Solutions Manual
Essentials of Corporate Finance
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CHAPTER 1
INTRODUCTION TO CORPORATE FINANCE

Answers to Concepts Review and Critical Thinking Questions

1. Capital budgeting (deciding on 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, difficulty in raising 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, and unlimited life.

4. 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. 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 functions of the treasurer's office.

5. To maximize the current market value (share price) of the equity of the firm (whether it's publicly traded or not).

6. 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.

7. A primary market transaction.

8. In auction markets like the NYSE, brokers and agents meet at a physical location (the exchange) to buy and sell their assets. Dealer markets like NASDAQ represent dealers operating in dispersed locales who buy and sell assets themselves, usually communicating with other dealers electronically or literally over the counter.

9. Since such organizations frequently pursue social or political missions, many different goals are conceivable. One goal that is often cited is revenue minimization; i.e., providing their goods and services to society at the lowest possible cost. Another approach might be to observe that even a not-for-profit business has equity. Thus, an appropriate goal would be to maximize the value of the equity.

10. An argument can be made either way. At one extreme, we could argue that in a market economy, all of these things are priced. This implies an optimal level of 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. The following is a classic (and highly relevant) thought question that illustrates this debate: "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?"

11. The goal will be the same, but the best course of action toward that goal may require adjustments due to different social, political, and economic climates.

12. 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.

13. 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 able to implement more effective monitoring mechanisms than can individual owners, given 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.

14. How much is too much? Who is worth more, Michael Rapino or LeBron James? 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 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.

15. The biggest reason that a company would "go dark" is because of the increased audit costs associated with Sarbanes-Oxley compliance. A company should always do a cost-benefit analysis, and it may be the case that the costs of complying with Sarbox outweigh the benefits. Of course, the company could always be trying to hide financial issues of the company! This is also one of the costs of going dark: Investors surely believe that some companies are going dark to avoid the increased scrutiny from Sarbox. This taints other companies that go dark just to avoid compliance costs. This is similar to the lemon problem with used automobiles: Buyers tend to underpay because they know a certain percentage of used cars are lemons. So, investors will tend to pay less for the company stock than they otherwise would. It is important to note that even if the company delists, its stock is still likely traded, but on the over-the-counter market pink sheets rather than on an organized exchange. This adds another cost since the stock is likely to be less liquid now. All else the same, investors pay less for an asset with less liquidity. Overall, the cost to the company is likely a reduced market value. Whether delisting is good or bad for investors depends on the individual circumstances of the company. It is also important to remember that there are already many small companies that file only limited financial information.

CHAPTER 2
WORKING WITH FINANCIAL STATEMENTS

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 can more safely meet short-term creditor demands. However, liquidity also has an opportunity cost. Firms generally reap higher returns by investing in illiquid, productive assets. 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, capital outlays would typically 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 NWC 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 company.

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 owners' equity, we must construct a balance sheet as follows:

Balance Sheet			
CA	$ 5,200	CL	$ 4,100
NFA	27,300	LTD	10,900
		OE	??
TA	$32,500	TL & OE	$32,500

We know that total liabilities and owners' equity (TL & OE) must equal total assets of $32,500. We also know that TL & OE is equal to current liabilities plus long-term debt plus owners' equity, so owners' equity is:

Owners' equity = $32,500 – 10,900 – 4,100
Owners' equity = $17,500

And net working capital (NWC) is:

NWC = CA – CL
NWC = $5,200 – 4,100
NWC = $1,100

2. The income statement for the company is:

Income Statement	
Sales	$757,000
Costs	316,000
Depreciation	41,000
EBIT	$400,000
Interest	36,000
EBT	$364,000
Taxes (21%)	76,440
Net income	$287,560

3. One equation for net income is:

Net income = Dividends + Addition to retained earnings

Rearranging, we get:

Addition to retained earnings = Net income – Dividends = $287,560 – 125,000 = $162,560

4. EPS = Net income/Shares = $287,560/75,000 = $3.83 per share

DPS = Dividends/Shares = $125,000/75,000 = $1.67 per share

5. Taxes = .10($11,600) + .12($47,150 – 11,600) + .22($100,525 – 47,150) + .24($191,950 – 100,525)

+ .32($195,000 – 191,950)
Taxes = $40,086.50

The average tax rate is the total tax paid divided by taxable income, so:

Average tax rate = $40,086.50/$195,000
Average tax rate = .2056, or 20.56%

The marginal tax rate is the tax rate on the next dollar of income. The person has net income of $195,000 and the 32 percent tax bracket is applicable to a taxable income up to $243,725, so the marginal tax rate is 32 percent.

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

Income Statement	
Sales	$63,300
Costs	24,200
Depreciation	2,300
EBIT	$36,800
Interest	1,800
Taxable income	$35,000
Taxes (22%)	7,700
Net income	$27,300

OCF = EBIT + Depreciation – Taxes
OCF = $36,800 + 2,300 – 7,700
OCF = $31,400

7. Net capital spending = $NFA_{end} – NFA_{beg}$ + Depreciation

Net capital spending = $3,200,000 – 2,450,000 + 347,000
Net capital spending = $1,097,000

8. Change in NWC = $NWC_{end} – NWC_{beg}$
Change in NWC = $(CA_{end} – CL_{end}) – (CA_{beg} – CL_{beg})$
Change in NWC = ($6,030 – 3,250) – ($5,530 – 2,610)
Change in NWC = $2,780 – 2,920
Change in NWC = –$140

9. Cash flow to creditors = Interest paid – Net new borrowing
Cash flow to creditors = Interest paid – (LTD_{end} – LTD_{beg})
Cash flow to creditors = $265,000 – ($2,730,000 – 2,400,000)
Cash flow to creditors = –$65,000

10. Cash flow to stockholders = Dividends paid – Net new equity
Cash flow to stockholders = Dividends paid – [($Common_{end}$ + $APIS_{end}$) – ($Common_{beg}$ + $APIS_{beg}$)]
Cash flow to stockholders = $654,000 – [($975,000 + 5,030,000) – ($770,000 + 4,890,000)]
Cash flow to stockholders = $309,000

Note, APIS is the additional paid-in surplus.

11. Cash flow from assets = Cash flow to creditors + Cash flow to stockholders
= –$65,000 + 309,000 = $244,000

Cash flow from assets = $244,000 = OCF – Change in NWC – Net capital spending
= $244,000 = OCF – (–$55,000) – 1,500,000

Operating cash flow = $244,000 – 55,000 + 1,500,000
Operating cash flow = $1,689,000

Intermediate

12. To find the book value of current assets, we use: NWC = CA – CL. Rearranging to solve for current assets, we get:

CA = NWC + CL
CA = $375,000 + 945,000
CA = $1,320,000

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

Book value CA	= $1,320,000	Market value NWC	= $1,250,000
Book value NFA	= 3,700,000	Market value NFA	= 5,800,000
Book value assets	= $5,020,000	Total	= $7,050,000

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

Income Statement	
Sales	$373,000
Costs	200,300
Other expenses	10,200
Depreciation	21,900
EBIT	$140,600
Interest	15,700
Taxable income	$124,900
Taxes	26,299
Net income	$ 98,601
Dividends	$21,450
Additions to RE	$77,151

a. OCF = EBIT + Depreciation – Taxes
OCF = $140,600 + 21,900 – 26,299
OCF = $136,201

b. CFC = Interest – Net new LTD
CFC = $15,700 – (–5,400)
CFC = $21,100

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
CFS = $21,450 – 7,300
CFS = $14,150

d. We know that CFA = CFC + CFS, so:

CFA = $21,100 + 14,150
CFA = $35,250

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
Net capital spending = $75,600 + 21,900
Net capital spending = $97,500

Now we can use:

CFA = OCF – Net capital spending – Change in NWC
$35,250 = $136,201 – 97,500 – Change in NWC
Change in NWC = $3,451

This means that the company increased its NWC by $3,451.

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

Net income = Dividends + Addition to retained earnings = $2,370 + 6,900 = $9,270

Now, looking at the income statement:

EBT – EBT × Tax rate = Net income

Recognize that EBT × Tax rate is the calculation for taxes. Solving this for EBT yields:

EBT = NI/(1 – Tax rate) = $9,270/(1 – .22) = $11,885

Now you can calculate:

EBIT = EBT + Interest = $11,885 + 5,800 = $17,685

The last step is to use:

EBIT = Sales – Costs – Depreciation
$17,685 = $79,400 – 53,900 – Depreciation
Depreciation = $7,815

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

Balance Sheet			
Cash	$ 155,000	Accounts payable	$ 273,000
Accounts receivable	157,000	Notes payable	203,800
Inventory	384,000	Current liabilities	$ 476,800
Current assets	$ 696,000	Long-term debt	1,079,000
		Total liabilities	$1,555,800
Tangible net fixed assets	$2,130,000		
Intangible net fixed assets	903,000	Common stock	??
		Accumulated ret. earnings	1,778,000
Total assets	$3,729,000	Total liab. & owners' equity	$3,729,000

Total liabilities and owners' equity is:

TL & OE = CL + LTD + Common stock + Retained earnings

Solving this equation for common stock gives us:

Common stock = $3,729,000 – 1,778,000 – 1,555,800
Common stock = $395,200

16. The market value of shareholders' equity cannot be negative. 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: Shareholders' equity = Max[(TA – TL), 0]. So, if TA are $12,900, equity is equal to $1,300, and if TA are $9,400, equity is equal to $0. We should note here that the book value of shareholders' equity can be negative.

17.

Income Statement	
Sales	$835,000
COGS	525,000
A&S expenses	120,000
Depreciation	165,000
EBIT	$25,000
Interest	90,000
Taxable income	–$65,000
Taxes (25%)	0
a. Net income	–$65,000

b. OCF = EBIT + Depreciation – Taxes
OCF = $25,000 + 165,000 – 0
OCF = $190,000

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.

18. 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 – Change in NWC – Net capital spending
Cash flow from assets = $190,000 – 0 – 0 = $190,000
Cash flow to stockholders = Dividends – Net new equity = $128,000 – 0 = $128,000

Cash flow to creditors = Cash flow from assets – Cash flow to stockholders
Cash flow to creditors = $190,000 – 128,000 = $62,000
Cash flow to creditors = Interest – Net new LTD
Net new LTD = Interest – Cash flow to creditors = $90,000 – 62,000 = $28,000

19. *a.*

Income Statement	
Sales	$45,686
Cost of goods sold	32,602
Depreciation	8,111
EBIT	$ 4,973
Interest	3,660
Taxable income	$ 1,313
Taxes (22%)	289
Net income	$ 1,024

b. OCF = EBIT + Depreciation – Taxes
= $4,973 + 8,111 – 289 = $12,795

c. Change in NWC $= NWC_{end} - NWC_{beg}$
$= (CA_{end} - CL_{end}) - (CA_{beg} - CL_{beg})$
= ($11,885 – 6,313) – ($9,630 – 5,413)
= $1,355

Net capital spending $= NFA_{end} - NFA_{beg}$ + Depreciation
= $33,664 – 27,348 + 8,111
= $14,427

CFA = OCF – Change in NWC – Net capital spending
= $12,795 – 1,355 – 14,427
= –$2,987

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 $2,987 in funds from its stockholders and creditors to make these investments.

d. Cash flow to creditors = Interest – Net new LTD = $3,660 – 0 = $3,660

Cash flow to stockholders = Cash flow from assets – Cash flow to creditors
= –$2,987 – 3,660 = –$6,647

We can also calculate the cash flow to stockholders as:

Cash flow to stockholders = Dividends – Net new equity

Solving for net new equity, we get:

Net new equity = $2,604 – (–6,647) = $9,251

The firm had positive earnings in an accounting sense (NI > 0) and had positive cash flow from operations. The firm invested $1,355 in new net working capital and $14,427 in new fixed assets. The firm had to raise $2,987 from its stakeholders to support this new investment. It accomplished this by raising $9,251 in the form of new equity. After paying out $2,604 of this in the form of dividends to shareholders and $3,660 in the form of interest to creditors, $2,987 was left to meet the firm's cash flow needs for investment.

20. *a.* Total assets_{2024} = $1,005 + 4,144 = $5,149

$\text{Total liabilities}_{2024}$ = $402 + 2,190 = $2,592
$\text{Owners' equity}_{2024}$ = $5,149 – 2,592 = $2,557

$\text{Total assets}_{2025}$ = $1,089 + 4,990 = $6,079
$\text{Total liabilities}_{2025}$ = $451 + 2,329 = $2,780
$\text{Owners' equity}_{2025}$ = $6,079 – 2,780 = $3,299

b. $\text{NWC}_{2024} = \text{CA}_{2024} – \text{CL}_{2024}$ = $1,005 – 402 = $603
$\text{NWC}_{2025} = \text{CA}_{2025} – \text{CL}_{2025}$ = $1,089 – 451 = $638
Change in NWC = $\text{NWC}_{2025} – \text{NWC}_{2024}$ = $638 – 603 = $35

c. We can calculate net capital spending as:
Net capital spending = $\text{Net fixed assets}_{2025} – \text{Net fixed assets}_{2024}$ + Depreciation
Net capital spending = $4,990 – 4,144 + 1,136 = $1,982

So, the company had a net capital spending cash flow of $1,982. We also know that net capital spending is:

Net capital spending = Fixed assets bought – Fixed assets sold
$1,982 = $2,080 – Fixed assets sold
Fixed assets sold = $2,080 – 1,982 = $98

To calculate the cash flow from assets, we must first calculate the operating cash flow. The income statement is:

Income Statement	
Sales	$12,751
Costs	5,946
Depreciation expense	1,136
EBIT	$ 5,669
Interest expense	323
EBT	$ 5,346
Taxes (21%)	1,123
Net income	$ 4,223

So, the operating cash flow is:

OCF = EBIT + Depreciation – Taxes = $5,669 + 1,136 – 1,123 = $5,682

And the cash flow from assets is:

Cash flow from assets = OCF – Change in NWC – Net capital spending
= $5,682 – 35 – 1,982 = $3,665

d. Net new borrowing = $LTD_{2025} – LTD_{2024}$ = $2,329 – 2,190 = $139
Cash flow to creditors = Interest – Net new LTD = $323 – 139 = $184

Net new borrowing = $139 = Debt issued – Debt retired
Debt retired = $420 – 139 = $281

21. To construct the cash flow identity, we will begin with cash flow from assets. Cash flow from assets is:

Cash flow from assets = OCF – Change in NWC – Net capital spending

So, the operating cash flow is:

OCF = EBIT + Depreciation – Taxes
OCF = $81,741 + 72,489 – 14,028
OCF = $140,202

Next, we will calculate the change in net working capital, which is:

Change in NWC = $NWC_{end} – NWC_{beg}$
Change in NWC = $(CA_{end} – CL_{end}) – (CA_{beg} – CL_{beg})$
Change in NWC = ($77,250 – 35,834) – ($61,240 – 31,870)
Change in NWC = $12,046

Now, we can calculate the net capital spending. The capital spending is:

Net capital spending = $NFA_{end} – NFA_{beg}$ + Depreciation
Net capital spending = $539,679 – 457,454 + 72,489
Net capital spending = $154,714

Now, we have the cash flow from assets, which is:

Cash flow from assets = OCF – Change in NWC – Net capital spending
Cash flow from assets = $140,202 – 12,046 – 154,714
Cash flow from assets = –$26,558

The company's assets generated an outflow of $26,558. The cash flow from operations was $140,202, and the company spent $12,046 on net working capital and $154,714 on fixed assets.

The cash flow to creditors is:

Cash flow to creditors = Interest paid – New long-term debt
Cash flow to creditors = Interest paid – (Long-term $debt_{end}$ – Long-term $debt_{beg}$)
Cash flow to creditors = $25,630 – ($201,900 – 181,000)
Cash flow to creditors = $4,730

The cash flow to stockholders is a little trickier in this problem. First, we need to calculate the new equity sold. The equity balance increased during the year. The only way to increase the equity balance is through retained earnings or selling equity. To calculate the new equity sold, we can use the following equation:

New equity = Ending equity – Beginning equity – Addition to retained earnings
New equity = $379,195 – 305,824 – 27,883
New equity = $45,488

What happened was the equity account increased by $73,371. Of this increase, $27,883 came from addition to retained earnings, so the remainder must have been the sale of new equity. Now we can calculate the cash flow to stockholders as:

Cash flow to stockholders = Dividends paid – Net new equity
Cash flow to stockholders = $14,200 – 45,488
Cash flow to stockholders = –$31,288

The company paid $4,730 to creditors and raised $31,288 from stockholders.

Finally, the cash flow identity is:

Cash flow from assets	=	Cash flow to creditors	+	Cash flow to stockholders
–$26,558	=	$4,730	+	–$31,288

The cash flow identity balances, which is what we expect.

Challenge

22. Net capital spending $= NFA_{end} - NFA_{beg} + \text{Depreciation}$

$= (NFA_{end} - NFA_{beg}) + (\text{Depreciation} + AD_{beg}) - AD_{beg}$
$= (NFA_{end} - NFA_{beg}) + AD_{end} - AD_{beg}$
$= (NFA_{end} + AD_{end}) - (NFA_{beg} + AD_{beg})$
$= FA_{end} - FA_{beg}$

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 unaffected.

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 mostly unchanged, liquidity has potentially decreased.

3. A current ratio of .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 balance with its most liquid asset (cash).

c. The capital intensity ratio tells us the dollar amount investment in assets needed to generate one dollar in sales.

d. Total asset turnover measures how much in sales is generated by each dollar of firm assets.

e. 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.

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 sizes or business types.

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 DuPont identity emphasizes the role of a firm's profitability, asset utilization efficiency, and financial leverage in achieving a 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 a 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 of comparing costs with other utilities of different sizes.

b. For a retailer such as JC Penney, expressing sales on a per square foot basis would be useful in comparing revenue production against other retailers.

c. For an airline such as Delta, 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 online service such as Google or Yahoo!, using a per web hit basis for costs would allow for comparisons with similar services.

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 Higher Education, the leading publisher of finance textbooks for the college market, the obvious standardization would be per book sold.

11. As with any ratio analysis, the ratios themselves do not necessarily indicate a problem, but indicate that something is different, and it is up to us to determine if a problem exists. If the cost of goods sold as a percentage of sales is increasing, we would expect that EBIT as a percentage of sales would decrease, all else constant. An increase in the cost of goods sold as a percentage of sales occurs because the cost of raw materials or other inventory is increasing at a faster rate than the sales price.

This may be a bad sign since the contribution of each sales dollar to net income and cash flow is lower. However, when a new product, for example, the HDTV, enters the market, the price of one unit will often be high relative to the cost of goods sold per unit, and demand, therefore sales, will initially be small. As the product market becomes more developed, price of the product generally drops, and sales increase as more competition enters the market. In this case, the increase in cost of goods sold as a percentage of sales is to be expected. The maker or seller expects to boost sales at a faster rate than its cost of goods sold increases. In this case, a good practice would be to examine the common-size income statements to see if this is an industry-wide occurrence.

12. If we assume that the cause is negative, the two reasons for the trend of increasing cost of goods sold as a percentage of sales are that costs are becoming too high or the sales price is not increasing fast enough. If the cause is an increase in the cost of goods sold, the manager should look at possible actions to control costs. If costs can be lowered by seeking lower cost suppliers of similar or higher quality, the cost of goods sold as a percentage of sales should decrease. Another alternative is to increase the sales price to cover the increase in the cost of goods sold. Depending on the industry, this may be difficult or impossible. For example, if the company sells most of its products under a long-term contract that has a fixed price, it may not be able to increase the sales price and will be forced to look for other cost-cutting possibilities. Additionally, if the market is competitive, the company might also be unable to increase the sales 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. Using the formula for NWC, we get:

NWC = CA – CL
CA = CL + NWC
CA = $5,730 + 2,945
CA = $8,675

So, the current ratio is:

Current ratio = CA/CL
Current ratio = $8,675/$5,730
Current ratio = 1.51 times

And the quick ratio is:

Quick ratio = (CA – Inventory)/CL
Quick ratio = ($8,675 – 3,720)/$5,730
Quick ratio = .86 times

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

Profit margin = Net income/Sales
Net income = Profit margin(Sales)
Net income = .05($13,400,000)
Net income = $670,000

ROA = Net income/TA
ROA = $670,000/$10,200,000
ROA = .0657, or 6.57%

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

TA = TD + TE
TE = TA – TD
TE = $10,200,000 – 4,900,000
TE = $5,300,000

ROE = Net income/TE
ROE = $670,000/$5,300,000
ROE = .1264, or 12.64%

3. Receivables turnover = Sales/Receivables

Receivables turnover = $4,986,340/$473,380
Receivables turnover = 10.53 times

Days' sales in receivables = 365 days/Receivables turnover
Days' sales in receivables = 365/10.53
Days' sales in receivables = 34.65 days

On average, the company's customers paid off their accounts in 34.65 days.

4. Inventory turnover = COGS/Inventory

Inventory turnover = $4,738,216/$385,342
Inventory turnover = 12.30 times

Days' sales in inventory = 365 days/Inventory turnover
Days' sales in inventory = 365/12.30
Days' sales in inventory = 29.68 days

On average, a unit of inventory sat on the shelf 29.68 days before it was sold.

5. Total debt ratio = .44 = TD/TA

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

.44 = TD/(TD + TE)

Solving this equation yields:

.44(TE) = .56(TD)

Debt-equity ratio = TD/TE = .44/.56 = .79

Equity multiplier = 1 + D/E = 1.79

6. Net income = Addition to RE + Dividends = $395,000 + 245,000 = $640,000

Earnings per share = NI/Shares = $640,000/165,000 = $3.88 per share

Dividends per share = Dividends/Shares = $245,000/165,000 = $1.48 per share

Book value per share = TE/Shares = $5,700,000/165,000 = $34.55 per share

Market-to-book ratio	= Share price/BVPS	= \$78/\$34.55 = 2.26 times
PE ratio	= Share price/EPS	= \$78/\$3.88 = 20.11 times
Sales per share	= Sales/Shares	= \$7,450,000/165,000 = \$45.15
P/S ratio	= Share price/Sales per share	= \$78/\$45.15 = 1.73 times

7. ROE = (PM)(TAT)(EM)
ROE = (.0605)(1.64)(1.27)
ROE = .1260, or 12.60%

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 = .1385 = (.054)(1.57)(EM)

EM = .1385/(.054)(1.57)
EM = 1.63

D/E = EM – 1
D/E = 1.63 – 1
D/E = .63

9. To find the days' sales in payables, we first need to find the payables turnover. The payables turnover was:

Payables turnover = COGS/Accounts payable
Payables turnover = \$83,261/\$18,452
Payables turnover = 4.51 times

Now, we can use the payables turnover to find the days' sales in payables as:

Days' sales in payables = 365 days/Payables turnover
Days' sales in payables = 365/4.51
Days' sales in payables = 80.89 days

The company left its bills to suppliers outstanding for 80.89 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.

10. The equity multiplier is:

EM = 1 + D/E
EM = 1 + .73
EM = 1.73

One formula to calculate return on equity is:

ROE = ROA(EM)
ROE = .079(1.73)
ROE = .1367, or 13.67%

ROE can also be calculated as:

ROE = NI/TE

So, net income is:

Net income = ROE(TE)
Net income = .1367($645,000)
Net income = $88,152.15

11. To find the internal growth rate, we need the plowback, or retention, ratio. The plowback ratio is:

$b = 1 - .35$
$b = .65$

Now, we can use the internal growth rate equation to find:

Internal growth rate = [(ROA)(*b*)]/[1 – (ROA)(*b*)]
Internal growth rate = [.076(.65)]/[1 – .076(.65)]
Internal growth rate = .0520, or 5.20%

12. To find the sustainable growth rate we need the plowback, or retention, ratio. The plowback ratio is:

$b = 1 - .20$
$b = .80$

Now, we can use the sustainable growth rate equation to find:

Sustainable growth rate = [(ROE)(*b*)]/[1 – (ROE)(*b*)]
Sustainable growth rate = [.141(.80)]/[1 – .141(.80)]
Sustainable growth rate = .1271, or 12.71%

13. We need the return on equity to calculate the sustainable growth rate. To calculate return on equity, we need to realize that the total asset turnover is the inverse of the capital intensity ratio and the equity multiplier is one plus the debt-equity ratio. So, the return on equity is:

ROE = (Profit margin)(Total asset turnover)(Equity multiplier)
ROE = (.081)(1/.95)(1 + 1.05)
ROE = .1748, or 17.48%

Next, we need the plowback ratio. The plowback ratio is one minus the payout ratio. We can calculate the payout ratio as the dividends divided by net income, so the plowback ratio is:

$b = 1 – \$24{,}000/\$97{,}000$
$b = .75$

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

Sustainable growth rate = [(ROE)(*b*)]/[1 – (ROE)(*b*)]
Sustainable growth rate = [.1748(.75)]/[1 – .1748(.75)]
Sustainable growth rate = .1515, or 15.15%

14. We need the return on equity to calculate the sustainable growth rate. Using the DuPont identity, the return on equity is:

ROE = (Profit margin)(Total asset turnover)(Equity multiplier)
ROE = (.052)(2.90)(.95)
ROE = .1433, or 14.33%

To find the sustainable growth rate, we need the plowback, or retention, ratio. The plowback ratio is:

$b = 1 – .35$
$b = .65$

Now, we can use the sustainable growth rate equation to find:

Sustainable growth rate = [(ROE)(*b*)]/[1 – (ROE)(*b*)]
Sustainable growth rate = [.1433(.65)]/[1 – .1433(.65)]
Sustainable growth rate = .1027, or 10.27%

15. To calculate the common-size balance sheet, we divide each asset account by total assets, and each liability and equity account by total liabilities and equity. For example, the common-size cash percentage for 2024 is:

Cash percentage = Cash/Total assets
Cash percentage = \$30,290/\$1,215,582
Cash percentage = .0249, or 2.49%

Repeating this procedure for each account, we get:

	2024		2025	
Assets				
Current assets				
Cash	$30,290	2.49%	$34,521	2.52%
Accounts receivable	72,981	6.00%	85,708	6.26%
Inventory	172,442	14.19%	204,086	14.90%
Total	$275,713	22.68%	$324,315	23.68%
Fixed assets				
Net plant and equipment	$939,869	77.32%	$1,045,107	76.32%
Total assets	$1,215,582	100%	$1,369,422	100%
Liabilities and owners' equity				
Current liabilities				
Accounts payable	$217,931	17.93%	$230,828	16.86%
Notes payable	100,645	8.28%	115,491	8.43%
Total	$318,576	26.21%	$346,319	25.29%
Long-term debt	$379,000	31.18%	$401,000	29.28%
Owners' equity				
Common stock and paid-in surplus	$192,000	15.79%	$201,000	14.68%
Accumulated retained earnings	326,006	26.82%	421,103	30.75%
Total	$518,006	42.61%	$622,103	45.43%
Total liabilities and owners' equity	$1,215,582	100%	$1,369,422	100%

16. *a.* The current ratio is calculated as:

Curent ratio = Current assets/Current liabilities

Current ratio$_{2024}$ = $275,713/$318,576
Current ratio$_{2024}$ = .87 times

Current ratio$_{2025}$ = $324,315/$346,319
Current ratio$_{2025}$ = .94 times

b. The quick ratio is calculated as:

Quick ratio = (Current assets – Inventory)/Current liabilities

Quick ratio$_{2024}$ = ($275,713 – 172,442)/$318,576
Quick ratio$_{2024}$ = .32 times

Quick ratio$_{2025}$ = ($324,315 – 204,086)/$346,319
Quick ratio$_{2025}$ = .35 times

c. The cash ratio is calculated as:

Cash ratio = Cash/Current liabilities

Cash ratio$_{2024}$ = $30,290/$318,576
Cash ratio$_{2024}$ = .10 times

Cash ratio$_{2025}$ = $34,521/$346,319
Cash ratio$_{2025}$ = .10 times

d. The debt-equity ratio is calculated as:

Debt-equity ratio = Total debt/Total equity
Debt-equity ratio = (Current liabilities + Long-term debt)/Total equity

Debt-equity ratio$_{2024}$ = ($318,576 + 379,000)/$518,006
Debt-equity ratio$_{2024}$ = 1.35 times

Debt-equity ratio$_{2025}$ = ($346,319 + 401,000)/$622,103
Debt-equity ratio$_{2025}$ = 1.20 times

And the equity multiplier is:

Equity multiplier = 1 + Debt-equity ratio

Equity multiplier$_{2024}$ = 1 + 1.35
Equity multiplier$_{2024}$ = 2.35 times

Equity multiplier$_{2025}$ = 1 + 1.20
Equity multiplier$_{2025}$ = 2.20 times

e. The total debt ratio is calculated as:

Total debt ratio = Total debt/Total assets
Total debt ratio = (Current liabilities + Long-term debt)/Total assets

Total debt ratio$_{2024}$ = ($318,576 + 379,000)/$1,215,582
Total debt ratio$_{2024}$ = .57 times

Total debt ratio$_{2025}$ = ($346,319 + 401,000)/$1,369,422
Total debt ratio$_{2025}$ = .55 times

17. Using the DuPont identity to calculate ROE, we get:

ROE = (Profit margin)(Total asset turnover)(Equity multiplier)
ROE = (Net income/Sales)(Sales/Total assets)(Total assets/Total equity)
ROE = ($86,432/$2,751,332)($2,751,332/$1,369,422)($1,369,422/$622,103)
ROE = .1389, or 13.89%

18. One equation to calculate ROA is:

ROA = (Profit margin)(Total asset turnover)

We can solve this equation to find total asset turnover as:

.058 = .051(Total asset turnover)
Total asset turnover = 1.14 times

Now, solve the ROE equation to find the equity multiplier, which is:

ROE = (ROA)(Equity multiplier)
.12 = .058(Equity multiplier)
Equity multiplier = 2.07 times

19. To calculate the ROA, we first need to find the net income. Using the profit margin equation, we find:

Profit margin = Net income/Sales
.057 = Net income/$12,700,000
Net income = $723,900

Now we can calculate ROA as:

ROA = Net income/Total assets
ROA = $723,900/$9,300,000
ROA = .0778, or 7.78%

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

ROA = NI/TA
ROA = $5,214/$49,500
ROA = .1053, or 10.53%

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

b = 1 – .30
b = .70

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

Internal growth rate = (ROA × *b*)/[1 – (ROA × *b*)]
Internal growth rate = [.1053(.70)]/[1 – .1053(.70)]
Internal growth rate = .0796, or 7.96%

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

ROE = NI/TE
ROE = $5,214/$37,000
ROE = .1409, or 14.09%

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:

Sustainable growth rate = (ROE × *b*)/[1 – (ROE × *b*)]
Sustainable growth rate = [.1409(.70)]/[1 – .1409(.70)]
Sustainable growth rate = .1094, or 10.94%

22. The total asset turnover is:

Total asset turnover = Sales/Total assets
Total asset turnover = $12,900,000/$6,800,000
Total asset turnover = 1.90 times

If the target total asset turnover is 2.10 times, we can use the total asset turnover equation to solve for the necessary sales level. The new sales level will be:

Total asset turnover = Sales/Total assets
2.10 = Sales/$6,800,000
Sales = $14,280,000

23. To find the ROE, we need the equity balance. Since we have the total debt, if we can find the total assets we can calculate the equity. Using the total debt ratio, we find total assets as:

Debt ratio = Total debt/Total assets
.65 = $674,000/Total assets
Total assets = $1,036,923

Total liabilities and equity is equal to total assets. Using this relationship, we find:

Total assets = Total debt + Total equity
$1,036,923 = $674,000 + Total equity
Total equity = $362,923

Now, we can calculate the ROE as:

ROE = Net income/Total equity
ROE = $36,180/$362,923
ROE = .0997, or 9.97%

24. The earnings per share are:

EPS = Net income/Shares
EPS = $7,600,000/3,700,000
EPS = $2.05

The price-earnings ratio is:

PE = Price/EPS
PE = $38/$2.05
PE = 18.50 times

The sales per share are:

Sales per share = Sales/Shares
Sales per share = $46,300,000/3,700,000
Sales per share = $12.51

The price-sales ratio is:

P/S = Price/Sales per share
P/S = $38/$12.51
P/S = 3.04 times

The book value per share is:

Book value per share = Book value of equity/Shares
Book value per share = $21,700,000/3,700,000
Book value per share = $5.86 per share

And the market-to-book ratio is:

Market-to-book = Market value per share/Book value per share
Market-to-book = $38/$5.86
Market-to-book = 6.48 times

25. To find the profit margin, we need the net income and sales. We can use the total asset turnover to find the sales and the return on assets to find the net income. Beginning with the total asset turnover, we find sales are:

Total asset turnover = Sales/Total assets
1.95 = Sales/$6,720,000
Sales = $13,104,000

And the net income is:

ROA = Net income/Total assets
.0790 = Net income/$6,720,000
Net income = $530,880

Now we can find the profit margin, which is:

Profit margin = Net income/Sales
Profit margin = $530,880/$13,104,000
Profit margin = .0405, or 4.05%

26. First, we need the enterprise value, which is:

Enterprise value = Market capitalization + Debt – Cash
Enterprise value = $875,000 + 240,000 – 43,000
Enterprise value = $1,072,000

And EBITDA is:

EBITDA = EBIT + Depreciation & Amortization
EBITDA = $98,160 + 173,000
EBITDA = $271,160

So, the enterprise value-EBITDA multiple is:

Enterprise value-EBITDA multiple = $1,072,000/$271,160
Enterprise value-EBITDA multiple = 3.95 times

Intermediate

27. This is a multistep 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 = .10 = (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 = [(.10)($2,754)]/[(1 + .57)($6,785)]

PM = .0259

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

PM = .0259 = NI/S
NI = .0259($6,785)
Net income = $175.41

28. The solution to this problem requires a number of steps. First, remember that Current assets + Net fixed assets = Total assets. So, if we find the current assets and the total assets, we can solve for net fixed assets. Using the numbers given for the current ratio and the current liabilities, we solve for current assets:

Current ratio = Current assets/Current liabilities
Current assets = Current ratio(Current liabilities)
Current assets = 1.35($1,270)
Current assets = $1,714.50

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

Profit margin = Net income/Sales
Net income = Profit margin(Sales)
Net income = .083($8,940)
Net income = $742.02

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

ROE = Net income/Total equity
Total equity = Net income/ROE
Total equity = $742.02/.132
Total equity = $5,621.36

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

Long-term debt ratio = .45 = LTD/(LTD + Total equity)

Inverting both sides gives:

1/.45 = (LTD + Total equity)/LTD = 1 + (Total equity/LTD)

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

2.222 = 1 + ($5,621.36/LTD)
LTD = $5,621.36/1.222
LTD = $4,599.30

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

Total debt = Current liabilities + LTD
Total debt = $1,270 + 4,599.30
Total debt = $5,869.30

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

Total assets = Total debt + Total equity
Total assets = $5,869.30 + 5,621.36
Total assets = $11,490.66

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

Net fixed assets = Total assets – Current assets
Net fixed assets = $11,490.66 – 1,714.50
Net fixed assets = $9,776.16

29. Child: Profit margin = Net income/Sales

Profit margin = $1.50/$50
Profit margin = .030, or 3.0%

Store: Profit margin = Net income/Sales
Profit margin = $10,650,000/$710,000,000
Profit margin = .0150, or 1.50%

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 = $10,650,000/($390,000,000 – 280,000,000)
ROE = .0968, or 9.68%

30. To calculate the profit margin, we first need to calculate the sales. Using the days' sales in receivables, we find the receivables turnover is:

Days' sales in receivables = 365 days/Receivables turnover
27.53 days = 365 days/Receivables turnover
Receivables turnover = 13.26 times

Now, we can use the receivables turnover to calculate the sales as:

Receivables turnover = Sales/Receivables
13.26 = Sales/$145,360
Sales = $1,927,221

So, the profit margin is:

Profit margin = Net income/Sales
Profit margin = $130,571/$1,927,221
Profit margin = .0678, or 6.78%

The total asset turnover is:

Total asset turnover = Sales/Total assets
Total asset turnover = $1,927,221/$785,160
Total asset turnover = 2.45 times

We need to use the DuPont identity to calculate the return on equity. Using this relationship, we get:

ROE = (Profit margin)(Total asset turnover)(1 + Debt-equity ratio)
ROE = (.0678)(2.45)(1 + .25)
ROE = .2079, or 20.79%

31. This problem requires us to work backward through the income statement. First, recognize that Net income = $(1 - T_C)$EBT. Plugging in the numbers given and solving for EBT, we get:

EBT = $18,451/(1 – .21)
EBT = $23,355.70

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

EBIT = EBT + Interest
EBIT = $23,355.70 + 4,131
EBIT = $27,486.70

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

EBITD = EBIT + Depreciation
EBITD = $27,486.70 + 5,193
EBITD = $32,679.70

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

Cash coverage ratio = EBITD/Interest
Cash coverage ratio = $32,679.70/$4,131
Cash coverage ratio = 7.91 times

32. To find the times interest earned, we need the EBIT and interest expense. EBIT is sales minus costs minus depreciation, so:

EBIT = Sales – Costs – Depreciation
EBIT = $613,000 – 245,380 – 62,900
EBIT = $304,720

Now, we need the interest expense. We know the EBIT, so if we find the taxable income (EBT), the difference between these two is the interest expense. To find EBT, we must work backward through the income statement. We need total dividends paid. We can use the dividends per share equation to find the total dividends. Doing so, we find:

DPS = Dividends/Shares
$1.51 = Dividends/20,000
Dividends = $30,200

Net income is the sum of dividends and addition to retained earnings, so:

Net income = Dividends + Addition to retained earnings
Net income = $30,200 + 70,600
Net income = $100,800

We know that the taxes are the taxable income times the tax rate. The net income is the taxable income minus taxes. Rearranging this equation, we get:

Net income = EBT – T_C(EBT)
Net income = (1 – T_C)(EBT)
$100,800 = (1 – .22)(EBT)
EBT = $129,231

Now, we can use the income statement relationship:

EBT = EBIT – Interest
$129,231 = $304,720 – Interest
Interest = $175,489

So, the times interest earned ratio is:

Times interest earned = EBIT/Interest
Times interest earned = $304,720/$175,489
Times interest earned = 1.74 times

33. To find the return on equity, we need the net income and total equity. We can use the total debt ratio to find the total assets as:

Total debt ratio = Total debt/Total assets
.43 = $691,000/Total assets
Total assets = $1,606,977

Using the balance sheet relationship that total assets is equal to total liabilities and equity, we find the total equity is:

Total assets = Total debt + Equity
$1,606,977 = $691,000 + Equity
Equity = $915,977

We have the return on equity and the equity. We can use the return on equity equation to find net income is:

ROE = Net income/Equity
.1180 = Net income/$915,977
Net income = $108,085

We have all the information necessary to calculate the ROA. Doing so, we find the ROA is:

ROA = Net income/Total assets
ROA = $108,085/$1,606,977
ROA = .0673, or 6.73%

34. Profit margin = Net income/Sales
Profit margin = –£24,387/£305,650
Profit margin = –.0798, or –7.98%

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:

Net income = Profit margin × Sales
Net income = –.0798($365,412)
Net income = –$29,155.25

35. *Short-term solvency ratios:*

Current ratio = Current assets/Current liabilities
Current ratio$_{2024}$ = $68,074/$61,722 = 1.10 times
Current ratio$_{2025}$ = $79,974/$71,677 = 1.12 times

Quick ratio = (Current assets – Inventory)/Current liabilities
Quick ratio$_{2024}$ = ($68,074 – 27,931)/$61,722 = .65 times
Quick ratio$_{2025}$ = ($79,974 – 32,586)/$71,677 = .66 times

Cash ratio = Cash/Current liabilities
Cash ratio$_{2024}$ = $26,450/$61,722 = .43 times
Cash ratio$_{2025}$ = $29,106/$71,677 = .41 times

Asset utilization ratios:
Total asset turnover = Sales/Total assets
Total asset turnover = $422,045/$478,319 = .88 times

Inventory turnover = Cost of goods sold/Inventory
Inventory turnover = $291,090/$32,586 = 8.93 times

Receivables turnover = Sales/Accounts receivable
Receivables turnover = $422,045/$18,282 = 23.09 times

Long-term solvency ratios:
Total debt ratio = (Total assets – Total equity)/Total assets
Total debt ratio$_{2024}$ = ($425,239 – 268,517)/$425,239 = .37 times
Total debt ratio$_{2025}$ = ($478,319 – 306,642)/$478,319 = .36 times

Debt-equity ratio = Total debt/Total equity
Debt-equity ratio$_{2024}$ = ($61,722 + 95,000)/$268,517 = .58 times
Debt-equity ratio$_{2025}$ = ($71,677 + 100,000)/$306,642 = .56 times

Equity multiplier = 1 + D/E
Equity multiplier$_{2024}$ = 1 + .58 = 1.58 times
Equity multiplier$_{2025}$ = 1 + .56 = 1.56 times

Times interest earned = EBIT/Interest
Times interest earned = $93,900/$16,400 = 5.73 times

Cash coverage ratio = (EBIT + Depreciation)/Interest
Cash coverage ratio = ($93,900 + 37,055)/$16,400 = 7.99 times

Profitability ratios:
Profit margin = Net income/Sales
Profit margin = $58,125/$422,045 = .1377, or 13.77%

Return on assets = Net income/Total assets
Return on assets = $58,125/$478,319 = .1215, or 12.15%

Return on equity = Net income/Total equity
Return on equity = $58,125/$306,642 = .1896, or 18.96%

36. The DuPont identity is:

ROE = (PM)(TAT)(EM)
ROE = (.1377)(.88)(1.56) = .1896, or 18.96%

37. Earnings per share = Net income/Shares
Earnings per share = $58,125/15,000 = $3.88 per share

Sales per share = Sales/Shares
Sales per share = $422,045/15,000 = $28.14 per share

PE ratio = Share price/Earnings per share
PE ratio = $79/$3.88 = 20.39 times

PS ratio = Share price/Sales per share
PS ratio = $79/$28.14 = 2.81 times

Dividends per share = Dividends/Shares
Dividends per share = $20,000/15,000 = $1.33 per share

Book value per share = Total equity/Shares
Book value per share = $306,642/15,000 shares = $20.44 per share

Market-to-book ratio = Share price/Book value per share
Market-to-book ratio = $79/$20.44 = 3.86 times

38. The current ratio appears to be relatively low when compared to the median; however, it is above the lower quartile, meaning that at least 25 percent of firms in the industry have a lower current ratio. Overall, it does not appear that the current ratio is out of line with the industry. The total asset turnover is low when compared to the industry. In fact, the total asset turnover is in the lower quartile. This means that the company does not use assets as efficiently overall or that the company has newer assets than the industry. This would mean that the assets have not been depreciated, which would mean a higher book value and a lower total asset turnover. The debt-equity ratio is in line with the industry, between the median and the upper quartile. The profit margin is in the upper quartile. The company may be better at controlling costs or has a better product, which enables it to charge a premium price. It could also be negative in that the company may have too high of a margin on its sales, which could reduce overall net income.

39. To find the profit margin, we can solve the DuPont identity. First, we need to find the retention ratio. The retention ratio for the company is:

$b = 1 - .25$
$b = .75$

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

Sustainable growth rate = (ROE × *b*)/[1 – (ROE × *b*)]
.12 = [ROE(.75)]/[1 – ROE(.75)]
ROE = .1429, or 14.29%

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

ROE = PM(TAT)(EM)
.1429 = PM(1/.65)(1 + .95)
PM = (.1429)/[(1/.65)(1.95)]
PM = .0476, or 4.76%

40. The earnings per share is the net income divided by the shares outstanding. Since all numbers are in millions, the earnings per share for Pfizer was:

EPS = $5,998/5,616
EPS = $1.07

And the earnings per share for Merck was:

EPS = $862/2,538
EPS = $.34

The market-to-book ratio is the stock price divided by the book value per share. To find the book value per share, we divide the total equity by the shares outstanding. The book value per share and market-to-book ratio for Pfizer were:

Book value per share = $95,661/5,616
Book value per share = $17.03

Market-to-book = $27.94/$17.03
Market-to-book = 1.64 times

And the market-to-book ratio for Merck was:

Book value per share = $45,911/2,538
Book value per share = $18.09

Market-to-book = $108.33/$18.09
Market-to-book = 5.99 times

The price-earnings ratio for Pfizer was:

PE = $27.94/$1.07
PE = 26.16 times

And for Merck, the PE was:

PE = $108.33/$.34
PE = 318.96 times

41. We are given the profit margin. Remember that:

ROA = PM(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:

b = 1 – .25
b = .75

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

Internal growth rate = (ROA × *b*)/[1 – (ROA × *b*)]
.062 = [ROA(.75)]/[1 – ROA(.75)]
ROA = .0778, or 7.78%

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

ROA = (PM)(TAT)
.0778 = .073(TAT)
TAT = .0778/.073
TAT = 1.07 times

42. We should begin by calculating the D/E ratio. We calculate the D/E ratio as follows:

Total debt ratio = .45 = TD/TA

Inverting both sides we get:

1/.45 = TA/TD

Next, we need to recognize that:

TA/TD = 1 + TE/TD

Substituting this into the previous equation, we get:

1/.45 = 1 + TE/TD

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

D/E = 1/[(1/.45) – 1]
D/E = .82

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

ROE = (PM)(TAT)(EM)
ROE = (.059)(1.35)(1 + .82)
ROE = .1448, or 14.48%

Now we can calculate the retention ratio as:

b = 1 – .40
b = .60

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

Sustainable growth rate = (ROE × b)/[1 – (ROE × b)]
Sustainable growth rate = [.1448(.60)]/[1 – .1448(.60)]
Sustainable growth rate = .0952, or 9.52%

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

b = 1 – $7,500/$16,300
b = .5399

And the ROE is:

ROE = $16,300/$77,000
ROE = .2117, or 21.17%

So, the sustainable growth rate is:

Sustainable growth rate = (ROE × b)/[1 – (ROE × b)]
Sustainable growth rate = [.2117(.5399)]/[1 – .2117(.5399)]
Sustainable growth rate = .1290, or 12.90%

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

New TA = 1.1290($67,000 + 77,000) = $162,580.65

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:

New TD = [D/(D + E)](TA)
New TD = [$67,000/($67,000 + 77,000)]($162,580.65)
New TD = $75,645.16

And the additional borrowing will be:

Additional borrowing = $75,645.16 – 67,000

Additional borrowing = $8,645.16

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:

ROA = $16,300/($67,000 + 77,000)
ROA = .1132, or 11.32%

This means the internal growth rate is:

Internal growth rate = (ROA × *b*)/[1 – (ROA × *b*)]
Internal growth rate = [.1132(.5399)]/[1 – .1132(.5399)]
Internal growth rate = .0651, or 6.51%

44. We need the ROE to calculate the sustainable growth rate. The ROE is:

ROE = (PM)(TAT)(EM)
ROE = (.064)(1/1.05)(1 + .65)
ROE = .1006, or 10.06%

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

Sustainable growth rate = (ROE × *b*)/[1 – (ROE × *b*)]
Sustainable growth rate = .12 = [.1006(*b*)]/[1 – .1006(*b*)]
b = 1.07

This implies the payout ratio is:

Payout ratio = 1 – *b*
Payout ratio = 1 – 1.07
Payout ratio = –.07

This answer indicates a dividend payout ratio of negative 7 percent, which is impossible. So, the growth rate is not consistent with the other constraints. The lowest possible payout rate is 0 (without issuing stock), which corresponds to a retention ratio of 1, or total earnings retention. This problem illustrates a key point we made in the chapter: Sustainable growth analysis forces the user to make internally consistent assumptions.

As an aside, we should note that it is possible to have a retention ratio greater than 1 if the company issues new stock. However, since the growth rate we are evaluating is perpetual, the company would have to issue stock every year, forever. But, doing so violates our underlying assumption that the sustainable growth rate requires no new equity.

The maximum sustainable growth rate for this company is:

Maximum sustainable growth rate = (ROE × *b*)/[1 – (ROE × *b*)]
Maximum sustainable growth rate = [.1006(1)]/[1 – .1006(1)]
Maximum sustainable growth rate = .1118, or 11.18%

45. Using the beginning of period total assets, the ROA is:

ROA_{Beg} = $1,241/$15,803
ROA_{Beg} = .0785, or 7.85%

Using the end of period total assets, the ROA is:

ROA_{End} = $1,241/$16,243
ROA_{End} = .0764, or 7.64%

The ROE using beginning of period equity is:

ROE_{Beg} = $1,241/$2,795
ROE_{Beg} = .4440, or 44.40%

The ROE using the end of period equity is:

ROE_{End} = $1,241/$3,235
ROE_{End} = .3836, or 38.36%

The retention ratio, which is one minus the dividend payout ratio, is:

b = 1 – Dividends/Net income
b = 1 – $801/$1,241
b = .3546, or 35.46%

With the growth rate equations, we need to use the ROA and ROE based on the end of period assets or equity, so the internal growth rate is:

Internal growth rate = [(ROA)(*b*)]/[1 – (ROA)(*b*)]
Internal growth rate = [(.0764)(.3546)]/[1 – (.0764)(.3546)]
Internal growth rate = .0278, or 2.78%

And the sustainable growth rate is:

Sustainable growth rate = [(ROE)(*b*)]/[1 – (ROE)(*b*)]
Sustainable growth rate = [(.3836)(.3546)]/[1 – (.3836)(.3546)]
Sustainable growth rate = .1574 or 15.74%

Using ROA × *b* and end of period assets to find the internal growth rate, we find:

Internal growth rate = $ROA_{End} \times b$
Internal growth rate = .0764 × .3546
Internal growth rate = .0271, or 2.71%

And, using ROE × *b* and the end of period equity to find the sustainable growth rate, we find:

Sustainable growth rate = $ROE_{End} \times b$
Sustainable growth rate = .3836 × .3546
Sustainable growth rate = .1360, or 13.60%

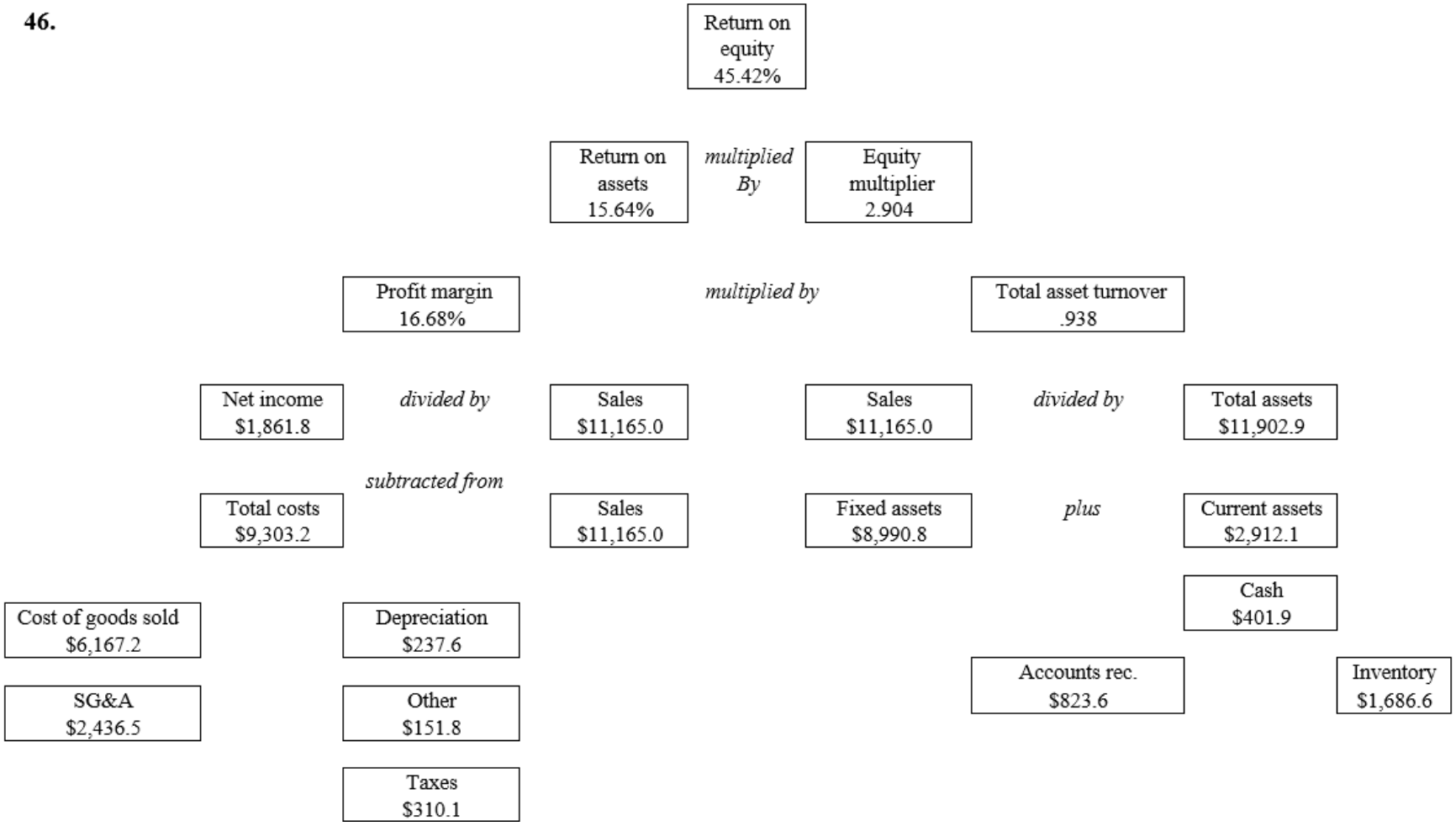
Using ROA × *b* and beginning of period assets to find the internal growth rate, we find:

Internal growth rate = $ROA_{Beg} \times b$
Internal growth rate = .0785 × .3546
Internal growth rate = .0278, or 2.78%

And, using ROE × *b* and the beginning of period equity to find the sustainable growth rate, we find:

Sustainable growth rate = $ROE_{Beg} \times b$
Sustainable growth rate = .4440 × .3546
Sustainable growth rate = .1574, or 15.74%

46.



CHAPTER 4
INTRODUCTION TO VALUATION: THE TIME VALUE OF MONEY

Answers to Concepts Review and Critical Thinking Questions

1. 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.

2. Future values grow (assuming a positive rate of return); present values shrink.

3. The future value rises (assuming a positive rate of return); the present value falls.

4. It depends. The large deposit will have a larger future value for some period, but after time, the smaller deposit with the larger interest rate will eventually become larger. The length of time for the smaller deposit to overtake the larger deposit depends on the amount deposited in each account and the interest rates.

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 $24,099. If TMCC uses it wisely, it will be worth more than $100,000 in thirty years.

7. This will probably make the security less desirable. TMCC will only repurchase the security prior to maturity if it 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 $100,000? 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 $100,000. This rise is a reflection of the time value of money. As time passes, the time until receipt of the $100,000 grows shorter, and the present value rises. In 2029, 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.

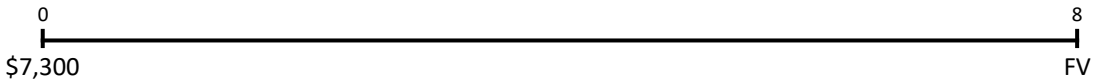
Solutions to Questions and Problems

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

Basic

1. The time line for the cash flows is:



The simple interest per year is:

$7,300 × .072 = $525.60

So, after 8 years you will have:

$525.60 × 8 = $4,204.80 in interest

The total balance will be $7,300 + 4,204.80 = $11,504.80

With compound interest we use the future value formula:

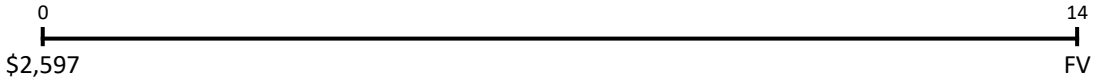
$FV = PV(1 + r)^t$
$FV = \$7,300(1.072)^8$
FV = $12,731.55

The difference is:

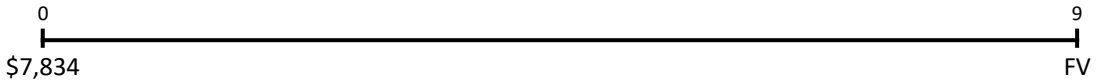
$12,731.55 – 11,504.80 = $1,226.75

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

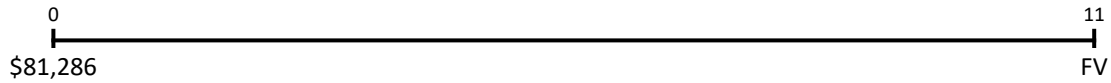
$FV = PV(1 + r)^t$



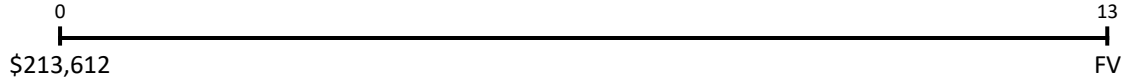
$FV = \$2,597(1.13)^{14}$ = $14,373.75



$FV = \$7,834(1.09)^9$ = $17,014.61



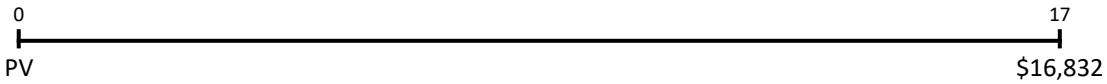
FV = $81,286(1.12)^{11} = $282,757.41



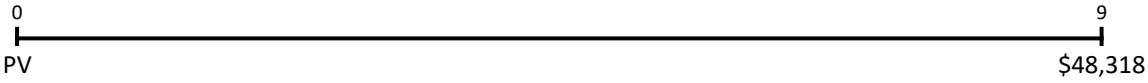
FV = $213,612(1.06)^{13} = $455,619.07

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

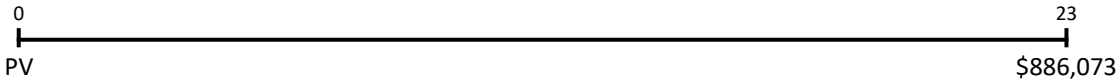
PV = FV/$(1 + r)^t$



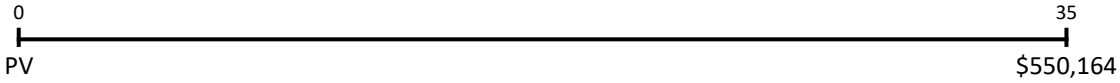
PV = $16,832/(1.12)^{17} = $2,451.49



PV = $48,318/(1.08)^{9} = $24,171.03



PV = $886,073/(1.10)^{23} = $98,955.00



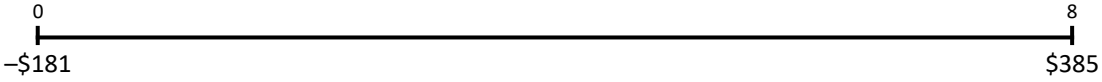
PV = $550,164/(1.19)^{35} = $1,248.38

4. 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:

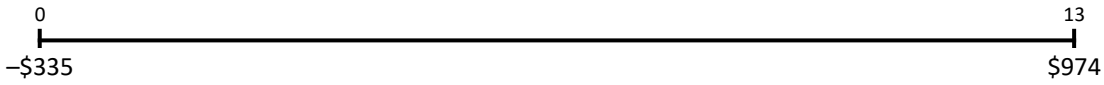
FV = PV$(1 + r)^t$

Solving for *r*, we get:

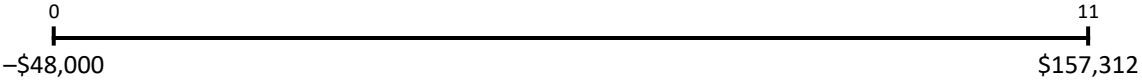
r = $(\text{FV/PV})^{1/t} - 1$



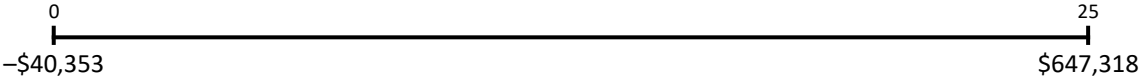
FV = $385 = 181(1 + r)^8$ *r* = ($385/$181)$^{1/8}$ – 1 = .0989, or 9.89%



FV = $974 = $335(1 + *r*)^{13} *r* = ($974/$335)$^{1/13}$ – 1 = .0856, or 8.56%



FV = $157,312 = $48,000(1 + *r*)^{11} *r* = ($157,312/$48,000)$^{1/11}$ – 1 = .1139, or 11.39%



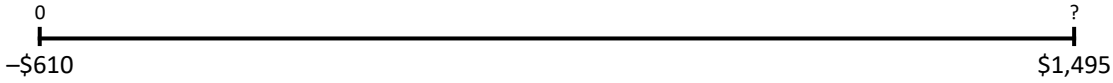
FV = $647,318 = $40,353(1 + *r*)^{25} *r* = ($647,318/$40,353)$^{1/25}$ – 1 = .1174, or 11.74%

5. 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:

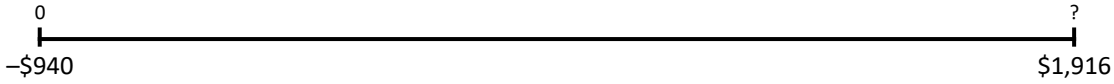
FV = PV(1 + *r*)^{t}

Solving for *t*, we get:

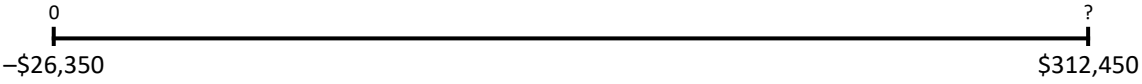
t = ln(FV/PV)/ln(1 + *r*)



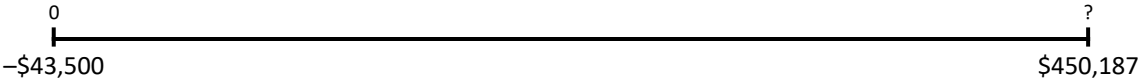
FV = $1,495 = $610(1.07)^{t} *t* = ln($1,495/$610)/ln1.07 = 13.25 years



FV = $1,916 = $940(1.08)^{t} *t* = ln($1,916/$940)/ln1.08 = 9.25 years

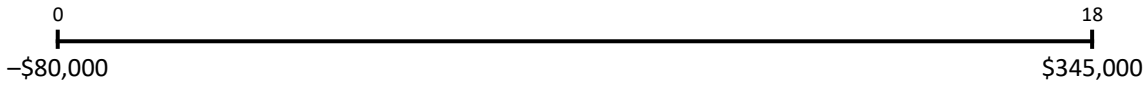


FV = $312,450 = $26,350(1.09)^{t} *t* = ln($312,450/$26,350)/ln1.09 = 28.70 years



FV = $450,187 = $43,500(1.11)^{t} *t* = ln($450,187/$43,500)/ln1.11 = 22.39 years

6. The time line is:



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:

$r = (FV/PV)^{1/t} - 1$
$r = (\$345{,}000/\$80{,}000)^{1/18} - 1$
$r = .0846$, or 8.46%

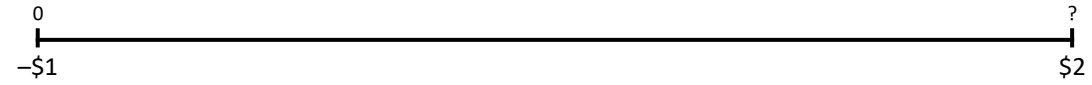
7. To find the length of time for money to double, triple, etc., the present value and future value are irrelevant as long as the future value is twice the present value for doubling, three times as large for tripling, etc. We can use either the FV or the PV formula. Both will give the same answer since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

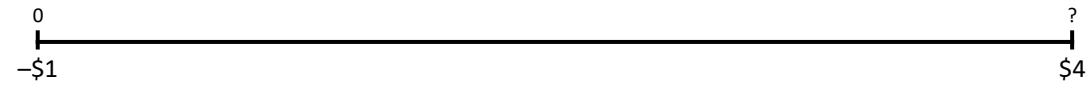
$t = \ln(FV/PV)/\ln(1 + r)$

The length of time to double your money is:



$FV = \$2 = \$1(1.036)^t$
$t = \ln 2/\ln 1.036 = 19.60$ years

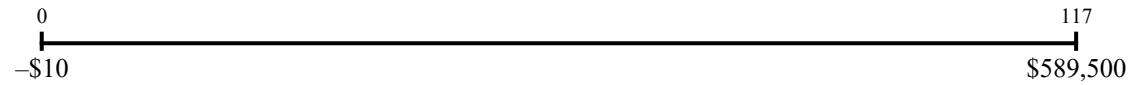
The length of time to quadruple your money is:



$FV = \$4 = \$1(1.036)^t$
$t = \ln 4/\ln 1.036 = 39.20$ years

Notice that the length of time to quadruple your money is twice as long as the time needed to double your money. This is an important concept of time value of money.

8. The time line is:



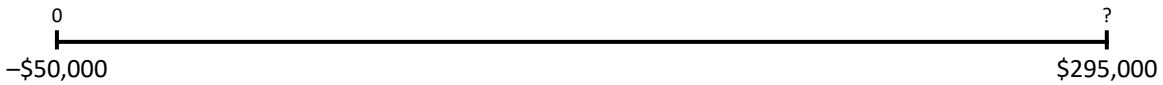
To answer this question, we can use either the FV or the PV formula. Both will give the same answer since they are the inverse of each other. We will use the FV formula, that is:

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

Solving for r, we get:

$r = (FV/PV)^{1/t} - 1$
$r = (\$589,500/\$10)^{1/117} - 1$
$r = .0984$, or 9.84%

9. The time line is:



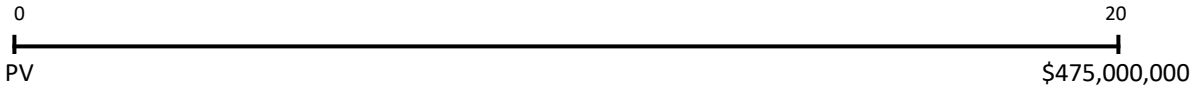
We can use either the FV or the PV formula. Both will give the same answer since they are the inverse of each other. We will use the FV formula, that is:

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

Solving for t, we get:

$t = \ln(FV/PV)/\ln(1 + r)$
$t = \ln(\$295,000/\$50,000)/\ln 1.048$
$t = 37.86$ years

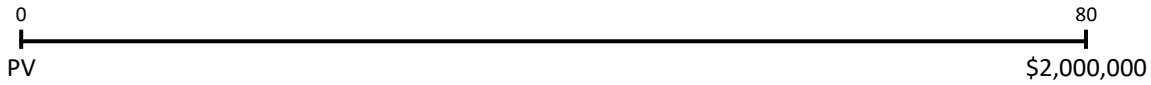
10. The time line is:



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

$PV = FV/(1 + r)^t$
$PV = \$475,000,000/(1.053)^{20}$
$PV = \$169,093,216.71$

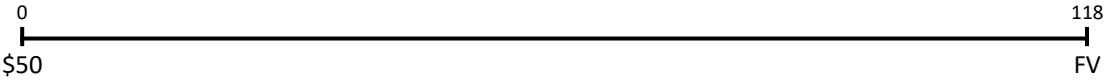
11. The time line is:



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

$PV = FV/(1 + r)^t$
$PV = \$2,000,000/(1.084)^{80}$
$PV = \$3,152.73$

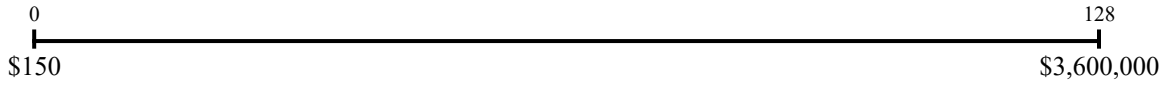
12. The time line is:



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

$FV = PV(1 + r)^t$
$FV = \$50(1.043)^{118}$
$FV = \$7,186.52$

13. The time line is:



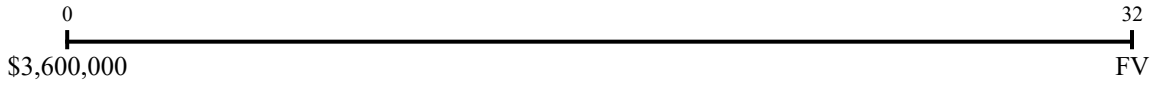
To answer this question, we can use either the FV or the PV formula. Both will give the same answer since they are the inverse of each other. We will use the FV formula, that is:

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

Solving for *r*, we get:

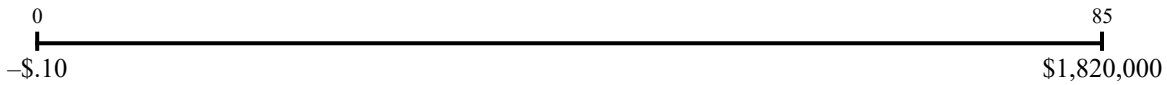
$r = (FV/PV)^{1/t} - 1$
$r = (\$3,600,000/\$150)^{1/128} - 1$
$r = .0820$, or 8.20%

To find the FV of the first prize in 2055, we use:



$FV = PV(1 + r)^t$
$FV = \$3,600,000(1.0820)^{32}$
$FV = \$44,807,974.36$

14. The time line is:



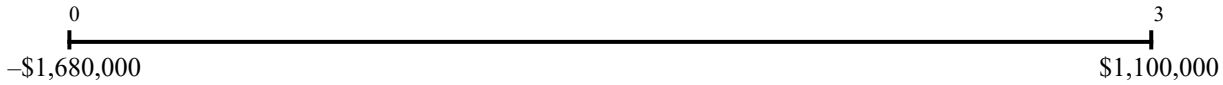
To answer this question, we can use either the FV or the PV formula. Both will give the same answer since they are the inverse of each other. We will use the FV formula, that is:

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

Solving for r, we get:

$r = (FV/PV)^{1/t} - 1$
$r = (\$1{,}820{,}000/\$.10)^{1/85} - 1$
$r = .2173$, or 21.73%

15. The time line is:



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

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

Solving for r, we get:

$r = (FV/PV)^{1/t} - 1$
$r = (\$1{,}100{,}000/\$1{,}680{,}000)^{1/3} - 1$
$r = -.1317$, or –13.17%

Intermediate

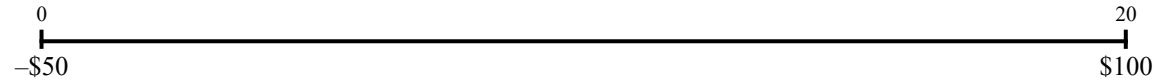
16. To answer this question, we can use either the FV or the PV formula. Both will give the same answer since they are the inverse of each other. We will use the FV formula, that is:

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

Solving for r, we get:

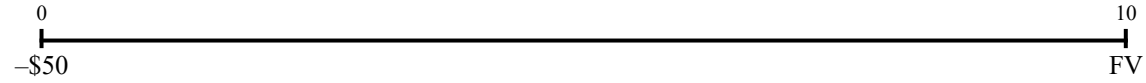
$r = (FV/PV)^{1/t} - 1$

a. The time line is:



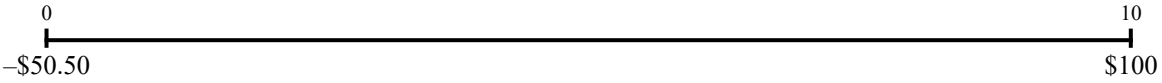
$r = (FV/PV)^{1/t} - 1$
$r = (\$100/\$50)^{1/20} - 1$
$r = .0353$, or 3.53%

b. The time line is:



$FV = PV(1 + r)^t$
$FV = \$50(1 + .027)^{10}$
$FV = \$65.26$

c. The time line is:



$r = (FV/PV)^{1/t} - 1$
$r = (\$100/\$65.26)^{1/10} - 1$
$r = .0436$, or 4.36%

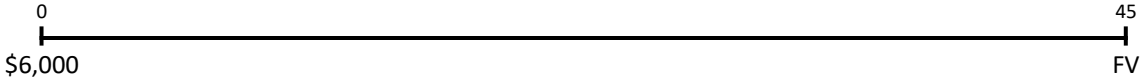
17. The time line is:

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

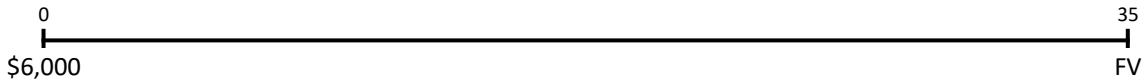
$PV = FV/(1 + r)^t$
$PV = \$295,000/(1.112)^9$
$PV = \$113,469.45$

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

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



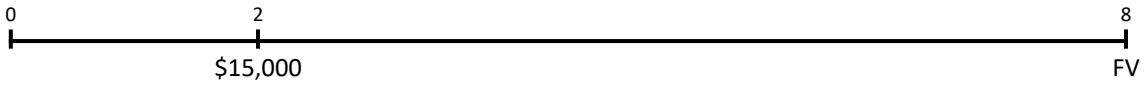
$FV = \$6,000(1.10)^{45}$
$FV = \$437,342.90$



FV = $6,000(1.10)^35
FV = $168,614.62

Better start early!

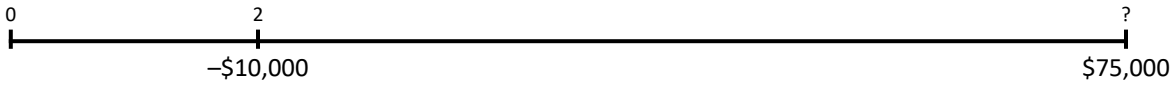
19. The time line is:



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 = $15,000(1.061)^6
FV = $21,398.51

20. The time line is:



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($75,000/$10,000)/ln1.11
t = 19.31

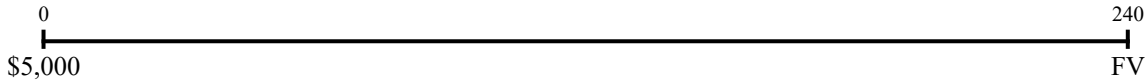
So, the money must be invested for 19.31 years. However, you will not receive the money for another two years. From now, you'll wait:

2 years + 19.31 years = 21.31 years

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

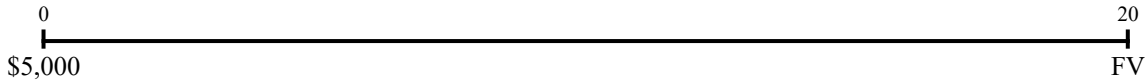
FV = PV(1 + *r*)^*t*

In Regency Bank, you will have:



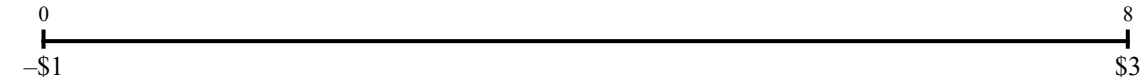
$FV = \$5{,}000(1.01)^{240}$
$FV = \$54{,}462.77$

And in King Bank, you will have:



$FV = \$5{,}000(1.12)^{20}$
$FV = \$48{,}231.47$

22. The time line is:



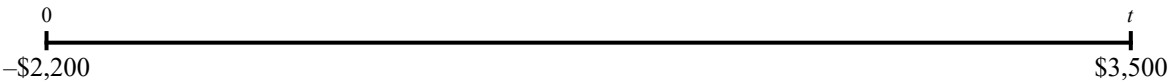
To find the length of time for money to double, triple, etc., the present value and future value are irrelevant as long as the future value is twice the present value for doubling, three times as large for tripling, etc. We also need to be careful about the number of periods. Since the length of the compounding is three months and we have 24 months, there are eight compounding periods. 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:

$r = (FV/PV)^{1/t} - 1$
$r = (\$3/\$1)^{1/8} - 1$
$r = .1472$, or 14.72%

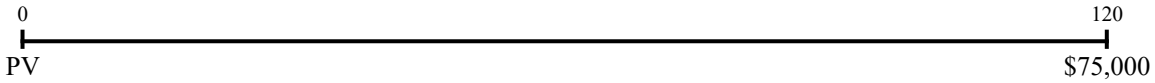
23. The time line is:



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:

$FV = PV(1 + r)^t$
$\$3{,}500 = \$2{,}200(1.0041)^t$
$t = \ln(\$3{,}500/\$2{,}200)/\ln 1.0041$
$t = 113.48$ months

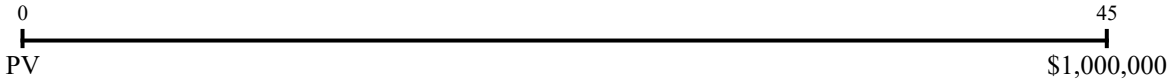
24. The time line is:



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

$PV = FV/(1 + r)^t$
$PV = \$75,000/1.0063^{120}$
$PV = \$35,299.17$

25. The time line is:



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

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

So, if you can earn 11.2 percent, you will need to invest:

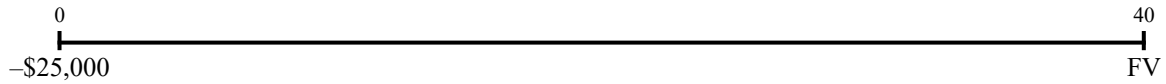
$PV = \$1,000,000/1.112^{45}$
$PV = \$8,419.47$

And if you can earn 5.6 percent, you will need to invest:

$PV = \$1,000,000/1.056^{45}$
$PV = \$86,123.90$

Challenge

26. The time line is:



In this case, we have an investment that earns two different interest rates. We will calculate the value of the investment at the end of the first 20 years then use this value with the second interest rate to find the final value at the end of 40 years. Using the future value equation, at the end of the first 20 years, the account will be worth:

Value in 20 years $= PV(1 + r)^t$
Value in 20 years $= \$25,000(1.06)^{20}$
Value in 20 years $= \$80,178.39$

Now we can find out how much this will be worth 20 years later at the end of the investment. Using the future value equation, we find:

Value in 40 years $= PV(1 + r)^t$

Value in 40 years = $80,178.39(1.10)^{20}$
Value in 40 years = $539,400.09

It is irrelevant which interest rate is offered when as long as each interest rate is offered for 20 years. We can find the value of the initial investment in 40 years with the following:

$FV = PV(1 + r_1)^t (1 + r_2)^t$
$FV = \$25,000(1.10)^{20}(1.06)^{20}$
FV = $539,400.09

With the commutative property of multiplication, it does not matter which order the interest rates occur; the final value will always be the same.

Calculator Solutions

1.

	N	I/Y	PV	PMT	FV
Enter	8	7.2%	$7,300		
Solve for					$12,731.55

$12,731.55 – 11,504.80 = $1,226.75

2.

	N	I/Y	PV	PMT	FV
Enter	14	13%	$2,597		
Solve for					$14,373.75

	N	I/Y	PV	PMT	FV
Enter	9	9%	$7,834		
Solve for					$17,014.61

	N	I/Y	PV	PMT	FV
Enter	11	12%	$81,286		
Solve for					$282,757.41

	N	I/Y	PV	PMT	FV
Enter	13	6%	$213,612		
Solve for					$455,619.07

3.

	N	I/Y	PV	PMT	FV
Enter	17	12%			$16,832
Solve for			$2,451.49		

	N	I/Y	PV	PMT	FV
Enter	9	8%			$48,318

Solve for			$24,171.03		
Enter	23	10%			$886,073
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$98,955.00		
Enter	35	19%			$550,164
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$1,248.38		

4.

Enter	8		$181		±$385
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for		9.89%			
Enter	13		$335		±$974
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for		8.56%			
Enter	11		$48,000		±$157,312
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for		11.39%			
Enter	25		$40,353		±$647,318
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for		11.74%			

5.

Enter		7%	$610		±$1,495
	N	**I/Y**	**PV**	**PMT**	**FV**
	13.25				
Enter		8%	$940		±$1,916
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for	9.25				
Enter		9%	$26,350		±$312,450
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for	28.70				
Enter		11%	$43,500		±$450,187
	N	**I/Y**	**PV**	**PMT**	**FV**

Solve for	22.39				

6.

Enter	18		$80,000		±$345,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for		8.46%			

7.

Enter		3.6%	$1		±$2
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for	19.60				

Enter		3.6%	$1		±$4
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for	39.20				

8.

Enter	117		±$10		$589,500
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for		9.84%			

9.

Enter		4.8%	$50,000		±$295,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for	37.86				

10.

Enter	20	5.3%			±$475,000,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$169,093,216.71		

11.

Enter	80	8.4%			±$2,000,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$3,152.73		

12.

Enter	118	4.3%	±$50		
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for					$7,186.52

13.

Enter	128		±$150		$3,600,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for		8.20%			

Enter	32	8.20%	±$3,600,000		
	N	**I/Y**	**PV**	**PMT**	**FV**

Solve for					$44,807,974.36

14.

Enter	85		±$.10		$1,820,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for		21.73%			

15.

Enter	3		±$1,680,000		$1,100,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for		–13.17%			

16. *a.*

Enter	20		±$50		$100
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for		3.53%			

b.

Enter	10	2.70%	±$50		
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for					$65.26

c.

Enter	10		±$65.26		$100
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for		4.36%			

17.

Enter	9	11.2%			±$295,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$113,469.45		

18.

Enter	45	10%	±$6,000		
	N	**I/Y**	**PV**	**PMT**	**FV**
					$437,342.90

Enter	35	10%	±$6,000		
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for					$168,614.62

19.

Enter	6	6.1%	±$15,000		
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for					$21,398.51

20.

Enter		11%	±$10,000		$75,000

	N	I/Y	PV	PMT	FV
Solve for	19.31				

From now, you'll wait 2 + 19.31 = 21.31 years.

21.

	N	I/Y	PV	PMT	FV
Enter	240	1%	±$5,000		
Solve for					$54,462.77

	N	I/Y	PV	PMT	FV
Enter	20	12%	±$5,000		
Solve for					$48,231.47

22.

	N	I/Y	PV	PMT	FV
Enter	8		±$1		$3
Solve for		14.72%			

23.

	N	I/Y	PV	PMT	FV
Enter		.41%	±$2,200		$3,500
Solve for	113.48				

24.

	N	I/Y	PV	PMT	FV
Enter	120	.63%			±$75,000
Solve for			$35,299.17		

25.

	N	I/Y	PV	PMT	FV
Enter	45	11.2%			±$1,000,000
Solve for			$8,419.47		

	N	I/Y	PV	PMT	FV
Enter	45	5.6%			±$1,000,000
Solve for			$86,123.90		

26.

	N	I/Y	PV	PMT	FV
Enter	20	6%	±$25,000		

Solve for					$80,178.39
Enter	20	10%	±$80,178.39		
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for					$539,400.09

CHAPTER 5
DISCOUNTED CASH FLOW VALUATION

Answers to Concepts Review and Critical Thinking Questions

1. Assuming positive cash flows and a positive interest rate, both the present and the future value will rise.

2. Assuming positive cash flows and a positive interest rate, the present value will fall, and the future value will rise.

3. It's deceptive, but very common. The deception is particularly irritating given that such lotteries are usually government sponsored!

4. The most important consideration is the interest rate the lottery uses to calculate the lump sum option. If you can earn an interest rate that is higher than you are being offered, you can create larger annuity payments. Of course, taxes are also a consideration, as well as how badly you really need $5 million today.

5. If the total amount of 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.

9. 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.

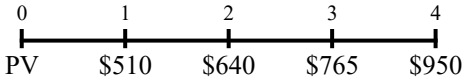
10. The problem is that the subsidy makes it easier to repay the loan, not to obtain it. However, the ability to repay the loan depends on future employment, not current need. For example, consider a student who is currently needy, but is preparing for a career in a high-paying area (such as corporate 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)?

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 time line is:



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:

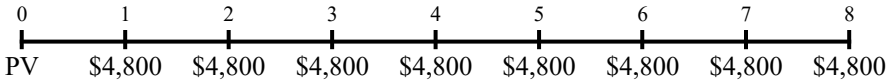
$PV = FV/(1 + r)^t$

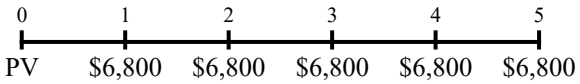
$PV@10\% = \$510/1.10 + \$640/1.10^2 + \$765/1.10^3 + \$950/1.10^4 = \$2,216.18$

$PV@18\% = \$510/1.18 + \$640/1.18^2 + \$765/1.18^3 + \$950/1.18^4 = \$1,847.44$

$PV@24\% = \$510/1.24 + \$640/1.24^2 + \$765/1.24^3 + \$950/1.24^4 = \$1,630.58$

The time lines are:





To find the PVA, we use the equation:

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

At a 5 percent interest rate:

X@5%: $PVA = \$4,800\{[1 - (1/1.05)^8]/.05\} = \$31,023.42$

Y@5%: $PVA = \$6,800\{[1 - (1/1.05)^5]/.05\} = \$29,440.44$

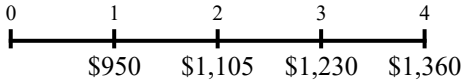
And at a 15 percent interest rate:

X@15%: $PVA = \$4,800\{[1 - (1/1.15)^8]/.15\} = \$21,539.14$

Y@15%: $PVA = \$6,800\{[1 - (1/1.15)^5]/.15\} = \$22,794.65$

Notice that the cash flow of X has a greater PV at a 5 percent interest rate, but a lower PV at a 15 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 larger cash flows early are more important since the cost of waiting (the interest rate) is so much greater.

2. The time line is:



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@6% $= \$950(1.06)^3 + \$1{,}105(1.06)^2 + \$1{,}230(1.06) + \$1{,}360 = \$5{,}036.84$

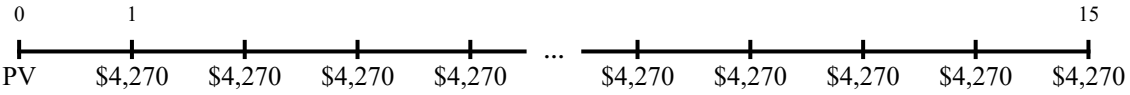
FV@13% $= \$950(1.13)^3 + \$1{,}105(1.13)^2 + \$1{,}230(1.13) + \$1{,}360 = \$5{,}531.63$

FV@27% $= \$950(1.27)^3 + \$1{,}105(1.27)^2 + \$1{,}230(1.27) + \$1{,}360 = \$6{,}650.32$

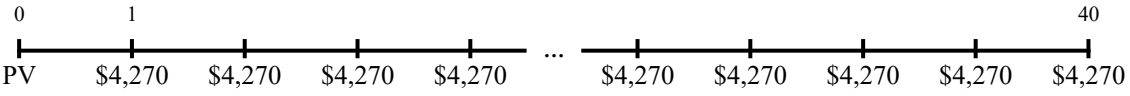
Notice, since we are finding the value at Year 4, the cash flow at Year 4 is added to the FV of the other cash flows. In other words, we do not need to compound this cash flow.

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

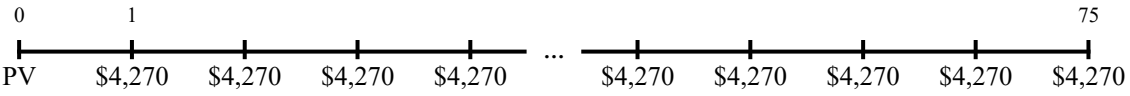
$PVA = C(\{1 - [1/(1 + r)^t]\}/r)$



PVA@15 yrs: $PVA = \$4{,}270\{[1 - (1/1.06)^{15}]/.06\} = \$41{,}471.30$



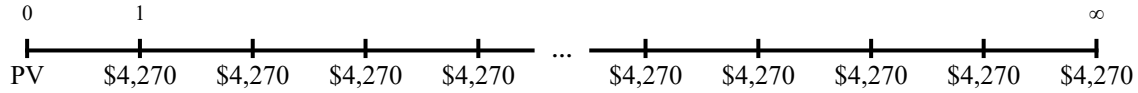
PVA@40 yrs: $PVA = \$4{,}270\{[1 - (1/1.06)^{40}]/.06\} = \$64{,}247.69$



PVA@75 yrs: $PVA = \$4{,}270\{[1 - (1/1.06)^{75}]/.06\} = \$70{,}266.47$

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

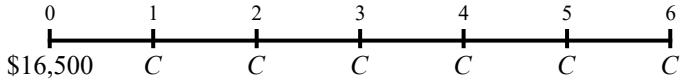
PV = C/r



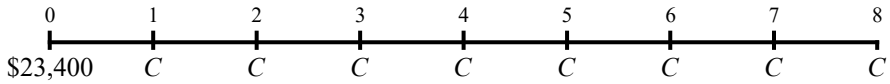
PV = $4,270/.06 = $71,166.67

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 $900.20.

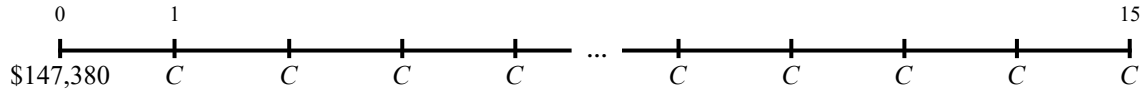
5. Here we have the PVA, the length of the annuity, and the interest rate. We want to calculate the annuity payment. Using the PVA equation and solving for the payment in each case, we find:



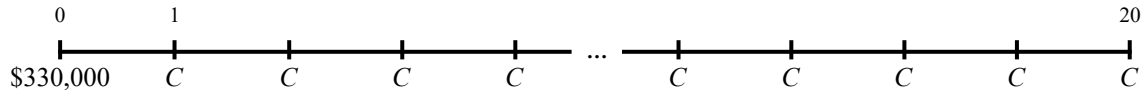
PVA = $C(\{1 – [1/(1 + r)^t]\}/r)$
$\$16,500 = C\{[1 – (1/1.11)^6]/.11\}$
$C = \$16,500/4.23054$
$C = \$3,900.21$



PVA = $C(\{1 – [1/(1 + r)^t]\}/r)$
$\$23,400 = C\{[1 – (1/1.07)^8]/.07\}$
$C = \$23,400/5.97130$
$C = \$3,918.75$

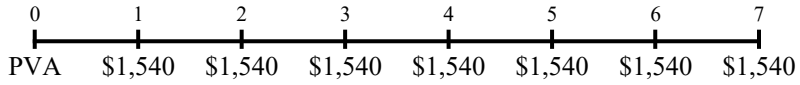


PVA = $C(\{1 – [1/(1 + r)^t]\}/r)$
$\$147,380 = C\{[1 – (1/1.08)^{15}]/.08\}$
$C = \$147,380/8.55948$
$C = \$17,218.34$

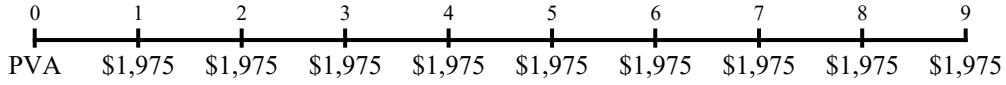


PVA = $C(\{1 – [1/(1 + r)^t]\}/r)$
$\$330,000 = C\{[1 – (1/1 .06)^{20}]/.06\}$
$C = \$330,000/11.46992$
$C = \$28,770.90$

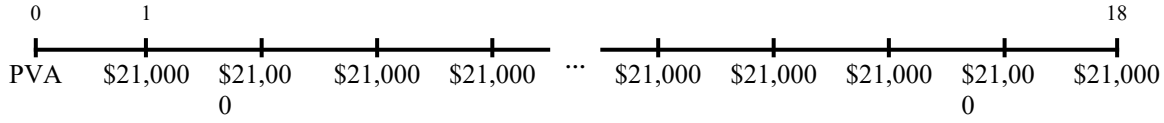
6. Here we need to find the present value of an annuity. Using the PVA equation, we find:



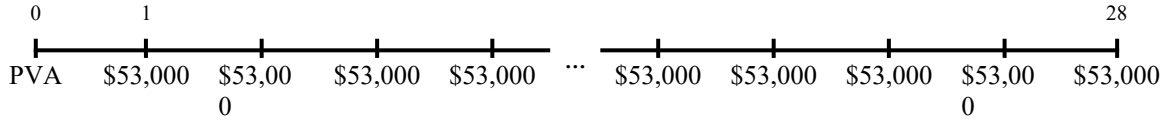
PVA = $C(\{1 - [1/(1 + r)^t]\}/r)$
PVA = $\$1,540\{[1 - (1/1.05)^7]/.05\}$
PVA = $8,911.02



PVA = $C(\{1 - [1/(1 + r)^t]\}/r)$
PVA = $\$1,975\{[1 - (1/1.10)^9]/.10\}$
PVA = $11,374.07

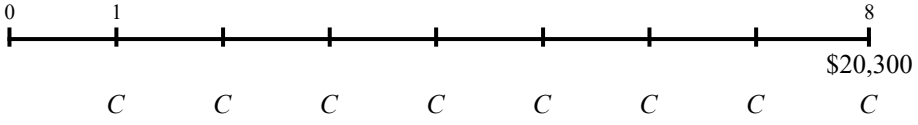


PVA = $C(\{1 - [1/(1 + r)^t]\}/r)$
PVA = $\$21,000\{[1 - (1/1.08)^{18}]/.08\}$
PVA = $196,809.63

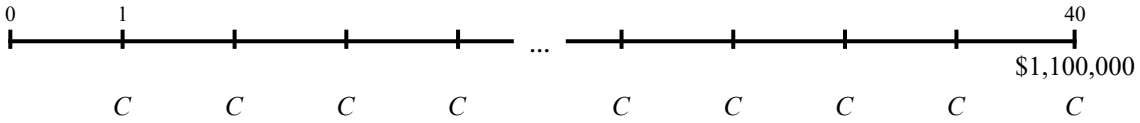


PVA = $C(\{1 - [1/(1 + r)^t]\}/r)$
PVA = $\$53,000\{[1 - (1/1.14)^{28}]/.14\}$
PVA = $368,915.10

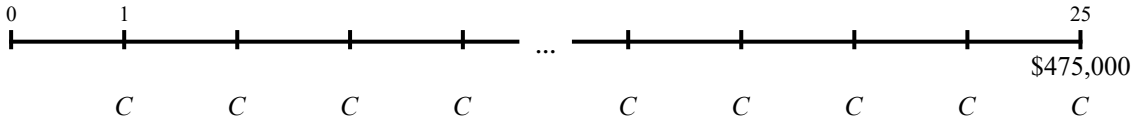
7. Here we have the FVA, the length of the annuity, and the interest rate. We want to calculate the annuity payment. Using the FVA equation:



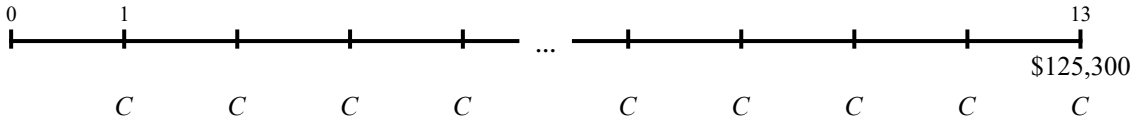
FVA = $C\{[(1 + r)^t - 1]/r\}$
$\$20,300 = C[(1.05^8 - 1)/.05]$
$C = \$20,300/9.54911$
$C = \$2,125.85$



FVA = $C\{[(1 + r)^t - 1]/r\}$
$\$1{,}100{,}000 = C[(1.07^{40} - 1)/.07]$
$C = \$1{,}100{,}000/199.63511$
$C = \$5{,}510.05$

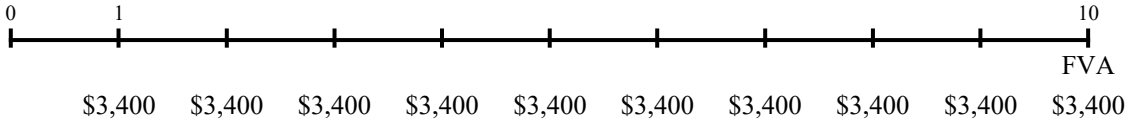


FVA = $C\{[(1 + r)^t - 1]/r\}$
$\$475{,}000 = C[(1.08^{25} - 1)/.08]$
$C = \$475{,}000/73.10594$
$C = \$6{,}497.42$

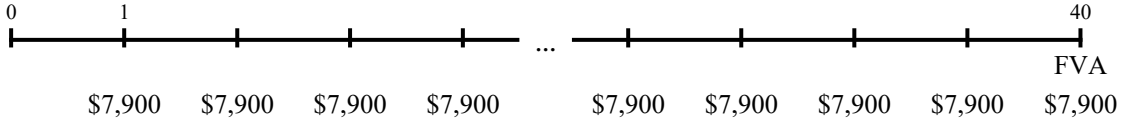


FVA = $C\{[(1 + r)^t - 1]/r\}$
$\$125{,}300 = C[(1.04^{13} - 1)/.04]$
$C = \$125{,}300/16.62684$
$C = \$7{,}536.01$

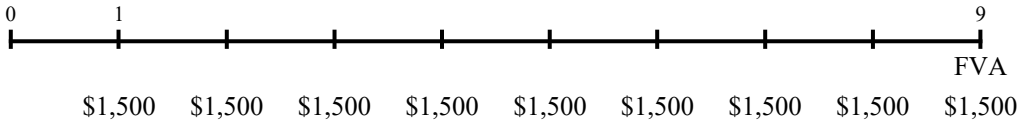
8. Here we need to find the future value of an annuity. Using the FVA equation, we find:



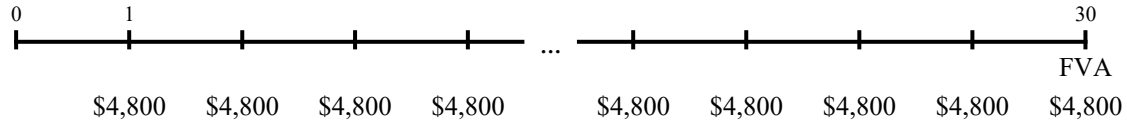
FVA = $C\{[(1 + r)^t - 1]/r\}$
$\text{FVA} = \$3{,}400[(1.07^{10} - 1)/.07]$
$\text{FVA} = \$46{,}975.92$



FVA = $C\{[(1 + r)^t - 1]/r\}$
$\text{FVA} = \$7{,}900[(1.08^{40} - 1)/.08]$
$\text{FVA} = \$2{,}046{,}546.50$



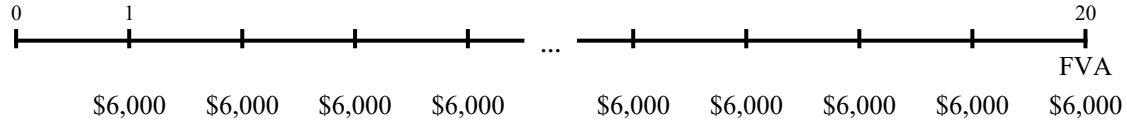
FVA = $C\{[(1 + r)^t - 1]/r\}$
FVA = $\$1,500[(1.09^9 - 1)/.09]$
FVA = $19,531.55



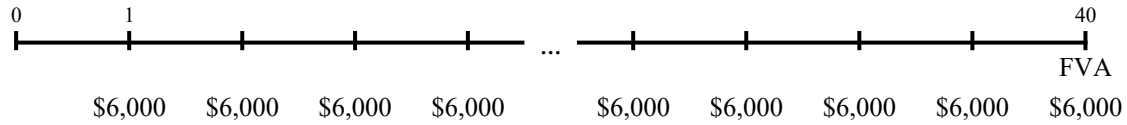
FVA = $C\{[(1 + r)^t - 1]/r\}$
FVA = $\$4,800[(1.11^{30} - 1)/.11]$
FVA = $955,300.21

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

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



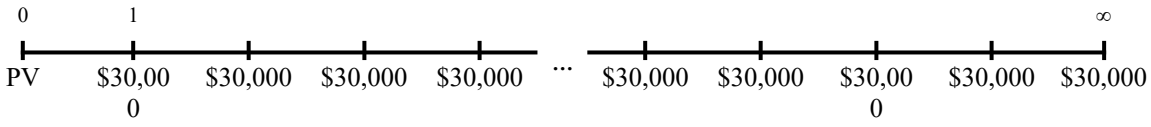
FVA for 20 years = $\$6,000[(1.098^{20} - 1)/.098]$
FVA for 20 years = $335,941.43



FVA for 40 years = $\$6,000[(1.098^{40} - 1)/.098]$
FVA for 40 years = $2,515,208.07

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

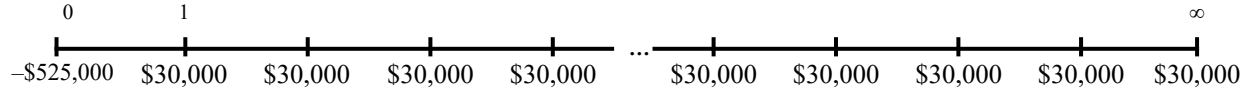
10. The time line is:



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

PV = C/r
PV = $30,000/.056
PV = $535,714.29

11. The time line is:



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
$525,000 = $30,000/$r$

We can now solve for the interest rate as follows:

r = $30,000/$525,000
r = .0571, or 5.71%

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

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

EAR = $[1 + (.071/4)]^4 - 1$ = .0729, or 7.29%

EAR = $[1 + (.180/12)]^{12} - 1$ = .1956, or 19.56%

EAR = $[1 + (.131/365)]^{365} - 1$ = .1399, or 13.99%

EAR = $[1 + (.122/365)]^2 - 1$ = .1257, or 12.57%

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

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

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

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

EAR = .131 = $[1 + (\text{APR}/2)]^2 - 1$	APR = $2[(1.131)^{1/2} - 1]$	= .1270, or 12.70%
EAR = .168 = $[1 + (\text{APR}/12)]^{12} - 1$	APR = $12[(1.168)^{1/12} - 1]$	= .1563, or 15.63%
EAR = .109 = $[1 + (\text{APR}/52)]^{52} - 1$	APR = $52[(1.109)^{1/52} - 1]$	= .1036, or 10.36%
EAR = .096 = $[1 + (\text{APR}/365)]^{365} - 1$	APR = $365[(1.096)^{1/365} - 1]$	= .0917, or 9.17%

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

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

So, for each bank, the EAR is:

First National: $EAR = [1 + (.129/12)]^{12} - 1 = .1369$, or 13.69%

First United: $EAR = [1 + (.132/2)]^2 - 1 = .1364$, or 13.64%

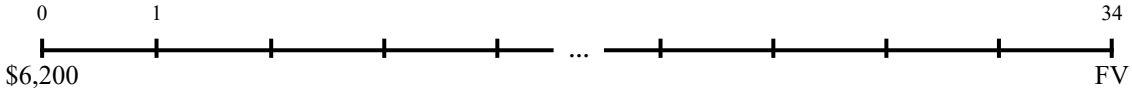
Notice that the higher APR does not necessarily result in the higher EAR. The number of compounding periods within a year will also affect the EAR.

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

$EAR = [1 + (APR/m)]^m - 1$
$APR = m[(1 + EAR)^{1/m} - 1]$
$APR = 365[(1 + .179)^{1/365} - 1]$
$APR = .1647$, or 16.47%

This is deceptive because the borrower is actually paying annualized interest of 17.9 percent per year, not the 16.47 percent reported on the loan contract.

16. The time line is:



For this problem, we need to find the FV of a lump sum using the equation:

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

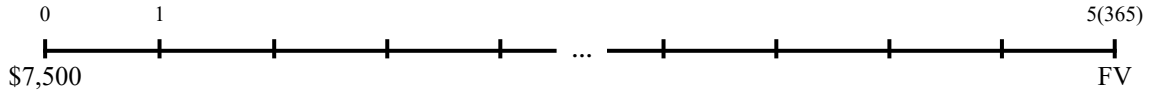
It is important to note that compounding occurs semiannually. To account for this, we will divide the interest rate by two (the number of compounding periods in a year), and multiply the number of periods by two. Doing so, we get:

$FV = \$6{,}200[1 + (.084/2)]^{17(2)}$
$FV = \$25{,}112.74$

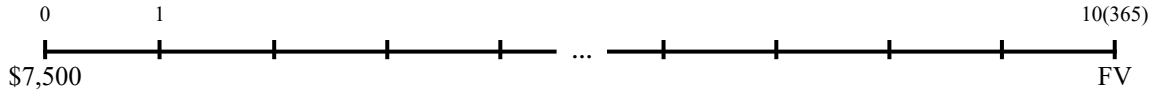
17. For this problem, we need to find the FV of a lump sum using the equation:

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

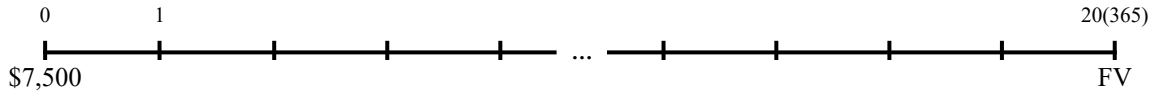
It is important to note that compounding occurs daily. To account for this, we will divide the interest rate by 365 (the number of days in a year, ignoring leap year), and multiply the number of periods by 365. Doing so, we get:



FV in 5 years = $\$7{,}500[1 + (.074/365)]^{5(365)}$
FV in 5 years = $10,857.60

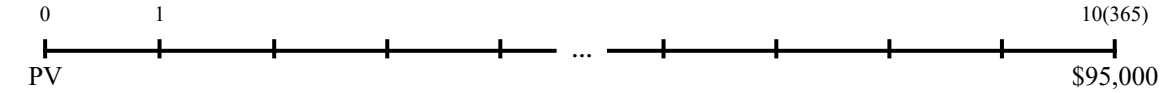


FV in 10 years = $\$7{,}500[1 + (.074/365)]^{10(365)}$
FV in 10 years = $15,718.34



FV in 20 years = $\$7{,}500[1 + (.074/365)]^{20(365)}$
FV in 20 years = $32,942.15

18. The time line is:



For this problem, we 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 = $\$95{,}000/[(1 + .084/365)^{10(365)}]$
PV = $41,016.46

19. The APR is the interest rate per period times the number of periods in a year. In this case, the interest rate is 23.8 percent per month, and there are 12 months in a year, so we get:

APR = 12(23.8%) = 285.60%

To find the EAR, we use the EAR formula:

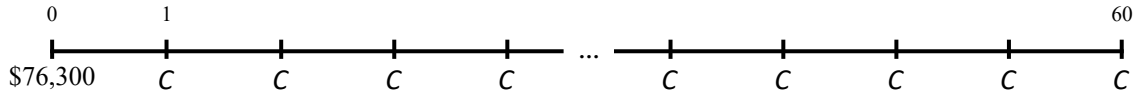
EAR = $[1 + (APR/m)]^m - 1$

EAR = $(1 + .238)^{12} - 1$

EAR = 11.9613, or 1,196.13%

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. The time line is:



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 = $C(\{1 - [1/(1 + r)^t]\}/r)$
$\$76,300 = C[1 - \{1/[1 + (.049/12)]^{60}\}/(.049/12)]$

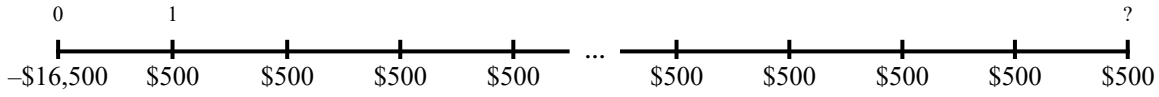
Solving for the payment, we get:

$C = \$76,300/53.1196$
$C = \$1,436.38$

To find the EAR, we use the EAR equation:

EAR = $[1 + (APR/m)]^m - 1$
EAR = $[1 + (.049/12)]^{12} - 1$
EAR = .0501, or 5.01%

21. The time line is:



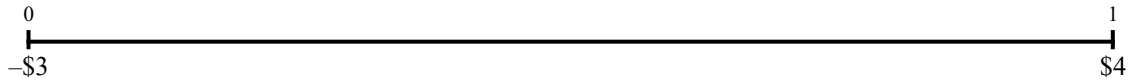
Here we need to find the length of an annuity. We know the interest rate, the PVA, and the payments. Using the PVA equation:

PVA = $C(\{1 - [1/(1 + r)^t]\}/r)$
$\$16,500 = \$500\{[1 - (1/1.018)^t]/.018\}$

Now we solve for t:

$1/1.018^t = 1 – (\$16{,}500/\$500)(.018)$
$1/1.018^t = .406$
$1.018^t = 1/.406 = 2.463$
$t = \ln 2.463/\ln 1.018$
$t = 50.53$ months

22. The time line is:



Here we are trying to find the interest rate when we know the PV and FV. Using the FV equation:

$FV = PV(1 + r)$
$\$4 = \$3(1 + r)$
$r = 4/3 – 1$
$r = .3333$, or 33.33% per week

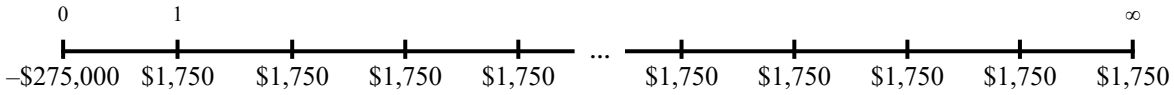
The interest rate is 33.33% per week. To find the APR, we multiply this rate by the number of weeks in a year, so:

APR = (52)33.33%
APR = 1,733.33%

And using the equation to find the EAR:

$EAR = [1 + (APR/m)]^m – 1$
$EAR = [1 + .3333]^{52} – 1$
EAR = 3,139,165.1569, or 313,916,515.69%

23. The time line is:



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:

$PV = C/r$
$\$275{,}000 = \$1{,}750/r$

We can now solve for the interest rate as follows:

$r = \$1{,}750/\$275{,}000$
$r = .0064$, or .64% per month

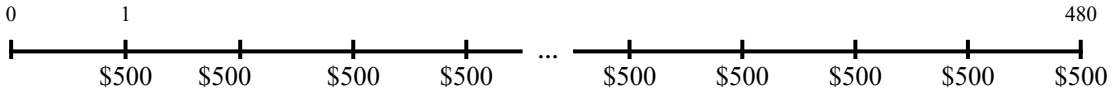
The interest rate is .64% per month. To find the APR, we multiply this rate by the number of months in a year, so:

APR = (12).64% = 7.64%

And using the equation to find an EAR:

EAR = $[1 + (APR/m)]^m - 1$
EAR = $[1 + .0064]^{12} - 1$
EAR = .0791, or 7.91%

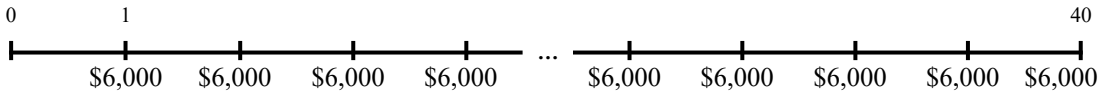
24. The time line is:



This problem requires us to find the FVA. The equation to find the FVA is:

FVA = $C\{[(1 + r)^t - 1]/r\}$
FVA = $\$500[\{[1 + (.10/12)]^{480} - 1\}/(.10/12)]$
FVA = $3,162,039.79

25. The time line is:



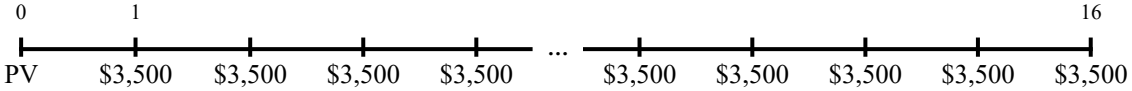
In the previous problem, the cash flows are monthly and the compounding period is monthly. The compounding periods are still monthly, but since the cash flows are annual, we need to use the EAR to calculate the future value of annual cash flows. It is important to remember that you have to make sure the compounding periods of the interest rate are the same as the timing of 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:

EAR = $[1 + (APR/m)]^m - 1$
EAR = $[1 + (.10/12)]^{12} - 1$
EAR = .1047, or 10.47%

Using the FVA equation, we get:

FVA = $C\{[(1 + r)^t - 1]/r\}$
FVA = $\$6,000[(1.1047^{40} - 1)/.1047]$
FVA = $3,019,718.42

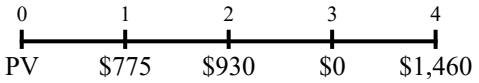
26. The time line is:



The cash flows are an annuity with four payments per year for four years, or 16 payments. We can use the PVA equation:

PVA = $C(\{1 - [1/(1 + r)^t]\}/r)$
PVA = $\$3{,}500\{[1 - (1/1.0061)^{16}]/.0061\}$
PVA = $\$53{,}199.67$

27. The time line is:



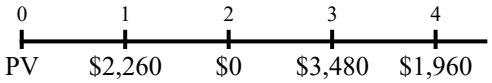
The cash flows are annual and the compounding period is quarterly, so we need to calculate the EAR to make the interest rate comparable with the timing of the cash flows. Using the equation for the EAR, we get:

EAR = $[1 + (\text{APR}/m)]^m - 1$
EAR = $[1 + (.085/4)]^4 - 1$
EAR = .0877, or 8.77%

And now we use the EAR to find the PV of each cash flow as a lump sum and add them together:

PV = $\$775/1.0877 + \$930/1.0877^2 + \$1{,}460/1.0877^4$
PV = $\$2{,}541.38$

28. The time line is:



Here the cash flows are annual and the given interest rate is annual, so we can use the interest rate given. We can find the PV of each cash flow and add them together.

PV = $\$2{,}260/1.0932 + \$3{,}480/1.0932^3 + \$1{,}960/1.0932^4$
PV = $\$6{,}103.32$

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:

$.073(10) = .73$

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

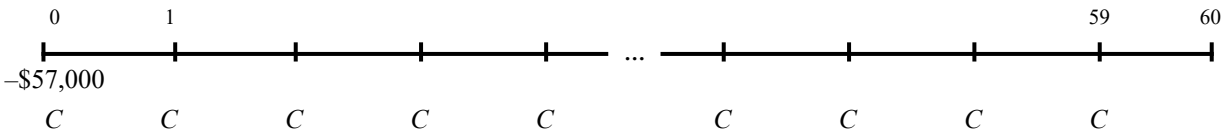
$(1 + r)^{10} - 1$

Setting the two equal, we get:

$(.073)(10) = (1 + r)^{10} - 1$

$r = 1.73^{1/10} - 1 = .0563$, or 5.63%

30. The time line is:



We need to use the PVA due equation, that is:

$PVA_{due} = (1 + r)PVA$

Using this equation:

$PVA_{due} = \$57,000 = [1 + (.054/12)] \times C[\{1 - 1/[1 + (.054/12)]^{60}\}/(.054/12)$
$\$56,744.65 = C\{1 - [1/(1 + .054/12)^{60}]\}/(.054/12)$
$C = \$1,081.27$

Notice, to find the payment for the PVA due we discount the loan amount for an ordinary annuity forward one period.

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

$FV = \$9,000[1 + (.015/12)]^6$
$FV = \$9,067.71$

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

$FV = \$9,067.71[1 + (.184/12)]^6$
$FV = \$9,934.58$

The problem asks for the interest accrued, so, to find the interest, we subtract the beginning balance from the FV. The interest accrued is:

Interest = $9,934.58 – 9,000
Interest = $934.58

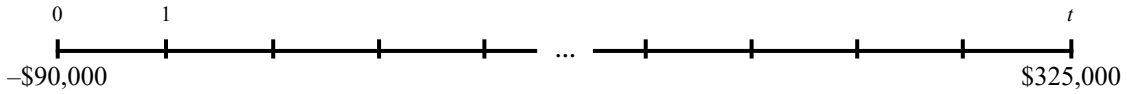
32. We will calculate the time we must wait if we deposit in the bank that pays simple interest. The interest amount we will receive each year in this bank will be:

Interest = $90,000(.048)
Interest = $4,320 per year

The deposit will have to increase by the difference between the amount we need by the amount we originally deposit divided by the interest earned per year, so the number of years it will take in the bank that pays simple interest is:

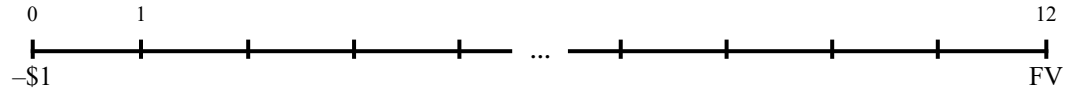
Years to wait = ($325,000 – 90,000)/$4,320
Years to wait = 54.40 years

To find the number of years it will take in the bank that pays compound interest, we can use the future value equation for a lump sum and solve for the periods. Doing so, we find:



$FV = PV(1 + r)^t$
$\$325,000 = \$90,000[1 + (.048/12)]^t$
t = 321.65 months, or 26.80 years

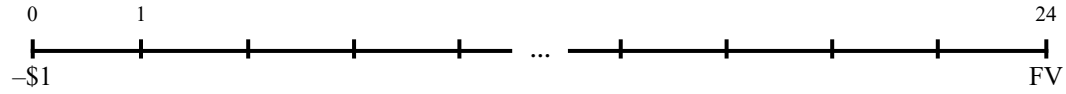
33. The time line is:



Here we need to find the future value of a lump sum. We need to make sure to use the correct number of periods. So, the future value after one year will be:

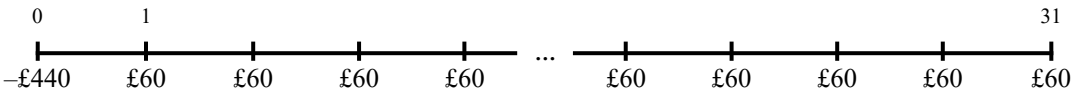
$FV = PV(1 + r)^t$
$FV = \$1(1.0074)^{12}$
$FV = \$1.09$

And the future value after two years will be:



$FV = PV(1 + r)^t$
$FV = \$1(1.0074)^{24}$
$FV = \$1.19$

34. The time line is:



Here we are given the PVA, number of periods, and the amount of the annuity. We need to solve for the interest rate. Even though the currency is pounds and not dollars, we can still use the same time value equations. Using the PVA equation:

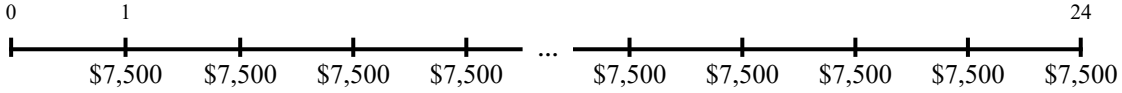
$PVA = C(\{1 - [1/(1 + r)^t]\}/r)$
$£440 = £60[\{1 - [1/(1 + r)^{31}]\}/r]$

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 decreases the PVA, and decreasing the interest rate increases the PVA. Using a spreadsheet, we find:

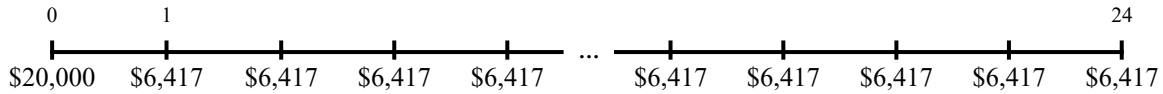
$r = 13.36\%$

Not bad for an English Literature major!

35. Here we need to compare two cash flows, so we will find the value today of both sets of cash flows. We need to make sure to use the monthly cash flows since the salary is paid monthly. Doing so, we find:



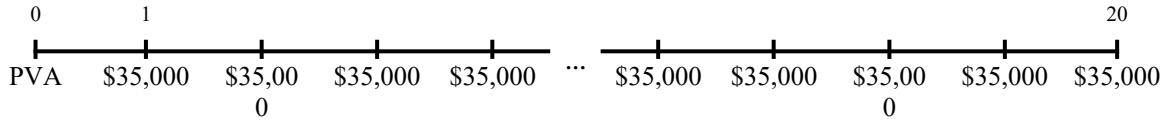
$PVA_1 = \$90,000/12(\{1 - 1/[1 + (.06/12)]^{24}\}/(.06/12))$
$PVA_1 = \$169,221.50$



$PVA_2 = \$20,000 + \$77,000/12(\{1 - 1/[1 + (.06/12)]^{24}\}/(.06/12))$
$PVA_2 = \$164,778.39$

You should choose the first option since it has a higher present value.

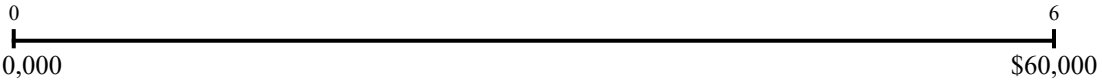
36. The time line is:



The cash flows are an annuity, so we can use the present value of an annuity equation. Doing so, we find:

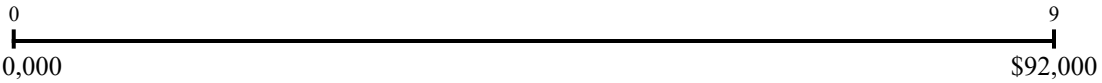
$PVA = C(\{1 - [1/(1 + r)^t]\}/r)$
$PVA = \$35,000(\{1 - [1/(1.09)^{20}]\}/.09)$
$PVA = \$319,499.10$

37. The investment we should choose is the investment with the higher rate of return. We will use the future value equation to find the interest rate for each option. Doing so, we find the return for Investment G is:



$FV = PV(1 + r)^t$
$\$60,000 = \$30,000(1 + r)^6$
$r = (\$60,000/\$30,000)^{1/6} – 1$
$r = .1225$, or 12.25%

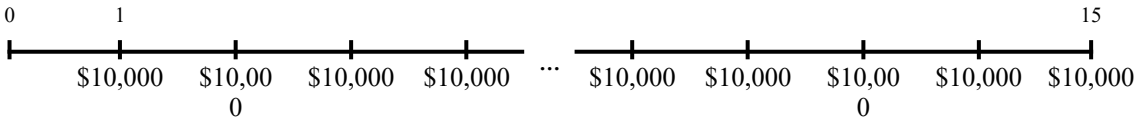
And the return for Investment H is:



$FV = PV(1 + r)^t$
$\$92,000 = \$30,000(1 + r)^9$
$r = (\$92,000/\$30,000)^{1/9} – 1$
$r = .1326$, or 13.26%

So, we should choose Investment H since it has a higher return.

38. The time line is:



The relationships between the present value of an annuity and the interest rate are:

PVA falls as *r* increases, and PVA rises as *r* decreases.
FVA rises as *r* increases, and FVA falls as *r* decreases.

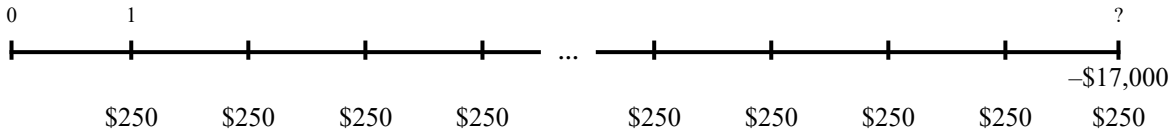
The present values of $10,000 per year for 15 years at the various interest rates given are:

$PVA@10\% = \$10,000\{[1 – (1/1.10)^{15}]/.10\} = \$76,060.80$

$PVA@5\% = \$10,000\{[1 – (1/1.05)^{15}]/.05\} = \$103,796.58$

$PVA@15\% = \$10,000\{[1 – (1/1.15)^{15}]/.15\} = \$58,473.70$

39. The time line is:



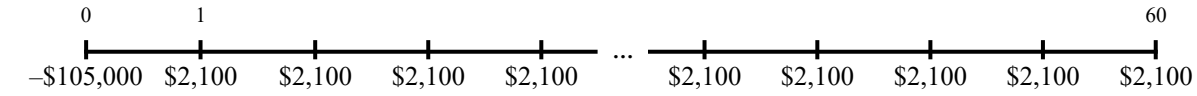
Here we are given the FVA, the interest rate, and the amount of the annuity. We need to solve for the number of payments. Using the FVA equation:

FVA = \$17,000 = \$250[{[1 + (.065/12)]^t – 1}/(.065/12)]

Solving for *t*, we get:

1.00542^t = 1 + (\$17,000/\$250)(.065/12)
t = ln1.36833/ln1.00542
t = 58.05 payments

40. The time line is:



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:

PVA = \$105,000 = \$2,100[{1 – [1/(1 + *r*)^{60}]}/*r*]

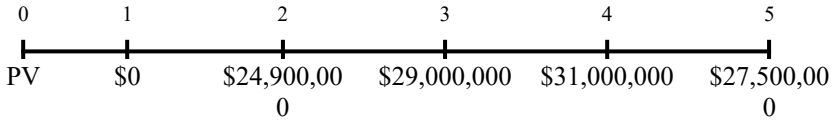
To find the interest rate, we need to solve this equation on a financial calculator, using a spreadsheet, or by trial and error. If you use trial and error, remember that increasing the interest rate lowers the PVA, and decreasing the interest rate increases the PVA. Using a spreadsheet, we find:

r = .618%

The APR is the periodic interest rate times the number of periods in the year, so:

APR = 12(.618%) = 7.42%

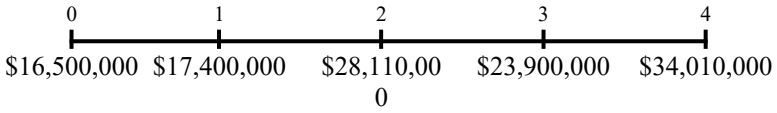
41. The time line is:



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 = \$24,900,000/1.11^2 + \$29,000,000/1.11^3 + \$31,000,000/1.11^4 + \$27,500,000/1.11^5
PV = \$78,154,520.37

42. The time line is:



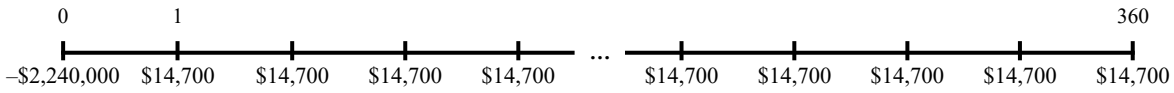
To solve this problem, we must find the PV of each cash flow and add them. To find the PV of a lump sum, we use:

$PV = FV/(1 + r)^t$
$PV = \$16,500,000 + \$17,400,000/1.11 + \$28,110,000/1.11^2 + \$23,900,000/1.11^3 + \$34,010,000/1.11^4$
$PV = \$94,869,296.72$

43. Here we are finding the interest rate for an annuity cash flow. We are given the PVA, the number of periods, and the amount of the annuity. We should also note that the PV of the annuity is the amount borrowed, not the purchase price, since we are making a down payment on the warehouse. The amount borrowed is:

Amount borrowed = .80($2,800,000) = $2,240,000

The time line is:



Using the PVA equation:

$PVA = \$2,240,000 = \$14,700[\{1 - [1/(1 + r)^{360}]\}/r]$

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 decreasing the interest rate increases the PVA. Using a spreadsheet, we find:

$r = .572\%$

The APR is the monthly interest rate times the number of months in the year, so:

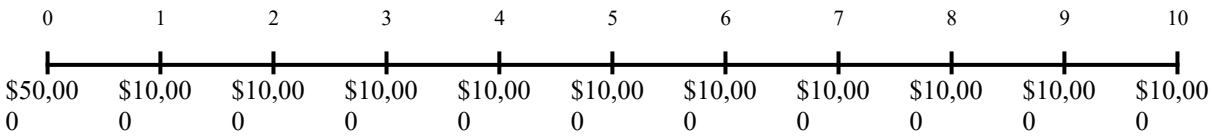
APR = 12(.572%)
APR = 6.86%

And the EAR is:

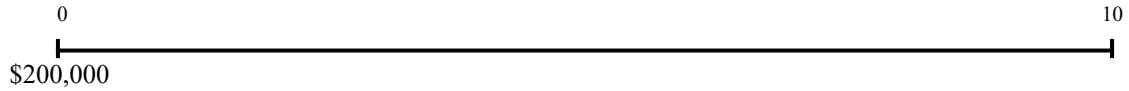
$EAR = (1 + .00572)^{12} - 1$
EAR = .0709, or 7.09%

44. Here we have two cash flow streams that will be combined in the future. In essence, we have three time lines. We will start with the time lines for the savings period, which are:

Bond account:



Stock account:



To find the withdrawal amount, we need to know the present value, as well as the interest rate and periods, which are given. The present value of the retirement account is the future value of the stock and bond account. We need to find the future value of each account and add the future values together. For the bond account, the future value is the value of the current savings plus the value of the annual deposits. So, the future value of the bond account will be:

$FV = C\{[(1 + r)^t - 1]/r\} + PV(1 + r)^t$
$FV = \$10{,}000\{[(1 + .06)^{10} - 1]/.06\} + \$50{,}000(1 + .06)^{10}$
$FV = \$221{,}350.33$

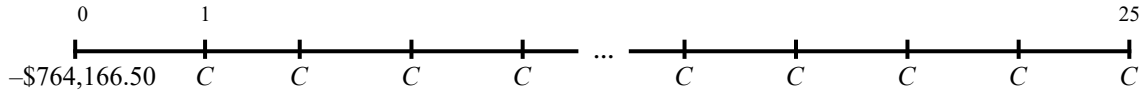
The total value of the stock account at retirement will be the future value of a lump sum, so:

$FV = PV(1 + r)^t$
$FV = \$200{,}000(1 + .105)^{10}$
$FV = \$542{,}816.17$

The total value of the account at retirement will be:

Total value at retirement = $221,350.33 + 542,816.17
Total value at retirement = $764,166.50

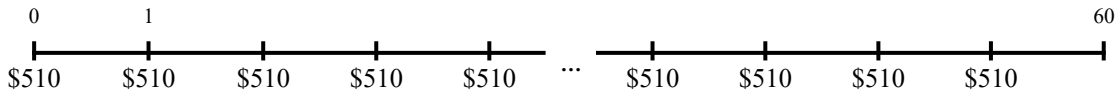
So, at retirement, we have:



This amount is the present value of the annual withdrawals. Now we can use the present value of an annuity equation to find the annuity amount. Doing so, we find the annual withdrawal will be:

$PVA = C(\{1 - [1/(1 + r)^t]\}/r)$
$\$764{,}166.50 = C[\{1 - [1/(1 + .053)^{25}]\}/.053]$
$C = \$55{,}861.16$

45. The time line is:



Here we are given the PVA for an annuity due, number of periods, and the amount of the annuity. We need to solve for the interest rate. Using the PVA equation:

$PVA_{due} = C[\{1 - [1/(1 + r)]^t\}/ r](1 + r)$
$\$26{,}500 = \$510[\{1 - [1/(1 + r)]^{60}\}/r](1 + r)$

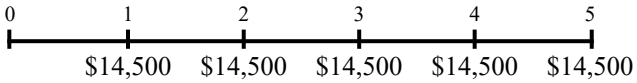
To find the interest rate, we need to solve this equation on a financial calculator, using a spreadsheet, or by trial and error. If you use trial and error, remember that increasing the interest rate decreases the PVA, and decreasing the interest rate increases the PVA. Using a spreadsheet, we find:

$r = .00502$, or .502%

This is the monthly interest rate. To find the APR with a monthly interest rate, we multiply the monthly rate by 12, so the APR is:

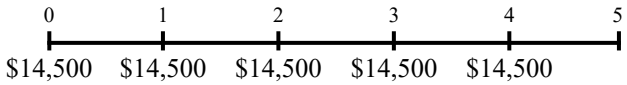
APR = .00502 × 12
APR = .0602, or 6.02%

46. *a.* If the payments are in the form of an ordinary annuity, the present value will be:



$PVA = C(\{1 - [1/(1 + r)^t]\}/r)$
$PVA = \$14{,}500[\{1 - [1/(1 + .068)^5]\}/ .068]$
PVA = $59,772.60

If the payments are an annuity due, the present value will be:



$PVA_{due} = (1 + r)PVA$
$PVA_{due} = (1 + .068)\$59{,}772.60$
$PVA_{due} = \$63{,}837.13$

b. We can find the future value of the ordinary annuity as:

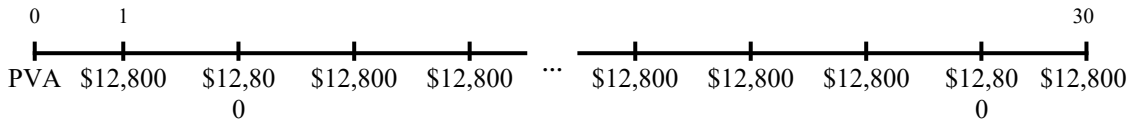
$FVA = C\{[(1 + r)^t - 1]/r\}$
$FVA = \$14{,}500\{[(1 + .068)^5 - 1]/.068\}$
FVA = $83,053.59

If the payments are an annuity due, the future value will be:

$FVA_{due} = (1 + r)FVA$
$FVA_{due} = (1 + .068)\$83,053.59$
$FVA_{due} = \$88,701.23$

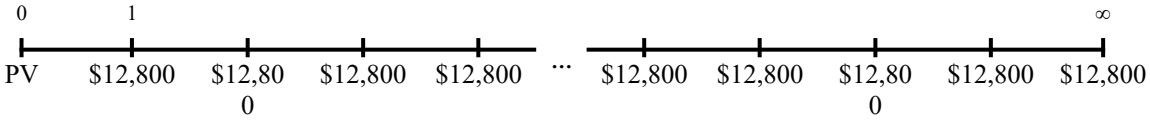
c. Assuming a positive interest rate, the present value of an annuity due will always be larger than the present value of an ordinary annuity. Each cash flow in an annuity due is received one period earlier, which means there is one period less to discount each cash flow. Assuming a positive interest rate, the future value of an annuity due will always be higher than the future value of an ordinary annuity. Since each cash flow is made one period sooner, each cash flow receives one extra period of compounding.

47. Here we need to find the difference between the present value of an annuity and the present value of a perpetuity. The annuity time line is:



$PVA = C(\{1 - [1/(1 + r)^t]\}/r)$
$PVA = \$12,800\{[1 - (1/1.043)^{30}]/.043\}$
$PVA = \$213,493.77$

And the present value of the perpetuity is:



$PVP = C/r$
$PVP = \$12,800/.043$
$PVP = \$297,674.42$

So, the difference in the present values is:

Difference = $297,674.42 – 213,493.77
Difference = $84,180.65

There is another common way to answer this question. We need to recognize that the difference in the cash flows is a perpetuity of $12,800 beginning 31 years from now. We can find the present value of this perpetuity and the solution will be the difference in the cash flows. So, we can find the present value of this perpetuity as:

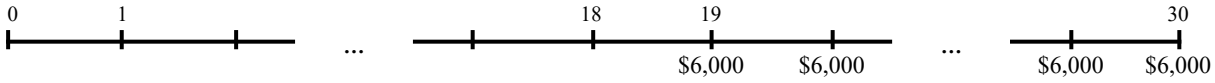
$PVP = C/r$
$PVP = \$12,800/.043$
$PVP = \$297,674.42$

This is the present value 30 years from now, one period before the first cash flows. We can now find the present value of this lump sum as:

$PV = FV/(1 + r)^t$
$PV = \$297,674.42/(1 + .043)^{30}$
$PV = \$84,180.65$

This is the same answer we calculated before.

48. The time line is:



Here we need to find the present value of an annuity at several different times. The annuity has semiannual payments, so we need the semiannual interest rate. The semiannual interest rate is:

Semiannual rate = .09/2
Semiannual rate = .045

Now, we can use the present value of an annuity equation. Doing so, we get:

$PVA = C(\{1 - [1/(1 + r)^t]\}/r)$
$PVA = \$6,000\{[1 - (1/1.045)^{20}]/.045\}$
$PVA = \$78,047.62$

This is the present value one period before the first payment. The first payment occurs nine and one-half years from now, so this is the value of the annuity nine years from now. Since the interest rate is semiannual, we must also be careful to use the number of semiannual periods. The value of the annuity five years from now is:

$PV = FV/(1 + r)^t$
$PV = \$78,047.62/(1 + .045)^8$
$PV = \$54,881.92$

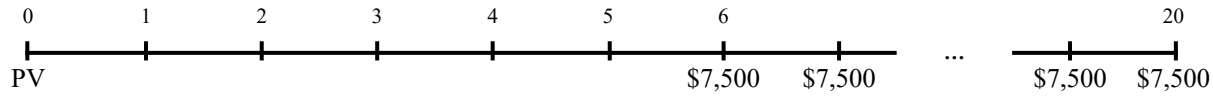
And the value of the annuity three years from now is:

$PV = FV/(1 + r)^t$
$PV = \$78,047.62/(1 + .045)^{12}$
$PV = \$46,021.86$

And the value of the annuity today is:

$PV = FV/(1 + r)^t$
$PV = \$78,047.62/(1 + .045)^{18}$
$PV = \$35,339.99$

49. The time line is:



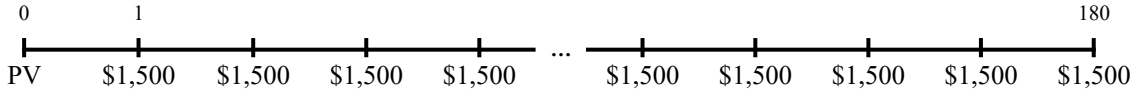
We want to find the value of the cash flows today, so we will find the PV of the annuity, and then bring the lump sum PV back to today. The annuity has 15 payments, so the PV of the annuity is:

$PVA = \$7,500\{[1 - (1/1.084^{15})]/.084\}$
$PVA = \$62,657.46$

Since this is an ordinary annuity equation, this is the PV one period before the first payment, so this is the PV at $t = 5$. To find the value today, we find the PV of this lump sum. The value today is:

$PV = \$62,657.46/1.084^{5}$
$PV = \$41,862.62$

50. The time line is:



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:

$PVA_2 = \$1,500\{1 - 1/[1 + (.06/12)]^{96}\}/(.06/12)]$
$PVA_2 = \$114,142.83$

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:

$PV = \$114,142.83/[1 + (.09/12)]^{84}$
$PV = \$60,934.61$

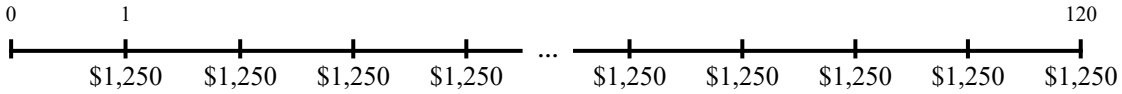
Now we need to find the PV of the annuity for the first seven years. The value of these cash flows today is:

$PVA_1 = \$1,500[\{1 - 1/[1 + (.09/12)]^{84}\}/(.09/12)]$
$PVA_1 = \$93,230.95$

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

$PV = \$60,934.61 + 93,230.95$
$PV = \$154,165.55$

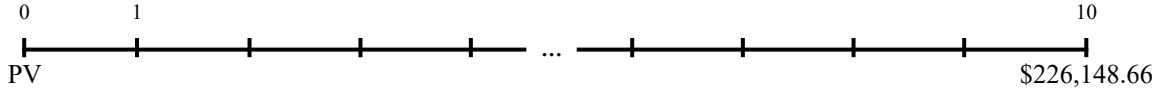
51. The time line for the annuity is:



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 = $1,250[{[1 + (.078/12)]^{120} – 1}/(.078/12)]
FVA = $226,148.66

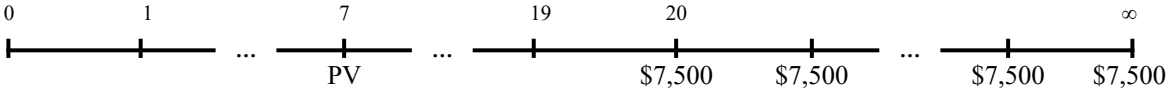
Now we have:



So, we need to find the PV of a lump sum that will give us the same FV. Using the FV of a lump sum with continuous compounding, we get:

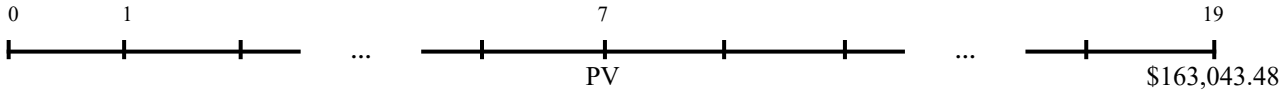
FV = $226,148.66 = PV(1 + .07)$^{(10)}$
PV = $226,148.66/1.07^{10}
PV = $114,962.51

52. The time line is:



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:

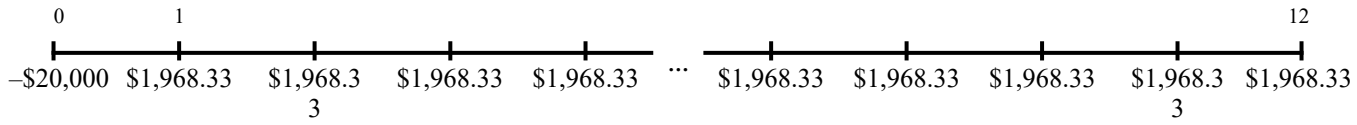
PV = $7,500/.046
PV = $163,043.48



Remember that the PV of perpetuity (and annuity) equations give the PV one period before the first payment, so, this is the value of the perpetuity at $t = 19$. To find the value at $t = 7$, we find the PV of this lump sum as:

PV = $163,043.48/1.046^{12}
PV = $95,043.67

53. The time line is:



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:

$PVA = \$20{,}000 = \$1{,}968.33\{(1 - [1/(1 + r)^{12}])/r\}$

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

$r = 2.657\%$ per month

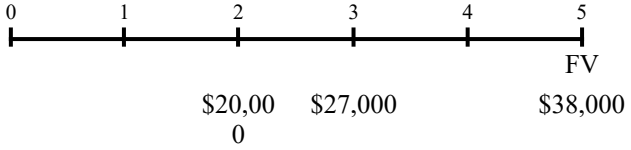
So the APR that would legally have to be quoted is:

$APR = 12(2.657\%)$
$APR = 31.88\%$

And the EAR is:

$EAR = 1.02657^{12} - 1$
$EAR = .3698$, or 36.98%

54. The time line is:



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:

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

$FV = \$20{,}000(1.064)^3 + \$27{,}000(1.064)^2 + \$38{,}000$
$FV = \$92{,}657.59$

Notice, since we are finding the value at Year 5, the cash flow at Year 5 is added to the FV of the other cash flows. In other words, we do not need to compound this cash flow. To find the value in Year 10, we need to find the future value of this lump sum. Doing so, we find:

$FV = PV(1 + r)^t$
$FV = \$92{,}657.59(1.064)^5$
$FV = \$126{,}354.05$

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 = \$56,500 = $C\{[1 - 1/(1 + .06)^5]/.06\}$
C = \$13,412.90

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:

Year	Beginning Balance	Total Payment	Interest Payment	Principal Payment	Ending Balance
1	\$56,500.00	\$13,412.90	\$3,390.00	\$10,022.90	\$46,477.10
2	46,477.10	13,412.90	2,788.63	10,624.27	35,852.83
3	35,852.83	13,412.90	2,151.17	11,261.73	24,591.11
4	24,591.11	13,412.90	1,475.47	11,937.43	12,653.68
5	12,653.68	13,412.90	759.22	12,653.68	0

In the third year, \$2,151.17 of interest is paid.

Total interest over life of the loan = \$3,390 + 2,788.63 + 2,151.17 + 1,475.47 + 759.22
Total interest over life of the loan = \$10,564.48

56. This amortization table calls for equal principal payments of \$11,300 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:

Year	Beginning Balance	Total Payment	Interest Payment	Principal Payment	Ending Balance
1	\$56,500	\$14,690	\$3,390	\$11,300	\$45,200
2	45,200	14,012	2,712	11,300	33,900
3	33,900	13,334	2,034	11,300	22,600
4	22,600	12,656	1,356	11,300	11,300
5	11,300	11,978	678	11,300	0

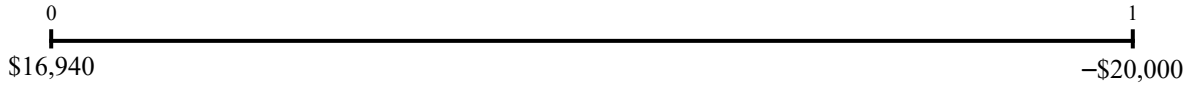
In the third year, \$2,034 of interest is paid.

Total interest over life of the loan = \$3,390 + 2,712 + 2,034 + 1,356 + 678
Total interest over life of the loan = \$10,170

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 time line is:

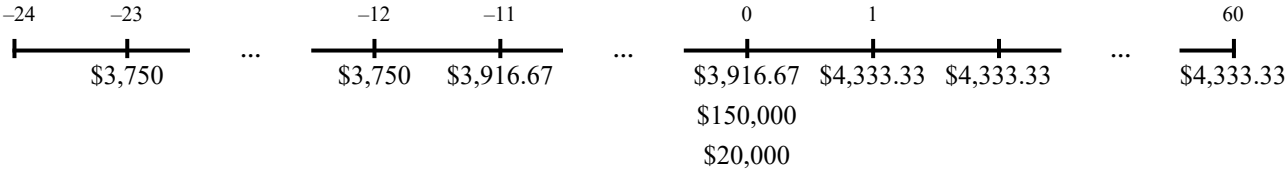


To find the APR and EAR, we need to use the actual cash flows of the loan. In other words, the interest rate quoted in the problem is only relevant to determine the total interest under the terms given. The cash flows of the loan are the $20,000 you must repay in one year, and the $16,940 you borrow today. The interest rate of the loan is:

$\$20,000 = \$16,940(1 + r)$
$r = \$20,000/\$16,940 – 1$
$r = .1806$, or 18.06%

Because of the discount, you only get the use of $16,940, and the interest you pay on that amount is 18.06%, not 15.3%.

58. The time line is:



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

$APR = 12(1.059^{1/12} – 1)$
$APR = .0575$, or 5.75%

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

$FVA = (\$45,000/12)[\{[1 + (.0575/12)]^{12} – 1\}/(.0575/12)]$
$FVA = \$46,204.28$

$FV = \$46,204.28(1.059)$
$FV = \$48,930.33$

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

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

FVA = ($47,000/12)[{[1 + (.0575/12)]^{12} – 1}/(.0575/12)]
FVA = $48,257.80

Next, we find the value today of the five years' future salary:

PVA = ($52,000/12){[{1 – {1/[1 + (.0575/12)]$^{12(5)}$}]/(.0575/12)}
PVA = $225,518.05

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

Award = $48,930.33 + 48,257.80 + 225,518.05 + 150,000 + 20,000
Award = $492,706.19

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.

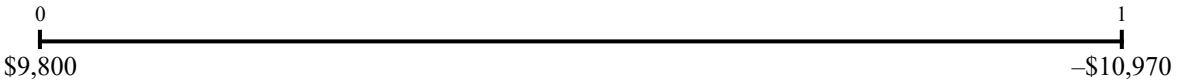
59. To find the interest rate of a loan, we need to look at the cash flows of the loan. Since this loan is in the form of a lump sum, the amount you will repay is the FV of the principal amount, which will be:

Loan repayment amount = $10,000(1.097)
Loan repayment amount = $10,970

The amount you will receive today is the principal amount of the loan times one minus the points.

Amount received = $10,000(1 – .02)
Amount received = $9,800

The time line is:



Now, we find the interest rate for this PV and FV.

$10,970 = $9,800(1 + *r*)
r = $10,970/$9,800 – 1
r = .1194, or 11.94%

60. 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:

$FV_1 = \$700(1.10)^5 = \$1,127.36$

$FV_2 = \$700(1.10)^4 = \$1,024.87$

$FV_3 = \$800(1.10)^3 = \$1,064.80$

$FV_4 = \$800(1.10)^2 = \$968$

$FV_5 = \$900(1.10)^1 = \$990$

Value at Year 6 = \$1,127.36 + 1,024.87 + 1,064.80 + 968 + 990 + 900
Value at Year 6 = \$6,075.03

Finding the FV of this lump sum at the child's 65th birthday:

$FV = \$6,075.03(1.07)^{59} = \$328,996.36$

The policy is not worth buying; the future value of the deposits is \$328,996.36, but the policy contract will pay off \$300,000. The premiums are worth \$28,996.36 more than the policy payoff.

Note, we could also compare the PV of the two cash flows. The PV of the premiums is:

$PV = \$700/1.10 + \$700/1.10^2 + \$800/1.10^3 + \$800/1.10^4 + \$900/1.10^5 + \$900/1.10^6$
PV = \$3,429.19

And the value today of the \$300,000 at age 65 is:

$PV = \$300,000/1.07^{59} = \$5,539.60$

$PV = \$5,539.60/1.10^6 = \$3,126.96$

The premiums still have the higher cash flow. At time zero, the difference is \$302.23. 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 \$302.23, the difference in the cash flows at time zero, for six years at 10 percent interest, and then for 59 years at a 7 percent interest rate. How much will it be worth? Without doing calculations, you know it will be worth \$28,996.36, the difference in the cash flows at Time 65!

Calculator Solutions

1.

CF_0	$0	**CF_0**	$0	**CF_0**	$0
C01	$510	**C01**	$510	**C01**	$510
F01	1	**F01**	1	**F01**	1
C02	$640	**C02**	$640	**C02**	$640
F02	1	**F02**	1	**F02**	1
C03	$765	**C03**	$765	**C03**	$765
F03	1	**F03**	1	**F03**	1
C04	$950	**C04**	$950	**C04**	$950
F04	1	**F04**	1	**F04**	1
I = 10%		I = 18%		I = 24%	
NPV CPT		NPV CPT		NPV CPT	
$2,216.18		$1,847.44		$1,630.58	

2.

Enter	8	5%		±$4,800	
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$31,023.42		

Enter	5	5%		±$6,800	
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$29,440.44		

Enter	8	15%		±$4,800	
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$21,539.14		

Enter	5	15%		±$6,800	
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$22,794.65		

3.

Enter	3	6%	±$950		
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for					$1,131.47

Enter	2	6%	±$1,105		
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for					$1,241.58

	N	I/Y	PV	PMT	FV
Enter	1	6%	±$1,230		
Solve for					$1,303.80

FV = $1,131.47 + 1,241.58 + 1,303.80 + 1,360 = $5,036.84

	N	I/Y	PV	PMT	FV
Enter	3	13%	±$950		
Solve for					$1,370.75

	N	I/Y	PV	PMT	FV
Enter	2	13%	±$1,105		
Solve for					$1,410.97

	N	I/Y	PV	PMT	FV
Enter	1	13%	±$1,230		
Solve for					$1,389.90

FV = $1,370.75 + 1,410.97 + 1,389.90 + 1,360 = $5,531.63

	N	I/Y	PV	PMT	FV
Enter	3	27%	±$950		
Solve for					$1,945.96

	N	I/Y	PV	PMT	FV
Enter	2	27%	±$1,105		
Solve for					$1,782.25

	N	I/Y	PV	PMT	FV
Enter	1	27%	±$1,230		
Solve for					$1,562.10

FV = $1,945.96 + 1,782.25 + 1,562.10 + 1,360 = $6,650.32

4.

	N	I/Y	PV	PMT	FV
Enter	15	6%		±$4,270	
Solve for			$41,471.30		

	N	I/Y	PV	PMT	FV
Enter	40	6%		±$4,270	
Solve for			$64,247.69		

	N	I/Y	PV	PMT	FV
Enter	75	6%		±$4,270	
Solve for			$70,266.47		

5.

	N	I/Y	PV	PMT	FV
Enter	6	11%	±$16,500		
Solve for				$3,900.21	
Enter	8	7%	±$23,400		
Solve for				$3,918.75	
Enter	15	8%	±$147,380		
Solve for				$17,218.34	
Enter	20	6%	±$330,000		
Solve for				$28,770.90	

6.

	N	I/Y	PV	PMT	FV
Enter	7	5%		±$1,540	
Solve for			$8,911.02		
Enter	9	10%		±$1,975	
Solve for			$11,374.07		
Enter	18	8%		±$21,000	
Solve for			$196,809.63		
Enter	28	14%		±$53,000	
Solve for			$368,915.10		

7.

	N	I/Y	PV	PMT	FV
Enter	8	5%			±$20,300
Solve for				$2,125.85	
Enter	40	7%			±$1,100,000
Solve for				$5,510.05	

Enter	25	8%			±$475,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for				$6,497.42	

Enter	13	4%			±$125,300
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for				$7,536.01	

8.

Enter	10	7%		±$3,400	
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for					$46,975.92

Enter	40	8%		±$7,900	
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for					$2,046,546.50

Enter	9	9%		±$1,500	
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for					$19,531.55

Enter	30	11%		±$4,800	
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for					$955,300.21

9.

Enter	20	9.8%		±$6,000	
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for					$335,941.43

Enter	40	9.8%		±$6,000	
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for					$2,515,208.07

12.

Enter	7.1%		4	
	NOM	**EFF**	**C/Y**	
Solve for		7.29%		

Enter	18.0%		12	
	NOM	**EFF**	**C/Y**	
Solve for		19.56%		

Enter	13.1%		365		
	NOM	**EFF**	**C/Y**		
Solve for		13.99%			

13.

Enter		13.1%	2		
	NOM	**EFF**	**C/Y**		
Solve for	12.70%				

Enter		16.8%	12		
	NOM	**EFF**	**C/Y**		
Solve for	15.63%				

Enter		10.9%	52		
	NOM	**EFF**	**C/Y**		
Solve for	10.36%				

Enter		9.6%	365		
	NOM	**EFF**	**C/Y**		
Solve for	9.17%				

14.

Enter	12.9%		12		
	NOM	**EFF**	**C/Y**		
Solve for		13.69%			

Enter	13.2%		2		
	NOM	**EFF**	**C/Y**		
Solve for		13.64%			

15.

Enter		17.9%	365		
	NOM	**EFF**	**C/Y**		
Solve for	16.47%				

16.

Enter	17 × 2	8.4%/2	±$6,200		
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for					$25,112.74

17.

Enter	5 × 365	7.4%/365	±$7,500		
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for					$10,857.60

Enter	10 × 365	7.4%/365	±$7,500		
	N	**I/Y**	**PV**	**PMT**	**FV**

Solve for					$15,718.34
Enter	20 × 365	7.4%/365	±$7,500		
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for					$32,942.15

18.

Enter	10 × 365	8.4%/365			±$95,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$41,016.46		

19.

Enter	285.60%		12		
	NOM	**EFF**	**C/Y**		
Solve for		1,196.13%			

20.

Enter	60	4.9%/12	±$76,300		
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for				$1,436.38	
Enter	4.9%		12		
	NOM	**EFF**	**C/Y**		
Solve for		5.01%			

21.

Enter		1.8%	$16,500	±$500	
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for	50.53				

22.

Enter	1,733.33%		52
	NOM	**EFF**	**C/Y**
Solve for		313,916,515.69%	

23.

Enter	7.64%		12
	NOM	**EFF**	**C/Y**
Solve for		7.91%	

24.

Enter	40 × 12	10%/12		±$500	
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for					$3,162,039.79

25.

Enter	10%		12
	NOM	**EFF**	**C/Y**

Solve for		10.47%			
Enter	40	10.47%		±$6,000	
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for					$3,019,718.42

26.

Enter	4 × 4	.61%		±$3,500	
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$53,199.67		

27.

Enter	8.5%		4
	NOM	**EFF**	**C/Y**
Solve for		8.77%	

CF_0	$0
C01	$775
F01	1
C02	$930
F02	1
C03	$0
F03	1
C04	$1,460
F04	1

I = 8.77%
NPV CPT
$2,541.38

28.

CF_0	$0
C01	$2,260
F01	1
C02	$0
F02	1
C03	$3,480
F03	1
C04	$1,960
F04	1

I = 9.32%
NPV CPT
$6,103.32

29. First Simple: $100(.073) = $7.30; 10-year investment = $100 + 10($7.30) = $173

Enter	10		±$100		$173
	N	**I/Y**	**PV**	**PMT**	**FV**

Solve for 5.63%

30. 2nd BGN 2nd SET

	N	I/Y	PV	PMT	FV
Enter	60	5.4%/12	±$57,000		
Solve for				$1,081.27	

31.

	N	I/Y	PV	PMT	FV
Enter	6	1.50%/12	±$9,000		
Solve for					$9,067.71

	N	I/Y	PV	PMT	FV
Enter	6	18.4%/12	±$9,067.71		
Solve for					$9,934.58

Interest = $9,934.58 – 9,000
Interest = $934.58

31. First: $90,000(.048) = $4,320 per year
($325,000 – 90,000)/$4,320 = 54.40 years

Second:

	N	I/Y	PV	PMT	FV
Enter		4.8%/12	±$90,000		$325,000
Solve for	321.65				

321.65/12 = 26.80 years

33.

	N	I/Y	PV	PMT	FV
Enter	12	.74%	±$1		
Solve for					$1.09

	N	I/Y	PV	PMT	FV
Enter	24	.74%	±$1		
Solve for					$1.19

34.

	N	I/Y	PV	PMT	FV
Enter	31		±£440	£60	
Solve for		13.36%			

35.

	N	I/Y	PV	PMT	FV
Enter	2 × 12	6%/12		±$90,000/12	

Solve for			$169,221.50		

Enter	2 × 12	6%/12		±$77,000/12	
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$144,778.39		

$144,778.39 + 20,000 = $164,778.39

36.

Enter	20	9%		±$35,000	
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$319,499.10		

37.

Enter	6		±$30,000		$60,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for		12.25%			

Enter	9		±$30,000		$92,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for		13.26%			

38.

Enter	15	10%		±$10,000	
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$76,060.80		

Enter	15	5%		±$10,000	
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$103,796.58		

Enter	15	15%		±$10,000	
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$58,473.70		

39.

Enter		6.5%/12		±$250	$17,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for	58.05				

40.

Enter	60		$105,000	±$2,100	
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for		.618%			

.618% × 12 = 7.42%

41.

CF_0	0
C01	0
F01	1
C02	$24,900,000
F02	1
C03	$29,000,000
F03	1
C04	$31,000,000
F04	1
C05	$27,500,000
F05	1

I = 11%
NPV CPT
$78,154,520.37

42.

CF_0	0
C01	$16,500,000
F01	1
C02	$17,400,000
F02	1
C03	$28,110,000
F03	1
C04	$23,900,000
F04	1
C05	$34,010,000
F05	1

I = 11%
NPV CPT
$94,869,296.72

43.

	N	**I/Y**	**PV**	**PMT**	**FV**
Enter	30 × 12		.80($2,800,000)	±$14,700	
Solve for		.572%			

APR = .572%(12) = 6.86%

	NOM	**EFF**	**C/Y**
Enter	6.86%		12
Solve for		7.09%	

44. Future value of bond account:

	N	**I/Y**	**PV**	**PMT**	**FV**
Enter	10	6%	±$50,000	±$10,000	
Solve for					$221,350.33

Future value of stock account:

	N	**I/Y**	**PV**	**PMT**	**FV**
Enter	10	10.5%	±$200,000		
Solve for					$542,816.17

Future value of retirement account:
FV = $221,350.33 + 542,816.17
FV = $764,166.50

Annual withdrawal amount:

	N	**I/Y**	**PV**	**PMT**	**FV**
Enter	25	5.3%	±$764,166.50		
Solve for				$55,861.16	

45. 2nd BGN 2nd SET

	N	I/Y	PV	PMT	FV
Enter	60		±$26,500	$510	
Solve for		.502%			

APR = .502%(12) = 6.02%

46.

a.

	N	I/Y	PV	PMT	FV
Enter	5	6.8%		±$14,500	
Solve for			$59,772.60		

2nd BGN 2nd SET

	N	I/Y	PV	PMT	FV
Enter	5	6.8%		±$14,500	
Solve for			$63,837.13		

b.

	N	I/Y	PV	PMT	FV
Enter	5	6.8%		±$14,500	
Solve for					$83,053.59

2nd BGN 2nd SET

	N	I/Y	PV	PMT	FV
Enter	5	6.8%		±$14,500	
Solve for					$88,701.23

47. Present value of annuity:

	N	I/Y	PV	PMT	FV
Enter	30	4.3%		±$12,800	
Solve for			$213,493.77		

And the present value of the perpetuity is:

PVP = C/r
PVP = $12,800/.043
PVP = $297,674.42

So the difference in the present values is:

Difference = $297,674.42 – 213,493.77
Difference = $84,180.65

48. Value at $t = 9$

	N	I/Y	PV	PMT	FV
Enter	10×2	9%/2		±$6,000	
Solve for			$78,047.62		

Value at $t = 5$

	N	I/Y	PV	PMT	FV
Enter	4×2	9%/2			±$78,047.62
Solve for			$54,881.92		

Value at $t = 3$

	N	I/Y	PV	PMT	FV
Enter	6×2	9%/2			±$78,047.62
Solve for			$46,021.86		

Value today

	N	I/Y	PV	PMT	FV
Enter	9×2	9%/2			±$78,047.62
Solve for			$35,339.99		

49.

	N	I/Y	PV	PMT	FV
Enter	15	8.4%		±$7,500	
Solve for			$62,657.46		

	N	I/Y	PV	PMT	FV
Enter	5	8.4%			±$62,657.46
Solve for			$41,862.62		

50.

	N	I/Y	PV	PMT	FV
Enter	96	6%/12		±$1,500	
Solve for			$114,142.83		

	N	I/Y	PV	PMT	FV
Enter	84	9%/12			±$114,142.83
Solve for			$60,934.61		

	N	I/Y	PV	PMT	FV
Enter	84	9%/12		±$1,500	
Solve for			$93,230.95		

$60,934.61 + 93,230.95 = $154,165.55

51.

Enter	10 × 12	7.8%/12		±$1,250	
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for					$226,148.66

Enter	10	7%			±$226,148.66
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$114,962.51		

52. PV@ Time = 14: $7,500/.046 = $163,043.48

Enter	12	4.6%			±$163,043.48
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$95,043.67		

53.

Enter	12		$20,000	±$1,968.33	
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for		2.657%			

APR = 2.657% × 12 = 31.88%

Enter	31.88%		12
	NOM	**EFF**	**C/Y**
Solve for		36.98%	

54.

CF_0	$0
C01	$0
F01	1
C02	$20,000
F02	1
C03	$27,000
F03	1
C04	$0
F04	1
C05	$38,000
F05	1

I = 6.4%
NPV NFV
$92,657.59

Enter	5	6.4%	±$92,657.59		
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for					$126,354.05

57.

Enter	1		$16,940		±$20,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for		18.06%			

58.

Enter		5.9%	12		
	NOM	**EFF**	**C/Y**		
Solve for	5.75%				

Enter	12	5.75%/12		±$45,000/12	
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for					$46,204.28

Enter	1	5.9%	±$46,204.28		
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for					$48,930.33

Enter	12	5.75%/12		±$47,000/12	
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for					$48,257.80

Enter	60	5.75%/12		±$52,000/12	
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$225,518.05		

Award = $48,930.33 + 48,257.80 + 225,518.05 + 150,000 + 20,000 = $492,706.19

59.

Enter	1		$9,800		±$10,970
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for		11.94%			

60. Value at Year 6:

Enter	5	10%	±$700		
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for					$1,127.36

Enter	4	10%	±$700		
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for					$1,024.87

	N	I/Y	PV	PMT	FV
Enter	3	10%	±$800		
Solve for					$1,064.80

	N	I/Y	PV	PMT	FV
Enter	2	10%	±$800		
Solve for					$968.00

	N	I/Y	PV	PMT	FV
Enter	1	10%	±$900		
Solve for					$990.00

So, at Year 6, the value is: $1,127.36 + 1,024.87 + 1,064.80 + 968 + 990 + 900 = $6,075.03

At Year 65, the value is:

	N	I/Y	PV	PMT	FV
Enter	59	7%	±$6,075.03		
Solve for					$328,996.36

The policy is not worth buying; the future value of the deposits is $328,996.36 but the policy contract will pay off $300,000.

CHAPTER 6
INTEREST RATES AND BOND VALUTION

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 were higher than the ask, 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 ask potential purchasers what coupon rate would be necessary to attract them. The coupon rate is fixed and 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 par.

7. Yes. Some investors have obligations that are denominated in dollars; i.e., they are nominal. Their primary concern is that an investment provides 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 because unrated bonds can be difficult to sell; many large investors are prohibited from investing in unrated issues.

9. 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. Bond ratings have a subjective factor to them. Split ratings reflect a difference of opinion among credit agencies.

11. 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."

12. One measure of liquidity is the bid-ask spread. Liquid instruments have relatively small spreads. Looking at Figure 6.4, the bellwether bond has a spread of .02 percent; it is one of the most liquid of all investments. Generally, liquidity declines after a bond is issued. Some older bonds will often have spreads that are much wider.

13. 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.

14. 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.

15. *a.* The bond price is the present value when discounting the future cash flows from a bond; YTM is the interest rate used in discounting the future cash flows (coupon payments and principal) back to their present values.

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.

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.

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

$P = €36\{[1 - 1/(1 + .032)^{19}]/.032\} + €1{,}000[1/(1 + .032)^{19}]$
$P = €1{,}056.29$

4. Here we need to find the YTM of a bond. The equation for the bond price is:

$P = ¥104{,}352 = ¥3{,}400(\text{PVIFA}_{R\%,16}) + ¥100{,}000(\text{PVIF}_{R\%,16})$

Notice the equation cannot be solved directly for R. Using a spreadsheet, a financial calculator, or trial and error, we find:

$R = \text{YTM} = 3.05\%$

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 lower than the coupon rate since the bond is a premium 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:

Approximate YTM = [Annual interest payment + (Price difference from par/Years to maturity)]/
[(Price + Par value)/2]

Solving for this problem, we get:

Approximate YTM = [¥3,400 + (– ¥4,352/16)]/[(¥104,352 + 100,000)/2] = .0306, or 3.06%

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:

$P = \$962 = C(\text{PVIFA}_{5.70\%,8}) + \$1{,}000(\text{PVIF}_{5.70\%,8})$

Solving for the coupon payment, we get:

$C = \$50.95$

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

Coupon rate = \$50.95/\$1,000
Coupon rate = .0510, or 5.10%

6. To find the price of this bond, we need to realize that the maturity of the bond is 14 years. The bond was issued 1 year ago, with 15 years to maturity, so there are 14 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:

$P = \$27(\text{PVIFA}_{3.05\%,28}) + \$1{,}000(\text{PVIF}_{3.05\%,28})$
$P = \$934.73$

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

$P = \$920 = \$28(\text{PVIFA}_{R\%,46}) + \$1{,}000(\text{PVIF}_{R\%,46})$

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

$R = 3.130\%$

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

YTM = 2 × 3.130%
YTM = 6.26%

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:

$P = \$1{,}037 = C(\text{PVIFA}_{2.65\%,29}) + \$1{,}000(\text{PVIF}_{2.65\%,29})$

Solving for the coupon payment, we get:

$C = \$28.34$

Since this is the semiannual payment, the annual coupon payment is:

2 × \$28.34 = \$56.69

And the coupon rate is the annual coupon payment divided by par value, so:

Coupon rate = \$56.69/\$1,000
Coupon rate = .0567, or 5.67%

9. The approximate relationship between nominal interest rates (R), real interest rates (r), and inflation (h) is:

$R \approx r + h$

Approximate r = .049 – .031
Approximate r = .018, or 1.80%

The Fisher equation, which shows the exact relationship between nominal interest rates, real interest rates, and inflation is:

$(1 + R) = (1 + r)(1 + h)$
$(1 + .049) = (1 + r)(1 + .031)$
$r = (1 + .049)/(1 + .031) – 1$
r = .0175, or 1.75%

10. The Fisher equation, which shows the exact relationship between nominal interest rates, real interest rates, and inflation is:

$(1 + R) = (1 + r)(1 + h)$

$R = (1 + .018)(1 + .064) – 1$
R = .0832, or 8.32%

11. The Fisher equation, which shows the exact relationship between nominal interest rates, real interest rates, and inflation is:

$(1 + R) = (1 + r)(1 + h)$

$h = (1 + .117)/(1 + .06) – 1$
h = .0538, or 5.38%

12. The Fisher equation, which shows the exact relationship between nominal interest rates, real interest rates, and inflation is:

$(1 + R) = (1 + r)(1 + h)$

$r = (1 + .1410)/(1.063) – 1$
r = .0734, or 7.34%

13. The coupon rate, located in the second column of the quote, is 2.375%. The bid price is:

Bid price = 90.202% × \$10,000
Bid price = \$9,020.20

The previous day's ask price is found by:

Previous day's asked price = Today's asked price – Change
Previous day's asked price = 90.216 – .002
Previous day's asked price = 90.214

The previous day's price in dollars was:

Previous day's dollar price = (90.214/100) × $10,000
Previous day's dollar price = $9,021.40

14. This is a premium bond because it sells for more than 100 percent of face value. The current yield is based on the asked price, so the current yield is:

Current yield = Annual coupon payment/Price
Current yield = $500/$10,572.20
Current yield = .0475, or 4.75%

The YTM is located under the "Asked Yield" column, so the YTM is 4.403%.

The bid-ask spread is the difference between the bid price and the ask price, so:

Bid-Ask spread = [(105.272 – 105.252)/100]($10,000)
Bid-Ask spread = $2.00

15. To find the price of a zero coupon bond, we need to find the value of the future cash flows. With a zero coupon bond, the only cash flow is the par value at maturity. We find the present value assuming semiannual compounding to keep the YTM of a zero coupon bond equivalent to the YTM of a coupon bond, so:

$P = \$10{,}000(\text{PVIF}_{2.10\%,58})$
$P = \$2{,}995.76$

16. To find the price of this bond, we need to find the present value of the bond's cash flows. So, the price of the bond is:

$P = \$55(\text{PVIFA}_{2.90\%,26}) + \$2{,}000(\text{PVIF}_{2.90\%,26})$
$P = \$1{,}945.75$

17. To find the price of this bond, we need to find the present value of the bond's cash flows. So, the price of the bond is:

$P = \$72.50(\text{PVIFA}_{1.35\%,26}) + \$5{,}000(\text{PVIF}_{1.35\%,26})$
$P = \$5{,}109.02$

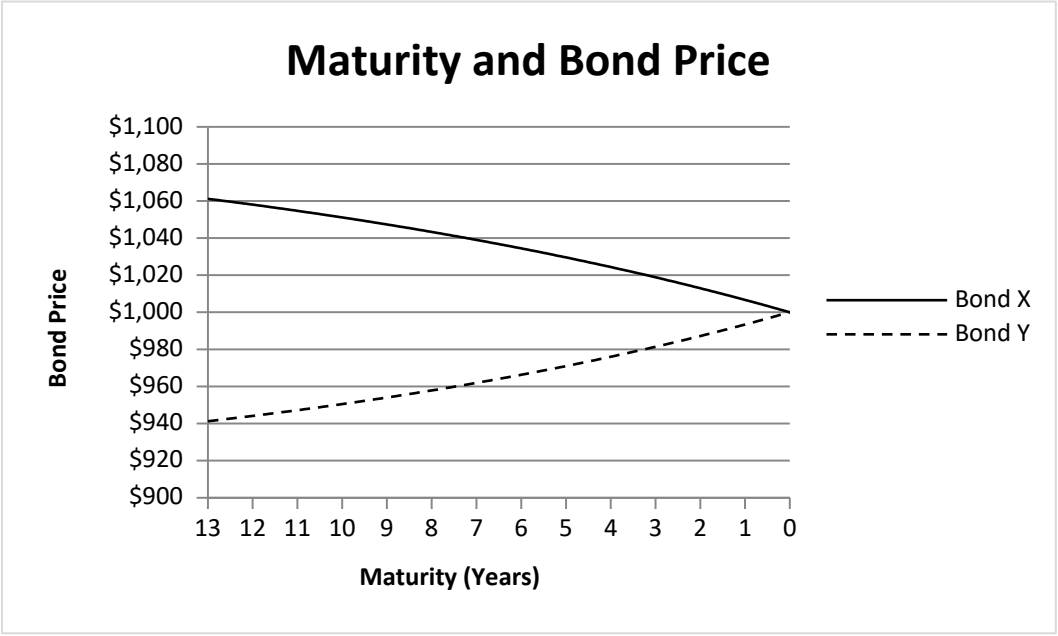
Intermediate

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

$P = C(\text{PVIFA}_{R\%,t}) + \$1{,}000(\text{PVIF}_{R\%,t})$

X: $P_0 = \$35.50(\text{PVIFA}_{3.2\%,26}) + \$1{,}000(\text{PVIF}_{3.2\%,26}) = \$1{,}061.15$
$P_1 = \$35.50(\text{PVIFA}_{3.2\%,24}) + \$1{,}000(\text{PVIF}_{3.2\%,24}) = \$1{,}058.02$
$P_3 = \$35.50(\text{PVIFA}_{3.2\%,20}) + \$1{,}000(\text{PVIF}_{3.2\%,20}) = \$1{,}051.12$
$P_8 = \$35.50(\text{PVIFA}_{3.2\%,10}) + \$1{,}000(\text{PVIF}_{3.2\%,10}) = \$1{,}029.55$
$P_{12} = \$35.50(\text{PVIFA}_{3.2\%,2}) + \$1{,}000(\text{PVIF}_{3.2\%,2}) = \$1{,}006.68$
$P_{13} = \$1{,}000$

Y: $P_0 = \$32(\text{PVIFA}_{3.55\%,26}) + \$1{,}000(\text{PVIF}_{3.55\%,26}) = \$941.21$
$P_1 = \$32(\text{PVIFA}_{3.55\%,24}) + \$1{,}000(\text{PVIF}_{3.55\%,24}) = \$944.09$
$P_3 = \$32(\text{PVIFA}_{3.55\%,20}) + \$1{,}000(\text{PVIF}_{3.55\%,20}) = \$950.48$
$P_8 = \$32(\text{PVIFA}_{3.55\%,10}) + \$1{,}000(\text{PVIF}_{3.55\%,10}) = \$970.97$
$P_{12} = \$32(\text{PVIFA}_{3.55\%,2}) + \$1{,}000(\text{PVIF}_{3.55\%,2}) = \$993.36$
$P_{13} = \$1{,}000$



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.

19. 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, 6.7 percent. If the YTM suddenly rises to 8.7 percent:

P_{Sam} = \$33.50(PVIFA$_{4.35\%,6}$) + \$1,000(PVIF$_{4.35\%,6}$) = \$948.17

P_{Dave} = \$33.50(PVIFA$_{4.35\%,40}$) + \$1,000(PVIF$_{4.35\%,40}$) = \$811.98

The percentage change in price is calculated as:

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

ΔP_{Sam}% = (\$948.17 – 1,000)/\$1,000 = –.0518, or –5.18%

ΔP_{Dave}% = (\$811.98 – 1,000)/\$1,000 = –.1880, or –18.80%

If the YTM suddenly falls to 4.7 percent:

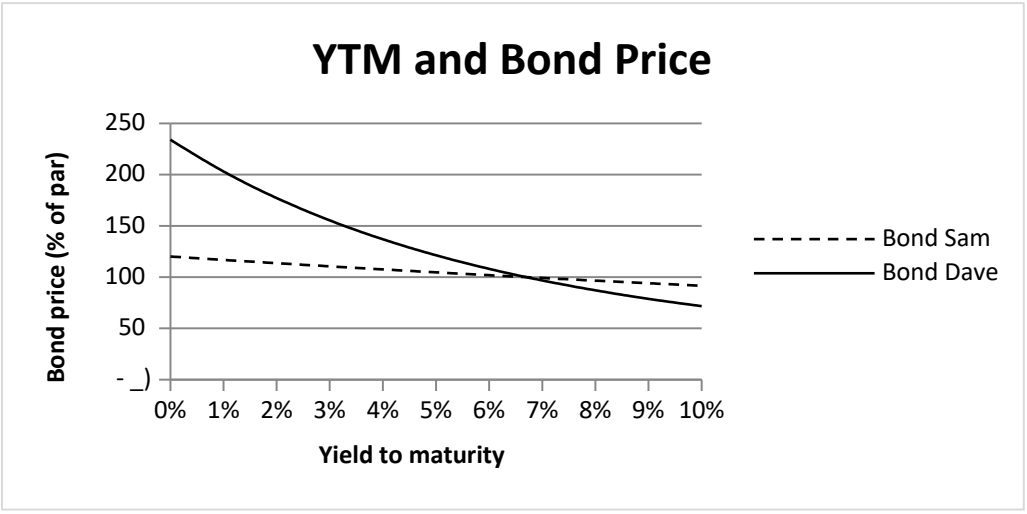
P_{Sam} = \$33.50(PVIFA$_{2.35\%,6}$) + \$1,000(PVIF$_{2.35\%,6}$) = \$1,055.36

P_{Dave} = \$33.50(PVIFA$_{2.35\%,40}$) + \$1,000(PVIF$_{2.35\%,40}$) = \$1,257.49

ΔP_{Sam}% = (\$1,055.36 – 1,000)/\$1,000 = .0554, or 5.54%

ΔP_{Dave}% = (\$1,257.49 – 1,000)/\$1,000 = .2575, or 25.75%

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



20. Initially, at a YTM of 7 percent, the prices of the two bonds are:

P_J = \$15(PVIFA$_{3.5\%,36}$) + \$1,000(PVIF$_{3.5\%,36}$) = \$594.19

P_K = \$45(PVIFA$_{3.5\%,36}$) + \$1,000(PVIF$_{3.5\%,36}$) = \$1,202.90

If the YTM rises from 7 percent to 9 percent:

P_J = \$15(PVIFA$_{4.5\%,36}$) + \$1,000(PVIF$_{4.5\%,36}$) = \$470.02

P_K = \$45(PVIFA$_{4.5\%,36}$) + \$1,000(PVIF$_{4.5\%,36}$) = \$1,000.00

The percentage change in price is calculated as:

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

$\Delta P_J\%$ = (\$470.02 – 594.19)/\$594.19 = –.2090, or –20.90%

$\Delta P_K\%$ = (\$1,000.00 – 1,202.90)/\$1,202.90 = –.1687, or –16.87%

If the YTM declines from 7 percent to 5 percent:

P_J = \$15(PVIFA$_{2.5\%,36}$) + \$1,000(PVIF$_{2.5\%,36}$) = \$764.44

P_K = \$45(PVIFA$_{2.5\%,36}$) + \$1,000(PVIF$_{2.5\%,36}$) = \$1,471.13

$\Delta P_J\%$ = (\$764.44 – 594.19)/\$594.19 = .2865, or 28.65%

$\Delta P_K\%$ = (\$1,471.13 – 1,202.90)/\$1,202.90 = .2230, or 22.30%

All else the same, the lower the coupon rate on a bond, the greater is its price sensitivity to changes in interest rates.

21. The current yield is:

Current yield = Annual coupon payment/Price

Current yield = \$59/\$1,063.20

Current yield = .0555, or 5.55%

The bond price equation for this bond is:

P_0 = \$1,063.20 = \$29.50(PVIFA$_{R\%,36}$) + \$1,000(PVIF$_{R\%,36}$)

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

R = 2.674%

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

YTM = 2 × 2.674%
YTM = 5.35%

The effective annual yield is the same as the EAR, so using the EAR equation from the previous chapter:

Effective annual yield = $(1 + .02674)^2 – 1$
Effective annual yield = .0542, or 5.42%

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

$P = \$925 = \$30(\text{PVIFA}_{R\%,40}) + \$1{,}000(\text{PVIF}_{R\%,40})$

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

$R = 3.343\%$

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

YTM = 2 × 3.343%
YTM = 6.69%

23. 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 two months until the next coupon payment, so four months have passed since the last coupon payment. The accrued interest for the bond is:

Accrued interest = \$53/2 × 4/6
Accrued interest = \$17.67

And we calculate the clean price as:

Clean price = Dirty price – Accrued interest
Clean price = \$1,053 – 17.67
Clean price = \$1,035.33

24. 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 two months until the next coupon payment, so four months have passed since the last coupon payment. The accrued interest for the bond is:

Accrued interest = \$68/2 × 4/6
Accrued interest = \$22.67

And we calculate the dirty price as:

Dirty price = Clean price + Accrued interest
Dirty price = \$1,027 + 22.67
Dirty price = \$1,049.67

25. The bond has 19 years to maturity, so the bond price equation is:

$P = \$1{,}075.40 = \$26.50(\text{PVIFA}_{R\%,38}) + \$1{,}000(\text{PVIF}_{R\%,38})$

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

$R = 2.348\%$

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

YTM = 2 × 2.348%
YTM = 4.70%

The current yield is the annual coupon payment divided by the bond price, so:

Current yield = $53/$1,075.40
Current yield = .0493, or 4.93%

26. *a.* The coupon bonds have a 5.4 percent coupon which matches the 5.4 percent 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:

Number of coupon bonds to sell = $55,000,000/$1,000
Number of coupon bonds to sell = 55,000

The number of zero coupon bonds to sell would be:

Price of zero coupon bonds = $1,000/$1.027^{40}$
Price of zero coupon bonds = $344.49

Number of zero coupon bonds to sell = $55,000,000/$344.49
Number of zero coupon bonds to sell = 159,654

b. The repayment of the coupon bond will be the par value plus the last coupon payment times the number of bonds issued. So:

Coupon bonds repayment = 55,000($1,027)
Coupon bonds repayment = $56,485,000

The repayment of the zero coupon bond will be the par value times the number of bonds issued, so:

Zeroes repayment = 159,654($1,000)
Zeroes repayment = $159,654,231

c. The total coupon payment for the coupon bonds will be the number of 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:

Coupon bonds: (55,000)($54)(1 – .21)
Coupon bonds = $2,346,300 cash outflow

Note that this is a 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:

$P_1 = \$1{,}000/1.027^{38}$
$P_1 = \$363.35$

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:

Year 1 interest deduction per bond = \$363.35 – 344.49
Year 1 interest deduction per bond = \$18.85

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:

Cash flow for zeroes in Year 1 = (159,654)(\$18.85)(.21)
Cash flow for zeroes in Year 1 = \$632,119.95

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. The maturity is indeterminate. A bond selling at par can have any length of maturity.

28. The bond asked price is 89.527, so the dollar price is:

Dollar price = 89.527/100 × \$1,000
Dollar price = \$895.27

So the bond price equation is:

$P = \$895.27 = \$19.25(\text{PVIFA}_{R\%,20}) + \$1{,}000(\text{PVIF}_{R\%,20})$

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

$R = 2.603\%$

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

YTM = 2 × 2.603%
YTM = 5.21%

29. The coupon rate of the bond is 4.125 percent and the bond matures in 16 years. The bond coupon payments are semiannual, so the asked price is:

$P = \$20.625(\text{PVIFA}_{2.805\%,32}) + \$1{,}000(\text{PVIF}_{2.805\%,32})$
$P = \$844.52$

The bid-ask spread is .0628. We also know the bid price must be less than the asked price, so the bid price is:

Bid price = \$844.52 – (.0628/100)(\$1,000)
Bid price = \$843.89

30. Here, we need to find the coupon rate of the bond. The price of the bond is:

Dollar price = 102.915% × \$1,000
Dollar price = \$1,029.15

So the bond price equation is:

$P = \$1{,}029.15 = C(\text{PVIFA}_{2.37\%,14}) + \$1{,}000(\text{PVIF}_{2.37\%,14})$

Solving for the coupon payment, we get:

$C = \$26.17$

Since this is the semiannual payment, the annual coupon payment is:

2 × \$26.17 = \$52.34

And the coupon rate is the coupon payment divided by the par value, so:

Coupon rate = \$52.34/\$1,000
Coupon rate = .0523, or 5.23%

31. Here we need to find the yield to maturity. The dollar price of the bond is:

Dollar price = 88.743% × \$2,000
Dollar price = \$1,774.86

So, the bond price equation is:

$P = \$1{,}774.86 = \$54(\text{PVIFA}_{R\%,24}) + \$2{,}000(\text{PVIF}_{R\%,24})$

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

$R = 3.393\%$

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

YTM = 2 × 3.393%
YTM = 6.79%

32. The bond price equation is:

$P = \$41.25(\text{PVIFA}_{2.815\%,14}) + \$2{,}000(\text{PVIF}_{2.815\%,14})$
$P = \$1{,}827.83$

The current yield is the annual coupon payment divided by the bond price, so:

Current yield = \$82.50/\$1,827.83
Current yield = .0451, or 4.51%

33. Here, we need to find the coupon rate of the bond. The dollar price of the bond is:

Dollar price = 104.310/100 × \$2,000
Dollar price = \$2,086.20

Now, we need to set up the bond pricing equation and solve for the coupon payment as follows:

$P = \$2{,}086.20 = C(\text{PVIFA}_{3.06\%,18}) + \$2{,}000(\text{PVIF}_{3.06\%,18})$

Solving for the coupon payment, we get:

$C = \$67.50$

Since this is the semiannual payment, the annual coupon payment is:

$2 \times \$67.50 = \$135.00$

And the coupon rate is the coupon payment divided by par value, so:

Coupon rate = \$135.00/\$2,000
Coupon rate = .0675, or 6.75%

Challenge

34. 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 are:

P: $P_0 = \$80(\text{PVIFA}_{7\%,15}) + \$1{,}000(\text{PVIF}_{7\%,15}) = \$1{,}091.08$

$P_1 = \$80(\text{PVIFA}_{7\%,14}) + \$1{,}000(\text{PVIF}_{7\%,14}) = \$1{,}087.45$

The current yield is:

Current yield = \$80/\$1,091.08
Current yield = .0733, or 7.33%

And the capital gains yield is:

Capital gains yield = (New price – Original price)/Original price
Capital gains yield = ($1,087.45 – 1,091.08)/$1,091.08
Capital gains yield = –.0033, or –.33%

The current price of Bond D and the price of Bond D in one year is:

D: $P_0 = \$60(\text{PVIFA}_{7\%,15}) + \$1{,}000(\text{PVIF}_{7\%,15}) = \$908.92$

$P_1 = \$60(\text{PVIFA}_{7\%,14}) + \$1{,}000(\text{PVIF}_{7\%,14}) = \$912.55$

The current yield is:

Current yield = $60/$908.92
Current yield = .0660, or 6.60%

And the capital gains yield is:

Capital gains yield = ($912.55 – 908.92)/$908.92
Capital gains yield = .0040, or .40%

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 percent, but this return is distributed differently between current income and capital gains.

35. *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:

$P_0 = \$1{,}050 = \$80(\text{PVIFA}_{R\%,17}) + \$1{,}000(\text{PVIF}_{R\%,17})$

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

R = YTM = 7.47%

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:

$P_2 = \$80(\text{PVIFA}_{6.471\%,15}) + \$1{,}000(\text{PVIF}_{6.471\%,15})$
$P_2 = \$1{,}144.03$

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:

$P_0 = \$1{,}050 = \$80(\text{PVIFA}_{R\%,2}) + \$1{,}144.03(\text{PVIF}_{R\%,2})$

Solving for R, we get:

R = HPY = 11.85%

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.

Calculator Solutions

3.

	N	I/Y	PV	PMT	FV
Enter	19	3.2%		±€36	±€1,000
Solve for			€1,056.29		

4.

	N	I/Y	PV	PMT	FV
Enter	16		±¥104,352	¥3,400	¥100,000
Solve for		3.05%			

5.

	N	I/Y	PV	PMT	FV
Enter	8	5.7%	±$962		$1,000
Solve for				$50.95	

Coupon rate = $50.95/$1,000 = 5.10%

6.

	N	I/Y	PV	PMT	FV
Enter	28	6.1%/2		±$54/2	±$1,000
Solve for			$934.73		

7.

	N	I/Y	PV	PMT	FV
Enter	46		±$920	$56/2	$1,000
Solve for		3.130%			

3.130% × 2 = 6.26%

8.

	N	I/Y	PV	PMT	FV
Enter	29	5.3%/2	±$1,037		$1,000
Solve for				$28.34	

$28.34(2)/$1,000 = .0567, or 5.67%

15.

	N	I/Y	PV	PMT	FV
Enter	58	4.2%/2			±$10,000
Solve for			$2,995.76		

16.

	N	I/Y	PV	PMT	FV
Enter	26	5.80%/2		±$110/2	±$2,000
Solve for			$1,945.75		

17.

Enter	32	2.70%/2		±$145/2	±$5,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$5,109.02		

18. Bond X

P_0

Enter	26	6.4%/2		±$71/2	±$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$1,061.15		

P_1

Enter	24	6.4%/2		±$71/2	±$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$1,058.02		

P_3

Enter	20	6.4%/2		±$71/2	±$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$1,051.12		

P_8

Enter	10	6.4%/2		±$71/2	±$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$1,029.55		

P_{12}

Enter	2	6.4%/2		±$71/2	±$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$1,006.68		

Bond Y

P_0

Enter	26	7.1%/2		±$64/2	±$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$941.21		

P_1

Enter	24	7.1%/2		±$64/2	±$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$944.09		

P_3

Enter	20	7.1%/2		±$64/2	±$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$950.48		

P_8

Enter	10	7.1%/2		±$64/2	±$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$970.97		

P_{12}

Enter	2	7.1%/2		±$64/2	±$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$993.36		

19. If both bonds sell at par, the initial YTM on both bonds is the coupon rate, 6.7 percent. If the YTM suddenly rises to 8.7 percent:

P_{Sam}

Enter	6	8.7%/2		±$67/2	±$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$948.17		

$\Delta P_{Sam}\% = (\$948.17 - 1{,}000)/\$1{,}000 = -5.18\%$

P_{Dave}

Enter	40	8.7%/2		±$67/2	±$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$811.98		

$\Delta P_{Dave}\% = (\$811.98 - 1{,}000)/\$1{,}000 = -18.80\%$

If the YTM suddenly falls to 4.7 percent:

P_{Sam}

Enter	6	4.7%/2		±$67/2	±$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$1,055.36		

$\Delta P_{Sam}\% = (\$1{,}055.36 - 1{,}000)/\$1{,}000 = + 5.54\%$

P_{Dave}

Enter	40	4.7%/2		±$67/2	±$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$1,257.49		

$\Delta P_{Dave}\% = (\$1{,}257.49 - 1{,}000)/\$1{,}000 = + 25.75\%$

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

20. Initially, at a YTM of 7 percent, the prices of the two bonds are:

P_J

Enter	36	7%/2		±$30/2	±$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$594.19		

P_K

Enter	36	7%/2		±$90/2	±$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$1,202.90		

If the YTM rises from 7 percent to 9 percent:

P_J

Enter	36	9%/2		±$30/2	±$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$470.02		

$\Delta P_J\% = (\$470.02 - 594.19)/\$594.19 = -20.90\%$

P_K

Enter	36	9%/2		±$90/2	±$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$1,000.00		

$\Delta P_K\% = (\$1,000.00 - 1,202.90)/\$1,202.90 = -16.87\%$

If the YTM declines from 7 percent to 5 percent:

P_J

Enter	36	5%/2		±$30/2	±$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$764.44		

$\Delta P_J\% = (\$764.44 - 594.19)/\$594.19 = + 28.65\%$

P_K

Enter	36	5%/2		±$90/2	±$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$1,471.13		

$\Delta P_K\% = (\$1,471.13 - 1,202.90)/\$1,202.90 = + 22.30\%$

All else the same, the lower the coupon rate on a bond, the greater is its price sensitivity to changes in interest rates.

21.

Enter	36		±$1,063.20	$59/2	$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for		2.674%			

$2.674\% \times 2 = 5.35\%$

Enter	5.35%		2
	NOM	**EFF**	**C/Y**
Solve for		5.42%	

22. 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.

	N	I/Y	PV	PMT	FV
Enter	40		±$925	$60/2	$1,000
Solve for		3.343%			

3.343% × 2 = 6.69%

25.

	N	I/Y	PV	PMT	FV
Enter	9 × 2		±$1,075.40	$53/2	$1,000
Solve for		2.348%			

YTM = 2 × 2.348%
YTM = 4.70%

26.

	N	I/Y	PV	PMT	FV
Enter	40	5.4%/2			±$1,000
Solve for			$344.49		

	N	I/Y	PV	PMT	FV
Enter	38	5.4%/2			±$1,000
Solve for			$363.35		

28.

	N	I/Y	PV	PMT	FV
Enter	10 × 2		±$895.27	$38.50/2	$1,000
Solve for		2.603%			

YTM = 2 × 2.603%
YTM = 5.21%

29.

	N	I/Y	PV	PMT	FV
Enter	16 × 2	5.61%/2		±$41.25/2	±$1,000
Solve for			$844.52		

30.

	N	I/Y	PV	PMT	FV
Enter	7 × 2	4.74%/2	±$1,029.15		$1,000
Solve for				$26.17	

Annual coupon = $26.17 × 2
Annual coupon = $52.34

Coupon rate = $52.34/$1,000
Coupon rate = .0523, or 5.23%

31.

Enter	12 × 2		±$1,774.86	$54	$2,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for		3.393%			

YTM = 2 × 3.393%
YTM = 6.79%

32.

Enter	7 × 2	5.63%/2		±$41.25	±$2,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$1,827.83		

33.

Enter	9 × 2	6.12%/2	±$2,086.20		$2,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for				$67.50	

Annual coupon = $67.50 × 2
Annual coupon = $135.00

Coupon rate = $135.00/$2,000
Coupon rate = .0675, or 6.75%

34.

Bond P

P_0

Enter	15	7%		±$80	±$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$1,091.08		

P_1

Enter	14	7%		±$80	±$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$1,087.45		

Bond D

P_0

Enter	15	7%		±$60	±$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$908.92		

P_1

Enter	14	7%		±$60	±$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$912.55		

35.

a.

Enter	17		±$1,050	$80	$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for		7.47%			

b.

Enter	15	6.47%		±$80	±$1,000
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for			$1,144.03		

The HPY is:

Enter	2		±$1,050	$80	$1,144.03
	N	**I/Y**	**PV**	**PMT**	**FV**
Solve for		11.85%			

CHAPTER 7
EQUITY MARKETS AND STOCK VALUATION

Answers to Concepts Review and Critical Thinking Questions

1. The value of any investment depends on 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 companies 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 the methods of this chapter by applying the general method of valuation. 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 of 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. The dividend growth model makes the implicit assumption that the stock price will grow at the same constant rate as the dividend. What this means is that if the cash flows on an investment grow at a constant rate through time, the value of that investment grows at the same rate as the cash flows.

8. For a particular year, this can (and often does) happen. Going back to the cash flow identity, the dividend payments depend on operating cash flow, capital spending, change in net working capital, and cash flow to creditors. The firm could have positive operating cash flow with negative earnings, sell fixed assets, reduce net working capital, or raise cash from creditors to pay dividends. While this is possible in the short term, as a practical matter over the longer term, the company would probably need to have a positive net income (at least on average) to maintain a dividend.

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 less for such shares than they would otherwise.

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. A reasonable limit for the growth rate is the growth rate of the economy, which in the U.S. has historically been about 3 to 3.5 percent (after accounting for inflation). As we will see in a later chapter, inflation has historically averaged about 3 percent, so 6 to 6.5 percent (before accounting for inflation) would be a reasonable limit.

13. In a declassified board, every board seat is up for election every year. This structure allows investors to vote out a director (and even the entire board) much more quickly if investors are dissatisfied. However, this structure also makes it more difficult to fight off a hostile takeover bid. In contrast, a classified board can more effectively negotiate on behalf of stockholders, perhaps securing better terms in a deal. Classified boards are also important for institutional memory. If an entire board were voted out in a single year, there would be no board members available to evaluate the company's direction with regards to previous decisions.

14. The major difficulty in using price ratio analysis is determining the correct benchmark PE ratio. In a previous chapter, we showed how the sustainable growth rate is determined, and in a future chapter we will discuss the required return. Although not exact measures, the growth rate and required return have a solid economic basis. With the PE ratio, like any other ratio, it is difficult to determine what the ratio should be. Since a small difference in the PE ratio can have a significant effect on the calculated stock price, it is easy to arrive at an incorrect valuation.

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:

$P_0 = D_0(1 + g)/(R - g)$
$P_0 = \$3.65(1.04)/(.105 - .04)$
$P_0 = \$58.40$

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

$P_3 = D_3(1 + g)/(R - g)$
$P_3 = D_0(1 + g)^4/(R - g)$
$P_3 = \$3.65(1.04)^4/(.105 - .04)$
$P_3 = \$65.69$

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

$P_{15} = D_{15}(1 + g)/(R - g)$
$P_{15} = D_0(1 + g)^{16}/(R - g)$
$P_{15} = \$3.65(1.04)^{16}/(.105 - .04)$
$P_{15} = \$105.18$

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 for which 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:

$P_3 = P_0(1 + g)^3$
$P_3 = \$58.40(1 + .04)^3$
$P_3 = \$65.69$

And the stock price in 15 years will be:

$P_{15} = P_0(1 + g)^{15}$
$P_{15} = \$58.40(1 + .04)^{15}$
$P_{15} = \$105.18$

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:

$R = D_1/P_0 + g$
$R = \$1.93/\$41 + .043$
$R = .0901$, or 9.01%

3. The dividend yield is the dividend next year divided by the current price, so the dividend yield is:

Dividend yield = D_1/P_0
Dividend yield = \$1.93/\$41
Dividend yield = .0471, or 4.71%

The capital gains yield, or percentage increase in the stock price, is the same as the dividend growth rate, so:

Capital gains yield = 4.3%

4. Using the constant growth model, we find the price of the stock today is:

$P_0 = D_1/(R - g)$
$P_0 = \$3.26/(.11 - .0375)$
$P_0 = \$44.97$

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

R = Dividend yield + Capital gains yield
$R = .056 + .032$
$R = .0880$, or 8.80%

6. We know the stock has a required return of 10.5 percent, and the dividend and capital gains yields are equal, so:

Dividend yield = 1/2(.105) = .0525 = Capital gains yield

Now we know both the dividend yield and capital gains yield. The dividend is the stock price times the dividend yield, so:

$D_1 = .0525(\$87)$
$D_1 = \$4.57$

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:

$\$4.57 = D_0(1 + .0525)$
$D_0 = \$4.57/1.0525$
$D_0 = \$4.34$

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 13 years, so the price of the stock is the PVA, which will be:

$P_0 = \$8.50(\text{PVIFA}_{10.3\%,13})$
$P_0 = \$59.45$

8. The price of 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 required return of the preferred stock is:

$R = D/P_0$
$R = \$3.25/\$104$
$R = .0313$, or 3.13%

9. If the company uses straight voting, you will need to own one-half of the shares, plus one share, in order to guarantee enough votes to win the election. So, the number of shares needed to guarantee election under straight voting will be:

Shares needed = (840,000 shares/2) + 1
Shares needed = 420,001

And the total cost to you will be the shares needed times the price per share, or:

Total cost = 420,001 × $48
Total cost = $20,160,048

If the company uses cumulative voting, you will need $1/(N + 1)$ percent of the stock (plus one share) to guarantee election, where N is the number of seats up for election. So, the percentage of the company's stock you need will be:

Percent of stock needed = $1/(N + 1)$
Percent of stock needed = 1/(4 + 1)
Percent of stock needed = .20, or 20%

So, the number of shares you need to purchase is:

Number of shares to purchase = (840,000 × .20) + 1
Number of shares to purchase = 168,001

And the total cost to you will be the shares needed times the price per share, or:

Total cost = 168,001 × $48
Total cost = $8,064,048

10. We need to find the growth rate of dividends. Using the constant growth model, we can solve the equation for g. Doing so, we find:

$g = R – (D_1/P_0)$
g = .101 – ($4.75/$73)
g = .0359, or 3.59%

11. Here we have a stock that pays no dividends for 20 years. Once the stock begins paying dividends, it will have the same dividends forever. We value the stock at that point, using the preferred stock equation. It is important to remember that the price we find will be the price one year before the first dividend, so:

$P_{19} = D_{20}/R$
P_{19} = $20/.071
P_{19} = $281.69

The price of the stock today is the present value of the stock price in the future. We discount the future stock price at the required return. The price of the stock today will be:

$P_0 = \$281.69/1.071^{19}$
$P_0 = \$76.52$

12. Here we need to value a stock with two different required returns. Using the constant growth model and a required return of 12 percent, the stock price today is:

$P_0 = D_1/(R - g)$
$P_0 = \$4.20/(.12 - .042)$
$P_0 = \$53.85$

And the stock price today with a required return of 8 percent will be:

$P_0 = D_1/(R - g)$
$P_0 = \$4.20/(.08 - .042)$
$P_0 = \$110.53$

All else held constant, a higher required return means that the stock will sell for a lower price. Also, notice that the stock price is very sensitive to the required return. In this case, the required return fell by 1/3 but the stock price more than doubled.

13. Using the equation to calculate the price of a share of stock with the PE ratio:

P = Benchmark PE ratio × EPS

With a PE ratio of 18, we find:

$P = 18(\$5.27)$
$P = \$94.86$

And with a PE ratio of 21, we find:

$P = 21(\$5.27)$
$P = \$110.67$

14. First, we need to find the sales per share, which is:

Sales per share = Sales/Shares outstanding
Sales per share = \$3,100,000/175,000
Sales per share = \$17.71

Using the equation to calculate the price of a share of stock with the PS ratio:

P = Benchmark PS ratio × Sales per share

With a PS ratio of 3.9, we find:

$P = 3.9(\$17.71)$
$P = \$69.09$

And with a PS ratio of 3.1, we find:

$P = 3.1(\$17.71)$

$P = \$54.91$

Intermediate

15. 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 the 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:

$P_9 = D_{10}/(R - g)$
$P_9 = \$18/(.115 - .037)$
$P_9 = \$230.77$

The price of the stock today is the PV of the stock price in the future. We discount the future stock price at the required return. The price of the stock today will be:

$P_0 = \$230.77/1.115^9$
$P_0 = \$86.64$

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

$P_0 = \$12.50/1.10 + \$20.50/1.10^2 + \$28.50/1.10^3 + \$36.50/1.10^4 + \$44.50/1.10^5$
$P_0 = \$102.28$

17. With nonconstant 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 nonconstant dividend period. The stock begins constant dividend 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:

$P_4 = D_4(1 + g)/(R - g)$
$P_4 = \$3.15(1.04)/(.105 - .04)$
$P_4 = \$50.40$

The price of the stock today is the PV of the first four dividends, plus the PV of the Year 4 stock price. So, the price of the stock today will be:

$P_0 = \$13/1.105 + \$10/1.105^2 + \$8/1.105^3 + \$3.15/1.105^4 + \$50.40/1.105^4$
$P_0 = \$61.80$

18. 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 3, one year before the constant dividend growth begins, as:

$P_3 = D_3(1 + g)/(R - g)$
$P_3 = D_0(1 + g_1)^3(1 + g_2)/(R - g)$
$P_3 = \$2.95(1.30)^3(1.04)/(.105 - .04)$
$P_3 = \$103.70$

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:

$P_0 = \$2.95(1.30)/1.105 + \$2.95(1.30)^2/1.105^2 + \$2.95(1.30)^3/1.105^3 + \$103.70/1.105^3$
$P_0 = \$89.21$

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

$P_0 = [D_0(1 + g_1)/(R - g_1)]\{1 - [(1 + g_1)/(1 + R)]^t\} + [(1 + g_1)/(1 + R)]^t[D_0(1 + g_2)/(R - g_2)]$
$P_0 = [\$2.95(1.30)/(.105 - .30)][1 - (1.30/1.105)^3] + (1.30/1.105)^3[\$2.95(1.04)/(.105 - .04)]$
$P_0 = \$89.21$

19. 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:

$P_0 = D_0(1 + g)/(R - g)$
$P_0 = \$10.15(1 - .03)/[(.095 - (-.03)]$
$P_0 = \$78.76$

20. 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:

$P_0 = \$53 = D_0(1 + g)/(R - g)$

Solving this equation for the dividend gives us:

$D_0 = \$53(.12 - .035)/1.035$
$D_0 = \$4.35$

21. The highest dividend yield will occur when the stock price is the lowest. So, using the 52-week low stock price, the highest dividend yield was:

Dividend yield = D/P_{Low}
Dividend yield = \$3.12/\$64.13
Dividend yield = .0487, or 4.87%

The lowest dividend yield occurred when the stock price was the highest, so:

Dividend yield = D/P_{High}
Dividend yield = \$3.12/\$82.56
Dividend yield = .0378, or 3.78%

22. With nonconstant dividends, we find the price of the stock when the dividends level off at a constant growth rate, and then find the present value of the future stock price, plus the present value of all dividends during the nonconstant growth period. Since the first dividend with constant growth is in Year 6, we can find the price of the stock in Year 5, one year before the constant dividend growth begins as:

$P_5 = D_6/(R - g)$
$P_5 = D_0(1 + g_1)^5(1 + g_2)/(R - g_2)$
$P_5 = \$6.45(1.08)^5(1.035)/(.10 - .035)$
$P_5 = \$150.79$

The price of the stock today is the present value of the first five dividends, plus the present value of the Year 5 stock price. The price of the stock today will be:

$P_0 = \$6.45(1.08)/1.10 + \$6.45(1.08)^2/1.10^2 + \$6.45(1.08)^3/1.10^3 + \$6.45(1.08)^4/1.10^4$
$+ \$6.45(1.08)^5/1.10^5 + \$150.79/1.10^5$
$P_0 = \$124.14$

According to the constant growth model, the stock seems to be overvalued. The factors that would affect the stock price are both the nonconstant growth rate and the long-term growth rate, the length of the nonconstant growth, and the required return.

23. 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:

$R = (D_1/P_0) + g$
$R = [\$2.50(1 + .005)/\$118.64] + .005$
$R = .0262$, or 2.62%

The required return depends on the company and the industry. As we will see in a later chapter, this required return appears to be low relative to historic stock returns.

24. 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:

$R = (D_1/P_0) + g$
$R = [\$1.12(1 - .105)/\$62.91] + (-.105)$
$R = -.0891$, or –8.91%

Obviously, this number is incorrect. The required return can never be negative. Acevedo investors must believe that the dividend growth rate over the past five years is not indicative of future growth in dividends.

25. The annual dividend paid to stockholders is $1.57, and the dividend yield is 1.9 percent. Using the equation for the dividend yield:

Dividend yield = Dividend/Stock price

We can plug the numbers in and solve for the stock price:

$.019 = \$1.57/P_0$
$P_0 = \$1.57/.019$
$P_0 = \$82.63$

The dividend yield quoted in the newspaper is rounded. This means the price calculated using the dividend will be slightly different from the actual price. The required return using the dividend discount model is:

$R = (D_1/P_0) + g$
$R = [\$1.57(1 + .04)/\$80.93] + .04$
$R = .0602$, or 6.02%

As we will see in a later chapter, this required return appears to be low relative to historic stock returns.

26. *a.* Using the equation to calculate the price of a share of stock with the PE ratio:

P = Benchmark PE ratio × EPS

So, with a PE ratio of 19, we find:

$P = 19(\$4.85)$
$P = \$92.15$

b. First, we need to find the earnings per share next year, which will be:

$EPS_1 = EPS_0(1 + g)$
$EPS_1 = \$4.85(1 + .04)$
$EPS_1 = \$5.04$

Using the equation to calculate the price of a share of stock with the PE ratio:

P_1 = Benchmark PE ratio × EPS_1
$P_1 = 19(\$5.04)$
$P_1 = \$95.84$

c. To find the implied return over the next year, we calculate the return as:

$R = (P_1 – P_0)/P_0$
$R = (\$95.84 – 92.15)/\$92.15$
$R = .04$, or 4%

Notice that the return is the same as the growth rate in earnings. Assuming a stock pays no dividends and the PE ratio is constant, this will always be true when using price ratios to evaluate the price of a share of stock.

27. We need to find the PE ratio each year, which is:

$PE_1 = \$61.26/\$2.70 = 22.69$
$PE_2 = \$68.40/\$2.84 = 24.08$
$PE_3 = \$71.70/\$3.20 = 22.41$
$PE_4 = \$76.33/\$3.50 = 21.81$

So, the average PE is:

Average PE = (22.69 + 24.08 + 22.41 + 21.81)/4
Average PE = 22.75

Next, we need to find the earnings per share next year, which will be:

$EPS_1 = EPS_0(1 + g)$
$EPS_1 = \$3.50(1 + .11)$
$EPS_1 = \$3.89$

Using the equation to calculate the price of a share of stock with the PE ratio:

P_1 = Benchmark PE ratio × EPS_1
$P_1 = 22.75(\$3.89)$
$P_1 = \$88.37$

28. First, we need to find the earnings per share next year, which will be:

$EPS_1 = EPS_0(1 + g)$
$EPS_1 = \$3.18(1 + .09)$
$EPS_1 = \$3.47$

To find the high target stock price, we need to find the average high PE ratio each year, which is:

$PE_1 = \$68.40/\$2.59 = 26.41$
$PE_2 = \$74.02/\$2.84 = 26.06$
$PE_3 = \$81.60/\$3.01 = 27.11$
$PE_4 = \$86.14/\$3.18 = 27.09$

So, the average high PE is:

Average high PE = (26.41 + 26.06 + 27.11 + 27.09)/4
Average high PE = 26.67

Using the equation to calculate the price of a share of stock with the PE ratio, the high target price is:

P_1 = Benchmark PE ratio × EPS_1
$P_1 = 26.67(\$3.47)$
$P_1 = \$92.44$

To find the low target stock price, we need to find the average low PE ratio each year, which is:

$PE_1 = \$45.33/\$2.59 = 17.50$
$PE_2 = \$49.50/\$2.84 = 17.43$
$PE_3 = \$46.25/\$3.01 = 15.37$
$PE_4 = \$58.13/\$3.18 = 18.28$

So, the average low PE is:

Average low PE = (17.50 + 17.43 + 15.37 + 18.28)/4
Average low PE = 17.14

Using the equation to calculate the price of a share of stock with the PE ratio, the low target price is:

P_1 = Benchmark PE ratio × EPS_1
$P_1 = 17.14(\$3.47)$
$P_1 = \$59.43$

29. To find the target price in five years, we first need to find the EPS in five years, which will be:

$EPS_5 = EPS_0(1 + g)^5$
$EPS_5 = \$2.85(1 + .08)^5$
$EPS_5 = \$4.19$

So, the target stock price in five years is:

P_5 = Benchmark PE ratio × EPS_5
$P_5 = 19(\$4.19)$
$P_5 = \$79.56$

30. We need to begin by finding the dividend for each year over the next five years, so:

$D_1 = \$1.87(1 + .13) = \$2.11$
$D_2 = \$1.87(1 + .13)^2 = \$2.39$
$D_3 = \$1.87(1 + .13)^3 = \$2.70$
$D_4 = \$1.87(1 + .13)^4 = \$3.05$
$D_5 = \$1.87(1 + .13)^5 = \$3.45$

To find the EPS in Year 5, we can use the dividends and payout ratio, which gives us:

$EPS_5 = D_5$/Payout ratio
$EPS_5 = \$3.45/.30$
$EPS_5 = \$11.48$

So, the terminal stock price in Year 5 will be:

P_5 = Benchmark PE ratio × EPS_5
$P_5 = 19(\$11.48)$
$P_5 = \$218.21$

The stock price today is the present value of the dividends for the next five years, plus the present value of the terminal stock price, discounted at the required return, or:

$P_0 = \$2.11/1.11 + \$2.39/1.11^2 + \$2.70/1.11^3 + \$3.05/1.11^4 + (\$3.45 + 218.21)/1.11^5$
$P_0 = \$139.36$

Challenge

31. We are asked to find the dividend yield and capital gains yield for each of the stocks. All of the stocks have a required return of 12 percent, 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: $P_0 = D_0(1 + g)/(R – g) = \$4.25(1.10)/(.12 – .10) = \$233.75$

Dividend yield = $D_1/P_0 = \$4.25(1.10)/\$233.75 = .02$, or 2%

Capital gains yield = .12 – .02 = .10, or 10%

X: $P_0 = D_0(1 + g)/(R – g) = \$4.25/(.12 – 0) = \$35.42$

Dividend yield = $D_1/P_0 = \$4.25/\$35.42 = .12$, or 12%

Capital gains yield = .12 – .12 = 0%

Y: $P_0 = D_0(1 + g)/(R – g) = \$4.25(1 – .05)/(.12 + .05) = \$23.75$

Dividend yield = $D_1/P_0 = \$4.25(.95)/\$23.75 = .17$, or 17%

Capital gains yield = .12 – .17 = –.05, or –5%

Z: $P_2 = D_2(1 + g)/(R – g) = D_0(1 + g_1)^2(1 + g_2)/(R – g_2)$

$P_2 = \$4.25(1.20)^2(1.05)/(.12 – .05) = \$91.80$

$P_0 = \$4.25(1.20)/1.12 + \$4.25(1.20)^2/1.12^2 + \$91.80/1.12^2 = \$82.61$

Dividend yield = $D_1/P_0 = \$4.25(1.20)/\$82.61 = .062$, or 6.2%

Capital gains yield = .12 – .062 = .058, or 5.8%

In all cases, the required return is 12 percent, but this 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.

32. *a*. Using the constant growth model, the price of the stock paying annual dividends will be:

$P_0 = D_0(1 + g)/(R – g)$
$P_0 = \$3.80(1.034)/(.105 – .034)$
$P_0 = \$55.34$

b. If the company pays quarterly dividends instead of annual dividends, the quarterly dividend will be one-fourth of the annual dividend, or:

Quarterly dividend = \$3.80(1.034)/4
Quarterly dividend = \$.9823

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:

Effective quarterly rate = $1.105^{.25} – 1$
Effective quarterly rate = .0253, or 2.53%

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:

Effective $D_1 = \$.9823(\text{FVIFA}_{2.53\%,4})$
Effective $D_1 = \$4.08$

Now, we can use the constant growth model to find the current stock price as:

$P_0 = \$4.08/(.105 – .034)$
$P_0 = \$57.47$

Note that we cannot 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.

CHAPTER 8
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.

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. If NPV is positive, then the present value of future cash inflows is greater than the initial investment cost; thus, the 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 the 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 pay back before this cutoff and reject projects that take longer to pay back.

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 the analysis is straightforward and simple. 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 average accounting return is interpreted as an average measure of the accounting performance of a project over time, computed as some average profit measure due to the project divided by some average balance sheet value for the project. This text computes AAR as average net income with respect to average (total) book value. Given some predetermined cutoff for AAR, the decision rule is to accept projects with an AAR in excess of the target measure and reject all other projects.

b. AAR is not a measure of cash flows and market value, but a measure of financial statement accounts that often bear little semblance to the relevant value of a project. In addition, the selection of a cutoff is arbitrary, and the time value of money is ignored. For a financial manager, both the reliance on accounting numbers rather than relevant market data and the exclusion of time value of money considerations are troubling. Despite these problems, AAR continues to be used in practice because (1) the accounting information is usually available, (2) analysts often use accounting ratios to analyze firm performance, and (3) managerial compensation is often tied to the attainment of certain target accounting ratio goals.

5. *a.* NPV is the sum of the present values of a project's cash flows. NPV specifically measures, after considering the time value of money, the net increase or decrease in firm wealth due to the project. The decision rule is to accept projects that have a positive NPV and reject projects with a negative NPV.

b. NPV is superior to the other methods of analysis presented in the text because it has no serious flaws. The method unambiguously ranks mutually exclusive projects and can differentiate between projects of different scale and time horizons. The only drawback to NPV is that it relies on cash flow and discount rate values that are often estimates and not certain, but this is a problem shared by the other performance criteria as well. A project with NPV = $2,500 implies that the total shareholder wealth of the firm will increase by $2,500 if the project is accepted.

6. *a.* The IRR is the discount rate that causes the NPV of a series of cash flows to be equal to zero. IRR can thus be interpreted as a financial break-even rate of return; at the IRR discount rate, the net value of the project is zero. The IRR decision rule is to accept projects with IRRs greater than the discount rate and to reject projects with IRRs less than the discount rate.

b. IRR is the interest rate that causes NPV for a series of cash flows to be zero. NPV is preferred in all situations to IRR; IRR can lead to ambiguous results if there are non-conventional cash flows, and ambiguously ranks some mutually exclusive projects. However, for stand-alone projects with conventional cash flows, IRR and NPV are interchangeable techniques.

c. IRR is frequently used because it is easier for many financial managers and analysts to rate performance in relative terms, such as "12%", than in absolute terms, such as "$46,000." IRR may be a preferred method to NPV in situations where an appropriate discount rate is unknown or uncertain; in this situation, IRR would provide more information about the project than would NPV.

7. *a.* The profitability index is the present value of the future cash flows divided by the initial investment. 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.

8. For a project with future cash flows that are an annuity:

Payback = I/C

And the IRR is:

$0 = -I + C/\text{IRR}$

Solving the IRR equation for IRR, we get:

IRR = C/I

Notice this is the reciprocal of the payback. So:

IRR = 1/Payback

For long-lived projects with relatively constant cash flows, the sooner the project pays back, the greater is the IRR.

9. There are several 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.

10. 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 (NPV, IRR, and profitability index) are only slightly more difficult in practice.

11. 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 intangible. 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!

12. The yield to maturity is the internal rate of return on a bond. The two concepts are identical with the exception that YTM is applied to bonds and IRR is applied to capital budgeting.

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 irrelevant. 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 because reinvestment is irrelevant 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's 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

Basic

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.

1. To calculate the payback period, we need to find the time that the project requires to recover its initial investment. After three years, the project has created:

$2,100 + 3,000 + 2,300 = $7,400

in cash flows. The project still needs to create another:

$8,500 – 7,400 = $1,100

in cash flows. During the fourth year, the cash flows from the project will be $1,700. So, the payback period will be three years, plus what we still need to make divided by what we will make during the fourth year. The payback period is:

Payback = 3 + ($1,100/$1,700)
Payback = 3.65 years

2. To calculate the payback period, we need to find the time that the project requires to recover its initial investment. The cash flows in this problem are an annuity, so the calculation is simpler. If the initial cost is $2,000, the payback period is:

Payback = 2 + ($110/$945)
Payback = 2.12 years

There is a shortcut to calculate payback period when the project cash flows are an annuity. Just divide the initial cost by the annual cash flow. For the $3,600 cost, the payback period is:

Payback = $3,600/$945
Payback = 3.81 years

The payback period for an initial cost of $8,500 is a little trickier. Notice that the total cash inflows after eight years will be:

Total cash inflows = 8($945)
Total cash inflows = $7,560

If the initial cost is $8,500, the project never pays back. Notice that if you use the shortcut for annuity cash flows, you get:

Payback = $8,500/$945
Payback = 8.99 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.

3. Project A has total cash flows of $35,000 through Year 2, so the cash flows are short by $13,000 of recapturing the initial investment, so the payback for Project A is:

Payback = 2 + ($13,000/$17,000)
Payback = 2.76 years

Project B has cash flows of:

Cash flows = $12,000 + 14,000 + 17,000
Cash flows = $43,000

during this first three years. The cash flows are still short by $17,000 of recapturing the initial investment, so the payback for Project B is:

Payback = 3 + ($17,000/$255,000)
Payback = 3.07 years

Using the payback criterion and a cutoff of three years, accept Project A and reject Project B.

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

Average net income = ($1,360,000 + 1,475,300 + 1,634,500 + 1,097,400)/4
Average net income = $1,391,800

And the average book value is:

Average book value = ($11,400,000 + 0)/2
Average book value = $5,700,000

So, the AAR for this project is:

AAR = Average net income/Average book value
AAR = $1,391,800/$5,700,000
AAR = .2442, or 24.42%

5. 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:

$$0 = -\$37,000 + \$18,000/(1 + IRR) + \$21,000/(1 + IRR)^2 + \$11,000/(1 + IRR)^3$$

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

IRR = 18.06%

Since the IRR is greater than the required return, we would accept the project.

6. The NPV of a project is the PV of the inflows minus the PV of the outflows. The equation for the NPV of this project at an 11 percent required return is:

$$NPV = -\$37,000 + \$18,000/1.11 + \$21,000/1.11^2 + \$11,000/1.11^3$$

NPV = $4,303.39

At a required return of 11 percent, the NPV is positive, so we would accept the project.

The equation for the NPV of the project at a 24 percent required return is:

NPV = –$37,000 + $18,000/1.24 + $21,000/$1.24^2$ + $11,000/$1.24^3$
NPV = –$3,056.86

At a required return of 24 percent, the NPV is negative, so we would reject the project.

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

NPV = –$71,000 + $14,600($PVIFA_{8\%,9}$)
NPV = $20,204.56

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

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

NPV = –$71,000 + $14,600($PVIFA_{20\%,9}$)
NPV = –$12,147.89

At a required return of 20 percent, 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 = –$71,000 + $14,600($PVIFA_{IRR,9}$)

IRR = 14.47%

8. 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 = –$19,900 + $10,300/(1 + IRR) + $10,800/$(1 + IRR)^2$ + $7,400/$(1 + IRR)^3$

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

IRR = 21.57%

9. The NPV of a project is the PV of the inflows minus the PV of the outflows. 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 = –$19,900 + 10,300 + 10,800 + 7,400
NPV = $8,600

The NPV at a 10 percent required return is:

NPV = –$19,900 + $10,300/1.1 + $10,800/$1.1^2$ + $7,400/$1.1^3$
NPV = $3,948.99

The NPV at a 20 percent required return is:

NPV = –$19,900 + $10,300/1.2 + $10,800/$1.2^2$ + $7,400/$1.2^3$
NPV = $465.74

And the NPV at a 30 percent required return is:

NPV = –$19,900 + $10,300/1.3 + $10,800/$1.3^2$ + $7,400/$1.3^3$
NPV = –$2,218.16

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.

10. *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:

$$0 = -\$45{,}400 + \$21{,}000/(1 + IRR) + \$19{,}600/(1 + IRR)^2 + \$16{,}700/(1 + IRR)^3 + \$8{,}700/(1 + IRR)^4$$

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

IRR = 19.44%

The equation for the IRR of Project B is:

$$0 = -\$45{,}400 + \$6{,}800/(1 + IRR) + \$15{,}600/(1 + IRR)^2 + \$19{,}700/(1 + IRR)^3 + \$33{,}300/(1 + IRR)^4$$

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

IRR = 18.66%

Examining the IRRs of the projects, we see that IRR_A is greater than IRR_B, so the 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:

$NPV_A = –\$45,400 + \$21,000/1.11 + \$19,600/1.11^2 + \$16,700/1.11^3 + \$8,700/1.11^4$
$NPV_A = \$7,368.57$

And the NPV of Project B is:

$NPV_B = –\$45,400 + \$6,800/1.11 + \$15,600/1.11^2 + \$19,700/1.11^3 + \$33,300/1.11^4$
$NPV_B = \$9,727.65$

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:

Crossover rate: $0 = \$14,200/(1 + R) + \$4,000/(1 + R)^2 – \$3,000/(1 + R)^3 – \$24,600/(1 + R)^4$

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

$R = 16.83\%$

At discount rates above 16.83 percent choose Project A; for discount rates below 16.83 percent choose Project B; we are indifferent between A and B at a discount rate of 16.83 percent.

11. 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:

$0 = –\$36,000 + \$16,500/(1 + IRR) + \$17,000/(1 + IRR)^2 + \$16,100/(1 + IRR)^3$

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

IRR = 17.98%

For Project Y, the equation to find the IRR is:

$0 = –\$36,000 + \$18,700/(1 + IRR) + \$14,600/(1 + IRR)^2 + \$15,900/(1 + IRR)^3$

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

IRR = 18.02%

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:

Crossover rate: $0 = –\$2,200/(1 + R) + \$2,400/(1 + R)^2 + \$200/(1 + R)^3$

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

$R = 16.87\%$

The table below shows the NPV of each project for different required returns. Notice that Project X always has a higher NPV for discount rates below 16.87 percent, and always has a lower NPV for discount rates above 16.87 percent.

R	NPV_X	NPV_Y
0%	$13,600.00	$13,200.00
5%	$9,041.57	$8,787.17
10%	$5,145.76	$5,012.02
15%	$1,788.28	$1,755.08
20%	–$1,127.31	–$1,076.39
25%	–$3,676.80	–$3,555.20

12. *a.* The equation for the NPV of the project is:

$NPV = –\$45,000,000 + \$65,000,000/1.12 – \$9,000,000/1.12^2$
$NPV = \$5,860,969.39$

The NPV is greater than zero, so we would accept the project.

b. The equation for the IRR of the project is:

$0 = –\$45,000,000 + \$65,000,000/(1 + IRR) – \$9,000,000/(1 + IRR)^2$

From Descartes rule of signs, we know there are potentially two IRRs since the cash flows change signs twice. From trial and error, the two IRRs are:

$IRR = 28.93\%, –84.49\%$

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.

13. The profitability index is defined as the PV of the future cash flows divided by the initial investment. The equation for the profitability index at a required return of 10 percent is:

$PI = [\$8,900/1.1 + \$7,700/1.1^2 + \$4,300/1.1^3]/\$15,300$
$PI = 1.156$

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

$PI = [\$8,900/1.15 + \$7,700/1.15^2 + \$4,300/1.15^3]/\$15,300$
$PI = 1.071$

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

$PI = [\$8,900/1.22 + \$7,700/1.22^2 + \$4,300/1.22^3]/\$15,300$
$PI = .970$

We would accept the project if the required return were 10 percent or 15 percent since the PI is greater than 1. We would reject the project if the required return were 22 percent since the PI is less than 1.

14. *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:

$PI_I = \$35,600(PVIFA_{10\%,3})/\$77,000$
$PI_I = 1.150$

$PI_{II} = \$11,400(PVIFA_{10\%,3})/\$23,500$
$PI_{II} = 1.206$

The profitability index decision rule implies that we accept Project II, since PI_{II} is greater than PI_I.

b. The NPV of each project is:

$NPV_I = –\$77,000 + \$35,600(PVIFA_{10\%,3})$
$NPV_I = \$11,531.93$

$NPV_{II} = –\$23,500 + \$11,400(PVIFA_{10\%,3})$
$NPV_{II} = \$4,850.11$

The NPV decision rule implies accepting Project I, since the NPV_I is greater than the NPV_{II}.

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 three times as large as Project II and produces a larger NPV, yet the profitability index criterion implies that Project II is more acceptable.

15. *a*. The payback period for each project is:

A: 3 + ($128,000/$329,000) = 3.39 years

B: 2 + ($3,400/$16,000) = 2.21 years

The payback criterion implies accepting Project B, because it pays back sooner than Project A.

b. The NPV for each project is:

A: $NPV = -\$262{,}000 + \$34{,}000/1.11 + \$50{,}000/1.11^2 + \$50{,}000/1.11^3 + \$329{,}000/1.11^4$
$NPV = \$62{,}493.81$
B: $NPV = -\$37{,}400 + \$18{,}000/1.11 + \$16{,}000/1.11^2 + \$16{,}000/1.11^3 + \$12{,}000/1.11^4$
$NPV = \$11{,}406.01$

NPV criterion implies we accept Project A because Project A has a higher NPV than Project B.

c. The IRR for each project is:

A: $\$262{,}000 = \$34{,}000/(1 + IRR) + \$50{,}000/(1 + IRR)^2 + \$50{,}000/(1 + IRR)^3 + \$329{,}000/(1 + IRR)^4$

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

IRR = 18.39%

B: $\$37{,}400 = \$18{,}000/(1 + IRR) + \$16{,}000/(1 + IRR)^2 + \$16{,}000/(1 + IRR)^3 + \$12{,}000/(1 + IRR)^4$

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

IRR = 25.55%

IRR decision rule implies we accept Project B because IRR for B is greater than IRR for A.

d. The profitability index for each project is:

A: $PI = (\$34{,}000/1.11 + \$50{,}000/1.11^2 + \$50{,}000/1.11^3 + \$329{,}000/1.11^4)/\$262{,}000$
$PI = 1.239$

B: $PI = (\$18{,}000/1.11 + \$16{,}000/1.11^2 + \$16{,}000/1.11^3 + \$12{,}000/1.11^4)/\$37{,}400$
$PI = 1.305$

Profitability index criterion implies we accept Project B because the PI for B is greater than the PI for A.

e. In this instance, the NPV criterion 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.

16. *a.* The IRR for each project is:

M: $\$130{,}000 = \$55{,}500/(1 + IRR) + \$69{,}400/(1 + IRR)^2 + \$64{,}100/(1 + IRR)^3 + \$36{,}500/(1 + IRR)^4$

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

IRR = 27.94%

N: $\$349,000 = \$154,300/(1 + IRR) + \$164,400/(1 + IRR)^2 + \$150,800/(1 + IRR)^3 + \$105,400/(1 + IRR)^4$

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

IRR = 25.01%

IRR decision rule implies we accept Project M because the IRR for M is greater than the IRR for N.

b. The NPV for each project is:

M: $NPV = -\$130,000 + \$55,500/1.15 + \$69,400/1.15^2 + \$64,100/1.15^3 + \$36,500/1.15^4$
$NPV = \$33,753.02$

N: $NPV = -\$349,000 + \$154,300/1.15 + \$164,400/1.15^2 + \$150,800/1.15^3 + \$105,400/1.15^4$
$NPV = \$68,900.17$

The NPV criterion implies we accept Project N because Project N has a higher NPV than Project M.

c. Accept Project N since the NPV is higher. IRR cannot be used to rank mutually exclusive projects.

17. *a.* The profitability index for each project is:

Y: $PI = (\$29,700/1.12 + \$26,500/1.12^2 + \$22,700/1.12^3 + \$16,600/1.12^4)/\$60,600$
$PI = 1.227$

Z: $PI = (\$39,000/1.12 + \$38,300/1.12^2 + \$32,500/1.12^3 + \$29,300/1.12^4)/\$93,000$
$PI = 1.152$

Profitability index criterion implies accept Project Y because its PI is greater than Project Z's.

b. The NPV for each project is:

Y: $NPV = -\$60,600 + \$29,700/1.12 + \$26,500/1.12^2 + \$22,700/1.12^3 + \$16,600/1.12^4$
$NPV = \$13,750.51$

Z: $NPV = -\$93,000 + \$39,000/1.12 + \$38,300/1.12^2 + \$32,500/1.12^3 + \$29,300/1.12^4$
$NPV = \$14,107.49$

c. Accept Project Z since the NPV is higher. The profitability index cannot be used to rank mutually exclusive projects.

18. 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 J from the cash flows from Project I. 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:

Crossover rate: $0 = \$29,900/(1 + R) + \$12,700/(1 + R)^2 – \$18,100/(1 + R)^3 – \$35,700/(1 + R)^4$

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

$R = 10.38\%$

At a lower interest rate, Project J is more valuable because of the higher total cash flows. At a higher interest rate, Project I becomes more valuable since the differential cash flows received in the first two years are larger than the cash flows for Project J.

19. If the payback period is exactly equal to the project's life then the IRR must be equal to zero since the project pays back exactly the initial investment. If the project never pays back its initial investment, then the IRR of the project must negative.

20. 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 = –$547,350 + 209,100 + 236,200 + 214,600 + 164,340
NPV = $276,890

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. If the future cash flows have no value today, the NPV of the project is the cash flow today, so at an infinite interest rate:

NPV = –$547,350

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:

$0 = –\$547,350 + \$209,100/(1 + IRR) + \$236,200/(1 + IRR)^2 + \$214,600/(1 + IRR)^3 + 164,340/(1 + IRR)^4$

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

IRR = 19.44%

21. *a*. The payback period for each project is:

F: 2 + ($17,900/$87,600) = 2.20 years

G: 3 + ($21,300/$168,800) = 3.13 years

The payback criterion implies accepting Project F because it pays back sooner than Project G. Project G does not meet the minimum payback of three years.

b. The NPV for each project is:

F: $NPV = –\$215,000 + \$104,800/1.10 + \$92,300/1.10^2 + \$87,600/1.10^3 + \$78,000/1.10^4 + \$70,800/1.10^5$

NPV = $119,605.17

G: NPV = –$318,000 + $74,600/1.10 + $96,500/$1.10^2$ + $125,600/$1.10^3$
+ $168,800/$1.10^4$ + $189,200/$1.10^5$
NPV = $156,706.37

NPV criterion implies we should accept Project G because Project G has a higher NPV than Project F.

c. Even though Project G does not meet the payback period of three years, it does provide the largest increase in shareholder wealth, therefore, choose Project G. Payback period should generally be ignored in this situation.

22. The MIRRs for the project with all three approaches is:

Discounting approach:

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

Time 0 cash flow = –$57,000 – $8,600/$1.10^5$
Time 0 cash flow = –$62,339.92

So, the MIRR using the discounting approach is:

0 = –$62,339.92 + $17,200/(1 + MIRR) + $22,300/$(1 + MIRR)^2$ + $27,900/$(1 + MIRR)^3$
+ $21,400/$(1 + MIRR)^4$

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

MIRR = 15.04%

Reinvestment approach:

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

Time 5 cash flow = $17,200($1.10^4$) + $22,300($1.10^3$) + $27,900($1.10^2$) + $21,400(1.10) – $8,600
Time 5 cash flow = $103,562.82

So, the MIRR using the reinvestment approach is:

0 = –$57,000 + $103,562.82/$(1 + MIRR)^5$
$103,562.82/$57,000 = $(1 + MIRR)^5$
MIRR = ($103,562.82/$57,000)$^{1/5}$ – 1
MIRR = .1268, or 12.68%

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

Time 0 cash flow = –$57,000 – $8,600/$1.10^5$

Time 0 cash flow = –$62,339.92

Time 5 cash flow = $17,200(1.10^4) + $22,300(1.10^3) + $27,900(1.10^2) + $21,400(1.10)
Time 5 cash flow = $112,162.82

So, the MIRR using the combination approach is:

0 = –$62,339.92 + $112,162.82/(1 + MIRR)^5
$112,162.82/$62,339.92 = (1 + MIRR)^5
MIRR = ($112,162.82/$62,339.92)$^{1/5}$ – 1
MIRR = .1246, or 12.46%

Intermediate

23. With different discounting and reinvestment rates, we need to make sure to use the appropriate interest rates. The MIRRs for the project with all three approaches are:

Discounting approach:

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

Time 0 cash flow = –$57,000 – $8,600/1.11^5
Time 0 cash flow = –$62,103.68

So, the MIRR using the discounting approach is:

0 = –$62,103.68 + $17,200/(1 + MIRR) + $22,300/(1 + MIRR)^2 + $27,900/(1 + MIRR)^3
+ $21,400/(1 + MIRR)^4

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

MIRR = 15.22%

Reinvestment approach:

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

Time 5 cash flow = $\$17,200(1.08^4) + \$22,300(1.08^3) + \$27,900(1.08^2) + \$21,400(1.08) – \$8,600$
Time 5 cash flow = $\$98,546.55$

So, the MIRR using the discounting approach is:

$0 = –\$57,000 + \$98,546.55/(1 + \text{MIRR})^5$
$\$98,546.55/\$57,000 = (1 + \text{MIRR})^5$
$\text{MIRR} = (\$98,546.55/\$57,000)^{1/5} – 1$
MIRR = .1157, or 11.57%

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:

Time 0 cash flow = $–\$57,000 – \$8,600/1.11^5$
Time 0 cash flow = –$62,103.68

Time 5 cash flow = $\$17,200(1.08^4) + \$22,300(1.08^3) + \$27,900(1.08^2) + \$21,400(1.08)$
Time 5 cash flow = $107,146.55

So, the MIRR using the discounting approach is:

$0 = –\$62,103.68 + \$107,146.55/(1 + \text{MIRR})^5$
$\$107,146.55/\$62,103.68 = (1 + \text{MIRR})^5$
$\text{MIRR} = (\$107,146.55/\$62,103.68)^{1/5} – 1$
MIRR = .1152, or 11.52%

24. 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 S from the cash flows from Project R. 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:

$0 = \$26,000 – \$3,000/(1 + R) – \$3,000/(1 + R)^2 – \$10,000/(1 + R)^3 – \$20,000/(1 + R)^4$
$– \$2,000/(1 + R)^5$

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

$R = 12.04\%$

The NPV of the projects at the crossover rate must be equal. The NPV of each project at the crossover rate is:

R: $NPV = -\$49,000 + \$18,000/1.1204 + \$18,000/1.1204^2 + \$23,000/1.1204^3 + \$9,000/1.1204^4 + \$5,000/1.1204^5$
$NPV = \$6,297.75$

S: $NPV = -\$75,000 + \$21,000/1.1204 + \$21,000/1.1204^2 + \$33,000/1.1204^3 + \$29,000/1.1204^4 + \$7,000/1.1204^5$
$NPV = \$6,297.75$

25. The IRR of the project is:

$\$83,000 = \$57,000/(1 + IRR) + \$44,000/(1 + IRR)^2$

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

IRR = 14.84%

At an interest rate of 12 percent, the NPV is:

$NPV = \$83,000 - \$57,000/1.12 - \$44,000/1.12^2$
$NPV = -\$2,969.39$

At an interest rate of zero percent, we can add cash flows, so the NPV is:

$NPV = \$83,000 - 57,000 - 44,000$
$NPV = -\$18,000$

And at an interest rate of 24 percent, the NPV is:

$NPV = \$83,000 - \$57,000/1.24 - \$44,000/1.24^2$
$NPV = \$8,416.23$

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.

26. By definition, the profitability index is:

PI = Discounted Value of Future Cash Flows/Initial Cost

But note that the discounted value of future cash flows is just the NPV overstated by the neglected initial costs, so:

NPV = Discounted Value of Future Cash Flows – Initial Cost
Discounted Value of Future Cash Flows = NPV + Initial Cost

Substituting, we get:

PI = (NPV + Initial Cost)/Initial Cost
PI = NPV/Initial Cost + 1
PI = NPV Index + 1
NPV Index = PI – 1

27. *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 × costs = $2I$
$C = 2I/$(PVIFA$_{R\%, N}$)

Challenge

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

PV of cash inflows = $C_1/(R – g)$
PV of cash inflows = \$195,000/(.11 – .04)
PV of cash inflows = \$2,785,714.29

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

NPV = –\$2,400,000 + 2,785,714.29
NPV = \$385,714.29

The NPV is positive, so we would accept 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 = –\$2,400,000 + \$195,000/(.11 – g)

Solving for g, we get:

g = .0288, or 2.88%

29. The IRR is the interest rate that makes the NPV of the project equal to zero. So, the IRR of the project is:

0 = \$25,000 – \$11,000/(1 + IRR) + \$7,000/(1 + 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:

$$x = \frac{-(-11{,}000) \pm \sqrt{(-11{,}000)^2 - 4(7{,}000)(25{,}000)}}{2(7{,}000)}$$

The square root term works out to be:

121,000,000 – 700,000,000 = –579,000,000

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.

30. 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:

Year 2 cash flow = \$610,000(1.04) = \$634,400
Year 3 cash flow = \$707,000(1.04) = \$735,280
Year 4 cash flow = \$580,000(1.04) = \$603,200
Year 5 cash flow = \$483,000(1.04) = \$502,320

So, the NPV of the project is:

NPV = –\$1,785,000 + \$634,400/1.11^2 + \$735,280/1.11^3 + \$603,200/1.11^4 + \$502,320/1.11^5
NPV = –\$37,027.33

And the IRR of the project is:

0 = –\$1,785,000 + \$634,400/(1 + IRR)^2 + \$735,280/(1 + IRR)^3 + \$603,200/(1 + IRR)^4
+ \$502,320/(1 + IRR)^5

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

IRR = 10.29%

While this may look like an 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

5.

CF_0	–$37,000
C01	$18,000
F01	1
C02	$21,000
F02	1
C03	$11,000
F03	1

IRR CPT
18.06%

6.

CF_0	–$37,000
C01	$18,000
F01	1
C02	$21,000
F02	1
C03	$11,000
F03	1

I = 11%
NPV CPT
$4,303.39

CF_0	–$37,000
C01	$18,000
F01	1
C02	$21,000
F02	1
C03	$11,000
F03	1

I = 24%
NPV CPT
–$3,056.86

7.

CF_0	–$71,000
C01	$14,600
F01	9

I = 8%
NPV CPT
$20,204.56

CF_0	–$71,000
C01	$14,600
F01	9

I = 20%
NPV CPT
–$12,147.89

CF_0	–$71,000
C01	$14,600
F01	9

IRR CPT
14.47%

8.

CF_0	–$19,900
C01	$10,300
F01	1
C02	$10,800
F02	1
C03	$7,400
F03	1

IRR CPT
21.57%

9.

CF_0	–$19,900
C01	$10,300
F01	1
C02	$10,800
F02	1
C03	$7,400
F03	1

I = 0%
NPV CPT
$8,600

CF_0	–$19,900
C01	$10,300
F01	1
C02	$10,800
F02	1
C03	$7,400
F03	1

I = 10%
NPV CPT
$3,948.99

CF_0	–$19,900
C01	$10,300
F01	1
C02	$10,800
F02	1
C03	$7,400
F03	1

I = 20%
NPV CPT
$465.74

CF_0	–$19,900
C01	$10,300
F01	1
C02	$10,800
F02	1
C03	$7,400
F03	1

I = 30%
NPV CPT
–$2,218.16

10. *Project A*

CF_0	–$45,400
C01	$21,000
F01	1
C02	$19,600
F02	1
C03	$16,700
F03	1
C04	$8,700
F04	1

IRR CPT
19.44%

CF_0	–$45,400
C01	$21,000
F01	1
C02	$19,600
F02	1
C03	$16,700
F03	1
C04	$8,700
F04	1

I = 11%
NPV CPT
$7,368.57

Project B

CF_0	–$45,400
C01	$6,800
F01	1
C02	$15,600
F02	1
C03	$19,700
F03	1
C04	$33,300
F04	1

IRR CPT
18.66%

CF_0	–$45,400
C01	$6,800
F01	1
C02	$15,600
F02	1
C03	$19,700
F03	1
C04	$33,300
F04	1

I = 11%
NPV CPT
$9,727.65

Crossover rate

CF$_0$	$0
C01	$14,200
F01	1
C02	$4,000
F02	1
C03	–$3,000
F03	1
C04	–$24,600
F04	1

IRR CPT
16.83%

11. *Project X*

CF$_0$	–$36,000
C01	$16,500
F01	1
C02	$17,000
F02	1
C03	$16,100
F03	1

I = 0%
NPV CPT
$13,600

CF$_0$	–$36,000
C01	$16,500
F01	1
C02	$17,000
F02	1
C03	$16,100
F03	1

I = 15%
NPV CPT
$1,788.28

CF$_0$	–$36,000
C01	$16,500
F01	1
C02	$17,000
F02	1
C03	$16,100
F03	1

I = 25%
NPV CPT
–$3,676.80

Project Y

CF$_0$	–$36,000
C01	$18,700
F01	1
C02	$14,600
F02	1
C03	$15,900
F03	1

I = 0%
NPV CPT
$13,200

CF$_0$	–$36,000
C01	$18,700
F01	1
C02	$14,600
F02	1
C03	$15,900
F03	1

I = 15%
NPV CPT
$1,755.08

CF$_0$	–$36,000
C01	$18,700
F01	1
C02	$14,600
F02	1
C03	$15,900
F03	1

I = 25%
NPV CPT
–$3,555.20

Crossover rate

CF$_0$	$0
C01	–$2,200
F01	1
C02	$2,400
F02	1
C03	$200
F03	1

IRR CPT
16.87%

12.

CF_0	–$45,000,000	**CF_0**	–$45,000,000
C01	$65,000,000	**C01**	$65,000,000
F01	1	**F01**	1
C02	–$9,000,000	**C02**	–$9,000,000
F02	1	**F02**	1
I = 12%		IRR CPT	
NPV CPT		28.93%	
$5,860,969.39			

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 –84.49%.

13.

CF_0	$0	**CF_0**	$0	**CF_0**	$0
C01	$8,900	**C01**	$8,900	**C01**	$8,900
F01	1	**F01**	1	**F01**	1
C02	$7,700	**C02**	$7,700	**C02**	$7,700
F02	1	**F02**	1	**F02**	1
C03	$4,300	**C03**	$4,300	**C03**	$4,300
F03	1	**F03**	1	**F03**	1
I = 10%		I = 15%		I = 22%	
NPV CPT		NPV CPT		NPV CPT	
$17,685.20		$16,388.76		$14,836.46	

@10%: PI = $17,685.20/$15,300 = 1.156
@15%: PI = $16,388.76/$15,300 = 1.071
@22%: PI = $14,836.46/$15,300 = .970

14. *Project I*

CF_0	$0	**CF_0**	–$77,000
C01	$35,600	**C01**	$35,600
F01	3	**F01**	3
I = 10%		I = 10%	
NPV CPT		NPV CPT	
$88,531.93		$11,531.93	

PI = $88,531.93/$77,000 = 1.150

Project II

CF_0	$0	**CF_0**	–$23,500
C01	$11,400	**C01**	$11,400
F01	3	**F01**	3
I = 10%		I = 10%	
NPV CPT		NPV CPT	
$28,350.11		$4,850.11	

PI = $28,350.11/$23,500 = 1.206

15.

CF(A)

c.		*d.*		*e.*	
CF_0	–$262,000	**CF_0**	–$262,000	**CF_0**	$0
C01	$34,000	**C01**	$34,000	**C01**	$34,000
F01	1	**F01**	1	**F01**	1
C02	$50,000	**C02**	$50,000	**C02**	$50,000
F02	2	**F02**	2	**F02**	2
C03	$329,000	**C03**	$329,000	**C03**	$329,000
F03	1	**F03**	1	**F03**	1
I = 11%		IRR CPT		I = 11%	
NPV CPT		18.39%		NPV CPT	
$62,493.81				$324,493.81	

PI = $324,493.81/$262,000 = 1.239

CF(B)

c.		*d.*		*e.*	
CF_0	–$37,400	**CF_0**	–$37,400	**CF_0**	$0
C01	$18,000	**C01**	$18,000	**C01**	$18,000
F01	1	**F01**	1	**F01**	1
C02	$16,000	**C02**	$16,000	**C02**	$16,000
F02	2	**F02**	2	**F02**	2
C03	$12,000	**C03**	$12,000	**C03**	$12,000
F03	1	**F03**	1	**F03**	1
I = 11%		IRR CPT		I = 11%	
NPV CPT		25.55%		NPV CPT	
$11,406.01				$48,806.01	

PI = $48,806.01/$37,400 = 1.305

16. *Project M*

CF_0	–$130,000	**CF_0**	–$130,000
C01	$55,500	**C01**	$55,500
F01	1	**F01**	1
C02	$69,400	**C02**	$69,400
F02	1	**F02**	1
C03	$64,100	**C03**	$64,100
F03	1	**F03**	1
C04	$36,500	**C04**	$36,500
F04	1	**F04**	1
CPT IRR		I = 15%	
27.94%		NPV CPT	
		$33,753.02	

Project N

CF_0	–$349,000	**CF_0**	–$349,000
C01	$154,300	**C01**	$154,300
F01	1	**F01**	1
C02	$164,400	**C02**	$164,400
F02	1	**F02**	1
C03	$150,800	**C03**	$150,800
F03	1	**F03**	1
C04	$105,400	**C04**	$105,400
F04	1	**F04**	1
CPT IRR		I = 15%	
25.01%		NPV CPT	
		$68,900.17	

17. *Project Y*

CF_0	$0	**CF_0**	–$60,600
C01	$29,700	**C01**	$29,700
F01	1	**F01**	1
C02	$26,500	**C02**	$26,500
F02	1	**F02**	1
C03	$22,700	**C03**	$22,700
F03	1	**F03**	1
C04	$16,600	**C04**	$16,600
F04	1	**F04**	1
I = 12%		I = 12%	
NPV CPT		NPV CPT	
$74,350.51		$13,750.51	

PI = $74,350.51/$60,600 = 1.227

Project Z

CF_0	$0	**CF_0**	–$93,000
C01	$39,000	**C01**	$39,000
F01	1	**F01**	1
C02	$38,300	**C02**	$38,300
F02	1	**F02**	1
C03	$32,500	**C03**	$32,500
F03	1	**F03**	1
C04	$29,300	**C04**	$29,300
F04	1	**F04**	1
I = 12%		I = 12%	
NPV CPT		NPV CPT	
$107,107.49		$14,107.49	

PI = $107,107.49/$93,000 = 1.152

18.

CF_0	$0
C01	$29,900
F01	1
C02	$12,700
F02	1
C03	–$18,100
F03	1
C04	–$35,700
F04	1

CPT IRR
10.38%

20.

CF0	–$547,350
C01	$209,100
F01	1
C02	$236,200
F02	1
C03	$214,600
F03	1
C04	$164,340
F04	1

I = 0%
NPV CPT
$276,890

CF0	–$574,350
C01	$209,100
F01	1
C02	$236,200
F02	1
C03	$214,600
F03	1
C04	$164,340
F04	1

IRR CPT
19.44%

21. *b.*

Project F

CF_0	–$215,000
C01	$104,800
F01	1
C02	$92,300
F02	1
C03	$87,600
F03	1
C04	$78,000
F04	1
C05	$70,800
F05	1

I = 10%
NPV CPT
$119,605.17

Project G

CF_0	–$318,000
C01	$74,600
F01	1
C02	$96,500
F02	1
C03	$125,600
F03	1
C04	$168,800
F04	1
C05	$189,200
F05	1

I = 10%
NPV CPT
$156,706.37

24. Crossover rate:

CF_0	$26,000
C01	–$3,000
F01	1
C02	–$3,000
F02	1
C03	–$10,000
F03	1
C04	–$20,000
F04	1
C05	–$2,000
F05	1

IRR CPT
12.04%

Project R

CF_0	–$49,000
C01	$18,000
F01	1
C02	$18,000
F02	1
C03	$23,000
F03	1
C04	$9,000
F04	1
C05	$5,000
F05	1

I = 12.04%
NPV CPT
$6,297.75

Project S

CF_0	–$75,000
C01	$21,000
F01	1
C02	$21,000
F02	1
C03	$33,000
F03	1
C04	$29,000
F04	1
C05	$7,000
F05	

I = 12.04%
NPV CPT
$6,297.75

25.

CF0	$83,000
C01	–$57,000
F01	1
C02	–$44,000
F02	1

I = 12%
NPV CPT

–$2,969.39

CF0	$83,000
C01	–$57,000
F01	1
C02	–$44,000
F02	1

I = 0%
NPV CPT

–$18,000

CF0	$83,000
C01	–$57,000
F01	1
C02	–$44,000
F02	1

I = 24%
NPV CPT

$8,416.23

CF0	$83,000
C01	–$57,000
F01	1
C02	–$44,000
F02	1

IRR CPT
14.84%

30.

CF_0	–$1,785,000
C01	$0
F01	1
C02	$634,400
F02	1
C03	$735,280
F03	1
C04	$603,200
F04	1
C05	$502,320
F05	1

CPT IRR
10.29%

CHAPTER 9
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 it.

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 each other.

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 remain unchanged, financing costs are irrelevant in the analysis of a project's incremental cash flows according to the stand-alone principle.

5. 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.

6. There are two particularly important considerations. The first is erosion. Will the essentialized book 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 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 that there is an active market for the used product.

7. 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.

8. 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!

9. Porsche would recognize that the outsized profits would dwindle as more products come to market and competition becomes more intense.

10. 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.

11. 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. At the margin, even if a firm is losing money, if marginal revenue exceeds marginal cost, the firm will lose less than it would without the new project.

12. The implication is that they will face hard capital rationing.

13. 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 project because the cash flows are usually harder to predict.

14. The option to abandon reflects our ability to reallocate assets if we find our initial estimates were too optimistic. The option to expand reflects our ability to increase cash flows from a project if we find our initial estimates were too pessimistic. Since the option to expand can increase cash flows and the option to abandon reduces losses, failing to consider these two options will generally lead us to underestimate a project's NPV.

Solutions to Questions and Problems

Basic

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.

1. The $3.1 million acquisition cost of the land six years ago is a sunk cost. The $3.7 million current aftertax value of the land is an opportunity cost if the land is used rather than sold. The $15.6 million cash outlay and $950,000 grading expenses are the initial fixed asset investments needed to get the project going. Therefore, the proper Year 0 cash flow to use in evaluating this project is:

$3,700,000 + 15,600,000 + 950,000 = $20,250,000

2. Sales due solely to the new product line are:

22,000($18,500) = $407,000,000

Increased sales of the motor home line occur because of the new product line introduction; thus:

2,600($103,000) = $267,800,000

in new sales is relevant. Erosion of luxury motor coach sales is also due to the new campers; thus:

1,400($155,000) = $217,000,000 loss in sales

is relevant. The net sales figure to use in evaluating the new line is thus:

$407,000,000 + 267,800,000 – 217,000,000 = $457,800,000

3. We need to construct a basic income statement. The income statement is:

Sales	$ 495,000
Variable costs	178,200
Fixed costs	157,000
Depreciation	46,000
EBT	$ 113,800
Taxes (21%)	23,898
Net income	$ 89,902

4. To find the OCF, we need to complete the income statement as follows:

Sales	$ 675,300
Costs	504,500
Depreciation	86,400
EBT	$ 84,400
Taxes (22%)	18,568
Net income	$ 65,832

The OCF for the company is:

OCF = EBIT + Depreciation – Taxes
OCF = $84,400 + 86,400 – 18,568
OCF = $152,232

The depreciation tax shield is the depreciation times the tax rate, so:

Depreciation tax shield = T_C(Depreciation)
Depreciation tax shield = .22($86,400)
Depreciation tax shield = $19,008

The depreciation tax shield shows us the increase in OCF by being able to expense depreciation.

5. 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:

Year	Beginning Book Value	MACRS	Depreciation	Ending Book Value
1	$1,325,000.00	0.1429	$189,342.50	$1,135,657.50
2	1,135,657.50	0.2449	324,492.50	811,165.00
3	811,165.00	0.1749	231,742.50	579,422.50
4	579,422.50	0.1249	165,492.50	413,930.00
5	413,930.00	0.0893	118,322.50	295,607.50
6	295,607.50	0.0892	118,190.00	177,417.50
7	177,417.50	0.0893	118,322.50	59,095.00
8	59,095.00	0.0446	59,095.00	0

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

Annual depreciation = $840,000/8
Annual depreciation = $105,000

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

Accumulated depreciation = 5($105,000)
Accumulated depreciation = $525,000

The book value at the end of Year 5 is thus:

BV_5 = $840,000 – 525,000
BV_5 = $315,000

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

Aftertax salvage value = $135,000 + ($315,000 – 135,000)(.21)
Aftertax salvage value = $172,800

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

Taxes on salvage value = (BV – MV)T_C

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

7. 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 5, 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:

$BV_4 = \$4,900,000 – 4,900,000(.2000 + .3200 + .1920 + .1152)$
$BV_4 = \$846,720$

The asset is sold at a gain to book value, so this gain is taxable.

Aftertax salvage value = \$1,600,000 + (\$846,720 – 1,600,000)(.21)
Aftertax salvage value = \$1,441,811

8. We need to calculate the OCF, so we need an income statement. The lost sales of the current sound board sold by the company will be a negative since it will lose the sales.

Sales of new	\$38,100,000
Lost sales of old	–7,854,000
Variable costs	16,635,300
Fixed costs	2,800,000
Depreciation	1,850,000
EBT	\$8,960,700
Tax	1,971,354
Net income	\$6,989,346

The OCF for the company is:

OCF = EBIT + Depreciation – Taxes
OCF = \$8,960,700 + 1,850,000 – 1,971,354
OCF = \$8,839,346

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:

OCF = (Sales – Costs)$(1 – T_C)$ + T_C(Depreciation)
OCF = (\$1,445,000 – 580,000)(1 – .21) + .21(\$1,960,000/3)
OCF = \$820,550

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:

NPV = –\$1,960,000 + \$820,550$(PVIFA_{12\%,3})$
NPV = \$10,822.65

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 that will be paid on this sale. So, the cash flows for each year of the project will be:

Year	Cash Flow	
0	–$2,210,000	= –$1,960,000 – 250,000
1	820,550	
2	820,550	
3	1,212,750	= $820,550 + 250,000 + 180,000 + ($0 – 180,000)(.21)

And the NPV of the project is:

NPV = –$2,210,000 + $820,550(PVIFA$_{12\%,2}$) + $1,212,750/1.12^3
NPV = $39,982.86

12. First we will calculate the annual depreciation for the equipment necessary for the project. The depreciation amount each year will be:

Year 1 depreciation = $1,960,000(.3333) = $653,268
Year 2 depreciation = $1,960,000(.4445) = $871,220
Year 3 depreciation = $1,960,000(.1481) = $290,276

So, the book value of the equipment at the end of three years, which will be the initial investment minus the accumulated depreciation, is:

Book value in 3 years = $1,960,000 – ($653,268 + 871,220 + 290,276)
Book value in 3 years = $145,236

The asset is sold at a gain to book value, so this gain is taxable.

Aftertax salvage value = $180,000 + ($145,236 – 180,000)(.21)
Aftertax salvage value = $172,700

To calculate the OCF, we will use the tax shield approach, so the cash flow each year is:

OCF = (Sales – Costs)(1 – T_C) + T_C(Depreciation)

Year	Cash Flow	
0	–$2,210,000	= –$1,960,000 – 250,000
1	820,536.28	= ($1,445,000 – 580,000)(.79) + .21($653,268)
2	866,306.20	= ($1,445,000 – 580,000)(.79) + .21($871,220)
3	1,167,007.52	= ($1,445,000 – 580,000)(.79) + .21($290,276) + $172,700 + 250,000

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:

NPV = –$2,210,000 + $820,536.28/1.12 + $866,306.20/1.12^2 + $1,167,007.52/1.12^3
NPV = $43,888.58

13. The book value of the equipment at the end of three years is zero, so the aftertax salvage value is:

Aftertax salvage value = $180,000 + ($0 – 180,000)(.21)
Aftertax salvage value = $142,200

To calculate the OCF, we will use the tax shield approach, so the cash flow each year is:

OCF = (Sales – Costs)(1 – T_C) + T_C(Depreciation)

Year	Cash Flow	
0	–$2,210,000	= –$1,960,000 – 250,000
1	1,094,950	= ($1,445,000 – 580,000)(.79) + .21($1,960,000)
2	683,350	= ($1,445,000 – 580,000)(.79)
3	1,075,550	= ($1,445,000 – 580,000)(.79) + $142,200 + 250,000

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:

NPV = –$2,210,000 + $1,094,950/1.12 + $683,350/$1.12^2$ + $1,075,550/$1.12^3$
NPV = $77,951.61

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

Annual depreciation = $385,000/5
Annual depreciation = $77,000

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

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

Aftertax salvage value = MV + (0 – MV)T_C
Aftertax salvage value = MV(1 – T_C)

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

Aftertax salvage value = $60,000(1 – .21)
Aftertax salvage value = $47,400

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

OCF = $135,000(1 – .21) + .21($77,000)
OCF = $122,820

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

NPV = –$385,000 – 35,000 + $122,820(PVIFA$_{10\%,5}$) + [($47,400 + 35,000)/1.10^5]
NPV = $96,748.35

15. Very often the book value of the equipment is zero and it is always zero with 100 percent bonus depreciation. If the book value is zero, the equation for the aftertax salvage value becomes:

Aftertax salvage value = MV + (0 – MV)T_C
Aftertax salvage value = MV(1 – T_C)

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

Aftertax salvage value = $60,000(1 – .21)
Aftertax salvage value = $47,400

Using the tax shield approach, we find the OCF for Year 1 is:

OCF = $135,000(1 – .21) + .21($385,000)
OCF = $187,500

And the OCF for Years 2 through 5 is:

OCF = $135,000(1 – .21)
OCF = $106,650

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

NPV = –$385,000 – 35,000 + $187,500/1.10 + $106,650/1.10^2 + $106,650/1.10^3 + $106,650/1.10^4
+ ($106,650 + 47,400 + 35,000)/1.10^5
NPV = $108,951.33

16. First, we will calculate the annual depreciation of the new equipment. It will be:

Annual depreciation charge = $535,000/5
Annual depreciation charge = $107,000

The aftertax salvage value of the equipment is:

Aftertax salvage value = $30,000(1 – .24)
Aftertax salvage value = $22,800

Using the tax shield approach, the OCF is:

OCF = $165,000(1 – .24) + .24($107,000)
OCF = $151,080

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:

$NPV = 0 = –\$535{,}000 + 60{,}000 + \$151{,}080(PVIFA_{IRR,5}) + [(\$22{,}800 – 60{,}000)/(1 + IRR)^5]$
IRR = 16.18%

17. To evaluate the project with a \$150,000 cost savings, we need the OCF to compute the NPV. Using the tax shield approach, the OCF is:

OCF = \$150,000(1 – .24) + .24(\$107,000)
OCF = \$139,680

$NPV = –\$535{,}000 + 60{,}000 + \$139{,}680(PVIFA_{11\%,5}) + [(\$22{,}800 – 60{,}000)/1.11^5]$
NPV = \$19,166.51

The NPV with a \$100,000 cost savings is:

OCF = \$100,000(1 – .24) + .24(\$107,000)
OCF = \$101,680

$NPV = –\$535{,}000 + 60{,}000 + \$101{,}680(PVIFA_{11\%,5}) + [(\$22{,}800 – 60{,}000)/1.11^5]$
NPV = –\$121,277.58

We would accept the project if cost savings were \$150,000, and reject the project if the cost savings were \$100,000.

18. 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.

Scenario	Unit Sales	Unit Price	Unit Variable Cost	Fixed Costs
Base	92,000	\$1,340	\$390.00	\$3,800,000
Best	105,800	1,541	331.50	3,230,000
Worst	78,20	1,139	448.50	4,370,000

19. 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: $\Delta NPV/\Delta P$. 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.

20. *a.* We will use the tax shield approach to calculate the OCF. The OCF is:

$OCF_{base} = [(P – v)Q – FC](1 – T_C) + T_C D$
$OCF_{base} = [(\$57 – 31)(50{,}000) – \$950{,}000](1 – .22) + .22(\$114{,}375)$
$OCF_{base} = \$298{,}162.50$

Now we can calculate the NPV using our base-case projections. There is no salvage value or NWC, so the NPV is:

$NPV_{base} = –\$915{,}000 + \$298{,}162.50(PVIFA_{10\%,8})$
$NPV_{base} = \$675{,}674.93$

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 51,000 units. The NPV at this sales level is:

$OCF_{new} = [(\$57 – 31)(51{,}000) – \$950{,}000](1 – .22) + .22(\$114{,}375)$
$OCF_{new} = \$318{,}442.50$

And the NPV is:

$NPV_{new} = –\$915{,}000 + \$318{,}442.50(PVIFA_{10\%,8})$
$NPV_{new} = \$783{,}867.24$

So, the change in NPV for every unit change in sales is:

$\Delta NPV/\Delta Q = (\$675{,}674.93 – 783{,}867.24)/(50{,}000 – 51{,}000)$
$\Delta NPV/\Delta Q = +\$108.19$

If sales were to drop by 500 units, then NPV would drop by:

NPV drop = $108.19(500)
NPV drop = $54,096.15

You may wonder why we chose 51,000 units. Because it doesn't matter! Whatever new quantity we use, when we calculate the change in NPV per unit sold, the ratio will be the same.

b. To find out how sensitive OCF is to a change in variable costs, we will compute the OCF at a variable cost of $32. 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 $32 is:

$OCF_{new} = [(\$57 – 32)(50{,}000) – \$950{,}000](1 – .22) + .22(\$114{,}375)$
$OCF_{new} = \$259{,}162.50$

So, the change in OCF for a $1 change in variable costs is:

$\Delta OCF/\Delta v = (\$298{,}162.50 – 259{,}162.50)/(\$31 – 32)$
$\Delta OCF/\Delta v = –\$39{,}000$

If variable costs decrease by $1 then OCF would increase by $39,000.

21. 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:

$OCF_{best} = \{[(\$57)(1.1) – (\$31)(.9)](50{,}000)(1.1) – \$950{,}000(.9)\}(1 – .22) + .22(\$114{,}375)$
$OCF_{best} = \$851{,}182.50$

The best-case NPV is:

$NPV_{best} = –\$915{,}000 + \$851{,}182.50(PVIFA_{10\%,8})$
$NPV_{best} = \$3{,}625{,}995.82$

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:

$OCF_{worst} = \{[(\$57)(.9) – (\$31)(1.1)](50{,}000)(.9) – \$950{,}000(1.1)\}(1 – .22) + .22(\$114{,}375)$
$OCF_{worst} = –\$186{,}217.50$

The worst-case NPV is:

$NPV_{worst} = –\$915{,}000 – \$186{,}217.50(PVIFA_{10\%,8})$
$NPV_{worst} = –\$1{,}908{,}456.62$

22. First, we need to calculate the cash flows. The marketing study is a sunk cost and should be ignored. The net income each year will be:

Sales of new product	\$915,000
Variable costs	183,000
Fixed costs	235,000
Depreciation	222,500
EBT	\$274,500
Tax	63,135
Net income	\$211,365

So, the OCF is:

OCF = EBIT + Depreciation – Taxes
OCF = \$274,500 + 222,500 – 63,135
OCF = \$433,865

The only initial cash flow is the cost of the equipment, so the payback period is:

Payback period = \$890,000/\$433,865
Payback period = 2.05 years

The NPV is:

$NPV = –\$890{,}000 + \$433{,}865(PVIFA_{13\%,4})$

NPV = $400,519.00

And the IRR is:

0 = –$890,000 + $433,865(PVIFA$_{IRR,4}$)
IRR = 33.32%

Intermediate

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

D_1 = $475,000(.2000) = $95,000
D_2 = $475,000(.3200) = $152,000
D_3 = $475,000(.1920) = $91,200
D_4 = $475,000(.1152) = $54,720

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

BV_4 = $475,000 – ($95,000 + 152,000 + 91,200 + 54,720)
BV_4 = $82,080

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

Aftertax salvage value = $45,000 + ($82,080 – 45,000)(.22)
Aftertax salvage value = $53,157.60

So, the OCF for each year will be:

OCF_1 = $170,000(1 – .22) + .22($95,000) = $153,500
OCF_2 = $170,000(1 – .22) + .22($152,000) = $166,040
OCF_3 = $170,000(1 – .22) + .22($91,200) = $152,664
OCF_4 = $170,000(1 – .22) + .22($54,720) = $144,638.40

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 $2,900 more in NWC each successive year. We will subtract the $20,000 from the initial cash flow, and subtract $2,900 each year from the OCF to account for this spending. In Year 4, we will add back the total spent on NWC, which is $28,700. The $2,900 spent on NWC capital during Year 4 is irrelevant. Why? Well, during this year the project required an additional $2,900, but we would get the money back immediately. So, the net cash flow for additional NWC would be zero. With this, the equation for the NPV of the project is:

NPV = –$475,000 – 20,000 + ($153,500 – 2,900)/1.09 + ($166,040 – 2,900)/$1.09^2$
+ ($152,664 – 2,900)/$1.09^3$ + ($144,638.40 + 28,700 + 53,157.60)/1.09^4
NPV = $56,577.58

24. Since we are using 100 percent bonus depreciation, the book value of the asset at the end of the project will be zero. So, the aftertax salvage value will be:

Aftertax salvage value = $45,000 + ($0 – 45,000)(.22)
Aftertax salvage value = $35,100

Using the depreciation tax shield approach, the OCF for each year will be:

OCF_1 = $170,000(1 – .22) + .22($475,000) = $237,100
OCF_2 = $170,000(1 – .22) = $132,600
OCF_3 = $170,000(1 – .22) = $132,600
OCF_4 = $170,000(1 – .22) = $132,600

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 $2,900 more in NWC each successive year. We will subtract the $20,000 from the initial cash flow and subtract $2,900 each year from the OCF to account for this spending. In Year 4, we will add back the total spent on NWC, which is $28,400. The $2,900 spent on NWC during Year 4 is irrelevant. Why? Well, during this year the project required an additional $2,900, but we would get the money back immediately. So, the net cash flow for additional NWC would be zero. With all this, the equation for the NPV of the project is:

$$NPV = -\$475,000 - 20,000 + (\$237,100 - 2,900)/1.11 + (\$132,600 - 2,900)/1.11^2 + (\$132,600 - 2,900)/1.11^3 + (\$132,600 + 28,700 + 35,100)/1.11^4$$
NPV = $68,315.19

25. The aftertax salvage value is:

Aftertax salvage value = $30,000(1 – .22)
Aftertax salvage value = $23,400

And the OCF each year will be:

	Year 1	Years 2-5
Sales	$287,000	$287,000
Variable costs	100,450	100,450
Fixed costs	48,000	48,000
Depreciation	425,000	0
EBIT	–$286,450	$138,550
Tax	–63,019	30,481
Net income	–$223,431	$108,069
+ Depreciation	425,000	0
OCF	$201,569	$108,069

Now we have all the necessary information to calculate the project NPV. The project NPV is:

$NPV = –\$425,000 – 27,000 + \$201,569/1.09 + \$108,069/1.09^2 + \$108,069/1.09^3 + \$108,069/1.09^4 + (\$108,069 + 23,400 + 27,000)/1.09^5$
$NPV = \$86,887.08$

26. Using the tax shield approach, the OCF at 61,000 units will be:

$OCF = [(P – v)Q – FC](1 – T_C) + T_C D$
$OCF = [(\$31 – 18)(61,000) – 275,000](1 – .21) + .21(\$735,000/4)$
$OCF = \$447,807.50$

We will calculate the OCF at 62,000 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:

$OCF = [(\$31 – 18)(62,000) – 275,000](1 – .21) + .21(\$735,000/4)$
$OCF = \$458,077.50$

The sensitivity of the OCF to changes in the quantity sold is:

$Sensitivity = \Delta OCF/\Delta Q = (\$447,807.50 – 458,077.50)/(61,000 – 62,000)$
$\Delta OCF/\Delta Q = +10.27$

OCF will increase by $10.27 for every additional unit sold.

27. *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.

Scenario	Unit Sales	Variable Cost	Fixed Costs
Base	200	$9,400	$525,000
Best	220	8,460	472,500
Worst	180	10,340	577,500

Using the tax shield approach, the OCF and NPV for the base-case estimate are:

$OCF_{base} = [(\$15,900 – 9,400)(200) – \$525,000](1 – .21) + .21(\$1,450,000/4)$
$OCF_{base} = \$688,375$

$NPV_{base} = –\$1,450,000 + \$688,375(PVIFA_{12\%,4})$
$NPV_{base} = \$640,835.36$

The OCF and NPV for the worst-case estimate are:

$OCF_{worst} = [(\$15,900 – 10,340)(180) – \$577,500](1 – .21) + .21(\$1,450,000/4)$
$OCF_{worst} = \$410,532$

$NPV_{worst} = –\$1,450,000 + \$410,532(PVIFA_{12\%,4})$
$NPV_{worst} = –\$203,070.90$

And the OCF and NPV for the best-case estimate are:

OCF_{best} = [($15,900 – 8,460)(220) – $472,500](1 – .21) + .21($1,450,000/4)
OCF_{best} = $995,922

NPV_{best} = –$1,450,000 + $995,922($PVIFA_{12\%,4}$)
NPV_{best} = $1,574,963.04

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 $530,000. The OCF using this level of fixed costs and the other base-case values with the tax shield approach, is:

OCF = [($15,900 – 9,400)(200) – $530,000](1 – .21) + .21($1,450,000/4)
OCF = $684,425

And the NPV is:

NPV = –$1,450,000 + $684,425($PVIFA_{12\%,4}$)
NPV = $628,837.83

The sensitivity of NPV to changes in fixed costs is:

ΔNPV/ΔFC = ($640,835.36 – 628,837.83)/($525,000 – 530,000)
ΔNPV/ΔFC = –$2.40

For every dollar fixed costs increase (decrease), NPV decreases (increases) by $2.40.

28. 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:

Sales		
New clubs	$925 × 50,000 =	$46,250,000
Exp. clubs	$1,375 × (–10,000) =	–13,750,000
Cheap clubs	$445 × 12,000 =	5,340,000
		$37,840,000

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:

Variable Costs		
New clubs	–$425 × 50,000 =	–$21,250,000
Exp. clubs	–$790 × (–10,000) =	7,900,000
Cheap clubs	–$230 × 12,000 =	–2,760,000
		–$16,111,000

The pro forma income statement will be:

Sales	$37,840,000
Variable costs	16,110,000

Fixed costs	9,500,000
Depreciation	5,850,000
EBIT	$6,380,000
Taxes	1,595,000
Net income	$4,785,000

Using the bottom-up OCF calculation, we get:

OCF = NI + Depreciation
OCF = $4,785,000 + 5,850,000
OCF = $10,635,000

So, the payback period is:

Payback period = 4 + $260,000/$10,635,000
Payback period = 4.02 years

The NPV is:

NPV = –$40,950,000 – 1,850,000 + $10,635,000($PVIFA_{10\%,7}$) + $1,850,000/$1.10^7$
NPV = $9,924,976.64

And the IRR is:

IRR = –$40,950,000 – 1,850,000 + $10,635,000($PVIFA_{IRR,7}$) + $1,850,000/$IRR^7$
IRR = 16.63%

Challenge

29. 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 0, the project will require an investment in equipment. The project will also require an investment in NWC. The initial NWC investment is given, and the subsequent NWC investment will be 15 percent of the increase in the following year's sales. So, the cash flow required for the project today will be:

Capital spending	–$12,900,000
Initial NWC	–1,600,000
Total cash flow	–$14,500,000

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 $2.4 million per year. To calculate depreciation each year, we use the initial equipment cost of $12.9 million, times the appropriate MACRS depreciation each year. The remainder of each income statement is calculated below. Notice at the bottom of the income statement we added back depreciation to get the OCF for each year. The section labeled "Net cash flows" will be discussed below:

Year	1	2	3	4	5
Ending book value	$11,056,590	$7,897,380	$5,641,170	$4,029,960	$2,877,990

Sales	$20,145,000	$25,675,000	$32,390,000	$28,835,000	$19,355,000
Variable costs	13,515,000	17,225,000	21,730,000	19,345,000	12,985,000
Fixed costs	2,400,000	2,400,000	2,400,000	2,400,000	2,400,000
Depreciation	1,843,410	3,159,210	2,256,210	1,611,210	1,151,970
EBIT	$2,386,590	$2,890,790	$6,003,790	$5,478,790	$2,818,030
Taxes	501,184	607,066	1,260,796	1,150,546	591,786
Net income	$1,885,406	$2,283,724	$4,742,994	$4,328,244	$2,226,244
Depreciation	1,843,410	3,159,210	2,256,210	1,611,210	1,151,970
Operating CF	$3,728,816	$5,442,934	$6,999,204	$5,939,454	$3,378,214
Net cash flows					
Operating CF	$3,728,816	$5,442,934	$6,999,204	$5,939,454	$3,378,214
Change in NWC	–829,500	–1,007,250	533,250	1,422,000	1,481,500
Capital spending					2,642,578
Total cash flow	$2,899,316	$4,435,684	$7,532,454	$7,361,454	$7,502,292

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 value of the equipment. The required NWC is 15 percent of the increase in sales in the next year. We will work through the NWC cash flow for Year 1. The total NWC in Year 1 will be 15 percent of the sales increase from Year 1 to Year 2, or:

Increase in NWC for Year 1 = .15($20,145,000 – 25,675,000)
Increase in NWC for Year 1 = –$829,500

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

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

Ending book value = $12,900,000 – ($1,843,410 + 3,159,210 + 2,256,210 + 1,611,210 + 1,151,970)
Ending book value = $2,877,990

The market value of the used equipment is 20 percent of the purchase price, or $2.58 million, so the aftertax salvage value will be:

Aftertax salvage value = $2,580,000 + ($2,877,990 – 2,580,000)(.21)
Aftertax salvage value = $2,642,578

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

$$NPV = –\$14,500,000 + \$2,899,316/1.18 + \$4,435,684/1.18^2 + \$7,532,454/1.18^3 + \$7,361,454/1.18^4 + \$7,502,292/1.18^5$$
$$NPV = \$2,803,447.84$$

And the IRR is:

$$NPV = 0 = –\$14,500,000 + \$2,899,316/(1 + IRR) + \$4,435,684/(1 + IRR)^2 + \$7,532,454/(1 + IRR)^3 + \$7,361,454/(1 + IRR)^4 + \$7,502,292/(1 + IRR)^5$$
$$IRR = 24.97\%$$

We should accept the project.

30. 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:

$D_1 = \$845,000(.3333) = \$281,638.50$
$D_2 = \$845,000(.4445) = \$375,602.50$
$D_3 = \$845,000(.1481) = \$125,144.50$
$D_4 = \$845,000(.0741) = \$62,614.50$

Using the tax shield approach, the OCF each year is:

$OCF_1 = (S – C)(1 – .22) + .22(\$281,638.50)$
$OCF_2 = (S – C)(1 – .22) + .22(\$375,602.50)$
$OCF_3 = (S – C)(1 – .22) + .22(\$125,144.50)$
$OCF_4 = (S – C)(1 – .22) + .22(\$62,614.50)$
$OCF_5 = (S – C)(1 – .22)$

Now we need the aftertax salvage value of the equipment. The aftertax salvage value is:

Aftertax salvage value = $\$105,000(1 – .22)$
Aftertax salvage value = \$81,900

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) multiplied by 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:

$$NPV = 0 = –\$845,000 – 65,000 + (S – C)(.78)(PVIFA_{9\%,5}) + .22(\$281,638.50/1.09 + \$375,602.50/1.09^2 + \$125,144.50/1.09^3 + \$62,614.50/1.09^4) + (\$65,000 + 81,900)/1.09^5$$

Solving this equation for the sales minus costs, we get:

$(S – C)(.78)(PVIFA_{9\%,5}) = \$657,112.16$
$S – C = \$216,587.92$

CHAPTER 10
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 the 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, that 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 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.

10. *a.* If the market is not weak form efficient, then this information could be acted on and a profit could be 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. Under (2), if the market is not semi-strong form efficient, then this information could be used to buy the stock "cheaply" 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, under (3) 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:

$R = [(\$93 - 81) + 2.05]/\$81$
$R = .1735$, or 17.35%

The dividend yield is the dividend divided by the beginning of the period price, so:

Dividend yield = $2.05/$81
Dividend yield = .0253, or 2.53%

And the capital gains yield is the increase in price divided by the initial price, so:

Capital gains yield = ($93 – 81)/$81
Capital gains yield = .1481, or 14.81%

2. Using the equation for total return, we find:

$R = [(\$61 - 81) + 2.05]/\$81$
$R = -.2216$, or –22.16%

And the dividend yield and capital gains yield are:

Dividend yield = $2.05/$81
Dividend yield = .0253, or 2.53%

Capital gains yield = ($61 – 81)/$81
Capital gains yield = –.2469, or –24.69%

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. However, this has happened on bonds.

3. To calculate the dollar return, we multiply the number of shares owned by the change in price per share and the dividend per share received. The total dollar return is:

Dollar return = 325($81.36 – 74.17 + 1.42)
Dollar return = $2,798.25

4. The total dollar return is the increase in price plus the coupon payment, so:

Total dollar return = $940 – 910 + 55
Total dollar return = $85

The total percentage return of the bond is:

R = [($940 – 910) + 55]/$910
R = .0934, or 9.34%

Notice here that we could have used the total dollar return of $85 in the numerator of this equation.

Using the Fisher equation, the real return was:

$(1 + R) = (1 + r)(1 + h)$

r = 1.0934/1.03 – 1
r = .0616, or 6.16%

5. The nominal return is the stated return, which is 12.2 percent. Using the Fisher equation, the real return was:

$(1 + R) = (1 + r)(1 + h)$

r = 1.122/1.030 – 1
r = .0893, or 8.93%

6. Using the Fisher equation, the real returns for government and corporate bonds were:

$(1 + R) = (1 + r)(1 + h)$

r_G = 1.056/1.030 – 1
r_G = .0252, or 2.52%

r_C = 1.068/1.030 – 1
r_C = .0369, or 3.69%

7. The average return is the sum of the returns, divided by the number of returns. The average return for each stock was:

$$\overline{X} = \left[\sum_{i=1}^{N} X_i\right] / N = \frac{.18 + .29 + .09 - .14 + .11}{5} = .1060, \text{ or } 10.60\%$$

$$\overline{Y} = \left[\sum_{i=1}^{N} Y_i\right] / N = \frac{.29 + .38 + .15 - .32 + .16}{5} = .1320, \text{ or } 13.20\%$$

Remembering back to "sadistics," we calculate the variance of each stock as:

$$\sigma_X^2 = \left[\sum_{i=1}^{N} (X_i - \overline{X})^2\right] / (N - 1)$$

$$\sigma_X^2 = \frac{1}{5-1}\left[(.18 - .106)^2 + (.29 - .106)^2 + (.09 - .106)^2 + (-.14 - .106)^2 + (.11 - .106)^2)\right]$$

$$\sigma_X^2 = .02503$$

$$\sigma_Y^2 = \frac{1}{5-1}\left[(.29 - .132)^2 + (.38 - .132)^2 + (.15 - .132)^2 + (-.32 - .132)^2 + (.16 - .132)^2)\right]$$

$$\sigma_Y^2 = .07297$$

The standard deviation is the square root of the variance, so the standard deviation of each stock is:

$\sigma_X = .02503^{1/2} = .1582$, or 15.82%

$\sigma_Y = .07297^{1/2} = .2701$, or 27.01%

8. We will calculate the sum of the returns for each asset and the observed risk premium first. Doing so, we get:

Year	Large-co. stock return	T-bill return	Risk premium
1973	–14.69%	6.93%	–21.62%
1974	–26.47	8.00	–34.47
1975	37.23	5.80	31.43
1976	23.93	5.08	18.85
1977	–7.16	5.12	–12.28
1978	6.57	7.18	–.61
	19.41%	38.11%	–18.70%

a. The average return for large-company stocks over this period was:

Large-company stock average return = 19.41%/6
Large-company stock average return = 3.24%

And the average return for T-bills over this period was:

T-bills average return = 38.11%/6
T-bills average return = 6.35%

b. Using the equation for variance, we find the variance for large company stocks over this period was:

$$\text{Variance} = 1/5[(-.1469 - .0324)^2 + (-.2647 - .0324)^2 + (.3723 - .0324)^2 + (.2393 - .0324)^2 + (-.0716 - .0324)^2 + (.0657 - .0324)^2]$$
$$\text{Variance} = .058136$$

And the standard deviation for large company stocks over this period was:

$$\text{Standard deviation} = .058136^{1/2}$$
Standard deviation = .2411, or 24.11%

Using the equation for variance, we find the variance for T-bills over this period was:

$$\text{Variance} = 1/5[(.0693 - .0635)^2 + (.0800 - .0635)^2 + (.0580 - .0635)^2 + (.0508 - .0635)^2 + (.0512 - .0635)^2 + (.0718 - .0635)^2]$$
$$\text{Variance} = .000144$$

And the standard deviation for T-bills over this period was:

$$\text{Standard deviation} = .000144^{1/2}$$
Standard deviation = .0120, or 1.20%

c. The average observed risk premium over this period was:

Average observed risk premium = –18.70%/6
Average observed risk premium = –3.12%

The variance of the observed risk premium was:

$$\text{Variance} = 1/5[(-.2162 - (-.0312))^2 + (-.3447 - (-.0312))^2 + (.3143 - (-.0312))^2 + (.1885 - (-.0312))^2 + (-.1228 - (-.0312))^2 + (-.0061 - (-.0312))^2]$$
$$\text{Variance} = .061833$$

And the standard deviation of the observed risk premium was:

$$\text{Standard deviation} = .061833^{1/2}$$
Standard deviation = .2487, or 24.87%

9. *a*. To find the average return, we sum all the returns and divide by the number of returns, so:

Average return = (.10 – .16 + .23 +.11 +.19)/5
Average return = .0940, or 9.40%

b. Using the equation to calculate variance, we find:
Variance = 1/4[(.10 – .094)^2 + (–.16 – .094)^2 + (.23 – .094)^2 + (.11 – .094)^2 + (.19 – .094)^2]
Variance = .02313

So, the standard deviation is:

Standard deviation = .02313$^{1/2}$
Standard deviation = .1521, or 15.21%

10. *a*. To calculate the average real return, we can use the average return of the asset and the average inflation rate in the Fisher equation. Doing so, we find:

$(1 + R) = (1 + r)(1 + h)$

$\breve{r}$ = 1.0940/1.033 – 1
$\breve{r}$ = .0591, or 5.91%

b. The average risk premium is the average return of the asset, minus the average risk-free rate, so, the average risk premium for this asset would be:

$\overline{RP} = \overline{R} - \overline{R_f}$
$\overline{RP} = .094 - .037$
$\overline{RP} = .057 \text{ , or } 5.7\%$

11. We can find the average real risk-free rate using the Fisher equation. The average real risk-free rate was:

$(1 + R) = (1 + r)(1 + h)$

$\overline{r_f} = 1.037/1.033 - 1$
$\overline{r_f} = .0039 \text{ , or } .39\%$

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:

$\overline{rp} = \overline{r} - \overline{r_f}$
$\overline{rp} = 5.91\% - .39\%$
$\overline{rp} = 5.52\%$

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.

13. To find the return on the zero-coupon bond, we first need to find the price of the bond today. We need to remember that the price for zero-coupon bonds is calculated with semiannual periods. Since one year has elapsed, the bond now has 24 years to maturity, so the price today is:

P_1 = \$1,000/1.032^{48}

P_1 = $220.48

There are no intermediate cash flows on a zero-coupon bond, so the return is the capital gain, or:

R = ($220.48 – 208.50)/$208.50
R = .0575, or 5.75%

14. The return of any asset is the increase in price, plus any dividends or cash flows, all divided by the initial price. Since preferred stock is assumed to have a par value of $100, the dividend was $2.90, so the return for the year was:

R = ($98.34 – 96.82 + 2.90)/$96.82
R = .0457, or 4.57%

15. The return of any asset is the increase in price, plus any dividends or cash flows, all divided by the initial price. This stock paid no dividend, so the return was:

R = ($59.44 – 53.18)/$53.18
R = .1177, or 11.77%

This is the return for three months, so the APR is:

APR = 4(11.77%)
APR = 47.09%

And the EAR is:

EAR = $(1 + .1177)^4 – 1$
EAR = .5607, or 56.07%

16. To find the real return each year, we will use the Fisher equation, which is:

$1 + R = (1 + r)(1 + \text{h})$

Using this relationship for each year, we find:

	T-bills	Inflation	Real Return
1926	.0327	–.0149	.0483
1927	.0312	–.0208	.0531
1928	.0356	–.0097	.0457
1929	.0475	.0020	.0454
1930	.0241	–.0603	.0898
1931	.0107	–.0952	.1170
1932	.0096	–.1030	.1255

So, the average real return was:

Average = (.0483 + .0531 + .0457 + .0454 + .0898 + .1170 + .1255)/7
Average = .0750, or 7.50%

Notice that the real return was higher than the nominal return during this period because of deflation, or negative inflation.

17. Looking at the long-term corporate bond return history in Figure 10.10, we see that the mean return was 6.8 percent, with a standard deviation of 8.4 percent. The range of returns you would expect to see 68 percent of the time is the mean plus or minus 1 standard deviation, or:

$R \in \mu \pm 1\sigma = 6.8\% \pm 8.4\% = -1.60\%$ to 15.20%

The range of returns you would expect to see 95 percent of the time is the mean plus or minus 2 standard deviations, or:

$R \in \mu \pm 2\sigma = 6.8\% \pm 2(8.4\%) = -10.00\%$ to 23.60%

18. Looking at the large-company stock return history in Figure 10.10, we see that the mean return was 12.2 percent, with a standard deviation of 19.7 percent. The range of returns you would expect to see 68 percent of the time is the mean plus or minus 1 standard deviation, or:

$R \in \mu \pm 1\sigma = 12.2\% \pm 19.7\% = -7.50\%$ to 31.90%

The range of returns you would expect to see 95 percent of the time is the mean plus or minus 2 standard deviations, or:

$R \in \mu \pm 2\sigma = 12.2\% \pm 2(19.7\%) = -27.20\%$ to 51.60%

Intermediate

19. 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:

$5(.103) = .19 - .27 + .06 + .14 + R$
$R = .395$, or 39.5%

The missing return has to be 39.5 percent. Now we can use the equation for the variance to find:

Variance = $1/4[(.19 - .103)^2 + (-.27 - .103)^2 + (.06 - .103)^2 + (.14 - .103)^2 + (.395 - .103)^2]$
Variance = .05880

And the standard deviation is:

Standard deviation = $.05880^{1/2}$
Standard deviation = .2425, or 24.25%

20. The arithmetic average return is the sum of the known returns divided by the number of returns, so:

Arithmetic average return = $(.12 + .34 + .08 - .26 + .31 + .06)/6$
Arithmetic average return = .1083, or 10.83%

Using the equation for the geometric return, we find:

Geometric average return = $[(1 + R_1) \times (1 + R_2) \times \ldots \times (1 + R_T)]^{1/T} - 1$
Geometric average return = $[(1 + .12)(1 + .34)(1 + .08)(1 - .26)(1 + .31)(1 + .06)]^{1/6} - 1$
Geometric average return = .0887, or 8.87%

Remember, the geometric average return will always be less than the arithmetic average return if the returns have any variation.

21. To calculate the arithmetic and geometric average returns, we must first calculate the return for each year. The return for each year is:

$R_1 = (\$81.27 - 73.20 + 1.05)/\$73.20 = .1246$, or 12.46%
$R_2 = (\$90.37 - 81.27 + 1.15)/\$81.27 = .1261$, or 12.61%
$R_3 = (\$86.18 - 90.37 + 1.26)/\$90.37 = -.0324$, or –3.24%
$R_4 = (\$95.68 - 86.18 + 1.39)/\$86.18 = .1264$, or 12.64%
$R_5 = (\$112.32 - 95.68 + 1.53)/\$95.68 = .1899$, or 18.99%

The arithmetic average return was:

$R_A = (.1246 + .1261 - .0324 + .1264 + .1899)/5$
$R_A = .1069$, or 10.69%

And the geometric average return was:

$R_G = [(1 + .1246)(1 + .1261)(1 - .0324)(1 + .1264)(1 + .1899)]^{1/5} - 1$
$R_G = .1043$, or 10.43%

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:

Year	T-bill return	Inflation	Real return
1973	.0693	.0880	–.0172
1974	.0800	.1220	–.0374
1975	.0580	.0701	–.0113
1976	.0508	.0481	.0026
1977	.0512	.0677	–.0155
1978	.0718	.0903	–.0170
1979	.1038	.1331	–.0259
1980	.1124	.1240	–.0103
	.5973	.7433	–.1320

a. The average return for T-bills over this period was:

Average return = .5973/8
Average return = .0747, or 7.47%

And the average inflation rate was:

Average inflation = .7433/8
Average inflation = .0929, or 9.29%

b. Using the equation for variance, we find the variance for T-bills over this period was:

$$\text{Variance} = 1/7[(.0693 - .0747)^2 + (.0800 - .0747)^2 + (.0580 - .0747)^2 + (.0508 - .0747)^2 + (.0512 - .0747)^2 + (.0718 - .0747)^2 + (.1038 - .0747)^2 + (.1124 - .0747)^2]$$
$$\text{Variance} = .000534$$

And the standard deviation for T-bills was:

$$\text{Standard deviation} = .000534^{1/2}$$
Standard deviation = .0231, or 2.31%

The variance of inflation over this period was:

$$\text{Variance} = 1/7[(.0880 - .0929)^2 + (.1220 - .0929)^2 + (.0701 - .0929)^2 + (.0481 - .0929)^2 + (.0677 - .0929)^2 + (.0903 - .0929)^2 + (.1331 - .0929)^2 + (.1240 - .0929)^2]$$
$$\text{Variance} = .000946$$

And the standard deviation of inflation was:

$$\text{Standard deviation} = .000946^{1/2}$$
Standard deviation = .0308, or 3.08%

c. The average observed real return over this period was:

Average observed real return = –.1320/8
Average observed real return = –.0165, or –1.65%

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 nominal return.

23. To find the return on the coupon bond, we first need to find the price of the bond today, so:

$P_1 = \$49(\text{PVIFA}_{5.8\%,9}) + \$1{,}000/1.058^9$
$P_1 = \$938.25$

You received the coupon payments on the bond, so the nominal return was:

$R = (\$938.25 – 945 + 49)/\$945$
$R = .0447$, or 4.47%

And using the Fisher equation to find the real return, we get:

$r = 1.0447/1.034 – 1$
$r = .0104$, or 1.04%

24. Looking at the long-term government bond return history in Figure 10.10, we see that the mean return was 5.6 percent, with a standard deviation of 10.2 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:

$\Pr(R < –4.6 \text{ or } R > 15.8) \approx {}^1/_3$

But we are only interested in one tail here, that is, returns less than –4.6 percent, so:

$\Pr(R < –4.6) \approx {}^1/_6$

You can use the z-statistic and the cumulative normal distribution table to find the answer as well. Doing so, we find:

$z = (X – \mu)/\sigma$

$z = (–4.6\% – 5.6\%)/10.2\% = –1.00$

Looking at the z-table, this gives a probability of 15.87%, or:

$\Pr(R < –4.6) \approx .1587$, 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% level: $R \in \mu \pm 2\sigma = 5.6\% \pm 2(10.2\%) = –14.80\%$ to 26.00%

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% level: $R \in \mu \pm 3\sigma = 5.6\% \pm 3(10.2\%) = -25.00\%$ to 36.20%

25. The mean return for small-company stocks was 16.0 percent, with a standard deviation of 31.0 percent. Doubling your money is a 100% return, so if the return distribution is normal, we can use the z-statistic. So:

$z = (X - \mu)/\sigma$

$z = (100\% - 16.0\%)/31.0\% = 2.710$ standard deviations above the mean

This corresponds to a probability of ≈ .337%, or about once every 300 years. Tripling your money would be:

$z = (200\% - 16.0\%)/31.0\% = 5.935$ standard deviations above the mean

This corresponds to a probability of (much) less than .5%. The actual answer is ≈.00000014649%, or about once every 683 million years.

26. It is impossible to lose more than 100 percent of your investment. Therefore, return distributions are truncated on the lower tail at –100 percent, and cannot truly follow a normal distribution.

Challenge

27. Using the z-statistic, we find:

$z = (X - \mu)/\sigma$

$z = (0\% - 12.2\%)/19.7\% = -.619$

$\Pr(R \leq 0) \approx 26.79\%$

28. For each of the questions asked here, we need to use the z-statistic, which is:

$z = (X - \mu)/\sigma$

a. $z_1 = (10\% - 6.8\%)/8.4\% = .3810$

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:

$\Pr(R \geq 10\%) = 1 - \Pr(R \leq 10\%) = 35.16\%$

For a return less than 0 percent:

$z_2 = (0\% - 6.8\%)/8.4\% = -.8095$

$\Pr(R < 0\%) = 1 - \Pr(R > 0\%) = 20.91\%$

b. The probability that T-bill returns will be greater than 10 percent is:

$z_3 = (10\% - 3.3\%)/3.1\% = 2.1613$

$\Pr(R \geq 10\%) = 1 - \Pr(R \leq 10\%) = 1 - .9847 \approx 1.53\%$

And the probability that T-bill returns will be less than 0 percent is:

$z_4 = (0\% - 3.3\%)/3.1\% = -1.0645$

$\Pr(R \leq 0) \approx 14.35\%$

c. The probability that the return on long-term corporate bonds will be less than –4.18 percent is:

$z_5 = (-4.18\% - 6.8\%)/8.4\% = -1.3071$

$\Pr(R \leq -4.18\%) \approx 9.56\%$

And the probability that T-bill returns will be greater than 10.38 percent is:

$z_6 = (10.38\% - 3.3\%)/3.1\% = 2.2839$

$\Pr(R \geq 10.38\%) = 1 - \Pr(R \leq 10.38\%) = 1 - .9888 \approx 1.12\%$

CHAPTER 11
RISK AND RETURN

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 unsystematic portion of the total risk can be eliminated at little cost. On the other hand, there are systematic 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 different 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 typically drop if the anticipated growth rate had been more than 2 percent, and prices would typically 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.* This is a systematic risk; market prices in general will most likely decline.
b. This is a firm specific risk; the company price will most likely stay constant.
c. This is a systematic risk; market prices in general will most likely stay constant.
d. This is a firm specific risk; the company price will most likely decline.
e. This is a 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 and expected return on a well-diversified portfolio are functions of systematic risk only.

7. Yes, the standard deviation can be less than that of every asset in the portfolio. However, β cannot be less than the smallest beta because β_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.

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 the layoffs per se that are being cheered but the cost savings associated with the layoffs. 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, which results in even lower prices. 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 the total investment in that asset divided by the total portfolio value. First, we will find the portfolio value, which is:

Total portfolio value = 125($61) + 250($21)
Total portfolio value = $12,875

The portfolio weight for each stock is:

Weight_A = 125($61)/$12,875 = .5922
Weight_B = 250($21)/$12,875 = .4078

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:

Total portfolio value = $3,780 + 9,250
Total portfolio value = $13,030

So, the expected return of this portfolio is:

$E(R_P)$ = ($3,780/$13,030)(.08) + ($9,250/$13,030)(.11)
$E(R_P)$ = .1013, or 10.13%

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:

$E(R_P) = .15(.08) + .35(.14) + .50(.11)$
$E(R_P) = .1160$, or 11.60%

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:

$E(R_P) = .1060 = .094w_X + .113(1 - w_X)$

We can now solve this equation for the weight of Stock X as:

$.1060 = .094w_X + .113 - .113w_X$
$.0070 = .019w_X$
$w_X = .3684$

So, the dollar amount invested in Stock X is the weight of Stock X times the total portfolio value, or:

Investment in X = .3684($10,000)
Investment in X = $3,684.21

And the dollar amount invested in Stock Y is:

Investment in Y = (1 – .3684)($10,000)
Investment in Y = $6,315.79

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

$E(R) = .20(-.21) + .80(.17)$
$E(R) = .0940$, or 9.40%

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

$E(R) = .10(-.23) + .60(.05) + .30(.32)$
$E(R) = .1030$, or 10.30%

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

$E(R_A) = .15(.03) + .55(.08) + .30(.17)$
$E(R_A) = .0995$, or 9.95%

$E(R_B) = .15(–.22) + .55(.10) + .30(.31)$
$E(R_B) = .1150$, or 11.50%

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 are:

$\sigma_A^2 = .15(.03 – .0995)^2 + .55(.08 – .0995)^2 + .30(.17 – .0995)^2$
$\sigma_A^2 = .00242$

$\sigma_A = .00242^{1/2}$
$\sigma_A = .0492$, or 4.92%

$\sigma_B^2 = .15(–.22 – .1150)^2 + .55(.10 – .1150)^2 + .30(.31 – .1150)^2$
$\sigma_B^2 = .02837$

$\sigma_B = .02837^{1/2}$
$\sigma_B = .1684$, or 16.84%

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:

$E(R_P) = .35(.11) + .40(.09) + .25(.15)$
$E(R_P) = .1120$, or 11.20%

If we own this portfolio, we would expect to earn a return of 11.20 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 of an equally weighted portfolio, we can sum the returns of each asset and divide by the number of assets, so the return of the portfolio in each state of the economy is:

Boom: $R_P = (.06 + .17 + .25)/3 = .1600$, or 16.00%
Bust: $R_P = (.11 – .09 – .21)/3 = –.0633$, or –6.33%

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 the products. Doing so, we find:

$E(R_P) = .75(.1600) + .25(–.0633)$
$E(R_P) = .1042$, or 10.42%

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

Boom: $R_P = .20(.06) + .20(.17) + .60(.25) = .1960$, or 19.60%
Bust: $R_P = .20(.11) + .20(-.09) + .60(-.21) = -.1220$, or –12.20%

And the expected return of the portfolio is:

$E(R_P) = .75(.1960) + .25(-.1220)$
$E(R_P) = .1165$, or 11.65%

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 of the portfolio is:

$\sigma_P^2 = .75(.1960 - .1165)^2 + .25(-.1220 - .1165)^2$
$\sigma_P^2 = .018961$

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:

Boom: $R_P = .25(.35) + .50(.40) + .25(.28) = .3575$, or 35.75%
Good: $R_P = .25(.16) + .50(.17) + .25(.09) = .1475$, or 14.75%
Poor: $R_P = .25(-.01) + .50(-.03) + .25(.01) = -.0150$, or –1.50%
Bust: $R_P = .25(-.10) + .50(-.12) + .25(-.09) = -.1075$, or –10.75%

And the expected return of the portfolio is:

$E(R_P) = .15(.3575) + .45(.1475) + .30(-.0150) + .10(-.1075)$
$E(R_P) = .1048$, or 10.48%

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 are:

$\sigma_P^2 = .15(.3575 - .1048)^2 + .45(.1475 - .1048)^2 + .30(-.0150 - .1048)^2 + .10(-.1075 - .1048)^2$
$\sigma_P^2 = .01921$

$\sigma_P = .01921^{1/2}$
$\sigma_P = .1386$, or 13.86%

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:

$\beta_P = .15(.84) + .20(1.25) + .30(1.08) + .35(1.41)$
$\beta_P = 1.19$

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:

$\beta_P = 1.0 = {}^1/_3(0) + {}^1/_3(1.19) + {}^1/_3(\beta_X)$

Solving for the beta of Stock X, we get:

$\beta_X = 1.81$

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:

$E(R_i) = .041 + (.113 - .041)(1.05)$
$E(R_i) = .1166$, or 11.66%

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:

$E(R_i) = .098 = .044 + .068\beta_i$

$\beta_i = .79$

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:

$E(R_i) = .1185 = .043 + [E(R_M) - .043](1.17)$

$E(R_M) = .1075$, or 10.75%

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:

$E(R_i) = .1150 = R_f + (.104 - R_f)(1.15)$

$.1150 = R_f + .1196 - 1.15R_f$

$R_f = .0307$, or 3.07%

17. 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, so the beta of the portfolio is:

$ß_P = w_W(1.10) + (1 - w_W)(0) = 1.10w_W$

So, to find the beta of the portfolio for any weight of the stock, we multiply the weight of the stock times its beta.

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:

$E(R_W) = .108 = .039 + MRP(1.10)$
$MRP = .069/1.10$
$MRP = .0627$, or 6.27%

So, now we know the CAPM equation for any stock is:

$E(R_P) = .039 + .0627ß_P$

The slope of the SML is equal to the market risk premium, which is .0627. Using these equations to fill in the table, we get the following results:

w_W	$E(R_P)$	$ß_P$
0%	3.90%	0.00
25	5.63	.275
50	7.35	.550
75	9.08	.825
100	10.80	1.100
125	12.53	1.375
150	14.25	1.650

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

$E(R_Y) = .039 + .068(1.20)$
$E(R_Y) = .1206$ or 12.06%

It is given in the problem that the expected return of Stock Y is 11.8 percent, but according to the CAPM the expected return of the stock should be 12.06 percent based on its level of risk. This means the stock return is too low, given its level of risk. Stock Y plots below the SML and is overvalued. In other words, its price must decrease to increase the expected return to 12.06 percent.

For Stock Z, we find:

$E(R_Z) = .039 + .068(.80)$
$E(R_Z) = .0934$, or 9.34%

The return given for Stock Z is 9.8 percent, but according to the CAPM the expected return of the stock should be 9.34 percent based on its level of risk. Stock Z plots above the SML and is undervalued. In other words, its price must increase to decrease the expected return to 9.34 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 .068, or 6.8 percent. Calculating the reward-to-risk ratio for Stock Y, we find:

Reward-to-risk ratio Y = (.1180 – .039)/1.20
Reward-to-risk ratio Y = .0658, or 6.58%

The reward-to-risk ratio for Stock Y 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. For Stock Z, we find:

Reward-to-risk ratio Z = (.0980 – .039)/.80
Reward-to-risk ratio Z = .0738, or 7.38%

The reward-to-risk ratio for Stock Z 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.

19. We need to set the reward-to-risk ratios of the two assets equal to each other, which is:

$(.1180 – R_f)/1.20 = (.0980 – R_f)/.80$

We can cross multiply to get:

$.80(.1180 – R_f) = 1.20(.0980 – R_f)$

Solving for the risk-free rate, we find:

$.0944 - .80R_f = .1176 - 1.20R_f$

$R_f = .0580$, or 5.80%

20. For a portfolio that is equally invested in large-company stocks and long-term corporate bonds:

$R = (12.20\% + 6.80\%)/2$
$R = 9.50\%$

For a portfolio that is equally invested in small-company stocks and Treasury bills:

$R = (16.00\% + 3.30\%)/2$
$R = 9.65\%$

21. Here we are given the expected return of the portfolio and the expected return of the assets in the portfolio and are asked to calculate the dollar amount of each asset in the portfolio. So, we need to find the weight of each asset in the portfolio. Since we know the total weight of the assets in the portfolio must equal 1 (or 100%), we can find the weight of each asset as:

$E(R_P) = .111 = .119x_H + .102(1 - x_H)$
$x_H = .5294$

$x_L = 1 - x_H$
$x_L = 1 - .5294$
$x_L = .4706$

The dollar investment in each asset is the weight of the asset times the value of the portfolio, so the dollar investment in each asset must be:

Investment in H = .5294($200,000)
Investment in H = $105,882.35

Investment in L = .4706($200,000)
Investment in L = $94,117.65

22. To find the expected return of the portfolio we first need to find the weight of each asset in the portfolio. The weights of the assets sum to 1 (or 100%), so we can solve for the weights using the betas of each asset and the beta of the portfolio. Doing so, we find:

$ß_P = 1 = x_J(1.25) + (1 - x_J)(.89)$
$x_J = .3056$

$x_K = 1 - .3056$
$x_K = .6944$

So, the expected return of the portfolio is:

$E(R_P) = .3056(.1290) + .6944(.0980)$
$E(R_P) = .1075$, or 10.75%

23. To find the expected return of the portfolio, we first need to find the weight of each asset in the portfolio. The weight of each asset is the dollar investment of that asset divided by the total dollar value of the portfolio, so:

Portfolio value = 350($43) + 840($29) + 425($94) + 600($51)
Portfolio value = $109,960

And the weight of each asset in the portfolio is:

x_W = 350($43)/$109,960
x_W = .1369

x_X = 840($29)/$109,960
x_X = .2215

x_Y = 425($94)/$109,960
x_Y = .3633

x_Z = 600($51)/$109,960
x_Z = .2783

With the weight of each asset, we can find the expected return of the portfolio, which is:

$E(R_P)$ = .1369(.10) + .2215(.15) + .3633(.11) + .2783(.14)
$E(R_P)$ = .1258, or 12.58%

Intermediate

24. *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:

$E(R_P)$ = (.114 + .031)/2
$E(R_P)$ = .0725, or 7.25%

b. We need to find the portfolio weights that result in a portfolio with a beta of .92. 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:

$\beta_P = .92 = w_S(1.13) + (1 - w_S)(0)$
$.92 = 1.13w_S + 0 - 0w_S$
$w_S = .92/1.13$
$w_S = .8142$

And, the weight of the risk-free asset is:

$w_{Rf} = 1 - .8142$
$w_{Rf} = .1858$

c. We need to find the portfolio weights that result in a portfolio with an expected return of 10 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:

$E(R_P) = .10 = .114w_S + .031(1 - w_S)$
$.10 = .114w_S + .031 - .031w_S$
$.069 = .083w_S$
$w_S = .8313$

So, the beta of the portfolio will be:

$\beta_P = .8313(1.13) + (1 - .8313)(0)$
$\beta_P = .939$

d. Solving for the beta of the portfolio as we did in part (b), we find:

$\beta_P = 2.26 = w_S(1.13) + (1 - w_S)(0)$

$w_S = 2.26/1.13 = 2$

$w_{Rf} = 1 - 2 = -1$

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.

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

Boom: $R_P = .4(.13) + .4(.29) + .2(.60) = .2880$, or 28.80%
Normal: $R_P = .4(.08) + .4(.11) + .2(.13) = .1020$, or 10.20%
Bust: $R_P = .4(.02) + .4(-.18) + .2(-.45) = -.1540$, or –15.40%

And the expected return of the portfolio is:

$E(R_P) = .25(.288) + .60(.102) + .15(-.154)$
$E(R_P) = .1101$, or 11.01%

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 are:

$\sigma_P^2 = .25(.288 - .1101)^2 + .60(.102 - .1101)^2 + .15(-.154 - .1101)^2$
$\sigma_P^2 = .01841$

$\sigma_P = .01841^{1/2}$
$\sigma_P = .1357$, or 13.57%

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:

$RP_i = E(R_P) - R_f = .1101 - .0430$
$RP_i = .0671$, or 6.71%

26. We know that the reward-to-risk ratios for all assets must be equal. This can be expressed as:

$[E(R_A) - R_f]/\beta_A = [E(R_B) - R_f]/\beta_B$

27. 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.

28. We know the total portfolio value and the investment in 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 = \$405,000/\$1,000,000 = .405

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:

$\beta_P = 1 = w_A(.82) + w_B(1.14) + w_C(1.23) + w_{Rf}(0)$
$1 = .175(.82) + .405(1.14) + w_C(1.23)$

Solving for the weight of Stock C, we find:

$w_C = .32097561$

So, the dollar investment in Stock C must be:

Investment in Stock C = .32097561(\$1,000,000)
Investment in Stock C = \$320,975.61

We also know the total portfolio weight must be one, so the weight of the risk-free asset must be one minus the asset weights we know, or:

$1 = w_A + w_B + w_C + w_{Rf}$
$w_{Rf} = 1 - .175 - .405 - .32097561$
$w_{Rf} = .09902439$

So, the dollar investment in the risk-free asset must be:

Investment in risk-free asset = .09902439(\$1,000,000)
Investment in risk-free asset = \$99,024.39

29. We know the expected return of the portfolio and of each asset, but only one portfolio weight. We need to recognize that the weight of the risk-free asset is one minus the weight of the other two assets. Mathematically, the expected return of the portfolio is:

$E(R_P) = .109 = .50(.128) + x_F(.097) + (1 - .50 - x_F)(.046)$
$.109 = .50(.128) + x_F(.097) + .046 - .023 - .046x_F$
$x_F = .4314$

So, the weight of the risk-free asset is:

$x_{Rf} = 1 - .50 - .4314$
$x_{Rf} = .0686$

And the amount of Stock F to buy is:

Amount of Stock F to buy = .4314($100,000)
Amount of Stock F to buy = $43,137.25

30. *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:

$E(R_A) = .15(-.08) + .60(.11) + .25(.30)$
$E(R_A) = .1290$, or 12.90%
$E(R_B) = .15(-.10) + .60(.09) + .25(.27)$
$E(R_B) = .1065$, or 10.65%

b. We can use the expected returns we calculated to find the slope of the SML. We know that the beta of Stock A is .35 greater than the beta of Stock B. Therefore, as beta increases by .35, the expected return on a security increases by .0225 (= .1290 – .1065). The slope of the SML equals:

Slope_{SML} = Rise/Run
Slope_{SML} = Increase in expected return/Increase in beta
$\text{Slope}_{SML} = (.1290 - .1065)/.35$
$\text{Slope}_{SML} = .0643$, or 6.43%

Since the market's beta is 1 and the risk-free rate has a beta of zero, the slope of the SML equals the expected market risk premium. So, the expected market risk premium must be 6.43 percent.

We could also solve this problem using CAPM. The equations for the expected returns of the two stocks are:

$E(R_A) = .1290 = R_f + (\beta_B + .35)(MRP)$
$E(R_B) = .1065 = R_f + \beta_B(MRP)$

Subtracting the CAPM equation for Stock B from the CAPM equation for Stock A yields:

$.0225 = .35MRP$
$MRP = .0643$, or 6.43%

which is the same answer as our previous result.

31. 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:

$E(R_I) = .15(.04) + .70(.19) + .15(.06)$
$E(R_I) = .1480$, or 14.80%

Using the CAPM to find the beta of Stock I, we find:

$.1480 = .035 + .07\beta_I$
$\beta_I = 1.61$

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:

$\sigma_I^2 = .15(.04 - .1480)^2 + .70(.19 - .1480)^2 + .15(.06 - .1480)^2$
$\sigma_I^2 = .00415$

$\sigma_I = .00415^{1/2}$
$\sigma_I = .0644$, or 6.44%

Using the same procedure for Stock II, we find the expected return to be:

$E(R_{II}) = .15(-.19) + .70(.10) + .15(.41)$
$E(R_{II}) = .1030$, or 10.30%

Using the CAPM to find the beta of Stock II, we find:

$.1030 = .035 + .07\beta_{II}$
$\beta_{II} = .97$

And the standard deviation of Stock II is:

$\sigma_{II}^2 = .15(-.19 - .1030)^2 + .70(.10 - .1030)^2 + .15(.41 - .1030)^2$
$\sigma_{II}^2 = .02702$

$\sigma_{II} = .02702^{1/2}$
$\sigma_{II} = .1644$, or 16.44%

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 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.

CHAPTER 12
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 their market values than are book values for equity.

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 DGM 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 DGM model requires a constant dividend growth rate forever; (3) the estimated cost of equity from this method is very sensitive to changes in the growth rate, 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 the growth rate are to use analysts' earnings and payout forecasts, or determine some appropriate average historical growth rate 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 DGM model, since the SML doesn't make any assumptions about the firm's dividends. The primary disadvantages of the SML method are (1) estimating three parameters: the risk-free rate, the expected return on the market, and beta, 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 is not directly 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 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.

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 riskier 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, at reasonable tax rates, the cost of equity does exceed the cost of debt.

9. $R_{Superior} = .12 + .75(.08) = .18$, or 18%

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 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:

$R_E = [\$3.15(1.045)/\$56] + .045$
$R_E = .1038$, or 10.38%

2. Here we have information to calculate the cost of equity using the CAPM. The cost of equity is:

$R_E = .045 + 1.13(.11 - .045)$
$R_E = .1185$, or 11.85%

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

$g_1 = (\$3.92 - 3.81)/\$3.81 = .0289$, or 2.89%
$g_2 = (\$4.05 - 3.92)/\$3.92 = .0332$, or 3.32%
$g_3 = (\$4.19 - 4.05)/\$4.05 = .0346$, or 3.46%
$g_4 = (\$4.41 - 4.19)/\$4.19 = .0525$, or 5.25%

So, the average arithmetic growth rate in dividends was:

$g = (.0289 + .0332 + .0346 + .0525)/4$
$g = .03728$, or 3.728%

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

$R_E = [\$4.41(1.03728)/\$83] + .03728$
$R_E = .0924$, or 9.24%

Calculating the geometric growth rate in dividends, we find:

$\$4.41 = \$3.81(1 + g)^4$
$g = .03724$, or 3.724%

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

$R_E = [\$4.41(1.03724)/\$83] + .03724$
$R_E = .0923$, or 9.23%

4. The cost of preferred stock is the dividend payment divided by the price, so:

$R_P = \$3.95/\$73$
$R_P = .0541$, or 5.41%

5. The pretax cost of debt is the YTM of the company's bonds, so:

$P_0 = \$940 = \$25(\text{PVIFA}_{R\%,38}) + \$1{,}000(\text{PVIF}_{R\%,38})$
$R = 2.757\%$
YTM = 2 × 2.757%
YTM = 5.51%

And the aftertax cost of debt is:

$R_D = .0551(1 - .21)$
$R_D = .0436$, or 4.36%

6. *a.* The pretax cost of debt is the YTM of the company's bonds, so:
$P_0 = \$970 = \$24(\text{PVIFA}_{R\%,46}) + \$1{,}000(\text{PVIF}_{R\%,46})$
$R = 2.511\%$
YTM = 2 × 2.511%
YTM = 5.02%

b. The aftertax cost of debt is:

$R_D = .0502(1 - .22)$
$R_D = .0392$, or 3.92%

c. The aftertax rate is more relevant because that is the actual cost to the company.

7. The book value of debt is the total par value of all outstanding debt, so:

BV_D = $75,000,000 + 40,000,000
BV_D = $115,000,000

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:

MV_D = .97($75,000,000) + .61($40,000,000)
MV_D = $72,750,000 + 24,400,000
MV_D = $97,150,000

The YTM of the zero coupon bonds is:

P_Z = $610 = $1,000($PVIF_{R\%,22}$)
R = 2.272%
YTM = 2 × 2.272% = 4.54%

So, the aftertax cost of the zero coupon bonds is:

R_Z = .0454(1 – .22)
R_Z = .0354, or 3.54%

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 = .0392($72,750,000/$97,150,000) + .0354($24,400,000/$97,150,000)
R_D = .0382, or 3.82%

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

WACC = .70(.13) + .05(.06) + .25(.07)(1 – .23)
WACC = .1075, or 10.75%

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

R_D = .07(1 – .23)
R_D = .0539, or 5.39%

Hence, on an aftertax basis, debt is cheaper than the preferred stock.

9. Here we need to use the debt-equity ratio to calculate the WACC. Doing so, we find:

WACC = .12(1/1.75) + .06(.75/1.75)(1 – .21)
WACC = .0889, or 8.89%

10. Here we have the WACC and need to find the debt-equity ratio of the company. Setting up the WACC equation, we find:

WACC = .0890 = .12(*E/V*) + .058(*D/V*)(1 – .25)

Rearranging the equation, we find:

.0890(*V/E*) = .12 + .058(.75)(*D/E*)

Now we must realize that the *V/E* is just the equity multiplier, which is equal to:

V/E = 1 + *D/E*

.0890(*D/E* + 1) = .12 + .0435(*D/E*)

Now we can solve for *D/E* as:

.0455(*D/E*) = .031
D/E = .6813

11. *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 = 4,200,000($8)
BV_E = $33,600,000

BV_D = $80,000,000 + 55,000,000
BV_D = $135,000,000

So, the total value of the company is:

V = $33,600,000 + 135,000,000
V = $168,600,000

And the book value weights of equity and debt are:

E/V = $33,600,000/$168,600,000
E/V = .1993

D/V = 1 – *E/V*
D/V = .8007

b. The market value of equity is the share price times the number of shares, so:

MV_E = 4,200,000($83)
MV_E = $348,600,000

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:

$MV_D = .98(\$80,000,000) + 1.05(\$55,000,000)$
$MV_D = \$136,150,000$

This makes the total market value of the company:

$V = \$348,600,000 + 136,150,000$
$V = \$484,750,000$

And the market value weights of equity and debt are:

$E/V = \$348,600,000/\$484,750,000$
$E/V = .7191$

$D/V = 1 - E/V$
$D/V = .2809$

c. The market value weights are more relevant because they represent a more current valuation of the debt and equity.

12. 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:

$R_E = [\$3.96(1.05)/\$83] + .05$
$R_E = .1001$, or 10.01%

Next, we need to find the YTM on both bond issues. Doing so, we find:

$P_1 = \$980 = \$27.50(\text{PVIFA}_{R\%,42}) + \$1,000(\text{PVIF}_{R\%,42})$
$R = 2.832\%$
YTM = 2.832% × 2
YTM = 5.66%

$P_2 = \$1,050 = \$29(\text{PVIFA}_{R\%,12}) + \$1,000(\text{PVIF}_{R\%,12})$
$R = 2.415\%$
YTM = 2.415% × 2
YTM = 4.83%

To find the weighted average aftertax cost of debt, we need the weight of each bond as a percentage of the total debt. We find:

$x_{D1} = .98(\$80,000,000)/\$136,150,000$
$x_{D1} = .5758$

$x_{D2} = 1.05(\$55,000,000)/\$136,150,000$
$x_{D2} = .4242$

Now we can multiply the weighted average cost of debt by 1 minus the tax rate to find the weighted average aftertax cost of debt. This gives us:

$R_D = (1 - .21)[(.5758)(.0566) + (.4242)(.0483)]$
$R_D = .0420$, or 4.20%

Using these costs and the weight of debt we calculated earlier, the WACC is:

WACC = .7191(.1001) + .2809(.0420)
WACC = .0838, or 8.38%

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

WACC = .095 = (1/1.85)(.14) + (.85/1.85)(1 – .23)R_D
$R_D = .0546$, or 5.46%

b. Using the equation to calculate WACC, we find:
WACC = .095 = (1/1.85)R_E + (.85/1.85)(.058)
$R_E = .1265$, or 12.65%

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

$MV_D = 15{,}000(\$1{,}000)(1.05) = \$15{,}750{,}000$
$MV_E = 650{,}000(\$84) = \$54{,}600{,}000$
$MV_P = 30{,}000(\$103) = \$3{,}090{,}000$

And the total market value of the firm is:

$V = \$15{,}750{,}000 + 54{,}600{,}000 + 3{,}090{,}000$
$V = \$73{,}440{,}000$

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

$R_E = .049 + .88(.06)$
$R_E = .1018$, or 10.18%

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

$P_0 = \$1{,}050 = \$29(PVIFA_{R\%,50}) + \$1{,}000(PVIF_{R\%,50})$
$R = 2.716\%$
YTM = 2.716% × 2
YTM = 5.43%

And the aftertax cost of debt is:

$R_D = (1 - .21)(.0543)$
$R_D = .0429$, or 4.29%

The cost of preferred stock is:

R_P = \$5.25/\$103
R_P = .0510, or 5.10%

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

WACC = .0429(\$15,750,000/\$73,440,000) + .1018(\$54,600,000/\$73,440,000)
+ .0510(\$3,090,000/\$73,440,000)
WACC = .0870, or 8.70%

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.

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

MV_D = 125,000(\$1,000)(.91) = \$113,750,000
MV_E = 6,700,000(\$57) = \$381,900,000
MV_P = 200,000(\$92) = \$18,400,000

And the total market value of the firm is:

V = \$113,750,000 + 381,900,000 + 18,400,000
V = \$514,050,000

So, the market value weights of the company's financing are:

D/V = \$113,750,000/\$514,050,000 = .2213
E/V = \$381,900,000 /\$514,050,000 = .7429
P/V = \$18,400,000/\$514,050,000 = .0358

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 = .053 + 1.08(.065)
R_E = .1232, or 12.32%

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

P_0 = \$910 = \$24($PVIFA_{R\%,30}$) + \$1,000($PVIF_{R\%,30}$)
R = 2.850%
YTM = 2.850% × 2
YTM = 5.70%

And the aftertax cost of debt is:

R_D = (1 – .22)(.0570)
R_D = .0445, or 4.45%

The cost of preferred stock is:

R_P = \$4.50/\$92
R_P = .0489, or 4.89%

Now we can calculate the WACC as:

WACC = .2213(.0445) + .0358(.0489) + .7429(.1232)
WACC = .1031, or 10.31%

16. *a.* Projects 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 IRR of the project. If the return calculated using the CAPM is lower than the project IRR, we should accept the project, if not, we reject the project. After considering risk via the CAPM:

E[W] = .04 + .83(.12 – .04) = .1064 > .099, so reject W
E[X] = .04 + .92(.12 – .04) = .1136 < .116, so accept X
E[Y] = .04 + 1.09(.12 – .04) = .1272 < .131, so accept Y
E[Z] = .04 + 1.35(.12 – .04) = .1480 > .143, so reject Z

c. Project X would be incorrectly rejected; Project Z would be incorrectly accepted.

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

MV_D = 10,000(\$2,000)(.96) = \$19,200,000
MV_E = 400,000(\$86) = \$34,400,000
MV_P = 30,000(\$74) = \$2,220,000

And the total market value of the firm is:

V = \$19,200,000 + 34,400,000 + 2,220,000
V = \$55,820,000

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

R_{E1} = .047 + .95(.12 – .047)
R_{E1} = .1164, or 11.64%

We can also find the cost of equity, using the dividend discount model. The cost of equity with the dividend discount model is:

R_{E2} = (\$4.20/\$86) + .05
R_{E2} = .0988, or 9.88%

Both estimates for the cost of equity seem reasonable, so we will use the average of the two. The cost of equity estimate is:

R_E = (.1164 + .0988)/2
R_E = .1076, or 10.76%

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

$P_0 = \$1{,}920 = \$59(\text{PVIFA}_{R\%,34}) + \$2{,}000(\text{PVIF}_{R\%,34})$
$R = 3.143\%$
YTM = 3.143% × 2
YTM = 6.29%

And the aftertax cost of debt is:

$R_D = (1 - .22)(.0629)$
$R_D = .0490$, or 4.90%

The cost of preferred stock is:

$R_P = \$3.80/\$74$
$R_P = .0514$, or 5.14%

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

WACC = .0490($19,200,000/$55,820,000) + .0514($2,220,000/$55,820,000)
+ .1076($34,400,000/$55,820,000)
WACC = .0852, or 8.52%

18. The bonds have 25 years to maturity so the price today is:

$P_0 = \$1{,}000/(1 + .049/2)^{50}$
$P_0 = \$298.13$

The market value of the debt is:

$\text{MV}_D = 230{,}000(\$298.13)$
$\text{MV}_D = \$68{,}569{,}297.35$

So, the total value of the firm is:

$V = \$68{,}569{,}297.35 + 120{,}000{,}000$
$V = \$188{,}569{,}297.35$

This means the weight of debt in the capital structure is:

$D/V = \$68{,}569{,}297.35/\$188{,}569{,}297.35$
$D/V = .3636$

19. To find the required return for the project, we need to adjust the company's WACC for the level of risk in the project. A debt-equity ratio of .65 implies a weight of debt of .65/1.65 and a weight of equity of 1/1.65, so the company's WACC is:

WACC = (.65/1.65)(.0460) + (1/1.65)(.1090)
WACC = .0842, or 8.42%

Adjusting for risk, the project discount rate is:

Project discount rate = .0842 + .03
Project discount rate = .1142, or 11.42%

Intermediate

20. 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 = .039 + 1.15(.072)
R_E = .1218, or 12.18%

And using the dividend growth model, the cost of equity is:

R_E = [$2.73(1.05)/$51] + .05
R_E = .1062, or 10.62%

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 the same as the historical average, and the estimate from the dividend growth model is about 1 percent lower 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 = (.1218 + .1062)/2
R_E = .1140, or 11.40%

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

WACC = (.55/1.55)(.051) + (1/1.55)(.11)
WACC = .0891, or 8.91%

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:

Project discount rate = 8.91% + 3%
Project discount rate = 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. The cash inflows are a growing perpetuity. If you remember, the equation for the PV of a growing perpetuity is the same as the dividend growth equation, so:

PV of future cash flows = $3,100,000/(.1191 – .02)
PV of future cash flows = $31,292,739

The project should only be undertaken if its cost is less than $31,292,739 since costs less than this amount will result in a positive NPV.

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:

$MV_1 = 1.0285(\$45,000,000)$
$MV_1 = \$46,282,500$

$MV_2 = 1.1280(\$40,000,000)$
$MV_2 = \$45,120,000$

$MV_3 = 1.0745(\$75,000,000)$
$MV_3 = \$80,587,500$

$MV_4 = 1.0275(\$65,000,000)$
$MV_4 = \$66,787,500$

So, the total market value of the company's debt is:

$MV_D = \$46,282,500 + 45,120,000 + 80,587,500 + 66,787,500$
$MV_D = \$238,777,500$

The weight of each debt issue is:

$x_1 = \$46,282,500/\$238,777,500$
$x_1 = .1938$, or 19.38%

$x_2 = \$45,120,000/\$238,777,500$
$x_2 = .1890$, or 18.90%

$x_3 = \$80,587,500/\$238,777,500$
$x_3 = .3375$, or 33.75%

$x_4 = \$66,787,500/\$238,777,500$
$x_4 = .2797$, or 27.97%

Next, we need to find the YTM for each bond issue. The YTM for each issue is:

$P_1 = \$1,028.50 = \$25(PVIFA_{R\%,10}) + \$1,000(PVIF_{R\%,10})$
$R_1 = 2.180\%$
$YTM_1 = 2.180\% \times 2$
$YTM_1 = 4.36\%$

$P_2 = \$1,128.00 = \$35.50(PVIFA_{R\%,16}) + \$1,000(PVIF_{R\%,16})$
$R_2 = 2.565\%$
$YTM_2 = 2.565\% \times 2$
$YTM_2 = 5.13\%$

$P_3 = \$1{,}074.50 = \$31.50(\text{PVIFA}_{R\%,31}) + \$1{,}000(\text{PVIF}_{R\%,31})$
$R_3 = 2.788\%$
$\text{YTM}_3 = 2.788\% \times 2$
$\text{YTM}_3 = 5.58\%$

$P_4 = \$1{,}027.50 = \$29.50(\text{PVIFA}_{R\%,50}) + \$1{,}000(\text{PVIF}_{R\%,50})$
$R_4 = 2.846\%$
$\text{YTM}_4 = 2.846\% \times 2$
$\text{YTM}_4 = 5.69\%$

The weighted average YTM of the company's debt is thus:

YTM = .1938(.0436) + .1890(.0513) + .3375(.0558) + .2797(.0569)
YTM = .0529, or 5.29%

And the aftertax cost of debt is:

$R_D = .0529(1 - .22)$
$R_D = .0412$, or 4.12%

22. *a.* Using the dividend growth model, the cost of equity is:

$R_E = [1.05)(1.04)/\$68] + .04$
$R_E = .0561$, or 5.61%

d. Using the CAPM, the cost of equity is:
$R_E = .044 + 1.15(.113 - .044)$
$R_E = .1234$, or 12.34%

e. 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.

23. First, we need to find the adjusted cash flow from assets (CFA*) for each year. We are given the projected EBIT, depreciation, increase in NWC, and capital spending. Each of these accounts increase at 18 percent per year. So, the CFA* for each of the next five years will be:

	Year 1	*Year 2*	*Year 3*	*Year 4*	*Year 5*
EBIT	\$2,300,000	\$2,714,000	\$3,202,520	\$3,778,974	\$4,459,189
Depreciation	175,000	206,500	243,670	287,531	339,286
Taxes*	483,000	569,940	672,529	793,584	936,430
Capital spending	125,000	147,500	174,050	205,379	242,347
Change in NWC	80,000	94,400	111,392	131,443	155,102
CFA*	\$1,787,000	\$2,108,660	\$2,488,219	\$2,936,098	\$3,464,596

The cash flows will grow at 3 percent in perpetuity, so the terminal value of the company in Year 5 will be:

Terminal value$_5$ = CFA*$_6$/(WACC – g)
Terminal value$_5$ = \$3,464,596(1 + .03)/(.085 – .03)
Terminal value$_5$ = \$64,882,431.51

The value of the company today is the present value of the first five CFA*s, plus the value today of the terminal value, or:

Company value = \$1,787,000/1.085 + \$2,108,660/1.085^2 + \$2,488,219/1.085^3
+ \$2,936,098/1.085^4 + (\$3,464,596 + 64,882,431.51)/1.085^5

Company value = \$52,958,754.33

To find the value of equity, we subtract the value of the debt from the total value of the company, which is:

Equity value = \$52,958,754.33 – 10,400,000
Equity value = \$42,558,754.33

Finally, the value per share is the total equity value divided by the shares outstanding, or:

Share price = \$42,558,754.33/750,000
Share price = \$56.75

24. The CFA* for each of the first five years will be the same as the previous problem. To calculate the terminal value, we can use the price-sales ratio, which will be:

Terminal value$_5$ = 2.6(\$23,700,000)
Terminal value$_5$ = \$61,620,000

The value of the company today is the present value of the first five CFA*s, plus the value today of the terminal value, or:

Company value = \$1,787,000/1.085 + \$2,108,660/1.085^2 + \$2,488,219/1.085^3
+ \$2,936,098/1.085^4 + (\$3,464,596 + 61,620,000)/1.085^5
Company value = \$50,789,089.19

25. To find the value of equity, we subtract the value of the debt from the total value of the company, which is:

Equity value = \$50,789,089.19 – 10,400,000
Equity value = \$40,389,089.19

Finally, the value per share is the total equity value divided by the shares outstanding, or:

Share price = \$40,389,089.19/750,000
Share price = \$53.85

Challenge

26. First, we need to find the adjusted cash flow from assets (CFA*) for each year. At the growth rates given, the projected CFA* for each of the next five years will be:

	Year 1	*Year 2*	*Year 3*	*Year 4*	*Year 5*
EBIT	$4,025,000	$4,628,750	$5,323,063	$6,121,522	$7,039,750
Depreciation	372,000	446,400	535,680	642,816	771,379
Taxes*	885,500	1,018,325	1,171,074	1,346,735	1,548,745
Capital spending	690,000	828,000	993,600	1,192,320	1,430,784
Change in NWC	137,500	151,250	166,375	183,013	201,314
CFA*	$2,684,000	$3,077,575	$3,527,694	$4,042,271	$4,630,287

The cash flows will grow at 3.5 percent in perpetuity, so the terminal value of the company in Year 5 will be:

Terminal value$_5$ = CFA*$_6$/(WACC – g)
Terminal value$_5$ = $4,630,287(1 + .035)/(.086 – .035)
Terminal value$_5$ = $93,967,580.43

The value of the company today is the present value of the first five CFA*s, plus the value today of the terminal value, or:

Company value = $2,684,000/1.086 + $3,077,575/1.086^2 + $3,527,694/1.086^3
+ $4,042,271/1.086^4 + ($4,630,287 + 93,967,580.43)/1.086^5
Company value = $76,011,931.12

To find the value of equity, we subtract the value of the debt from the total value of the company, which is:

Equity value = $76,011,931.12 – 19,500,000
Equity value = $56,511,931.12

Finally, the value per share is the total equity value divided by the shares outstanding, or:

Share price = $56,511,931.12/400,000
Share price = $141.28

27. 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:

Accounts payable weight = .15/1.15 = .1304
Long-term debt weight = 1/1.15 = .8696

Since the accounts payable has the same cost as the overall WACC, we can write the equation for the WACC as:

WACC = (1/1.60)(.13) + (.60/1.60)[(.1304)WACC + (.8696)(.07)(1 – .21)]

Solving for WACC, we find:

WACC = .08125 + .375[(.1304)WACC + .04809]
WACC = .08125 + (.04891)WACC + .01803
(.9511)WACC = .0993
WACC = .1044, or 10.44%

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:

NPV = –$67,000,000 + $8,900,000/.1044
NPV = $18,258,375.30

28. *a.* The $3.9 million cost of the land 3 years ago is a sunk cost and irrelevant; the $4.2 million appraised value of the land is an opportunity cost and is relevant. So, the total initial cash flow is:

CF_0 = –$4,200,000 – 38,000,000 – 1,500,000
CF_0 = –$43,700,000

b. To find the required return for the project, we need to adjust the company's WACC for the level of risk in the project. We begin by calculating the market value of each type of financing, so:

MV_D = 215,000($1,000)(.95) = $204,250,000
MV_E = 8,900,000($67) = $596,300,000
MV_P = 500,000($83) = $41,500,000

The total market value of the company is:

V = $204,250,000 + 596,300,000 + 41,500,000
V = $842,050,000

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 = .045 + 1.10(.07)
R_E = .1220, or 12.20%

The cost of debt is the YTM of the company's outstanding bonds, so:

P_0 = $950 = $25.50($PVIFA_{R\%,50}$) + $1,000($PVIF_{R\%,50}$)
R = 2.735%

YTM = 2.735% × 2
YTM = 5.47%

And the aftertax cost of debt is:

$R_D = (1 – .25)(.0547)$
$R_D = .0410$, or 4.10%

The cost of preferred stock is:

$R_P = \$4.20/\$83$
$R_P = .0506$, or 5.06%

To find the required return on this project, we first need to calculate the WACC for the company. The company's WACC is:

WACC = [($596.30/$842.05)(.1220) + ($41.50/$842.05)(.0506) + ($204.25/$842.05)(.0410)]
WACC = .0988, or 9.88%

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:

Project required return = .0988 + .02
Project required return = .1188, or 11.88%

c. The annual depreciation for the equipment will be:

$38,000,000/8 = $4,750,000

So, the book value of the equipment at the end of five years will be:

$BV_5 = \$38,000,000 – 5(\$4,750,000)$
$BV_5 = \$14,250,000$

So, the aftertax salvage value will be:

Aftertax salvage value = $5,000,000 + .25($14,250,000 – 5,000,000)
Aftertax salvage value = $7,312,500

d. Using the tax shield approach, the OCF for this project is:

$OCF = [(P – v)Q – FC](1 – T_C) + T_C D$
OCF = [($13,450 – 10,600)(8,500) – 6,900,000](1 – .25) + .25($38,00,000/8)
OCF = $14,181,250

e. 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, the recovery of the initial NWC, and the aftertax value of the land in five years since it will be an opportunity cost. So, the cash flows for the project are:

Year	*Cash Flow*
0	–$43,700,000
1	14,181,250
2	14,181,250
3	14,181,250
4	14,181,250
5	27,493,750

Using the required return of 11.88 percent, the NPV of the project is:

$NPV = –\$43,700,000 + \$14,181,250(PVIFA_{11886\%,4}) + \$27,493,750/1.1188^5$
$NPV = \$15,160,843.35$

And the IRR is:

$NPV = 0 = –\$43,700,000 + \$14,181,250(PVIFA_{IRR\%,4}) + \$27,493,750/(1 + IRR)^5$
$IRR = 23.77\%$

CHAPTER 13
LEVERAGE AND CAPITAL STRUCTURE

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. 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 interests by managing this asset in ways that maximizes its value. To the extent that a bankruptcy filing prevents "a race to the courthouse steps," it would seem to be a reasonable alternative to complicated and expensive litigation.

8. As in the previous question, it could be argued that using bankruptcy laws as a sword may 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 this possibility.

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 abrogated them to the detriment of its employees. It is important thing to keep in mind 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. As with any management decision, the goal is to maximize the value of shareholder equity. To accomplish this with respect to the capital structure decision, management attempts to choose the capital structure with the lowest cost of capital.

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 8,000 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	$13,300	$19,000	$23,750
Interest	0	0	0
NI	$13,300	$19,000	$23,750
EPS	$1.66	$2.38	$2.97
%ΔEPS	–30	——	+25

b. The company's share price is:

Share price = Equity/Shares outstanding
Share price = $252,000/8,000
Share price = $31.50

If the company undergoes the proposed recapitalization, it will repurchase:

Shares repurchased = Debt issued/Share price
Shares repurchased = $60,000/$31.50
Shares repurchased = 1,904.76

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

Interest payment = $60,000(.07)
Interest payment = $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	$13,300	$19,000	$23,750
Interest	4,200	4,200	4,200
NI	$ 9,100	$14,800	$19,550
EPS	$1.49	$ 2.43	$3.21
%ΔEPS	–38.51	—	+32.09

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 $31.50, and there are still 8,000 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	$13,300	$19,000	$23,750
Interest	0	0	0
Taxes	2,793	3,990	4,988
NI	$10,507	$15,010	$18,763
EPS	$1.31	$1.88	$2.35
%ΔEPS	–30	—	+25

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	$13,300	$19,000	$23,750
Interest	4,200	4,200	4,200
Taxes	1,911	3,108	4,106
NI	$ 7,189	$11,692	$15,445
EPS	$1.18	$1.92	$2.53
%ΔEPS	–38.51	—	+32.09

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:

ROE = NI/$252,000

The ROE for each state of the economy under the current capital structure and no taxes is:

	Recession	Normal	Expansion
ROE	.0528	.0754	.0942
%ΔROE	–30	—	+25

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:

Equity = $252,000 – 60,000
Equity = $192,000

So, the ROE for each state of the economy is:

ROE = NI/$192,000

	Recession	Normal	Expansion
ROE	.0474	.0771	.1018
%ΔROE	–38.51	—	+32.09

c. If there are corporate taxes and the company maintains its current capital structure, the ROE is:

	Recession	Normal	Expansion
ROE	.0417	.0596	.0745
%ΔROE	–30	—	+25

If the company undertakes the proposed recapitalization, and there are corporate taxes, the ROE for each state of the economy is:

	Recession	Normal	Expansion
ROE	.0374	.0609	.0804
%ΔROE	–38.51	—	+32.09

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:

EPS = $300,000/160,000 shares
EPS = $1.88

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 = $300,000 – .08($642,000)
NI = $248,640

And the EPS will be:

EPS = $248,640/145,000 shares
EPS = $1.71

Plan I has the higher EPS when EBIT is $300,000.

b. Under Plan I, the net income is $700,000 and the EPS is:

EPS = $700,000/160,000 shares
EPS = $4.38

Under Plan II, the net income is:

NI = $700,000 – .08($642,000)
NI = $648,640

And the EPS is:

EPS = $648,640/145,000 shares
EPS = $4.47

Plan II has the higher EPS when EBIT is $700,000.

c. To find the break-even EBIT for two different capital structures, we set the equations for EPS equal to each other and solve for EBIT. The break-even EBIT is:
EBIT/160,000 = [EBIT – .08($642,000)]/145,000
EBIT = $547,840

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:

Share price = $642,000/(160,000 – 145,000)
Share price = $42.80 per share

The value of the company under the all-equity plan is:

V = $42.80(160,000 shares)
V = $6,848,000

And the value of the company under the levered plan is:

V = $42.80(145,000 shares) + $642,000 debt
V = $6,848,000

6. *a.* The income statement for each capitalization plan is:

	I	*II*	*All-equity*
EBIT	$70,000	$70,000	$70,000
Interest	18,095	27,335	0
NI	$51,905	$42,665	$70,000
EPS	$3.39	$3.31	$3.50

Plan II has the highest EPS; the all-equity plan has the lowest EPS.

b. The break-even level of EBIT occurs when the capitalization plans result in the same EPS. The EPS is calculated as:

EPS = (EBIT – $R_D D$)/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 break-even EBIT for two different capital structures, we set the equations equal to each other and solve for EBIT. The break-even EBIT between the all-equity capital structure and Plan I is:

EBIT/20,000 = [EBIT – .10($180,950)]/15,300
EBIT = $77,000

And the break-even EBIT between the all-equity capital structure and Plan II is:

EBIT/20,000 = [EBIT – .10($273,350)]/12,900
EBIT = $77,000

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:

[EBIT – .10($180,950)]/15,300 = [EBIT – .10($273,350)]/12,900
EBIT = $77,000

This break-even level of EBIT is the same as in part (b) again because of M&M Proposition I.

d. The income statement for each capitalization plan with corporate income taxes is:

	I	*II*	*All-equity*
EBIT	$70,000	$70,000	$70,000
Interest	18,095	27,335	0
Taxes	10,900	8,960	14,700
NI	$41,005	$33,705	$55,300
EPS	$2.68	$2.61	$2.77

Plan II still has the highest EPS; the all-equity plan still has the lowest EPS.

We can calculate the EPS as:

EPS = [(EBIT – $R_D D$)(1 – T_C)]/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 break-even EBIT between the all-equity plan and Plan I is:

EBIT(1 – .21)/20,000 = [EBIT – .10($180,050)](1 – .21)/15,300
EBIT = $77,000

The break-even EBIT between the all-equity plan and Plan II is:

EBIT(1 – .21)/20,000 = [EBIT – .10($273,350)](1 – .21)/12,900
EBIT = $77,000

And the break-even between Plan I and Plan II is:

[EBIT – .10($180,050)](1 – .21)/15,300 = [EBIT – .10($273,350)](1 – .21)/12,900
EBIT = $77,000

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:

P = $180,950/(20,000 – 15,300 shares)
P = $38.50 per share

And under Plan II, the value per share is:

P = $273,350/(20,000 – 12,900 shares)
P = $38.50 per share

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

8. *a.* The earnings per share are:

EPS = $49,000/7,500 shares
EPS = $6.53

So, the cash flow for the investor is:

Cash flow = $6.53(100 shares)
Cash flow = $653.33

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 = $53(7,500)
V = $397,500

Under the proposed capital structure, the firm will raise new debt in the amount of:

D = .30($397,500)
D = $119,250

This means the number of shares repurchased will be:

Shares repurchased = $119,250/$53
Shares repurchased = 2,250

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:

NI = $49,000 – .08($119,250)
NI = $39,460

This means the EPS under the new capital structure will be:

EPS = $39,460/(7,500 – 2,250 shares)
EPS = $7.52

Since all earnings are paid as dividends, the shareholder will receive:

Shareholder cash flow = $7.52(100 shares)
Shareholder cash flow = $751.62

c. To replicate the proposed capital structure, the shareholder should sell 30 percent of their shares, or 30 shares, and lend the proceeds at 8 percent. The shareholder will have an interest cash flow of:

Interest cash flow = 30($53)(.08)
Interest cash flow = $127.20

The shareholder will receive dividend payments on the remaining 70 shares, so the dividends received will be:

Dividends received = $7.52(70 shares)
Dividends received = $526.13

The total cash flow for the shareholder under these assumptions will be:

Total cash flow = $127.20 + 526.13
Total cash flow = $653.33

This is the same cash flow we calculated in part (a).

b. 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 total value of the company is the share price times the number of shares, so:

V = $50(8,000)
V = $400,000

The investor will receive dividends in proportion to the percentage of the company's shares they own. The total dividends received by the shareholder will be:

Dividends received = $49,000($15,000/$400,000)
Dividends received = $1,837.50

b. Under the proposed capital structure, the firm will raise new debt in the amount of:

D = .25($400,000)
D = $100,000

This means the number of shares repurchased will be:

Shares repurchased = $100,000/$50
Shares repurchased = 2,000

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:

Net income = $49,000 – .07($100,000)
Net income = $42,000

This means the EPS under the new capital structure will be:

EPS = $42,000/(8,000 – 2,000)
EPS = $7.00

The number of shares owned by the shareholder is the dollar amount invested divided by the share price, so:

Shares owned = $15,000/$50
Shares owned = 300

Since all earnings are paid as dividends, the shareholder will receive:

Shareholder cash flow = $7.00(300 shares)
Shareholder cash flow = $2,100.00

c. To replicate the proposed capital structure, the shareholder should sell 25 percent of their shares, or 75 shares, and lend the proceeds at 7 percent. The shareholder will have an interest cash flow of:

Interest cash flow = 75($50)(.07)
Interest cash flow = $262.50

The shareholder will receive dividend payments on the remaining 225 shares, so the dividends received will be:

Dividends received = $7.00(225 shares)
Dividends received = $1,575.00

The total cash flow for the shareholder under these assumptions will be:

Total cash flow = $262.50 + 1,575
Total cash flow = $1.837.50

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.

10. *a.* With the information provided, we can use the equation for calculating WACC to find the cost of equity. The equation for WACC (assuming no taxes) is:

$$\text{WACC} = (E/V)R_E + (D/V)R_D$$

The company has a debt-equity ratio of 1.25, which implies the weight of debt is 1.25/2.25, and the weight of equity is 1/2.25, so:

WACC = .083 = (1/2.25)R_E + (1.25/2.25)(.051)
R_E = .1230, or 12.30%

c. To find the cost of equity under different capital structures, we can again use the WACC equation. With a debt-equity ratio of 2, the cost of equity is:

.083 = (1/3)R_E + (2/3)(.051)
R_E = .1470, or 14.70%
With a debt-equity ratio of .5, the cost of equity is:

$.083 = (1/1.5)R_E + (.5/1.5)(.051)$
$R_E = .0990$, or 9.90%

And with a debt-equity ratio of 0, the cost of equity is:

$.083 = (1)R_E + (0)(.051)$
R_E = WACC = .0830, or 8.30%

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

WACC = R_E = .0970, or 9.70%

b. To find the cost of equity for the company with leverage, we need to use M&M Proposition I with no taxes, so:

$R_E = R_A + (R_A - R_D)(D/E)$
$R_E = .0970 + (.0970 - .064)(.30/.70)$
$R_E = .1111$, or 11.11%

c. Using M&M Proposition I with no taxes again, we get:

$R_E = R_A + (R_A - R_D)(D/E)$
$R_E = .0970 + (.0970 - .064)(.60/.40)$
$R_E = .1465$, or 14.65%

d. The WACC with 30 percent debt is:

WACC = $(E/V)R_E + (D/V)R_D$
WACC = .70(.1204) + .30(.064)
WACC = .0970, or 9.70%

And the WACC with 60 percent debt is:

WACC = $(E/V)R_E + (D/V)R_D$
WACC = .40(.1665) + .60(.064)
WACC = .0970, or 9.70%

12. Using M&M Proposition I with taxes, the value of the levered firm is:

$V_L = V_U + T_C D$
V_L = \$785,000 + .21(\$325,000)
V_L = \$853,250

13. The interest tax shield is the total interest paid times the tax rate, so:

Interest tax shield = Interest paid(T_C)
Interest tax shield = \$17,400,000(.22)
Interest tax shield = \$3,828,000

The interest tax shield represents the tax savings in current income due to the deductibility of a firm's qualified debt expenses.

Intermediate

14. M&M Proposition I with no taxes states the value of the levered firm is equal to the value of the unlevered firm. So, with no taxes, the value of the firm if it issues debt is:

$V_U = V_L = \$61{,}000{,}000$

With corporate taxes, we need to use M&M Proposition I with taxes, so the value of the firm is:

$V_L = V_U + T_C D$
$V_L = \$61{,}000{,}000 + .23(\$19{,}800{,}000)$
$V_L = \$65{,}554{,}000$

15. The value of the firm is the value of the debt plus the value of the equity. We can use this relationship to find the value of equity in each case. The value of the equity with no taxes is:

$V = E + D$
$\$61{,}000{,}000 = E + 19{,}800{,}000$
$E = \$41{,}200{,}000$

So, the debt-equity ratio is:

Debt-equity ratio = \$19,800,000/\$41,200,000
Debt-equity ratio = .48

With taxes, the value of the equity becomes:

$V = E + D$
$\$65{,}554{,}000 = E + 19{,}800{,}000$
$E = \$45{,}754{,}000$

So, the debt-equity ratio is:

Debt-equity ratio = \$19,800,000/\$45,754,000
Debt-equity ratio = .43

16. When the company is all-equity financed, the cost of equity is:

WACC = R_E = .1010, or 10.10%

Using M&M Proposition I with no taxes, the cost of equity will be:

$R_E = R_A + (R_A - R_D)(D/E)$
$R_E = .1010 + (.1010 - .0580)(1)$
$R_E = .1440$, or 14.40%

And the new WACC will be:

WACC = $(E/V)R_E + (D/V)R_D$
WACC = (.50).1440 + (.50).0580
WACC = .1010, or 10.10%

Challenge

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

V_U = EBIT$(1 - T_C)/R_0$
V_U = \$42,400(1 – .22)/.11
V_U = \$300,654.55

b. The general expression for the value of a leveraged firm is:

$V_L = V_U + T_C D$

If debt is 50 percent of V_U, then $D = (.50)V_U$, and we have:

$V_L = V_U + T_C[(.50)V_U]$
V_L = \$300,654.55 + .22(.50)(\$300,654.55)
V_L = \$333,726.55

And if debt is 100 percent of V_U, then $D = (1.0)V_U$, and we have:

$V_L = V_U + T_C[(1.0)V_U]$
V_L = \$300,654.55 + .22(1.0)(\$300,654.55)
V_L = \$366,798.55

c. According to M&M Proposition I with taxes:

$V_L = V_U + T_C D$

With debt being 50 percent of the value of the levered firm, D must equal $(.50)V_L$, so:

$V_L = V_U + T_C[(.50)V_L]$
V_L = \$300,654.55 + .22(.50)(V_L)
V_L = \$337,814.10

If the debt is 100 percent of the levered value, D must equal V_L, so:

$V_L = V_U + T_C[(1.0)V_L]$
V_L = \$300,654.55 + .22(1.0)(V_L)
V_L = \$385,454.55

18. 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:

$R_E = [EBIT(1 - T_C)/E] - [R_D(D/E)(1 - T_C)]$
$R_E = R_A V_U/E - [R_D(D/E)(1 - T_C)]$
$R_E = R_A(V_L - T_C D)/E - [R_D(D/E)(1 - T_C)]$
$R_E = R_A(E + D - T_C D)/E - [R_D(D/E)(1 - T_C)]$
$R_E = R_A + (R_A - R_D)(D/E)(1 - T_C)$

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:

$WACC = R_A[(E/V) + (E/V)(D/E)(1 - T_C)] + R_D(1 - T_C)[(D/V) - (E/V)(D/E)]$
$WACC = R_A[(E/V) + (D/V)(1 - T_C)]$
$WACC = R_A[\{(E + D)/V\} - T_C(D/V)]$
$WACC = R_A[1 - T_C(D/V)]$

Thus, with a debt-to-value ratio of 1, the WACC is $R_A(1 - T_C)$. This result makes intuitive sense. It says that the cost of capital is the same as it would be for an all equity firm, but with the tax benefit of debt.

To find the value of the firm, M&M Proposition I with taxes states:

$V_L = V_U + T_C D$

Since the firm is entirely financed by debt, the value of the firm must be equal to the amount of debt, so:

$V_L = D$

Substituting, we get:

$D = V_U + T_C D$
$D - T_C D = V_U$
$D(1 - T_C) = V_U$
$D = V_U/(1 - T_C)$
$V_L = V_U/(1 - T_C)$

Again, this result makes intuitive sense. The value of the firm is equal to its all-equity value grossed up by the tax benefit of debt.

19. 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:

$R_E = [EBIT(1 - T_C)/E] - [R_D(D/E)(1 - T_C)]$

If we assume that EBIT and T_C are constant, then we can treat the unlevered firm as a perpetuity whose per-period cash flows are $EBIT(1 - T_C)$. Then:

$V_U = EBIT(1 - T_C)/R_A$

Substituting, we get:

$R_E = R_A V_U/E - [R_D(D/E)(1 - T_C)]$

Note that we've implicitly assumed, with M&M, that R_A is independent of capital structure, so that R_A of the unlevered firm can be treated as the required return on assets of the leveraged firm.

Recalling, from M&M Proposition I with taxes that $V_L = V_U + T_C D$, rearranging, and substituting, we get:

$R_E = R_A(V_L - T_C D)/E - [R_D(D/E)(1 - T_C)]$
$R_E = R_A(E + D - T_C D)/E - [R_D(D/E)(1 - T_C)]$
$R_E = R_A + (R_A - R_D)(D/E)(1 - T_C)$

This result is known as M&M Proposition II with taxes.

20. M&M Proposition II, with no taxes is:

$R_E = R_A + (R_A - R_f)(D/E)$

Note that we assumed the return on debt was the risk-free rate. 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:

$\beta_E(R_M - R_f) + R_f = (1 + D/E)\beta_A(R_M - R_f) + R_f$
$\beta_E(R_M - R_f) = (1 + \text{D/E})\beta_A(R_M - R_f)$
$\beta_E = \beta_A(1 + D/E)$

CHAPTER 14
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. First, relatively young and less profitable firms generally should not make cash distributions. They need the cash to fund investments (and flotation costs discourage the raising of outside cash). However, as a firm matures, it begins to generate free cash flow (which, you will recall, is internally generated cash flow beyond that needed to fund profitable investment activities). Significant free cash flow can lead to agency problems if it is not distributed. Managers may become tempted to pursue empire building or otherwise spend the excess cash in ways not in the shareholders' best interests. Thus, firms come under pressure to make distributions rather than hoard cash. And, consistent with what we observe, we expect large firms with a history of profitability to make large distributions. Thus, the life cycle theory says that firms trade off the agency costs of excess cash retention against the potential future costs of external equity financing. A firm should begin making distributions when it generates sufficient internal cash flow to fund its investment needs now and into the foreseeable future.

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 that will benefit the fundholders directly.

6. The change in price is due to the change in dividends, not 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.

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, and therefore 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 yielding, taxable bonds.

Solutions to Questions and Problems

Basic

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.

1. With no taxes we would expect the stock price to drop by exactly the amount of the dividend, so the new stock price will be:

New stock price = $74 – 1.63
New stock price = $72.37

Your total stock investment will be worth:

Stock value = 300 × $72.37
Stock value = $21,711

2. Your total portfolio value will be the total stock value plus the dividends received, so:

Portfolio value = (300 × $72.37) + (300 × $1.63)
Portfolio value = $22,200

Technically speaking, the dividends will not arrive in your portfolio until the payment date.

3. The aftertax dividend is the pretax dividend times one minus the tax rate, so:

Aftertax dividend = $6.35(1 – .15)
Aftertax dividend = $5.40

The stock price should drop by the aftertax dividend amount, or:

Ex-dividend price = $84.65 – 5.40
Ex-dividend price = $79.25

4. *a.* Since the par value is $.50 and the common stock account is $30,000, there are 60,000 shares outstanding. The shares outstanding increases by 10 percent, so:

New shares outstanding = 60,000(1.10)
New shares outstanding = 66,000

New shares issued = 6,000

Since the par value of the new shares is $.50, the capital surplus per share is $41.50. The total capital surplus is therefore:

Capital surplus on new shares = 6,000($35.50)
Capital surplus on new shares = $213,000

Common stock ($.50 par value)	$ 33,000
Capital surplus	398,000
Retained earnings	376,600
	$807,600

b. The shares outstanding increases by 25 percent, so:

New shares outstanding = 60,000(1.25)
New shares outstanding = 75,000

New shares issued = 15,000

Since the par value of the new shares is $.50, the capital surplus per share is $35.50. The total capital surplus is therefore:

Capital surplus on new shares = 15,000($35.50)
Capital surplus on new shares = $532,500

Common stock ($.50 par value)	$ 37,500
Capital surplus	717,500
Retained earnings	52,600
	$807,600

5. *a.* To find the new shares outstanding, we multiply the current shares outstanding times the ratio of new shares to old shares, so:

New shares outstanding = 60,000(4/1)
New shares outstanding = 240,000

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:

New par value = $.50(1/4)
New par value = $.125 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:

New shares outstanding = 60,000(1/5)
New shares outstanding = 12,000

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:

New par value = $.50(5/1)
New par value = $2.50 per share

6. To find the new stock price, we multiply the current stock price by the ratio of old shares to new shares, so:

a. $79(3/5) = $47.40

b. $79(1/1.15) = $68.70

c. $79(1/1.425) = $55.44

d. $79(7/4) = $138.25

e. To find the new shares outstanding, we multiply the current shares outstanding times the ratio of new shares to old shares, so:

a: 580,000(5/3) = 966,667

b: 580,000(1.15) = 667,000

c: 580,000(1.425) = 826,500

d: 580,000(4/7) = 331,429

7. The stock price is the total market value of equity divided by the shares outstanding, so:

P_0 = $417,400 equity/15,000 shares
P_0 = $27.83 per share

Ignoring tax effects, the stock price will drop by the amount of the dividend, so:

P_X = $27.83 – 1.55
P_X = $26.28

The total dividends paid will be:

$1.55 per share(15,000 shares) = $23,250

The equity and cash accounts will both decline by $23,250.

8. Repurchasing the shares will reduce cash and shareholders' equity by $23,250. The shares repurchased will be the total purchase amount divided by the stock price, so:

Shares bought = $23,250/$27.83
Shares bought = 835.53

And the new shares outstanding will be:

New shares outstanding = 15,000 – 835.53
New shares outstanding = 14,164.47

After repurchase, the new stock price is:

Share price = ($417,400 – 23,250)/14,164.47 shares
Share price = $27.83

The repurchase is effectively the same as the cash dividend because you either hold a share worth $27.83, or a share worth $26.28 and $1.55 in cash. Therefore, if you participate in the repurchase according to the dividend payout percentage, you are unaffected.

9. The stock price is the total market value of equity divided by the shares outstanding, so:

P_0 = $670,000 equity/13,000 shares
P_0 = $51.54 per share

The shares outstanding will increase by 25 percent, so:

New shares outstanding = 13,000(1.25)
New shares outstanding = 16,250

The new stock price is the market value of equity divided by the new shares outstanding, so:

P_X = $670,000/16,250 shares
P_X = $41.23

10. With a stock dividend, the shares outstanding will increase by one plus the dividend percentage, so:

New shares outstanding = 205,000(1.15)
New shares outstanding = 235,750

New shares issued = 235,750 − 205,000 = 30,750

The capital surplus is the capital paid in excess of par value, which is $1, so:

Capital surplus for new shares = 30,750($63)
Capital surplus for new shares = $1,937,250

The new capital surplus will be the old capital surplus plus the additional capital surplus for the new shares, so:

Capital surplus = $505,700 + 1,937,250
Capital surplus = $2,442,950

The new equity portion of the balance sheet will look like this:

Common stock ($1 par value)	$ 235,750
Capital surplus	2,442,950
Retained earnings	675,800
	$3,354,500

11. 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:

New par value = $1(1/4)
New par value = $.25 per share

The total dividends paid this year will be the dividend amount times the number of shares outstanding. The company had 205,000 shares outstanding before the split. We must remember to adjust the shares outstanding for the stock split, so:

Total dividends paid this year = $.80(205,000 shares)(4/1 split)
Total dividends paid this year = $656,000

The dividends increased by 10 percent, so the total dividends paid last year were:

Last year's dividends = $656,000/1.10
Last year's dividends = $596,363.64

And to find the dividends per share, we divide this amount by the shares outstanding last year. Doing so, we get:

Dividends per share last year = $596,363.64/205,000 shares
Dividends per share last year = $2.91

Intermediate

12. *a.* If the company makes a dividend payment, we can calculate the wealth of a shareholder as:

Dividend per share = $62,500/15,000 shares
Dividend per share = $4.17

The stock price after the dividend payment will be:

P_X = $51 – 4.17
P_X = $46.83 per share

The shareholder will have a stock worth $46.83 and a dividend of $4.17 for a total wealth of $51.

If the company makes a repurchase, it will repurchase:

Shares repurchased = $62,500/$51
Shares repurchased = 1,225.49 shares

If the shareholder lets their shares be repurchased, they will have $51 in cash. If the shareholder keeps their shares, they are still worth $51.

b. If the company pays dividends, the current EPS is $1.83, and the PE ratio is:

PE = $46.83/$1.83
PE = 25.59

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 = $1.83(15,000)/(15,000 – 1,225.49)
EPS = $1.99

The stock price will remain at $51 per share, so the PE ratio is:

PE = $51/$1.99
PE = 25.59

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.

13. *a.* The price of a share of stock is the present value of the dividends. The dividend per share each year will be:

Year 1 dividend per share = $425,000/20,000 = $21.25
Year 2 dividend per share = $775,000/20,000 = $38.75

The required return is 12 percent, so the stock price today is:

$P_0 = \$21.25/1.12 + \$38.75/1.12^2 = \$49.86$

b. The dividend increase for existing shareholders for Year 1 will be the new dividend amount minus the current dividend amount, which is:

Dividend increase = $550,000 – 425,000 = $125,000

In order to pay this increase in dividends, the firm must sell new shares. The number of new shares that must be sold is the dividend increase divided by the stock price, or:

New shares to sell = $125,000/$49.86 = 2,506.79

The new shareholders invested a total of $125,000 in the company at Year 1. At Year 2, the total dividends that must be paid to these new shareholders is the investment amount of $125,000 times 1 plus the required return of 12 percent, or:

Dividends to new shareholders at Year 2 = $125,000(1.12) = $140,000

Since this amount must be paid to the new shareholders at Year 2, it will reduce the amount available to current shareholders. The amount available to current shareholders at Year 2 will be:

Total dividends to current shareholders at Year 2 = $775,000 – 140,000 = $635,000

So, the dividend per share to the current shareholders will now be:

Year 1 dividend per share = $550,000/20,000 = $27.50
Year 2 dividend per share = $635,000/20,000 = $31.75

The new stock price today is:

$P_0 = \$27.50/1.12 + \$31.75/1.12^2 = \$49.86$

This is the same price as we found with the original dividend policy.

Challenge

14. Assuming no capital gains tax, the aftertax return for the Gordon Company is the capital gains growth rate, plus the dividend yield times 1 minus the tax rate. Using the constant growth dividend model, we get:

Aftertax return = $g + D(1 - T_C) = .11$

Solving for g, we get:

$.11 = g + .029(1 - .35)$
$g = .0912$, or 9.12%

The equivalent pretax return for Gordon Company is:

Pretax return = $g + D$
Pretax return = .0912 + .029
Pretax return = .1202, or 12.02%

15. 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 need to multiply the corporate tax rate times one minus the dividend exemption percentage, so:

$P_0 - P_X = D[1 - (.21)(.50)]/(1 - .21)$
$P_0 - P_X = 1.1329D$

e. Since different investors have widely varying tax rates on ordinary income and capital gains, dividend payments have different aftertax implications for different investors. This differential taxation among investors is one aspect of what we have called the clientele effect.

CHAPTER 15
RASING 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 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 908 Devices 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 6.5 million of the shares were underpriced. The other 19.7 million were, in effect, priced completely correctly.

8. 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 in stocks from the undersubscribed and, quite possibly, overpriced issues.

9. Going back to the chapter on risk and return, the greater the risk of an investment, the greater the required return. Venture capital is expensive because it is extremely risk. Although all companies are begun with an expectation of future cash flows, the reality is that many, if not the majority, will fail without ever having provided a positive return to investors.

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.

Solutions to Questions and Problems

Basic

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. If you receive 1,000 shares of each, the profit is:

Profit = 1,000($13) – 1,000($7)
Profit = $6,000

Since you will only receive one-half of the shares of the oversubscribed issue, your profit will be:

Expected profit = 500($13) – 1,000($7)
Expected profit = –$500

This is an example of the winner's curse.

2. Using X to stand for the required sale proceeds, the equation to calculate the total sale proceeds, including flotation costs is:

X(1 – .07) = $80,000,000
X = $86,021,505 required total proceeds from sale

So the number of shares offered is the total amount raised divided by the offer price, which is:

Number of shares offered = $86,021,505/$27
Number of shares offered = 3,185,982

3. This is the same as the previous problem, except we need to include the $2,300,000 of expenses in the amount the company needs to raise, so:

X(1 – .07) = $80,000,000 + 2,300,000
X = $88,494,624 required total proceeds from sale

So, the number of shares offered was:

Number of shares offered = $88,494,624/$27
Number of shares offered = 3,277,579

4. 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:

Net amount raised = (35,000,000 shares)($26.97) – 1,600,000 – 425,000
Net amount raised = $941,925,000

The company received $941,925,000 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 $29 per share, and the company received $26.97 per share. The difference, which is the underwriters spread, is also a direct cost. The total direct costs were:

Total direct costs = $1,600,000 + ($29 – 26.97)(35,000,000 shares)
Total direct costs = $72,650,000

We are given part of the indirect costs in the problem. Another indirect cost is the immediate price appreciation. The total indirect costs were:

Total indirect costs = $425,000 + ($33.81 – 29)(35,000,000 shares)
Total indirect costs = $168,775,000

This makes the total costs:

Total costs = $72,650,000 + 168,775,000
Total costs = $241,425,000

The flotation costs as a percentage of the amount raised is the total cost divided by the amount raised, so:

Flotation costs = $241,425,000/$941,925,000
Flotation costs = .2563, or 25.63%

5. Using X to stand for the required sale proceeds, the equation to calculate the total sale proceeds, including flotation costs, is:

$X(1 - .075) = \$74,300,000$
$X = \$80,324,324$ required total proceeds from sale

So the number of shares offered is the total amount raised divided by the offer price, which is:

Number of shares offered = $80,324,324/$28
Number of shares offered = 2,868,726

6. This is basically the same as the previous problem, except that we need to include the $1,500,000 of expenses in the amount the company needs to raise, so:

$X(1 - .075) = \$74,300,000 + 1,500,000$
$X = \$81,945,946$ required total proceeds from sale

Number of shares offered = $81,945,946/$28
Number of shares offered = 2,926,641

CHAPTER 16
SHORT-TERM FINANCIAL 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. There was no effect on the operating 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. The company will need less financing because it is essentially borrowing more from its suppliers. Among other things, the company 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 receivables 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.

2. The total liabilities and equity of the company are the value of equity, plus current liabilities and long-term debt, so:

Total liabilities and equity = $15,975 + 2,950 + 8,600
Total liabilities and equity = $27,525

We have NWC other than cash. Since NWC is current assets minus current liabilities, NWC other than cash is:

NWC other than cash = Accounts receivable + Inventory – Current liabilities
$2,160 = Accounts receivable + Inventory – $2,950
Accounts receivable + Inventory = $2,160 + 2,950
Accounts receivable + Inventory = $5,110

Since total assets must equal total liabilities and equity, we can solve for cash as:

Cash = Total assets – Fixed assets – (Accounts receivable + Inventory)
Cash = $27,525 – 19,750 – 5,110
Cash = $2,665

So, the current assets are:

Current assets = $2,665 + 5,110
Current assets = $7,775

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 affect 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 and operating cycles.

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 does 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 always 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 and operating cycles.

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:

	Q1	*Q2*	*Q3*	*Q4*
Beginning receivables	$355.00	$390.00	$420.00	$455.00
Sales	780.00	840.00	910.00	980.00
Cash collections	–745.00	–810.00	–875.00	–945.00
Ending receivables	$390.00	$420.00	$455.00	$490.00

b. A 60-day collection period implies all receivables outstanding from the previous quarter are collected in the current quarter, and:

(90 – 60)/90 = 1/3 of current sales are collected. So:

	Q1	*Q2*	*Q3*	*Q4*
Beginning receivables	$355.00	$520.00	$560.00	$606.67
Sales	780.00	840.00	910.00	980.00
Cash collections	–615.00	–800.00	–863.33	–933.33
Ending receivables	$520.00	$560.00	$606.67	$653.33

c. A 30-day collection period implies all receivables outstanding from the previous quarter are collected in the current quarter, and:

(90 – 30)/90 = 2/3 of current sales are collected. So:

	Q1	*Q2*	*Q3*	*Q4*
Beginning receivables	$355.00	$260.00	$280.00	$303.33
Sales	780.00	840.00	910.00	980.00
Cash collections	–875.00	–820.00	–886.67	–956.67
Ending receivables	$260.00	$280.00	$303.33	$326.67

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 = $80,345/[($13,810 + 16,850)/2]
Inventory turnover = 5.2410 times

Inventory period = 365 days/Inventory turnover
Inventory period = 365 days/5.2410
Inventory period = 69.64 days

And the receivables turnover and receivables period are:

Receivables turnover = Credit sales/Average receivables
Receivables turnover = $153,875/[($6,341 + 6,732)/2]
Receivables turnover = 23.5409 times

Receivables period = 365 days/Receivables turnover
Receivables period = 365 days/23.5409
Receivables period = 15.50 days

So, the operating cycle is:

Operating cycle = 69.64 days + 15.50 days
Operating cycle = 85.15 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 = $80,345/[$7,620 + 8,653)/2]
Payables turnover = 9.8746 times

Payables period = 365 days/Payables turnover
Payables period = 365 days/9.8746
Payables period = 36.96 days

So, the cash cycle is:

Cash cycle = 85.15 days – 36.96 days
Cash cycle = 48.18 days

The firm is receiving cash on average 48.18 days after it pays its bills.

7. If we factor immediately, we receive cash an average of 32 days sooner. The number of periods in a year are:

Number of periods = 365/32
Number of periods = 11.4063

The EAR of this arrangement is:

EAR = (1 + Periodic rate)^m – 1
EAR = (1 + 1.5/98.5)$^{11.4063}$ – 1
EAR = .1881, or 18.81%

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:

	Q1	*Q2*	*Q3*	*Q4*
Payment of accounts	$288.00	$322.50	$369.00	$293.25

b. Since the payables period is 90 days, the payment in each period is 30 percent of the current period's sales, so:

	Q1	*Q2*	*Q3*	*Q4*
Payment of accounts	$255.00	$288.00	$322.50	$369.00

c. Since the payables period is 60 days, the payment in each period is two-thirds of last quarter's orders, plus one-third of this quarter's orders, or:

Quarterly payments = 2/3(.30) times current sales + 1/3(.30) next period sales.

	Q1	*Q2*	*Q3*	*Q4*
Payment of accounts	$266.00	$299.50	$338.00	$343.75

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) of next period sales

	Q1	*Q2*	*Q3*	*Q4*
Payment of accounts	$1,807.50	$1,962.50	$1,742.50	$1,713.75
Wages, taxes, other expenses	450.00	546.00	478.00	438.00
Long-term financing expenses	110.00	110.00	110.00	110.00
Total	$2,367.50	$2,618.50	$2,330.50	$2,261.75

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 = ($84,000 – 62,000)/.15
November sales = $146,666.67

b. The December sales are the uncollected sales from December divided by the collection rate of the previous months' sales, so:

December sales = $62,000/(.20 + .15)
December sales = $177,142.86

c. The collections each month for this company are:

Collections = .15(Sales from 2 months ago) + .20(Last month's sales) + .65(Current sales)

January collections = .15($146,666.67) + .20($177,142.86) + .65($165,000)
January collections = $164,678.57

February collections = .15($177,142.86) + .20($165,000) + .65($187,000)
February collections = $181,121.43

March collections = .15($165,000) + .20($187,000) + .65($204,000)
March collections = $194,750.00

11. The sales collections each month will be:

Sales collections = .35(current month sales) + .60(previous month's sales)

Given this collection, the cash budget will be:

	April	*May*	*June*
Beginning cash balance	$115,000	$92,240	$93,205
Cash receipts			
Cash collections from credit sales	245,040	300,865	311,470
Total cash available	$360,040	$393,105	$404,675
Cash disbursements			
Purchases	$134,400	$112,500	$141,600
Wages, taxes, and expenses	46,100	58,200	69,600
Interest	11,200	11,200	11,200
Equipment purchases	76,100	118,000	0
Total cash disbursements	$267,800	$299,900	$222,400
Ending cash balance	$92,240	$93,205	$182,275

12. *a.* A 45-day collection period implies all receivables outstanding from previous quarter are collected in the current quarter, and (90 – 45)/90 = 1/2 of current sales are collected.

	Q1	*Q2*	*Q3*	*Q4*
Beginning receivables	$1,350	$1,650	$1,950	$1,850
Sales	3,300	3,900	3,700	2,800
Cash collections	3,000	3,600	3,800	3,250
Ending receivables	$1,650	$1,950	$1,850	$1,400

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.

	Q1	*Q2*	*Q3*	*Q4*
Beginning receivables	$1,350	$2,200	$2,600	$2,467
Sales	3,300	3,900	3,700	2,800
Cash collections	2,450	3,500	3,833	3,400
Ending receivables	$2,200	$2,600	$2,467	$1,867

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.

	Q1	*Q2*	*Q3*	*Q4*
Beginning receivables	$1,350	$1,100	$1,300	$1,233
Sales	3,300	3,900	3,700	2,800
Cash collections	3,550	3,700	3,767	3,100
Ending receivables	$1,100	$1,300	$1,233	$933

Intermediate

13. *a.* If you borrow $50,000,000, the compensating balance will be:

Compensating balance = $50,000,000(.05)
Compensating balance = $2,500,000

Your total repayment will be based on the full amount of the loan including the compensating balance, so at the end of the year you will owe:

End of year balance = $50,000,000(1 + .0051)^{12}
End of year balance = $53,147,309.04

You will receive your compensating balance back at the end, so the year-end cash flow will be:

Year-end cash flow = $53,147,309.04 – 2,500,000
Year-end cash flow = $50,647,309.04

However, with the compensating balance, you will only get the use of:

Amount received = $50,000,000 – 50,000,000(.05)
Amount received = $47,500,000

This means the periodic interest rate is:

FV = PV(1 + *R*)
$50,647,309.04 = $47,500,000(1 + *R*)
R = $50,647,309.04/$47,500,000 – 1
EAR = .0663, or 6.63%

b. To end up with $15,000,000, you must borrow:

Amount to borrow = $15,000,000/(1 – .05)
Amount to borrow = $15,789,474

The total interest you will pay on the loan is:

Total interest paid = $15,789,474(1.0051)^{6} – 15,789,474
Total interest paid = $489,360.21

14. *a.* The EAR of your investment account is:

EAR = 1.009^{4} – 1
EAR = .0365, or 3.65%

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:

Opportunity cost = .05($75,000,000 – 30,000,000)(1.0090)^4 – .05($75,000,000 – 30,000,000)
Opportunity cost = $82,100.08

And the interest you will pay to the bank on the loan is:

Interest cost = $30,000,000(1.0195)^4 – 30,000,000
Interest cost = $2,409,339.12

So, the EAR of the loan in the amount of $30 million is:

EAR = ($82,100.08 + 2,409,339.12)/$30,000,000
EAR = .0830, or 8.30%

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:

EAR = 1.0195^4 – 1
EAR = .0803, or 8.03%

15. Here, we need to use the cash and operating cycles to calculate the average accounts payable and average accounts receivable. We are given the cash cycle and the operating cycle, so the payables period is:

Cash cycle = Operating cycle – Payables period
38.75 days = 54.20 days – Accounts payable period
Accounts payable period = 15.45 days

Now, we can use the payables period equation to find the accounts payable turnover, which is:

Payables period = 365/Payables turnover
15.45 = 365/Payables turnover
Payables turnover = 23.62 times

Now, we can solve the payables turnover equation to find the average payables:

Payables turnover = Cost of goods sold/Average payables
23.62 = $465,000/Average payables
Average payables = $19,682.88

Next, we can find the average accounts receivable. Using the equation for the operating cycle, the accounts receivable period is:

Operating cycle = Inventory period + Receivables period
54.20 days = 27.45 days + Receivables period
Receivables period = 26.75 days

Using the receivables period equation, we find:

Receivables period = 365/Receivables turnover
26.75 = 365/Receivables turnover
Receivables turnover = 13.64 times

Finally, the average accounts receivable balance is:

Receivables turnover = Credit sales/Average accounts receivable
13.64 = $749,000/Average accounts receivable
Average accounts receivable = $54,892.47

16. Since the company has a 32-day collection period, only those sales made in the first 58 days of the quarter will be collected in that quarter. Total cash collections in the first quarter will be:

Q1 cash collections = Beginning receivables + (58/90)(Quarter 1 sales)
Q1 cash collections = $245 + (58/90)($440)
Q1 cash collections = $529

And cash collection in the second quarter will be sales made in the first 58 days of the quarter plus sales made in the last 32 days of the first quarter, so:

Q2 cash collections = (58/90)(Quarter 2 sales) + (32/90)(Quarter 1 sales)
Q2 cash collections = (58/90)($552) + (32/90)($440)
Q2 cash collections = $512

Quarter 3 and Quarter 4 collections will be:

Q3 cash collections = (58/90)(Quarter 3 sales) + (32/90)(Quarter 2 sales)
Q3 cash collections = (58/90)($669) + (32/90)($552)
Q3 cash collections = $627

Q4 cash collections = (58/90)(Quarter 4 sales) + (32/90)(Quarter 3 sales)
Q4 cash collections = (58/90)($625) + (32/90)($669)
Q4 cash collections = $641

The beginning receivables in each quarter will be the sales made in the last 32 days of the previous quarter, so:

Q2 beginning receivables = (32/90)(Quarter 1 sales)
Q2 beginning receivables = (32/90)($440)
Q2 beginning receivables = $156

Q3 beginning receivables = (32/90)(Quarter 2 sales)
Q3 beginning receivables = (32/90)($552)
Q3 beginning receivables = $196

Q4 beginning receivables = (32/90)(Quarter 3 sales)
Q4 beginning receivables = (32/90)($669)
Q4 beginning receivables = $238

The cash budget (in millions) for the company is:

	Q1	*Q2*	*Q3*	*Q4*
Beginning receivables	$245	$156	$196	$238
Sales	440	552	669	625
Cash collections	529	512	627	641
Ending receivables	$156	$196	$238	$222
Total cash collections	$529	$512	$627	$641
Total cash disbursements	365	487	857	518
Net cash inflow	$164	$25	–$230	$123
Beginning cash balance	$20	$184	$209	–$21
Net cash inflow	164	25	–230	123
Ending cash balance	$184	$209	–$21	$102
Minimum cash balance	–20	–20	–20	–20
Cumulative surplus (deficit)	$164	$189	–$41	$82

The company has a cash surplus for much of the year, but in Quarter 3, it will need to raise $41 million to cover its cash flows.

Challenge

17. *a.* For every dollar borrowed, you pay interest of:

Interest = $1[(1 + .0204)^4 – 1] = $.084

You also must maintain a compensating balance of 4.5 percent of the funds borrowed, so for each dollar borrowed, you will only receive:

Amount received = $1(1 – .045) = $.955

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:

EAR = (1.0204^4 – 1)/(1 – .045)
EAR = .0881, or 8.81%

Another way to calculate the EAR is using the FVIF (or PVIF). For each dollar borrowed, we must repay:

Amount owed = $1(1.0204)^4$
Amount owed = $1.0841
At the end of the year the compensating balance will be returned, so your net cash flow at the end of the year will be:

End of year cash flow = $1.0841 – .045
End of year cash flow = $1.0391

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:

FV = PV(1 + *R*)
$1.0391 = $.955(1 + *R*)
R = $1.0391/$.955 – 1
EAR = .0881, or 8.81%

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:

Interest = $115,000,000($1.0204^4$ – 1)
Interest = $9,675,075.56

For whatever loan amount you take, you will only receive 95.5 percent of that amount since you must maintain a 4.5 percent compensating balance on the portion of the credit line used. The credit line also has a fee of .55 percent, so you will only get to use:

Amount received = .955($115,000,000) – .0055($300,000,000)
Amount received = $108,175,000
So, the EAR of the loan is:

EAR = $9,675,075.56/$108,175,000
EAR = .0894, or 8.94%

18. You will pay interest of:

Interest = $25,000,000(.1035)
Interest = $2,587,500

Additionally, the compensating balance on the loan is:

Compensating balance = $25,000,000(.045)
Compensating balance = $1,125,000

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 $25 million loan is:

Cash received = $25,000,000 – 2,587,500 – 1,125,000
Cash received = $21,287,500

The EAR is the interest amount divided by the loan amount, so:

EAR = $2,587,500/$21,287,500
EAR = .1216, or 12.16%

We can also use the FVIF (or PVIF) here to calculate the EAR. Your cash flow at the beginning of the year is $21,287,500. At the end of the year, your cash flow includes the loan repayment, but you will also receive your compensating balance back, so:

End of year cash flow = $25,000,000 – 1,125,000
End of year cash flow = $23,875,000

So, using the time value of money, the EAR is:

$23,875,000 = $21,287,500(1 + *R*)
R = $23,875,000/$21,287,500 – 1
EAR = .1216, or 12.16%

CHAPTER 17
WORKING CAPITAL 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 9 discusses another reason.

2. If it has too much cash, it can 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. Auto manufacturers often argue that due to the cyclical nature of their business, cash reserves are a good way to deal with future economic downturns. This is debatable, but it is true that auto manufacturers' operating cash flows are very sensitive to the business cycle, and enormous losses have occurred during recent downturns.

5. 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.

6. 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.

7. 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.

8. *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.

9. 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.

10. 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.

11. 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 buybacks could be structured to leave capital structure unchanged.

12. 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.

13. *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 banker's 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.

14. Trade credit is usually granted on open account. The invoice is the credit instrument.

15. The costs of granting credit are carrying costs, namely, the cost of debt, possibility of default, and the cash discount. The major cost of not granting credit is the opportunity cost of lost sales. The sum of these costs for different levels of receivables creates the total credit cost curve.

16. *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.

17. *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.

18. *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.

19. 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 of 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.

20. 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.

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 available balance is the amount you have on deposit, or $76,000. By writing a check, you now have a disbursement float. Your book balance is the amount on deposit minus the amount of the check, or:

Book balance = $76,000 – 19,300
Book balance = $56,700

2. The available balance is the amount you have on deposit, or $10,400. This is a collection float since you are waiting for the deposited check to clear into your account. The book balance is the amount on deposit plus the collection float, or:

Book balance = $10,400 + 2,700
Book balance = $13,100

3. Your disbursement float is the amount of the check you wrote, or $3,800. The collection float is the amount of the check deposited, or –$4,100. The net float is the sum of the disbursement float and collection float, or:

Net float = $3,800 – 4,100
Net float = –$300

4. *a.* There are 30 days until the account is overdue. If you take the full period, you must remit:

Remittance = 275($180)
Remittance = $49,500

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:

Remittance = (1 – .01)($49,500)
Remittance = $49,005

c. The implicit interest is the difference between the two remittance amounts, or:

Implicit interest = $49,500 – 49,005
Implicit interest = $495

The number of days' credit offered is:

Days' credit = 30 – 10
Days' credit = 20 days

5. The average daily float is the average value 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:

Average daily float = 4($73,000)/30
Average daily float = $9,733.33

6. *a.* The disbursement float is the average daily value of checks written times the average number of days for the checks to clear, so:

Disbursement float = 4($17,500)
Disbursement float = $70,000

The collection float is the average daily value of checks received times the average number of days for the checks to clear, so:

Collection float = 2(–$21,700)
Collection float = –$43,400

The net float is the disbursement float plus the collection float, so:

Net float = $70,000 – 43,400
Net float = $26,600

b. The new collection float will be:

Collection float = 1(–$21,700)
Collection float = –$21,700

And the new net float will be:

Net float = $70,000 – 21,700
Net float = $48,300

7. The total sales of the firm are equal to the total credit sales since all sales are on credit, so:

Total credit sales = 8,700($475)
Total credit sales = $4,132,500

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:

Average collection period = .45(10) + .55(40)
Average collection period = 26.50 days

The receivables turnover is 365 divided by the average collection period, so:

Receivables turnover = 365/26.50
Receivables turnover = 13.7736 times

And the average receivables are the credit sales divided by the receivables turnover so:

Average receivables = $4,132,500/13.7736
Average receivables = $300,030.82

If the firm increases the cash discount, then more people will pay sooner, thus lowering the average collection period. If the average collection period declines, the receivables turnover increases, which will lead to a decrease in the average receivables.

8. The receivables turnover is:

Receivables turnover = 365/Average collection period
Receivables turnover = 365/31
Receivables turnover = 11.774 times

And the average receivables are:

Average receivables = Sales/Receivables turnover
Average receivables = $27,000,000/11.774
Average receivables = $2,293,150.68

9. *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:

Average collection period = .70(10 days) + .30(30 days)
Average collection period = 16 days

b. And the average daily balance is:
Average balance = 975($1,750)(16)(12/365)
Average balance = $897,534.25

10. The daily sales are:

Daily sales = $25,400/7
Daily sales = $3,628.57

Since the average collection period is 29 days, the average accounts receivable is:

Average accounts receivable = $3,628.57(29)
Average accounts receivable = $105,228.57

11. The interest rate for the term of the discount is:

Interest rate = .01/.99
Interest rate = .0101, or 1.01%

And the interest is for:

30 – 10 = 20 days

So, using the EAR equation, the effective annual interest rate is:

EAR = (1 + Periodic rate)^m – 1
EAR = $1.0101^{365/20}$ – 1
EAR = .2013, or 20.13%

a. The periodic interest rate is:

Interest rate = .02/.98
Interest rate = .0204, or 2.04%

And the EAR is:

EAR = $1.0204^{365/20}$ – 1
EAR = .4459, or 44.59%

b. The EAR is:

EAR = $1.0101^{365/35}$ – 1
EAR = .1105, or 11.05%

c. The EAR is:

$EAR = 1.0101^{365/16} - 1$
$EAR = .2577$, or 25.77%

12. The receivables turnover is:

Receivables turnover = 365/Average collection period
Receivables turnover = 365/26
Receivables turnover = 14.0385 times

And the annual credit sales are:

Annual credit sales = Receivables turnover × Average daily receivables
Annual credit sales = 14.0385($53,600)
Annual credit sales = $752,461.54

13. The carrying costs are the average inventory times the cost of carrying an individual unit, so:

Carrying costs = (4,400/2)($6.15)
Carrying costs = $13,530

The order costs are the number of orders times the cost of an order, so:

Restocking costs = (52)($900)
Restocking costs = $46,800

The economic order quantity is:

$EOQ = [(2T \times F)/CC]^{1/2}$
$EOQ = [2(52)(4,400)($900)/$6.15]^{1/2}$
EOQ = 8,183.27

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.

14. The carrying costs are the average inventory times the cost of carrying an individual unit, so:

Carrying costs = (290/2)($39)
Carrying costs = $5,655

The order costs are the number of orders times the cost of an order, so:

Restocking costs = 52($475)
Restocking costs = $24,700

The economic order quantity is:

EOQ = $[(2T \times F)/CC]^{1/2}$
EOQ = $[2(52)(290)(\$475)/\$39]^{1/2}$
EOQ = 606.08

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.

The number of orders per year will be the total units sold per year divided by the EOQ, so:

Number of orders per year = 52(290)/606.08
Number of orders per year = 24.88

Intermediate

15. The total carrying costs are:

Carrying costs = $(Q/2) \times CC$

where CC is the carrying cost per unit. The restocking costs are:

Restocking costs = $F \times (T/Q)$

So, the total cost is:

Total cost = Carrying cost + Restocking costs
Total cost = $(Q/2) \times CC + F \times (T/Q)$

Using calculus to find the minimum point of the curve, we take the derivative and set it equal to zero. Doing so, we find:

$\partial/\partial Q = 0 = (CC/2) + (F \times T \times -Q^{-2})$
$-Q^{-2} = -CC/ (2 \times F \times T)$
$Q^{-2} = CC/ (2 \times F \times T)$
$Q^2 = (2 \times F \times T)/CC$
$Q = [(2 \times F \times T)/CC]^{1/2}$

To prove this point is a minimum, we can find the second derivative, which is:

$\partial/\partial Q[(CC/2) + F \times T \times -Q^{-2})] = F \times T \times 2Q^{-3} = (2 \times F \times T)/Q^3$

Since the second derivative is greater than zero so long as F, T, and Q are all positive, the first derivative is at a minimum.

Challenge

16. Since the company sells 700 suits per week, and there are 52 weeks per year, the total number of suits sold is:

Total suits sold = 700 × 52 = 36,400

And the EOQ is 500 suits, so the number of orders per year is:

Orders per year = 36,400/500 = 72.80

To determine the day when the next order is placed, we need to determine when the last order was placed. Since the suits arrived on Monday and there is a 3-day delay from the time the order was placed until the suits arrive, the last order was placed Friday. Since there are five days between the orders, the next order will be placed on Wednesday

Alternatively, we could consider that the store sells 100 suits per day (700 per week/7 days). This implies that the store will be at the safety stock of 100 suits on Saturday when it opens. Since the suits must arrive before the store opens on Saturday, they should be ordered 3 days prior to account for the delivery time, which again means the suits should be ordered on Wednesday.

CHAPTER 18
INTERNATIONAL ASPECTS OF FINANCIAL MANAGEMENT

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 (SF 1.13 versus SF 1.10).

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 rubles to purchase a dollar as the higher inflation in Russia will devalue the ruble. 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 should be higher.

c. Nominal interest rates in Australia should be higher; relative real rates in the two countries should be the same.

4. A Yankee bond is most accurately described by *d*.

5. Either. 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 a currency depreciation.

6. The main advantage is the avoidance of the tariff. 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 pesos will be worth more dollars.

American importers: their situation in general worsens because the purchase of the imported goods for a fixed number of pesos 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. False. If the financial markets are perfectly competitive, the difference between the Eurodollar rate and the U.S. rate will be due to differences in risk and government regulation. Therefore, speculating in those markets will not be 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. Using the quotes from the table, we get:

a. \$100(Z4.01060/\$1) = Z401.06

b. \$1.0747

c. €5,000,000($1.0747/€) = $5,373,500

Alternatively, the question can be answered as:

€5,000,000/(€.9305/$) = $5,373,455

The difference is due to rounding in the exchange rate quote.

d. Singapore dollar

e. Mexican peso

f. (SF .9305/$)($10747/€) = 1.0294 SF/€

This is a cross-rate.

g. Most valuable: Kuwaiti dinar = $3.2624

Least valuable: Venezuelan dinar = $.00003929

2. *a.* You would prefer £100, since:

(£100)($1.2685/£1) = $126.85

b. You would still prefer £100. Using the $/£ exchange rate and the Can$/$ exchange rate to find the amount of Canadian dollars £100 will buy, we get:

(£100)($1.2685/£1)(Can$1.3681/$1) = Can$173.54

c. Using the quotes in the book to find the Can$/£ cross rate, we find:

(Can$1.2685/$1)($1.681/£1) = Can$1.7354/£1

The £/Can$ exchange rate is the inverse of the Can$/£ exchange rate, so:

£1/Can$1.7354 = £.5762/Can$

3. *a.* F_{180} = ¥161.40(per $). The yen is selling at a premium because it is more expensive in the forward market than in the spot market ($.00619 versus $.00620).

b. F_{90} = $.6668/A$. The Australian dollar is selling at a premium because it is more expensive in the forward market than in the spot market ($.6668 versus $.6692).

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 U.S. dollar will fall relative to the Australian dollar, because it will take more U.S. dollars to buy the Australian dollar in the future than it does today.

4. *a.* The U.S. dollar, since one Canadian dollar will buy:

(Can$1)/(Can$1.41/$1) = $.7092

b. The cost in U.S. dollars is:

(Can$3.50)/(Can$1.41/$1) = $2.48

Among the reasons that absolute PPP doesn't hold are tariffs and other barriers to trade, transaction 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$1.47 versus Can$1.41).

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:

(¥128/$1)($1.26/£1) = ¥161.28/£1

b. The yen is quoted too high relative to the pound. Take out a loan for $1 and buy ¥128. Use the ¥128 to purchase pounds at the cross-rate, which will give you:

¥128(£1/¥156) = £.82051

Use the yen to buy back dollars and repay the loan. The cost to repay the loan will be one dollar, so the profit is:

£.82051($1.26/£1) – $1 = $.0338

Your arbitrage profit is $.0338 per dollar used.

6. We can rearrange the approximate 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:

Australia: R_{FC} = (A$1.4889 – A$1.4997)/A$1.4997 + .043 = .0358, or 3.58%

Japan: R_{FC} = (¥161.40 – ¥161.45)/¥161.45 + .043 = .0427, or 4.27%

Great Britain: R_{FC} = (£.7873 – £.7883)/£.7883 + .043 = .0417, or 4.17%

7. If we invest in the U.S. for the next three months, we will have:

$30,000,000(1.0041)^3 = $30,370,514.97

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)(£.813/$1)(1.0033)^3/(£.827/$1) = $29,785,077.02

The company should invest in the U.S.

8. Using the relative purchasing power parity equation:

$F_t = S_0 \times [1 + (h_{FC} - h_{US})]^t$

We find:

Z 4.09 = Z 4.02[1 + ($h_{FC} - h_{US}$)]^3
$h_{FC} - h_{US}$ = (Z 4.09/Z 4.021)$^{1/3}$ – 1
$h_{FC} - h_{US}$ = .0058, or .58%

Inflation in Poland is expected to exceed that in the U.S. by .58% over this period.

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 rate stays the same, the profit will be:

Profit = 30,000[$175 – {(S$218.50)/(S$1.3560/$1)}]
Profit = $415,929.20

If the exchange rate rises, we must adjust the cost by the increased exchange rate, so:

Profit = 30,000[$175 – {(S$218.50)/1.1(S$1.3560/$1)}]
Profit = $855,390.19

If the exchange rate falls, we must adjust the cost by the decreased exchange rate, so:

Profit = 30,000[$175 – {(S$218.50)/.9(S$1.3560/$1)}]
Profit = –$121,189.77

To calculate the break-even change in the exchange rate, we need to find the exchange rate that makes the cost in Singapore dollars equal to the selling price in U.S. dollars, so:

$175 = S$218.50/S_T
S_T = S$1.2486/$1

This is a decline of:

Decline = (S$1.2486 – 1.3560)/S$1.3560
Decline = –.0792, or –7.92%

10. *a.* If IRP holds, then:

F_{180} = (NKr 10.61)[1 + (.045 – .041)]$^{1/2}$
F_{180} = NKr 10.6312

Since given F_{180} is NKr 10.64, an arbitrage opportunity exists; the forward premium is too high. Borrow NKr 1 today at 4.57% interest. Agree to a 180-day forward contract at Kr 10.64. Convert the loan proceeds into dollars:

NKr 1 ($1/NKr 10.61) = $.09425

Invest these dollars at 4.1%, ending up with $.09614. Convert the dollars back into krone as:

$.09614(NKr 10.64/$1) = NKr 1.02290

Repay the NKr 1 loan, ending with a profit of:

NKr 1.02290 – NKr 1.02194 = NKr .00095

b. To find the forward rate that eliminates arbitrage, we use the interest rate parity condition, so:

F_{180} = (NKr 10.61)[1 + (.045 – .041)]$^{1/2}$
F_{180} = NKr 10.6312

Intermediate

11. *a.* The yen is expected to get stronger, since it will take fewer yen to buy one dollar in the future than it does today.

b. $h_{JAP} - h_{US} \approx$ (¥157.46 – ¥158.23)/¥158.23
$h_{JAP} - h_{US} =$ –.0049, or –.49%

$(1 - .0049)^4 - 1 = -.0193$, or –1.93%

The approximate inflation differential between the U.S. and Japan is –1.93% annually, i.e., the U.S. inflation is 1.93% greater than in Japan.

12. We need to find the change in the exchange rate over time so we need to use the relative purchasing power parity relationship:

$E(S_t) = S_0 \times [1 + (h_{FC} - h_{US})]^t$

Using this relationship, we find the exchange rate in one year should be:

$E(S_1)$ = 363.18[1 + (.047 – .036)]^1
$E(S_1)$ = HUF 367.17

The exchange rate in two years should be:

$E(S_2)$ = 363.18[1 + (.047 – .036)]^2
$E(S_2)$ = HUF 371.21
And the exchange rate in five years should be:

$E(S_5) = 363.18[1 + (.047 – .036)]^5$
$E(S_5) =$ HUF 383.60

13. Pounds are cheaper in New York, so we start there. Buy:

$10,000(£/$1.2539) = £7,975.12

in New York. Sell the £7,975.12 in London for:

£7,975.12($1.2539/£) = $10,007.18

Your profit is $10,007.18 – 10,000 = $7.18

for each $10,000 transaction.

14. If purchasing power parity holds, the exchange rate will be:

króna 725/$5.49 = króna 132.0583/$

15. *a.* To construct the balance sheet in dollars, we need to convert the account balances to dollars. At the current exchange rate, we get:

Assets = solaris43,000($/solaris1.50) = $28,666.67
Debt = solaris12,000($/solaris1.50) = $8,000.00
Equity = solaris31,000($/solaris1.50) = $20,666.67

b. In one year, if the exchange rate is solaris 1.60/$, the accounts will be:

Assets = solaris43,000($/solaris1.60) = $26,875
Debt = solaris12,000($/solaris1.60) = $7,500
Equity = solaris31,000($/solaris1.60) = $19,375

c. If the exchange rate is solaris 1.41/$, the accounts will be:

Assets = solaris43,000($/solaris1.41) = $30,496.45
Debt = solaris12,000($/solaris1.41) = $8,510.64
Equity = solaris31,000($/solaris1.41) = $21,985.82

Challenge

16. 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	$12,000.00
		Equity	32,250.00
Assets	$44,250.00	Total liabilities and equity	$44,250.00

Now we need to convert the balance sheet accounts to dollars, which gives us:

Assets = solaris44,250($/solaris1.54) = $28,733.77
Debt = solaris12,000($/solaris1.54) = $7,792.21
Equity = solaris32,250($/solaris1.54) = $20,941.56