can decline quickly, Dell does not have inventory which is purchased and then declines quickly in value before it is sold. If this happens, the inventory may be sold at a loss. While this approach is valuable, it is difficult to implement. For example, Dell manufacturing plants will often have areas set aside that are the suppliers. When parts are needed, it is a matter of going across the floor to get new parts. In fact, most computer manufacturers are trying to implement similar inventory systems.

### Solutions to Questions and Problems

*NOTE: All end of chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.*

#### Basic

1. a. There are 30 days until account is overdue. If you take the full period, you must remit:
- $$\text{Remittance} = 300(\$115)$$
- $$\text{Remittance} = \$34,500$$
- b. There is a 1 percent discount offered, with a 10 day discount period. If you take the discount, you will only have to remit:
- $$\text{Remittance} = (1 - .01)(\$34,500)$$
- $$\text{Remittance} = \$34,155$$
- c. The implicit interest is the difference between the two remittance amounts, or:
- $$\text{Implicit interest} = \$34,500 - 34,155$$
- $$\text{Implicit interest} = \$345$$

## B-338 SOLUTIONS

The number of days' credit offered is:

$$\text{Days' credit} = 30 - 10$$

$$\text{Days' credit} = 20 \text{ days}$$

2. The receivables turnover is:

$$\text{Receivables turnover} = 365 / \text{Average collection period}$$

$$\text{Receivables turnover} = 365 / 39$$

$$\text{Receivables turnover} = 9.359 \text{ times}$$

And the average receivables are:

$$\text{Average receivables} = \text{Sales} / \text{Receivables period}$$

$$\text{Average receivables} = \$57,000,000 / 9.359$$

$$\text{Average receivables} = \$6,090,411$$

3. a. The average collection period is the percentage of accounts taking the discount times the discount period, plus the percentage of accounts not taking the discount times the days' until full payment is required, so:

$$\text{Average collection period} = .70(10 \text{ days}) + .30(30 \text{ days})$$

$$\text{Average collection period} = 16 \text{ days}$$

- b. And the average daily balance is:

$$\text{Average balance} = 1,500(\$1,900)(16)(12/365)$$

$$\text{Average balance} = \$1,499,178.08$$

4. The daily sales are:

$$\text{Daily sales} = \$23,000 / 7$$

$$\text{Daily sales} = \$3,285.71$$

Since the average collection period is 32 days, the average accounts receivable is:

$$\text{Average accounts receivable} = \$3,285.71(32)$$

$$\text{Average accounts receivable} = \$105,142.86$$

5. The interest rate for the term of the discount is:

$$\text{Interest rate} = .02 / .98$$

$$\text{Interest rate} = .0204 \text{ or } 2.04\%$$

And the interest is for:

$$35 - 10 = 25 \text{ days}$$

So, using the EAR equation, the effective annual interest rate is:

$$\begin{aligned}\text{EAR} &= (1 + \text{Periodic rate})^m - 1 \\ \text{EAR} &= (1.0204)^{365/25} - 1 \\ \text{EAR} &= .3431 \text{ or } 34.31\%\end{aligned}$$

a. The periodic interest rate is:

$$\begin{aligned}\text{Interest rate} &= .03/.97 \\ \text{Interest rate} &= .0309 \text{ or } 3.09\%\end{aligned}$$

And the EAR is:

$$\begin{aligned}\text{EAR} &= (1.0309)^{365/25} - 1 \\ \text{EAR} &= .5600 \text{ or } 56.00\%\end{aligned}$$

b. The EAR is:

$$\begin{aligned}\text{EAR} &= (1.0204)^{365/50} - 1 \\ \text{EAR} &= .1589 \text{ or } 15.89\%\end{aligned}$$

c. The EAR is:

$$\begin{aligned}\text{EAR} &= (1.0204)^{365/20} - 1 \\ \text{EAR} &= .4459 \text{ or } 44.59\%\end{aligned}$$

6. The receivables turnover is:

$$\begin{aligned}\text{Receivables turnover} &= 365/\text{Average collection period} \\ \text{Receivables turnover} &= 365/42 \\ \text{Receivables turnover} &= 8.69048 \text{ times}\end{aligned}$$

And the annual credit sales are:

$$\begin{aligned}\text{Annual credit sales} &= \text{Receivables turnover} \times \text{Average daily receivables} \\ \text{Annual credit sales} &= 8.690(\$43,000) \\ \text{Annual credit sales} &= \$373,690.48\end{aligned}$$

7. The total sales of the firm are equal to the total credit sales since all sales are on credit, so:

$$\begin{aligned}\text{Total credit sales} &= 4,500(\$400) \\ \text{Total credit sales} &= \$1,800,000\end{aligned}$$

The average collection period is the percentage of accounts taking the discount times the discount period, plus the percentage of accounts not taking the discount times the days' until full payment is required, so:

$$\begin{aligned}\text{Average collection period} &= .60(10) + .40(40) \\ \text{Average collection period} &= 22 \text{ days}\end{aligned}$$

## B-340 SOLUTIONS

The receivables turnover is 365 divided by the average collection period, so:

$$\text{Receivables turnover} = 365/22$$

$$\text{Receivables turnover} = 16.591 \text{ times}$$

And the average receivables are the credit sales divided by the receivables turnover so:

$$\text{Average receivables} = \$1,800,000/16.591$$

$$\text{Average receivables} = \$108,493.15$$

If the firm increases the cash discount, more people will pay sooner, thus lowering the average collection period. If the ACP declines, the receivables turnover increases, which will lead to a decrease in the average receivables.

8. The average collection period is the net credit terms plus the days overdue, so:

$$\text{Average collection period} = 30 + 7$$

$$\text{Average collection period} = 37 \text{ days}$$

The receivables turnover is 365 divided by the average collection period, so:

$$\text{Receivables turnover} = 365/37$$

$$\text{Receivables turnover} = 9.865 \text{ times}$$

And the average receivables are the credit sales divided by the receivables turnover so:

$$\text{Average receivables} = \$8,000,000 / 9.865$$

$$\text{Average receivables} = \$810,958.90$$

9. a. The cash outlay for the credit decision is the variable cost of the engine. If this is a one-time order, the cash inflow is the present value of the sales price of the engine times one minus the default probability. So, the NPV per unit is:

$$\text{NPV} = -\$1,400,000 + (1 - .005)(\$1,650,000)/1.025$$

$$\text{NPV} = \$201,707.32 \text{ per unit}$$

The company should fill the order.

- b. To find the breakeven probability of default,  $\pi$ , we simply use the NPV equation from part a, set it equal to zero, and solve for  $\pi$ . Doing so, we get:

$$\text{NPV} = 0 = -\$1,400,000 + (1 - \pi)(\$1,650,000)/1.025$$

$$\pi = .1303 \text{ or } 13.03\%$$

We would not accept the order if the default probability was higher than 13.03 percent.

- c. If the customer will become a repeat customer, the cash inflow changes. The cash inflow is now one minus the default probability, times the sales price minus the variable cost. We need to use the sales price minus the variable cost since we will have to build another engine for the customer in one period. Additionally, this cash inflow is now a perpetuity, so the NPV under these assumptions is:

$$\text{NPV} = -\$1,400,000 + (1 - .005)(\$1,650,000 - 1,400,000)/.025$$

$$\text{NPV} = \$8,550,000.00 \text{ per unit}$$

The company should fill the order. The breakeven default probability under these assumptions is:

$$\text{NPV} = 0 = -\$1,400,000 + (1 - \pi)(\$1,650,000 - 1,400,000)/.025$$

$$\pi = .8600 \text{ or } 86.00\%$$

We would not accept the order if the default probability was higher than 86.00 percent. This default probability is much higher than in part *b* because the customer may become a repeat customer.

- d. It is assumed that if a person has paid his or her bills in the past, they will pay their bills in the future. This implies that if someone doesn't default when credit is first granted, then they will be a good customer far into the future, and the possible gains from the future business outweigh the possible losses from granting credit the first time.

10. The cost of switching is the lost sales from the existing policy plus the incremental variable costs under the new policy, so:

$$\text{Cost of switching} = \$780(1,420) + \$475(1,505 - 1,420)$$

$$\text{Cost of switching} = \$1,147,975$$

The benefit of switching is the new sales price minus the variable costs per unit, times the incremental units sold, so:

$$\text{Benefit of switching} = (\$780 - 475)(1,505 - 1,420)$$

$$\text{Benefit of switching} = \$25,925$$

The benefit of switching is a perpetuity, so the NPV of the decision to switch is:

$$\text{NPV} = -\$1,147,975 + \$25,925/.015$$

$$\text{NPV} = \$580,358.33$$

The firm will have to bear the cost of sales for one month before they receive any revenue from credit sales, which is why the initial cost is for one month. Receivables will grow over the one month credit period and will then remain stable with payments and new sales offsetting one another.

11. The carrying costs are the average inventory times the cost of carrying an individual unit, so:

$$\text{Carrying costs} = (2,500/2)(\$10) = \$12,500$$

## B-342 SOLUTIONS

The order costs are the number of orders times the cost of an order, so:

$$\text{Order costs} = (52)(\$2,400) = \$124,800$$

The economic order quantity is:

$$\begin{aligned}\text{EOQ} &= [(2T \times F)/CC]^{1/2} \\ \text{EOQ} &= [2(52)(2,500)(\$2,400)/\$10]^{1/2} \\ \text{EOQ} &= 7,899.37\end{aligned}$$

The firm's policy is not optimal, since the carrying costs and the order costs are not equal. The company should increase the order size and decrease the number of orders.

- 12.** The carrying costs are the average inventory times the cost of carrying an individual unit, so:

$$\text{Carrying costs} = (450/2)(\$37) = \$8,325$$

The order costs are the number of orders times the cost of an order, so:

$$\text{Restocking costs} = 52(\$125) = \$6,500$$

The economic order quantity is:

$$\begin{aligned}\text{EOQ} &= [(2T \times F)/CC]^{1/2} \\ \text{EOQ} &= [2(52)(450)(\$125)/\$37]^{1/2} \\ \text{EOQ} &= 397.63\end{aligned}$$

The number of orders per year will be the total units sold per year divided by the EOQ, so:

$$\begin{aligned}\text{Number of orders per year} &= 52(450)/397.63 \\ \text{Number of orders per year} &= 58.85\end{aligned}$$

The firm's policy is not optimal, since the carrying costs and the order costs are not equal. The company should decrease the order size and increase the number of orders.

### Intermediate

- 13.** The total carrying costs are:

$$\text{Carrying costs} = (Q/2) \times CC$$

where CC is the carrying cost per unit. The restocking costs are:

$$\text{Restocking costs} = F \times (T/Q)$$

Setting these equations equal to each other and solving for Q, we find:

$$\begin{aligned}CC \times (Q/2) &= F \times (T/Q) \\ Q^2 &= 2 \times F \times T / CC \\ Q &= [2F \times T / CC]^{1/2} = \text{EOQ}\end{aligned}$$

- 14.** The cash flow from either policy is:

$$\text{Cash flow} = (P - v)Q$$

So, the cash flows from the old policy are:

$$\text{Cash flow from old policy} = (\$82 - 43)(4,150)$$

$$\text{Cash flow from old policy} = \$161,850$$

And the cash flow from the new policy would be:

$$\text{Cash flow from new policy} = (\$84 - 43)(4,380)$$

$$\text{Cash flow from new policy} = \$179,580$$

So, the incremental cash flow would be:

$$\text{Incremental cash flow} = \$179,580 - 161,850$$

$$\text{Incremental cash flow} = \$17,730$$

The incremental cash flow is a perpetuity. The cost of initiating the new policy is:

$$\text{Cost of new policy} = -[PQ + v(Q' - Q)]$$

So, the NPV of the decision to change credit policies is:

$$\text{NPV} = -[(\$82)(4,150) + (\$43)(4,380 - 4,150)] + \$17,730/.03$$

$$\text{NPV} = \$240,810.00$$

- 15.** The cash flow from the old policy is:

$$\text{Cash flow from old policy} = (\$330 - 260)(1,250)$$

$$\text{Cash flow from old policy} = \$87,500$$

And the cash flow from the new policy will be:

$$\text{Cash flow from new policy} = (\$334 - 265)(1,310)$$

$$\text{Cash flow from new policy} = \$90,390$$

The incremental cash flow, which is a perpetuity, is the difference between the old policy cash flows and the new policy cash flows, so:

$$\text{Incremental cash flow} = \$90,390 - 87,500$$

$$\text{Incremental cash flow} = \$2,890$$

## B-344 SOLUTIONS

The cost of switching credit policies is:

$$\text{Cost of new policy} = -[PQ + Q(v' - v) + v'(Q' - Q)]$$

In this cost equation, we need to account for the increased variable cost for all units produced. This includes the units we already sell, plus the increased variable costs for the incremental units. So, the NPV of switching credit policies is:

$$\begin{aligned}\text{NPV} &= -[(\$330)(1,250) + (1,250)(\$265 - 260) + (\$265)(1,310 - 1,250)] + (\$2,890/.02) \\ \text{NPV} &= -\$290,150.00\end{aligned}$$

16. If the cost of subscribing to the credit agency is less than the savings from collection of the bad debts, the company should subscribe. The cost of the subscription is:

$$\begin{aligned}\text{Cost of the subscription} &= \$500 + \$4(400) \\ \text{Cost of the subscription} &= \$2,100\end{aligned}$$

And the savings from having no bad debts will be:

$$\begin{aligned}\text{Savings from not selling to bad credit risks} &= (\$280)(400)(0.03) \\ \text{Savings from not selling to bad credit risks} &= \$3,360\end{aligned}$$

So, the company's net savings will be:

$$\begin{aligned}\text{Net savings} &= \$3,360 - 2,100 \\ \text{Net savings} &= \$1,260\end{aligned}$$

The company should subscribe to the credit agency.

### Challenge

17. The cost of switching credit policies is:

$$\text{Cost of new policy} = -[PQ + Q(v' - v) + v'(Q' - Q)]$$

And the cash flow from switching, which is a perpetuity, is:

$$\text{Cash flow from new policy} = [Q'(P' - v) - Q(P - v)]$$

To find the breakeven quantity sold for switching credit policies, we set the NPV equal to zero and solve for  $Q'$ . Doing so, we find:

$$\begin{aligned}\text{NPV} = 0 &= -[(\$82)(4,150) + (\$43)(Q' - 4,150)] + [(Q')(\$84 - 43) - (4,150)(\$82 - 43)]/.03 \\ 0 &= -\$340,300 - \$43Q' + \$178,450 + \$1,366.67Q' - \$5,395,000 \\ \$1,323.67Q' &= \$5,556,850 \\ Q' &= 4,198.07\end{aligned}$$

- 18.** We can use the equation for the NPV we constructed in Problem 17. Using the sales figure of 4,380 units and solving for  $P'$ , we get:

$$\begin{aligned} \text{NPV} = 0 &= [-(\$82)(4,150) - (\$43)(4,200 - 4,150)] + [(P' - 43)(4,200) - (\$82 - 43)(4,150)]/.03 \\ 0 &= -\$340,300 - 2,150 + \$140,000P' - 6,020,000 - 5,395,000 \\ \$140,000P' &= \$11,757,450 \\ P' &= \$83.98 \end{aligned}$$

- 19.** From Problem 15, the incremental cash flow from the new credit policy will be:

$$\text{Incremental cash flow} = Q'(P' - v') - Q(P - v)$$

And the cost of the new policy is:

$$\text{Cost of new policy} = -[PQ + Q(v' - v) + v'(Q' - Q)]$$

Setting the NPV equal to zero and solving for  $P'$ , we get:

$$\begin{aligned} \text{NPV} = 0 &= -[(\$330)(1,250) + (\$265 - 260)(1,250) + (\$265)(1,310 - 1,250)] + [(1,310)(P' - 265) - \\ &\quad (1,250)(\$330 - 260)]/.02 \\ 0 &= -[\$412,500 + 6,250 + 15,900] + \$65,500P' - 17,357,500 - 4,375,000 \\ \$65,500P' &= \$22,167,150 \\ P' &= \$338.43 \end{aligned}$$

- 20.** The company places an order every five days. The number of orders per year will be:

$$\text{Orders per year} = 365/5 = 73 \text{ times}$$

The next order should be placed after the close of business Saturday.

B-346 SOLUTIONS

**APPENDIX 21A**

1. The cash flow from the old policy is the quantity sold times the price, so:

$$\text{Cash flow from old policy} = 50,000(\$525)$$

$$\text{Cash flow from old policy} = \$26,250,000$$

The cash flow from the new policy is the quantity sold times the new price, all times one minus the default rate, so:

$$\text{Cash flow from new policy} = 50,000(\$547)(1 - .025)$$

$$\text{Cash flow from new policy} = \$26,666,250$$

The incremental cash flow is the difference in the two cash flows, so:

$$\text{Incremental cash flow} = \$26,666,250 - 26,250,000$$

$$\text{Incremental cash flow} = \$416,250$$

The cash flows from the new policy are a perpetuity. The cost is the old cash flow, so the NPV of the decision to switch is:

$$\text{NPV} = -\$26,250,000 + \$416,250/.02$$

$$\text{NPV} = -\$5,437,500$$

2. a. The old price as a percentage of the new price is:

$$\$88/\$90.72 = .97$$

So the discount is:

$$\text{Discount} = 1 - .97 = .03 \text{ or } 3\%$$

The credit terms will be:

Credit terms: 3/20, net 30

- b. We are unable to determine for certain since no information is given concerning the percentage of customers who will take the discount. However, the maximum receivables would occur if all customers took the credit, so:

$$\text{Receivables} = 3,000(\$88)$$

$$\text{Receivables} = \$264,000 \text{ (at a maximum)}$$

- c. Since the quantity sold does not change, variable cost is the same under either plan.

d. No, because:

$$d - \pi = .03 - .10$$

$$d - \pi = -.07 \text{ or } -7\%$$

Therefore the NPV will be negative. The NPV is:

$$\text{NPV} = -3,000(\$88) + (3,000)(\$90.72)(.03 - .10)/(.01)$$

$$\text{NPV} = -\$2,169,600$$

The breakeven credit price is:

$$P(1 + r)/(1 - \pi) = \$88(1.01)/(.9)$$

$$P = \$98.76$$

This implies that the breakeven discount is:

$$\text{Breakeven discount} = 1 - (\$88/\$98.76)$$

$$\text{Breakeven discount} = .1089 \text{ or } 10.89\%$$

The NPV at this discount rate is:

$$\text{NPV} = -3,000(\$88) + (3,000)(\$98.76)(.1089 - .10)/(.01)$$

$$\text{NPV} \approx 0$$

3. a. The cost of the credit policy switch is the quantity sold times the variable cost. The cash inflow is the price times the quantity sold, times one minus the default rate. This is a one-time, lump sum, so we need to discount this value one period. Doing so, we find the NPV is:

$$\text{NPV} = -12(\$910) + (1 - .2)(12)(\$1,340)/1.02$$

$$\text{NPV} = \$1,691.76$$

The order should be taken since the NPV is positive.

- b. To find the breakeven default rate,  $\pi$ , we just need to set the NPV equal to zero and solve for the breakeven default rate. Doing so, we get:

$$\text{NPV} = 0 = -12(\$910) + (1 - \pi)(12)(\$1,340)/1.02$$

$$\pi = .3073 \text{ or } 30.73\%$$

- c. Effectively, the cash discount is:

$$\text{Cash discount} = (\$1,340 - 1,310)/\$1,340$$

$$\text{Cash discount} = .0224 \text{ or } 2.24\%$$

Since the discount rate is less than the default rate, credit should not be granted. The firm would be better off taking the \$1,310 up-front than taking an 80% chance of making \$1,340.

## B-348 SOLUTIONS

4. a. The cash discount is:

$$\begin{aligned}\text{Cash discount} &= (\$68 - 63)/\$68 \\ \text{Cash discount} &= .0735 \text{ or } 7.35\%\end{aligned}$$

The default probability is one minus the probability of payment, or:

$$\begin{aligned}\text{Default probability} &= 1 - .90 \\ \text{Default probability} &= .10\end{aligned}$$

Since the default probability is greater than the cash discount, credit should not be granted; the NPV of doing so is negative.

- b. Due to the increase in both quantity sold and credit price when credit is granted, an additional incremental cost is incurred of:

$$\begin{aligned}\text{Additional cost} &= (6,200)(\$31 - 29) + (6,900 - 6,200)(\$31) \\ \text{Additional cost} &= \$34,100\end{aligned}$$

The breakeven price under these assumptions is:

$$\begin{aligned}\text{NPV} = 0 &= -\$34,100 - (6,200)(\$63) + \{6,900[(1 - .10)P' - \$31] - 6,200(\$63 - 29)\}/(1.0075^3 - 1) \\ \text{NPV} &= -\$34,100 - 390,600 + 273,940.31P' - 9,435,721.83 - 9,298,972.24 \\ \$19,159,394.07 &= \$273,940.31P' \\ P' &= \$69.94\end{aligned}$$

- c. The credit report is an additional cost, so we have to include it in our analysis. The NPV when using the credit reports is:

$$\begin{aligned}\text{NPV} &= 6,200(29) - .90(6,900)31 - 6,200(63) - 6,900(\$2) + \{6,900[0.90(68 - 31) - 2] \\ &\quad - 6,200(63 - 29)\}/(1.0075^3 - 1) \\ \text{NPV} &= \$179,800 - 192,510 - 390,600 - 13,800 - 228,063.03 \\ \text{NPV} &= -\$189,046.97\end{aligned}$$

The reports should not be purchased and credit should not be granted.

5. We can express the old cash flow as:

$$\text{Old cash flow} = (P - v)Q$$

And the new cash flow will be:

$$\text{New cash flow} = (P - v)(1 - \alpha)Q' + \alpha Q' [(1 - \pi)P' - v]$$

So, the incremental cash flow is

$$\text{Incremental cash flow} = -(P - v)Q + (P - v)(1 - \alpha)Q' + \alpha Q' [(1 - \pi)P' - v]$$

$$\text{Incremental cash flow} = (P - v)(Q' - Q) + \alpha Q' [(1 - \pi)P' - P]$$

Thus:

$$\text{NPV} = (P - v)(Q' - Q) - \alpha PQ' + \left[ \frac{(P - v)(Q' - Q) + \alpha Q' \{(1 - \pi)P' - P\}}{R} \right]$$

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# CHAPTER 22

## INTERNATIONAL CORPORATE FINANCE

### Answers to Concepts Review and Critical Thinking Questions

1.
  - a. The dollar is selling at a premium because it is more expensive in the forward market than in the spot market (SFr 1.53 versus SFr 1.50).
  - b. The franc is expected to depreciate relative to the dollar because it will take more francs to buy one dollar in the future than it does today.
  - c. Inflation in Switzerland is higher than in the United States, as are interest rates.
2. The exchange rate will increase, as it will take progressively more pesos to purchase a dollar. This is the relative PPP relationship.
3.
  - a. The Australian dollar is expected to weaken relative to the dollar, because it will take more A\$ in the future to buy one dollar than it does today.
  - b. The inflation rate in Australia is higher.
  - c. Nominal interest rates in Australia are higher; relative real rates in the two countries are the same.
4. A Yankee bond is most accurately described by *d*.
5. No. For example, if a country's currency strengthens, imports become cheaper (good), but its exports become more expensive for others to buy (bad). The reverse is true for currency depreciation.
6. Additional advantages include being closer to the final consumer and, thereby, saving on transportation, significantly lower wages, and less exposure to exchange rate risk. Disadvantages include political risk and costs of supervising distant operations.
7. One key thing to remember is that dividend payments are made in the home currency. More generally, it may be that the owners of the multinational are primarily domestic and are ultimately concerned about their wealth denominated in their home currency because, unlike a multinational, they are not internationally diversified.
8.
  - a. False. If prices are rising faster in Great Britain, it will take more pounds to buy the same amount of goods that one dollar can buy; the pound will depreciate relative to the dollar.
  - b. False. The forward market would already reflect the projected deterioration of the euro relative to the dollar. Only if you feel that there might be additional, unanticipated weakening of the euro that isn't reflected in forward rates today will the forward hedge protect you against additional declines.

- c. True. The market would only be correct on average, while you would be correct all the time.
9. a. American exporters: their situation in general improves because a sale of the exported goods for a fixed number of euros will be worth more dollars.  
American importers: their situation in general worsens because the purchase of the imported goods for a fixed number of euros will cost more in dollars.
- b. American exporters: they would generally be better off if the British government's intentions result in a strengthened pound.  
American importers: they would generally be worse off if the pound strengthens.
- c. American exporters: would generally be much worse off, because an extreme case of fiscal expansion like this one will make American goods prohibitively expensive to buy, or else Brazilian sales, if fixed in reais, would become worth an unacceptably low number of dollars.  
American importers: would generally be much better off, because Brazilian goods will become much cheaper to purchase in dollars.
10. IRP is the most likely to hold because it presents the easiest and least costly means to exploit any arbitrage opportunities. Relative PPP is least likely to hold since it depends on the absence of market imperfections and frictions in order to hold strictly.

### Solutions to Questions and Problems

*NOTE: All end of chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.*

#### Basic

1. Using the quotes from the table, we get:

- a.  $\$100(\text{€}0.7877/\$1) = \text{€}78.77$
- b.  $\$1.2695$
- c.  $\text{€}5\text{M}(\$1.2695/\text{€}) = \$6,347,594$
- d. Singapore dollar
- e. Mexican peso
- f.  $(\text{P}10.9075/\$1)(\$1.2695/\text{€}1) = \text{P}13.8473/\text{€}$

This is a cross rate.

- g. Most valuable: Kuwait dinar =  $\$3.4578$   
Least valuable: Columbian peso =  $\$0.0004088$

## B-352 SOLUTIONS

2. a. You would prefer £100, since:

$$(\text{£}100)(\text{£}1/\text{\$}0.5383) = \$185.760$$

- b. You would still prefer £100. Using the \$/£ exchange rate and the SF/£ exchange rate to find the amount of Swiss francs £100 will buy, we get:

$$(\text{£}100)(\$1.8576/\text{£}1)(\text{\$/SF } 0.8073) = \text{SF } 230.1003$$

- c. Using the quotes in the book to find the SF/£ cross rate, we find:

$$(\text{\$/SF } 0.8073)(\$1.8576/\text{£}1) = \text{SF } 2.3010/\text{£}1$$

The £/SF exchange rate is the inverse of the SF/£ exchange rate, so:

$$\text{£}1/\text{SF } 2.3010 = \text{£}0.4346/\text{SF } 1$$

3. a.  $F_{180} = \text{¥}112.85$  (per \$). The yen is selling at a premium because it is more expensive in the forward market than in the spot market (\$0.0086371 versus \$0.0088613).

- b.  $F_{90} = \$0.8842/\text{C}\$1$ . The dollar is selling at a discount because it is less expensive in the forward market than in the spot market (\$0.8790 versus \$0.8842).

- c. The value of the dollar will fall relative to the yen, since it takes more dollars to buy one yen in the future than it does today. The value of the dollar will rise relative to the Canadian dollar, because it will take fewer dollars to buy one Canadian dollar in the future than it does today.

4. a. The U.S. dollar, since one Canadian dollar will buy:

$$(\text{Can}\$1)/(\text{Can}\$1.15/\text{\$}1) = \$0.8696$$

- b. The cost in U.S. dollars is:

$$(\text{Can}\$2.50)/(\text{Can}\$1.15/\text{\$}1) = \$2.17$$

Among the reasons that absolute PPP doesn't hold are tariffs and other barriers to trade, transactions costs, taxes, and different tastes.

- c. The U.S. dollar is selling at a premium, because it is more expensive in the forward market than in the spot market (Can\$1.19 versus Can\$1.15).

- d. The Canadian dollar is expected to depreciate in value relative to the dollar, because it takes more Canadian dollars to buy one U.S. dollar in the future than it does today.

- e. Interest rates in the United States are probably lower than they are in Canada.

5. a. The cross rate in ¥/£ terms is:

$$(\text{¥}118/\text{\$}1)(\$1.81/\text{£}1) = \text{¥}213.58/\text{£}1$$

- b. The yen is quoted too low relative to the pound. Take out a loan for \$1 and buy ¥118. Use the ¥118 to purchase pounds at the cross-rate, which will give you:

$$¥118(£1/¥204) = £0.5784$$

Use the pounds to buy back dollars and repay the loan. The cost to repay the loan will be:

$$£0.5784(\$1.81/£1) = \$1.0470$$

You arbitrage profit is \$0.0470 per dollar used.

6. We can rearrange the interest rate parity condition to answer this question. The equation we will use is:

$$R_{FC} = (F_t - S_0)/S_0 + R_{US}$$

Using this relationship, we find:

$$\text{Great Britain: } R_{FC} = (£0.5363 - £0.5383)/£0.5383 + .025 = .0213 \text{ or } 2.13\%$$

$$\text{Japan: } R_{FC} = (¥112.85 - ¥115.78)/¥115.78 + .025 = -.0003 \text{ or } -0.03\%$$

$$\text{Switzerland: } R_{FC} = (\text{SFr } 1.2152 - \text{SFr } 1.2387)/\text{SFr } 1.2387 + .025 = .0060 \text{ or } 0.60\%$$

7. If we invest in the U.S. for the next three months, we will have:

$$\$30,000,000(1.0048)^3 = \$30,434,076.92$$

If we invest in Great Britain, we must exchange the dollars today for pounds, and exchange the pounds for dollars in three months. After making these transactions, the dollar amount we would have in three months would be:

$$(\$30,000,000)(£0.54/\$1)(1.0057)^3/(£0.53/\$1) = \$31,091,701.91$$

The company should invest in Great Britain.

8. Using the relative purchasing power parity equation:

$$F_t = S_0 \times [1 + (h_{FC} - h_{US})]^t$$

We find:

$$Z3.27 = Z3.18[1 + (h_{FC} - h_{US})]^3$$

$$h_{FC} - h_{US} = (Z3.27/Z3.18)^{1/3} - 1$$

$$h_{FC} - h_{US} = .0093 \text{ or } 0.93\%$$

Inflation in Poland is expected to exceed that in the U.S. by 0.93% over this period.

## B-354 SOLUTIONS

9. The profit will be the quantity sold, times the sales price minus the cost of production. The production cost is in Singapore dollars, so we must convert this to U.S. dollars. Doing so, we find that if the exchange rates stay the same, the profit will be:

$$\begin{aligned}\text{Profit} &= 30,000[\$140 - \{(\text{S}\$204.70)/(\text{S}\$1.5803/\text{\$1})\}] \\ \text{Profit} &= \$314,028.98\end{aligned}$$

If the exchange rate rises, we must adjust the cost by the increased exchange rate, so:

$$\begin{aligned}\text{Profit} &= 30,000[\$140 - \{(\text{S}\$204.70)/(1.1(\text{S}\$1.5803/\text{\$1}))\}] \\ \text{Profit} &= \$667,299.07\end{aligned}$$

If the exchange rate falls, we must adjust the cost by the decreased exchange rate, so:

$$\begin{aligned}\text{Profit} &= 30,000[\$140 - \{(\text{S}\$204.70)/(0.9(\text{S}\$1.5803/\text{\$1}))\}] \\ \text{Profit} &= -\$117,745.58\end{aligned}$$

To calculate the breakeven change in the exchange rate, we need to find the exchange rate that make the cost in Singapore dollars equal to the selling price in U.S. dollars, so:

$$\begin{aligned}\$140 &= \text{S}\$204.70/S_T \\ S_T &= \text{S}\$1.4621/\text{\$1} \\ S_T &= -0.0748 \text{ or } -7.48\% \text{ decline}\end{aligned}$$

10. a. If IRP holds, then:

$$\begin{aligned}F_{180} &= (\text{Kr } 6.18)[1 + (.08 - .05)]^{1/2} \\ F_{180} &= \text{Kr } 6.2720\end{aligned}$$

Since given  $F_{180}$  is Kr6.30, an arbitrage opportunity exists; the forward premium is too high. Borrow Kr1 today at 8% interest. Agree to a 180-day forward contract at Kr 6.30. Convert the loan proceeds into dollars:

$$\text{Kr } 1 (\text{\$/Kr } 6.18) = \$0.16181$$

Invest these dollars at 5%, ending up with \$0.1658. Convert the dollars back into krone as

$$\$0.1658(\text{Kr } 6.30/\text{\$1}) = \text{Kr } 1.044424$$

Repay the Kr 1 loan, ending with a profit of:

$$\text{Kr } 1.044424 - \text{Kr } 1.038868 = \text{Kr } 0.00556$$

- b. To find the forward rate that eliminates arbitrage, we use the interest rate parity condition, so:

$$\begin{aligned}F_{180} &= (\text{Kr } 6.18)[1 + (.08 - .05)]^{1/2} \\ F_{180} &= \text{Kr } 6.2720\end{aligned}$$

11. The international Fisher effect states that the real interest rate across countries is equal. We can rearrange the international Fisher effect as follows to answer this question:

$$R_{US} - h_{US} = R_{FC} - h_{FC}$$

$$h_{FC} = R_{FC} + h_{US} - R_{US}$$

a.  $h_{AUS} = .05 + .037 - .043$   
 $h_{AUS} = .044$  or 4.4%

b.  $h_{CAN} = .07 + .037 - .043$   
 $h_{CAN} = .064$  or 6.4%

c.  $h_{TAI} = .10 + .037 - .043$   
 $h_{TAI} = .094$  or 9.4%

12. a. The yen is expected to get weaker, since it will take more yen to buy one dollar in the future than it does today.

b.  $h_{US} - h_{JAP} \approx (\text{¥}122.68 - \text{¥}120.43)/\text{¥}120.43$   
 $h_{US} - h_{JAP} = 0.0187$  or 1.87%

$$(1 + .0187)^4 - 1 = 0.0769$$
 or 7.69%

The approximate inflation differential between the U.S. and Japan is 7.69% annually.

13. We need to find the change in the exchange rate over time so we need to use the relative purchasing power parity relationship:

$$F_t = S_0 \times [1 + (h_{FC} - h_{US})]^t$$

Using this relationship, we find the exchange rate in one year should be:

$$F_1 = 221.53[1 + (.086 - .049)]^1$$

$$F_1 = \text{HUF } 229.73$$

The exchange rate in two years should be:

$$F_2 = 221.53[1 + (.086 - .049)]^2$$

$$F_2 = \text{HUF } 238.23$$

And the exchange rate in five years should be:

$$F_5 = 221.53[1 + (.086 - .049)]^5$$

$$F_5 = \text{HUF } 265.66$$

B-356 SOLUTIONS

Intermediate

14. First, we need to forecast the future spot rate for each of the next three years. From interest rate and purchasing power parity, the expected exchange rate is:

$$E(S_T) = [(1 + R_{US}) / (1 + R_{FC})]^T S_0$$

So:

$$E(S_1) = (1.0480 / 1.0410)^1 \$1.22/\text{€} = \$1.2282/\text{€}$$

$$E(S_2) = (1.0480 / 1.0410)^2 \$1.22/\text{€} = \$1.2365/\text{€}$$

$$E(S_3) = (1.0480 / 1.0410)^3 \$1.22/\text{€} = \$1.2448/\text{€}$$

Now we can use these future spot rates to find the dollar cash flows. The dollar cash flow each year will be:

$$\text{Year 0 cash flow} = -\text{€}\$12,000,000(\$1.22/\text{€}) = -\$14,640,000.00$$

$$\text{Year 1 cash flow} = \text{€}\$2,700,000(\$1.2282/\text{€}) = \$3,316,149.86$$

$$\text{Year 2 cash flow} = \text{€}\$3,500,000(\$1.2365/\text{€}) = \$4,327,618.63$$

$$\text{Year 3 cash flow} = (\text{€}\$3,300,000 + 7,400,000)(\$1.2448/\text{€}) = \$13,319,111.90$$

And the NPV of the project will be:

$$\text{NPV} = -\$14,640,000 + \$3,316,149.86/1.13 + \$4,327,618.63/1.13^2 + \$13,319,111.90/1.13^3$$

$$\text{NPV} = \$914,618.73$$

15. a. Implicitly, it is assumed that interest rates won't change over the life of the project, but the exchange rate is projected to decline because the Euroswiss rate is lower than the Eurodollar rate.
- b. We can use relative purchasing power parity to calculate the dollar cash flows at each time. The equation is:

$$E[S_t] = (\text{SFr } 1.26)[1 + (.07 - .08)]^t$$

$$E[S_t] = 1.26(.99)^t$$

So, the cash flows each year in U.S. dollar terms will be:

<u>t</u>	<u>SFr</u>	<u>E[S<sub>t</sub>]</u>	<u>US\$</u>
0	-27.0M	1.2600	-\$21,428,571.43
1	+7.5M	1.2474	\$6,012,506.01
2	+7.5M	1.2349	\$6,073,238.40
3	+7.5M	1.2226	\$6,134,584.24
4	+7.5M	1.2104	\$6,196,549.74
5	+7.5M	1.1982	\$6,259,141.15

And the NPV is:

$$\begin{aligned} \text{NPV} &= -\$21,428,571.43 + \$6,012,506.01/1.13 + \$6,073,238.40/1.13^2 + \$6,134,584.24/1.13^3 + \\ &\quad \$6,196,549.74/1.13^4 + \$6,259,141.15/1.13^5 \\ \text{NPV} &= \$97,712.51 \end{aligned}$$

- c. Rearranging the relative purchasing power parity equation to find the required return in Swiss francs, we get:

$$\begin{aligned} R_{\text{SFr}} &= 1.13[1 + (.07 - .08)] - 1 \\ R_{\text{SFr}} &= 11.87\% \end{aligned}$$

So the NPV in Swiss francs is:

$$\begin{aligned} \text{NPV} &= -\text{SFr } 27.0\text{M} + \text{SFr } 7.5\text{M}(\text{PVIFA}_{11.87\%,5}) \\ \text{NPV} &= \text{SFr } 123,117.76 \end{aligned}$$

Converting the NPV to dollars at the spot rate, we get the NPV in U.S. dollars as:

$$\begin{aligned} \text{NPV} &= (\text{SFr } 123,117.76)(\$1/\text{SFr } 1.26) \\ \text{NPV} &= \$97,712.51 \end{aligned}$$

16. a. To construct the balance sheet in dollars, we need to convert the account balances to dollars. At the current exchange rate, we get:

$$\begin{aligned} \text{Assets} &= \text{solaris } 15,000 / (\$ / \text{solaris } 1.20) = \$12,500 \\ \text{Debt} &= \text{solaris } 6,000 / (\$ / \text{solaris } 1.20) = \$5,000 \\ \text{Equity} &= \text{solaris } 9,000 / (\$ / \text{solaris } 1.20) = \$7,500 \end{aligned}$$

- b. In one year, if the exchange rate is solaris 1.40/\$, the accounts will be:

$$\begin{aligned} \text{Assets} &= \text{solaris } 15,000 / (\$ / \text{solaris } 1.40) = \$10,714.29 \\ \text{Debt} &= \text{solaris } 6,000 / (\$ / \text{solaris } 1.40) = \$4,285.71 \\ \text{Equity} &= \text{solaris } 9,000 / (\$ / \text{solaris } 1.40) = \$6,428.57 \end{aligned}$$

- b. If the exchange rate is solaris 1.15/\$, the accounts will be:

$$\begin{aligned} \text{Assets} &= \text{solaris } 15,000 / (\$ / \text{solaris } 1.15) = \$13,043.48 \\ \text{Debt} &= \text{solaris } 6,000 / (\$ / \text{solaris } 1.15) = \$5,217.39 \\ \text{Equity} &= \text{solaris } 9,000 / (\$ / \text{solaris } 1.15) = \$7,826.09 \end{aligned}$$

B-358 SOLUTIONS

Challenge

17. First, we need to construct the end of year balance sheet in solaris. Since the company has retained earnings, the equity account will increase, which necessarily implies the assets will also increase by the same amount. So, the balance sheet at the end of the year in solaris will be:

Balance Sheet (solaris)			
		Liabilities	\$6,000.00
		Equity	<u>10,100.00</u>
Assets	<u>\$16,100.00</u>	Total liabilities & equity	<u>\$16,100.00</u>

Now we need to convert the balance sheet accounts to dollars, which gives us:

$$\text{Assets} = \text{solaris } 16,100 / (\$ / \text{solaris } 1.24) = \$12,983.87$$

$$\text{Debt} = \text{solaris } 6,000 / (\$ / \text{solaris } 1.24) = \$4,838.71$$

$$\text{Equity} = \text{solaris } 10,100 / (\$ / \text{solaris } 1.24) = \$8,145.16$$

18. a. The domestic Fisher effect is:

$$1 + R_{US} = (1 + r_{US})(1 + h_{US})$$

$$1 + r_{US} = (1 + R_{US}) / (1 + h_{US})$$

This relationship must hold for any country, that is:

$$1 + r_{FC} = (1 + R_{FC}) / (1 + h_{FC})$$

The international Fisher effect states that real rates are equal across countries, so:

$$1 + r_{US} = (1 + R_{US}) / (1 + h_{US}) = (1 + R_{FC}) / (1 + h_{FC}) = 1 + r_{FC}$$

- b. The exact form of unbiased interest rate parity is:

$$E[S_t] = F_t = S_0 [(1 + R_{FC}) / (1 + R_{US})]^t$$

- c. The exact form for relative PPP is:

$$E[S_t] = S_0 [(1 + h_{FC}) / (1 + h_{US})]^t$$

d. For the home currency approach, we calculate the expected currency spot rate at time  $t$  as:

$$E[S_t] = (\text{€}0.5)[1.07/1.05]^t = (\text{€}0.5)(1.019)^t$$

We then convert the euro cash flows using this equation at every time, and find the present value. Doing so, we find:

$$\begin{aligned} \text{NPV} &= - [\text{€}2\text{M}/(\text{€}0.5)] + \{\text{€}0.9\text{M}/[1.019(\text{€}0.5)]\}/1.1 + \{\text{€}0.9\text{M}/[1.019^2(\text{€}0.5)]\}/1.1^2 + \\ &\quad \{\text{€}0.9\text{M}/[1.019^3(\text{€}0.5/\text{\$}1)]\}/1.1^3 \\ \text{NPV} &= \$316,230.72 \end{aligned}$$

For the foreign currency approach we first find the return in the euros as:

$$R_{FC} = 1.10(1.07/1.05) - 1 = 0.121$$

Next, we find the NPV in euros as:

$$\text{NPV} = - \text{€}2\text{M} + (\text{€}0.9\text{M})/1.121 + (\text{€}0.9\text{M})/1.121^2 + (\text{€}0.9\text{M})/1.121^3 = \text{€}158,115.36$$

And finally, we convert the euros to dollars at the current exchange rate, which is:

$$\text{NPV} (\text{\$}) = \text{€}158,115.36 / (\text{€}0.5/\text{\$}1) = \$316,230.72$$

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# **CHAPTER 23**

## **RISK MANAGEMENT: AN INTRODUCTION TO FINANCIAL ENGINEERING**

### **Answers to Concepts Review and Critical Thinking Questions**

1. Since the firm is selling futures, it wants to be able to deliver the lumber; therefore, it is a supplier. Since a decline in lumber prices would reduce the income of a lumber supplier, it has hedged its price risk by selling lumber futures. Losses in the spot market due to a fall in lumber prices are offset by gains on the short position in lumber futures.
2. Buying call options gives the firm the right to purchase pork bellies; therefore, it must be a consumer of pork bellies. While a rise in pork belly prices is bad for the consumer, this risk is offset by the gain on the call options; if pork belly prices actually decline, the consumer enjoys lower costs, while the call option expires worthless.
3. Forward contracts are usually designed by the parties involved for their specific needs and are rarely sold in the secondary market; forwards are somewhat customized financial contracts. All gains and losses on the forward position are settled at the maturity date. Futures contracts are standardized to facilitate their liquidity and to allow them to be effectively traded on organized futures exchanges. Gains and losses on futures are marked-to-market daily. The default risk is greatly reduced with futures, since the exchange acts as an intermediary between the two parties, guaranteeing performance; default risk is also reduced because the daily settlement procedure keeps large loss positions from accumulating. You might prefer to use forwards instead of futures if your hedging needs were different from the standard contract size and maturity dates offered by the futures contract.
4. The firm is hurt by declining oil prices, so it should sell oil futures contracts. The firm may not be able to create a perfect hedge because the quantity of oil it needs to hedge doesn't match the standard contract size on crude oil futures, or perhaps the exact settlement date the company requires isn't available on these futures (exposing the firm to basis risk), or maybe the firm produces a different grade of crude oil than that specified for delivery in the futures contract.
5. The firm is directly exposed to fluctuations in the price of natural gas, since it is a natural gas user. In addition, the firm is indirectly exposed to fluctuations in the price of oil. If oil becomes less expensive relative to natural gas, its competitors will enjoy a cost advantage relative to the firm.
6. Buying the call options is a form of insurance policy for the firm. If cotton prices rise, the firm is protected by the call, while if prices actually decline, they can just allow the call to expire worthless. However, options hedges are costly because of the initial premium that must be paid. The futures contract can be entered into at no initial cost, with the disadvantage that the firm is locking in one price for cotton; it can't profit from cotton price declines.

7. The put option on the bond gives the owner the right to sell the bond at the option's strike price. If bond prices decline, the owner of the put option profits. However, since bond prices and interest rates move in opposite directions, if the put owner profits from a decline in bond prices, he would also profit from a rise in interest rates. Hence, a call option on interest rates is conceptually the same thing as a put option on bond prices.
8. The company would like to lock in the current low rates, or at least be protected from a rise in rates, allowing for the possibility of benefit if rates actually fall. The former hedge could be implemented by selling bond futures; the latter could be implemented by buying put options on bond prices or buying call options on interest rates.
9. A swap contract is an agreement between parties to exchange assets over several time intervals in the future. The swap contract is usually an exchange of cash flows, but not necessarily so. Since a forward contract is also an agreement between parties to exchange assets in the future, but at a single point in time, a swap can be viewed as a series of forward contracts with different settlement dates. The firm participating in the swap agreement is exposed to the default risk of the dealer, in that the dealer may not make the cash flow payments called for in the contract. The dealer faces the same risk from the contracting party, but can more easily hedge its default risk by entering into an offsetting swap agreement with another party.
10. The firm will borrow at a fixed rate of interest, receive fixed rate payments from the dealer as part of the swap agreement, and make floating rate payments back to the dealer; the net position of the firm is that it has effectively borrowed at floating rates.
11. Transactions exposure is the short-term exposure due to uncertain prices in the near future. Economic exposure is the long-term exposure due to changes in overall economic conditions. There are a variety of instruments available to hedge transaction exposure, but very few long-term hedging instruments exist. It is much more difficult to hedge against economic exposure, since fundamental changes in the business generally must be made to offset long-run changes in the economic environment.
12. The risk is that the dollar will strengthen relative to the yen, since the fixed yen payments in the future will be worth fewer dollars. Since this implies a decline in the  $\$/¥$  exchange rate, the firm should sell yen futures.
13.
  - a. Buy oil and natural gas futures contracts, since these are probably your primary resource costs. If it is a coal-fired plant, a cross-hedge might be implemented by selling natural gas futures, since coal and natural gas prices are somewhat negatively related in the market; coal and natural gas are somewhat substitutable.
  - b. Buy sugar and cocoa futures, since these are probably your primary commodity inputs.
  - c. Sell corn futures, since a record harvest implies low corn prices.
  - d. Buy silver and platinum futures, since these are primary commodity inputs required in the manufacture of photographic equipment.
  - e. Sell natural gas futures, since excess supply in the market implies low prices.
  - f. Assuming the bank doesn't resell its mortgage portfolio in the secondary market, buy bond futures.
  - g. Sell stock index futures, using an index most closely associated with the stocks in your fund, such as the S&P 100 or the Major Market Index for large blue-chip stocks.
  - h. Buy Swiss franc futures, since the risk is that the dollar will weaken relative to the franc over the next six months, which implies a rise in the  $\$/SFr$  exchange rate.

## B-362 SOLUTIONS

- i. Sell Euro futures, since the risk is that the dollar will strengthen relative to the Euro over the next three months, which implies a decline in the \$/€ exchange rate.
14. Sysco must have felt that the combination of fixed plus swap would result in an overall better rate. In other words, variable rate available via a swap may have been more attractive than the rate available from issuing a floating-rate bond.

### Solutions to Questions and Problems

*NOTE: All end of chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.*

#### Basic

1. The initial price is \$1,696 per metric ton and each contract is for 10 metric tons, so the initial contract value is:

$$\text{Initial contract value} = (\$1,696 \text{ per ton})(10 \text{ tons per contract}) = \$16,960$$

And the final contract value is:

$$\text{Final contract value} = (\$1,634 \text{ per ton})(10 \text{ tons per contract}) = \$16,340$$

You will have a loss on this futures position of:

$$\text{Loss on futures contract} = \$16,960 - 16,340 = \$620$$

2. The price quote is \$11.485 per ounce and each contract is for 5,000 ounces, so the initial contract value is:

$$\text{Initial contract value} = (\$11.485 \text{ per oz.})(5,000 \text{ oz. per contract}) = \$57,425$$

At a final price of \$12.06 per ounce, the value of the position is:

$$\text{Final contract value} = (\$12.06 \text{ per oz.})(5,000 \text{ oz. per contract}) = \$60,300$$

Since this is a short position, there is a net loss of:

$$\$60,300 - 57,425 = \$2,875 \text{ per contract}$$

Since you sold five contracts, the net loss is:

$$\text{Net loss} = 5(\$2,875) = \$14,375$$

At a final price of \$11.18 per ounce, the value of the position is:

$$\text{Final contract value} = (\$11.18 \text{ per oz.})(5,000 \text{ oz. per contract}) = \$55,900$$

Since this is a short position, there is a net gain of  $\$57,425 - 55,900 = \$1,525$

Since you sold five contracts, the net gain is:

$$\text{Net gain} = 5(\$1,525) = \$7,625$$

With a short position, you make a profit when the price falls, and incur a loss when the price rises.

3. The price quote is \$0.1145 per pound and each contract is for 15,000 pounds, so the cost per contract is:

$$\text{Cost} = (\$0.1145 \text{ per pound})(15,000 \text{ pounds per contract}) = \$1,718$$

If the price of orange juice at expiration is \$1.46 per pound, the call is out of the money since the strike price is above the spot price. The contracts will expire worthless, so your loss will be the initial investment of \$1,718.

If orange juice prices at contract expiration are \$1.67 per pound, the call is in the money since the price per pound is above the strike price. The payoff on your position is the current price minus the strike price, times the 15,000 pounds per contract, or:

$$\text{Payoff} = (\$1.67 - 1.55)(15,000) = \$1,800$$

And the profit is the payoff minus the initial cost of the contract, or:

$$\text{Profit} = \$1,800 - 1,718 = \$82$$

4. The call options give the manager the right to purchase oil futures contracts at a futures price of \$65 per barrel. The manager will exercise the option if the price rises above \$65. Selling put options obligates the manager to buy oil futures contracts at a futures price of \$65 per barrel. The put holder will exercise the option if the price falls below \$65. The payoffs per barrel are:

Oil futures price:	\$60	\$62	\$65	\$68	\$70
Value of call option position:	0	0	0	3	5
Value of put option position:	<u>-5</u>	<u>-3</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total value:	-\$5	-\$3	\$0	\$3	\$5

The payoff profile is identical to that of a forward contract with a \$65 strike price.

B-364 SOLUTIONS

Intermediate

5. a. You're concerned about a rise in corn prices, so you would buy December contracts. Since each contract is for 5,000 bushels, the number of contracts you would need to buy is:

$$\text{Number of contracts to buy} = 75,000/5,000 = 15$$

By doing so, you're effectively locking in the settle price in December, 2006 of \$2.76 per bushel of corn, or:

$$\text{Total price for 75,000 bushels} = 15(\$2.76)(5,000) = \$207,000$$

- b. If the price of corn at expiration is \$2.85 per bushel, the value of you futures position is:

$$\text{Value of future position} = (\$2.85 \text{ per bu.})(5,000 \text{ bu. per contract})(15 \text{ contracts}) = \$213,750$$

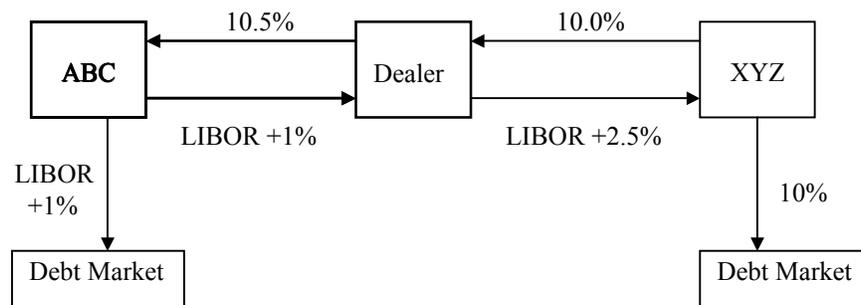
Ignoring any transaction costs, your gain on the futures position will be:

$$\text{Gain} = \$213,750 - 207,000 = \$6,750$$

While the price of the corn your firm needs has become \$6,750 more expensive since July, your profit from the futures position has netted out this higher cost.

6. a. XYZ has a comparative advantage relative to ABC in borrowing at fixed interest rates, while ABC has a comparative advantage relative to XYZ in borrowing at floating interest rates. Since the spread between ABC and XYZ's fixed rate costs is only 1%, while their differential is 2% in floating rate markets, there is an opportunity for a 3% total gain by entering into a fixed for floating rate swap agreement.

- b. If the swap dealer must capture 2% of the available gain, there is 1% left for ABC and XYZ. Any division of that gain is feasible; in an actual swap deal, the divisions would probably be negotiated by the dealer. One possible combination is  $\frac{1}{2}\%$  for ABC and  $\frac{1}{2}\%$  for XYZ:



*Challenge*

7. The financial engineer can replicate the payoffs of owning a put option by selling a forward contract and buying a call. For example, suppose the forward contract has a settle price of \$50 and the exercise price of the call is also \$50. The payoffs below show that the position is the same as owning a put with an exercise price of \$50:

Price of coal:	\$40	\$45	\$50	\$55	\$60
Value of call option position:	0	0	0	5	10
Value of forward position:	10	5	0	-5	-10
Total value:	\$10	\$5	\$0	\$0	\$0
Value of put position:	\$10	\$5	\$0	\$0	\$0

The payoffs for the combined position are exactly the same as those of owning a put. This means that, in general, the relationship between puts, calls, and forwards must be such that the cost of the two strategies will be the same, or an arbitrage opportunity exists. In general, given any two of the instruments, the third can be synthesized.

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# CHAPTER 24

## OPTION VALUATION

### Answers to Concepts Review and Critical Thinking Questions

1. Increasing the time to expiration increases the value of an option. The reason is that the option gives the holder the right to buy or sell. The longer the holder has that right, the more time there is for the option to increase (or decrease in the case of a put) in value. For example, imagine an out-of-the-money option that is about to expire. Because the option is essentially worthless, increasing the time to expiration would obviously increase its value.
2. An increase in volatility acts to increase both call and put values because the greater volatility increases the possibility of favorable in-the-money payoffs.
3. Interest rate increases are good for calls and bad for puts. The reason is that if a call is exercised in the future, we have to pay a fixed amount at that time. The higher the interest rate, the lower the present value of that fixed amount. The reverse is true for puts in that we receive a fixed amount.
4. If you buy a put option on a stock that you already own you guarantee that you can sell the stock for the exercise price of the put. Thus, you have effectively insured yourself against a stock price decline below this point. This is the protective put strategy.
5. The intrinsic value of a call is  $\text{Max}[S - E, 0]$ . The intrinsic value of a put is  $\text{Max}[E - S, 0]$ . The intrinsic value of an option is the value at expiration.
6. The time value of both a call option and a put option is the difference between the price of the option and the intrinsic value. For both types of options, as maturity increases, the time value increases since you have a longer time to realize a price increase (decrease). A call option is more sensitive to the maturity of the contract.
7. Since you have a large number of stock options in the company, you have an incentive to accept the second project, which will increase the overall risk of the company and reduce the value of the firm's debt. However, accepting the risky project will increase your wealth, as the options are more valuable when the risk of the firm increases.
8. Rearranging the put-call parity formula, we get:  $S - \text{PV}(E) = C - P$ . Since we know that the stock price and exercise price are the same, assuming a positive interest rate, the left hand side of the equation must be greater than zero. This implies the price of the call must be higher than the price of the put in this situation.
9. Rearranging the put-call parity formula, we get:  $S - \text{PV}(E) = C - P$ . If the call and the put have the same price, we know  $C - P = 0$ . This must mean the stock price is equal to the present value of the exercise price, so the put is in-the-money.
10. A stock can be replicated using a long call (to capture the upside gains), a short put (to reflect the downside losses) and a T-bill (to reflect the time value component – the “wait” factor).

**Solutions to Questions and Problems**

*NOTE: All end of chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.*

Basic

1. With continuous compounding, the FV is:

$$FV = \$1,000 \times e^{.09(7)} = \$1,877.61$$

2. With continuous compounding, the PV is:

$$PV = \$10,000 \times e^{-.09(4)} = \$6,976.76$$

3. Using put-call parity and solving for the put price, we get:

$$\begin{aligned} \$57 + P &= \$60e^{-(.026)(.25)} + \$3.85 \\ P &= \$6.46 \end{aligned}$$

4. Using put-call parity and solving for the call price we get:

$$\begin{aligned} \$53 + \$4.89 &= \$50e^{-(.048)(.5)} + C \\ C &= \$9.08 \end{aligned}$$

5. Using put-call parity and solving for the stock price we get:

$$\begin{aligned} S + \$2.87 &= \$85e^{-(.048)(3/12)} + \$5.12 \\ S &= \$86.24 \end{aligned}$$

6. Using put-call parity, we can solve for the risk-free rate as follows:

$$\begin{aligned} \$48.30 + \$3.89 &= \$50e^{-R(2/12)} + \$2.65 \\ \$49.54 &= \$50e^{-R(2/12)} \\ 0.9908 &= e^{-R(2/12)} \\ \ln(0.9908) &= \ln(e^{-R(2/12)}) \\ -0.00924 &= -R(2/12) \\ R_f &= .0555 \text{ or } 5.55\% \end{aligned}$$

7. Using put-call parity, we can solve for the risk-free rate as follows:

$$\begin{aligned} \$74.12 + \$2.80 &= \$70e^{-R(5/12)} + \$8.10 \\ \$68.82 &= \$70e^{-R(5/12)} \\ 0.9831 &= e^{-R(5/12)} \\ \ln(0.9831) &= \ln(e^{-R(5/12)}) \\ -0.0170 &= -R(5/12) \\ R_f &= .0408 \text{ or } 4.08\% \end{aligned}$$

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8. Using the Black-Scholes option pricing model to find the price of the call option, we find:

$$d_1 = [\ln(\$69/\$65) + (.06 + .54^2/2) \times (3/12)] / (.54 \times \sqrt{3/12}) = .4117$$

$$d_2 = .4117 - (.54 \times \sqrt{3/12}) = .1417$$

$$N(d_1) = .6597$$

$$N(d_2) = .5564$$

Putting these values into the Black-Scholes model, we find the call price is:

$$C = \$69(.6597) - (\$65e^{-.06(.25)})(.5564) = \$9.90$$

Using put-call parity, the put price is:

$$\text{Put} = \$65e^{-.06(.25)} + 9.90 - 69 = \$4.93$$

9. Using the Black-Scholes option pricing model to find the price of the call option, we find:

$$d_1 = [\ln(\$86/\$90) + (.055 + .62^2/2) \times (8/12)] / (.62 \times \sqrt{8/12}) = .2357$$

$$d_2 = .2357 - (.62 \times \sqrt{8/12}) = -.2705$$

$$N(d_1) = .5932$$

$$N(d_2) = .3934$$

Putting these values into the Black-Scholes model, we find the call price is:

$$C = \$86(.5932) - (\$90e^{-.055(8/12)})(.3934) = \$16.88$$

Using put-call parity, the put price is:

$$\text{Put} = \$90e^{-.055(8/12)} + 16.88 - 86 = \$17.64$$

10. The delta of a call option is  $N(d_1)$ , so:

$$d_1 = [\ln(\$94/\$85) + (.05 + .56^2/2) \times .75] / (.56 \times \sqrt{.75}) = .5273$$

$$N(d_1) = .7010$$

For a call option the delta is .7010. For a put option, the delta is:

$$\text{Put delta} = .7010 - 1 = -.2990$$

The delta tells us the change in the price of an option for a \$1 change in the price of the underlying asset.

11. Using the Black-Scholes option pricing model, with a 'stock' price is \$1,700,000 and an exercise price is \$1,825,000, the price you should receive is:

$$d_1 = [\ln(\$1,700,000/\$1,825,000) + (.05 + .20^2/2) \times (12/12)] / (.20 \times \sqrt{12/12}) = -.0048$$

$$d_2 = -.0048 - (.20 \times \sqrt{12/12}) = -.2048$$

$$N(d_1) = .4981$$

$$N(d_2) = .4189$$

Putting these values into the Black-Scholes model, we find the call price is:

$$C = \$1,700,000(.4981) - (\$1,825,000e^{-.05(1)})(.4189) = \$119,599.04$$

12. Using the call price we found in the previous problem and put-call parity, you would need to pay:

$$\text{Put} = \$1,825,000e^{-.05(1)} + 119,599.04 - 1,700,000 = \$155,592.74$$

You would have to pay \$155,592.74 in order to guarantee the right to sell the land for \$1,825,000.

13. Using the Black-Scholes option pricing model to find the price of the call option, we find:

$$d_1 = [\ln(\$76/\$70) + (.06 + .53^2/2) \times (6/12)] / (.53 \times \sqrt{6/12}) = .4869$$

$$d_2 = .4869 - (.53 \times \sqrt{6/12}) = .1121$$

$$N(d_1) = .6868$$

$$N(d_2) = .5446$$

Putting these values into the Black-Scholes model, we find the call price is:

$$C = \$76(.6868) - (\$70e^{-.06(.50)})(.5446) = \$15.20$$

Using put-call parity, we find the put price is:

$$\text{Put} = \$70e^{-.06(.50)} + 15.20 - 76 = \$7.13$$

a. The intrinsic value of each option is:

$$\text{Call intrinsic value} = \text{Max}[S - E, 0] = \$6$$

$$\text{Put intrinsic value} = \text{Max}[E - S, 0] = \$0$$

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b. Option value consists of time value and intrinsic value, so:

Call option value = Intrinsic value + Time value

$$\$15.20 = \$6 + TV$$

$$TV = \$9.20$$

Put option value = Intrinsic value + Time value

$$\$7.13 = \$0 + TV$$

$$TV = \$7.13$$

c. The time premium (theta) is more important for a call option than a put option, therefore, the time premium is, in general, larger for a call option.

14. Using put-call parity, the price of the put option is:

$$\$27.05 + P = \$25e^{-0.05(1/3)} + \$3.81$$

$$P = \$1.35$$

### Intermediate

15. If the exercise price is equal to zero, the call price will equal the stock price, which is \$85.

16. If the standard deviation is zero,  $d_1$  and  $d_2$  go to  $+\infty$ , so  $N(d_1)$  and  $N(d_2)$  go to 1. This is the no risk call option formula we discussed in an earlier chapter, so:

$$C = S - Ee^{-rt}$$

$$C = \$83 - \$80e^{-0.05(6/12)} = \$4.98$$

17. If the standard deviation is infinite,  $d_1$  goes to positive infinity so  $N(d_1)$  goes to 1, and  $d_2$  goes to negative infinity so  $N(d_2)$  goes to 0. In this case, the call price is equal to the stock price, which is \$42.

18. We can use the Black-Scholes model to value the equity of a firm. Using the asset value of \$12,500 as the stock price, and the face value of debt of \$10,000 as the exercise price, the value of the firm's equity is:

$$d_1 = [\ln(\$10,500/\$10,000) + (.06 + .27^2/2) \times 1] / (.27 \times \sqrt{1}) = .5379$$

$$d_2 = .5379 - (.27 \times \sqrt{1}) = .2679$$

$$N(d_1) = .7047$$

$$N(d_2) = .6056$$

Putting these values into the Black-Scholes model, we find the equity value is:

$$\text{Equity} = \$10,500(.7047) - (\$10,000e^{-0.06(1)})(.6056) = \$1,695.67$$

The value of the debt is the firm value minus the value of the equity, so:

$$D = \$10,500 - 1,695.67 = \$8,804.33$$

19. a. We can use the Black-Scholes model to value the equity of a firm. Using the asset value of \$11,400 as the stock price, and the face value of debt of \$10,000 as the exercise price, the value of the firm if it accepts project A is:

$$d_1 = [\ln(\$11,400/\$10,000) + (.06 + .46^2/2) \times 1] / (.46 \times \sqrt{1}) = .6453$$

$$d_2 = .6453 - (.46 \times \sqrt{1}) = .1853$$

$$N(d_1) = .7406$$

$$N(d_2) = .5735$$

Putting these values into the Black-Scholes model, we find the equity value is:

$$E_A = \$11,400(.7406) - (\$10,000e^{-.06(1)})(.5735) = \$3,042.17$$

The value of the debt is the firm value minus the value of the equity, so:

$$D_A = \$11,400 - 3,042.17 = \$8,357.83$$

And the value of the firm if it accepts Project B is:

$$d_1 = [\ln(\$11,800/\$10,000) + (.06 + .24^2/2) \times 1] / (.24 \times \sqrt{1}) = 1.0596$$

$$d_2 = 1.0596 - (.24 \times \sqrt{1}) = .8196$$

$$N(d_1) = .8553$$

$$N(d_2) = .7938$$

Putting these values into the Black-Scholes model, we find the equity value is:

$$E_B = \$11,800(.8553) - (\$10,000e^{-.06(1)})(.7938) = \$2,617.45$$

The value of the debt is the firm value minus the value of the equity, so:

$$D_B = \$11,800 - 2,617.45 = \$9,182.55$$

- b. Although the NPV of project B is higher, the equity value with project A is higher. While NPV represents the increase in the value of the assets of the firm, in this case, the increase in the value of the firm's assets resulting from project B is mostly allocated to the debtholders, resulting in a smaller increase in the value of the equity. Stockholders would, therefore, prefer project A even though it has a lower NPV.

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- c. Yes. If the same group of investors have equal stakes in the firm as bondholders and stockholders, then total firm value matters and project B should be chosen, since it increases the value of the firm to \$11,800 instead of \$11,400.
- d. Stockholders may have an incentive to take on more risky, less profitable projects if the firm is leveraged; the higher the firm's debt load, all else the same, the greater is this incentive.

20. We can use the Black-Scholes model to value the equity of a firm. Using the asset value of \$22,000 as the stock price, and the face value of debt of \$20,000 as the exercise price, the value of the firm's equity is:

$$d_1 = [\ln(\$22,000/\$20,000) + (.05 + .43^2/2) \times 1] / (.43 \times \sqrt{1}) = .5529$$

$$d_2 = .5529 - (.43 \times \sqrt{1}) = .1229$$

$$N(d_1) = .7098$$

$$N(d_2) = .5489$$

Putting these values into the Black-Scholes model, we find the equity value is:

$$\text{Equity} = \$22,000(.7098) - (\$20,000e^{-.05(1)})(.5489) = \$5,173.62$$

The value of the debt is the firm value minus the value of the equity, so:

$$D = \$22,000 - 5,173.62 = \$16,826.38$$

The return on the company's debt is:

$$\$16,826.38 = \$20,000e^{-R(1)}$$

$$.8413 = e^{-R}$$

$$R_D = -\ln(.8413) = .1728 \text{ or } 17.28\%$$

21. a. The combined value of equity and debt of the two firms is:

$$\text{Equity} = \$1,695.67 + 5,173.62 = \$6,869.29$$

$$\text{Debt} = \$8,804.33 + 16,826.38 = \$25,630.71$$

- b. For the new firm, the combined market value of assets is \$32,500, and the combined face value of debt is \$30,000. Using Black-Scholes to find the value of equity for the new firm, we find:

$$d_1 = [\ln(\$32,500/\$30,000) + (.05 + .19^2/2) \times 1] / (.19 \times \sqrt{1}) = .7794$$

$$d_2 = .7794 - (.19 \times \sqrt{1}) = .5894$$

$$N(d_1) = .7821$$

$$N(d_2) = .7222$$

Putting these values into the Black-Scholes model, we find the equity value is:

$$E = \$32,500(.7821) - (\$30,000e^{-.05(1)})(.7222) = \$4,809.72$$

The value of the debt is the firm value minus the value of the equity, so:

$$D = \$32,500 - 4,809.72 = \$27,690.28$$

c. The change in the value of the firm's equity is:

$$\text{Equity value change} = \$4,809.72 - 6,869.29 = -\$2,059.57$$

The change in the value of the firm's debt is:

$$\text{Debt} = \$27,690.28 - 25,630.71 = \$2,059.57$$

d. In a purely financial merger, when the standard deviation of the assets declines, the value of the equity declines as well. The shareholders will lose exactly the amount the bondholders gain. The bondholders gain as a result of the coinsurance effect. That is, it is less likely that the new company will default on the debt.

22. a. Using Black-Scholes model to value the equity, we get:

$$d_1 = [\ln(\$22,000,000/\$30,000,000) + (.06 + .33^2/2) \times 10] / (.33 \times \sqrt{10}) = .7995$$

$$d_2 = .7995 - (.33 \times \sqrt{10}) = -.2440$$

$$N(d_1) = .7880$$

$$N(d_2) = .4036$$

Putting these values into Black-Scholes:

$$E = \$22,000,000(.7880) - (\$30,000,000e^{-.06(10)})(.4036) = \$10,691,058.14$$

b. The value of the debt is the firm value minus the value of the equity, so:

$$D = \$22,000,000 - 10,691,058.14 = \$11,308,941.86$$

c. Using the equation for the PV of a continuously compounded lump sum, we get:

$$\begin{aligned} \$11,308,941.86 &= \$30,000,000e^{-R(10)} \\ .37696 &= e^{-R(10)} \end{aligned}$$

$$R_D = -(1/10)\ln(.37696) = .0976 \text{ or } 9.76\%$$

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d. Using Black-Scholes model to value the equity, we get:

$$d_1 = [\ln(\$22,750,000/\$30,000,000) + (.06 + .33^2/2) \times 10] / (.33 \times \sqrt{10}) = .8316$$

$$d_2 = .8316 - (.33 \times \sqrt{10}) = -.2119$$

$$N(d_1) = .7972$$

$$N(d_2) = .4161$$

Putting these values into Black-Scholes:

$$E = \$22,750,000(.7972) - (\$30,000,000e^{-.06(10)})(.4161) = \$11,285,543.58$$

e. The value of the debt is the firm value minus the value of the equity, so:

$$D = \$22,750,000 - 11,285,543.58 = \$11,464,456.42$$

Using the equation for the PV of a continuously compounded lump sum, we get:

$$\$11,464,456.42 = \$30,000,000e^{-R(10)}$$

$$.38215 = e^{-R10}$$

$$R_D = -(1/10)\ln(.38215) = .0962 \text{ or } 9.62\%$$

When the firm accepts the new project, part of the NPV accrues to bondholders. This increases the present value of the bond, thus reducing the return on the bond. Additionally, the new project makes the firm safer in the sense it increases the value of assets, thus increasing the probability the call will end in-the-money and the bondholders will receive their payment.

Challenge

23. a. Using the equation for the PV of a continuously compounded lump sum, we get:

$$PV = \$30,000 \times e^{-.07(2)} = \$26,080.75$$

b. Using Black-Scholes model to value the equity, we get:

$$d_1 = [\ln(\$13,000/\$30,000) + (.07 + .60^2/2) \times 2] / (.60 \times \sqrt{2}) = -.3963$$

$$d_2 = -.3963 - (.60 \times \sqrt{2}) = -1.2448$$

$$N(d_1) = .3460$$

$$N(d_2) = .1066$$

Putting these values into Black-Scholes:

$$E = \$13,000(.3460) - (\$30,000e^{-.07(2)})(.1066) = \$1,717.10$$

And using put-call parity, the price of the put option is:

$$\text{Put} = \$30,000e^{-.07(10)} + 1,717.10 - 13,000 = \$14,797.85$$

- c. The value of a risky bond is the value of a risk-free bond minus the value of a put option on the firm's equity, so:

$$\text{Value of risky bond} = \$26,080.75 - 14,797.85 = \$11,282.90$$

Using the equation for the PV of a continuously compounded lump sum to find the return on debt, we get:

$$\begin{aligned} \$11,282.90 &= \$30,000e^{-R(2)} \\ .3761 &= e^{-R2} \\ R_D &= -(1/2)\ln(.3761) = .4890 \text{ or } 48.90\% \end{aligned}$$

- d. The value of the debt with five years to maturity at the risk-free rate is:

$$\text{PV} = \$30,000 \times e^{-.07(5)} = \$21,140.64$$

Using Black-Scholes model to value the equity, we get:

$$d_1 = [\ln(\$13,000/\$30,000) + (.07 + .60^2/2) \times 5] / (.60 \times \sqrt{5}) = .3084$$

$$d_2 = .3084 - (.60 \times \sqrt{5}) = -1.0332$$

$$N(d_1) = .6211$$

$$N(d_2) = .1507$$

Putting these values into Black-Scholes:

$$E = \$13,000(.6211) - (\$30,000e^{-.07(5)})(.1507) = \$4,887.58$$

And using put-call parity, the price of the put option is:

$$\text{Put} = \$30,000e^{-.07(5)} + \$4,887.58 - \$13,000 = \$13,028.23$$

The value of a risky bond is the value of a risk-free bond minus the value of a put option on the firm's equity, so:

$$\text{Value of risky bond} = \$21,140.64 - 13,028.23 = \$8,112.42$$

Using the equation for the PV of a continuously compounded lump sum to find the return on debt, we get:

$$\begin{aligned} \$8,112.42 &= \$30,000e^{-R(5)} \\ .2704 &= e^{-R5} \\ R_D &= -(1/5)\ln(.2704) = .2616 \text{ or } 26.16\% \end{aligned}$$

## B-376 SOLUTIONS

The value of the debt declines because of the time value of money, i.e., it will be longer until shareholders receive their payment. However, the required return on the debt declines. Under the current situation, it is not likely the company will have the assets to pay off bondholders. Under the new plan where the company operates for five more years, the probability of increasing the value of assets to meet or exceed the face value of debt is higher than if the company only operates for two more years.

24. a. Using the equation for the PV of a continuously compounded lump sum, we get:

$$PV = \$60,000 \times e^{-.07(5)} = \$42,281.29$$

- b. Using Black-Scholes model to value the equity, we get:

$$d_1 = [\ln(\$57,000/\$60,000) + (.07 + .44^2/2) \times 5] / (.44 \times \sqrt{5}) = .7955$$

$$d_2 = .7955 - (.44 \times \sqrt{5}) = -.1883$$

$$N(d_1) = .7868$$

$$N(d_2) = .4253$$

Putting these values into Black-Scholes:

$$E = \$57,000(.7868) - (\$60,000e^{-.07(5)})(.4253) = \$26,867.85$$

And using put-call parity, the price of the put option is:

$$\text{Put} = \$60,000e^{-.07(5)} + 26,867.85 - 57,000 = \$12,149.14$$

- c. The value of a risky bond is the value of a risk-free bond minus the value of a put option on the firm's equity, so:

$$\text{Value of risky bond} = \$42,281.29 - 12,149.14 = \$30,132.15$$

Using the equation for the PV of a continuously compounded lump sum to find the return on debt, we get:

$$\$30,132.15 = \$60,000e^{-R(5)}$$

$$.5022 = e^{-R(5)}$$

$$R_D = -(1/5)\ln(.5022) = .1378 \text{ or } 13.78\%$$

d. Using the equation for the PV of a continuously compounded lump sum, we get:

$$PV = \$60,000 \times e^{-.07(5)} = \$42,281.29$$

Using Black-Scholes model to value the equity, we get:

$$d_1 = [\ln(\$57,000/\$60,000) + (.07 + .55^2/2) \times 5] / (.55 \times \sqrt{5}) = .8578$$

$$d_2 = .8578 - (.55 \times \sqrt{5}) = -.3720$$

$$N(d_1) = .8045$$

$$N(d_2) = .3549$$

Putting these values into Black-Scholes:

$$E = \$57,000(.8045) - (\$60,000e^{-.07(5)})(.3549) = \$30,849.41$$

And using put-call parity, the price of the put option is:

$$\text{Put} = \$60,000e^{-.07(5)} + 30,849.41 - 57,000 = \$16,130.70$$

The value of a risky bond is the value of a risk-free bond minus the value of a put option on the firm's equity, so:

$$\text{Value of risky bond} = \$42,281.29 - 16,130.70 = \$26,150.59$$

Using the equation for the PV of a continuously compounded lump sum to find the return on debt, we get:

$$\$26,150.59 = \$60,000e^{-R(5)}$$

$$.4358 = e^{-R(5)}$$

$$R_D = -(1/5)\ln(.4358) = .1661 \text{ or } 16.61\%$$

The value of the debt declines. Since the standard deviation of the company's assets increases, the value of the put option on the face value of the bond increases, which decreases the bond's current value.

e. From c and d, bondholders lose:  $\$26,150.59 - 30,132.15 = -\$3,981.56$   
 From c and d, stockholders gain:  $\$30,849.41 - 26,867.85 = \$3,981.56$

This is an agency problem for bondholders. Management, acting to increase shareholder wealth in this manner, will reduce bondholder wealth by the exact amount that shareholder wealth is increased.

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25. a. Going back to the chapter on dividends, the price of the stock will decline by the amount of the dividend (less any tax effects). Therefore, we would expect the price of the stock to drop when a dividend is paid, reducing the upside potential of the call by the amount of the dividend. The price of a call option will decrease when the dividend yield increases.

b. Using the Black-Scholes model with dividends, we get:

$$d_1 = [\ln(\$117/\$110) + (.05 - .03 + .50^2/2) \times .5] / (.50 \times \sqrt{.5}) = .3796$$

$$d_2 = .3796 - (.50 \times \sqrt{.5}) = .0260$$

$$N(d_1) = .6479$$

$$N(d_2) = .5104$$

$$C = \$117e^{-(.02)(.5)}(.6479) - (\$110e^{-.02(.5)})(.5104) = \$19.92$$

26. a. Going back to the chapter on dividends, the price of the stock will decline by the amount of the dividend (less any tax effects). Therefore, we would expect the price of the stock to drop when a dividend is paid. The price of put option will increase when the dividend yield increases.

b. Using put-call parity to find the price of the put option, we get:

$$\$117e^{-.02(.5)} + P = \$110e^{-.05(.5)} + 19.92$$

$$P = \$11.94$$

27.  $N(d_1)$  is the probability that “z” is less than or equal to  $N(d_1)$ , so  $1 - N(d_1)$  is the probability that “z” is greater than  $N(d_1)$ . Because of the symmetry of the normal distribution, this is the same thing as the probability that “z” is less than  $N(-d_1)$ . So:

$$N(d_1) - 1 = N(-d_1).$$

28. From put-call parity:

$$P = E \times e^{-Rt} + C - S$$

Substituting the Black-Scholes call option formula for  $C$  and using the result in the previous question produces the put option formula:

$$P = E \times e^{-Rt} + C - S$$

$$P = E \times e^{-Rt} + S \times N(d_1) - E \times e^{-Rt} \times N(d_2) - S$$

$$P = S \times (N(d_1) - 1) + E \times e^{-Rt} \times (1 - N(d_2))$$

$$P = E \times e^{-Rt} \times N(-d_2) - S \times N(-d_1)$$

- 29.** Based on Black-Scholes, the call option is worth \$50! The reason is that present value of the exercise price is zero, so the second term disappears. Also,  $d_1$  is infinite, so  $N(d_1)$  is equal to one. The problem is that the call option is European with an infinite expiration, so why would you pay anything for it since you can *never* exercise it? The paradox can be resolved by examining the price of the stock. Remember that the call option formula only applies to a non-dividend paying stock. If the stock will never pay a dividend, it (and a call option to buy it at any price) must be worthless.
- 30.** The delta of the call option is  $N(d_1)$  and the delta of the put option is  $N(d_1) - 1$ . Since you are selling a put option, the delta of the portfolio is  $N(d_1) - [N(d_1) - 1]$ . This leaves the overall delta of your position as 1. This position will change dollar for dollar in value with the underlying asset. This position replicates the dollar “action” on the underlying asset.

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# CHAPTER 25

## MERGERS AND ACQUISITIONS

### Answers to Concepts Review and Critical Thinking Questions

1. In the purchase method, assets are recorded at market value, and goodwill is created to account for the excess of the purchase price over this recorded value. In the pooling of interests method, the balance sheets of the two firms are simply combined; no goodwill is created. The choice of accounting method has no direct impact on the cash flows of the firms. EPS will probably be lower under the purchase method because reported income is usually lower due to the required amortization of the goodwill created in the purchase.
2.
  - a. Greenmail refers to the practice of paying unwanted suitors who hold an equity stake in the firm a premium over the market value of their shares, to eliminate the potential takeover threat.
  - b. A white knight refers to an outside bidder that a target firm brings in to acquire it, rescuing the firm from a takeover by some other unwanted hostile bidder.
  - c. A golden parachute refers to lucrative compensation and termination packages granted to management in the event the firm is acquired.
  - d. The crown jewels usually refer to the most valuable or prestigious assets of the firm, which in the event of a hostile takeover attempt, the target sometimes threatens to sell.
  - e. Shark repellent generally refers to any defensive tactic employed by the firm to resist hostile takeover attempts.
  - f. A corporate raider usually refers to a person or firm that specializes in the hostile takeover of other firms.
  - g. A poison pill is an amendment to the corporate charter granting the shareholders the right to purchase shares at little or no cost in the event of a hostile takeover, thus making the acquisition prohibitively expensive for the hostile bidder.
  - h. A tender offer is the legal mechanism required by the SEC when a bidding firm goes directly to the shareholders of the target firm in an effort to purchase their shares.
  - i. A leveraged buyout refers to the purchase of the shares of a publicly-held company and its subsequent conversion into a privately-held company, financed primarily with debt.
3. Diversification doesn't create value in and of itself because diversification reduces unsystematic, not systematic, risk. As discussed in the chapter on options, there is a more subtle issue as well. Reducing unsystematic risk benefits bondholders by making default less likely. However, if a merger is done purely to diversify (i.e., no operating synergy), then the NPV of the merger is zero. If the NPV is zero, and the bondholders are better off, then stockholders must be worse off.
4. A firm might choose to split up because the newer, smaller firms may be better able to focus on their particular markets. Thus, reverse synergy is a possibility. An added advantage is that performance evaluation becomes much easier once the split is made because the new firm's financial results (and stock prices) are no longer commingled.
5. It depends on how they are used. If they are used to protect management, then they are not good for stockholders. If they are used by management to negotiate the best possible terms of a merger, then they are good for stockholders.

6. One of the primary advantages of a taxable merger is the write-up in the basis of the target firm's assets, while one of the primary disadvantages is the capital gains tax that is payable. The situation is the reverse for a tax-free merger.

The basic determinant of tax status is whether or not the old stockholders will continue to participate in the new company, which is usually determined by whether they get any shares in the bidding firm. An LBO is usually taxable because the acquiring group pays off the current stockholders in full, usually in cash.

7. Economies of scale occur when average cost declines as output levels increase. A merger in this particular case might make sense because Eastern and Western may need less total capital investment to handle the peak power needs, thereby reducing average generation costs.
8. Among the defensive tactics often employed by management are seeking white knights, threatening to sell the crown jewels, appealing to regulatory agencies and the courts (if possible), and targeted share repurchases. Frequently, antitakeover charter amendments are available as well, such as poison pills, poison puts, golden parachutes, lockup agreements, and supermajority amendments, but these require shareholder approval, so they can't be immediately used if time is short. While target firm shareholders may benefit from management actively fighting acquisition bids, in that it encourages higher bidding and may solicit bids from other parties as well, there is also the danger that such defensive tactics will discourage potential bidders from seeking the firm in the first place, which harms the shareholders.
9. In a cash offer, it almost surely does not make sense. In a stock offer, management may feel that one suitor is a better long-run investment than the other, but this is only valid if the market is not efficient. In general, the highest offer is the best one.
10. Various reasons include: (1) Anticipated gains may be smaller than thought; (2) Bidding firms are typically much larger, so any gains are spread thinly across shares; (3) Management may not be acting in the shareholders' best interest with many acquisitions; (4) Competition in the market for takeovers may force prices for target firms up to the zero NPV level; and (5) Market participants may have already discounted the gains from the merger before it is announced.

### **Solutions to Questions and Problems**

*NOTE: All end of chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.*

#### Basic

1. For the merger to make economic sense, the acquirer must feel the acquisition will increase value by at least the amount of the premium over the market value, so:

$$\text{Minimum economic value} = \$690,000,000 - 625,000,000 = \$65,000,000$$

B-382 SOLUTIONS

2. a) Since neither company has any debt, using the pooling method, the asset value of the combined must equal the value of the equity, so:

$$\text{Assets} = \text{Equity} = 25,000(\$20) + 15,000(\$7) = \$605,000$$

- b) With the purchase method, the assets of the combined firm will be the book value of Firm X, the acquiring company, plus the market value of Firm Y, the target company, so:

$$\text{Assets from X} = 25,000(\$20) = \$500,000 \text{ (book value)}$$

$$\text{Assets from Y} = 15,000(\$18) = \$270,000 \text{ (market value)}$$

The purchase price of Firm Y is the number of shares outstanding times the sum of the current stock price per share plus the premium per share, so:

$$\text{Purchase price of Y} = 15,000(\$18 + 5) = \$345,000$$

The goodwill created will be:

$$\text{Goodwill} = \$345,000 - 270,000 = \$75,000$$

And the total asset of the combined company will be:

$$\text{Total assets XY} = \text{Total equity XY} = \$500,000 + 270,000 + 75,000 = \$845,000$$

3. In the pooling method, all accounts of both companies are added together to total the accounts in the new company, so the post-merger balance sheet will be:

<i>Meat Co., post-merger</i>			
Current assets	\$11,400	Current liabilities	\$ 4,600
Fixed assets	29,100	Long-term debt	5,400
		Equity	<u>30,500</u>
Total	<u>\$40,500</u>		<u>\$40,500</u>

4. Since the acquisition is funded by long-term debt, the post-merger balance sheet will have long-term debt equal to the original long-term debt of Meat's balance sheet, plus the original long-term debt on Loaf's balance sheet, plus the new long-term debt issue, so:

$$\text{Post-merger long-term debt} = \$3,600 + 1,800 + 18,000 = \$23,400$$

Goodwill will be created since the acquisition price is greater than the book value. The goodwill amount is equal to the purchase price minus the market value of assets, plus the market value of the acquired company's debt. Generally, the market value of current assets is equal to the book value, so:

$$\begin{aligned} \text{Goodwill} &= \$18,000 - (\$13,000 \text{ market value FA}) - (\$3,400 \text{ market value CA}) + (\$1,200 + 1,800) \\ \text{Goodwill} &= \$4,600 \end{aligned}$$

Equity will remain the same as the pre-merger balance sheet of the acquiring firm. Current assets and debt accounts will be the sum of the two firm's pre-merger balance sheet accounts, and the fixed assets will be the sum of the pre-merger fixed assets of the acquirer and the market value of fixed assets of the target firm. The post-merger balance sheet will be:

<i>Meat Co., post-merger</i>			
Current assets	\$11,400	Current liabilities	\$ 4,600
Fixed assets	36,000	Long-term debt	23,400
Goodwill	<u>4,600</u>	Equity	<u>24,000</u>
Total	\$52,000		\$52,000

5. In the pooling method, all accounts of both companies are added together to total the accounts in the new company, so the post-merger balance sheet will be:

<i>Silver Enterprises, post-merger</i>			
Current assets	\$ 3,700	Current liabilities	\$ 2,900
Other assets	1,150	Long-term debt	2,900
Net fixed assets	<u>12,700</u>	Equity	<u>11,7950</u>
Total	\$17,550		\$17,550

6. Since the acquisition is funded by long-term debt, the post-merger balance sheet will have long-term debt equal to the original long-term debt of Silver's balance sheet plus the new long-term debt issue, so:

$$\text{Post-merger long-term debt} = \$2,900 + 8,700 = \$11,600$$

Equity will remain the same as the pre-merger balance sheet of the acquiring firm. Current assets, current liabilities, long-term debt, and other assets will be the sum of the two firm's pre-merger balance sheet accounts, and the fixed assets will be the sum of the pre-merger fixed assets of the acquirer and the market value of fixed assets of the target firm. Note, in this case, the market value and the book value of fixed assets are the same. We can calculate the goodwill as the plug variable which makes the balance sheet balance. The post-merger balance sheet will be:

<i>Silver Enterprises, post-merger</i>			
Current assets	\$ 3,700	Current liabilities	\$ 2,900
Other assets	1,150	Long-term debt	11,600
Net fixed assets	14,900	Equity	7,300
Goodwill	<u>2,050</u>		
Total	\$21,800		<u>\$21,800</u>

## B-384 SOLUTIONS

7. a. The cash cost is the amount of cash offered, so the cash cost is \$95 million.

To calculate the cost of the stock offer, we first need to calculate the value of the target to the acquirer. The value of the target firm to the acquiring firm will be the market value of the target plus the PV of the incremental cash flows generated by the target firm. The cash flows are a perpetuity, so

$$V^* = \$76,000,000 + \$3,100,000/.10 = \$107,000,000$$

The cost of the stock offer is the percentage of the acquiring firm given up times the sum of the market value of the acquiring firm and the value of the target firm to the acquiring firm. So, the equity cost will be:

$$\text{Equity cost} = .40(\$130,000,000 + 107,000,000) = \$94,800,000$$

- b. The NPV of each offer is the value of the target firm to the acquiring firm minus the cost of acquisition, so:

$$\text{NPV cash} = \$107,000,000 - 95,000,000 = \$12,000,000$$

$$\text{NPV stock} = \$107,000,000 - 94,800,000 = \$12,200,000$$

- c. Since the NPV is greater with the stock offer the acquisition should be in stock.

8. a. The EPS of the combined company will be the sum of the earnings of both companies divided by the shares in the combined company. Since the stock offer is one share of the acquiring firm for three shares of the target firm, new shares in the acquiring firm will increase by one-third. So, the new EPS will be:

$$\text{EPS} = (\$225,000 + 675,000)/[180,000 + (1/3)(75,000)] = \$4.39$$

The market price of Pitt will remain unchanged if it is a zero NPV acquisition. Using the PE ratio, we find the current market price of Pitt stock, which is:

$$P = 21(\$675,000)/180,000 = \$78.75$$

If the acquisition has a zero NPV, the stock price should remain unchanged. Therefore, the new PE will be:

$$P/E = \$78.75/\$4.39 = 17.94$$

- b. The value of Jolie to Pitt must be the market value of the company since the NPV of the acquisition is zero. Therefore, the value is:

$$V^* = \$225,000(8.75) = \$1,968,750$$

The cost of the acquisition is the number of shares offered times the share price, so the cost is:

$$\text{Cost} = (1/3)(75,000)(\$78.75) = \$1,968,750$$

So, the NPV of the acquisition is:

$$\text{NPV} = 0 = V^* + \Delta V - \text{Cost} = \$1,968,750 + \Delta V - 1,968,750$$

$$\Delta V = \$0$$

Although there is no economic value to the takeover, it is possible that Pitt is motivated to purchase Jolie for other than financial reasons.

9. a. The NPV of the merger is the market value of the target firm, plus the value of the synergy, minus the acquisition costs, so:

$$\text{NPV} = 1,000(\$19) + \$4,000 - 1,000(\$21.50) = \$1,500$$

- b. Since the NPV goes directly to stockholders, the share price of the merged firm will be the market value of the acquiring firm plus the NPV of the acquisition, divided by the number of shares outstanding, so:

$$\text{Share price} = [2,100(\$37) + \$1,500]/2,100 = \$37.71$$

- c. The merger premium is the premium per share times the number of shares of the target firm outstanding, so the merger premium is:

$$\text{Merger premium} = 1,000(\$21.50 - 19) = \$2,500$$

- d. The number of new shares will be the number of shares of the target times the exchange ratio, so:

$$\text{New shares created} = 1,000(1/2) = 500 \text{ new shares}$$

The value of the merged firm will be the market value of the acquirer plus the market value of the target plus the synergy benefits, so:

$$V_{BT} = 2,100(\$37) + 1,000(\$19) + 4,000 = \$100,700$$

The price per share of the merged firm will be the value of the merged firm divided by the total shares of the new firm, which is:

$$P = \$100,700/(2,100 + 500) = \$38.73$$

- e. The NPV of the acquisition using a share exchange is the market value of the target firm plus synergy benefits, minus the cost. The cost is the value per share of the merged firm times the number of shares offered to the target firm shareholders, so:

$$\text{NPV} = 1,000(\$19) + \$4,000 - 500(\$38.73) = \$3,634.62$$

## B-386 SOLUTIONS

### Intermediate

10. The cash offer is better for the target firm shareholders since they receive \$21.50 per share. In the share offer, the target firm's shareholders will receive:

$$\text{Equity offer value} = (1/2)(\$19) = \$9.50 \text{ per share}$$

From Problem 9, we know the value of the merged firm's assets will be \$107,000. The number of shares in the new firm will be:

$$\text{Shares in new firm} = 2,100 + 1,000x$$

that is, the number of shares outstanding in the bidding firm, plus the number of shares outstanding in the target firm, times the exchange ratio. This means the post merger share price will be:

$$P = \$100,700 / (2,100 + 1,000x)$$

To make the target firm's shareholders indifferent, they must receive the same wealth, so:

$$1,000(x)P = 1,000(\$21.50)$$

This equation shows that the new offer is the shares outstanding in the target company times the exchange ratio times the new stock price. The value under the cash offer is the shares outstanding times the cash offer price. Solving this equation for P, we find:

$$P = \$21.50 / x$$

Combining the two equations, we find:

$$\begin{aligned} \$100,700 / (2,100 + 1,000x) &= \$21.50 / x \\ x &= .5701 \end{aligned}$$

There is a simpler solution that requires an economic understanding of the merger terms. If the target firm's shareholders are indifferent, the bidding firm's shareholders are indifferent as well. That is, the offer is a zero sum game. Using the new stock price produced by the cash deal, we find:

$$\text{Exchange ratio} = \$21.50 / \$37.71 = .5701$$

11. The cost of the acquisition is:

$$\text{Cost} = 200(\$10) = \$2,000$$

Since the stock price of the acquiring firm is \$32, the firm will have to give up:

$$\text{Shares offered} = \$2,000 / \$32 = 62.50 \text{ shares}$$

- a. The EPS of the merged firm will be the combined EPS of the existing firms divided by the new shares outstanding, so:

$$\text{EPS} = (\$2,700 + 800) / (500 + 62.50) = \$6.22$$

- b. The PE of the acquiring firm is:

$$\text{Original P/E} = \$32/(\$2,700/500) = 5.93 \text{ times}$$

Assuming the PE ratio does not change, the new stock price will be:

$$\text{New P} = \$6.22(5.93) = \$36.87$$

- c. If the market correctly analyzes the earnings, the stock price will remain unchanged since this is a zero NPV acquisition, so:

$$\text{New P/E} = \$32/\$6.22 = 5.14 \text{ times}$$

- d. The new share price will be the combined market value of the two existing companies divided by the number of shares outstanding in the merged company. So:

$$P = [(500)(\$32) + 200(\$7)]/(500 + 62.50) = \$30.93$$

And the PE ratio of the merged company will be:

$$P/E = \$30.93/\$6.22 = 4.97 \text{ times}$$

At the proposed bid price, this is a negative NPV acquisition for A since the share price declines. They should revise their bid downward until the NPV is zero.

12. Beginning with the fact that the NPV of a merger is the value of the target minus the cost, we get:

$$\text{NPV} = V_B^* - \text{Cost}$$

$$\text{NPV} = \Delta V + V_B - \text{Cost}$$

$$\text{NPV} = \Delta V - (\text{Cost} - V_B)$$

$$\text{NPV} = \Delta V - \text{Merger premium}$$

13. a. The synergy will be the present value of the incremental cash flows of the proposed purchase. Since the cash flows are perpetual, the synergy value is:

$$\text{Synergy value} = \$600,000 / .08$$

$$\text{Synergy value} = \$7,500,000$$

- b. The value of Flash-in-the-Pan to Fly-by-Night is the synergy plus the current market value of Flash-in-the-Pan, which is:

$$\text{Value} = \$7,500,000 + 20,000,000$$

$$\text{Value} = \$27,500,000$$

- c. The value of the cash option is the amount of cash paid, or \$25 million. The value of the stock acquisition is the percentage of ownership in the merged company, times the value of the merged company, so:

$$\text{Stock acquisition value} = .25(\$27,500,000 + 35,000,000)$$

$$\text{Stock acquisition value} = \$15,625,000$$

## B-388 SOLUTIONS

d. The NPV is the value of the acquisition minus the cost, so the NPV of each alternative is:

$$\text{NPV of cash offer} = \$27,500,000 - 25,000,000$$

$$\text{NPV of cash offer} = \$2,500,000$$

$$\text{NPV of stock offer} = \$27,500,000 - 15,625,000$$

$$\text{NPV of stock offer} = \$11,875,000$$

e. The acquirer should make the stock offer since its NPV is greater.

14. a. The number of shares after the acquisition will be the current number of shares outstanding for the acquiring firm, plus the number of new shares created for the acquisition, which is:

$$\text{Number of shares after acquisition} = 30,000,000 + 15,000,000$$

$$\text{Number of shares after acquisition} = 45,000,000$$

And the share price will be the value of the combined company divided by the shares outstanding, which will be:

$$\text{New stock price} = \$1,000,000,000 / 45,000,000$$

$$\text{New stock price} = \$22.22$$

b. Let  $\alpha$  equal the fraction of ownership for the target shareholders in the new firm. We can set the percentage of ownership in the new firm equal to the value of the cash offer, so:

$$\alpha(\$1,000,000,000) = \$300,000,000$$

$$\alpha = .30 \text{ or } 30\%$$

So, the shareholders of the target firm would be equally as well off if they received 30 percent of the stock in the new company as if they received the cash offer. The ownership percentage of the target firm shareholders in the new firm can be expressed as:

$$\text{Ownership} = \text{New shares issued} / (\text{New shares issued} + \text{Current shares of acquiring firm})$$

$$.30 = \text{New shares issued} / (\text{New shares issued} + 30,000,000)$$

$$\text{New shares issued} = 12,857,143$$

To find the exchange ratio, we divide the new shares issued to the shareholders of the target firm by the existing number of shares in the target firm, so:

$$\text{Exchange ratio} = \text{New shares} / \text{Existing shares in target firm}$$

$$\text{Exchange ratio} = 12,857,143 / 20,000,000$$

$$\text{Exchange ratio} = .6429$$

An exchange ratio of .6429 shares of the merged company for each share of the target company owned would make the value of the stock offer equivalent to the value of the cash offer.

Challenge

15. a. To find the value of the target to the acquirer, we need to find the share price with the new growth rate. We begin by finding the required return for shareholders of the target firm. The earnings per share of the target are:

$$\text{EPS}_p = \$620,000/500,000 = \$1.24 \text{ per share}$$

The price per share is:

$$P_p = 9(\$1.24) = \$11.16$$

And the dividends per share are:

$$\text{DPS}_p = \$310,000/500,000 = \$0.62$$

The current required return for Pulitzer shareholders, which incorporates the risk of the company is:

$$R_E = [\$0.62(1.05)/\$11.16] + .05 = .1083$$

The price per share of Pulitzer with the new growth rate is:

$$P_p = \$0.62(1.07)/(.1083 - .07) = \$17.31$$

The value of the target firm to the acquiring firm is the number of shares outstanding times the price per share under the new growth rate assumptions, so:

$$V_T^* = 500,000(\$17.31) = \$8,653,043.48$$

- b. The gain to the acquiring firm will be the value of the target firm to the acquiring firm minus the market value of the target, so:

$$\text{Gain} = \$8,653,043.48 - 500,000(\$11.16) = \$3,073,043.48$$

- c. The NPV of the acquisition is the value of the target firm to the acquiring firm minus the cost of the acquisition, so:

$$\text{NPV} = \$8,653,043.48 - 500,000(\$18) = -\$346,956.52$$

- d. The most the acquiring firm should be willing to pay per share is the offer price per share plus the NPV per share, so:

$$\text{Maximum bid price} = \$18 + (-\$346,956.52/500,000) = \$17.31$$

Notice, this is the same value we calculated earlier in part *a* as the value of the target to the acquirer.

## B-390 SOLUTIONS

- e. The price of the stock in the merged firm would be the market value of the acquiring firm plus the value of the target to the acquirer, divided by the number of shares in the merged firm, so:

$$P_{FP} = (\$30,000,000 + 8,653,043.48)/(1,000,000 + 100,000) = \$35.14$$

The NPV of the stock offer is the value of the target to the acquirer minus the value offered to the target shareholders. The value offered to the target shareholders is the stock price of the merged firm times the number of shares offered, so:

$$NPV = \$8,653,043.48 - 100,000(\$35.14) = \$5,139,130.43$$

- f. Yes, the acquisition should go forward, and Foxy should offer the 100,000 shares since the NPV is higher.
- g. Using the new growth rate in the dividend growth model, along with the dividend and required return we calculated earlier, the price of the target under these assumptions is:

$$P_P = \$0.62(1.06)/(.1083 - .06) = \$13.60$$

And the value of the target firm to the acquiring firm is:

$$V_P^* = 500,000(\$13.60) = \$6,798,620.69$$

The gain to the acquiring firm will be:

$$\text{Gain} = \$6,798,620.89 - 500,000(\$11.16) = \$1,218,620.69$$

The NPV of the cash offer is now:

$$NPV \text{ cash} = \$6,798,620.89 - 500,000(\$18) = -\$2,201,379.31$$

And the new price per share of the merged firm will be:

$$P_{FP} = [\$30,000,000 + 6,798,620.89]/(1,000,000 + 100,000) = \$33.45$$

And the NPV of the stock offer under the new assumption will be:

$$NPV \text{ stock} = \$6,798,620.89 - 100,000(\$33.45) = \$3,453,291.54$$

Even with the lower projected growth rate, the stock offer still has a positive NPV. Foxy should purchase Pulitzer with a stock offer of 100,000 shares.

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# CHAPTER 26

## LEASING

### Answers to Concepts Review and Critical Thinking Questions

1. Some key differences are: (1) Lease payments are fully tax-deductible, but only the interest portion of the loan is; (2) The lessee does not own the asset and cannot depreciate it for tax purposes; (3) In the event of a default, the lessor cannot force bankruptcy; and (4) The lessee does not obtain title to the asset at the end of the lease (absent some additional arrangement).
2. The less profitable one because leasing provides, among other things, a mechanism for transferring tax benefits from entities that value them less to entities that value them more.
3. Potential problems include: (1) Care must be taken in interpreting the IRR (a high or low IRR is preferred depending on the setup of the analysis); and (2) Care must be taken to ensure the IRR under examination is *not* the implicit interest rate just based on the lease payments.
4.
  - a. Leasing is a form of secured borrowing. It reduces a firm's cost of capital only if it is cheaper than other forms of secured borrowing. The reduction of uncertainty is not particularly relevant; what matters is the NAL.
  - b. The statement is not always true. For example, a lease often requires an advance lease payment or security deposit and may be implicitly secured by other assets of the firm.
  - c. Leasing would probably not disappear, since it does reduce the uncertainty about salvage value and the transactions costs of transferring ownership. However, the use of leasing would be greatly reduced.
5. A lease must be disclosed on the balance sheet if one of the following criteria is met:
  1. The lease transfers ownership of the asset by the end of the lease. In this case, the firm essentially owns the asset and will have access to its residual value.
  2. The lessee can purchase the asset at a price below its fair market value (bargain purchase option) when the lease ends. The firm essentially owns the asset and will have access to most of its residual value.
  3. The lease term is for 75% or more of the estimated economic life of the asset. The firm basically has access to the majority of the benefits of the asset, without any responsibility for the consequences of its disposal.
  4. The present value of the lease payments is 90% or more of the fair market value of the asset at the start of the lease. The firm is essentially purchasing the asset on an installment basis.
6. The lease must meet the following IRS standards for the lease payments to be tax deductible:
  1. The lease term must be less than 80% of the economic life of the asset. If the term is longer, the lease is considered to be a conditional sale.
  2. The lease should not contain a bargain purchase option, which the IRS interprets as an equity interest in the asset.
  3. The lease payment schedule should not provide for very high payments early and very low payments late in the life of the lease. This would indicate that the lease is being used simply to avoid taxes.

## B-392 SOLUTIONS

4. Renewal options should be reasonable and based on the fair market value of the asset at renewal time. This indicates that the lease is for legitimate business purposes, not tax avoidance.
7. As the term implies, off-balance sheet financing involves financing arrangements that are not required to be reported on the firm's balance sheet. Such activities, if reported at all, appear only in the footnotes to the statements. Operating leases (those that do not meet the criteria in problem 2) provide off-balance sheet financing. For accounting purposes, total assets will be lower and some financial ratios may be artificially high. Financial analysts are generally not fooled by such practices. There are no economic consequences, since the cash flows of the firm are not affected by how the lease is treated for accounting purposes.
8. The lessee may not be able to take advantage of the depreciation tax shield and may not be able to obtain favorable lease arrangements for "passing on" the tax shield benefits. The lessee might also need the cash flow from the sale to meet immediate needs, but will be able to meet the lease obligation cash flows in the future.
9. Since the relevant cash flows are all aftertax, the aftertax discount rate is appropriate.
10. AirTran's financial position was such that the package of leasing and buying probably resulted in the overall best aftertax cost. In particular, AirTran may not have been in a position to use all of the tax credits and also may not have had the credit strength to borrow and buy the plane without facing a credit downgrade and/or substantially higher rates.
11. There is the tax motive, but, beyond this, GE Commercial Finance knows that, in the event of a default, AirTran would relinquish the planes, which would then be re-leased. Fungible assets, such as planes, which can be readily reclaimed and redeployed are good candidates for leasing.
12. They will be re-leased to AirTran or another air transportation firm, used by GE Commercial Finance, or they will simply be sold. There is an active market for used aircraft.

### Solutions to Questions and Problems

*NOTE: All end of chapter problems were solved using a spreadsheet. Many problems require multiple steps. Due to space and readability constraints, when these intermediate steps are included in this solutions manual, rounding may appear to have occurred. However, the final answer for each problem is found without rounding during any step in the problem.*

#### Basic

1. We will calculate cash flows from the depreciation tax shield first. The depreciation tax shield is:

$$\text{Depreciation tax shield} = (\$4,500,000/4)(.35) = \$393,750$$

The aftertax cost of the lease payments will be:

$$\text{Aftertax lease payment} = (\$1,275,000)(1 - .35) = \$871,000$$

So, the total cash flows from leasing are:

$$\text{OCF} = \$393,750 + 871,000 = \$1,264,750$$

The aftertax cost of debt is:

$$\text{Aftertax debt cost} = .08(1 - .35) = .052$$

Using all of this information, we can calculate the NAL as:

$$\text{NAL} = \$4,500,000 - \$1,264,750(\text{PVIFA}_{5,20\%,4}) = \$36,016.25$$

The NAL is positive so you should lease.

2. If we assume the lessor has the same cost of debt and the same tax rate, the NAL to the lessor is the negative of our company's NAL, so:

$$\text{NAL} = -\$36,016.25$$

3. To find the maximum lease payment that would satisfy both the lessor and the lessee, we need to find the payment that makes the NAL equal to zero. Using the NAL equation and solving for the OCF, we find:

$$\text{NAL} = 0 = \$4,500,000 - \text{OCF}(\text{PVIFA}_{5,20\%,4})$$

$$\text{OCF} = \$1,274,954.24$$

The OCF for this lease is composed of the depreciation tax shield cash flow, as well as the aftertax lease payment. Subtracting out the depreciation tax shield cash flow we calculated earlier, we find:

$$\text{Aftertax lease payment} = \$1,274,954.24 - 393,750 = \$881,204.24$$

Since this is the aftertax lease payment, we can now calculate the breakeven pretax lease payment as:

$$\text{Breakeven lease payment} = \$881,204.24 / (1 - .35) = \$1,355,698.83$$

4. If the tax rate is zero, there is no depreciation tax shield foregone. Also, the aftertax lease payment is the same as the pretax payment, and the aftertax cost of debt is the same as the pretax cost. So:

$$\text{Cost of debt} = .08$$

$$\text{Annual cost of leasing} = \text{leasing payment} = \$1,340,000$$

The NAL to leasing with these assumptions is:

$$\text{NAL} = \$4,500,000 - \$1,340,000(\text{PVIFA}_{8\%,4}) = \$61,750.03$$

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5. We already calculated the breakeven lease payment for the lessor in Problem 3. Since the assumption about the lessor concerning the tax rate have not changed. So, the lessor breaks even with a payment of \$1,355,698.83.

For the lessee, we need to calculate the breakeven lease payment which results in a zero NAL. Using the assumptions in Problem 4, we find:

$$\begin{aligned} \text{NAL} = 0 &= \$4,500,000 - \text{PMT}(\text{PVIFA}_{8\%,4}) \\ \text{PMT} &= \$1,358,643.62 \end{aligned}$$

So, the range of lease payments that would satisfy both the lessee and the lessor are:

$$\text{Total payment range} = \$1,355,698.83 \text{ to } \$1,358,643.62$$

6. The appropriate depreciation percentages for a 3-year MACRS class asset can be found in Chapter 10. The depreciation percentages are .3333, .4444, .1482, and 0.0741. The cash flows from leasing are:

$$\begin{aligned} \text{Year 1: } &(\$4,500,000)(.3333)(.35) + \$871,000 = \$1,395,948 \\ \text{Year 2: } &(\$4,500,000)(.4444)(.35) + \$871,000 = \$1,570,930 \\ \text{Year 3: } &(\$4,500,000)(.1482)(.35) + \$871,000 = \$1,104,415 \\ \text{Year 4: } &(\$4,500,000)(.0741)(.35) + \$871,000 = \$987,708 \end{aligned}$$

$$\begin{aligned} \text{NAL} &= \$4,500,000 - \$1,395,948/1.052 - \$1,570,930/1.052^2 - \$1,104,415/1.052^3 - \$987,708/1.052^4 \\ \text{NAL} &= -\$1,445.36 \end{aligned}$$

The machine should not be leased. This is because of the accelerated tax benefits due to depreciation, which represents a cost in the decision to lease compared to an advantage of the decision to purchase.

### Intermediate

7. The pretax cost savings are not relevant to the lease versus buy decision, since the firm will definitely use the equipment and realize the savings regardless of the financing choice made. The depreciation tax shield is:

$$\text{Depreciation tax shield lost} = (\$7,000,000/5)(.34) = \$476,000$$

And the aftertax lease payment is:

$$\text{Aftertax lease payment} = \$1,650,000(1 - .34) = \$1,089,000$$

The aftertax cost of debt is:

$$\text{Aftertax debt cost} = .09(1 - .34) = .0594 \text{ or } 5.94\%$$

With these cash flows, the NAL is:

$$\text{NAL} = \$7,000,000 - 1,089,000 - \$1,089,000(\text{PVIFA}_{5.94\%,4}) - \$476,000(\text{PVIFA}_{5.94\%,5}) = \$123,947.57$$

The equipment should be leased.

To find the maximum payment, we find where the NAL is equal to zero, and solve for the payment. Using X to represent the maximum payment:

$$\begin{aligned} \text{NAL} = 0 &= \$7,000,000 - X(1.0594)(\text{PVIFA}_{5.94\%,5}) - \$476,000(\text{PVIFA}_{5.94\%,5}) \\ X &= \$1,116,729.56 \end{aligned}$$

So the maximum pretax lease payment is:

$$\text{Pretax lease payment} = \$1,116,729.56 / (1 - .34) = \$1,692,014.48$$

8. The aftertax residual value of the asset is an opportunity cost to the leasing decision, occurring at the end of the project life (year 5). Also, the residual value is not really a debt-like cash flow, since there is uncertainty associated with it at year 0. Nevertheless, although a higher discount rate may be appropriate, we'll use the aftertax cost of debt to discount the residual value as is common in practice. Setting the NAL equal to zero:

$$\begin{aligned} \text{NAL} = 0 &= \$7,000,000 - X(1.0594)(\text{PVIFA}_{5.94\%,5}) - 476,000(\text{PVIFA}_{5.94\%,5}) - 500,000/1.0594^5 \\ X &= \$1,032,904.26 \end{aligned}$$

So, the maximum pretax lease payment is:

$$\text{Pretax lease payment} = \$1,032,904.26 / (1 - .34) = \$1,565,006.46$$

9. The security deposit is a cash outflow at the beginning of the lease and a cash inflow at the end of the lease when it is returned. The NAL with these assumptions is:

$$\begin{aligned} \text{NAL} &= \$7,000,000 - 200,000 - 1,089,000 - \$1,089,000(\text{PVIFA}_{5.94\%,4}) - \$476,000(\text{PVIFA}_{5.94\%,5}) \\ &\quad + \$200,000/1.0594^5 \\ \text{NAL} &= \$73,822.90 \end{aligned}$$

With the security deposit, the firm should still lease the equipment rather than buy it, because the NAL is greater than zero. We could also solve this problem another way. From Problem 7, we know that the NAL without the security deposit is \$123,947.57, so, if we find the present value of the security deposit, we can simply add this to \$123,947.57. The present value of the security deposit is:

$$\text{PV of security deposit} = -\$200,000 + \$200,000/1.0594^5 = -\$50,124.67$$

So, the NAL with the security deposit is:

$$\text{NAL} = \$123,947.57 - 50,124.67 = \$73,822.90$$

10. a. Since the both companies have the same tax rate, there is only one lease payment that will result in a zero NAL for each company. We will calculate cash flows from the depreciation tax shield first. The depreciation tax shield is:

$$\text{Depreciation tax shield} = (\$360,000/3)(.34) = \$40,800$$

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The aftertax cost of debt is:

$$\text{Aftertax debt cost} = .10(1 - .34) = .0660$$

Using all of this information, we can calculate the lease payment as:

$$\begin{aligned} \text{NAL} = 0 &= \$360,000 - \text{PMT}(1 - .34)(\text{PVIFA}_{6.60\%,3}) + \$40,800(\text{PVIFA}_{6.60\%,3}) \\ \text{PMT} &= \$144,510.96 \end{aligned}$$

- b. Since the lessor's tax bracket is unchanged, the zero NAL lease payment is the same as we found in part *a*. The lessee will not realize the depreciation tax shield, and the aftertax cost of debt will be the same as the pretax cost of debt. So, the lessee's maximum lease payment will be:

$$\begin{aligned} \text{NAL} = 0 &= -\$360,000 + \text{PMT}(\text{PVIFA}_{10\%,3}) \\ \text{PMT} &= \$144,761.33 \end{aligned}$$

Both parties have positive NAL for lease payments between \$144,510.96 and \$144,761.33.

11. The APR of the loan is the lease factor times 2,400, so:

$$\text{APR} = 0.00385(2,400) = 9.24\%$$

To calculate the lease payment we first need the net capitalized cost, which is the base capitalized cost plus any other costs, minus and down payment or rebates. So, the net capitalized cost is:

$$\begin{aligned} \text{Net capitalized cost} &= \$40,000 + 450 - 2,000 \\ \text{Net capitalized cost} &= \$38,450 \end{aligned}$$

The depreciation charge is the net capitalized cost minus the residual value, divided by the term of the lease, which is:

$$\begin{aligned} \text{Depreciation charge} &= (\$38,450 - 20,400) / 36 \\ \text{Depreciation charge} &= \$501.39 \end{aligned}$$

Next, we can calculate the finance charge, which is the net capitalized cost plus the residual value, times the lease factor, or:

$$\begin{aligned} \text{Finance charge} &= (\$38,450 + 20,400)(0.00385) \\ \text{Finance charge} &= \$226.57 \end{aligned}$$

And the taxes on each monthly payment will be:

$$\begin{aligned} \text{Taxes} &= (\$501.39 + 226.57)(0.07) \\ \text{Taxes} &= \$50.96 \end{aligned}$$

The monthly lease payment is the sum of the depreciation charge, the finance charge, and taxes, which will be:

$$\begin{aligned} \text{Lease payment} &= \$501.39 + 226.57 + 50.96 \\ \text{Lease payment} &= \$778.92 \end{aligned}$$

Challenge

12. With a four-year loan, the annual loan payment will be

$$\begin{aligned} \$4,500,000 &= \text{PMT}(\text{PVIFA}_{8\%,4}) \\ \text{PMT} &= \$1,358,643.62 \end{aligned}$$

The aftertax loan payment is found by:

$$\text{Aftertax payment} = \text{Pretax payment} - \text{Interest tax shield}$$

So, we need to find the interest tax shield. To find this, we need a loan amortization table since the interest payment each year is the beginning balance times the loan interest rate of 8 percent. The interest tax shield is the interest payment times the tax rate. The amortization table for this loan is:

Year	Beginning balance	Total payment	Interest payment	Principal payment	Ending balance
1	\$4,500,000.00	\$1,358,643.62	\$360,000.00	\$998,643.62	\$3,501,356.38
2	3,501,356.38	1,358,643.62	280,108.51	1,078,535.11	2,422,821.27
3	2,422,821.27	1,358,643.62	193,825.70	1,164,817.92	1,258,003.35
4	1,258,003.35	1,358,643.62	100,640.27	1,258,003.35	0.00

So, the total cash flows each year are:

	<u>Aftertax loan payment</u>	<u>OCF</u>	<u>Total cash flow</u>
Year 1:	$\$1,358,643.62 - (\$360,000)(.35) = \$1,232,643.62$	$- 1,264,750$	$= -\$32,106.38$
Year 2:	$\$1,358,643.62 - (\$280,108.51)(.35) = \$1,260,605.64$	$- 1,264,750$	$= - 4,144.36$
Year 3:	$\$1,358,643.62 - (\$193,825.70)(.35) = \$1,290,804.62$	$- 1,264,750$	$= 26,054.62$
Year 4:	$\$1,358,643.62 - (\$100,640.27)(.35) = \$1,323,419.53$	$- 1,264,750$	$= 58,669.53$

So, the NAL with the loan payments is:

$$\begin{aligned} \text{NAL} &= 0 - \$32,106.38/1.052 - \$4,144.36/1.052^2 + \$26,054.62/1.052^3 + \$58,669.53/1.052^4 \\ \text{NAL} &= \$36,016.25 \end{aligned}$$

The NAL is the same because the present value of the aftertax loan payments, discounted at the aftertax cost of capital (which is the aftertax cost of debt) equals \$4,500,000.